DIAGNOSTIC REGIONAL ANALYSIS ON THE SHORTFALLS IN DEVELOPMENT AND UTILISATION OF HUMAN RESOURCES IN INDIA

A Statistical Study on the Spatial Variations by Districts of India

PRASANTA PATHAK, M.Stat.

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Dedicated

to My Parents

Acknowledgement

This research study started with the thought that the vast human resources of India, if developed and utilised properly, might act as assets to the economy; otherwise that become liabilities, and might retard the growth and prosperity of the economy. Mass illiteracy and semi-literacy, and mass unemployment and under-employment problems, facing our country with serious repercussions on its economy, made me choose the present research topic in consultation with my research supervisor **Prof. M.N. Pal. Prof. Pal's** rich expertise and long valued experience in the field of Regional Planning had become extremely useful while investigating the problems in a comprehensive way, as the actual problems were found to be more complicated due to vastness and wide geographical diversities of India. We sat together in several brain-storming academic sessions, yielding important results, sometimes even ending up in truce after constructive academic clashes between our thoughts. In fact, without that, the work might not have been completed so rigorously. I learnt from him much of the art of applying mathematical and statistical techniques appropriately in actual handling of the real-life problems. No words would suffice to express my gratitude towards him.

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"Mine is a long and sad tale", said the Mouse, turning to Alice and sighing.
"It is a long tail, certainly", said Alice, looking down with wonder at the Mouse' tail, "but why do you call it sad ?"

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Abstract

The main objective of this study has been estimation of model formulations, empirical evaluations and statistical analyses for identifying the existing regional patterns and structures of human resource development in the formative phase of human life-span through education, and the utilisation, or otherwise non-utilisation, during the activity phase of life-span in existing productive and related activities of our labour-abundant developing economy of India. Despite some awareness to the problems of development and balanced-utilisations of human resources into activities and also despite the various follow-up planning efforts undertaken, or stated to be undertaken, as reported in different "Five-Year Plan" and related documents of Indian national government in post-independent era, no positive results are yet in sight towards some significant reduction at least, if not the complete elimination, of the problems. In fact, the problems are so deep-rooted, with their diverse manifestations in different geographical areas of our large country, that any centralised decision-making towards solution could not visualise proper follow-up action programmes needed at regional

levels to sort out micro-level intricacies or complexities present in this connection.

It is to be emphasized also that the relevant data-base has been yet very scanty for any reasonable kind of decentralised regional evaluations of the existing patterns and structures needed in this regard for a proper understanding of micro-level situations. However, in our labour-abundant economy with ever-increasing population growth, the growing human labour stock is becoming more and more liabilities than assets in national economy. Thus it is felt that some sort of exploratory research investigations must start in this connection for at least an evaluation of the existing regional patterns and structures and also a diagnosis of the varying intensities of the problems as they exist in different geographical areas, so that we are in a position to clarify our visions towards the dimensions of tasks ahead for attempting for the much desired solution of the problems related to human resource development and utilisation. With this motivation, the present piece of statistical investigation is undertaken on the analyses of spatial variations by districts of India. This is to be carried out in the following important aspects of shortfalls in human resource development and utilisation.

(i) Identification of spatial patterns and their changes in the decade : 1960-61 to 1970-71, for different intensities of shortfalls (or gaps) towards reaching the objective of full education for all boys (scope of present study limited to boys only) in the over-all formative phase (5 to 18+ years of age) of basic skill-development through education, with breakdowns in the three education phases, I : Primary, II : Middle and III : High + Higher Secondary. Here it is proposed to identify the gaps, by the three formative phases, for both time-points 1960-61 and 1970-71, through detailed comparative analyses between the age distribution of total male population for almost entire life-span and the age distribution of school-attending boys within the period of formative phase for each of the smallest possible areal units of observation proposed in our study, if possible directly, otherwise indirectly through statistically consistent procedures.

(ii) Identification of spatial patterns and their changes in decade : 1960-61 to 1970-71, for different intensities of shortfalls towards reaching the desired objective of full employment of all males (scope of present study is limited to males only) in the over-all activity phase (19 to 60+ years of age) of gainful absorptions into productive and related activities of of our national economy, with breakdowns into initial job-searching activity phase IV (19 to 35^+ years) and main activity phase V (36 to 60^+ years). Here also it is proposed to identify the short-falls in full employment situation, by the two activity phases for both time-points 1960-61 and 1970-71, through the detailed comparative analyses between the age-distribution of male workers in the life-span enveloping the over-all activity phase, and the age distribution of total male population as referred to already in (i), for each of the smallest possible areal units of observation proposed in our study, if possible directly, otherwise indirectly through statistically consistent procedures.

(iii) Empirical evaluations of the labour-absorptive behaviours of broadly the primary agricultural activities together and the different secondary manufacturing activities (in all, for 20 manufacturing sectors as per two-digited NIC classifications) at a time-point around 1971 (decided by the availability of detailed raw data from official sources). Here we propose to fit statistically the labour absorption functions for the above-mentioned activity-bases with the detailed data on labour-absorption level, output-base, capital-base, etc. by all districts of India. The results of above functional fits would be used finally for identification of agricultural-labour surplus areas and the regional patterns of over-all labour-absorptive efficiency of manufacturing activities.

(iv) Finally attempts will be made, as far as possible, for a synthetic regional analysis based on the preceding aspects of study.

From the aspects of study as covered above, it is clear that the design of our investigation is for making a comprehensive assessment on the existing situations of shortfalls from, or non-attainments of, certain desired goal of accomplishment as expected for our dynamic human labour-stock at all different but inter-connected important phases of effective life-span of actions. The regional structure and trend of different phase characters or attributes and their various inter-connections as could be identified or unfolded, under the existing situations of shortfalls, cannot certainly be the ideal one that signifies the desired goal of accomplishment. But unless we are in a position to identify or unfold the complexities of our existing situation, we are not in a position to clarify our vision towards conditioning of our on-going processes of development and activity, needed to bridge up the gap between the existing situation and the desired goal of accomplishment. The present attempt is, however, limited to the comprehensive assessment of the complexities of the existing situation, and not much beyond, except the identification of the present behavioural patterns of human resource-absorptive performances of our existing primary and secondary activity-bases, that could enlighten us only on the dimensions of the tasks ahead in respect of the conditioning of our on-going processes of productive and related activities, but not on the actual details of action-programming for the conditioning processes of development and activity requirement. A full-fledged action-programme formulation for reduction of shortfalls from the desired goal of accomplishment, needed for human resource development and utilisation with necessary regional dimensions, would require further complementary studies on evaluations of much of dynamic as well as spatial linkages and interactions with other sectors as well; this is, however, not within the scope of present study, undertaken by an individual research worker with his limited available resources. What has been aimed at here is to show a regional approach for understanding the present pattern and short period trend so that a desirable spatial pattern on the question of human resource development and utilisation and the related basic skill-formative facility and labour-absorptive activity generations, could be easily visualised for future on sound regional principles, with special attentions to more problem-ridden areas. The present regional approach is essentially of inter-disciplinary nature in which an integration of the geographic principles of spatial variation analysis and the economic principles of labour-absorptive behaviour analysis in the context of human resource development and utilisation has been attempted through applications of varieties of statistical techniques, mathematical tools and analytical devices.

The statistical and analytical methods that have been applied in this dissertation, with necessary modifications, if needed, befitting our complex situations, for different screenings establishing reliable data-base, varieties of relevant spatial index formulation, depictions of many important inter-connections and inter-relations and also certain important trend paths etc., are briefly hinted below :

(a) The statistical investigations, intended in this study for identifications of spatial configurations and variations, are to be based on information and data as could be obtained from official sources and publications, related to age-specific estimates on population, education, employment, details of labour-absorptive production activities, etc.. However, the framework of official data compilation or reporting or presentation and the limitations implicit in the routine collection of basic raw data —— often for incompleteness, reporting bias, conceptum-standardisation, etc., cannot be expected to be so tailor-made as to suit or serve our purpose directly in our detailed statistical analyses. The official data compilations for broad areal units like States have not, however, suffered so much as that for small areal units like districts, on the question of consistencies, precision and comparability of raw data. Any way, as the design of our study is to make a detailed accounting of district-level variations ultimately, it becomes important to attempt some sort of feasible generation of reliable data-base, making full use of official information and data through appropriate analytic screenings. Thus, quite a considerable portion of this dissertation has necessarily been devoted to make use and evolve appropriate statistical and other analytic methods for establishing reliable data-base at both State and district levels, particularly for the two census years 1961 and 1971 under consideration of our study.

(b) The analytic screenings applied for the generation of data-base have been of different types, depending upon the nature of situations involved at the compilation stage. One such important type of analytic screening used for building up of the age-specific data of male population or of its two particular segments of our interest, namely, 1. school-attending boys in different educational sub-phases covering the broad formative phase from 5 to 18^+ years of age, and 2. male workers in important phases within the over-all activity-phase from 19 to 60^+ years of age, has been made (i) through an initial elimination or minimisation, if necessary, of " random fluctuation component" of reporting error, by a standard method of " series analysis" and (ii) for final estimation of reliable data-base, through fitting in two stages appropriate models of continuous type by OLS and restricted OLS or NILeS procedures.

(c) Another important analytic screening has been done for the model age-distribution profile related to activity phase of only 1971 (and not for 1961) as established from officially reported data-base, finally compiled in this connection on a sampling basis over the raw data schedules of 1971 total census counts. Here to eliminate the sampling error, the presence of which could be checked from some relevant aggregate data given on the basis of total counts of the same 1971 census, we shifted the 1971 model age profile on proportionate employment a little downward by a rigourous mathematical procedure so that the final model profile becomes reflective of the exact decadal change in employment as established through comparable census counts with adjustments for comparability in concept of employment-status for 1961 with that of 1971. It is to be noted in this connection that the census definition of workers for 1961 and 1971 differred, and to achieve time-path comparability, the necessary adjustments that are needed for our purpose have been done by granting the rigourous analytic screening as already done in connection with their study for establishing the district level workers of 1961, with definition comparable to that of 1971.

(d) By all above mentioned analytic screenings, together with some algebraic adjustment procedures, we could establish the data-base for the three segments of population, with certain desired level of consistency and reliability, with areal breakdowns upto State level only, and not below the State. Thus, by use of these reliable data base, we could only establish our various indices of non-enrollment for different education phases and also those of incidences of unemployment in different activity phases, through appropriate algebraic treatment, for States of India and also for India.

(e) In the absence of possibilities of direct estimation of such indices for districts by the same procedure as used for States, we had to go for indirect evaluation of the relative variation in values of a particular phase index for districts as compared with that of the corresponding parent State. This we have done by the " indicator method" of economic index formulation by use of appropriate districtwise surrogate indicators that could be used in cross-ratio form with our actual State estimates of different phase indices to generate the corresponding district estimates. The indicator method is, however, modified for statistical consistency in terms of divergence-matching and high inter-correlation between the estimated and the actual values with known all-India actual data and available State break-downs. If necessary, the surrogate indicator has been used in appropriately power-transformed form to achieve above mentioned statistical consistency.

(f) To identify any 'formal' regional configuration based on any composite characteristic which is reflected in more than one inter-related spatial variables, we have not only used the super-imposing technique of mapping according to geographic principles, but also formulated regional index for the composite characteristic according to multivariate statistical principles so that it could be used more gainfully with added advantage of unified spatial ranking and of using simplified mapping technique for the same purpose, particularly when the number of constituent variables is more than two. Thus, in connection with our composite index formulation for the entire formative phase, we examined the applicability of three important principles of index formulation, namely, 1. Kendall's optimal index formulation [1939], based on the aggregate representation maximising principle, 2. Pal's equity index formulation [1963, 1971], based on the specific representation equalising principle, and 3. Pal's equi-spaced optimal index formulation [1985, 1989], based on the principle of aggregate representation maximisation subject to the restriction of equi-spacing of specific representations in certain desirable order. However, we had to finally modify Pal's equi-spaced optimal index formulation procedure with further restriction on specific representations to achieve certain desirable consistency of interpretation. We have also used Pal's equity formulation [1963] for formulation of a synthetic liability index of non-engaged human resources, constructed with a certain special device that made the common specific representation of the synthetic index coincident with the maximised aggregate representation.

(g) The composite index of non-enrollment as formulated for the formative phase, has associated the order of its magnitudes with the districts, and as such the marginal rate of spatial change of a constituent phase-index relative to the composite index (as could be measured by the corresponding regression coefficient) could be compared between time-points for a measure of change in spatial disparity in phase-index character between time-points.

(h) Some mathematical and statistical formulations of other important indices like the employment opportunity index and the different labour-absorptive and productive efficiency measures related to different activity-bases borrow the supports of economic principles and phenomena. For identifications of agricultural labour surplus areas we needed an integration of both geographical and economic principles together with the use of certain statistical evaluation procedure establishing normal spatial trend path for the existing spatial variation in agricultural activity-bases.

(i) It is emphasized that various multivariate regression analyses have been attempted in many instances of this dissertation by judicious choices between OLS (Ordinary Least Squares) and recently developed VLS (Vertical Least Squares) regression procedures [Pal & De 1979], and, at times, by a combination of both, if necessary, for eliminating the problems involved in any particular situation — in connection with our depiction of many important interconnections and for various inter-relation analyses, apart from the statistical fittings of various age-distribution model profiles, as already referred to in (b), and of different labour absorption functions for agriculture and detailed manufacturing activity-bases.

(j) The question of choice among (1) OLS, (2) VLS and also (3) combined VLS and OLS regressions rests on the underlying error assumptions as implicit with the two regression procedures. It is implicit in the OLS regression that only the dependent variable in a multivariate regression fit contains error of observation, while for a VLS regression in a multicollinear system of all variables, it is more realistically assumed that all variables involved in the fit contain errors. The corroborative consequence of the OLS error assumption is that the OLS regression is developed by an axis-biased least squaring along the axis of dependent variable, with the result of maximum possible explanation for dependent variable, giving rise to maximised value of OLS correlation coefficient. On the other hand, the corroborative consequence of the VLS error assumption is that the VLS regression is developed through the joint error minimisation, without any bias towards any particular variable-axis, but along the lines vertical to the central axis of closest fit through the scatter of observation points in the Euclidean space of all variables. Thus the maximum possible axis-biased OLS explanation of dependent variable, in the form of maximised value of OLS correlation coefficient, is not attained by the unbiased vertical least squaring procedure implicit in the VLS regression, with the result that the VLS correlation coefficient turns out to be always lower than the corresponding OLS correlation coefficient. However, it should be noted that the OLS regression fit fails to identify the true and distinct roles of explanatory variables by the corresponding regression coefficients because of its axis-biased least squaring even in presence of high degree of multicollinearity among explanatory variables. Thus, when it is more important to identify truly the relative roles of different explanatory variables in a multicollinear system the VLS regression fit becomes relatively more useful because of its realistic assumption, recognising the presence of errors in all inter-connected variables. Thus we have found, the OLS fit is more useful than the other when we are concerned, for example, in estimating age-distribution model profiles as referred to already in (b). On the other hand, the VLS fit is found to be more useful than the other, when we are concerned, for example, in estimating the relative roles of different phase-indices in explaining the spatial variation in liability measure of non-engaged human resources. Yet in another instance, we had to take resort to a combined application of both (referred to as " VLS-δ Constrained OLS" regression in one of the chapters of this dissertation), particularly for our statistical fittings of certain forms of labour absorption functions.

(k) Moreover, we can achieve certain useful discriminatory power through VLS procedure of regression which we cannot have through OLS procedure of regression. The particular discrimination in which we have been interested is : out of a set of multicollinear variables, we have to search for that particular variable which is best explained by the most relevant combination among other variables. Now, every additional increase in the number of explanatory variables (regressors) always increases the multiple correlation coefficient in the OLS regression, whereas it may at times decrease the correlation coefficient in the VLS regression, indicating the redundance of the inclusion of an additional regressor in the multicollinear set-up. This advantageous property provides us with the discriminatory power of identifying the most relevant combination of regressors for a particular choice of regressand. With varying choices of regressand and different combinations of regressors, the best dependent variable and the corresponding combination can be uniquely identified by the maximum value of VLS correlation coefficient. This mode of discrimination by VLS regression has been very successfully utilised in many situations for synthetic analysis, in order to unfold the underlying complexities of varieties of interaction present in an extended system of many spatial measures.

Thus, by all these applications of statistical and analytic methods as hinted above, we have gone for the detailed investigations according to the design of spatial analysis, as already mentioned, on the important aspects of shortfalls in human resource development and utilisation in India and these have been presented in this dissertation with breakdowns according to the following five chapters as entitled below :

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Chapter 1

THE FRAMEWORK OF STUDY ON SPATIAL ANALYSIS OF HUMAN RESOURCES WITH REFERENCE TO INDIA

1.1 Objective of the Present Study and the Nature of Problem :

In the context relating to problems of development and utilisation of human resources, our knowledge and information are yet scanty, so that it is almost a stupendous task to depict some sort of reasonable picture at the least, on its regional variation. But, in a vast developing country like India, where the problems of development and utilisation of human resources are acceleratingly increasing with varying regional intensities, we can possibly remain no longer as silent spectators. Because of this urgency, despite the difficulty of limited availability of information in this study-area, we have spared no pains to apply our maximum possible efforts towards an empirical evaluation of the existing spatial patterns of development and utilisation of human resources, so that we are in a position to clarify our visions on the dimensions of the problems that exist in different areas of our country.

Thus the main objective of this study has been the estimating model formulations, empirical evaluations and statistical analyses for identifying the existing regional patterns and structures of human resources in the formative phase of human life-span through education, and the utilisation, or, otherwise, non-utilisation during the subsequent activity-phase, in existing productive and related activities of the labour-abundant developing economy of India, (details on the division of human life-span into critical phases, would be elaborated in due course). Regarding the question of responses of various productive activities on the utilisation of human resources, our further objective would be to try for appropriate statistical evaluations of the labour absorptive behaviours of broadly the primary agricultural activities and the different types of secondary manufacturing activities. With a motive to execute our task of empirical evaluations as precisely and objectively as possible, we would try to develop and the appropriate quantitative and statistical tools, with the fitness of the situation, to overcome the difficulties of limited availability of basic data and information. With these objectives in view for our investigation we now address ourselves to an understanding of the nature of problem and the relevant past background so that we are in a position to design the framework of our analysis in a proper manner.

It should be noted that human labour stock at any point of time in our area can be categorised as assets only when it can be utilised fully; otherwise, it becomes a liability for the society in question. In many developing countries like India, the association of the mass poverty with a high-degree of non-utilisation and under-utilisation of human resources is a previling feature. India's vastness in respect of geographical area and ever-increasing population, along with its diversities in geographical, cultural, socio-economic as well as political aspects have, in fact, made the problems of unemployment and poverty more and more complex in dimensions. An awareness to these problems has been always there even in the past, but real efforts towards overcoming this chronic problem has started only after the 'Independence' of India. Even then the complexities of situations are so deep-rooted that we have hardly any reasonable solution yet in sight, to this problem. The fundamental reason is that despite our awareness to this problem, our vision on the intricate details of it is never clear to chalk out an unfailing solution path. Thus, although India has started its planned efforts for all round development, formally from 1951, after attaining independence from the British colonial rule, no significant results have emerged yet in reality towards a reasonably substantial, if not full, utilisation of vast human resources in India. As the time is passing, the problem of human resource utilisation is becoming more and more pronounced due to the high population growth rate resulted from an over-all improvement in health conditions (a result of our post-independent planned efforts).

There were, of course, good intentions in our national planning efforts for tackling this problem of human resource utilisation in the form of allocation of central fund for both education and employment generation. Our expectations in this regard, however, were made on the basis of some algebraic or normative procedures without a proper decentralised regional assessments and follow-up action programmes. As a result, the targets in view were never attained, aggrevating the situation more and more. In fact, this problem cannot be solved entirely on a national level. It must simultaneously be attacked on regional levels also, granting the limited geographical mobility of human resources and other locally available input factors, contributing to productive activities that absorb and utilise human resources. Generally, the characteristics of demand-supply-migration mechanism for manpower can be expected to operate on a large scale only within a limited regional hinterland around the place of human settlement.

The regional labour supply is determined by prevailing demographic conditions and the available educational facilities in different regions. In the post-independence period, it has been our experience that simultaneously with the fall in mortality rates and the increase in life-expectancy, which actually are the results of improvement in health conditions through various welfare programmes, there has not been any matching decline in the birth rate, resulting from our existing family planning programmes. In fact, because of the inherent orthodoxy and conservatism of major illiterate or semi-illiterate people (of mostly the predominant primary sector), a desired change in demographic condition could hardly been achieved by family planning efforts. Unless we have more effective results, possibly through a kind of proper birth control measures that would take into account the enlightenment of people's cultural niche through education, etc., we cannot expect a counter-balancing fall in mortality rate along with an increase in life-expectancy, as achieved. Thus, all the past family planning programmes have failed unfortunately in this particular aspect, especially in vast rural areas where literacy rate has yet remained very poor. On the other hand, from some partial success of similar programmes as achieved among the more literate people of urban areas, it is strongly believed that the basic prerequisite for the success of such programmes, particularly in the rural areas, rests on the mass education at least upto Secondary or Higher Secondary level for understanding the rationality of the family planning need. This standard of mass education cannot, however, be achieved unless certain minimum level of economic conditions could be guaranteed for all people. If the desirable full absorption of human resources in gainful economic activities is assured then only the latter condition will follow automatically. Thus, full education of the mass with a substantial absorption of the labour is must for the most desirable welfare-oriented demographic condition.

It would, however, be a long drawn process over time to switch over from the existing demographic situation to the desirable one. Keeping full education of mass together with substantial absorption of labour as goals in view, we aim at finding out the task-load to bridge up the gap between the desirable and the existing situations. Thus, in more concrete terms, our task-load in divided into two parts —— 1) corresponding to the development of human resources in the formative age-group of 5 years to 18+ years, pertaining to the formative phase of basic-skill development through education, and the other, corresponding to the utilisation of human resources in the working age-group of 19 years to 60 years pertaining to the activity phase. The terms like skill formative phase and activity phase used above will be clarified in due course.

In the education phase the mobility of human resources could be accepted as negligible. The age-specific immobility of human resources, when considered along with the spatial variations in their concentrations and levels of socio-economic development, leads to a spatial variation in the share of human resources, actually engaged in education. The prevailing demographic structure also will vary spatially. The assessment of spatial patterns in respect of both, are necessary, in order to find out the gaps relating to non-development of human resources in the education phase. These would ultimately help us in clarifying our vision regarding the task ahead for fulfilling the goal of full education to all in the initial stage of basic-skill formation before their entry into activity phase.

In the activity phase, although there can be some amount of mobility of human resources with advanced educational attainments, the major portion of human resources would have very restricted mobility for absorption in activities. Here also we would expect a spatial variation in the share of human resources, now utilised in various activities. Particularly so, because the activities themselves are spatially agglomerating in different degrees. In fact, this has been well established in two recent studies relating to the fundamental material production sectors of agriculture and industry (ref. to R. Mukhopadhyay [1988] and V. Saha [1984]). According to the first study, advanced areas in agricultural activities are concentrated in a very limited part of northern India, leaving aside a vast geographical coverage of agriculturally backward areas. The findings of the second study are that the industrial activities in India are developed by taking advantage of localisation economy, which means that only a few urban-industrial centres have practically agglomerated almost all manufacturing activities. Influenced by these two fundamental material production activities, the tertiary activities also have a similarly agglomerating type of spatial spread. As a result of the more concentrating activity distribution as compared with the spatial distribution of educational facilities, the share of non-utilized human resources in the activity phase is likely to be spatially more varying than that in the education phase.

So, it is all the more necessary to identify the spatial distribution of demographic contribution of total human resources, their break-down into educated and non-educated segments and also the present absorption patterns in various activities. Here, we call those as educated who have completed Secondary/Higher Secondary levels. In our planned effort, the uneducated and the semi-educated segments would tend to become nils in the forward time-path, but at present these segments join the labour force in substantial form.

In the present state of under-developed economy, all are, however, not absorbed in activities. Here also, the gaps relating to non-utilisation of human resources may be found out by the assessment of the spatial patterns in respect of both the spatially varying demographic structure and the share of human resources actually utilized through absorption in activities. This knowledge would be an useful pre-requisite on the prevailing situation for any assessment on the task ahead towards fulfilling the goal of at least a substantial, if not full, utilization of human resources. It goes without saying that the task of eliminating the non-utilization of human resources in the activity phase gains more importance for any healthier state of economic upliftment from the present poverty-stricken state.

From our past experience and also from the findings of a few research studies (ref. to The Indian Year Book of Education : Elementary Education [1964], Report on Education in India, 1973-75 [1975], Challenge of Education - A policy perspective [1985]) it is revealed that the persisting gap in the education phase has occurred mainly due to poverty on the economic front. This is particularly true for more or less 80 percent of Indian population inhabited mainly in rural areas (ref. to Census of India, General Population Tables [1971] and Census of India, Provisional Population Totals, Workers & Non-workers [1981]). The parents/guardians either do not have often enough economic means to send their children and wards to schools or prefer to have their children employed in ready jobs at home or outside only to supplement their family income (in cash or kind) or, at times, their own or hired work-load. Non-appreciation on the need for children's education also follows from the present state of abundant illiteracy among masses. This kind of illiteracy cannot be allowed to continue indefinitely in the interest of a healthy economic progress through reduction of mass poverty. All these boil down to our task of eliminating the gaps due to non-utilisation of human resources in the activity phase. Clearly, matching levels of production activities need to be generated in order to make the task successful. The increase in production activities requires, however, more of investments for addition to capital stock and also appropriate uses of the stock.

With this in view actually we have tried to relate the level of labour absorption in different activities to the relevant technological factors on which to make planning decisions. Broadly speaking the capital and the output levels are the two important factors of our interest in decision making. The level of labour absorption cannot, however, remain same in all regions for the same levels of capital stock and output generation; it is definitely subject to change due to prevalent conditions in the regional activity-specialisations. As such in our models on the analysis of labour absorption relations, in addition to the two broad technological factors, a suitable surrogate factor depicting the level of regional specialisation would be incorporated by details of activities.

In a regional perspective we may use such relations for knowing the levels of labour absorption that will be possible in any of the major sectors if we take a prior decision on the level of investment and the level of output, granting the prevalent regional activity-specialisation pattern. So, with the knowledge about the regional pattern of the extent of the gap in the activity phase it is possible to clarify our vision on the short falls in activity levels for taking any future planning measures towards reduction of non-utilisation and under-utilisation of human resources in activities.

Thus, we are justified in our stated objectives of regional evaluations on the development, utilisation and non-utilisation of human resources (more specifically the males) and also the responses of the main primary agriculture and secondary manufacturing activities to the nature of labour absorption patterns. These would mainly entail on the following facets of analytical investigations.

1) Age-specific demographic structure by regions at selected time-points, age-specific human resource development in the education phase and the determination of the residual non-developed segment of human resources by regions at selected time-points.

2) Present spatial patterns of human resource utilisation in broad activities and determination of non-utilised human resources in the activity phase.

3) Theoretical construction and empirical evaluations of labour absorption functions for the primary activities and detailed manufacturing activities, and also the derivations of labour-absorptive efficiency measures for an identification of the differential nature of activities towards utilisation of human resources for respective productive purposes,

under the prevailing condition of labour-abundant national economy.

So long our discussions have been centred around the totality of human resources without any sex-differentiation. However, with the prevailing conditions of our society in India, there has been an wide difference in the behaviour patterns of males and females towards skill formation and participation to non-domestic formal work. As such, likewise the need for micro-level regional analysis, there is also the need for micro-level investigations separately for both male and female human resources. However, the scope of present study has been kept restricted mainly to the skill-formation and utilisation of the male segment of human resources.

1.2 Historical Background : A Critical Review

Under native pressures, there has been some sort of consciousness of human resource development in India even in the British colonial period prior to the independence. In fact, the national political leaders, mostly from the then Indian National Congress (INC), were pressurising the British Government from time to time on education reforms for human resource development. In fact it was in 1938 when a non-official plan for educational development was drawn up as a part of national development framework by the INC. Under this constant pressure the British Government of India set up ultimately a Committee in 1943 under the chairmanship of John Sargent to look into the details of educational plan formulations. The Sargent's report on educational plan formulation entitled " Post-War Educational Development in India" was put forward officially in 1944. This committee recommended compulsory enrolment in schools for the children in the age-group 6-14 years with emphasis on proper teaching facilities. However, the committee preferred highly selective admission to Secondary and higher standards of education. This restriction was, however, rejected after independence as the constitution of free India preached the liberty of thoughts and expressions and the equality of status and opportunity. The compulsory formal education in the age-group 6-14 years was suggested to be fully effective within a span of 40 years. However, in view of the optimistic desire of the political leaders of INC for a faster educational growth, the above period was considered to be too long; but, when they were really entrusted with the governance of free India, their action programmes in the educational front, as followed, were not sufficient to fulfil their optimism.

In all the past years after India's independence, the plan efforts for educational development have remained very insignificant. In fact the shares of expenditure on education to total plan expenditure in different Five Year Plans had a more or less declining trend, as could be seen from the table below (ref. to A Handbook of Educational and Allied Statistics [1980]) :

Plan	Percentage of Total Plan Expenditure on Education
First Five Year Plan (1951-56)	7.86
Second Five Year Plan (1956-1961)	5.83
Third Five Year Plan (1961-66)	6.87
Fourth Five Year Plan (1969-74)	4.94
Fifth Five Year Plan (1974-79)	4.00 (approx.)

However, this meagre expenditure is really far below the desired expenditure for educating the overwhelming content of illiterate children in the age-group 6-14 years, as visualised by Sargent Committee. In fact, the situation is deteriorating in view of high growth rate of population due to improving health conditions and diminishing attention towards providing new facilities needed for educational development. Because of this non-matching expenditure pattern we could not even reach the target of Sargent Plan in so many years after independence. If this trend of educational development efforts persist, the target can hardly be achieved even in the next hundred years or so.

In principle, however, compulsory education for children has been taken for granted even in free India also. Naturally, our efforts must be geared accordingly to achieve that situation. We should, in fact, advocate compulsory education not only for those of age less than or equal to 14 years, but also for the other segment of population whose ages lie in the range from 14 to 19 years. This could allow the students to achieve minimum academic maturity through Secondary/Higher Secondary level of education. The aspect of attaining minimum maturity level before entrance to the job-market is important, and this, in fact, has been formally safe-guarded under existing constitutional provisions through the declaration that children of age below 18 years, neither could take-up jobs nor could enter into marital relationships legally. This maturity aspect is important for two reasons : (1) family welfare programmes for halting demographic growth could be better appreciated if the education standard comes upto the Secondary/Higher Secondary level, (2) exploitation of child-labour is not good for the society as a whole, particularly in an unemployed and under-employed economy. Granting that compulsory education will be upto Secondary/Higher Secondary level, the task is supposed to be much more than what was thought earlier.

Sargent Committee recommended provision of proper educational facilities at the very initial stage of education including qualified teachers, and the same has also been emphasized in the subsequent five year plans. Let us review how far the intensions of national planners in this regard have actually been carried out into practice.

Analysing the break-downs of total direct educational expenditure in the year 1977-78 by different sequential stages of education viz. (1) Primary and Middle, (2) Secondary and Higher Secondary and (3) Under-graduate, Graduate and Post-graduate levels (general and Professional) our observations are as given below. The first stage of education, in which we have about 90 percent of the total intake of pupils, does not get adequate attention in terms of financial support; the share of total direct educational expenditure has been only about 50 percent at this stage. On the other hand, Secondary and Higher Secondary stage with only 7.5 percent intake of all pupils, gets an expenditure share at the order of 30 percent and the advanced educational stage (i.e. stage (3)), with only 2.5 percent of the total intake of pupils, receives an expenditure share as high as 20 percent (ref. to Handbook of Educational and Allied Statistics /_1980_7). This proportionate allocation of total direct expenditures by stages have remained more or less same over different plan periods. The stagnancy in the expenditure share in the initial stage of education is not reflective of the enhanced attention needed for full education in that stage, particularly with higher relative growth of population in the age group 6-14 years. The Sargent Committee's report was criticised for not taking into consideration the population growth rate factor, by the Indian leaders, but the post-independence expenditure pattern does not show that any corrective measure has been incorporated to ensure full education of children in the specified age-group related to the first stage. It does not seem that our educational planners have any clear cut idea about the optimal allocation pattern needed at this stage to impart compulsory education with certain time-phasing target. Our conclusion on the performance of educational plans partains to average Indian situation. If the details of regional variations are examined in the same manner, we come across with many underdeveloped regions with still worse situations.

In the 30 years of planning period from 1950-51 to 1980-81 the average intake of pupils in the advanced educational level (collegiate and Professional education) has been at the order of 2.5 per cent of total intake of all pupils at various levels, as already noted; but this proportionate intake figure has improved considerably during the period with an estimate of 1 percent in 1950-51 to 4 percent in 1980-81 (Ref. to A Hand Book of Educational and Allied Statistics /̲1980_7 and also Education in India /̲1977-78, 1978-79, 1979-80, 1980-81_7). As the expenditure share has remained more or less stagnant in these years the relative level of expenditure per pupil has, in fact, deteriorated during the period even for the advanced educational level. That means our educational development efforts not only lost its orientation towards achieving the goal of full education at the initial stage but also has failed to achieve its goal for quality improvement in the advanced education level. Certainly students at any level of education are getting less and less attention in the forward time path.

This means that the educational performance programming has not been matched with the good intentions of the educational planners as visualised. However, from time to time different committees and commissions were formed to survey the existing education systems and suggest necessary action programmes. Most of these commission or committee reports (ref. to the Report of the University Education Commission, 1948-49 [1950], the Report of the Secondary Education Commission, 1952-53 [1962], the Report of the Education Commission 1964-66 [1966], the Report of the Working Group on Vocationalisation of Education and Work Experience, 1966 [1968], the Report of the Working Party on Educational Planning, 1968 [1968], the Report on Education in India, 1973-75 [1975], the Report of Syllabuses and Text Books Review Committee, 1977 [1977]) were suggestive of — (1) the desired syllabuses and course contents at different educational stages and the necessity of their updating, (2) the necessary steps for improvement of the existing standard of education through employing more qualified teachers and improvement in teaching methods, necessary reforms in examination systems and so on, (3) administrative machineries for standardisation of educational programmes between institutions spread over geographical areas, (4) extension of educational facilities to weaker sections of the population and expansion of it to backward areas or regions, (5) necessary educational reforms and policies for making education more consistent with the national objectives, and, (6) improvement in the administrative operations and planning methods.

Amidst the above routine works of the Commissions and Committees only a few made major impact in reality. For example, the Commission on University Education, 1948-49, was set up under the Chairmanship of S. Radhakrishnan to probe the role of university education. This committee's recommendations have prompted the government to provide vocational educational facilities (like the polytechnics) mainly to serve as an alternative to university education for those who have passed Secondary/Higher Secondary examinations. The establishment of the higher technological institutions, the Indian Institute of Technology, the agricultural universities are all the outcome of the same committee's recommendations.

The recommendations made by the Secondary Education Commission, 1952-53, under the Chairmanship of A.L. Mudaliar helped in qualitative improvement of science education at school stage, arranging technical and vocational courses, optimal at the Secondary stage and reforming examination and evaluation systems at the school stage.

There are also few Commissions and committees whose reports and subsequent recommendations deviates from the routine works and are very important and rather pertinent in national context, but are lacking any befitting follow-up action as far as their implementation is concerned. Among these the report of the working group, 1966, appointed by the Planning Commission under the Chairmanship of S.K. Bose is one. It considered implications of the programme of vocationalization of education and work experience in Primary, Middle and Secondary/Higher Secondary stages. They specified the concept of work experience and the contents for different stages of education. They also worked on the implementation aspects and advocated its introduction in all primary and middle schools. As a result of this report the 1968 education policy put major emphasis on the vocationalization at the Higher Secondary stage; but no significant impact was made in practice due to lack of detailed and rational plan actions, absence of appropriate course curricula, lack of physical facilities and teachers, trained in vocational training. After that the National Review Committee on Higher Secondary Education [1978] has been appointed to review the curriculum of higher secondary education with special reference to vocationalization of education. Its areas of work is actually outlined in the light of the document " Higher Secondary Education and its Vocationalisation" [1976] prepared and published by National Council of Educational Research and Training (NCERT).

The Report of the Working Party on Educational Planning, Administration and Evaluation, 1968, also deserves special mention. Led by J P Naik, the team emphasized the necessity of comprehensive educational planning, decentralisation of the educational planning system with the districts as the basic units and provision for state plans, removal of regional imbalances, determination of priority at various levels etc.

However, all these good intentions and suggestions which have been emphasized and re-emphasized time and again in various investigative reports have remained mostly as documents in various plan drafts and reports. We have already mentioned that most of the Commissions and Committees do only routine type of jobs and there are only a few exceptions that are innovative, at least in ideas; but very few recommendations are really carried out in practice. The glaring supportive examples are fall in education standards, lack of uniformity in educational programmes from Secondary/Higher Secondary stage onwards, lack of physical facilities and necessary funds which act as obstructions to the target of universalisation of elementary education, insignificant vocationalisation at the Secondary/Higher Secondary stages, insignificant flow of students to advanced education, serious regional imbalances with respect to educational development and so on. There is, in fact, no dearth of good ideas and intentions; what lack actually is the efforts for experiencing those in practical operations & the required financial support. If one intends to go into the operational aspects of educational plan implementation, the deficiencies of present planning practices as have been brought into notice by Raghavan [1982], and recorded below, must be removed.

(i) The present approach of planning in the education sector confines attention only to the additional investments (plan) and is not made comprehensive by taking into account the existing investments.

(ii) In absence of multi-level approach as implicit in area planning, the disparities in performances among small areal units like districts or blocks are seldom studied in depth. The educational authorities in districts or blocks are not made aware of any specific targets and they have only some vague notions about the policies. In such a situation, it is rather natural that guardians, students, teaching community and other interested groups will not be effectively involved.

(iii) It is highly centralised and at the same time of aggregated and undifferentiated nature. Even when the educational development programmes, based on global targets, have failed miserably, no serious attempt has yet been made to draw up the plan on the basis of programmes and projects at micro-level.

(iv) The system of monitoring and evaluation does not operate in all practical senses. Besides, its utility is never realised in absence of effective multi-level regional planning for a proper development of educational system.

(v) The purpose of education and the necessity of maintenance of its quality/standard in matching terms with the changing need overtime do not seem to have received any serious consideration by the authorities concerned.

(vi) Moreover, there has been seldom any consideration for effective analysis on the relevant socio-economic variables that affect the educational attainment of people.

In the face of all these criticisms, it is interesting to note that once upon a time the Indian leaders had criticised the Sargent Plan, for the same serious defect. With the absence of investigations on the micro-level details, there is hardly any scope for proper implementations of policies and ideas on education. It is true that for building up of appropriate implementable models of planning in education there must be a relevant theoretical base as well as a reliable and matching data-base at micro-level; but none of these have crystalised meaningfully over so many years after independence. Even existing theories have hardly been tested in Indian context, and the huge existing data, relevant for educational planning, have remained still unexplored to a great extent. One interesting feature that one notices is that the attention for human resource development programmes is strongly biased towards the development of higher and advanced education without a proper creation of foundations at the lower formative levels. As such, the programmes concentrating on human resource utilisation through absorption in apprenticeship or jobs are also biased towards high-level manpowers, such as engineers, doctors, scientists, etc. and also some comparably qualified (say, middle level) manpower such as technicians, craftsmen, paramedical staff, graduate level agricultural extension workers, etc.; any large scale absorption of manpower with lower standard in attainments of skill, could hardly be found.

The concern for planning for skilled human resources was stated explicitly in a resolution of the Indian National Congress as early as in 1887. It said, " .... having regard to the poverty of the people it is desirable that the Government be moved to elaborate a system of technical education suitable to the condition of the country and to employ more extensively than at present the skill and talents of the people of the country". Systematic planning efforts, which started much later, were guided by the recommendations of the Sargent Committee on Technical Education [1943] and the Bhore Committee on Health Survey and Development [1946]. While among the more important recommendations of these Committees the " doctor to population" ratio norm of 1 : 2,000 set by the latter is not realized even today, the former suggested diversification of secondary education courses and establishment of high technical schools on the speculation that the demand for the middle level technical manpower would grow with the development of the economy. The particular stress on the development of technically and/or scientifically skilled manpower in the planning efforts could as well be observed in the recommendations of number of other subsequent expert Committees viz. the Scientific Manpower Committee [1949], University Education Commission [1950], Engineering Personnel Committee [1956], Report of the Working Group on Technical Education and Vocational Training [1960], Health Survey and Planning Committee [1961], Education Commission [1964], etc. and also All-India Council for Technical Education (AICTE) sub-Committee on Mining, 1955, 1962 Technical Committee, Bhabha Committee on Electronics, AICTE Sub-Committee on Commerce, 1964, and Inter-Ministerial Steering Group on Employment and Manpower, 1965. All these Committees or Commissions have been giving priority to development of engineering, technical, medical and craftsmanship skill in a fraction of those who are completing schooling successfully and opting for further training, and they have been more concerned about absorption of such skilled human resources in various economic activities and recommended accordingly, since otherwise the cost and effort spent for the development of this special category of human resources might go waste. It is rather apparent that when such recommendations have been implemented, the real benefits are earned mainly by a small section of the job seekers. Two main reasons for this are (1) only ten to fifteen percent of the students enrolled in Class I come for Secondary education (ref. to Singh [1987]) and (2) the vocationalisation of secondary education which began in the mid-seventies after anouncement of the education policy of 1968, had a very weak and uneven growth pattern spread over 11 states and Union Territories with Tamil Nadu accounting for more than half of the 1600 schools offering vocational courses by 1983-84 (ref. to Chaudhury [1986]). We may for the time being keep aside that very small fraction of highly privileged students who go for higher education on different specialized technical lines in the IIT's and some such institutions.

When Malathi Bolar [1980] writes " The working group reports on Agricultural and Engineering and Medical personnel for the Fifth Five Year Plan, the sub-committees of the AICTE for select group of trained personnel, and even the various working groups for the Sixth Plan under formulation confronted by the massive range of yet undefined problems and constrained by paucity of data, continue to focus on high level manpower, certain select middle level categories or unemployment generally. Programmes for first and intermediate level skill development appear more to be an act of faith", her last statement does not seem to have much scientific or logical base. Actually in those first two levels the problem is much more massive and complex. The problem has remained unsolved over several plan periods and thus whatever programmes have been formulated toward solving this, have remained rather unclear or sketchy.

It is argued that if the majority of students were diverted to vocational courses at the school stage the acute unemployment among educated young men could be easily solved, and yet we find that vocational training has not made much headway. Perhaps it is thought that without a matching expansion of employment opportunities the expenses for vocational training might go waste. Though it sounds absurd that the employment situation would change merely through vocationalisation of school education without a corresponding expansion of economic activities one cannot disagree with the fact that if vocationalisation of school education is done meaningfully to match with the existing socio-economic structure it can generate among the young men the aspiration and self-confidence to work independently and efficiently, if they could be inspired to innovative outlook. We can always find cases where the existing economic activities lack efficiency and innovativeness. Also, it is not true that the existing economic activities have been able to explore fully the scopes of expansion. So to remove these gaps and drawbacks for further possible expansion of existing activities there remains the necessity to cover more school students under appropriate vocational training schemes. Yet, above all, what still remains much more essential is not only the skill-formation alone, but to create proper foundations by giving intensive & compulsory training to all at the stages of elementary and middle level education, in our predominantly agriculture based economy. It has been substantially proved in a review article by Lockheed, Jamison and Lau [1980], which examined the studies on the effects of a farmer's educational level on his productivity that higher levels of formal education increase farmers' efficiency, and education has a higher payoff for farmers in a changing, modernizing environment than in a static traditional one. Unfortunately this important requirement for productivity growth is still not met at a gross level.

As before the Seventh Five Year Plan period had started in 1985 with great hopes and with good number of promises (ref. to Seventh Five Year Plan, 1985-90 [1985]).

The formation of a seperate ministry for the management of human resource problems in this plan period together with the immense emphasis, laid upon human resource development and utilisation at least in the form of plan-budget proposals implied indirectly the extra ordinary gravity of the situation that was reached at the end of the last plan period with respect to human resource utilisation. This time the plan provided larger allocations for human resource development including education, culture, health, welfare of women and youth, uplift of scheduled caste and tribes and other weaker sections. This also proposed to increase absorption of labour in various economic activities at a rate higher than the earlier ones. The difference of the Seventh Plan from the earlier plans could be clearly noted from the following categorical statement of the Prime Minister in the last National Development Council (NDC) meeting, " For the first time in the history of planning not only would there be no current backlog of unemployment, but the previous backlog would be reduced". A special attention was paid also on expanding the coverage under existing anti-poverty programmes and ensuring the infrastructure for primary health care to be fully operational by the end of the Plan. Poverty and to some extent the health factor was thought to be major causes other than inadequate schooling facilities including unplanned spatial network of school positions, for the overall high drop-out rate (inclusive of stagnation) of around 65% during only the primary education. However, amid all these good proposals and aims what were missing as in other previous plans were the plans and policies on operations and implementation. The planners agreed that there were loop-holes in the operation of past anti-poverty programmes and they wanted to plug those and integrate those programmes and various sectoral and area development programmes into a comprehensive design of integrated development of each area during the current plan period. However, there was no specific and emphatic mention about the steps which would be taken to achieve a balanced development of all areas.

Now we are at the end of the Seventh Five Year Plan period and attempts are being made to assess the successes and the failures on different fronts of the Seventh Plan. As in the past, this time also we will get an information feed-back on the levels of achievement diseased by serious problems due to gaps and non-comparability, and its spatial break-up is as usual not expected to go beyond the State boundaries. Thus, in its totality, it would be proved again that nothing have worked according to documented desires for achieving balanced regional development.

1.3 The Source and the Nature of Available Data

In this study we have depended only on the official sources of information and data, mostly the government publications. Whereas the all-India Census publications, particularly those with data on social and cultural aspects, have become useful in the identification of the regional pattern of certain demographic characteristics, relevant to our research objectives, economic tables of the same publications have not always been on detailed census counts and at times produced on the basis of some sort of sample information; as such, these are utilised judiciously with some sort of checking from other reports and census counts wherever it is possible. However, we could use the economic tables for identification of the regional pattern of the age-distribution of working population. For information and data on the development of human resources through education in various regions or spatial units our dependence has been mostly on the annual publications of the educational statistics by the Ministry of Education. All these data, however, could not be used directly for analysis as certain biases and fluctuations/variations needed appropriate smoothening and balancing through logical steps. Moreover, certain gaps of information in the available data, including the loss of information due to aggregation at various levels, needed appropriate and feasible filling-up by meticulous choice and application of statistical methods and techniques.

Our main source of the all-India spatial data on various manufacturing activities, is the raw compilation made by the Annual Survey of Industries for the reference year 1976 (actually it is the financial year : April, 1975 to March, 1976, surveyed subsequently in 1976), on the factory establishments. The generous help provided by the authorities concerned, responsible for the storage of raw data at the Calcutta branch of the Central Statistical Organisation, is greatly acknowledged; without this help the part of the analysis on the responses of activities to labour absorptions could never be attempted. In this connection the district aggregates of basic variables have been worked out from the raw data only. Prior to the enactment of the Industrial Statistics Act, 1942 and the Census of Manufacturing Industries Rules, 1945, the details of Indian industrial statistics were really not available for practical use. Whatever data were collected on certain large manufacturing establishments by non-government or some private agencies for research purposes, were not only limited in coverage but also not comparable between sources regarding the concepts, definitions and data collection procedures. To understand particularly the structure of the then industrial activities, the collection of relevant statistical data, with the initiative of the Government of India, commenced from 1946 through the Census of Manufacturing Industries (CMI) on a regular basis. The CMI was conducted annually and continued till the reference year 1958. Though in this, the field survey responsibilities were entrusted to the respective State Statistical Authorities, uniformity in the standards of concepts, definitions and data collection and tabulation procedures was maintained under the technical guidance of Directorate of Industrial Statistics (DIS), a central authority of the Central Statistical Organisation (CSO), Government of India.

According to the CMI classification on the basis of available information there were 63 industry groups in total and out of those only about 46% (i.e. 29 industry groups) were covered in the survey. Also, the geographical coverage of the survey was not over-all the States in the country. Though, this was increased gradually in the period from 1946 to 1958, but the coverage of industry groups remained the same during the period. It was only from the year 1950 when the DIS started supplementing the CMI information with the data collected through the Sample Survey of Manufacturing Industries (SSMI) covering all the industry groups under the CMI classification, with the purpose of providing comprehensive industrial statistics. Such comprehensive national statistics were needed especially for national income estimation & also these were useful for spatial analysis on industrial patterns.

However, due to simultaneous operation of CMI and SSMI there was duplication of work for the industry groups covered under the former. To avoid this and also with an aim to collect comprehensive industrial statistics for all industry groups both the CMI and the SSMI were replaced by the Annual Survey of Industries (ASI) from the reference year 1959 through promulgation of the Collection of Statistics Act, 1953 and the Collection of Statistics (Central) Rules, 1959. The ASI series of industrial statistics is thus not comparable with those of the CMI series.

The ASI was conducted regularly on annual basis under the Indian Standard Industrial Classification (ISIC) scheme since its inception in 1959, except for the reference year 1972. With effect from 1973-74 ISIC scheme got replaced by a new scheme called the National Industrial Classification (NIC) and thus the comparability of the ASI data under the two different schemes was almost lost. Now a long series of comparable industrial data is neither available from the CMI source nor from the ASI source and hence any comparative growth analysis on regional basis is not possible. Here, however, we have only made use of the spatial data of the year 1975-76 and the details of the analyses will be discussed in due course.

1.4 The Problems and the Need for Regional Analytic Solutions

The problems of human resource development arise mainly out of the dual nature of this type of resource. While development and utilisation of human resources become a gainful function or activity, non-development, under-utilisation or non-utilisation of the same becomes a loss or a burden for the society. The welfare state of a human society which is a complicated manifestation of sundry biological and psychological dimensions formed through interaction of human beings within themselves and with the surroundings, depends on how gainfully its members are absorbed in various functions or activities. If there are segments of non-developed, under-utilised or non-utilised human resources in the society, their justful right to survive gainfully acts as a retarding force to the growth of human welfare conditions. This, at every step of planning for the development of human resources, necessitates aiming for total development and utilisation of such resources.

In the total life-span of any human being we could see only the two main phases of human resource development and utilisation —— (1) phase of development by formation of skill through education in the age-interval of 6 years to 25 years, and (2) phase of absorption in various gainful activities in the age-interval of 16 years to roughly 60 years. Two different phases determine respectively the possible state of welfare in the future and that persists currently. Also, these are the only phases to which almost all the human beings who are likely to be economically active or are actually economically active, belong. Here our interest is not in the details of how in each phase the human resources become eligible for having different scopes of development and utilisation i.e. in the developmental phase of skill-formation, our interest is not in how a cohort of students get channelised in different types or stages of education, or, in the phase of absorption, the interest is not in what all various occupations a cohort of mature and able persons are getting involved. In other words, the approach of the present study is only oriented towards finding some sort of over-all picture of effective human resource development and utilisation.

The dual nature of manifestation of human resources as " assets" (when it could be developed and utilised) and " liability" (when it remains non-developed and unutilised) has played a very important role in our objective setting under the logic that total development and utilisation is more basic and important an issue than fixing ways and avenues for proper development and utilisation. Our main concern has been always that these resources are for immediate and continuous use and cannot really be asked to wait in queue for scopes of development and absorption, or cannot be stored or stocked in a non-developed or unutilised state for long.

In the phase of education and training, the level of its attainment in respect of skill-formation is determined not only by the available school, college, university and other institutional facilities, but also by the economic status of the people who would avail of such facilities. Besides, there are several other socio-cultural determining factors. There is one more determining factor that plays quite an important role and it is the locational advantages and disadvantages of the available educational facilities. The restricted mobility of human resources has made it all the more important. Thus, the significance of spatial concentration or dispersal of such facilities against the back-drop of spatial distribution of human resources gains special importance. To be more specific, while the existence of a school or a college or a university within the boundaries of a locality (or, hinterland of a human settlement) works rather effectively in creating greater human urge to make use of the facility, it is the economic status or the level of economic development of the locality that plays the most effective role in turning the urge into reality. There are number of studies (ref. to Pal [1963], Pal [1975], Saha [1985], Pal and Mukhopadhyay [1989] and Mukhopadhyay [1988] which have established conclusively the existence of wide spatial disparities in economic development level and also there are studies (ref. to Naik [1965], Report of the Education Commission [1966], Report of the Working Party on Educational Planning, Administration and Evaluation [1968], Raghavan [1982] and Pathak [1986]) which have brought into light the wide range of spatial variation in the provision of educational and training facilities. For regional planning of human resources in the developmental phase we need to analyse the manifestation of all such disparities in the spatial variation of the two complementary segments of human resources —— the developed and utilised and the non-developed and non-utilised.

While there are definite constraints and limiting factors hindering the growth of scopes of human resource development and utilisation, the problem is further aggravated by ever-increasing population growth rate. It is now well-known that the family planning and the family welfare programmes, after so many years of their implementation in free India, have not been successful in bringing down the growth rate significantly at all-India level. The success of the programmes in the few advanced urban agglomerations has been overshadowed by failures or insignificant achievements in most of the lion's share of other areas. While lack of proper educational background of the parents results with high chance in gaining the parenthood of a good number of children, their common weakness on the economic front increases the chance of non-education of their children too. This is how the number of uneducated persons have the good chance of getting multiplied generation after generation, in the Indian context, with wide spread incidences of poverty.

The glaring example of rural-urban differences with regard to implementation and success of family planning and welfare programmes could be observed not only in every state, but also in every district within a state. And, this is another major factor which compels us to adopt a regional analytic approach toward planning for human resource development and utilisation.

The aspect of utilisation in the activity phase is dependent on mainly three factors —— (1) availability of jobs, necessary raw materials, capital, etc. and its quality, (2) qualification, skill and experience of the work-force or the job seekers and (3) mobility characteristics of the work-force or the job seekers. It has been adequately established by Pal [1963 & 1975], Saha [1984] and Pal & Mukhopadhyay [1989] that spatial disparities in all spheres of economic activities persist extensively in serious proportions throughout India and thus, there are wide ranging differences in the levels of development of various spatial units. Against this background, what goes without saying is that there will be obviously enough disparities in employment opportunities. On the other hand, from the point of view of planning for creating further job opportunities in accordance with the requirement, the definition and the dimension of the problem differ from one spatial unit to another due to disparities in the human resource development in the developmental phase. A district or a State with greater concentration of educated and/or skilled manpower, will obviously have a pattern of and a worked out scheme for labour absorption different from those corresponding to a district or State with less concentration of manpower of those types. The factor that plays the most crucial role in creating this difference is the basic human attitude to stay in the closest possible neighbourhood of his native place of residence, avoiding the risk and the cost involved in a shift or commuting to distant places of work for earning the livelihood. On the other hand, it is the type of an activity that determines what kind of skilled/semi-skilled/unskilled manpower would be necessary for its execution, and once it is known, a supportive labour force settle in a cluster around the activity centre. The movements of human resources that are generated out of labour absorbing economic activities, remain restricted not only within the boundaries of a spatial unit, (a district, or, a State), but influence population in the neighbouring and even distant spatial units as well, although in a limited scale. The mobility characteristics of human resources give rise to one or both way interaction between any two spatial units in the form of migration of population from one unit to another. In normal situation, labour force (normally with advanced skill) migrate with or without their families from one place to another when jobs are assured. As the scopes of labour absorption in a place expand, the more and more migration of population to that place takes place. At one time point a paradoxical situation is reached when the expansion process attains a state of saturation and yet the population in-flow to that place does not stop or wane. This is particularly noted in the urban centres of a labour surplus economy. In fact, the incidences of underemployment and unemployment problems are the effects of not only the growth of population disproportionate to the growth of job opportunities, but also the large scale disparities in the growth of the spatial units, generating unusual migratory forces. The third contributing factor is the incidences of child labour —— a cheap, compromising, least ambitious and easily manageable labour force coming out of the poverty stricken mass. In absence of required facilities to keep them absorbed in education and training, the possibilities of absorption in jobs of the true labour force (consisting of mature workers) are not only getting limited by such child labour, (for further details on effects of child labour referred to Rodgers and Standing [1981]), this ultimately is giving birth to a labour force, bottom laded by unskilled or semiskilled labour. So, in the absorption phase any planning for human resource development and utilisation without necessary spatial characterisation becomes ineffective for all practical purposes.

Looking at the stagnated percentage of the total budgeted expenditure on education & training it becomes clear that the critical problem of human resource development is only superficially gone into by the government bodies and planners. Of course, the growth of education in terms of absolute figures may give them a scope of remaining self-complacent, but the growth in terms relative to the growth of population, gives the real picture and the plan proceedings should actually be based on it. The measures of growth in relative terms are bound to differ from one spatial unit to another and if this pattern ideally dictates the plan formulations, tackling the total severity and complexity of the problem, it is bound to shoot up the percentage of the budgeted allocation on education and training by multiple times. Actually, the drawbacks could be traced in the basic approach of planning for the utilisation of human resources with respect to education and absorption in jobs. Problems are always visualised in a highly aggregated and non-analytical way and accordingly the objectives, the targets and the programmes are fixed at a global level by one or more Central or State authorities. The Finance Commissions' reports which influence plan allocations greatly, are seemed to follow somewhat uniform yardstick for all the states in measuring the society's needs and this approach itself misses lot of valuable information in the process e.g. socio-economic and socio-cultural differences between any two spatial units, differences in people's aspirations, and nature of activities from one region to another, differences in performances of different spatial units over time and in broader terms differences of various characteristics of human geography. These different types of information are either not available in a usable form or are available discretely in some non-comparative forms or are lacking any reliable data-base. What demands a serious rethinking is that even after completion of so many plan periods no serious attempt has yet been made to form a more or less universally acceptable information bank on the above parameters for real formulation and fruitful implementation of multi-level planning. In fact, what is till to be realised by the plan and policy makers is that the existing approach of deciding from the top the investment amounts for human resource development and utilisation in various activities could provide the desired results if the human beings are something like controllable machines; otherwise, the approach should be demand-based —— the actual demands for education and job at the grass root level in all regions, and should be based on involvement of people in every region so that all could work together and prepare for reaching the set targets.

1.5 The Scope of the Present Study

Our basic objective of doing a spatial analysis of human resource development and utilisation in India, along with making a critical assessment of the temporal change that such resource undergoes due to implementation of various plans and programmes and due to various other political and socio-economic changes, is partially a topic of economics and partially of geography; but, that are not all as it involves additionally human psychology concerned with education and absorption in jobs. So, for fulfilling our objective on a quantitative base all these disciplines are to be considered in an integrated way using such effective tools as statistics & mathematics. It is perhaps the topic's complexity and interdesciplinary nature which so far discouraged detail and in-depth study in spite of its immense gravity. The second inhibiting factor was non-availability of a reliable data base at the district or any other spatial unit level. Though we get lot of data and information through official sources it usually suffer from number of gaps and inconsistencies for various technical and non-technical reasons. Besides, these are generally not collected with any specific plan or objective in mind, and thus in an attempt to serve any specific purpose or objective one commonly faces the problem of not having data or information on certain relevant parameters. In spite of these limitations we realised that those data could still be used to form certain reliable data bases that could serve our purpose to a good extent, and in this certain appropriate statistical methods and techniques have been fruitfully utilised.

The problems, connected directly to our basic objectives, are actually problems of regional science, wherein the geographic variation of different social, economic and various other inter-related aspects of life are dealt scientifically in an integrated way. The work of Isard and his followers (ref. to Isard, Bramhall, Alonso and Stevens [1958]) may be referred in this connection. Now, such integration becomes very effective if observations from sundry disciplines are appropriately quantified. We, therefore, have proceeded accordingly, and appropriate statistical methods and techniques are applied with success in the integration, following principles of regional science.

In this study, while investigating different dimensions of human resource development and its temporal change, our aim has been also to analyse its spatial variation so as to identify the spatial configurations of human resource development. Different dimensions of human resource development e.g. education, utilisation in activities, etc., when act in an interactive way within themselves over space, should generate some kind of resultant spatial configurations. An analytical study of all these configurations falls within the scope of regional science and here too statistics has very useful roles to play. Such studies are particularly useful in operational regional development plan formulation as it give in specific quantified terms the details of strengths and weaknesses of different spatial units in an interactive environment. The difference between the approach of our studies and the approach of the geographers' studies on spatial variation is that we emphasize more the use of quantitative and analytical techniques for regional plan formulation and they rely mostly on analysis through regional mapping. According to Preston [1958], Keeble [1967] & Pal [1974], the geographic approach is yet to be improved through the needed analytic skills as available in the econometric approaches and the statistical methods and techniques, so that any regional structure of characteristics or activities could be more comprehensively formulated. Pal's [1963, 1971, 1974, 1979] research contributions have been extensively on this line and he has shown how the limitations of the geographers' approaches in regional science could be overcome by applying multivariate statistical methods and techniques. His method of regionalisation through construction of composite indices has been found particularly effective and much more useful than the cumbersome technique of superimposing maps. A critical review by Pal [1973] on methods of composite formal regionalisation under geographical, economic and statistical considerations may be referred to in this context.

In fact, the scope of regional science is vast enough to overcome the shortcomings of not only the geographers' approaches, but also the economists'. For instance, the economists focus their attention more on inputs, outputs and production relations, but without much objective verification on the spatial variation of their characteristics. Saha

[1984], in the context of estimation of the regional Production Functions for different manufacturing industries, and subsequently Pathak and Saha [1987], in the context of introducing the concept of Regional Labour Absorption Function and its estimation, have established through their substantial research studies that different forces of regionalisation which generate out of various spatial advantages and disadvantages do have significant impact on the relation operative among various factors of production. Present dissertation has gone in greater depth and details of the concept of Regional Labour Absorption Function and it has been reaffirmed that without any verification of the existent variation in the spatial characteristics of various input and output factors of any production relation, it is wrong to assume that it would operate uniformly and universally in every spatial unit. This realisation with definite proof, is particularly of significance in the context of manpower planning in a vast country like India where spatial variations in geographic, economic, social and other features are rather remarkable, and yet the plan formulations are done & policy decisions are taken without deserving concern about these variations.

These regional studies give us additionally a scope to identify the favourable and the unfavourable regional structures against the background of our study objectives. This is very useful in regional as well as national planning as it gives one a scope of rational learning from within the system while trying to convert an unfavourable regional structure to a favourable one. With the stated scope and approach, we now proceed to make a diagnostic regional analysis on the shortfalls in human resource development and utilisation, in the subsequent chapters entitled :

Chapter 1 : The Framework of Study on Spatial Analysis of Human Resources with Reference to India.

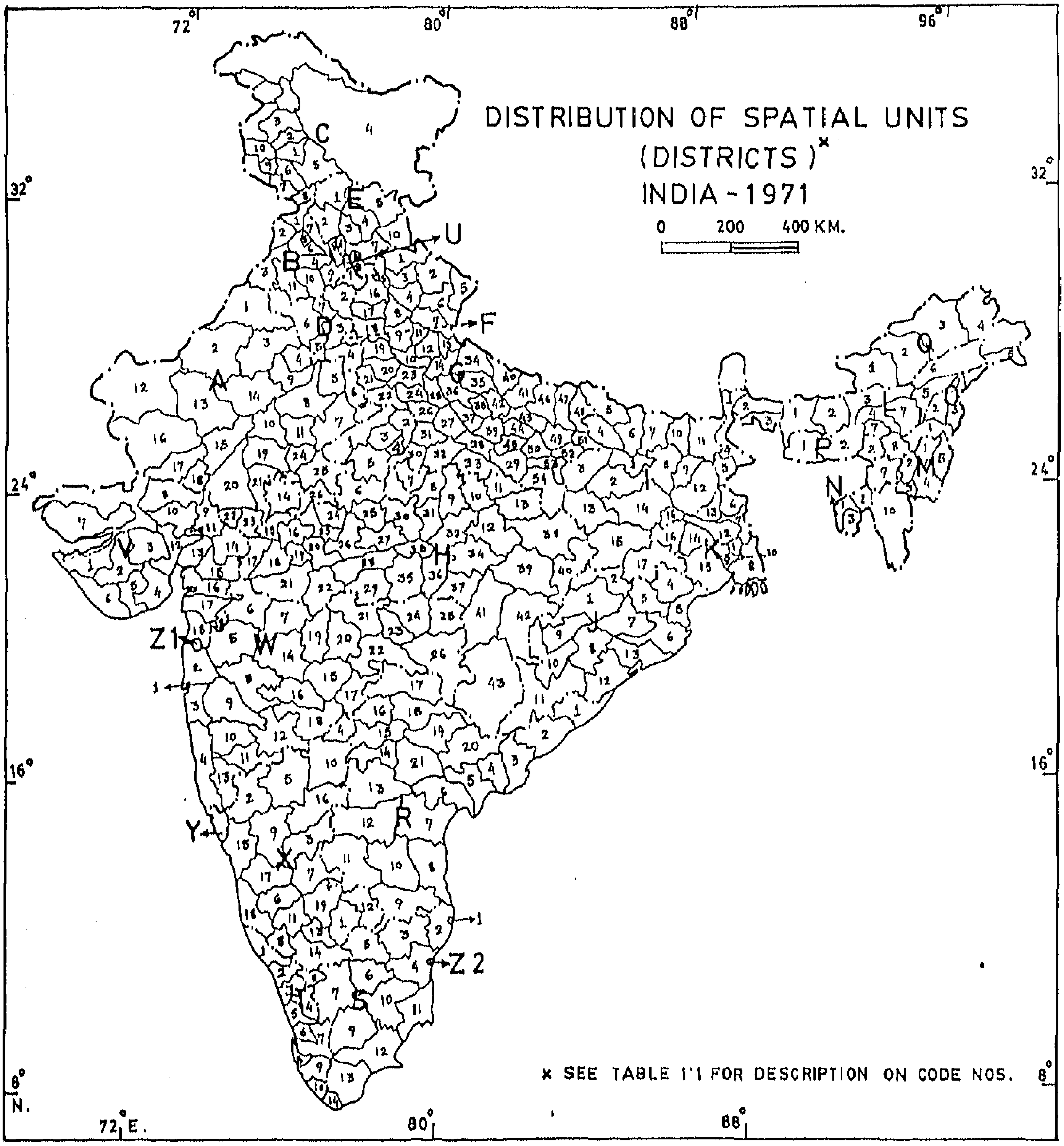
Chapter 2 : Human Resources in the Formative Phase : the Generation of Spatial Measures of Non-development of Basic-skill and the Regional Analysis — 1961 to 1971.

Chapter 3 : Human Resources in the Activity Phase : the Generation of Spatial Measures on the Incidences of Unemployment and the Employment Opportunity and the Related Regional Analysis — 1961 to 1971.

Chapter 4 : Estimation of Labour Absorption Functions for Agriculture and Manufacturing Activity-Bases, the Formulation and Characterisation of Manufacturing Labour-Absorptive Efficiency and the Spatial Analysis.

Chapter 5 : Synthetic Regional Analysis.

The basic all-India maps, depicting the 'distribution of spatial units (districts)' in 1971 and the 'distribution of spatial units (districts) with manufacturing industries' in 1976 which have been extremely useful in our cartographic presentation, are presented in Figure 1.1 and Figure 1.2 along with descriptions on the code numbers used.



DISTRIBUTION OF SPATIAL UNITS
(DISTRICTS)*
INDIA - 1971
0 200 400 KM.
* SEE TABLE 1'1 FOR DESCRIPTION ON CODE NOS.
72° 80° 88° 96°
32° 24° 16° 8° N.
72°E.

FIG. 1'1

Table 1.1 : Description on State and District Codes of Figure 1.1, INDIA - 1971

A. RAJASTHAN

1. Ganganagar
2. Bikaner
3. Churu
4. Jhunjhunu
5. Alwar
6. Bharatpur
7. Sawai Madhopur
8. Jaipur
9. Sikar
10. Ajmer
11. Tonk
12. Jaisalmer
13. Jodhpur
14. Nagaur
15. Pali
16. Burmer
17. Jalore
18. Sirohi
19. Bhilwara
20. Udaipur
21. Chittaurgarh
22. Dungarpur
23. Banswara
24. Bundi
25. Kota
26. Jhalawar

B. PUNJAB

1. Gurdaspur
2. Amritsar

B. PUNJAB (Contd.)

3. Firozpur
4. Ludhiana
5. Jullander
6. Kapurthala
7. Hoshiarpur
8. Ropar
9. Patiala
10. Sangrur
11. Bhatinda

C. JAMMU & KASHMIR

1. Amantanag
2. Srinagar
3. Baramula
4. Ladakh
5. Doda
6. Udhampur
7. Jammu
8. Kathua
9. Rajauri
10. Punch

D. HARYANA

1. Ambala
2. Karnal
3. Rohtak
4. Gurgaon
5. Mahendranagar
6. Hisar
7. Jind

E. HIMACHAL PRADESH

1. Chamba
2. Kangra
3. Mandi
4. Kulu
5. Lahul & Spiti
6. Bilaspur
7. Mahasu
8. Simla
9. Sirmaur
10. Kinnaur

F. DELHI

G. UTTAR PRADESH

1. Uttar Kashi
2. Chamoli
3. Tehri Garhwal
4. Garhwal
5. Pithorgarh
6. Almora
7. Nainital
8. Bijnore
9. Moradabad
10. Budaun
11. Rampur
12. Bareilly
13. Pilbhit
14. Shahjahanpur
15. Dehradun
16. Saharanpur
17. Muzaffarnagar

Table 1.1 (Contd.)

G.	UTTAR PRADESH (Contd.)	G.	UTTAR PRADESH (Contd.)	H.	MADHYA PRADESH (Contd.)
18.	Meerut	49.	Azamgarh	24.	Rajgarh
19.	Bulandshar	50.	Jaunpur	25.	Vidisha
20.	Aligarh	51.	Ballia	26.	Sehore
21.	Mathura	52.	Ghazipur	27.	Raisen
22.	Agra	53.	Varanasi	28.	Hoshangabad
23.	Etah	54.	Mirazapur	29.	Betul
24.	Mainpuri			30.	Sagar
25.	Farrukhabad	H.	MADHYA PRADESH	31.	Damoh
26.	Etawah	1.	Morena	32.	Jabalpur
27.	Kanpur	2.	Bhind	33.	Narsimhapur
28.	Fatehpur	3.	Gwalior	34.	Mandla
29.	Allahabad	4.	Datia	35.	Chhindwara
30.	Jhansi	5.	Shivpuri	36.	Seoni
31.	Jalaun	6.	Gunna	37.	Balaghat
32.	Hamirpur	7.	Tikamgarh	38.	Surguja
33.	Banda	8.	Chhatarpur	39.	Bilaspur
34.	Kheri	9.	Panna	40.	Raigarh
35.	Sitapur	10.	Satna	41.	Durg
36.	Hardoi	11.	Rewa	42.	Raipur
37.	Unnao	12.	Shahdol	43.	Bastar
38.	Lucknow	13.	Sidhi		
39.	Rae Bareli	14.	Mandsaur	I.	BIHAR
40.	Bahraich	15.	Ratlam	1.	Patna
41.	Gonda	16.	Ujjain	2.	Gaya
42.	Bara Banki	17.	Jhabua	3.	Shahabad
43.	Faizabad	18.	Dhar	4.	Saran
44.	Sultanpur	19.	Indore	5.	Champaran
45.	Pratapgarh	20.	Dewas	6.	Muzaffarpur
46.	Basti	21.	Khargone	7.	Darbhanga
47.	Gorakhpur	22.	Khandwa	8.	Monghyr
48.	Deoria	23.	Shajapur	9.	Bhagalpur

Table 1.1 (Contd.)

I. BIHAR (Contd.)

10. Saharsa
11. Purnea
12. Santhal Parganas
13. Palamau
14. Hazaribagh
15. Ranchi
16. Dhanbad
17. Singhbhum

J. ORISSA

1. Sambalpur
2. Sundargarh
3. Keonjhar
4. Mayurbhanj
5. Balasore
6. Cuttack
7. Dhenkanal
8. Baudh Khondmals
9. Bolangir
10. Kalahandi
11. Koraput
12. Ganjam
13. Puri

K. WEST BENGAL

1. Darjeeling
2. Jalpaiguri
3. Cooch Behar
4. West Dinajpur
5. Malda
6. Murshidabad

K. WEST BENGAL (Contd.)

7. Nadia
8. 24-Parganas
9. Howrah
10. Calcutta
11. Hooghly
12. Burdwan
13. Birbhum
14. Bankura
15. Midnapore
16. Purulia

L. ASSAM

1. Goalpara
2. Kamrup
3. Darrang
4. Nowgong
5. Sibsagar
6. Lakhimpur
7. Mikir Hills
8. North Cachar Hills
9. Cachar
10. Mizo

M. MANIPUR

1. Manipur North
2. Manipur West
3. Manipur South
4. Manipur Central
5. Manipur East

N. TRIPURA

1. West Tripura
2. North Tripura
3. South Tripura

O. NAGALAND

1. Kohima
2. Mokokchung
3. Tuensang

P. MEGHALAYA

1. Garo Hills
2. United Khasi & Jaintia Hills

Q. ARUNACHAL PRADESH

1. Kameng
2. Subansiri
3. Siang
4. Lohit
5. Tirap

R. ANDHRA PRADESH

1. Srikakulam
2. Vishakhapatnam
3. East Godavari
4. West Godavari
5. Krishna
6. Guntur
7. Ongole
8. Nellore
9. Chittoor

Table 1.1 (Contd.)

R.	ANDHRA PRADESH (Contd.)	S.	TAMIL NADU (Contd.)	V.	GUJARAT (Contd.)
10.	Cuddapah	11.	Thanjavur	6.	Junagadh
11.	Anantapur	12.	Ramanathpuram	7.	Kutch
12.	Kurnool	13.	Tirunelveli	8.	Banaskantha
13.	Mahbubnagar	14.	Kanyakumari	9.	Sabarkantha
14.	Hyderabad			10.	Mahesana
15.	Medak	T.	KERALA	11.	Gandhinagar
16.	Nizamabad	1.	Cannanore	12.	Ahmedabad
17.	Adilabad	2.	Kozikode	13.	Kheda
18.	Karimnagar	3.	Malappuram	14.	Panchmahals
19.	Warangal	4.	Palghat	15.	Vadodara
20.	Khammam	5.	Trichur	16.	Bharuch
21.	Nalgonda	6.	Ernakulam	17.	Surat
		7.	Kottayam	18.	Valsad
S.	TAMIL NADU	8.	Alleppey	19.	The Dangs
1.	Madras	9.	Quilon		
2.	Chingleput	10.	Trivandrum	W.	MAHARASHTRA
3.	North Arcot			1.	Greater Bombay
4.	South Arcot	U.	CHANDIGARH	2.	Thana
5.	Dharmapuri	V.	GUJARAT	3.	Kolaba
6.	Salem	1.	Jamnagar	4.	Ratnagiri
7.	Coimbatore	2.	Rajkot	5.	Nasik
8.	Nilgiris	3.	Surendranagar	6.	Dhulia
9.	Madurai	4.	Bhavnagar	7.	Jalgaon
10.	Tiruchirapalli	5.	Amreli	8.	Ahmadnagar

Table 1.1 (Concluded)

W.	MAHARASHTRA (Contd.)	X.	KARNATAKA (Contd.)
9.	Poona	4.	Bidar
10.	Satara	5.	Bijapur
11.	Sangli	6.	Chikmagalur
12.	Sholapur	7.	Chitradurga
13.	Kolhapur	8.	Coorg
14.	Aurangabad	9.	Dharwar
15.	Parbhani	10.	Gulbarga
16.	Bhir	11.	Hassan
17.	Nanded	12.	Kolar
18.	Osmanabad	13.	Mandya
19.	Buldhana	14.	Mysore
20.	Akola	15.	North Kanara
21.	Amravati	16.	Raichur
22.	Yeotmal	17.	Shimoga
23.	Wardha	18.	South Kanara
24.	Nagpur	19.	Tumkur
25.	Bhandara		
26.	Chandrapur	Y.	GOA
X.	KARNATAKA	Z1.	DADRA & NAGAR HAVELI
1.	Bangalore		
2.	Belgaum	Z2.	PONDICHERRY
3.	Bellary		

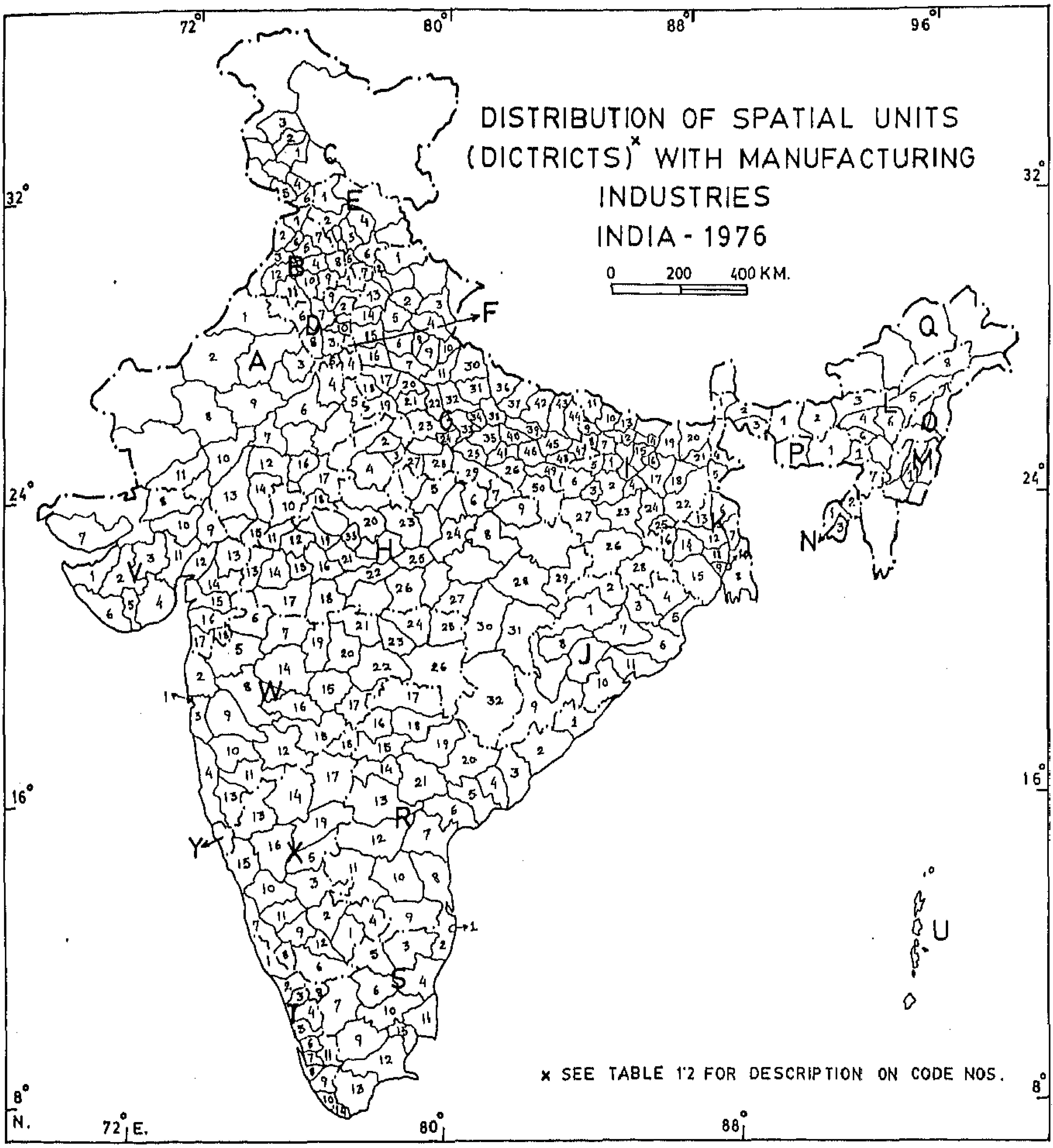

DISTRIBUTION OF SPATIAL UNITS (DICTRICTS)x WITH MANUFACTURING INDUSTRIES INDIA - 1976
0 200 400 KM.
x SEE TABLE 1'2 FOR DESCRIPTION ON CODE NOS.

FIG. 1'2

Table 1.2 : Description on State and District Codes of Figure 1.2, INDIA - 1976

A. RAJASTHAN

1. Ganganagar
2. Bikaner
3. Jhunjhunu
4. Alwar
5. Bharatpur
6. Jaipur
7. Ajmer
8. Jodhpur
9. Nagaur
10. Pali
11. Jalore
12. Bhilwara
13. Udaipur
14. Chittaurgarh
15. Banswara
16. Bundi
17. Kota
18. Jhalawar

B. PUNJAB

1. Gurdaspur
2. Amritsar
3. Firozpur

B. PUNJAB (Contd.)

4. Ludhiana
5. Jullunder
6. Kapurthala
7. Hoshiarpur
8. Ropar + Chandigarh
9. Patiala
10. Sangrur
11. Bhatinda
12. Faridkot

C. JAMMU & KASHMIR

1. Anantanag
2. Srinagar
3. Baramula
4. Udhampur
5. Jammu
6. Kathua

D. HARYANA

1. Ambala
2. Karnal
3. Rohtak

D. HARYANA (Contd.)

4. Gurgaon
5. Mahendragarh
6. Hisar
7. Jindh
8. Bhiwani
9. Kurukshetra
10. Sonipath

E. HIMACHAL PRADESH

1. Chamba
2. Kangra
3. Mandi
4. Bilaspur
5. Solan
6. Simla
7. Sirmaur

F. DELHI

G. UTTAR PRADESH

1. Uttar Kashi
2. Garhwal
3. Almora
4. Nainital

Table 1.2 (Contd.)

G.	UTTAR PRADESH (Contd.)	G.	UTTAR PRADESH (Contd.)	H.	MADHYA PRADESH (Contd.)
5.	Bijnore	29.	Banda	2.	Gwalior
6.	Moradabad	30.	Kheri	3.	Datia
7.	Budaun	31.	Sitapur	4.	Shivpuri
8.	Rampur	32.	Hardoi	5.	Chhatarpur
9.	Bareilly	33.	Unnao	6.	Satna
10.	Pilbhit	34.	Lucknow	7.	Rewa
11.	Shahjahanpur	35.	Raebareli	8.	Shahdol
12.	Dehradun	36.	Bahraich	9.	Sidhi
13.	Saharanpur	37.	Gonda	10.	Mandsaur
14.	Muzaffarnagar	38.	Barabanki	11.	Ratlam
15.	Meerut	39.	Faizabad	12.	Ujjain
16.	Bulandshar	40.	Sultanpur	13.	Jhabua
17.	Aligarh	41.	Pratapgarh	14.	Dhar
18.	Mathura	42.	Basti	15.	Indore
19.	Agra	43.	Gorakhpur	16.	Dewas
20.	Etah	44.	Deoria	17.	West Nimar
21.	Mainpuri	45.	Azamgarh	18.	East Nimar
22.	Farrukhabad	46.	Jaunpur	19.	Shajapur
23.	Etawah	47.	Ballia	20.	Vidisha
24.	Kanpur	48.	Ghazipur	21.	Sehore
25.	Fatehpur	49.	Varanasi	22.	Hoshangabad
26.	Allahabad	50.	Mirazapur	23.	Sagar
27.	Jhansi	H.	MADHYA PRADESH	24.	Jabalpur
28.	Hamirpur	1.	Morena	25.	Narsimhapur

Table 1.2 (Contd.)

H. MADHYA PRADESH (Contd.)

26. Chhindwara
27. Balaghat
28. Bilaspur
29. Raigarh
30. Durg + Rajnandgaon
31. Raipur
32. Bastar
33. Bhopal

I. BIHAR

1. Patna
2. Gaya
3. Aurangabad
4. Nawada
5. Bhojpur
6. Rohtas
7. Saran
8. Siwan
9. Gopalganj
10. East Champaran
11. West Champaran
12. Muzaffarpur
13. Sitamarhi
14. Darbhanga

I. BIHAR (Contd.)

15. Samastipur
16. Begusarai
17. Monghyr
18. Bhagalpur
19. Saharsa
20. Purnea
21. Katihar
22. Santhal Parganas
23. Hazaribagh
24. Giridih
25. Dhanbad
26. Ranchi
27. Palamau
28. Singhbhum

J. ORISSA

1. Sambalpur
2. Sundargarh
3. Keonjhar
4. Mayurbhanj
5. Balasore
6. Cuttack
7. Dhenkanal
8. Bolangir
9. Koraput
10. Ganjam
11. Puri

K. WEST BENGAL

1. Darjeeling
2. Jalpaiguri
3. Cooch Behar
4. West Dinajpur
5. Malda
6. Murshidabad
7. Nadia
8. 24-Parganas
9. Howrah
10. Calcutta
11. Hooghly
12. Burdwan
13. Birbhum
14. Bankura
15. Midnapore
16. Purulia

L. ASSAM

1. Goalpara
2. Kamrup
3. Darrang
4. Nowgong
5. Sibsagar
6. Mikir Hills
7. Cachar
8. Dibrugarh + Lakhimpur

Table 1.2 (Contd.)

M. MANIPUR

1. Central Manipur

N. TRIPURA

1. West Tripura
2. North Tripura
3. South Tripura

O. NAGALAND

P. MEGHALAYA

1. United khasi & Jaintia Hills

Q. ARUNACHAL PRADESH

R. ANDHRA PRADESH

1. Srikakulam
2. Vishakhapatnam
3. East Godavari + Yanam
4. West Godavari
5. Krishna
6. Guntur
7. Ongole
8. Nellore
9. Chittoor
10. Cuddapah

R. ANDHRA PRADESH (Contd.)

11. Anantapur
12. Kurnool
13. Mehbubnagar
14. Hyderabad
15. Medak
16. Nizamabad
17. Adilabad
18. Karimnagar
19. Warangal
20. Khammam
21. Nalgonda

S. TAMIL NADU

1. Madras
2. Chingleput
3. North Arcot
4. South Arcot
5. Dharampuri
6. Salem
7. Coimbatore
8. Nilgiris
9. Madurai
10. Tiruchirapalli
11. Thanjavur + Karaikal
12. Ramanathpuram
13. Tirunelveli

Table 1.2 (Concluded)

S. TAMIL NADU (Contd.)

14. Kanyakumari
15. Pudukotai

T. KERALA

1. Cannanore
2. Kozikode + Mahe
3. Malappurum
4. Palghat
5. Trichur
6. Ernakulam
7. Kottayam
8. Alleppey
9. Quilon
10. Trivandrum
11. Idukki

U. ANDAMAN & NICOBAR

V. GUJARAT

1. Jamnagar
2. Rajkot
3. Surendranagar
4. Bhavnagar
5. Amreli
6. Junagadh + Diu

V. GUJARAT (Contd.)

7. Kutch
8. Banaskantha
9. Sabarkantha
10. Mahesana
11. Ahmedabad + Gandhinagar
12. Kheda
13. Panch Mahals
14. Vadodara
15. Bharuch
16. Surat + Daman
17. Valsad
18. The Dangs

W. MAHARASHTRA

1. Greater Bombay
2. Thana
3. Kolaba
4. Ratnagiri
5. Nasik
6. Dhulia
7. Jalgaon
8. Ahmednagar
9. Pune
10. Satara
11. Sangli
12. Sholapur
13. Kolhapur
14. Aurangabad
15. Parbhani
16. Bhir
17. Nanded

W. MAHARASHTRA (Contd.)

18. Osmanabad
19. Buldhana
20. Akola
21. Amravati
22. Yeotmal
23. Wardha
24. Nagpur
25. Bhandara
26. Chandrapur

X. KARNATAKA

1. Bangalore
2. Tumkur
3. Chitradurga
4. Kolar
5. Bellary
6. Mysore
7. South Kanara
8. Coorg
9. Hassan
10. Shimoga
11. Chikmagalur
12. Mandya
13. Belgaum
14. Bijapur
15. North Kanara
16. Dharwad
17. Gulbarga
18. Bidar
19. Raichur

Y. GOA

Chapter 2

HUMAN RESOURCES IN THE FORMATIVE PHASE : THE GENERATION OF SPATIAL MEASURES OF NON-DEVELOPMENT OF BASIC-SKILL AND THE REGIONAL ANALYSIS - 1961 TO 1971

2.1 The Formative Phase of Human Resource Development : Concepts and Definitions

In the absence of an atmosphere of healthy growth and educational enlightenment, the utilisation of human resources in its formative stage of childhood without allowing for its proper growth in skill-development through basic education, amounts to its exploitation and mis-use. In the long run, this adds to the problem of a proper development of an economy which already suffers from the question of unemployment and underemployment. This formative stage of childhood would be referred to as the initial stage of basic skill-development. In this stage it is accepted universally that all children should be compulsorily involved in developing their mental faculties through basic education, and at this premature stage they should not be burdened with manual work and duties; premature use of human resource in the form of child-labour is nothing but exploitation by the society, and that makes them crippled throughout their careers.

On the other hand, by imparting basic education to all children of the society, a future labour force with advanced skill to work may be ensured. In many studies it has been established that the level of skill of labour force and their background educational levels are highly correlated (ref. to

Blaug [1970, 1973, 1978], Fields [1980]). And it goes without saying that higher the skill of labour force, the greater would be its impact through higher economic growth and labour productivity (ref. to Blaug [1970], Secomski [1970], Browman [1980], Lockheed, Jamison, Law [1980], Psacharopoulas [1980]).

In any advanced society the work opportunity remains open to both the males and the females; but in a under-developed or developing country like India males are more educated than females and in consequence to this, the predominance of male human resource utilisation (60% to 70% of total workers) is perceived. However, the females do involve themselves in various day-to-day domestic activities which are not formally recognised. Because of this fundamental difference in the nature of jobs they participate generally, both segments of the labour force should be studied separately and not in combined form. To start with, in the present study we concentrate our attention on the skill development of male human resources. The study, however, may as well be repeated on the female segment following the same methods and techniques as suggested in the subsequent sections.

Here, we take it for granted that the completion of school education upto Higher Secondary or some other equivalent stage is essential for basic skill-development. Thus, our national objective should be full and, if possible, compulsory education for all boys (also for girls, but not considered in our study) of ages upto 18 years or less. The implicit presumption (consistent though in Indian context) being that the boys normally pass their Higher Secondary or equivalent examinations by 18^{+} years of age. It is questionable, however, why we choose the demarcation age at 18^{+} years; it could as well be, say, 14^{+} years, since the participation in the labour force by boys (or, girls) of ages greater than or equal to 15 years is accepted as legal (ref. to the Gazette of India [1986], Extraordinary, Part II, Section 1, Ministry of Law and Justice, Govt. of India). Our arguments behind choosing the demarcation age of 18^{+} years are that -- (1) the boys (or, the girls) do not attain adequate physical and mental maturity before the age of 19 years; the support to this could be had from the suggested ages of marriage of the boys and the girls in family welfare programmes and also from the stipulated minimum age of casting votes, (2) at the age of 14^{+} years, the boys (or, the girls) can only complete the middle school (upto Class VIII) level education, but the knowledge gained in the process is not commensurate with the present day advancement of science and technology and its consequent productive activities. Therefore, full education upto Higher Secondary level has been considered essential for acquiring reasonable work ability in anyone's career. It is not necessary that pupils of age above 14 years will all be enrolled in Higher Secondary or some other education at equivalent level. They might as well undergo some vocational training to have themselves suitably prepared and equipped with technical or equivalent skills prior to entrance to the job market. Besides, thinking from the angle of protecting labourers' interest in securing jobs at reasonable wage rates, there is also the necessity to impose restrictions in stricter terms so as to discourage more effectively the intake of children to the labour market. It is to be emphasized that the unauthorized intake of huge number of child labour in productive activities leads to a consequent adult unemployment and underemployment in India's economy (ref. to the Report of the Committee on the Child Labour [1979]). While allowing the children to participate in the labour market supplements the family income showing an immediate gain for the head of the family, it has a far-reaching depressing effect. Apart from the fact of crippling the children's career, this reduces the scope of absorption of adult workers in jobs and also it handicaps the already-employed labourers' bargaining power. To the employers, the use of child labour in activities is not only a subsidy, but also a direct inducement to the payment of low wages to the adult workers. Ultimately what results out of the employers' interest in short term gain is the creation of a stagnating segment of unskilled and semi-skilled labourers with low productivity and also disgruntled under-paid workers, that generate products or services with deteriorated quality. Against this perspective, our choice of the demarcating age-line could be considered to be more realistic in the context of problems arising out of abundant illiteracy, predominant unskilled labour and cumulating incidences of unemployment and underemployment.

Keeping the question of determining the extent of child labour in mind, one of our objectives in this study has been to assess the gap which has to be covered to reach the objective of full education of all boys aged upto 18+ years at least. There are number of studies, investigating into the causes behind creation of this gap (ref. to the Indian Year Book of Education, Elementary Education [1964], Report of the Committee on Child Labour [1979], Rodgers and Standing [1981], Singh [1987]). None of these investigations, however, give any detailed spatial breakdowns of the incidences of child-labour. But our interest here is to identify the geographical areas where the gap lies and to what extent. Once the areas with differential levels of this gap are identified, it would then be easier to formulate appropriate planning measures for implementation to fill up this gap.

The numbers or the percentages of boys not enrolled in the schools in any State or Union Territory or in India as a whole, of course, might serve the purpose of getting some crude estimates of the gap. But, these estimates are often erroneous and inconsistent, and, at times, suffers from significant abnormal fluctuations. Moreover, such estimates being based on figures obtained through aggregating the observations over all districts in each State, or, over all States in a Nation, or, over all ages of boys who are not enrolled, it suffers from the information loss and mis-reporting due to aggregation. We have tried to assess the gap in such a way that the effects of such drawbacks and inconsistencies a·~ kept at its minimum.

Certain presumptions which form the basis of our study are : (1) the children normally start getting school education from 5 years of age and complete it at the age of 18^+ years, (2) there exists inter-state variation in the demographic structure represented in terms of age-distribution, but that within a State is not significantly different, (3) there exists inter-state variation in the age-distribution of children enrolled in the schools, but that within a State is not significantly different, and (4) the children whose activities are controlled mostly by the parents (or, guardians) may be classified in three broad age-groups : (I) 5 to 9^+ years, (II) 10 to 14^+ years, (III) 15 to 18^+ years, with sequentially increasing maturity. We are going to show that these age groups correspond to three characteristic phases of basic-skill development through formal education in the formative stage.

The first group, in the age interval of 5 to 9^+ years which is to be designated as Phase I, is considered to be in a phase of transition (from no-education to entry into formal education), when under the domestic or internal influence of parents (or, guardians) and the external influences of the availabilities of educational facilities and environments the group gets segmented into two sub-classes of children : (i) the privileged and (ii) the under-privileged or non-privileged. While the former gets the scope of continuing with the school education, the children in the latter are either never admitted to schooling or drop out eventually from the schools before completing the required years of education. One might note that in the age interval 5 to 9^+ years, the children are expected to complete their primary education (i.e. tentatively from class one to class four or five). Those who are not enrolled or who drop-out from the schools at this stage are supposed to be serving no useful purpose towards generating economic gains, and therefore assumed to be remaining idle or doing domestic jobs. They only shape that potential labour force which is devoid of basic-skill. The upper age limit of 9^+ years of this phase is particularly very significant in the sense that this is the empirically observed modal age in the statistical age-distribution curves for the school attending boys in the range 5 to 18^+ years for Indian States, on the average. This might be indicating that in the perspective of India's socio-economic environment, the primary schooling system could retain the interested boys in various schools maximum upto the age of 9 years and then the rate of dropping from schools exceeded the rate of retention and/or fresh enrolment in primary education. Thus after the age of 9^+ years it becomes quite clear who all would continue with the scheduled human resource development programmes through formal education and who all would stay out of such programmes.

The children in the age intervals of 10 years to 14^+ years and 15 years to 18^+ years, to be designated phase II and phase III respectively, might play effective roles in the labour market in revealed or disguised ways, with gains in terms of money or good or both. To be precise, they might become a part of the labour force in revealed or disguised forms by not getting enrolled in the schools. These groups, again, may be matched, in a sense, with the stage of Middle School (i.e., tentatively from class five to class eight) and the High and Higher Secondary Schools or those of equivalent standard. It is worth mentioning that in the process of labour absorption at the adult stage beyond 18^+ years of age, the educational qualification, in terms of completed stages of education, acts as the fore-most important factor for screening and classifying the job searchers. Besides the job market, the completed stages of education also determine the future scope for further advanced-education. The parental control over the children regarding their continuance through those phases of education does get influenced by these factors. And, as such, the parental attitude toward onward basic education of their children are expected to change significantly for transition from one phase of education to another, matching with the corresponding age-intervals. Since the children from both phases II and III have the possibilities of joining the labour force, we consider them as to pass through a stage of potential child labour absorption. While the more elderly children of third phase (15 to 18+ years) has greater scope and possibility of spontaneous participation in the labour force than those in the second phase (10 to 14+ years) because of the adaptivity acquired through sheer maturity in age for children in phase III, the less matured children in phase II, we understand, might be joining the labour force more under domestic compulsion. Thus the implications of passing through the stage of potential child-labour absorption by the children in the two phases, are not the same.

Now the boys in the transitional phase (or, first phase), who are not enrolled in formal school education, are likely to be mostly illiterates and this is the only group of children which will shape the potential labour force without basic-skill in the future (since attaining certain minimum level of education is pre-requisite for basic-skill development (ref. to Blaugh [1970, 1973, 1978], Fields [1980]). The boys who are not enrolled in the second phase are not all illiterates, though a majority of them may be so. Those who have been never enrolled or have dropped out from primary schools will constitute its illiterate segment and the rest would have completed their primary education. So, the children in Phase II should form, in course of time, the potential unskilled or partially skilled labour force. Again, the non-enrolled boys in Phase III can be classified into three sub-classes : (1) the illiterates or those who have not completed their primary education, (2) the literates who have completed education at the primary level, but not at the middle school level and (3) those who have completed only their middle school level education, but not beyond. Those in this third sub-group might generate subsequently a semi-skilled labour force with completed education upto eighth standard. So, the potential labour force which might take shape from the third group of non-enrolled boys will have in it not only the unskilled and the partially skilled labourers, but also semi-skilled labourers. And, as we know from the relationship between education and income (ref. to Hansen [1963], Henderson-Stewart [1965], Carnoy [1967], Blaug, Layard and Woodhall [1969], Psacharopoulas [1973], Mazumdar [1979], Fields [1980], Berry [1980]) the unskilled labourers will be most lowly paid and the partially skilled labourers will be less paid than the semi-skilled labourers. Thus, in summary, the non-enrolled boys in Phase I would be those with non-developed basic-skill, and the non-enrolled boys in Phase II would contribute to the bulk of illegal child-labour force, while the non-enrolled boys in Phase III would be those with the under-developed basic skill. Because of these differential implications, our detailed investigation in this chapter would be by these three phases separately. It has already been mentioned that the present scope of study will take account of boys only.

In this investigation, our first objective would be to estimate the proportionate size of boys in each phase who are not enrolled in school education. We mean here only the formal school level education. As such the insignificant minority of boys undergoing some sort of vocational training after Phase II stage of their education have remained excluded from our consideration. This non-consideration will not, however, affect our estimates to any considerable extent, since the major scope of such training is open mostly to boys completing partly or fully the Phase III stage of education.

Now, the estimated size of male population in each phase may be considered as the size of desired entrants to schools (under the objective of full education), while the phasewise estimated size of non-enrolled boys are actually derived from the gaps between the desired entrants and the actual entrants to schools. The higher the gaps, the more will be the mis-use and under-use of human resources in economic activities. And as such the extent of these gaps on space may serve as the indicators of associated planning tasks. Here it is implicit that the full and/or compulsory education to all children upto the age of 18+ years at least is rather basic in the context of planning for human resource development.

Pathak [1986] in his first and preliminary study on this topic has already brought into light certain important findings. He estimated the gaps for a good number of major States in the two census years 1960-61 and 1970-71, and examined its regional variation as well as the direction of the decadal change of this variation. Here we go into the topic in much greater detail, covering almost the whole of India by districts for the same two time points.

By now, it must have been clear that to fulfill our objectives we need to identify and also estimate the age-distribution of the male population and also the age-distribution of the male population attending school education, in each spatial unit (a State, or a district) and for each reference year, so that the gaps of non-enrolled boys be estimated on the basis of a reliable data-base. In the formation of the data-base through identification and estimation of the said population age structure, we use some suitable mathematical models and statistical methods. Subsequently, for regional analysis and for analysing the temporal change, we use skillfully certain concepts of regional systems, some specialised statistical and mathematical tools and the geographical mapping techniques. In the following sections we discuss step by step the concepts and the methods which have been used in the empirical analyses to fulfill our objectives.

2.2 The Methods, Techniques, Models and the Concepts for Regional Analysis :

As already stated, due to severe limitations in the availability of reliable and detailed data, no serious study over human resource development has so far been made for its comprehensive spatial evaluation. We too have faced similar problems of data-limitations in our present efforts in this direction of analysis. On the face of this severe problem of data-gaps, we have tried our best here to evolve appropriate statistical methods, with the fitness of the situations, for generating at least some sort of consistent and reliable database at small geographical area level, say, by districts of India. These statistically generated data-base would then be used for comprehensive and detailed regional analysis on human resource development, at least for the diagnosis and depiction of the regional patterns of problem areas in the context to start with. Following subsections (2.2.1) to (2.2.6) will now be devoted to explain the methods that have been evolved for this purpose.

2.2.1 Methods of Estimation of the Single Year Age-Distribution of Male Population by States : 1960-61, 1970-71

As stated already, we propose to estimate first the statistical models establishing the single year age-distribution of male population for all States (or, groups of small States and for Union Territories) of India. The data-base has been established for this from the single year age returns as available by States in the Social and Cultural Tables of the Census of India publications [1961 and 1971]. These returns suffer from lot of inconsistent fluctuations, the major of which is the concentration of population at ages that are generally multiples of five; this we suspect to be due to reporting bias towards round figures in multiples of five. These have been smoothed first by calculating the distribution in terms of single year age return proportions with respect to total males, of five-year moving averages starting from the age of 2 to 95 years, and then by multiplying the proportions by a correction factor so as to equalise the sum of these proportions (based on moving averages) with the sum of actually observed proportions in the said age range. Our attempt has been for obtaining a best-fit continuous curve to the moving average proportions by single year age, so that it may be reliably used for generating the required data-base. In this context we initially tried with varieties of model structures, such as, simple and complex hyperbolic, logarithmic, modified exponential and also some other mixed curvilinear structures, with a view to obtain the best-fit models matching with our data. Details of these exploratory works are, however, not recorded here, and only the one which has been found to be statistically best in our context, has been considered. Thus the model of the following modified exponential type with a threshold parameter, when fitted by two-stage Non-linear Iterative Least Squares method (two-stage NILeS method), has given the best results (ref. to Wold [1966]). In the first stage, we fit the following :

Model (A.1) : $\ln(1 + ky) = a + bx_* + cx_*^2$

where y is the moving average proportion of the male population at age x, x_* equals (x/100), k is the threshold parameter and the three regression parameters are a, b and c.

The parameters a, b and c are estimated by the method of Ordinary Least Squares (OLS) at that stage when in the search procedure over various positive integer values of k, we end up with an optimal choice (say, $k = k_*$) at which the multiple correlation, R, becomes maximum or asymptotically maximum. When it is the case of asymptotically maximum value, then the two consecutive values of R close to the asymptotic value are estimated such that their difference evaluated at, say $k = k'$, and $k = k' + 1$ become very close to zero at some level of approximation. Then we take $k_* = k'$ with the corresponding value of estimate of R as to be the approximate value of the asymptotically maximum R.

Now, in the first stage, we really do not minimise the sum of squares of errors associated with y; rather we do so for the errors associated with ln (1 + ky). To obtain improved and more appropriate parameter estimates by minimising the sum of squares of the errors associated with y, we move to the second stage of estimation of the following mathematically equivalent version of the model (A.1). This revised version of model (A.1), given below in (A.2) has on its left, the proportion y and, on the right, x in a functionally transformed form. To transform x functionally we make use of the estimates of b and c, obtained in the first stage. The parameters k and a of model (A.1) now appear in the changed form as s and t in the model (A.2).

<u>Model (A.2)</u> : $y = s + te^{g(h + x_*)^2}$,

where y and x_* mean the same as before, g and h are obtained from the first stage OLS estimates of b and c (say, $\hat{b}$ and $\hat{c}$ respectively) in the following way :

$$g = \hat{c} \quad \text{and} \quad h = \hat{b} / 2\hat{c},$$

and the least square estimates of s and t are obtained by regressing y on $e^{g(h + x_*)^2}$.

We use the model (A.2) to estimate the single year age return proportions of males by different States (or group of States or Union Territories) in India for each reference year and form the data-base. After examining all the single year age-distributions of males, it has been found that the upper bound of 95 years of age could practically be considered as the maximum age of survival for our purpose. Thus the total proportion of males in the age range from zero to 95 years, both inclusive, in any State or Union Territory could be taken as unity.

After fitting the models empirically by States, we used the model estimates of proportionate figures in conjunction with the corresponding total males to form finally the reliable data-base showing Statewise single year age returns of males.

2.2.2 Methods of Estimation of the Single Year Age-Distributions of School-attending Boys by States : 1960-61, 1970-71 :

Our next task is to estimate the statistical models towards finding the single year age-distribution of school-attending boys for all States of India. Here the sources of data are the annual publications entitled 'Education in India'

[1960-61, 1964-65 and 1970-71]. Though all these publications give only the aggregate of all-India single year age-distributions of boys (and also for girls) undergoing formal or vocational, general or professional training by various stages of education, but Statewise breakdowns of these data are not reported in such detailed form, particularly for our initial time-point of study, 1960-61. The single year age-distribution of school-attending boys' by States are available only from the year 1964-65 covering the time-point of our study, 1970-71. While this is just an information gap of one type, the gap of another type is the non-availability of complete single year age-distribution of school-attending boys at primary, middle and high/higher secondary levels by States. The distributions are disturbed by the clubbing of single year age frequencies at tail-ends of the distributions by the above-mentioned levels of education. The age-ranges of school-attending boys for which detailed single year age-distributions have been made available are (i) 4 to 13 years for primary education, (ii) 10 to 16 years for middle education and (iii) 13 to 19 years for high/higher secondary education; the distributions on either ends of above ranges under various levels of education are only obtained in certain aggregated forms. It is to be noted here that there has been some amount of overlaps of age ranges between two consecutive levels of education as noted above. Naturally the third level of high/higher secondary education is expected to have an overlap with the age-range of still higher or the advanced level of education beyond the third. This advanced level of education is not under our consideration except for those who are in the age-range of our interest. As there is no State level data on the age-distribution of boys under advanced level of education, the marginal data in its lower tail below 19 years of age that ought to have been considered for our purpose, are not available. This generates the information gap of third type.

In the first and preliminary study on this topic by Pathak [1986], statistical methods for bridging the information gaps of the first two types have been suggested. Further research in pursuit of a simpler and more versatile method of bridging all three types of information gaps has come off with the following model formulation against the background of certain simplifying and yet realistic assumptions.

As we do not expect any significant change over the short span of four years between 1960-61 and 1964-65, particularly in the absence of any new educational policy programmes in the period, we assume that there has been no significant changes in the Statewise age-distributions of school-attending boys in proportionate forms in that period. This assumption is useful in obtaining the Statewise age-distributions of school-attending boys in 1960-61, on the basis of the estimated Statewise age-distributions of the proportions of school going boys in 1964-65, as applied to 1960-61 enrolment totals. This eliminates the first type of information gap. The problem posed by the information gap of the second type, being due to the aggregation of single year age frequencies at the tail-ends by each educational level, its solution lies in spanning the partially aggregated information at the tail-ends over ages. The problem arising from the information gap of the third type is solved by assuming that there is no significant State to State variation in the age-distribution of boys attending the advanced level of education beyond the high/higher secondary level. Under this assumption, the available all-India distribution for the boys in advanced level of education could be used uniformly for all States, for the marginal corrections of the third type of information gaps.

For retrieving the State level age-distributions for the year 1960-61 (first type of information gap) and also for spanning the aggregated information at tail-ends (second type of information gap), it has been necessary for us to identify first the single year age-distributions of school-attending boys at each level of education by States, on the basis of the available limited data on single year age frequencies as mentioned already. In this connection, the statistical model that is found to be most suitable among those which have been tried to be fitted empirically (ref. to Pathak [1986] for the exploratory work) is that of a complex modified exponential variety as given below.

<u>Model (A.3)</u> : $y = 1 - e^{A + Bx + Cx^2}$

where y = cumulated proportion of boys of ages less than or equal to x years, and A, B, C are the parameters.

We have made the statistical fits of this model in two stages. First, the statistical fit is made by the OLS on the mathematically equivalent form of model (A.3), as shown in model (A.4).

<u>Model (A.4)</u> : $\ln (1-y) = A + Bx + Cx^2$

At the second stage we fit model (A.3) by applying the method of restricted OLS on the generalised version of this model, shown in model (A.5).

<u>Model (A.5)</u> : $y_* = U + V e^{\hat{A} + \hat{B}x + \hat{C}x^2}$

where $y_* = 1-y$, x is same as before, $\hat{A}$, $\hat{B}$ and $\hat{C}$ are the first stage OLS estimates of A, B and C respectively and V is the regression coefficient estimated by OLS with the restriction that the intercept parameter U = 0.

While fitting empirically the above models, we have kept in mind that, except for the level of primary education, the limited available data on the age-distributions of boys attending the different levels of education, are truncated below. The possibility of truncation does not arise in case of the primary education, since there exists no pre-condition like the necessity of passing any qualifying examination preceding the primary level. In fact, in the transitional phase at the beginning of education, pupils' first time entrance to the formal education is rather a smooth progressive process without any institutional restrictions. This is not the case with the subsequent levels of education wherein the entrances are sequentially linked through a systematic passing of qualifying examinations at the preceding levels. In consequence, we could pre-suppose the existence of zero frequency in the lower extreme of age-distribution meant for the primary level of education only, and not for other subsequent levels. This incorporation of an additional single year extreme age-class with zero frequency gives improved statistical fits of the models for primary level of education only (and not for others). However, if the observed proportion in the lowest single year age class is already smaller than, say, 0.001, the above mentioned incorporation for the primary level of education seems to be unnecessary, and hence not done in such situations.

The single year age-distribution models fitted for the three educational levels in each State have been used next to generate and form the data-base on the aggregate single year age-distribution of all school-attending boys (age specific). The details of this is presented below.

Derivation of the Data-base on Number of Boys Undergoing School Education in Specified Age-intervals : The volume of enrolment of boys are available from the stated published sources for different years by various levels of education, viz., primary, middle, high/higher secondary, various degrees and diplomas, etc., in each State, Union Territory and India as a whole. Once the age-distribution of boys enrolled for each of those levels is estimated by each State by the methods discussed in the preceding sub-section, the data-base then could be easily derived by simple algebraic treatments on the number of boys undergoing school education in the specified age-intervals desired. Thus, for any given State (or, any broad geographical area under consideration) if the estimated cumulative proportions of boys at age less than or equal to x years in (1) primary, (2) middle, (3) high/higher secondary school-education and in (4) the advanced level of education of all types, are denoted respectively by $\hat{Y}_x^{\,p}$, $\hat{Y}_x^{\,m}$, $\hat{Y}_x^{\,h}$ and $\hat{Y}_x^{\,a}$, it follows immediately that, at any age of x years, the total estimated number, designated by $\hat{N}_x$, of boys attending schools, colleges, universities or similar such institutions for any selected time-point 1960-61 or 1970-71 is given by following relation (2.1).

$$\hat{N}_x = N^p (\hat{y}_x^{\,p} - \hat{y}_{x-1}^{\,p}) + N^m (\hat{y}_x^{\,m} - \hat{y}_{x-1}^{\,m})$$

$$+ N^h (\hat{y}_x^{\,h} - \hat{y}_{x-1}^{\,h}) + N^a (\hat{y}_x^{\,a} - \hat{y}_{x-1}^{\,a}) \quad \ldots (2.1)$$

where N^p, N^m, N^h and N^a stand respectively for the total enrolment of boys in primary, middle, high/ higher secondary schools and in other institutions of advanced levels of education.

It has been made clear in our discussions through preceding section (2.1) that x will range from 5 to 18^+ years, both inclusive. It has to be noted, as pointed out earlier, that the estimates of $\hat{y}_x^{\,a}$ used in relation (2.1) above for different States or such broad geographical areas are taken from the corresponding estimates as obtained by fitting the relevant models (A.4) and (A.5) to the all-India data on the single year age-distribution of boys attending the advanced level of education (ref. to the treatments stated earlier in sub-section (2.2.2) for solving information gap of third type). Finally from the estimates $\left\{ \hat{N}_x \right\}$, (5 years $\leq x \leq 18^+$ years), relating to any chosen State or such broad geographical areas, we can derive the distribution of all boys by specified age-intervals of our interest, who are in different phases of education.

2.2.3 Estimations of the Gaps Between the Desired Maximal and the Actual Entrants in the Phases of Education by States : 1960-61, 1970-71

We now have the two estimated single year age-distributions, (1) for total males, denoted by $\{\hat{P}_x\}$, and defined for $x \geq 0$ in the life-span considered, and (2) for the males undergoing education, denoted by $\{\hat{N}_x\}$, and defined for 5 years $\leq x \leq 18^+$ years, the age-range corresponding to the age-range for basic education in the formative phase. Algebraically, the difference of $\hat{N}_x$ from $\hat{P}_x$ for any common class-interval or common single year in the interval 5 to 18^+ years gives the extent of non-enrolment of boys in the particular class-interval or at the age x years. Theoretically speaking, the estimate $\hat{N}_x$ cannot exceed the estimate $\hat{P}_x$ for any particular x. Our initial estimates for different states mostly satisfied this theoretical requirement, yet there have been marginal cases of violation of this requirement at times in some states, particularly for the time point, 1970-71. The source of this marginal inconsistencies happens to be due to the inconsistencies that were present in the raw data as collected from different non-comparable sources, and on which our initial model estimates were built up. For example, while the educational data are collected through existing official machineries of States, the census data are collected through ad-hoc periodical surveys. Despite ad hocism, the census estimates appeared to be more dependable, particularly after we have shed off the possible age-bias-errors through the use of moving averages. On the other hand, the official machineries often' over reported the incidences of enrolment in education (ref. to Third All India Educational Survey [1979]). Again, in Kerala the percentage enrolment in primary education reported in some published documents of the Planning Commission exceeded the figure of maximum possible value of 100% (ref. to Pal and Learmonth [1964]). Similar examples are there also in the reports of the Second All-India Educational Survey [1967]. As such we had to refine and adjust our raw-data on educational enrolment, consulting various related documents from different other sources. We have consulted particularly the reports of the First, the Second and the Third All-India Educational Survey [1960, 1967 and 1979], so that there remains no discrepancy in the requirement that $\hat{P}_x \geq \hat{N}_x$ for any common age-interval of x.

Our main concern, however, has been the three phases (strictly speaking, sub-phases of the formative phase of human resources) as already defined in terms of age-intervals : (1) 5 to 9^+ years, (2) 10 to 14^+ years and (3) 15 to 18^+ years. The estimates of the aggregate male enrolments for these three phases will be denoted here afterwards by $\hat{N}(I)$, $\hat{N}(II)$ and $\hat{N}(III)$ respectively in order of increasing maturity in the formative phase of education. Thus, we have

$$\hat{N}(I) = \sum_{x=5}^{9^+} \hat{N}_x, \quad \hat{N}(II) = \sum_{x=10}^{14^+} \hat{N}_x \text{ and } \hat{N}(III) = \sum_{x=15}^{18^+} \hat{N}_x$$

Clearly the actual total male enrolments, say $\hat{N}$, in the over-all formative phase of development of human resources is given by :

$$\hat{N} = \hat{N}(I) + \hat{N}(II) + \hat{N}(III) \qquad \ldots \quad (2.2)$$

While this gives the phase-wise distribution of actual enrolments, the corresponding estimates of $\hat{N}(I)$, $\hat{N}(II)$ and $\hat{N}(III)$ are really the estimates of actual entrants to school education in the three phases. The corresponding estimates of the desired maximal entrants to school education, to be designated hereafterwards by $\hat{P}(I)$, $\hat{P}(II)$ and $\hat{P}(III)$ respectively for the three phases, are built up from the estimates $\left\{\hat{P}_x\right\}$, 5 years $\leq x \leq 18^+$ years, in a similar fashion as shown below :

$$\hat{P}(I) = \sum_{x=5}^{9^+} \hat{P}_x, \quad \hat{P}(II) = \sum_{x=10}^{14^+} \hat{P}_x \text{ and } \hat{P}(III) = \sum_{x=15}^{18^+} \hat{P}_x$$

Consequently, the desired maximal of total male enrolments, say $\hat{P}$, in the over-all formative phase of development of human resources is given by

$$\hat{P} = \hat{P}(I) + \hat{P}(II) + \hat{P}(III) \qquad \ldots (2.3)$$

Our final interest is in the estimations of the gaps, between the desired maximal and the actual total male enrolments in the said three phases, to be designated hereafterwards by $\hat{G}(I)$, $\hat{G}(II)$ and $\hat{G}(III)$, that hold the following algebraic relation

$$\hat{G}(I) = \hat{P}(I) - \hat{N}(I), \quad \hat{G}(II) = \hat{P}(II) - \hat{N}(II) \quad \text{and}$$
$$\hat{G}(III) = \hat{P}(III) - \hat{N}(III)$$

These estimates $\hat{G}(I)$, $\hat{G}(II)$ and $\hat{G}(III)$ really give the total male non-enrolments to basic education in the three phases. The percentage of non-enrolled boys, g(I), g(II), g(III) are then given by :

$$\left.\begin{aligned} g(I) &= 100(\hat{G}(I)/\ \hat{P}(I)) \\ g(II) &= 100(\hat{G}(II)/\ \hat{P}(II)) \\ g(III) &= 100(\hat{G}(III)/\ \hat{P}(III)) \end{aligned}\right\} \qquad \ldots (2.4)$$

The estimates of g(I), g(II), g(III), as to be built up from available raw-data and our statistical models just discussed, are meant for the states or such broad geographical areas in India. But, for our regional analysis, these broad estimates are not enough for a depiction of the problem areas of the non-development of basic skills at micro level. We have yet to find out such estimates as g(I), g(II) and g(III) for smaller geographical areas like, say, districts of India, so that the spatial patterns on the incidences of non-enrolment could be identified. The relevant methodological aspects will be taken up in a subsequent section, followed by empirical estimations and analyses. But before that, we propose next to review briefly the concepts of regional systems and the related methods and techniques used for analyses.

2.2.4 Concepts and the Techniques of Regional Analysis : A Brief Review

(i) Regional systems : In different areas of a country or a State, the developmental activities, like human 'resource' building-up through education and training, or economic activities like employment generating production and service, activities, either grow or decline over time under the influence of the on-going momentum of processes related to the activities. In a time horizon, a desired state of activities on some future date is obtained as a by-product of certain pre-assigned goals and objectives under prevalent social conditions and aspirations. The existent momentum of the on-going processes may or may not be sufficient to achieve that desired state of activities on a specified future date. If it is sufficient, there is no decision problem to be considered to change the pace of its momentum. If it is not sufficient, the existing momentum of processes can take the present state of activities to a state on the specified future date, which can be called the " usual" state at the future time-point. The short-fall in the " usual" state from the " desired" state of activities on the same future time-point really leads to decision-problems on how to condition and control the momentum of the on-going processes. As activities occur in space (i.e. geographical areas and locations), the differenti ˉ spatial patterns of decision problems often ensue and a consideration of a spatial dimension to the problem becomes unavoidable. In such complexities of situations, the identification of the present spatial structure of activities and the implicit behavioural processes becomes necessary.

Much of geographers' works are in the identification and evaluation of regional structures on many aspects of socio-economic activities and physical phenomena. They usually delineate " regions" by grouping or linking spatial or areal units (geographical areas or locations) on the basis of various characteristics relevant to a certain context of study (ref. to Pal /1974/, for details). This often helps in the identification of disparities in the present state of activities and thus, in the diagnosis of problem areas to be considered. The regional analysts, however, have to proceed further for the identification of the behavioural processes of activities and the measures necessary to control and/or condition the processes, if required for solutions of decision problems present. Complexities of this requirement make the decision problems often not solvable fully; yet, various attempts are made for certain partial solutions at least. Our present attempt is also for comprehensive diagnosis of the developmental problems and the consequent decision makings on human resources. We still fear that the data limitations in this area of study are so severe in India that any comprehensive regional analysis can hardly be achieved by an individual regional analyst in his first research efforts.

However, the nature of regional analysis, when to be attempted in a comprehensive manner, has to be through " system approach" as has been emphasized by pioneer regional analysts like Isard, Stevens, Alonso and Bramhall [1958]. Broadly speaking any " system" is characterized by the attributes of objects related to relevant context of study and the various interactions between the attributes of objects (ref. to Harvey [1969]). The way we have to identify the regional structures for diagnosis of developmental problems and the relevant behavioural processes for decision-making, is nothing but an implicit use of a kind of " regional system approach" (ref. to Pal [1974], for details). In this " regions" are some kind of structural units relevant to a context of study whose attributes and relationships both 'spatial' and 'temporal' (time path setting), and also both within and between, bind them together as a regional system.

As regions, which could have again interacting component parts within, are structural units in any regional system approach, we like to summarise first the concepts of regions that are prevalent in the literature of regional analysis. In the literatures on regional delineation or regionalisation, the term " region" refers to a [illegible] of the following three concepts (ref. to Hartshorne [1958] and Pal [1971, 1973, 1974].

" Ad hoc region : or a region in the general sense, is simply a particular piece of area which may be in some way distinctive from other areas;

Formal region : or a homogeneous or uniform region is an area within which the variations of one or more selected features fall within a certain narrow range; and

Functional region : or a region of coherent organisation or a model region, is an area in which one or more selected phenomena of movement connect the diverse localities within it into a functionally organised unit".

Thus formal regionalisation or the delineation of formal regions means identification and classification of areas on space with respect to some relevant attributes of objects of our interest in a regional system for establishing its formal structures. Functional regionalisation, on the other hand, is done on the basis of establishing spatial linkages or flow or movement of those attributes/characteristics/variables towards finding its functional interaction structures on the micro-level formal entities. The two types of regionalisation together, then, help in identifying and studying the structural units on space and their spatial interactions for a regional system. Our objective here is to identify first the formal regional structures. The functional regional structure evaluation possibilities are not yet in sight for the absence of any functional data, necessary for establishing interactions on space at a time-point. However, we shall try to find out the temporal change on the formal structure between the two selected time-points of 1960-61 and 1970-71, and on the basis of this comparative study we would try to find out if there are any differential pattern reflections of functional interactive forces to result into changed formal structure, if any.

Generally the adhoc regions are taken for granted and not delineated with reference to a context. In fact these regions lack the relevant defining features of a regional system. However, in the Indian federal set-up the States which are not only the broad linguistic formal regions but also the broad functional regions for administrative purpose, control much of the planning investments in the national planning system (not the formal or functional planning system in its true sense). Thus, for certain planning purposes States of India may be considered as ad hoc regions acting as controlling sub-systems (ref. to Hermansen /̲1969_7 for definition) for much of plan implementations ... this regard in the over-all national planning framework. The human resource development programmes, although fall in the common schedule of the State planning board and the national planning commission in India their execution and related plan implementations are largely controlled by the States. For this importance of States, we would also make our spatial analysis, at times, by States of India for depicting relative pictures in this context, which might be of interest to those involved in the control and implementation of planning programmes in those ad hoc regions of States.

(ii) <u>Basic quantitative tools for regional analysis</u> : For any formal regionalisation or the identification of formal regional (or, spatial) configuration, the attributes of objects that are to be taken into account could be both quantitative and qualitative. Very often we have to handle a large number of quantitative attributes. As such, the quantitative tools that are to be deviced in this connection become essential. In this subsection, we shall discuss such basic quantitative tools of regional analyses. In the evaluation of regional structures the spatial objects on which the relevant attributes are generally quantified, are certain micro-level units, like the settlements or localities or talukas or districts or district-groups, etc. The basic micro-level areal units, having been the geographical area of some admini ative or functional convenience, are often not of same size in actual geographical area. To make the attributes of such unequal-sized spatial objects or basic areal units comparable, simple quantitative tools like, the location factor or location quotient are used. A quantitative attribute or characteristic measured by its total magnitudes for different basic areal units, is usually converted into corresponding location factors, which are defined below :

Denoting the Location Factor of a characteristic U by L^U we may express its magnitude for the i^{th} areal unit by

$$L_i^U = \frac{u_i \Big/ \sum_{j=1}^{N} u_j}{a_i \Big/ \sum_{j=1}^{N} a_j} = \frac{u_i/a_i}{\sum_{j=1}^{N} u_j \Big/ \sum_{j=1}^{N} a_j} \quad \ldots (2.5)$$

where $i = 1, 2, \ldots, N$ in the universe of study, covering all areas units of the over-all regional system (or, the nation) under consideration, $(u_1, u_2, \dots u_N)$ is the set of observations on characteristic U for all N areal units and $(a_1, a_2, \dots, a_N)$ is the set of observations on the characteristic A, measuring the corresponding geographical areas of the N areal units.

Clearly, the <u>critical value</u> of L^U is unity and that is the value of the Location Factor for the universe of study signifying the central value for the over-all regional system. Those areal units which have values higher than unity will have higher levels of concentrations of the characteristic U and those areal units which have values below unity will have lower concentration of U, compared with the central representative value of the regional system as a whole. If there were no variation in the geographical areas of the areal units, L^U would have been the measure of absolute concentration of U and as such L^U is referred to, at times, as the Absolute Location Factor. However, we will refer to it simply by the Location Factor or Location Quotient when there is no ambiguity that the distribution of U is sought in relation to the geographical area A only.

However, when the distribution of U is sought in relation to any characteristic V other than A (and obviously distinct from U also), the corresponding location factor for

U relative to V will be denoted by L^{UV} and called the <u>Relative Location Factor (or, Quotient)</u>. Thus, in general Location Factor L^{UV} for U relative to V for the i^{th} areal unit is defined as follows.

$$L_i^{UV} = \frac{u_i \Big/ \sum_{j=1}^{N} u_j}{v_i \Big/ \sum_{j=1}^{N} v_j} \quad \ldots \quad (2.6)$$

for $i = 1, 2, \ldots, N$

Clearly the relative location factor L^{UV} is algebraically equivalent to the ratio (L^U/L^V). Here also the <u>critical central value</u> of L^{UV} is unity and the interpretations of its values above or below unity are same as before (for details on Location Factors, ref. to Pal [1971]). The importance of L^{UV} over and above L^U could be illustrated with a typical example as follows. The extent of on-going human resource developmental activities on space may be measured by the total enrolment in various educational stages by different districts. The distribution of this total enrolment in every district (or, areal unit) may be examined relative to either the geographical area, or the total population, or even the total literate and educated persons of that district. Each of the corresponding measures of location factors (absolute or relative) has its distinct interpretative implications in different geographical areas or regions in the regional system. In fact, mapping (or, cartographic examination) made on each may become useful in drawing important conclusions on the spatial patterns, but all these spatial patterns need not be totally coincident or concommitant everywhere for all such location factors of the characteristic of total enrolment. For a comprehensive depiction of the spatial patterns on this characteristic and for the identification of local peculiarities, one may have to examine all these location factors together.

Again a composite characteristic (such as human resource development) might be reflected or identified through several simple sub-characteristics (such as the enrolments, separately in each of the three considered phases). And we could measure the extent of concentration of these sub-characteristics, each by both forms of location factors, which are all to be considered simultaneously for the comprehensive depiction of the spatial patterns and associations related to this composite characteristic. Thus, there is a need for quantitative tools for simultaneous considerations of the multiplicity of location factors, related to both simple and composite characteristics. The mapping of a simple location factor L^{U}, or L^{UV} under the uniformity criterion of formal regions, leads to the formation of what is usually called the <u>simple formal regional configuration</u>, the subsequent analysis of which may lead to a <u>formal regionalisation</u> of the simple characteristic, whereas, for a composite characteristic one has to examine many inter-related sub-characteristics of simple type, each of which either reflect partially the composite characteristic or be reflected by it. Thus, a simultaneous consideration of many inter-related or inter-dependent spatial variables or location factors becomes unavoidable. A formal regional configuration, identified on the basis of more than one such spatial variables or location factors is known as composite formal regional configuration, the analysis of which may lead to the corresponding composite formal regionalisation. There exist already some basic quantitative tools and methods that are useful for identifying a composite formal regional configuration. We shall discuss on them in the next sub-section.

We shall conclude this sub-section describing an over-all measure of disparity for the regional system as a whole. This over-all measure of disparity, usually called the Coefficient of Localisation, gives a single quantitative figure of concentration of a characteristic for the regional system as a whole, which depicts a summary picture of the corresponding location factor, giving its detailed spatial concentration. This coefficient (as used by Sergant Florence [1954] in the Economic Survey of Europe : 1954) may be expressed as follows.

$$K^{UV} = \frac{1}{2} \sum_{j=1}^{N} w_j \left| L_j^{UV} - 1 \right| \qquad \ldots \quad (2.7)$$

where $w_j = v_j \Big/ \sum_{i=1}^{N} v_i$

and L_j^{UV} = the value of the location factor L^{UV} for j^{th} areal unit.

Clearly K^{UV} is a weighted aggregation of the absolute variations of L^{UV}'s from the central critical value of unity. A factor $\frac{1}{2}$ has been multiplied with the weighted sum of absolute deviations in recognition of the fact that the totals of the positive and the negative deviations in absolute form are the same. As such K^{UV} becomes useful when we are comparing the over-all concentrations, measured in terms of different characteristics. Note that K^{UV} varies in the possible range $0 \leq K^{UV} < 1$. The value of $K^{UV} = 0$ indicates the perfectly even spatial distribution of U relative to V. The distribution of U relative to V becomes more and more concentrated as K^{UV} tends to unity. There is a comparable measure of this variety given by Lorenz [1905] for measuring the over-all concentration (ref. to Wright [1936] for its spatial case). But this measure is not considered suitable for our study, because of its complex mature of algebraic formulation, for which it becomes cumbrous and also less sensitive measure of disparity as compared with the coefficient of localisation.

(iii) Quantitative Methods for Composite Formal Regional configuration : For an identification of any composite formal regional configuration, we have to deal with a group of inter-related or inter-dependent spatial variables or location factors simultaneously. As such, corresponding to each of those spatial variables, we get a simple formal regional configuration through mapping. Then, the simultaneous consideration of all such simple configurations for the portrayal of the composite configuration, happens to be a stupendous task, as attempted usually by geographers by their super-imposing technique of composite mapping (ref. to e.g. Learmonth et al., [1960, 1962], Schwartzberg [1962] and Spate and Learmonth [1967]). In fact, the super-imposing technique of mapping is somewhat manageable when the number of spatial variables to be considered for composite mapping does not exceed two. But when the number is three or more and if those are not having very strong spatial association, then the super-imposing technique of mapping becomes intractable. To clarify this point, let us consider that each spatial variable is classified, for example, into only the three classes in order of magnitude of its values (say, the classes of high, medium and low values). Now, if the number of spatial variables to be considered for the composite mapping be n, then the total number of classes, say C, to be dealt in a super-imposing technique of mapping would be as large as 3^n. In particular for n = 2, we get C = 9, whereas for n = 3, we have C = 27, and as n takes higher and higher values, C becomes larger and larger. Clearly, this simple illustration helps in substantiating our contention of unmanageability with number of spatial variables greater than two in composite mapping.

In fact, the use of the super-imposing technique of mapping for only two spatial variables are often useful (for details ref. to Pal [1973, 1974]). But the complexity of using this technique for more than two spatial variables discourages us to use it in our analysis. In such situations, we shall take resort to the available quantitative tools for composite index formulations for groups or sub-groups of inter-related spatial variables that are under simultaneous consideration for the identification of a composite formal regional configuration. For these quantitative tools and further statistical treatment necessary for composite formal regionalisation, we refer to the pioneering works of Kendall [1939] and Pal [1963, 1971, 1973, 1974, 1985 (1990), 1989]. The practical need for composite spatial index formulation for a composite characteristic has been aptly focused and well elaborated in Pal [1971, 1973 and 1974]. According to Pal, the absolute and the relative location factors, for example, as discussed earlier, are generally concomitant in magnitudes over different areal units of observation and only in a limited number of observations there may be discordance in the magnitudes because of certain local peculiarities. Thus, for example, in an area where opportunities of agricultural practices are not much, the people residing therein may have to depend primarily on non-agricultural activities. Now, if one is interested to see whether an area is more industrialised or not as compared with other areas on the basis of absolute or relative location factors of industrial activity, measured by, say, labour participation, it would be found that the absolute location factor of the area, without having the possibilities of agricultural production, will be comparably much lower than the corresponding value of the relative location factor which may be comparable to some of the really industrialised areas having high values in both the location factors. One could be easily misguided about the comparative ranking between two areas in respect of the composite characteristic of industrialisation, if one judges by a single location factor only and not by both the factors simultaneously. This illustrates the need for formulation of a composite index, moderating the values of both relative and absolute location factors, particularly for the areas with discordant values as stated earlier. This principle of moderation for realistic visualisation of the joint effect of any number of simultaneously operative and inter-related spatial variables could be generalised in any situation where there is a necessity of evaluation of the influencing or influenced composite characteristic under formal criterion.

Now, for a right depiction of inter-relations, measured by linear correlation coefficients among pairs of all the variables under consideration, there is also the necessity to check the statistical distributions of the variables, as has particularly been emphasized by Pal. Proper identification of the inter-relation that exists between any pair of variables, is not possible through computation of a " product moment linear correlation coefficient" , if the statistical distributions of two variables are not made almost similar through suitable mathematical transformations.

Now before discussing the existing methods of composite index formulation we would introduce certain terminologies as standardised in the recent work on the most generalised composite index formulation by Pal [1985 (1990)]. The location factors under suitable mathematical transformations will be called the <u>spatial indices</u>, or simply, the indices (including the cases where transformations are not necessary). Suppose the indices, $z_1, z_2, \ldots, z_n$, are to be considered simultaneously for a construction of the composite index, designated by I. Then, denoting the correlation between z_i and I by r_i, i.e. $r_i = r_{I,z_i}$, we call r_i the <u>Specific Representation</u> of the i^{th} constituent index in the formulation of the composite index I. The <u>Aggregate Representation</u> (or, <u>the Average Representation</u>) by the composite index is defined as the square root of the average of all squared specific representations. Denoting the aggregate representation by ρ we may then write

$$\rho = \left(\frac{1}{n} \sum_{i=1}^{n} r_i^2\right)^{\frac{1}{2}} \qquad \ldots (2.8)$$

Now, prior to the formulation of the most generalised composite index by Pal, the statistical construction of the composite indices has been based on two principles -- (1) the aggregate representation maximising principle (optimal-index formulation) and (2) the specific representation equalising principle (equity-index formulation). Later these have been found to be the special cases of the most generalised formulation of Pal (ref. to Pal [1985 (1990)]). Not only these two but also another important class of composite index formulation, formulated by Pal and Mukhopadhyay [1989] and designated as the <u>equi-spaced optimal index formulation</u>, is a special case of Pal's most generalised index formulation. However, the importance of the composite index formulation, based on the classical principles, has not reduced although the most generalised formulation with the particular specification of equi-spaced optimal formulation has much greater manoeuvrability with specific situations of operational importance. We shall examine in certain contexts of this dissertation, the fitness of application of the particular formulating principle used in our empirical situations.

The logic which is followed in the formulation of a composite index is the following. We try to measure, in terms of the composite index, a common character which itself may not be measurable directly but influences or itself gets influenced by a number of spatial variables. As such the variables are likely to be strongly inter-related. That is the reason why suitable mathematical transformation of the variables in the initial stage, might become essential for proper identification of the interrelations through the linear correlation coefficients. In the construction of the composite index, representing an over-all characteristic, the selection of the group of constituent variables becomes possible due to high likelihood of strong inter-relationships among them. Any variable not having much relation with the group of strongly inter-related variables, is most likely to be found irrelevant in the construction of the composite index and thus, will not find its place in the final group of constituent variables. Whether the composite index is to be constructed by following the maximising principle or not, is decided on the basis of our prior knowledge on the interrelations among the variables as represented through the inter-correlations among the corresponding indices. If the correlations are all equally high, the composite index that may be obtained by following the method of optimal-index formulation of Kendall /̲1939_7, would be same or almost similar to the one which might be obtained by following the method of equity-index formulation of Pal /̲1963, 1971_7. In fact, he has shown in his most generalised index formulation /̲1985 (1990)_7, under what conditions on the correlation matrix, Kendall's and Pal's formulations would be identical or nearly so. Our above contention is in conformity with what was claimed and proved in that paper through a theorem. However, it is quite possible that in the final group of constituent variables the importance of the variables are quite diversely correlated with reference to the common characteristic. Other than the variables own characteristic roles, the observational or sampling errors might also be contributing to such diversity. In such situation one has to be cautious while constructing the composite index following the maximising principle. Mathematical maximisation being the sole objective in the formulation of this index, the derivation of specific representations gets dictated solely by the mathematical aspect. Such specific representations would hardly be reflective or tallying with what have otherwise been proved or experienced (for a comparative study ref. to Pal and Chattopadhyay /̲1972_7). Thus, in the cases where specific representations are widely diverse, a constituent variable with highest importance with reference to a common characteristic might get, for example, a very low specific representation in the composite index. In such a situation, construction of the composite index on the basis of specific representation equalising principle is quite useful in avoiding anomalies of above nature. In fact, in absence of any apriori knowledge about the importance of different variables in the characterisation of the common character, the equity principle is the most unbiased and wise. Since of the two principles, the maximising principle is least constrained by externally imposed conditions, it yields a higher value of the aggregate representation. This is the reason why construction of the composite index on the basis of maximising principle is often taken into account, particularly as long as the specific representations are within certain narrow range of high values and not widely varying.

Now for an areal unit of observation, we have values of constituent variables ($z_1, z_2, \ldots, z_n$) of the composite index I that may be regarded mathematically as a point in the n-dimensional space, when these n constituent variables or indices are strongly inter-correlated, the scatter of observations will be closely around a central line (through the mean point of the variables or indices). In Kendall's study on crop-productivity in England by counties and by several crop-yield variables [1939], an attempt was made to fit this line by the least squares principle, and this line of the closest fit, satisfying the maximising principle of aggregate representation was then termed by Kendall himself as the " productivity axis", (because of the nature of data used in his study). In general context, we refer to this axis (or, line) as the " <u>Central Axis</u>". Its determination is algebraically equivalent to the determination of " first principal component" as formulated by Hotelling [1933], and due to maximisation of $(n\rho^2)$ by the first principal component, the squared aggregate representation, ρ^2, also gets maximised. Hotelling's principal component analysis involves computation of a series of " principal components" out of a given set of variables and it does not restrict itself only to the first principal component. The procedure of computation assumes before hand for mathematical convenience the mutual independence of the principal components, and after computation of the first principal component subsequent components are found out based on the principle of explaining maximally the residual variation that remains unexplained by the preceding components. The regional studies of Berry [1960], Berry and Rao [1968] and Dasgupta [1971] are based on the use of a number of principal components. To us, the property of mutual independence of the components is hardly acceptable since in regional literature, the indices represented by the components are often oblique than orthogonal (see, Pal [1968]). In the cases where consideration of only the first principal component is not enough for accounting a significantly major part of the total variation of the variables or indices, we suggest a formation of some distinct sub-groups of the variables or indices, each characterised by strong mutual inter-correlations among the variables, and construction of subgroupwise composite indices so as to examine finally the correlation between any two sub-group indices for identification of their obliqueness (see Pal [1968, 1973] for further details). By all these theoritical discussions, what we actually like to emphasise is that, in composite formal regionalisation based on a common characteristic, one should do the choice, the required transformation and the final inclusion of relevant variables or indices in the composite index, on the basis of a supporting logic of strong inter-correlation among the variables or indices. However, we shall examine all these further if specific empirical situations arise, and try to find and use the appropriate method of index formulation depending upon the nature of inter-relations present in our data.

(iv) <u>Computational procedures for the three special cases of the most generalised index formulations</u> : For a composite index to be constructed from n spatial variables or indices, we denote the constituent variables (if necessary in finally transformed forms) by $x_1, x_2, \ldots, x_n$ and the composite index by I*. Let $\bar{x}_i$ and σ_i be the mean and the standard deviations of the i-th constituent variable or index. Then, the type of composite indices that we are considering here are all of the following form

$$I_j^* = \frac{\sum_{i=1}^{n} a_i \; x_{ij}}{\sum_{i=1}^{n} a_i \; \bar{x}_i} \qquad \ldots \quad (2.9)$$

where j is the areal unit for which the composite index being evaluated. The values of a_i's differ depending on the principle based on which the index is formulated.

In the form (2.9) the critical central value of the composite index I* is unity (i.e., $\bar{I}^* = 1$) corresponding to the average point of the observations on the n constituent variables, i.e, $(\bar{x}_1, \bar{x}_2, \ldots\ldots, \bar{x}_n)$. However, when we consider the relevant location factors as the constituent spatial variables, the mean value of any $\bar{x}_i$ does not necessarily coincide with its critical central value of unity (note that even any power-transformed location factor, if used, has also the same critical central value of unity). In order to get the exact correspondance between the set of unit values standing for the critical central values of all constituent location factors (or, power transformed location factors), with the critical central value of unity standing for the final composite index, we slightly modify our composite index formulation I* [ref. to equation (2.9)] to the composite index formulation I as given below.

$$I_j = \frac{\sum_{i=1}^{n} a_i \ x_{ij}}{\sum_{i=1}^{n} a_i} \qquad \ldots (2.10)$$

Clearly, the relation between I_j^* and I_j for any j-th areal unit will be the following.

$$I_j = \bar{I} \ I_j^* , \quad \text{where} \ \bar{I} = (\sum_i a_i \bar{x}_i / \sum_i a_i)$$

Note that the standard deviation of I is given by $\sigma_I = \rho/(\sum_i a_i)$. The two formulas I^* and I are, however, statistically identical, except for a change in the scale of measurement. So there would not be any substantive change in regional analysis whatever be the formula we use. The estimated values of a_i's under (i) Pal's equity formulation, (ii) Kendall's optimal formulation and (iii) Pal's equi-spaced optimal formulation would be different as also the methods of such estimations. We shall now take up these separately. Here afterwards, the correlation between the i-th and the j-th constituent indices (or, location factors) will be denoted by r_{ij} and the overall correlation matrix by R, with its representative (i, j)-th element as r_{ij}. As all the three formulations are special cases of the most generalised formulations, it is worthwhile to record here the salient features of computational procedure for the most generalised index formulation first and then go for those special cases.

The main parameters of interest in the construction of the most generalised composite index (Pal [1985 (1990)]) are : the combining weight vector $(w_1, w_2, \ldots, w_i, \ldots, w_n)$, the specific representation vector $(r_1, r_2, \ldots, r_i, \ldots, r_n)$, and the derived representation multiplier vector $(m_1, m_2, \ldots, m_i, \ldots, m_n)$, where $m_i = r_i/\rho$ for each i, with the aggregate representation

$$\rho = \left(\frac{1}{n} \sum_{i=1}^{n} r_i^2\right)^{\frac{1}{2}}$$

Once the combining weight vector is determined for a particular special case, we get the estimates of a_i's in that particular formulation by the relation :

$$a_i = w_i/\sigma_i \quad \text{for all } i \qquad \ldots (2.11)$$

For the most generalised formulation we have the following established relations :

$$\sum_{i=1}^{n} m_i^2 = n \qquad \ldots (2.12)$$

$$\sum_{i=1}^{n} w_i m_i = 1 \qquad \ldots (2.13)$$

$$\sum_{j=1}^{n} r_{ij} w_j = \rho^2 m_i, \qquad \ldots (2.14)$$

for i = 1, 2, ..., n

If either the weight vector or the multiplier vector is known (by some external condition), the parameters of generalised index formulation can be completely solved from the algebraic solutions of relations (2.12), (2.13) and (2.14) and the relations

$$\rho m_i = r_i, \quad i = 1, 2, \ldots, n \qquad \ldots (2.15)$$

The special cases of formulations are now discussed below.

(iv) (a) Pal's equity index formulation : The generalised index formulation reduces to Pal's [1963, 1971] equity index formulation only when we have

$$m_1 = m_2 = \ldots\ldots = m_n = 1 \qquad \ldots (2.16)$$

The relations (2.12) through (2.14) then reduces to

$$\sum_{i=1}^{n} w_i = 1 \qquad \ldots (2.17)$$

and

$$\sum_{j=1}^{n} r_{ij} w_j = \rho_E^2 \qquad \ldots (2.18)$$

from which w_i's are solvable (here, in this specific case, writing ρ_E for ρ, $\rho = r_1 = r_2 = \ldots\ldots = r_n$).

(iv) (b) Kendall's optimal index formulation : This classical formulation was evolved first by Kendall as early as in 1939 through the comparable regression approach of the least squares minimisation, here, the minimisation of the aggregate of squared departures of the scatter of points in n-dimensional variable space, from the best fit central axis through the scatter, passing through mean point. Later Pal [1985 (1990)] has proved that his generalised formulation reduces to Kendall's formulation, when

$$w_i = m_i/n, \quad \text{for each } i = 1, 2, \ldots, n \qquad \ldots (2.19)$$

Using this relation, an iterative procedure for computing its parameters can be summarised as follows :

> " We begin with weights $w_i = \frac{1}{n}$ for all i at the first iteration. With the weight vector of, say, s-th iteration, the multiplier vector can be solved by use of relation (2.14) first and then correcting for the involved constant of proportionality, here ρ^2, by use of relation (2.12). Further, the relation (2.19) is used to get the weight vector of next $(s+1)^{th}$ iteration from the

estimated multiplier vector of s^{th} iteration. Finally when the weight vector of two consecutive iterations are empirically identical, the iteration process is stopped and the final weight vector is obtained. With this weight vector, all other parameters can easily be computed for the optimal index".

For this index the aggregate representation ρ is specifically designated by ρ_M.

(iv) (c) Pal's equi-spaced optimal formulation : The mathematical development for equi-spaced optimal formulation was accomplished firstly by Pal himself and its first application was made in collaboration with R.N. Mukhopadhyay (ref. to Pal and Mukhopadhyay [1989]) in connection with their study on an appropriate spatial economic development index formulation for India. The final estimations of the weight vector and the multiplier vector, etc., preceded the estimations to their initial related forms called the proportionate weight vector :

$$\left.\begin{array}{l} (w_{1*}, w_{2*}, \ldots, w_{i*}, \ldots, w_{n*}) \\ \text{with } \sum_{i=1}^{n} w_{i*} = 1 \end{array}\right\} \quad \ldots (2.20)$$

and its corresponding proportional multiplier vector : $(m_{1*}, m_{2*}, \ldots, m_{i*}, \ldots, m_{n*})$, where the estimating equation system (2.14) is taken in the following form

$$\sum_{j=1}^{n} r_{ij} w_{j*} = m_{i*} \qquad \ldots (2.21)$$

$$\text{for } i = 1, 2, \ldots, n$$

Next for the relations comparable to (2.13) and (2.12), we substitute

$$A^2 = \sum_{i=1}^{n} w_{i*} \; m_{i*} \qquad \ldots (2.22)$$

and $$B^2 = \sum_{i=1}^{n} m_{i*}^2/n \qquad \ldots (2.23)$$

Then, from comparison of (2.23) and (2.12), we get

$$m_i = m_i^*/B, \quad \text{for all } i \qquad \ldots (2.24)$$

Again, from relations (2.22), (2.24) and (2.13), we get

$$w_i = \left(\frac{B}{A^2}\right) w_{i*}, \quad \text{for all } i \qquad \ldots (2.25)$$

Also, using relations (2.21), (2.25), (2.24) and (2.14), we get

$$\rho_S^2 = B^2/A^2, \ \text{i.e. } \rho_S = B/A, \qquad \ldots (2.26)$$

(denoting ρ specifically for this index formulation by ρ_S). Finally using (2.26) and (2.24), and noting that $r_i = \rho_S m_i$, we get

$$r_i = m_{i*}/A, \quad \text{for all } i \qquad \ldots (2.27)$$

By use of the relations (2.20) through (2.27) the parameters of the generalised index formulation can as well be solved, starting from either the proportionate weight vector or the proportional multiplier vector given by some external conditions. The equi-spacing of specific representations provides such an external condition for equi-spaced formulations. There can be many equi-spaced formulations, depending upon the particular choices of its aggregate representation ρ_S, lying in between the range between ρ_E and ρ_M. The unique equi-spaced optimal formulation is that equi-spaced index formulation which maximises ρ_S^2 subject to equi-spacing conditions, with or without some other desirable constraints, if necessary (details regarding the imposition of further desirable constraints are given in the paper quoted, but not discussed here). It should be noted that both the optimal ordering (Kendall's) and the equi-spaced optimal ordering (Pal's) of constituent variables by values of specific representations could be the same. The optimal ordering of variables would be called the normal ordering, as it is supported by the revealed evidence of empirical interactions between variables as depicted in the correlation matrix R. Often this normal ordering is identical with the ordering by the magnitudes of column-sums of the correlation matrix.

For convenience in presenting the equi-spacing condition in a systematic form, we assume henceforth that the suffixes of variables x_i's are so chosen that the specific representations of r_i's are in decreasing sequence of normal ordering (or, <u>any revised ordering</u>, if chosen, under theoretical compulsions), the multiplier m_i's and hence the proportionate multipliers m_{i*}'s also follow the same ordering. Thus, with our choice of suffixes, a particular choice of ordering could be taken in the following sequence of values :

$$\underset{(\text{max.})}{m_{1*}} > m_{2*} > \cdots\cdots > m_{(n-1)*} > \underset{(\text{min.})}{m_{n*}}$$

From linear equi-spacing conditions, we have

$$(m_{1*} - m_{2*}) = (m_{2*} - m_{3*}) = \cdots\cdots = (m_{(n-1)*} - m_{n*}) = \Delta \text{ , say,}$$

so that we get

$$\left.\begin{aligned} \Delta &= (m_{1*} - m_{n*})/(n-1) \\ &\text{and} \\ m_{j*} &= m_{1*} - (j-1)\Delta \text{ , for } j = 1, 2, \ldots, n \end{aligned}\right\} \quad \ldots(2.28)$$

By use of these equi-spacing conditions on the equation system (2.21) and re-recording the relation (2.20), we have the following system of (n-1) equations :

$$\left.\begin{aligned} &\sum_{j=1}^{n} R_{ij}\, w_{j*} = 0, \quad \text{for } i = 1, 2, \ldots, , (n-2), \\ &\text{where } R_{ij} = r_{nj} + r_{ij} - r_{(i+1), j} - r_{(n-1), j}, \\ &\text{and} \quad \sum_{j=1}^{n} w_{j*} = 1 \end{aligned}\right\} \quad \ldots (2.29)$$

From these (n-1) equations, we can express w_{j*}'s as linear functions as given below.

$$\left.\begin{aligned} &w_{j*} = h_j + k_j\, w_{1*}, \quad \text{for } j = 1,2,\ldots,n \\ &\text{in which } h_1 = 0 \text{ and } k_1 = 1, \\ &\text{and} \quad \sum_{i=1}^{n} h_i = 1, \quad \sum_{i=1}^{n} k_i = 0 \quad \text{(by virtue of} \\ &\text{the last equation in (2.29)} \end{aligned}\right\} \quad \ldots (2.30)$$

Then we make the following computations as intermediate stages :

$$\left.\begin{aligned} D_1 &= \sum_{j=1}^{n} r_{1j}\, h_j, & E_1 &= \sum_{j=1}^{n} r_{1j} k_j \\ D_n &= \sum_{j=1}^{n} r_{nj}\, h_j, & E_n &= \sum_{j=1}^{n} r_{nj} k_j \\ S &= \sum_{j=1}^{n} (j-1) h_j/(n-1), & T &= \sum_{j=1}^{n} (j-1) k_j/(n-1) \end{aligned}\right\} \quad \ldots (2.31)$$

The derived parameters in terms of these intermediate parameters are :

$$\left.\begin{aligned}
Q_1 &= D_1 - S\ (D_1 - D_n),\\
Q_2 &= E_1 - S\ (E_1 - E_n) - T(D_1 - D_n),\\
Q_3 &= - T(E_1 - E_n),\\
P_1 &= \frac{1}{4}\ (D_1 + D_n)^2 + \frac{(n+1)}{12(n-1)}\ (D_1 - D_n)^2\\
P_2 &= \frac{1}{2}\ (D_1 + D_n)\ (E_1 + E_n) + \\
&\qquad \frac{n+1}{6(n-1)} (D_1 - D_n)\ (E_1 - E_n)\\
\text{and}\quad P_3 &= \frac{1}{4}\ (E_1 + E_n)^2 + \frac{n+1}{12(n-1)}\ (E_1 - E_n)^2
\end{aligned}\right\} \qquad \ldots (2.32)$$

These estimates are used to get the following relations as established by Pal in his paper :

$$\left.\begin{aligned}
m_{1*} &= D_1 + E_1 w_{1*}\\
m_{n*} &= D_n + E_n w_{1*}\\
A^2 &= Q_1 + Q_2 w_{1*} + Q_3 w_{1*}^2\\
B^2 &= P_1 + P_2 w_{1*} + P_3 w_{1*}^2
\end{aligned}\right\} \qquad \ldots (2.33)$$

and hence from (2.26),

$$\rho_S^2 = \frac{P_1 + P_2 w_{1*} + P_3 w_{1*}^2}{Q_1 + Q_2 w_{1*} + Q_3 w_{1*}^2} \qquad \ldots (2.34)$$

Next for each particular choice of ρ_S in the range between ρ_E and ρ_M, we can solve for w_{1*} from the quadratic equation (2.34). This equation has either both the roots real or both imaginary. Normally we get real and fractional roots due to choice of strongly associated spatial variables. Imaginary roots might be obtained in rare occasions due to assumptions inconsistent to our theoretical development, e.g., if ρ_S^2 is chosen greater than ρ_M^2 then we might get imaginary roots. Usually one of the two roots corresponds to a smaller range of specific representations and the other corresponds to a larger range in comparison to that as present in the Kendall's index. The former root is, however, logically more acceptable since it distorts less the less represented variables in the index. It should, however, be noted that both the roots correspond to the same aggregate representation although one of them would give an acceptable range of specific representations. This shows that aggregate representation should not be considered as the sole determining factor in the choice of an index and also, it reveals the importance of the specific representations in this context. Once w_{1*} is known, we can deduce all parameters of such an equi-spaced formulation from the relevant relations as given earlier.

Finally for the unique equi-spaced optimal formulation the mathematical first order condition for extreme ρ_S^2 has been applied on equation (2.34) to get the following simplified relations :

$$\rho_S^2 = \frac{P_2 + 2P_3 w_{1*}}{Q_2 + 2Q_3 w_{1*}} = \frac{2P_1 + P_2 w_{1*}}{2Q_1 + Q_2 w_{1*}} \qquad \ldots (2.35)$$

On further simplification, we can deduce

$$w_{1*} = \frac{P_2Q_2 - 4P_1Q_3 - \rho_S^2 (Q_2^2 - 4Q_1Q_3)}{2(P_2Q_3 - P_3Q_2)} \qquad \ldots (2.36)$$

In equations (2.35) and (2.36), ρ_S^2 is either ρ_S^2 (max.) or ρ_S^2 (min.). Putting $\rho_S^2 = y$ in relation (2.35) and simplifying, we get the following quadratic equation

$$(Q_2^2 - 4Q_1Q_3)y^2 - 2(P_2Q_2 - 2P_1Q_3 - 2P_3Q_1)y + (P_2^2 - P_1P_3) = 0 \qquad \ldots (2.37)$$

The two solutions of this quadratic equation with simplified discriminant, are given by :

$$y = \frac{P_2Q_2 - 2P_1Q_3 - 2P_3Q_1 \pm 2\sqrt{(P_1Q_3 - P_3Q_1)^2 - (P_2Q_3 - P_3Q_2)(P_1Q_2 - P_2Q_1)}}{Q_2^2 - 4Q_1Q_3} \qquad \ldots (2.38)$$

When the expression under the radical sign in the numerator of (2.38) is positive, we get two real solutions of y, one of which is ρ_S^2 (max.) and the other ρ_S^2 (min.). Using ρ_S^2 (max.)

for ρ_S^2 in equation (2.36), we get our required equi-spaced optimal w_{1*}. With this value of w_{1*}, all parameters of the equi-spaced optimal index formulation can be solved from preceding relations. This gives the free equi-spaced optimal formulation without any further constraints.

(iv) (d) Composite index in the simplest case of two variables : an example : In the case of two variables it has been proved (ref. to Theorem 8 in Pal [1985 (1990)] that the equity and the optimal formulations converge to a single formulation (i.e., it satisfies both equalising and maximising principles) with the following alternative forms corresponding to j-th areal unit,

$$I_j^* = \left(\frac{\sigma_2}{\sigma_2\,\bar{x}_1 + \sigma_1\,\bar{x}_2}\right) x_{1j} + \left(\frac{\sigma_1}{\sigma_2\,\bar{x}_1 + \sigma_1\,\bar{x}_2}\right) x_{2j} \qquad \ldots (2.39)$$

$$\left.\begin{aligned} \text{and} \quad I_j &= \left(\frac{\sigma_2}{\sigma_1 + \sigma_2}\right) x_{1j} + \left(\frac{\sigma_1}{\sigma_1 + \sigma_2}\right) x_{2j} \\ &= A\, I_j^*, \quad \text{with } A = \frac{\sigma_2\,\bar{x}_1 + \sigma_1\,\bar{x}_2}{\sigma_1 + \sigma_2} \end{aligned}\right\} \qquad \ldots (2.40)$$

In Pal's [1963] original equity formulation he used the form (2.39), which was later modified to (2.40). As in the general cases, these two forms are statistically identical except for a change in the scale of measurement.

As such, the specific representations and the aggregate representation (coincident for this two variable case) for either formulas (2.39) and (2.40) are identical and the common value ρ, (any specific or aggregate representation), is given by

$$\rho = \frac{1}{2}\,(1 + r_{12})^{1/2} \qquad \ldots (2.41)$$

Here the constituent variables ought to be in such transformed forms that the value of r_{12} can be taken to be positive (i.e., $0 < r_{12} < 1$). From (2.41) it is apparent that the values of ρ will always exceed 0.71 (the value when $r_{12} = 0$), and thus the representation of the constituent variables will always be on the higher side, from 0.71 to 1.00. It shows the high level of dependability of the index constructed out of two variables only. It is for this reason, sub-group indices, each with a relevant pair of constituent variables could be formed to start with and finally those sub-group indices could be combined again by the same principle to arrive at the ultimate composite index. This kind of sequential formations with pairs of variables, at times, could have more interpretative convenience (ref. for example, to Mukhopadhyay [1988]).

2.2.5 Formulation of Phasewise Indices of Non-development of Basic-Skill (INBS) by States and the Generation of District-Level Estimates by Statistically Consistent Indicator Method

We have described in sub-section (2.2.3) the statistical methods determining $\hat{G}(I)$, $\hat{G}(II)$ and $\hat{G}(III)$ the phasewise estimates of the number of boys, not enrolled in school education, and also $\hat{P}(I)$, $\hat{P}(II)$ and $\hat{P}(III)$, determining the phasewise estimates of the number of desired maximal entrants (boys), both by the States of India. The correspon-ding all-India estimates could be easily built up, by aggrega-ting in each phase all State estimates for both G and P at any time-point, 1960-61 or 1970-71. The estimates of non-enrolled boys, $\hat{G}(I)$, $\hat{G}(II)$ and $\hat{G}(III)$, can be taken as to reflect the extent of non-development of basic-skill, relative to the corresponding maximal entrants, $\hat{P}(I)$, $\hat{P}(II)$ and $\hat{P}(III)$ respec-tively, in the formal education. Granting this, we can now use the algebraic formulation of the relative location factor L_i^{UV} for a characteristic U relative to some other characteris-tic V (ref. to relation (2.6) in sub-section (2.2.4)), with <u>mutatis mutandis</u> for variables U and V. It should be noted that the algebraic formulation of L_i^{UV} can be expressed in the following equivalent form

$$L_i^{UV} = \frac{u_i \Big/ \sum_{j=1}^{N} u_j}{v_i \Big/ \sum_{j=1}^{N} v_j} = \frac{(u_i/v_i)}{(\sum_j u_j \Big/ \sum_j v_j)}$$

Here the numerator on the right hand extreme side is a ratio estimate of u to v for the i-th areal unit and the corresponding denominator is the similar aggregate estimate for the totality of all areal units (representing all-India, in our study). These ratio estimates are denoted as follows with reference to data on the characteristics of our concern :

$$g_i(\varphi) = \hat{G}_i(\varphi)/\hat{P}_i(\varphi),$$

for φ = I, II or III, defined for any i-th areal unit,

and $$g(\varphi) = \sum_j \hat{G}_j(\varphi)/\sum_j \hat{P}_j(\varphi), \text{ for } \varphi = \text{I, II or III},$$

As $g(\varphi)$ is supposed to stand for the all-India estimates, the subscript j here extends over all areal units, covering the total geographical area of India. In particular when the areal units are the States of India, the summation for i extends over all States of India, comprising its total geographical area. As we shall be interested also in the district-level estimates within each State of India, we shall further specify the notation $g_j(\varphi)$ for the j-th State of India by $g_{oj}(\varphi)$, and for any i-th district in the j-th State by $g_{ij}(\varphi)$. The corresponding location factors will now be denoted as follows :

$L_{oj}(\varphi) = g_{oj}(\varphi)/g(\varphi)$; φ = I, II or III,

(the estimate of j-th State of India for different phases),

and $L_{ij}(\varphi) = g_{ij}(\varphi)/g(\varphi)$, φ = I, II or III,

(the estimate of i-th district in j-th State of India for different phases).

From the fore-going discussion, it is clear that we are in a position to directly estimate the location factors $L_{oj}(\varphi)$, for the States of India for each phase φ = I, II or III. We have yet to evolve or generate methods to estimate the location factors $L_{ij}(\varphi)$, φ = I, II, III, for the districts in different States of India. However, we shall specify the nomenclature of these location factors, whether for districts or for States of India, by <u>Indices of Non-development of Basic-Skill or the Indices of NBS</u> for phase φ = I, II or III. These indices measure the degree to which the human resources remain non-developed in any phase, by not acquiring the basic skill through formal education upto some level corresponding to the phase.

We shall next concentrate our attention to evolve statistically consistent method for the generation of district estimates $L_{ij}(\varphi)$, given the State estimates of $L_{oj}(\varphi)$, through the use of some appropriate indicators, reflecting the non-development of basic-skill, at least indirectly. Clearly, any factor which has strong association with the dropping out of boys from, or, non-admission to schools, could be used as such indicators. We shall, however, make statistically the consistency-checking for such use with the available State-level estimates. If necessary, we would even moderate the distribution of the final indicators through power transformation for obtaining matching reflections of the distributions of available State-level estimates of $L_{oj}(\varphi)$ for each phase, before its application for corresponding district-level estimates.

The most plausible indicator that could be taken to surrogate the extent of non-development of basic-skill is the rates of illiteracy on which data are available by districts of India for both the Census years 1961 and 1971 (ref. to Census of India, Paper No. 1 [1962] and Census of India, Series I, Part II-A(ii) [1971]). In fact, that census estimates are available not for illiteracy, but for its complement, the literacy, with literate persons defined to be those who can at least read or write in any language. The illiteracy rate is thus the number of persons (here, males only) devoid of any education expressed as a percentage or proportion to all persons in all age groups together - and not confined to any particular phase as per our definitions. We have, however, made the correction in this range by omitting those persons who are below the age of 5 years, (using the single year age distributions as fitted by States, and assuming that male persons below 5 years mostly do not enter into any formal education). Thus, our illiteracy rates refer to the range of ages more than or equal to 5 years, the starting of our phase I (5 to 9^+ years). Clearly, the age-range considered in our definition of illiteracy rate does not coincide with the ranges accepted in three different phases. Even then large proportions of non-enrolled boys in three phases refer to the illiterates who are included in our illiteracy rates and its coverage is possibly most comprehensive in phase I. However, as the age-ranges accepted in different phases differ from that of our illiteracy rate, we have, however, examined how matching our indicator of illiteracy is for the surrogation with reference to comparable State data for which direct estimates are available for both the surrogating and the would-be surrogated variables. Here we propose to examine for the strong positive association between the would-be surrogated variables of the three phases and the surrogating variable in different power-transformed forms (if such transformations are necessary). We shall also examine which power transformation of the surrogating variable would be most suitable in each phase so that the coefficient of variations in the State-level estimates of the location factor of illiteracy and the location factors $L_{oj}(\varphi)$, φ = I, II and III, are most coincident. The actual procedures adapted in this connection will be discussed in further details while we go for empirical evaluations in the next Section.

2.2.6 Tools for the Comparative Evaluation of Formal Spatial Configurations Over Time-points with Necessary Adjustments

For assessing quantitatively the relative backwardness of different districts and the States in the context of human resource development in the formative phase, comparison among the estimated indices of NBS, $L_{ij}(\varphi)$ or $L_{oj}(\varphi)$ by the districts and the States in each phase becomes very useful. Though one may proceed with pairwise comparison, but that becomes an insurmountable task when we have to deal with N X N matrix of such comparative data on total N number of areal units and the value of N is large. Thus one has to resort preferably to the technique of drawing geographical maps in order to depict a comprehensive picture of the characteristic under consideration with due recognition of the relative spatial orientation of areal units. We too will be using this technique for each time-point of reference and for each phase for the whole of India. It should be pointed out that for both 1960-61 and 1970-71, we have used a common benchmark of all-India figure in the formulation of indices for time-path comparison.

In fact, we have used 1970-71 all-India figures of $g(\varphi)$ as the benchmark in the denominators of $L_{oj}(\varphi)$ and $L_{ij}(\varphi)$ for both 1970-71 itself as well as for 1960-61, so that a similar index in a phase is statistically comparable over time. In this procedure of index formulation, the central critical value of any $L(\varphi)$ is unity, in 1970-71, while that for 1960-61 are likely to be different. In fact, this necessitates no change in the 1970-71 estimates of the indices in any phase. But the usual 1960-61 estimates of $L_{oj}(\varphi)$ and $L_{ij}(\varphi)$ with 1960-61 all-India value of $g(\varphi)$ as the benchmark for comparison, needs correction of their multiplications by the 1960-61 all-India estimate with the corresponding 1970-71 benchmark figure (i.e., the ratio of 1960-61 estimate of $g(\varphi)$ to 1970-71 estimate of the same). Henceforth these corrected estimates of 1960-61 would be referred to by the same notations $L_{oj}(\varphi)$ and $L_{ij}(\varphi)$, eventhough 1970-71 all-India benchmark is used in them. It should also be noted that geographical coverages of districts are not always comparable between the census years 1961 and 1971. As such we had to make adjustments of district boundaries of 1961 so that they are almost identical to those in 1971. Thus all estimates of 1960-61 are so adjusted that they permit comparison with the corresponding estimates of 1970-71 for the common geographical coverages of 1970-71 district boundaries. In this connection, for the newly formed or reorganised districts or States of 1970-71 we re-estimate the

1960-61 percentages of non-enrolled boys through weighted interpolation, or in extra-ordinary cases (particularly for metropolitan areas or districts) through comparative judgement on the actual 1960-61 and 1970-71 estimates, and here we make use of the available information on (1) their changes in geographical areas as also redefinition of their boundaries, (2) worked-out densities of their male population, (ref. to General Population Tables, Census 1971, Series I, Part II A(i) for relevant information on (1) and (2)), and (3) their relative positioning with respect to the extent of non-enrolment of boys in 1970-71. This point will be further clear during the subsequent empirical analysis.

After making all these necessary adjustments to permit both the time-path and spatial comparisons, we first classify the data on any index for 1970-71 and the same classification boundaries are used to map an index of a particular phase with both 1960-61 and 1970-71 estimates separately. The classification is done in such a way that the middle district-group having index values in the neighbourhood of all-India critical central value of unity, contains about a third of the total number of districts. The range of index values of the districts in this middle group, with central critical value at its centre, is then used as a scale for dividing the whole range of districtwise index values into finite number of distinct class intervals of equal length. These classes in ascending order of index values, may then contain districts characterised by (i) extremely low, (ii) very low, (iii) low, (iv) medium, (v) high, (vi) very high and (vii) extremely high concentration of the incidences of non-enrolment in schools. These classified data are finally mapped with appropriate distinctive shadings for different classes.

2.3.1 Empirical Evaluations : State-level Data-Base

So long we have been referring to broad geographical break downs by States of India or the broad geographical areas. We would now be precise in our definition of these broad geographical areas as the first level of break downs of India on which we build our initial reliable data-base. In this, the big major States and also the Union Territory of Delhi (for its importance as the Capital of India) are taken as they are, but some contiguous small States and Union Territories are clubbed together to get some sort of comparable size in population, etc. The clubbing done thus, are as recorded below :

(1) Jammu and Kashmir and Himachal Pradesh have been combined together at both the time points, (2) Punjab, Haryana and Chandigarh of 1970-71 have been combined to match approximately with the State of Punjab as was in 1960-61, (3) Assam and Meghalaya of 1970-71 have been combined similarly to match it with Assam of 1960-61, (4) Tripura, Nagaland, Manipur and

Arunachal Pradesh of 1970-71 have been combined and compared with the combined State and Union Territories of Tripura, Nagaland, Manipur and NEFA of 1960-61. Henceforth these clubbed broad geographical areas will also be referred to as States of India in our discussions. It should be noted that except the second group, others as clubbed above are hill-areas and as such people there are expected to behave similarly in respect of activity pattern of human resources. The second grouping has been made more on account of their combined existence in 1961, and also noting that the two broad States in this group still have a common capital in the Union Territory, namely Chandigarh. Further, it is to be noticed that certain States and Union Territories that are small in size, have not been taken into consideration initially, while estimating the single year age distributions, although later, we would try to interpolate some of their levels through isometric spatial interpolations as done in geographical studies. These are (1) Goa, Daman and Diu, (2) Pondicherry, Karaikal, Mahe and Yanam, (3) Dadra and Nagar Haveli, (4) Andaman and Nicobar Islands, (5) Laccadive, Minnicoy and Amindivi Islands and (6) Sikkim. These areas together, however, are almost insignificant as compared to the totality of all States considered for estimations of all-India figures, and as such their initial non-consideration would not practically affect the all-India estimates.

We now present in the following paragraphs the details of application of the methods, described already, along with empirical evaluation in the perspective of our objectives, as highlighted already.

The parameters for the initial Model (A.1) as described in Section (2.2.1), including the degree of fit of the initial model structures by States as measured by the multiple correlation coefficient R, are estimated and presented in Tables (2.1.1) and (2.1.2) respectively for the two time-points of our consideration, i.e. 1960-61 and 1970-71. The male population totals by States are also compiled and recorded in the same tables. In the next two tables, numbered (2.2.1) and (2.2.2), the final estimates of the parameters for the modified version of the Model (A.1) in the form of Model (A.2), are recorded, together with the linear correlation coefficient, r, for the restructured model fit by States, respectively for 1960-61 and 1970-71.

The estimates related to the parameters of Model (A.3), (ref. to Section (2.2.2)), obtained through the statistical fits of its derived models in the forms of Model (A.4) and Model (A.5), and also by use of the published Statewise data on age-distributions of boys enrolled in the Primary education in the years 1964-65 and 1970-71, have been presented in Tables (2.3.1) and (2.3.2) respectively. The similar kinds of estimates of parameters for enrolments in the (1) Middle education

Table 2.1.1 : Parameter-Estimates of Model (A.1) for Single Year Age Returns of Total Males : 1960-61

State/Union Territory	Total Males	Threshold Parameter k	Regression Coefficients a	b	c	Correlation Coefficient R
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	18161671	26	0.590862	-1.029569	0.403595	0.9862
Assam	6328129	114	1.619000	-2.481476	0.717126	0.9886
Bihar	23301449	6392	5.076759	0.309030	-5.857565	0.9924
Gujarat	10633902	43	0.928221	-1.783410	0.824851	0.9936
Himachal Pradesh & Jammu-Kashmir	2599330	15	0.377438	-0.693903	0.301250	0.9895
Mysore (Karnataka)	12040923	61	1.113284	-1.850554	0.662283	0.9896
Kerala	8361927	1233	3.637081	-1.518568	-2.634521	0.9956
Madhya Pradesh	16578204	12960	5.737774	0.943994	-7.014520	0.9926
Maharashtra	20428882	41	0.840665	-1.427597	0.526567	0.9905
Orissa	8770586	51	0.955238	-1.487267	0.441181	0.9862
Punjab	10891576	82	1.342869	-2.241620	0.851709	0.9917
Rajasthan	10564082	39	0.850465	-1.603790	0.720983	0.9896
Tamil Nadu	16910978	8	0.208634	-0.366517	0.144353	0.9918
Tripura, Nagaland, Manipur & N.E.F.A. (Arunachal Pradesh)	1199902	3130	4.487608	0.799511	-4.089290	0.9907
Uttar Pradesh	38634201	60	1.072407	-1.698244	0.545738	0.9897
West Bengal	18599144	15397	5.797710	1.670727	-7.780180	0.9949
Delhi	1489378	1	0.030506	-0.060874	0.029088	0.9838

Table 2.1.2 : Parameter-Estimates of Model (A.1) for Single Year Age Returns of Total Males : 1970-71

State/Union Territory	Total Males	Threshold Parameter k	Regression Coefficients a	Regression Coefficients b	Regression Coefficients c	Correlation Coefficient R
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	22008663	56	1.028814	-1.638523	0.532130	0.9876
Assam & Meghalaya	8406031	2203	4.250615	-1.568123	-3.173697	0.9935
Bihar	28846944	3436	4.532957	-0.351020	-4.742080	0.9913
Gujarat	13802494	67	1.233394	-2.204815	0.911399	0.9947
Himachal Pradesh & Jammu-Kashmir	4225272	83	1.315331	-2.007797	0.607772	0.9921
Karnataka (Mysore)	14971900	66	1.175831	-1.963197	0.720333	0.9921
Kerala	10587851	1171	3.579939	-1.450214	-2.616178	0.9958
Madhya Pradesh	21455334	4220	4.715761	-0.157641	-5.136180	0.9913
Maharashtra	26116351	38	0.804924	-1.406895	0.555657	0.9941
Orissa	11041083	3654	4.507347	0.264248	-5.456252	0.9898
Punjab, Haryana & Chandigarh	12790853	164	1.926810	-2.761090	0.728572	0.9899
Rajasthan	13484383	84	1.399068	-2.399118	0.921256	0.9899
Tamil Nadu	20828021	11	0.278661	-0.482252	0.185183	0.9928
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A.)	1870116	67	1.184696	-1.962703	0.711171	0.9930
Uttar Pradesh	47016421	164	1.858350	-2.326841	0.283612	0.9882
West Bengal	23435987	48	0.956680	-1.643129	0.623414	0.9921
Delhi	2257515	1	0.029735	-0.056635	0.025157	0.9886

Table 2.2.1 : Parameter-Estimates for Modified Version (A.2) of Model (A.1) on Single Year Age Returns of Total Males : 1960-61

State/Union Territory	g	h	Regression Coefficients s	t	Correlation Coefficient r
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	0.403595	-1.275498	-0.038436	0.036011	0.9853
Assam	0.717126	-1.730153	-0.008659	0.005157	0.9842
Bihar	-5.857565	-0.026379	-0.000232	0.025564	0.9464
Gujarat	0.824851	-1.081050	-0.023252	0.022448	0.9921
Himachal Pradesh & Jammu-Kashmir	0.301250	-1.151706	-0.066621	0.065176	0.9890
Mysore (Karnataka)	0.662283	-1.397102	-0.016372	0.013706	0.9874
Kerala	-2.634521	0.288206	-0.000976	0.039128	0.9849
Madhya Pradesh	-7.014520	-0.067289	0.000069	0.024484	0.9631
Maharashtra	0.526567	-1.355570	-0.024240	0.021401	0.9885
Orissa	0.441181	-1.685552	-0.019513	0.014522	0.9837
Punjab	0.851709	-1.315954	-0.012411	0.010808	0.9913
Rajasthan	0.720983	-1.112225	-0.025688	0.024651	0.9886
Tamil Nadu	0.144353	-1.269516	-0.124938	0.121982	0.9916
Tripura, Nagaland, Manipur and N.E.F.A. (Arunachal Pradesh)	-4.089290	-0.097757	-0.000292	0.029702	0.9760
Uttar Pradesh	0.545738	-1.555915	-0.016693	0.013024	0.9879
West Bengal	-7.780180	-0.107371	0.000133	0.022913	0.9554
Delhi	0.029088	-1.046377	-0.999611	0.998275	0.9837

Table 2.2.2 : Parameter-Estimates for Modified Version (A.2) of Model (A.1) on Single Year Age Returns of Total Males : 1970-71

State/Union Territory	g	h	Regression Coefficients s	Regression Coefficients t	Correlation Coefficient r
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	0.532130	-1.539676	-0.017878	0.014180	0.9858
Assam & Meghalaya	-3.173697	0.247050	-0.000609	0.039526	0.9802
Bihar	-4.742080	0.037011	-0.000436	0.027905	0.9581
Gujarat	0.911399	-1.209577	-0.014860	0.013479	0.9917
Himachal Pradesh & Jammu-Kashmir	0.607772	-1.651768	-0.012067	0.008569	0.9902
Karnataka (Mysore)	0.720333	-1.362701	-0.015149	0.012900	0.9902
Kerala	-2.616178	0.277163	-0.000973	0.038016	0.9901
Madhya Pradesh	-5.136180	0.015346	-0.000319	0.026915	0.9605
Maharashtra	0.555657	-1.265974	-0.026281	0.024142	0.9928
Orissa	-5.456252	-0.024215	-0.000254	0.025021	0.9570
Punjab, Haryana & Chandigarh	0.728572	-1.894864	-0.006112	0.003075	0.9859
Rajasthan	0.921256	-1.302091	-0.012031	0.010195	0.9873
Tamil Nadu	0.185183	-1.302096	-0.090867	0.087723	0.9925
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A.)	0.711171	-1.379909	-0.014873	0.012583	0.9908
Uttar Pradesh	0.283612	-4.102155	-0.006205	0.000334	0.9845
West Bengal	0.623414	-1.317847	-0.020726	0.018314	0.9900
Delhi	0.025157	-1.125631	-0.999502	0.997372	0.9886

Table 2.3.1 : Model Parameter-estimates for Primary Education in India by States : 1964-65

State/Union Territory	Regression Coefficients				Correlation coefficient	
	A	B	C	V	Model (A.4)	Model (A.5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	-1.498316	0.603498	-0.062162	0.998677	0.9998	0.9987
Assam	-1.755272	0.769003	-0.085832	1.000569	0.9996	0.9968
Bihar	-2.128471	0.853139	-0.087047	0.997711	0.9992	0.9984
Gujarat	-1.036611	0.430452	-0.044577	1.000144	0.9999	0.9999
Himachal Pradesh & Jammu-Kashmir	-1.669109	0.662701	-0.065799	0.998293	0.9997	0.9997
Mysore (Karnataka)	-1.709448	0.633330	-0.060070	0.995480	0.9995	0.9978
Kerala	-1.631041	0.605085	-0.057944	0.995937	0.9992	0.9973
Madhya Pradesh	-0.954174	0.398557	-0.041779	0.999640	0.9999	0.9999
Maharashtra	-1.144739	0.427739	-0.040205	0.998749	0.9999	0.9998
Orissa	-1.235226	0.570870	-0.065469	0.999381	0.9998	0.9998
Punjab	-2.956831	0.974847	-0.080178	0.982363	0.9984	0.9921
Rajasthan	-0.998150	0.421057	-0.044669	0.996423	0.9991	0.9989
Tamil Nadu	-1.323877	0.570598	-0.062142	1.000198	0.9999	0.9995
Tripura, Nagaland Manipur and N.E.F.A (Arunachal Pradesh)	-0.963145	0.431774	-0.050647	0.995941	0.9993	0.9982
Uttar Pradesh	-0.841311	0.412574	-0.049464	1.001661	0.9999	0.9996
West Bengal	-2.389670	0.818373	-0.070467	0.991655	0.9987	0.9970
Delhi	-2.577323	0.898815	-0.079522	0.990037	0.9992	0.9950

Table 2.3.2 : Model Parameter-estimates for Primary Education in India by States : 1970-71

State/Union Territory	Regression Coefficients				Correlation coefficient	
	A	B	C	V	Model (A.4)	Model (A.5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	-1.099190	0.503168	-0.058039	0.998796	0.9998	0.9992
Assam & Meghalaya	-2.882433	1.141403	-0.113917	0.976058	0.9988	0.9734
Bihar	-1.884167	0.750840	-0.076989	0.999568	0.9994	0.9973
Gujarat	-1.171498	0.450608	-0.044134	0.997897	0.9997	0.9992
Himachal Pradesh & Jammu-Kashmir	-2.595464	0.898074	-0.079189	0.990793	0.9951	0.9902
Karnataka (Mysore)	-2.067484	0.815346	-0.079555	0.986418	0.9994	0.9961
Kerala	-1.212233	0.501041	-0.053429	0.998660	0.9996	0.9982
Madhya Pradesh	-1.268230	0.484038	-0.046737	0.998331	0.9998	0.9996
Maharashtra	-1.213312	0.449684	-0.042061	0.998120	0.9998	0.9996
Orissa	-2.445793	0.929686	-0.091713	0.998667	0.9994	0.9937
Punjab, Haryana & Chandigarh	-2.397802	0.828333	-0.072481	0.990727	0.9984	0.9948
Rajasthan	-1.491726	0.564483	-0.052809	0.985728	0.9975	0.9942
Tamil Nadu	-2.020404	0.759135	-0.073910	0.994957	0.9995	0.9951
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A)	-1.551291	0.634065	-0.065695	0.992322	0.9990	0.9966
Uttar Pradesh	-1.344420	0.579608	-0.062415	0.997166	0.9997	0.9991
West Bengal	-2.451872	0.833777	-0.071308	0.990201	0.9983	0.9961
Delhi	-2.409024	0.863646	-0.078587	0.992874	0.9996	0.9967

Table 2.4.1 : Model Parameter-estimates for Middle Education in India by States : 1964-65

State/Union Territory	Regression Coefficients				Correlation coefficient	
	A	B	C	V	Model (A.4)	Model (A.5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	-5.316696	1.224778	-0.069427	0.999524	0.9999	0.9995
Assam	-5.359528	1.382487	-0.086377	0.987550	0.9995	0.9992
Bihar	-7.679586	1.703621	-0.094369	0.992678	0.9989	0.9991
Gujarat	-6.484109	1.268605	-0.062197	0.998281	0.9998	0.9996
Himachal Pradesh & Jammu-Kashmir	-9.355440	1.841419	-0.090766	0.999667	0.9999	0.9999
Mysore (Karnataka)	-4.604295	1.031988	-0.056915	1.001207	0.9987	0.9977
Kerala	-7.247262	1.451770	-0.072656	1.001027	0.9998	0.9998
Madhya Pradesh	-6.680480	1.282508	-0.061829	0.997412	0.9996	0.9990
Maharashtra	-5.974887	1.132889	-0.053733	0.998274	0.9997	0.9992
Orissa	-11.348423	2.209127	-0.107956	0.995929	0.9998	0.9987
Punjab	-12.191077	2.279583	-0.106475	0.992407	0.9995	0.9978
Rajasthan	-5.477349	1.081792	-0.053647	0.999252	0.9999	0.9998
Tamil Nadu	-7.074472	1.516729	-0.080889	0.999732	0.9998	0.9995
Tripura, Nagaland, Manipur and N.E.F.A. (Arunachal Pradesh)	-8.996796	1.799423	-0.089893	1.002109	0.9996	0.9992
Uttar Pradesh	-7.574647	1.529665	-0.077904	0.999279	0.9999	0.9999
West Bengal	-12.419539	2.313524	-0.107611	0.994094	0.9997	0.9978
Delhi	-9.405314	1.912949	-0.097390	0.999064	0.9998	0.9998

Table 2.4.2 : Model Parameter-estimates for Middle Education in India by States : 1970-71

State/Union Territory	Regression Coefficients				Correlation coefficient	
	A	B	C	V	Model (A.4)	Model (A.5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	-6.354930	1.437274	-0.080207	0.997552	0.9997	0.9993
Assam & Meghalaya	-14.144847	2.897470	-0.150113	1.005144	0.9998	0.9995
Bihar	-9.969477	2.057926	-0.106860	0.998074	0.9999	0.9996
Gujarat	-9.486148	1.782500	-0.083803	0.994814	0.9995	0.9980
Himachal Pradesh & Jammu-Kashmir	-11.036613	2.182742	-0.107464	1.005635	0.9945	0.9899
Karnataka (Mysore)	-8.185266	1.669794	-0.085202	1.000516	0.9999	0.9999
Kerala	-7.318225	1.483262	-0.075228	0.999585	0.9999	0.9998
Madhya Pradesh	-7.469363	1.427497	-0.068380	0.997128	0.9997	0.9991
Maharashtra	-7.071656	1.332071	-0.062691	0.997699	0.9997	0.9990
Orissa	-9.841764	2.085237	-0.110094	0.996780	0.9998	0.9992
Punjab, Haryana, and Chandigarh	-11.509283	2.165863	-0.101973	0.994159	0.9996	0.9986
Rajasthan	-7.038081	1.359492	-0.065780	0.998320	0.9998	0.9995
Tamil Nadu	-7.084083	1.508091	-0.079878	0.999841	0.9999	0.9999
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A)	-12.744540	2.409771	-0.113878	0.995906	0.9996	0.9989
Uttar Pradesh	-6.424235	1.352526	-0.071667	1.000063	0.9999	0.9999
West Bengal	-11.291681	2.105936	-0.098497	0.990439	0.9985	0.9960
Delhi	-8.943242	1.867436	-0.097010	0.999323	0.9993	0.9984

Table 2.5.1 : Model Parameter-estimates for High and Higher Secondary Education in India by States : 1964-65

State/Union Territory	Regression Coefficients				Correlation coefficient	
	A	B	C	V	Model (A.4)	Model (A.5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	-10.907968	1.798542	-0.073932	1.000225	0.9999	0.9998
Assam	-10.864187	1.839413	-0.078179	0.996514	0.9997	0.9995
Bihar	-17.162576	2.764745	-0.111679	0.994586	0.9993	0.9960
Gujarat	-12.151678	1.818597	-0.068061	0.999844	0.9999	0.9998
Himachal Pradesh & Jammu-Kashmir	-11.619606	1.833499	-0.072210	1.002564	0.9996	0.9987
Mysore (Karnataka)	- 5.500040	0.983823	-0.043131	1.000536	0.9987	0.9975
Kerala	- 7.776012	1.307350	-0.054444	1.001143	0.9994	0.9984
Madhya Pradesh	- 8.284269	1.275057	-0.049176	1.000368	0.9999	0.9999
Maharashtra	- 9.597679	1.419148	-0.052484	0.998794	0.9998	0.9995
Orissa	-20.318526	3.049394	-0.114837	0.996315	0.9997	0.9985
Punjab	-21.492470	3.181305	-0.117754	0.994487	0.9998	0.9985
Rajasthan	-11.361010	1.726540	-0.065688	1.000223	0.9998	0.9996
Tamil Nadu	-13.765895	2.182792	-0.086666	1.000296	0.9999	0.9998
Tripura, Nagaland, Manipur and N.E.F.A. (Arunachal Pradesh)	-18.008676	2.705584	-0.101736	0.998009	0.9999	0.9996
Uttar Pradesh	- 9.081809	1.518017	-0.063657	1.000353	0.9999	0.9998
West Bengal	-21.023658	3.098175	-0.114115	0.995368	0.9999	0.9991
Delhi	-16.130563	2.542343	-0.100046	0.999809	0.9992	0.9982

Table 2.5.2 : Model Parameter-estimates for High and Higher Secondary Education in India by States : 1970-71

State/Union Territory	Regression Coefficients				Correlation coefficient	
	A	B	C	V	Model (A.4)	Model (A.5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	- 7.232530	1.434812	-0.067806	0.991524	0.9996	0.9972
Assam & Meghalaya	-15.914103	2.583920	-0.105436	0.996863	0.9999	0.9997
Bihar	-14.516742	2.289359	-0.091229	1.002455	0.9990	0.9985
Gujarat	-14.626618	2.227308	-0.084908	0.999819	0.9999	0.9999
Himachal Pradesh & Jammu-Kashmir	-12.141807	2.096038	-0.088907	0.994995	0.9986	0.9905
Karnataka (Mysore)	- 9.158185	1.550455	-0.065014	0.998525	0.9986	0.9978
Kerala	-12.294411	2.035677	-0.083632	0.999611	0.9995	0.9978
Madhya Pradesh	-11.306355	1.703519	-0.064259	0.999672	0.9999	0.9998
Maharashtra	-11.572176	1.718899	-0.063828	0.998503	0.9999	0.9996
Orissa	-18.050595	2.899114	-0.116371	0.998270	0.9999	0.9996
Punjab, Haryana and Chandigarh	-19.672601	2.918761	-0.108476	0.996656	0.9996	0.9990
Rajasthan	- 7.290338	1.195544	-0.048683	1.003000	0.9982	0.9969
Tamil Nadu	-150.625214	20.414902	-0.692163	1.039556	0.9885	0.9841
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A.)	-10.710154	1.736574	-0.070184	1.001433	0.9993	0.9983
Uttar Pradesh	- 9.995124	1.650236	-0.068157	1.000581	0.9999	0.9997
West Bengal	-25.702655	3.702525	-0.133636	0.975658	0.9957	0.9856
Delhi	-15.136570	2.398242	-0.094961	0.998690	0.9996	0.9992

and (2) High and Higher Secondary education, as obtained from the statistical fits, using the same models, with the data referring to the same years, are shown in (1) Tables (2.4.1) and (2.4.2) and in (2) Tables (2.5.1) and (2.5.2) respectively. Further, we present just below the similar kinds of parameter estimates, related to above mentioned models, after making the statistical fits with the published data on age-distributions of boys enrolled throughout India for the advanced level of education -- general/professional, formal/vocational, collegiate/university types, in the years 1960-61 and 1970-71.

Model Parameter-estimates for Advanced Level of Education, India : 1960-61, 1970-71

Year	A	B	C	V	Correlation coefficient	
					Model (A.4)	Model (A.5)
1960-61	-3.3620	0.5301	-0.0206	1.0040	0.9983	0.9969
1970-71	-4.9386	0.7210	-0.0262	1.0023	0.9997	0.9993

Following the procedures as discussed in the sub-section (2.2.3), using the relation (2.1) through (2.4), and also taking account of all the relevant results just discussed above, we estimate the non-enrolment percentages of boys in each phase, designated by g(I), g(II) and g(III), by States for 1960-61 and 1970-71. The corresponding derived figures of the total estimated number of boys by each phase are shown in Tables (2.6.1)

Table 2.6.1 : Total Number of Boys and Non-enrolment Percentages by Phases for States of India : 1960-61

State/Union Territory	First Phase Age group : 5-10 years		Second Phase Age group : 10-15 years		Third Phase Age group : 15-19 years	
	Total Boys	Non-enrolment Percentage g_{oj}(I)	Total Boys	Non-enrolment Percentage g_{oj}(II)	Total Boys	Non-enrolment Percentage g_{oj}(III)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	2393389	39.99	2119324	66.95	1514044	90.82
Assam	907181	38.46	776363	69.29	538983	89.88
Bihar	2921377	46.65	2805482	70.00	2110860	90.99
Gujarat	1540799	40.65	1323648	53.43	920656	79.47
Himachal Pradesh & Jammu-Kashmir	340205	50.06	302342	64.28	216564	88.38
Mysore (Karnataka)	1672330	38.95	1452287	60.07	1020731	86.85
Kerala	1149067	24.73	1037753	48.58	748358	80.52
Madhya Pradesh	1993457	53.02	1955294	69.22	1492781	88.04
Maharashtra	2748397	47.61	2412589	53.40	1711023	80.54
Orissa	1161487	47.59	1024648	78.20	730080	94.46
Punjab	1532885	38.65	1314699	53.15	914446	80.58
Rajasthan	1497042	57.50	1294947	69.81	906145	87.40
Tamil Nadu	2138770	21.80	1924599	55.70	1393886	82.06
Tripura, Nagaland, Manipur and N.E.F.A (Arunachal Pradesh)	154136	32.93	142339	59.56	104147	83.44
Uttar Pradesh	5175552	49.46	4531556	70.54	3208179	89.00
West Bengal	2125263	36.56	2145632	58.21	1676087	85.51
Delhi	199399	34.01	178248	48.35	128153	74.22
All-India	29650736	42.81	26741750	63.32	19335123	86.46

Table 2.6.2 : Total Number of Boys and Non-enrolment Percentages by Phases for States of India : 1970-71

State/Union Territory	First Phase Age group : 5-10 years		Second Phase Age group : 10-15 years		Third Phase Age group : 15-19 years	
	Total Boys	Non-enrolment Percentage $g_{oj}(I)$	Total Boys	Non-enrolment Percentage $g_{oj}(II)$	Total Boys	Non-enrolment Percentage $g_{oj}(III)$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	2974053	36.48	2607618	63.93	1848240	89.04
Assam & Meghalaya	1186163	37.06	1061647	64.32	757815	86.17
Bihar	3773794	40.16	3541376	63.69	2621384	85.64
Gujarat	2024912	39.34	1729637	46.86	1198150	69.12
Himachal Pradesh & Jammu-Kashmir	576325	42.21	501160	55.90	352820	79.49
Karnataka	2095988	36.19	1813533	58.03	1270724	80.99
Kerala	1416670	20.35	1280599	42.57	924307	72.17
Madhya Pradesh	2757325	47.98	2603802	64.32	1935323	78.58
Maharashtra	3580118	40.89	3136450	47.73	2220235	70.00
Orissa	1356504	42.60	1304697	66.61	984673	89.61
Punjab, Haryana and Chandigarh	1862404	30.88	1584714	45.72	1095265	69.57
Rajasthan	1987424	53.73	1692206	66.14	1169286	79.89
Tamil Nadu	2654728	20.66	2385581	50.38	1725952	67.05
Tripura, Nagaland, Manipur & Arunachal Pradesh (N.E.F.A)	261135	31.01	226111	55.87	158548	79.15
Uttar Pradesh	6485091	36.52	5630800	53.48	3957716	78.61
West Bengal	3253578	35.57	2835580	45.74	1998577	72.78
Delhi	297178	26.53	267087	42.85	193033	55.63
All-India	38543390	37.34	34202598	55.34	24412048	77.66

and (2.6.2), referring respectively to 1960-61 and 1970-71. The similar all-India estimates are also recorded at the end of these tables.

In all the above mentioned tables, the degrees of reliability of different model fits are depicted in final correlation coefficients, as presented with the corresponding tables. It should be noted that the values of correlation coefficient, r, for the final fits (ref. to Model (A.2)) of the population distributions by States were mostly as high as between 0.98 and 0.99, except for a very few States where these were a little less, between 0.95 to 0.98. The model fits for the preceding Model (A.1) had been also quite good (the values of R were between 0.984 and 0.996), so that the values of the parameters of this model, that had been subsequently used in the final Model (A.2) were quite dependable. In the event of reporting bias around ages which are multiples of five in the original raw data, as available in the Censuses of 1961 and 1971, the model fits with such high values of the correlation coefficients support the appropriateness of the choice of model structures and the methods of estimation for the identifications of the population distributions on which a reliable data-base by phases could be established for 1960-61 and 1970-71. The model fits by States for the distributions of enrolled school-going boys were even much better —— the values of correlation coefficients had been mostly around 0.99, and all above 0.973. These very high degrees of fits also establish the appropriateness of the choices of model structures on enrolment statistics. As such, we claim that these established distributions on enrolment statistics by phases would very well serve the purpose of formation of the reliable data-base for the different States of India in 1960-61 and 1970-71.

2.3.2 Empirical Evaluations : Analysis of Actual State-level Indices and the Construction of District-level Indices by Appropriate Indicators

On the basis of the reliable data-base just established by States, we can now construct easily (ref. to subsection (2.2.5)) the indices of Non-development of Basic Skill (NBS) for each of the phases I, II and III, by States of India and also for India, as the aggregate of States, relating to the two time-points, 1960-61 and 1970-71. These State-estimates of the indices of NBS, recorded in Tables (2.7.1) and (2.7.2) respectively for 1960-61 and 1970-71, could be regarded as the actual estimates, while we have yet to substantiate empirically the justification of using the location factor of illiteracy in appropriate transformed forms for the generation of the district level indices of NBS by States by the methods already discussed in sub-section (2.2.5). For this, we shall now examine the matching behavioural patterns that actually exist between the indices of NBS and the differently transformed

Table 2.7.1 : Phasewise Indices of Non-development of Basic-Skill (NBS) and the Location Factor of Illiteracy by States of India : 1960-61

State/Union Territory	Index of NBS for			Location Factor of Illiteracy $L_{oj}(T)$
	First Phase $L_{oj}(I)$	Second Phase $L_{oj}(II)$	Third Phase $L_{oj}(III)$	
(1)	(2)	(3)	(4)	(5)
Andhra Pradesh	1.0710	1.2096	1.1695	1.2367
Assam	1.0300	1.2519	1.1574	1.0334
Bihar	1.2494	1.2648	1.1717	1.2925
Gujarat	1.0887	0.9653	1.0234	0.9458
Himachal Pradesh & Jammu-Kashmir	1.3407	1.1615	1.1381	1.4754
Mysore (Karnataka)	1.0431	1.0854	1.1184	1.0771
Kerala	0.6623	0.8777	1.0368	0.6809
Madhya Pradesh	1.4201	1.2507	1.1337	1.3749
Maharashtra	1.2752	0.9649	1.0371	0.9598
Orissa	1.2744	1.4130	1.2163	1.1323
Punjab	1.0350	0.9604	1.0376	1.1388
Rajasthan	1.5400	1.2614	1.1255	1.3485
Tamil Nadu	0.5838	1.0064	1.0566	0.9327
Tripura, Nagaland, Manipur and N.E.F.A (Arunachal Pradesh)	0.8819	1.0762	1.0745	1.2376
Uttar Pradesh	1.3245	1.2745	1.1461	1.2918
West Bengal	0.9790	1.0518	1.1011	1.1028
Delhi	0.9109	0.8735	0.9557	0.5479
All-India	1.1466	1.1441	1.1134	1.1246

Table 2.7.2 : Phasewise Indices of Non-development of Basic-Skill (NBS) and the Location Factor of Illiteracy by States of India : 1970-71

State/Union Territory	Index of NBS for First Phase $L_{oj}(I)$	Second Phase $L_{oj}(II)$	Third Phase $L_{oj}(III)$	Location Factor of Illiteracy $L_{oj}(T)$
(1)	(2)	(3)	(4)	(5)
Andhra Pradesh	0.9769	1.1552	1.1466	1.1570
Assam and Meghalaya	0.9926	1.1621	1.1096	1.0681
Bihar	1.0755	1.1508	1.1027	1.2539
Gujarat	1.0535	0.8467	0.8900	0.8264
Himachal Pradesh & Jammu-Kashmir	1.1305	1.0101	1.0236	1.1406
Karnataka	0.9692	1.0485	1.0429	0.9498
Kerala	0.5450	0.7692	0.9293	0.4223
Madhya Pradesh	1.2850	1.1622	1.0119	1.2154
Maharashtra	1.0952	0.8624	0.9014	0.7502
Orissa	1.1410	1.2035	1.1539	1.1084
Punjab, Haryana & Chandigarh	0.8271	0.8261	0.8959	0.9784
Rajasthan	1.4389	1.1950	1.0287	1.2138
Tamil Nadu	0.5534	0.9103	0.8634	0.7670
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A)	0.8305	1.0095	1.0193	1.0297
Uttar Pradesh	0.9780	0.9664	1.0123	1.1840
West Bengal	0.9527	0.8264	0.9372	0.9290
Delhi	0.7106	0.7743	0.7163	0.4886
All-India	1.0000	1.0000	1.0000	1.0000*

*The All-India value of unity of $L_{oj}(T)$ corresponds to 44.46% illiteracy.

location factors of illiteracy. The State-level estimates of the location factors of illiteracy, as would be necessary for the above mentioned purpose, are also recorded in Tables (2.7.1) and (2.7.2) for the years 1960-61 and 1970-71 respectively. It should be noted that the indices and location factors, as presented in these two tables for the two time-points are comparable not only between States but also over time-points by each of the three phases separately, with the benchmark of the central critical value of unity at 1970-71 for each phase.

In sub-section (2.2.5) we have already discussed, from a theoretical standpoint, why we would like to use the location factor of illiteracy as the surrogate for the indices of NBS in different phases. It now gets the statistical support when we notice a considerable degree of positive association between the location factor of illiteracy and any index of NBS -- the corresponding correlation coefficients are 0.72, 0.78 and 0.74 respectively for phases I, II and III respectively, when computed over the pooled State-level values of 1960-61 and 1970-71. However, a cursory look into the data of Tables (2.7.1) and (2.7.2) reveals that the range between the maximum and the minimum values of the location factor of illiteracy is about 1.053, while the corresponding ranges for the indices of NBS in the three phases differed considerably from this value. The range-value that is nearest to the above mentioned range-value (1.053) is that for the phase I -- about

0.996 in magnitude, while those for the phases II and III were considerably lower -- around 0.5 for both. These differences in the range-values give an initial indication that the same location factor of illiteracy, without any matching moderation on its range of variation through some sorts of transformation, could not be used for surrogating all the three indices of NBS by phases. As the range between the maximum and the minimum values of any variable is a crude estimate of the variation for all its values we would go by a more precise estimate of the coefficient of variation in this context. For evolving appropriate surrogates for the indices of NBS, we propose to use power transformation (which is acceptable simply because it keeps the central critical value of unity invariant) of the location factor of illiteracy in such a way that the transformed location factor becomes most matching with a particular index of NBS for a phase, when judged by the similarity in the values of coefficient of variation for the transformed location factor and the particular index of NBS. The location factor for the surrogate variable of illiteracy, without any transformation, will be denoted henceforth by L(T). For a reduction in the values of coefficient of variation, the power transformation required on L(T) would be a fractional number and we would use the fractional numbers in the simple form, like $^1/n$, n = 1, 2, 3, ..., for the said power transformation on L(T). Thus we would examine for the matching coefficients of variations (to be calculated over the pooled State-values of 1960-61 and 1970-71 together) between any of indices of NBS, L(I), L(II) and L(III), on the one hand, and any of transformed surrogate variables, L(T), $[L(T)]^{1/2}$, $[L(T)]^{1/3}$, ..., on the other. Thus, when calculated from the values of these variables given in Tables (2.7.1) and (2.7.2), the coefficients of variation turn out to be 0.24, 0.16 and 0.10 respectively for L(I), L(II) and L(III), while those for L(T), $[L(T)]^{1/2}$, $[L(T)]^{1/3}$ have been respectively 0.24, 0.13 and 0.09. The corresponding values for $[L(T)]^{1/n}$, $n > 3$, are further down and considered not necessary for our purpose. Thus, from the estimates of coefficients of variation as recorded above, it is evident that the most matching surrogate variable for L(I) is L(T) itself, that for L(II) is $[L(T)]^{1/2}$ and that for L(III) is $[L(T)]^{1/3}$, if we accept to use the simple fractional numbers for power transformations, without going for any further refinements on the fractional numbers for exact matching. We go for the simple fractional numbers, simply because it is easy to comprehend square rooting (power $1/2$) and cube-rooting (power $1/3$) of a variable. It should be noted that the exact matching of L(T) and L(I) (for phase I), as perceived through covariation-agreement, supports our expectations, described earlier from a theoretical stand-point in subsection (2.2.5), on the good matching possibilities between L(T) and L(I). Also, the matching between $[L(T)]^{1/2}$ and L(II) (for phase II) and also that between $[L(T)]^{1/3}$ and L(III) (for phase III), as perceived through nearest covariation-agreements, show that untransformed L(T) could hardly be used as surrogates for the indices L(II) and L(III), which had been also visualised on theoretical grounds in the sub-section (2.2.5). Thus, having established the nature of possible surrogate variables for the indices of NBS in the three phases, we next use these forms of surrogate variables that could be estimated for all districts in different States of India for both 1960-61 and 1970-71, and use them in conjunction with the corresponding Statewise estimates of $L(\varphi)$, φ = I, II, III, for the generation of district-wise estimates of $L(\varphi)$ within different States of India for both time-points. The exact formulas to be used in this connection for the i-th district in j-th State of India, relating to the phase φ, are as follows :

$$L_{ij}(\varphi) = L_{oj}(\varphi) \cdot [L_{ij}(T)]^{1/n} \qquad \ldots (2.42)$$

with the correspondences of n = 1, 2, 3 respectively for φ = I, II, III.

In this, $L_{ij}(T)$ stands for the location factor of illiteracy for the i-th district in j-th State of India with the State-level central critical values as unities (i.e., $L_j(T) = 1$ for all j at any specific time-point), and the State-level actual estimates, $L_{oj}(\varphi)$, are those as already presented in Tables (2.7.1) and (2.7.2).

Now to obtain the percentage of non-enrolled boys $g_{ij}(\varphi)$ for the i-th district in j-th State of India relating to phase φ, we have simply to multiply the corresponding values of $L_{ij}(\varphi)$, for both the time-points, with the same 1970-71 all-India percentage of non-enrolled boys $g(\varphi)$. The derived estimates of the percentage of non-enrolled boys by districts, $g_{ij}(\varphi)$, and States, $g_{oj}(\varphi)$, and also for all-India $g(\varphi)$, (for original geographical coverages of States and Union Territories as prevalent in 1970-71) are recorded in Table (A.1) in Appendix . The corresponding detailed districtwise estimates of $L_{ij}(\varphi)$ along with the individual State estimates $L_{oj}(\varphi)$ are presented in Table (A.2) in the same Appendix. In these tables, the respective data are comparable both spatially and temporally for each of the phases φ = I, II and III.

2.4 The Construction of an Appropriate Composite Index of Non-development of Basic-Skill

We have just estimated the district level values of indices of NBS for the three different phases, designated as $L_{ij}(I)$, $L_{ij}(II)$ and $L_{ij}(III)$. The enrolment of school going boys in the three phases, I, II and III (which correspond mostly to (i) Primary, (ii) Middle and (iii) High and Higher Secondary levels of education) are progressively linked, in the sense that the intake in phase I comes from the desired maximal entrants for that phase, while the intakes in phases II and III come from the preceding phases I and II respectively (as pointed out earlier in details). Thus, any short fall in enrolment of boys in phase I would have chain-effect in both phases II and III with increasing intensities for the additional drop-outs from phase I to phase II and also from phase II to phase III sequentially. Thus, among the three linked indices $L_{ij}(I)$, $L_{ij}(II)$ and $L_{ij}(III)$, the first phase index $L_{ij}(I)$ is the most important index of non-development of basic-skill, and the second and the third phase indices $L_{ij}(II)$ and $L_{ij}(III)$ are in further decreasing order of importance in this context. From our knowledge of the decreasing magnitudes of the coefficients of variation from phase I to phase III, it is also clear that the spatial variations in the index of NBS will be most pronounced for phase I and that will be least pronounced for phase III. Thus, different spatial patterns would emerge for the three sub-phases of the formative phase, when the corresponding indices of NBS are mapped. None of these indices would depict the comprehensive spatial pattern for the entire formative phase of basic-skill development (comprised of all three phases together). Thus, in order to get a comprehensive spatial pattern of non-development of basic-skill for the entire formative phase, we propose to construct an appropriate Composite Index of Non-development of Basic-Skill, by combining the three partial indices of NBS, $L_{ij}(I)$, $L_{ij}(II)$ and $L_{ij}(III)$, with their consistent and meaningful representations (with due regards to their order of importance). Our search for the most appropriate composite index starts from the following sub-section.

2.4.1 Constructions of the Equity and the Optimal Indices

The general methods of computations for the Composite Equity Index and the Composite Optimal Index for any total number, n, of constituent variables have been described in sub-sections 2.2.4 (iv)(a) and 2.2.4 (iv)(b) respectively. While these general methods could now be used for the computations of these two classical forms of index formulation for n = 3, the computation of the equity formulation can as well be done by the following simplified method, particularly for n = 3. For this particular case, the weight vector turns out to be as follows :

$$\left.\begin{aligned} w_i &= D_i/(\sum_{j=1}^{3} D_j), \quad \text{for } i = 1, 2, 3 \\ \text{where } D_1 &= (1 - r_{23})\ (1 + r_{23} - r_{12} - r_{13}), \\ D_2 &= (1 - r_{13})\ (1 + r_{13} - r_{12} - r_{23}), \\ \text{and } D_3 &= (1 - r_{12})\ (1 + r_{12} - r_{13} - r_{23}) \end{aligned}\right\} \quad \ldots(2.43)$$

The correlation matrix for the indices of NBS for the phases, φ = I, II and III, is as given below, when it is computed from the district level index values of $L_{ij}(\varphi)$ for 1970-71.

$$\begin{pmatrix} 1 & r_{12} & r_{13} \\ r_{12} & 1 & r_{23} \\ r_{13} & r_{23} & 1 \end{pmatrix} = \begin{pmatrix} 1.0 & 0.7552 & 0.6018 \\ 0.7552 & 1.0 & 0.8778 \\ 0.6018 & 0.8778 & 1.0 \end{pmatrix} \quad \ldots(2.44)$$

(columns of the right-hand matrix: I, II, III)

The parameters of the composite equity index and the composite optimal index as computed from the above correlation matrix, are as recorded below :

Table 2.8(a) : The Estimates of Parameters of the Equity Index

r_1	0.894017	w_1	0.536225
r_2	0.894017	w_2	-0.104679
r_3	0.894017	w_3	0.568454
ρ_E	0.894017		

Table 2.8(b) : The Estimates of Parameters of the Optimal Index

r_1	0.854822	w_1	0.312418
r_2	0.966577	w_2	0.353262
r_3	0.911326	w_3	0.333068
ρ_M	0.912050		

A comparison between the two indices just computed, reveals that ρ_M = 0.912050 is a little greater than ρ_E = 0.894017. As expected the values of r_i's are all equal to ρ_E in the equity index, while for the optimal index, the phase II index of NBS is most represented in the composite optimal index (r_2 = 0.966577), the phase III is the next (r_3 = 0.911326) and the phase I is the least represented one (r_1 = 0.854822). This is the Normal Statistical Ordering (i.e. $r_2 > r_3 > r_1$) and this normal ordering, designated by N, of specific representations is not acceptable for our purpose, since it differs from the phase ordering, designated by φ and as propounded theoretically in Section (2.4) above. In the equity index, the specific representation range is zero and the phase ordering is not explicitly brought out in it. But what goes against the acceptance of equity index for our purpose is the negative weight w_2 = -0.104679 for phase II index of NBS, which is not consistent with the corresponding positive value of the specific representation r_2 = 0.894017. It should be noted that if a constituent variable is positively associated with the composite index, the corresponding weight must be also of positive magnitude (in fact, r_i and w_i should have similar algebraic sign for consistent interpretations of point estimates of the composite index. Thus, the composite equity index is also not acceptable for the violation of the required consistency in it.

2.4.2 Constructions of the Equi-spaced Optimal Indices for Different Orderings of Specific Representations

From an examination of values of r_i's presented in Table 2.8(b) it appears as though the Equi-spaced Optimal Index, with the normal ordering of specific representations, would be practically identical with the optimal index, variable by variable. This conjecture turns out to be correct in our actual computations made later in this sub-section. For the three constituent variable case (i.e. n = 3), we have certain simplifications of the general procedures of computation (ref. to sub-section 2.2.4 (iv)(c)) that we shall describe below. It should be noted that for n = 3, we have only one equi-spaced condition :

$$(1-r_{13}-2r_{12})w_{1*} + (r_{12}+r_{23}-2)w_{2*} + (1+r_{13}-2r_{23})w_{3*} = 0$$

and the proportionality constraint :

$$w_{1*} + w_{2*} + w_{3*} = 1,$$

with the use of re-suffixed variables in the correlation matrix, tallying with that specific ordering which is followed in the particular accepted ordering. For the three variable case, we have the following three possible orderings :

Type of Ordering	Implicit Phase Order		Corresponding Re-suffixed Variable order
1) N-ordering (Normal Statistical Ordering) :	II > III > I	⟹	1 > 2 > 3
2) B-ordering (Bottom Up-graded Normal Ordering) :	II > I > III	⟹	1 > 2 > 3
3) φ-ordering (Phase-order Preserving Ordering) :	I > II > III	⟹	1 > 2 > 3

For example, the correlation matrix as shown in subsection (2.4.1) would be the starting correlation matrix for φ-ordering, and for the B-ordering the starting correlation matrix will be

$$\begin{pmatrix} 1 & r_{12} & r_{13} \\ r_{12} & 1 & r_{23} \\ r_{13} & r_{23} & 1 \end{pmatrix} = \begin{pmatrix} 1.0 & 0.7552 & 0.8778 \\ 0.7552 & 1.0 & 0.6018 \\ 0.8778 & 0.6018 & 1.0 \end{pmatrix}$$

It should be noted that for the three variable case, the equi-spaced condition is the same for the ordering considered and the reverse ordering. For example, for the φ-ordering (I > II > III), its reverse ordering is (III > II > I), and the solutions for the equi-spaced optimal index would support one of these two cases with the interaction structures present in the correlation matrix. Thus, it has also to be examined whether our expected φ-ordering could be solved from the corresponding correlation matrix.

Solving the equi-spaced condition and the proportional weight vector constraint, we get

.../-

$$\left.\begin{aligned}
&h_1 = 0,\\
&h_2 = \frac{1 + r_{13} - 2r_{23}}{3(1-r_{23})-(r_{12}-r_{13})}, \quad h_3 = \frac{2 - r_{12} - r_{23}}{3(1-r_{23})-(r_{12}-r_{13})}\\
&\text{and } k_1 = 1,\\
&k_2 = \frac{2(r_{23} - r_{12})}{3(1-r_{23})-(r_{12}-r_{13})}, \quad k_3 = -1 - \frac{2(r_{23} - r_{12})}{3(1-r_{23})-(r_{12}-r_{13})}\\
&\text{with } h_1 + h_2 + h_3 = h_2 + h_3 = 1\\
&\text{and } k_1 + k_2 + k_3 = 1 + k_2 + k_3 = 0
\end{aligned}\right\} \quad ..(2.45)$$

with the use of these values of h_i's and k_i's, we compute the intermediate parameters :

$$\left.\begin{aligned}
&D_1 = \sum_{j=1}^{3} r_{1j}\, h_j, && E_1 = \sum_{j=1}^{3} r_{1j}\, k_j,\\
&D_3 = \sum_{j=1}^{3} r_{3j}\, h_j, && E_3 = \sum_{j=1}^{3} r_{3j}\, k_j,\\
&S = \frac{1}{2}\sum_{j=1}^{3} (j-1)\, h_j, && T = \frac{1}{2}\sum_{j=1}^{3} (j-1)\, k_j,\\
&Q_1 = D_1 - S(D_1 - D_3), && P_1 = \frac{1}{4}(D_1+D_3)^2 + \frac{1}{6}(D_1-D_3)^2,\\
&Q_2 = E_1-S(E_1-E_3) - T(D_1-D_3), && P_2 = \frac{1}{2}(D_1+D_3)(E_1+E_3) +\\
& && \quad \frac{1}{3}(D_1-D_3)(E_1-E_3),\\
&Q_3 = -T(E_1 - E_3), && P_3 = \frac{1}{4}(E_1+E_3)^2 + \frac{1}{6}(E_1-E_3)^2,\\
&A^2 = Q_1 + Q_2 w_{1*} + Q_3 w_{1*}^2, && B^2 = P_1 + P_2 w_{1*} + P_3 w_{1*}^2
\end{aligned}\right\}$$

...(2.46)

From these, using the optimality condition of extremum ρ^2, which yields a quadratic equation in ρ^2, the two extremum roots (one giving ρ^2(max.) and the other ρ^2(min.)) are given by :

$$\rho^2(\text{extremum}) = \frac{P_2Q_2-2(P_1Q_3+P_3Q_1) \pm 2\sqrt{(P_1Q_3-P_3Q_1)^2 - (P_2Q_3-P_3Q_2)(P_1Q_2-P_2Q_1)}}{Q_2^2 - 4Q_1Q_3} \quad \ldots (2.47)$$

Using the ρ^2(max.) values we can determine the corresponding solution of w_{1*} as given below :

$$w_{1*} = \frac{P_2Q_2 - 4P_1Q_3 - \rho^2(\text{max.})(Q_2^2 - 4Q_1Q_3)}{2(P_2Q_3 - P_3Q_2)} \quad \ldots (2.48)$$

Once this equi-spaced optimal solution of w_{1*} is obtained, we can deduce the following parameters :

$$\left.\begin{array}{ll} w_{1*} = h_1 + k_1w_{1*}, & m_{1*} = D_1 + E_1w_{1*} \\ w_{2*} = h_2 + k_2w_{1*}, & m_{2*} = \frac{1}{2}(m_{1*} + m_{3*}) \\ w_{3*} = h_3 + k_3w_{1*}, & m_{3*} = D_3 + E_3w_{1*} \end{array}\right\} \quad \ldots (2.49)$$

Now, the actual parameters of the equi-spaced optimal index formulation, with certain ordering (pre-assigned), can be computed easily as follows :

$$m_j = (\tfrac{1}{B})m_{j*}, \quad w_j = (B/A^2)w_{j*}, \quad r_j = m_j\,\rho(\text{max.}) \quad \ldots (2.50)$$

We shall designate here afterwards the ρ(max.) value by ρ_{SN}, ρ_{SB} and $\rho_{S\varphi}$ when the equi-spaced optimal index is computed with N-ordering, B-ordering and φ-ordering respectively. For any arbitrary (non-optimal) equi-spaced index, its aggregate representation will be generally denoted by simply ρ_S, with or without a numerical second suffix.

For computation of any (non-optimal) equi-spaced index, we can compute for certain feasibly accepted values of ρ_S^2, the following quadratic equation in w_{1*}

$$\rho_S^2 = \frac{P_1 + P_2 w_{1*} + P_3 w_{1*}^2}{Q_1 + Q_2 w_{1*} + Q_3 w_{1*}^2} \qquad \dots (2.51)$$

are to be solved for w_{1*}. Generally we notice that if $\rho_E^2 < \rho_S^2 < \rho_M^2$, then we may get two consistent roots of w_{1*}, one of which (generally the lower one) corresponds to a lower specific representation range than the other, although both would give identical ρ_S. Obviously the root which corresponds to the lower specific representation range is the one which is acceptable, since this does not deteriorate the representativeness of the lower order variables as compared to the other. However, if $\rho_S^2 < \rho_E^2$, we have found with our type of linked constituent variables, that we have only one consistent root of w_{1*} as solution to equation (2.51). Next with the acceptable value of w_{1*} we make routine calculations, by use of relations (2.49) and (2.50), to get the parameters of the equi-spaced index (ref. to the last paragraph of this sub-section for specific numerical illustration in this context).

On the basis of this simplified computational procedures, we estimate the parameters of the three possible equi-spaced optimal indices, shown in Table 2.8(c). In this table, the final tabulation has, however, been made according to the original φ-ordering of the variables (namely, I ⟶ 1, II ⟶ 2, III ⟶ 3). It should be noted that the starting correlation matrix corresponding to N-ordering or B-ordering or φ-ordering has supported the ordering written earlier, and not the corresponding reverse ordering.

Table 2.8(c) : Estimates of the Parameters of Different Equi-spaced Optimal Indices

	Equi-spaced Optimal Indices			φ (phase symbol)
	N-ordering	B-ordering	φ-ordering	
r_1	0.8552708	0.9068239	0.9015851	I
r_2	0.9665643	0.9462537	0.8941168	II
r_3	0.9109175	0.8673930	0.8866486	III
ρ	0.9120500 $= \rho_{SN}$	0.9073952 $= \rho_{SB}$	0.8941376 $= \rho_{S\varphi}$	
w_1	0.3131941	0.4434001	0.5482081	I
w_2	0.3538648	0.2924670	-0.0908807	II
w_3	0.3316993	0.2635034	0.5426493	III

From the analysis of the estimates, presented in this table, in conjunction with those given in Tables 2.8(a) and 2.8(b), it is clear that ρ_M is practically coincident with ρ_{SN} and also the values of r_i's, as we surmised from an examination of specific representations of the optimal index. The values of ρ_{SB} and $\rho_{S\varphi}$ are, however, decreasing in the order quoted and both lying, as expected, between ρ_M and ρ_E. For the conjecture that we have made in favour of the necessity of φ-ordering of importance of representations of constituent variables in the composite index, the equi-spaced optimal indices based on N-ordering and B-ordering do not suit our purpose. However, for the φ-ordering, although the φ-order is preserved in the equi-spaced optimal formulation, the specific representations are very feebly decreasing from $\varphi = I$ to $\varphi = III$. In fact, in respect of aggregate representation it is almost same as the equity index ($\rho_E = 0.9040 < 0.9041 = \rho_{S\varphi}$). As it is very close to the equity index, it has the same consistency problem in weight vector, as we perceived in the equity index; the value of w_2 here is -0.0908807. As such, even this equi-spaced optimal index formulation is not the acceptable one. This leads us to try for some kind of new formulation, still preserving the φ-order as in the above mentioned index.

Before going for this, we shall now present, for the sake of illustrations, a few (non-optimal) equi-spaced indices in support of our statement made earlier. Here we shall select, (i) a value of ρ_S, say ρ_{S1}, $\rho_E < \rho_{S1} < \rho_M$, following the N-ordering, and also, (ii) another value of ρ_S, say ρ_{S2}, where $\rho_{S2} < \rho_E$, following the φ-ordering. We have actually selected

$$\rho^2_{S1} = \frac{1}{2}(\rho^2_E + \rho^2_M) = 0.8156$$

and $$\rho^2_{S2} = 0.7860 < 0.7993 = \rho^2_E$$

Table 2.8(d) : Estimates of Parameters of Some Non-optimal Equi-spaced Indices with Selected Values ρ^2_S

	N-ordering		φ-ordering		φ-order
	w_{1*} =0.0296416	w_{1*} =0.6992437	w_{1*} =0.6528207	w_{1*} =0.4467735	
r_1	0.8864006	0.8063382	0.9556025	leads to inconsistency with negative value for w_{2*}	I
r_2	0.9196073	0.9934036	0.8846730		II
r_3	0.9030039	0.8998709	0.8137434		III
ρ_S	0.9031060 $= \rho_{S1}$	0.9031060 $= \rho_{S1}$	0.8865664 $= \rho_{S2}$	0.8865664 $= \rho_{S2}$	

Clearly, from this table we can verify that for the same given value of ρ^2_{S1} in between ρ^2_E and ρ^2_M, we have two roots of w_{1*}, of which the lower value leads to an acceptable equi-spaced index formulation (using N-ordering) with lower specific representation range. On the other hand, with the same given value of ρ^2_{S2}, less than ρ^2_E, we have again two roots of w_{1*}, of which the higher value leads to an acceptable equi-spaced index formulation (using φ-ordering). The φ-order preserving equi-spaced index formulation (with chosen ρ_{S2}) has also yielded a consistent weight vector :

$$(w_1, w_2, w_3) = (0.6373516, 0.0287199, 0.3102322)$$

As this index is φ-order preserving and consistent, it is acceptable for our purpose; yet we have not used it, simply because of the arbitrariness in the choice of ρ^2_{S2}. We shall try to evolve in the next sub-section a consistent φ-order preserving equi-spaced index formulation that will make ρ^2_S unique.

2.4.3 Construction of a Consistent Optimal Equi-spaced Index : A modified φ-order preserving formulation

We have argued earlier theoretically in Section (2.4), that φ = I is the fundamental starting phase and any shortfall in enrolment of school-going boys from the desired maximal entrants becomes the most important indicator of non-development of basic-skill as incidences of drop-out go on increasing over subsequent phases II and III. For this sort of sequential linkages with the subsequent phase having been dependent on the preceding phase progressively, one expects that the higher the level of education in the starting point of a phase, the more is the distortions in spatial patterns, and as such, one would expect to get $r_{12} > r_{13}$ and $r_{23} > r_{12}$. We shall now show from the statistical standpoint that the N-ordering depicted by the optimal index also corroborates above type of relation.

It has been proved by Pal [1985 (1990)] in a theorem that when the correlation matrix R is a symmetric circulant matrix (this means that the column-sums of the correlation matrix R are the same constant), then Pal's equity index formulation coincides with Kendall's optimal formulation. It immediately follows that as the departures between column-sums become wider and wider, the two indices differ with the higher and higher specific representation range in the optimal index. In fact, the ordering of the specific representations as emerge actually in the optimal index, often coincides with the ordering of the column sums. Thus, the N-ordering of the Kendall's optimal index is depicted by the ordering of the Column-sums of R. In the present case the N-ordering of Kendall's index is as given below :

Second column-sum > third column-sum > First column-sum,

i.e., $1 + r_{12} + r_{23} > 1 + r_{13} + r_{23} > 1 + r_{12} + r_{13}$.

From these inequalities, we can derive :

$$r_{12} > r_{13} \text{ and } r_{23} > r_{12}.$$

Also noting that $r_{33} = 1$, we have

$$r_{33} > r_{23} > r_{12} > r_{13} \quad \ldots (2.52)$$

This is the sort of inequality relation for pairwise correlation coefficients that we expected theoretically for the sequentially linked phase variables (measuring the extent of non-development of basic-skill). It should be noted that when this sort of inequality relations exist between linked variables, the middle second phase is bound to get maximum representation in the optimal index formulation, but actually one of the extreme phase (the first phase, in case of non-development as substantiated earlier) ought to have received such maximal representation. This practical realisation goes against the general use of mathematically optimised formulation without any constraint.

As the specific representations in both Kendall's optimal index formulation and Pal's equi-spaced optimal index formulation (with the same normal ordering) are practically coincident -- variable by variable, we expect that the positive differences

$$(1 - r_{23}) = (r_{33} - r_{23}),\ (r_{23} - r_{12}) \text{ and } (r_{12} - r_{13})$$

are in the same order of magnitudes (numerically these values are respectively 0.1222, 0.1226 and 0.1534). Then it is possible that

$$3(1 - r_{23}) > (r_{12} - r_{13})$$

i.e. $$3(1 - r_{23}) - (r_{12} - r_{13}) > 0$$

This shows that the common denominator of h_2, h_3, k_2, k_3 (ref. to relations (2.45)) is positive. The numerators of h_3, k_2 are clearly positive, and the numerator of k_3 is clearly negative. The numerator of h_2 can be expressed as follows :

$$1 + r_{13} - 2r_{23} = -(r_{23} - r_{12}) - (r_{12} - r_{13}) + (1 - r_{23})$$

As the three positive differences $(r_{23} - r_{12})$, $(r_{12} - r_{13})$ and $(1 - r_{23})$ are likely to be of same magnitude, it is possible that the numerator of h_2 is negative, which in turn means h_2 is negative. Thus with the sort of correlation matrix R that yields the optimal index as almost identical to the equi-spaced index (with normal ordering), we are likely to get,

$$h_2 < 0,\ k_2 > 0,\ h_3 > 0 \quad \text{and} \quad k_3 < 0 \qquad \ldots (2.53)$$

Now the unconstrained phase-order preserving equi-spaced optimal index formulation (designated here by u within parenthesis for stressing the fact that it is unconstrained) reveals that the first phase turns out to be actually the most important one and the third phase the least (ref. to the values of r_i's given in Table 2.8(c) under the column showing φ-order preserving index). However, this index gave a negative value for w_{2*} which is not a consistent value. As the un-constrained phase-order preserving equi-spaced optimal index formulation gives the negative value for $w_{2*}(u)$, we must have $h_2 < 0$, when $k_2 > 0$. This additionally confirms the likelihood of getting negative values of h_2, while $k_2 > 0$, as expected and shown in inequality relation (2.53). Next, from the initial estimating equations (ref. to subsection 2.2.4 (iv)(c)), we have

$$m_{1*} = w_{1*} + r_{12}w_{2*} + r_{13}w_{3*}$$

and $$m_{3*} = r_{13}w_{1*} + r_{23}w_{2*} + w_{3*}$$

Then the range (note that the specific representation range $r_1 - r_3$ is proportional to 2Δ) :

$$\begin{aligned} 2\Delta &= m_{1*} - m_{3*} \\ &= (1 - r_{13})w_{1*} + (r_{12} - r_{23})w_{2*} + (r_{13} - 1)w_{3*} \end{aligned}$$

Using relations for w_{i*}'s from the relation (2.49), we get

$$\begin{aligned} 2\Delta = &\left\{(1-r_{13})h_1 + (r_{12}-r_{23})h_2 + (r_{13}-1)h_3\right\} \\ &+ w_{1*}\left\{(1-r_{13})k_1 + (r_{12}-r_{23})k_2 + (r_{13}-1)k_3\right\} \quad \ldots (2.54) \end{aligned}$$

For the modified φ-order preserving equi-spaced formulation with the unqueness in the value of ρ_S^2, we ignore the unconstrained phase-order preserving equi-spaced optimal index formulation and take objective now of :

minimising the range of 2Δ subject to the constraint that $w_{2*} \geq 0$ ... (2.55)

We had, however, $h_2 + k_2 w_{1*}(u) < 0$. Then the w_{1*} of this constrained formulation must be such that $w_{1*} > w_{1*}(u)$, since $k_2 > 0$ and $h_2 < 0$. Then the constraint $w_{2*} \geq 0$ implies that

$$h_2 + k_2 w_{1*} \geq 0$$

$$\text{or} \quad w_{1*} \geq -\frac{h_2}{k_2} \ (> 0)$$

Let, $$w_{1*} = c^2 - \frac{h_2}{k_2}, \qquad \ldots (2.56)$$

where c^2 is some non-negative constant to be determined under the objective of the minimisation of the specific representation range (i.e. minimising 2Δ).

Now, from relation (2.54), we get

$$2\Delta = \left\{(1-r_{13})h_1 + (r_{12}-r_{23})h_2 + (r_{13}-1)h_3\right\}$$
$$+ \left(c^2 - \frac{h_2}{k_2}\right)\left\{(1-r_{13})k_1 + (r_{12}-r_{13})k_2 + (r_{13}-1)k_3\right\}.$$

Using the relations $h_1 = 0$, $k_1 = 1$, $\Sigma h_j = 1$, $\Sigma k_j = 0$, i.e. using $h_3 = 1 - h_2$ and $k_3 = -(1+k_2)$, we get

.../-

$$2\Delta = \left\{(r_{12}-r_{23})h_2 + (r_{13}-1)(1-h_2)\right\} + (c^2 - \frac{h_2}{k_2})\left\{(1-r_{13}) + (r_{12}-r_{23})k_2 + (1-r_{13})(1+k_2)\right\}$$

$$= \left\{(1+r_{12}-r_{23}-r_{13})h_2 + (r_{13}-1)\right\} + (c^2 - \frac{h_2}{k_2})\left\{2(1+r_{13}) + (1+r_{12}-r_{23}-r_{13})k_2\right\}$$

i.e. $$2\Delta = \left[\left\{(1+r_{12}-r_{23}-r_{13})h_2 + (r_{13}-1) - \frac{h_2}{k_2}\left\{2(1+r_{13}) + (1+r_{12}-r_{23}-r_{13})k_2\right\}\right] + c^2\left[2(1+r_{13}) + \left\{(1-r_{23}) + (r_{12}-r_{13})\right\}k_2\right] \quad \ldots (2.57)$$

Here c^2 is the only undetermined value to be taken care of through the objective of the minimisation of 2Δ. Now, the coefficient of c^2, namely $\left[2(1+r_{13}) + \left\{(1-r_{23}) + (r_{12}-r_{13})\right\}k_2\right]$ is greater than zero since $(1+r_{13}) > 0$, $(1-r_{23}) > 0$, $(r_{12}-r_{13}) > 0$ and also $k_2 > 0$. Hence, the minimum value of 2Δ is attained only when $c^2 = 0$. This means, from the relation (2.56), that

$$w_{1*} = -\frac{h_2}{k_2} \quad \ldots (2.58)$$

This is the estimate of w_{1*} for the final specific representation range minimising and phase-order preserving equi-spaced index formulation, subject to non-negativity constraint on the weight vector. This is obviously a consistent (in respect of weight vector) equi-spaced optimal (in respect of specific representation range minimisation) index formulation (for sequentially linked variables), and here afterwards, we shall refer this index by the <u>Consistent Equi-spaced Optimal Index Formulation</u> (for three linked variables). The ρ_S^2 for it will be specifically denoted by ρ_{SR}^2. It should be noted that, with our present correlation matrix, ρ_{SR}^2, ρ_E^2, $\rho_{S\varphi}^2$ are very close to each other, maintaining the relation $\rho_{SR}^2 < \rho_E^2 < \rho_{S\varphi}^2$. It should also be noted that, using the value of w_{1*} as solved in (2.58) for this index, we can go for estimation of all its necessary parameters, including that of ρ_{SR}^2 by using relations (2.49), (2.50) and (2.51). The estimated values of the parameters are as shown below in Table 2.8(e).

Table 2.8(e) : Estimates of the Parameters of the Consistent Equi-spaced Optimal Index Formulation

r_1	0.9439784		w_1	0.6181275	φ = I
r_2	0.8878119		w_2	0.0	φ = II
r_3	0.8316453		w_3	0.3673397	φ = III
ρ_{SR}	0.8889954				

Based on this specific representation range minimising and phase-order preserving consistent equi-spaced optimal index formulation, we shall derive the final composite index of non-development of basic-skill, to be designated henceforth by L_{ij}

(the value of the i-th district in j-th State of India with the central critical value of unity at the benchmark time-point of 1970-71). Although we shall use this composite index based on this formulation that be-fits our empirical situation, other formulations are found to be well associated with this index formulation as revealed in the following correlation matrix.

Table 2.8(f) : Pairwise Correlation Coefficients for the Different Composite Index Formulations

The symbols for different composite index formulations					
SR	Sφ	E	SB	SN	M
1.0	0.9932513	0.9910341	0.9889374	0.9710764	0.9709336
	1.0	0.9998421	0.9862268	0.9789691	0.9789406
		1.0	0.9846368	0.9790111	0.9790007
			1.0	0.9939937	0.9938976
				1.0	0.9999994
					1.0

N.B. : For the calculation of the correlation coefficient, $r_{\alpha\beta}$, between any two generalised index formulation of Pal [1985 (1990)], designated by α and β, we have the following formulas established by him :

$$r_{\alpha\beta} = \sum_j r_j(\alpha) \cdot w_j(\beta)/\rho_\beta = \sum_j r_j(\beta) \cdot w_j(\alpha)/\rho_\alpha$$

These estimates of pair-wise correlation coefficients reveal that all different index formulations would depict quite comparable spatial patterns, except possibly for certain local peculiarities that would be appropriately depicted by our final composite index formulation (designated by the symbol SR), but not always by other composite index formulations (because of the absence of either φ-order preserving property or the consistency in weight vector). It should be noted that, even though $w_2 = 0$ in the final composite index formulation, it matters very little because of the use of linked phase variables and the first and the third phase variables are good enough to take care of the variations of the second phase variable. After all, the specific representation of this second phase variable is still as high as $r_2 = 0.8878$ (lying in between $r_1 = 0.9440$ and $r_3 = 0.8316$), despite the fact that we have $w_2 = 0$ for this formulation. And, in the calculations of this final index, we have made use of the entire correlation matrix of all the three constituent phase variables, without ignoring any of the relationships that exist between the second phase variable and each of the other two.

A point on an alternative possible formulation is to be marked. It may possibly be argued, why we do not use the entire formative range of ages (i.e. 5 years to 18^{+} years as a whole and formulate the composite index, say L'_{ij}, following the same kind of algebraic formulation and evaluation as used for a particular partial phase or sub-phase, say, $L_{ij}(I)$. We do not accept this for the following reasons. For the type of linkages that we have between progressive phases in respect of enrolment of boys, we are most likely to get L'_{ij} as to be most related to $L_{ij}(II)$, followed by decreasing magnitudes of its (L'_{ij}'s) relation with $L_{ij}(III)$ and $L_{ij}(I)$, which actually depict the normal ordering of specific representations, which is already shown to be unacceptable. Moreover, our final index L_{ij} would be more useful in local peculiarity studies when it is seen in conjunction with individual constituent variables $L_{ij}(I)$, $L_{ij}(II)$ and $L_{ij}(III)$.

2.4.4 Empirical Evaluation of the Composite Index of Non-development of Basic-Skill and its Statistical Relationships

The empirical formulation for the composite index of non-development of basic-skill L_{ij}, as evaluated on the basis of our finally modified formulation, namely, the consistent equi-spaced optimal formulation, is as given below :

$$\left.\begin{array}{l} L_{ij} = 0.375015\, L_{ij}(I) + 0.624985\, L_{ij}(III), \\ \qquad \text{aggregate representation : } \rho_{SR} = 0.8890 \end{array}\right\} \quad \ldots(2.59)$$

This empirical formulation has taken into account the entire correlation matrix R for all the three constituent variables, including $L_{ij}(II)$, for 1970-71. As mentioned earlier, for our modified optimal formulation, the coefficient of $L_{ij}(II)$ has been necessarily zero, ensuring the desired consistency of non-negative coefficients for all the constituent variables in the formulation.

As the above empirical formulation (2.59) is computed by use of the 1970-71 correlation matrix R, the regressions of $L_{ij}(\varphi)$ on L_{ij}, as in 1970-71, can be easily written down (with the regression estimate of $L_{ij}(\varphi)$ denoted by $\hat{L}_{ij}(\varphi)$) from the following formula (ref. to Pal [1971] for details) :

$$\left.\begin{aligned} \hat{L}_{ij}(\varphi) &= \alpha_\varphi + \beta_\varphi L_{ij}; \quad \text{correlation coefficient} = r_\varphi \\ \text{where } \beta_\varphi &= \sigma_\varphi \sum_{k=1}^{3} (w_k/\sigma_k) \\ \text{and } \alpha_\varphi &= \overline{L_{ij}}(\varphi) - \beta_\varphi \overline{L_{ij}} \end{aligned}\right\} \quad \ldots (2.60)$$

with σ_φ and $\overline{L_{ij}}(\varphi)$ denoting s.d. and mean of $L_{ij}(\varphi)$, and $\overline{L_{ij}}$ = mean of L_{ij}.

The empirical fits of these regressions are given below.

<u>1970-71 regression equations</u>

$$\left.\begin{aligned} \hat{L}_{ij}(I) &= -0.631140 + 1.648276\, L_{ij}; & r_1 &= 0.9440 \\ \hat{L}_{ij}(II) &= 0.048794 + 0.947744\, L_{ij}; & r_2 &= 0.8878 \\ \hat{L}_{ij}(III) &= 0.402616 + 0.587757\, L_{ij}; & r_3 &= 0.8316 \end{aligned}\right\} \quad \ldots (2.61)$$

It is to be noted that the same algebraic formulation, shown empirically in (2.59), is to be used also for the formulation of 1960-61 composite index values, so that the values c the composite index become comparable between the two time-points 1960-61 and 1970-71 (given that the constituent phase indices are also comparable similarly). Once such composite index values for 1960-61 have been estimated, they are not expected to have the same degrees of statistical correlation with the values of each of the constituent phase variables, as we have noted for 1970-71 in the equation system (2.61). The actual empirical fits of these regressions of $L_{ij}(\varphi)$ on L_{ij} with 1960-61 data are the following :

1960-61 regression equations

$$\left.\begin{aligned} \hat{L}_{ij}(I) &= -0.984776 + 1.905662\, L_{ij}; \\ &\qquad \text{Correlation Coefficient} = 0.9697 \\ \hat{L}_{ij}(II) &= 0.074805 + 0.941616\, L_{ij}; \\ &\qquad \text{Correlation Coefficient} = 0.8572 \\ \hat{L}_{ij}(III) &= 0.590906 + 0.456566\, L_{ij}; \\ &\qquad \text{Correlation Coefficient} = 0.8457 \end{aligned}\right\} \quad \therefore (2.62)$$

On the basis of the three correlation coefficients (comparable to specific representations r_i's), the estimated aggregate representation for 1960-61 composite index L_{ij} turns out to be $\rho = 0.8926$, which is a little higher than what has been obtained for 1970-71 composite index shown in (2.59). Thus, the algebraic formulation shown in (2.59) turns out to be almost equally good in respect of the aggregate representation. In respect of specific representations, the constituent indices for the first and the third phases, show slightly better representations in 1960-61 than in 1970-71. However, the values of specific representations for a particular phase in both the time-points are numerically very high and close to each other. It is to be noted that the desired phase-order preserving property of the index formulation (2.59) remains as it is in 1960-61 (i.e. here also in 1961, the revealed values of correlation coefficients are in decreasing order with the increasing order of the phases).

The regression equations given in equation systems (2.61) and (2.62) would be useful for identification of local peculiarities when we are analysing the general spatial patterns through mappings of L_{ij} for 1960-61 and 1970-71. The algebraic difference between the actual value $L_{ij}(\varphi)$ and the corresponding regression estimate $\hat{L}_{ij}(\varphi)$ (i.e., $L_{ij}(\varphi) - \hat{L}_{ij}(\varphi)$) will be considered statistically significant (at 5% level of chance) when its absolute value is above thrice the standard error of estimate of the corresponding regression fit. In such situations, with values of $L_{ij}(\varphi)$ significantly above or below the regression line, the local peculiarities with departures from the general pattern as depicted through $\hat{L}_{ij}(\varphi)$ (i.e., the regressand of L_{ij}), for the i-th district of j-th State would be easily diagnosed through comparative analysis.

The empirical estimates of L_{ij} as calculated by the use of the formulation (2.59) for the two time-points 1960-61 and 1970-71 are recorded in a subsequent Table (2.10).

2.5 Classification of Indices for Mapping

The spatial data on $L_{ij}(\varphi)$ and L_{ij}, just generated above, are now to be classified for ranking and mapping of district values, so that formal regional configurations could be identified for further regional analysis. We have already mentioned in subsection (2.2.6) how we have chosen the boundary values for different classes. The class-ranks are qualitatively mentioned as : EH (extremely high), VH (very high), H (high), M (medium), L (low), VL (very low) and EL (extremely low), corresponding to specified quantitative intervals of values in descending order of magnitudes of an index $L_{ij}(\varphi)$ (or, composite index L_{ij}). It should be noted that the quantitative interval length is the same for all classes for an index. By use of methods described in sub-section (2.2.6), this interval length, $\Delta L_{ij}(\varphi)$, works out to be as follows :

$$\Delta L_{ij}(I) = 0.25, \quad \Delta L_{ij}(II) = 0.17, \quad \Delta L_{ij}(III) = 0.10$$

The interval length for classification of the composite index values is not, however, ascertained by the method of subsection (2.2.6), but by use of the $\Delta L_{ij}(\varphi)$ values just shown above ..

the relation (2.59). The use of this connecting relation (2.59) seems to be more logical for getting comparable class interval length, ΔL_{ij}, which would form the basis for a classification of L_{ij} values in the usual way. In this way we get the values of $\Delta L_{ij} = 0.15$. It should be noted that the same class-boundaries will be used for both 1960-61 and 1970-71 data, although, likewise other cases, we derive our class-boundaries from the statistical distributions of $L_{ij}(\varphi)$ in 1970-71.

In addition to giving the class-boundaries by index values $L_{ij}(\varphi)$, we have also given them in terms of corresponding percentages of non-enrolled boys. It should be noted that the index-values are comparable spatially and temporally only for each phase, but the actual percentages (not the xlaxx classified ranks) of non-enrolled boys (shown in all maps for phase wise indices) could be compared spatially and temporally between any pair of phases also. Again as the percentage of non-enrolled boys is the complement of the percentage of enrolled school-going boys, one can as well describe the class boundaries in terms of percentage of enrolled school-going boys — here, however, the qualitative class-ranking should receive a reverse impression (i.e., EL values of non-enrolled boys would be treated as EH values of enrolled boys and similar kinds of reversals for other pairs of class). We now describe below the qualitative class-ranks and the defining boundary values (with alternative equivalent boundary values, where possible) for each of the indices $L_{ij}(\varphi)$ and the composite index L_{ij}. We have also shown the frequencies of districts by those classes for each $L_{ij}(\varphi)$ or L_{ij} at both time-points 1960-61 and 1970-71 (the total number of districts for all-India has been 349 in our counts for both time-points, with adjustment for 1960-61).

Table 2.9 : Boundary Values for the Classification of Indices with the Corresponding Class-ranks and the Frequency of Districts by Classes in 1960-61 and 1970-71

(a) The first phase index of NBS : $L_{ij}(I)$

Class ranks	Class-boundaries by L_{ij} (I) (defining)	Alternative class-boundaries by percentage of boys		Frequency of districts	
		non-enrolled	enrolled	1960-61	1970-71
EH	1.625 and above	60.68 and above	below 39.32	27	1
VH	1.375 to 1.625	51.34 to 60.68	39.32 to 48.66	81	41
H	1.125 to 1.375	42.01 to 51.34	48.66 to 57.99	120	87
M	0.875 to 1.125	32.67 to 42.01	57.99 to 67.33	78	120
L	0.625 to 0.875	23.34 to 32.67	67.33 to 76.66	27	62
VL	0.375 to 0.625	14.00 to 23.34	76.66 to 86.00	14	23
EL	below 0.375	below 14.00	86.00 and above	2	5

Table 2.9 (contd.)

Table 2.9 (Contd.)

(b) The second phase index of NBS : $L_{ij}(II)$

Class ranks	Class-boundaries by $L_{ij}(II)$ (defining)	Alternative class-boundaries by percentage of boys: non-enrolled	Alternative class-boundaries by percentage of boys: enrolled	Frequency of districts: 1960-61	Frequency of districts: 1970-71
EH	1.425 and above	78.86 and above	below 21.14	8	1
VH	1.255 to 1.425	69.45 to 78.86	21.14 to 30.55	112	24
H	1.085 to 1.255	60.04 to 69.45	30.55 to 39.96	114	109
M	0.915 to 1.085	50.64 to 60.04	39.96 to 49.36	87	114
L	0.745 to 0.915	41.23 to 50.64	49.36 to 58.77	24	85
VL	0.575 to 0.745	31.82 to 41.23	58.77 to 68.18	4	13
EL	below 0.575	below 31.82	68.18 and above	0	3

(c) The third phase index of NBS : $L_{ij}(III)$

Class ranks	Class-boundaries by $L_{ij}(III)$ (defining)	Alternative class-boundaries by percentage of boys: non-enrolled	Alternative class-boundaries by percentage of boys: enrolled	Frequency of districts: 1960-61	Frequency of districts: 1970-71
EH	1.250 and above	97.07 and above	below 2.93	7	2
VH	1.150 to 1.250	89.31 to 97.07	2.93 to 10.69	127	24
H	1.050 to 1.150	81.54 to 89.31	10.69 to 18.46	149	97
M	0.950 to 1.050	73.78 to 81.54	18.46 to 26.22	55	133
L	0.850 to 0.950	66.01 to 73.78	26.22 to 33.99	8	71
VL	0.750 to 0.850	58.24 to 66.01	33.99 to 41.76	2	15
EL	below 0.750	below 58.24	41.76 and above	1	7

Table 2.9 (contd.)

Table 2.9 (concluded)

(d) The composite index of NBS : L_{ij}

Class ranks	Class-boundaries by L_{ij} (defining)	Frequency of districts 1960-61	1970-71
EH	1.375 and above	17	1
VH	1.225 to 1.375	106	28
H	1.075 to 1.225	129	113
M	0.925 to 1.075	68	127
L	0.775 to 0.925	23	53
VL	0.625 to 0.775	4	21
EL	below 0.625	2	6

The class-ranks for all phasewise indices of NBS by districts have been tabulated, along with the corresponding actual index values (ref. to sub-section (2.3.2)), in the appendix Table (A.2). Also the class-ranks for the composite index of NBS by districts are shown, along with actual index values (ref. to sub-section (2.4.4)), in Table (2.10). These classified values for all the indices by two time-points are then separately mapped and shown in Figures (2.1) to (2.8).

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Table 2.10 : Composite Indices of Non-Development of Basic-Skill for Boys : Estimates and Classified Ranks for Districts of India in 1960-61 and 1970-71

Districts by States and Union Territories	TOTAL PHASE Composite Index : L_{11} 1960-61	1970-71
(1)	(2)	(3)
INDIA	1.126 (H)	1.000 (M)
ANDHRA PRADESH	1.132 (H)	1.083 (H)
1. Srikakulam	1.196 (H)	1.147 (H)
2. Vishakhapatnam	1.192 (H)	1.125 (H)
3. East Godavari	1.094 (H)	1.034 (M)
4. West Godavari	1.038 (M)	0.996 (M)
5. Krishna	1.029 (M)	0.980 (M)
6. Guntur	1.047 (M)	0.873 (L)
7. Ongole	1.102 (H)	1.016 (M)
8. Nellore	1.134 (H)	0.951 (M)
9. Chittoor	1.116 (H)	0.995 (M)
10. Cuddapah	1.092 (H)	1.011 (M)
11. Anantapur	1.115 (H)	1.048 (M)
12. Kurnool	1.100 (H)	1.048 (M)
13. Mahbubnagar	1.232(VH)	1.110 (H)
14. Hyderabad	0.940 (M)	0.695(VL)
15. Medak	1.212 (H)	1.175 (H)
16. Nizamabad	1.216 (H)	1.164 (H)
17. Adilabad	1.264(VH)	1.215 (H)
18. Karimnagar	1.236(VH)	1.190 (H)
19. Warangal	1.207 (H)	1.162 (H)
20. Khammam	1.226(VH)	1.176 (H)
21. Nalgonda	1.227(VH)	1.177 (H)
ASSAM	1.109 (H)	1.066 (M)
1. Goalpara	1.203 (H)	1.150 (H)
2. Kamrup	1.084 (H)	1.050 (M)
3. Darrang	1.185 (H)	1.150 (H)
4. Nowgong	1.122 (H)	1.066 (M)
5. Sibsagar	1.002 (M)	0.971 (M)
6. Lakhimpur	1.088 (H)	1.048 (M)
7. Mikir Hills	1.321(VH)	1.191 (H)
8. North Cachar Hills	1.202 (H)	1.085 (H)
9. Cachar	1.070 (M)	1.022 (M)
10. Mizo	0.878 (L)	0.740(VL)
BIHAR	1.201 (H)	1.093 (H)
1. Patna	1.026 (M)	0.943 (M)
2. Gaya	1.180 (H)	1.056 (M)
3. Shahabad	1.122 (H)	1.062 (M)
4. Saran	1.168 (H)	1.074 (M)
BIHAR (Contd.)		
5. Champaran	1.302(VH)	1.188 (H)
6. Muzaffarpur	1.220 (H)	1.131 (H)
7. Darbhanga	1.219 (H)	1.116 (H)
8. Monghyr	1.194 (H)	1.090 (H)
9. Bhagalpur	1.185 (H)	1.089 (H)
10. Saharsa	1.273(VH)	1.160 (H)
11. Purnea	1.254(VH)	1.164 (H)
12. Santhal Parganas	1.272(VH)	1.156 (H)
13. Palamau	1.286(VH)	1.164 (H)
14. Hazaribagh	1.268(VH)	1.142 (H)
15. Ranchi	1.209 (H)	1.063 (M)
16. Dhanbad	1.110 (H)	0.973 (M)
17. Singhbhum	1.136 (H)	1.018 (M)
GUJARAT	1.048 (M)	0.952 (M)
1. Jamnagar	1.117 (H)	1.024 (M)
2. Rajkot	1.027 (M)	0.902 (L)
3. Surendranagar	1.154 (H)	1.046 (M)
4. Bhavnagar	1.089 (H)	0.990 (M)
5. Amreli	1.082 (H)	0.989 (M)
6. Junagadh	1.131 (H)	1.031 (M)
7. Kutch	1.159 (H)	1.086 (H)
8. Banaskantha	1.340(VH)	1.283(VH)
9. Sabarkantha	1.120 (H)	0.982 (M)
10. Mahesana	0.981 (M)	0.893 (L)
11. Gandhinagar	0.875 (L)	0.827 (L)
12. Ahmedabad	0.870 (L)	0.750(VL)
13. Kheda	0.937 (M)	0.805 (L)
14. Panchmahals	1.222 (H)	1.141 (H)
15. Vadodara	0.976 (M)	0.880 (L)
16. Bharuch	0.969 (M)	0.946 (M)
17. Surat	0.989 (M)	0.921 (L)
18. Valsad	1.015 (M)	0.946 (M)
19. The Dangs	1.423(EH)	1.330(VH)

N.B. : Ranking Symbols for the Composite Index

Range of Value	Symbol
1.375 and above	EH
1.225 - 1.375	VH
1.075 - 1.225	H
0.925 - 1.075	M
0.775 - 0.925	L
0.625 - 0.775	VL
below 0.625	EL

Table 2.10 (Contd.)

Districts by States and Union Territories	TOTAL PHASE Composite Index : L_{ij}	
	1960-61	1970-71
(1)	(2)	(3)
HARYANA	1.075 (M)	0.893 (L)
1. Ambala	0.969 (M)	0.823 (L)
2. Karnal	1.122 (H)	0.939 (M)
3. Rohtak	1.044 (M)	0.829 (L)
4. Gurgaon	1.058 (M)	0.864 (L)
5. Mahendranagar	1.066 (M)	0.852 (L)
6. Hisar	1.119 (H)	0.944 (M)
7. Jind	1.148 (H)	0.997 (M)
HIMACHAL PRADESH	1.088 (H)	0.940 (M)
1. Chamba	1.238 (VH)	1.131 (H)
2. Kangra	0.992 (M)	0.867 (L)
3. Mandi	1.097 (H)	0.934 (M)
4. Kulu	1.188 (H)	1.025 (M)
5. Lahul & Spiti	1.093 (H)	1.005 (M)
6. Bilaspur	1.076 (H)	0.922 (L)
7. Mahasu	1.091 (H)	0.976 (M)
8. Simla	1.024 (M)	0.871 (L)
9. Sirmaur	1.173 (H)	1.059 (M)
10. Kinnaur	1.138 (H)	0.942 (M)
JAMMU & KASHMIR	1.245 (VH)	1.148 (H)
1. Anantanag	1.282 (VH)	1.187 (H)
2. Srinagar	1.203 (H)	1.116 (H)
3. Baramula	1.285 (VH)	1.218 (H)
4. Ladakh	1.263 (VH)	1.204 (H)
5. Doda	1.272 (VH)	1.204 (H)
6. Udhampur	1.280 (VH)	1.198 (H)
7. Jammu	1.146 (H)	0.992 (M)
8. Kathua	1.235 (VH)	1.106 (H)
9. Rajauri	1.310 (VH)	1.204 (H)
10. Punch	1.279 (VH)	1.191 (H)
KARNATAKA	1.090 (H)	1.015 (M)
1. Bangalore	0.979 (M)	0.877 (L)
2. Belgaum	1.067 (M)	1.003 (M)
3. Bellary	1.142 (H)	1.101 (H)
4. Bidar	1.244 (VH)	1.158 (H)
5. Bijapur	1.065 (M)	1.033 (M)
6. Chikmagalur	1.071 (M)	0.984 (M)
7. Chitradurga	1.081 (H)	1.010 (M)
8. Coorg	0.992 (M)	0.894 (L)
9. Dharwar	0.938 (M)	0.878 (L)
10. Gulbarga	1.242 (VH)	1.187 (H)
11. Hassan	1.098 (H)	1.022 (M)
12. Kolar	1.157 (H)	1.084 (H)
13. Mandya	1.214 (H)	1.150 (H)
14. Mysore	1.175 (H)	1.129 (H)
15. North Kanara	0.994 (M)	0.903 (L)
16. Raichur	1.220 (H)	1.159 (H)
17. Shimoga	1.062 (M)	0.959 (M)
18. South Kanara	1.021 (M)	0.862 (L)
19. Tumkur	1.118 (H)	1.038 (M)
KERALA	0.896 (L)	0.785 (L)
1. Cannanore	0.942 (M)	0.856 (L)
2. Kozikode	0.954 (M)	0.802 (L)
3. Malappuram	0.978 (M)	0.838 (L)
4. Palghat	1.124 (H)	1.020 (M)
5. Trichur	0.897 (L)	0.791 (L)
6. Ernakulam	0.852 (L)	0.704 (VL)
7. Kottayam	0.777 (L)	0.670 (VL)
8. Alleppey	0.754 (VL)	0.584 (EL)
9. Quilon	0.852 (L)	0.709 (VL)
10. Trivandrum	0.922 (L)	0.742 (VL)
MADHYA PRADESH	1.241 (VH)	1.114 (H)
1. Morena	1.282 (VH)	1.149 (H)
2. Bhind	1.231 (VH)	1.083 (H)
3. Gwalior	1.087 (H)	0.950 (M)
4. Datia	1.274 (VH)	1.110 (H)
5. Shivpuri	1.340 (VH)	1.194 (H)
6. Gunna	1.304 (VH)	1.188 (H)
7. Tikamgarh	1.378 (EH)	1.255 (VH)
8. Chhatarpur	1.352 (VH)	1.244 (VH)
9. Panna	1.352 (VH)	1.235 (VH)
10. Satna	1.250 (VH)	1.119 (H)
11. Rewa	1.254 (VH)	1.135 (H)
12. Shahdol	1.360 (VH)	1.236 (VH)
13. Sidhi	1.399 (EH)	1.294 (VH)
14. Mandsaur	1.131 (H)	0.995 (M)
15. Ratlam	1.180 (H)	1.074 (M)
16. Ujjain	1.142 (H)	1.019 (M)
17. Jhabua	1.461 (EH)	1.374 (VH)
18. Dhar	1.311 (VH)	1.208 (H)
19. Indore	0.930 (M)	0.817 (L)
20. Dewas	1.226 (VH)	1.103 (H)
21. Khargone	1.273 (VH)	1.175 (H)
22. Khandwa	1.119 (H)	1.028 (M)
23. Shajapur	1.287 (VH)	1.145 (H)
24. Rajgarh	1.373 (VH)	1.236 (VH)
25. Vidisha	1.314 (VH)	1.181 (H)
26. Sehore	1.200 (H)	1.033 (M)
27. Raisen	1.311 (VH)	1.180 (H)
28. Hoshangabad	1.142 (H)	0.995 (M)
29. Betul	1.242 (VH)	1.104 (H)
30. Sagar	1.197 (H)	1.035 (M)
31. Damoh	1.217 (H)	1.091 (H)
32. Jabalpur	1.060 (M)	0.938 (M)
33. Narsimhapur	1.171 (H)	1.027 (M)
34. Mandla	1.286 (VH)	1.164 (H)
35. Chhindwara	1.255 (VH)	1.126 (H)
36. Seoni	1.238 (VH)	1.128 (H)
37. Balaghat	1.149 (H)	1.047 (M)
38. Surguja	1.385 (EH)	1.269 (VH)
39. Bilaspur	1.197 (H)	1.072 (M)
40. Raigarh	1.268 (VH)	1.134 (H)
41. Durg	1.212 (H)	1.058 (M)
42. Raipur	1.191 (H)	1.063 (M)
43. Bastar	1.430 (EH)	1.333 (VH)

Table 2.10 (Contd.)

Districts by States and Union Territories	TOTAL PHASE Composite Index : L_{ij}	
	1960-61	1970-71
(1)	(2)	(3)
MAHARASHTRA	1.126 (H)	0.974 (M)
1. Greater Bombay	0.720(VL)	0.611(EL)
2. Thana	1.142 (H)	0.987 (M)
3. Kolaba	1.217 (H)	1.041 (M)
4. Ratnagiri	1.124 (H)	0.948 (M)
5. Nasik	1.170 (H)	1.020 (M)
6. Dhulia	1.201 (H)	1.116 (H)
7. Jalgaon	1.006 (M)	0.838 (L)
8. Ahmadnagar	1.170 (H)	1.011 (M)
9. Poona	1.058 (M)	0.878 (L)
10. Satara	1.038 (M)	0.950 (M)
11. Sangli	1.129 (H)	0.975 (M)
12. Sholapur	1.209 (H)	1.056 (M)
13. Kolhapur	1.158 (H)	0.997 (M)
14. Aurangabad	1.338(VH)	1.130 (H)
15. Parbhani	1.390(EH)	1.220 (H)
16. Bhir	1.400(EH)	1.230(VH)
17. Nanded	1.397(EH)	1.256(VH)
18. Osmanabad	1.356(VH)	1.161 (H)
19. Buldhana	1.141 (H)	0.969 (M)
20. Akola	1.081 (H)	0.960 (M)
21. Amravati	1.063 (M)	0.952 (M)
22. Yeotmal	1.234(VH)	1.118 (H)
23. Wardha	1.104 (H)	0.947 (M)
24. Nagpur	1.027 (M)	0.882 (L)
25. Bhandara	1.161 (H)	0.992 (M)
26. Chandrapur	1.339(VH)	1.190 (H)
MANIPUR	0.854 (L)	0.854 (L)
1. Manipur North	1.004 (M)	1.007 (M)
2. Manipur West	1.010 (M)	1.014 (M)
3. Manipur South	0.870 (L)	0.870 (L)
4. Manipur Central	0.829 (L)	0.829 (L)
5. Manipur East	0.859 (L)	0.859 (L)
MEGHALAYA	1.176 (H)	1.102 (H)
1. Garo Hills	1.262(VH)	1.158 (H)
2. United Khasi & Jaintia Hills	1.121 (H)	1.064 (M)
NAGALAND	1.068 (M)	0.980 (M)
1. Kohima	1.014 (M)	0.918 (L)
2. Mokokchung	0.940 (M)	0.860 (L)
3. Tuensang	1.233(VH)	1.163 (H)
ORISSA	1.238(VH)	1.149 (H)
1. Sambalpur	1.202 (H)	1.119 (H)
2. Sundargarh	1.300(VH)	1.171 (H)
3. Keonjhar	1.316(VH)	1.228(VH)
4. Mayurbhanj	1.394(EH)	1.286(VH)
5. Balasore	1.072 (M)	1.021 (M)
6. Cuttack	1.074 (M)	0.988 (M)
ORISSA (Contd.)		
7. Dhenkanol	1.177 (H)	1.098 (H)
8. Baudh Khondmals	1.287(VH)	1.221 (H)
9. Bolangir	1.377(EH)	1.230(VH)
10. Kalahandi	1.426(EH)	1.347(VH)
11. Koraput	1.479(EH)	1.425(EH)
12. Ganjam	1.226(VH)	1.156 (H)
13. Puri	1.094 (H)	0.988 (M)
PUNJAB	1.016 (M)	0.857 (L)
1. Gurdaspur	1.029 (M)	0.847 (L)
2. Amritsar	0.990 (M)	0.852 (L)
3. Firozpur	1.067 (M)	0.927 (M)
4. Ludhiana	0.911 (L)	0.760(VL)
5. Jullunder	0.923 (L)	0.765(VL)
6. Kapurthala	0.981 (M)	0.834 (L)
7. Hoshiarpur	0.958 (M)	0.742(VL)
8. Ropar	0.966 (M)	0.795 (L)
9. Patiala	1.046 (M)	0.886 (L)
10. Sangrur	1.148 (H)	0.972 (M)
11. Bhatinda	1.109 (H)	0.972 (M)
RAJASTHAN	1.281(VH)	1.183 (H)
1. Ganganagar	1.258(VH)	1.178 (H)
2. Bikaner	1.154 (H)	1.094 (H)
3. Churu	1.230(VH)	1.182 (H)
4. Jhunjhunu	1.179 (H)	1.062 (M)
5. Alwar	1.270(VH)	1.161 (H)
6. Bharatpur	1.273(VH)	1.175 (H)
7. Sawai Madhopur	1.317(VH)	1.222 (H)
8. Jaipur	1.230(VH)	1.111 (H)
9. Sikar	1.246(VH)	1.134 (H)
10. Ajmer	1.111 (H)	1.003 (M)
11. Tonk	1.355(VH)	1.250(VH)
12. Jaisalmer	1.423(EH)	1.288(VH)
13. Jodhpur	1.237(VH)	1.158 (H)
14. Nagaur	1.316(VH)	1.250(VH)
15. Pali	1.306(VH)	1.208 (H)
16. Barmer	1.430(EH)	1.344(VH)
17. Jalore	1.416(EH)	1.350(VH)
18. Sirohi	1.314(VH)	1.233(VH)
19. Bhilwara	1.356(VH)	1.260(VH)
20. Udaipur	1.311(VH)	1.213 (H)
21. Chittaurgarh	1.319(VH)	1.197 (H)
22. Dungarpur	1.367(VH)	1.261(VH)
23. Banswara	1.410(EH)	1.308(VH)
24. Bundi	1.345(VH)	1.242(VH)
25. Kota	1.207 (H)	1.069 (M)
26. Jhalawar	1.306(VH)	1.206 (H)

Table 2.10 (Concluded)

Districts by States and Union Territories	TOTAL PHASE Composite Index : L_{ij}	
	1960-61	1970-71
(1)	(2)	(3)
TAMIL NADU	0.880 (L)	0.747(VL)
1. Madras	0.571(EL)	0.506(EL)
2. Chingleput	0.924 (L)	0.747(VL)
3. North Arcot	0.956 (M)	0.794 (L)
4. South Arcot	0.921 (L)	0.832 (L)
5. Dharmapuri	1.088 (H)	0.960 (M)
6. Salem	0.965 (M)	0.847 (L)
7. Coimbatore	0.893 (L)	0.752(VL)
8. Nilgiris	0.839 (L)	0.668(VL)
9. Madurai	0.841 (L)	0.709(VL)
10. Tiruchirapalli	0.878 (L)	0.753(VL)
11. Thanjavur	0.835 (L)	0.732(VL)
12. Ramanathpuram	0.838 (L)	0.713(VL)
13. Tirunelveli	0.820 (L)	0.685(VL)
14. Kanyakumari	0.748(VL)	0.597(EL)
TRIPURA	1.016 (M)	0.925 (M)
1. West Tripura	1.002 (M)	0.911 (L)
2. North Tripura	1.000 (M)	0.910 (L)
3. South Tripura	1.062 (M)	0.966 (M)
UTTAR PRADESH	1.213 (H)	0.999 (M)
1. Uttar Kashi	1.195 (H)	0.938 (M)
2. Chamoli	1.353(VH)	1.112 (H)
3. Tehri Garhwal	1.142 (H)	0.945 (M)
4. Garhwal	1.329(VH)	1.108 (H)
5. Pithorgarh	1.348(VH)	1.106 (H)
6. Almora	1.363(VH)	1.116 (H)
7. Nainital	1.370(VH)	1.136 (H)
8. Bijnore	1.228(VH)	1.034 (M)
9. Moradabad	1.308(VH)	1.086 (H)
10. Budaun	1.374(VH)	1.142 (H)
11. Rampur	1.331(VH)	1.147 (H)
12. Bareilly	1.291(VH)	1.078 (H)
13. Pilbhit	1.306(VH)	1.079 (H)
14. Shahjahanpur	1.313(VH)	1.079 (H)
15. Dehradun	0.937 (M)	0.764(VL)
16. Saharanpur	1.202 (H)	0.999 (M)
17. Muzaffarnagar	1.240(VH)	1.006 (M)
18. Meerut	1.140 (H)	0.924 (L)
19. Bulandshahr	1.208 (H)	0.985 (M)
20. Aligarh	1.180 (H)	0.960 (M)
21. Mathura	1.141 (H)	0.943 (M)
22. Agra	1.125 (H)	0.933 (M)
23. Etah	1.240(VH)	1.009 (M)
24. Mainpuri	1.184 (H)	0.975 (M)
25. Farrukhabad	1.170 (H)	0.968 (M)
26. Etawah	1.128 (H)	0.916 (L)
27. Kanpur	1.024 (M)	0.837 (L)
28. Fatehpur	1.215 (H)	0.997 (M)
29. Allahabad	1.172 (H)	0.953 (M)
30. Jhansi	1.172 (H)	0.954 (M)
31. Jalaun	1.105 (H)	0.902 (L)

Districts by States and Union Territories	TOTAL PHASE Composite Index : L_{ij}	
	1960-61	1970-71
(1)	(2)	(3)
UTTAR PRADESH (Contd.)		
32. Hamirpur	1.222 (H)	1.003 (M)
33. Banda	1.239(VH)	1.023 (M)
34. Kheri	1.320(VH)	1.108 (H)
35. Sitapur	1.293(VH)	1.078 (H)
36. Hardoi	1.258(VH)	1.039 (M)
37. Unnao	1.261(VH)	1.027 (M)
38. Lucknow	1.058 (M)	0.882 (L)
39. Rae Bareili	1.277(VH)	1.031 (M)
40. Bahraich	1.307(VH)	1.135 (H)
41. Gonda	1.310(VH)	1.100 (H)
42. Bara Banki	1.311(VH)	1.105 (H)
43. Faizabad	1.260(VH)	1.019 (M)
44. Sultanpur	1.272(VH)	1.030 (M)
45. Pratapgarh	1.244(VH)	1.003 (M)
46. Basti	1.308(VH)	1.069 (M)
47. Gorakhpur	1.228(VH)	1.011 (M)
48. Deoria	1.250(VH)	1.023 (M)
49. Azamgarh	1.224 (H)	1.016 (M)
50. Jaunpur	1.179 (H)	0.966 (M)
51. Ballia	1.161 (H)	0.980 (M)
52. Ghazipur	1.192 (H)	1.008 (M)
53. Varanasi	1.088 (H)	0.904 (L)
54. Mirazapur	1.208 (H)	1.020 (M)
WEST BENGAL	1.055 (M)	0.943 (M)
1. Darjeeling	1.054 (M)	0.957 (M)
2. Jalpaiguri	1.209 (H)	1.084 (H)
3. Cooch Behar	1.158 (H)	1.095 (H)
4. West Dinajpur	1.222 (H)	1.095 (H)
5. Malda	1.272(VH)	1.166 (H)
6. Murshidabad	1.250(VH)	1.150 (H)
7. Nadia	1.107 (H)	0.998 (M)
8. 24-Parganas	1.009 (M)	0.866 (L)
9. Howrah	0.951 (M)	0.837 (L)
10. Calcutta	0.745(VL)	0.633(VL)
11. Hooghly	0.981 (M)	0.868 (L)
12. Burdwan	1.064 (M)	0.942 (M)
13. Birbhum	1.147 (H)	1.040 (M)
14. Bankura	1.102 (H)	1.011 (M)
15. Midnapore	1.036 (M)	0.905 (L)
16. Purulia	1.173 (H)	1.055 (M)
ARUNACHAL PRADESH	1.183 (H)	1.169 (H)
1. Kameng	1.212 (H)	1.198 (H)
2. Subansiri	1.248(VH)	1.234(VH)
3. Siang	1.154 (H)	1.140 (H)
4. Lohit	1.174 (H)	1.092 (H)
5. Tirap	1.181 (H)	1.167 (H)
CHANDIGARH	0.601(EL)	0.514(EL)
DELHI	0.935 (M)	0.714(VL)
DADRA & NAGAR HAVELI	1.078 (H)	0.934 (M)
GOA	1.016 (M)	0.898 (L)
PONDICHERRY	0.777 (L)	0.615(VL)

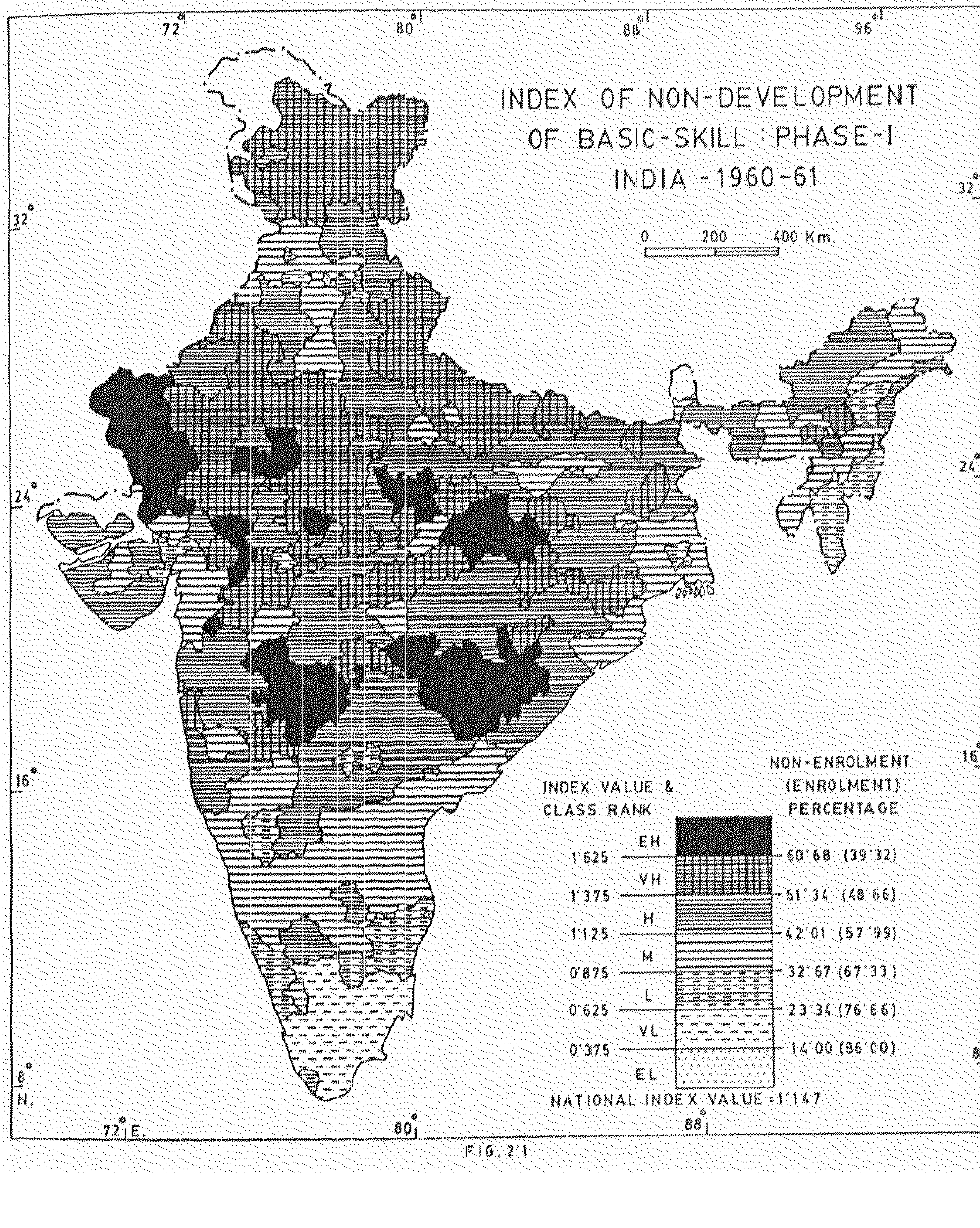
2.6 Regional Analysis on the Measures of Non-development of Basic-Skill and the Findings

Our approach in the regional analysis, based on formal regional structure evaluation, would be to diagnose the variations in spatial patterns of human resource development activities -- here the development of basic-skill in the formative phase and its shortfalls (i.e., the implicit non-development), and also to evaluate the trend of its change over the decade under consideration. Apart from the diagnosis and evaluation of spatial patterns, problem areas, and the trend of change, here our principle has been to take lessons from the relatively favourable formal regional structures, and try to examine whether the conditions that led to favourable structure could be created in or transferred to an area where relatively less favourable formal structure is existing. It should be emphasized at the outset that the data limitations are often so severe that we cannot always make proper examinations that are necessary to make comprehensive suggestions for improvements based on our principle. Yet the attempts made here for the diagnosis and evaluation of the spatially distributed problem areas and prospects related to human resource development activities would be useful for clarifying our visions on possible tasks ahead for a proper kind of planning attention.

Along this line of approach, we shall now make attempts for regional analysis on the basis of measures of non-development (complementarily-development) of basic-skills just evolved, tabulated and mapped. Our attempts in this respect will be first by individual phasewise measures of non-development, highlighting on the phase-specific problem and favourable areas, and then for a comprehensive picture of non-development for the entire formative phase of human resource development. Finally we shall go for an analysis of State-level values with all these measures to depict comparative pictures of non-development by these broad administrative regions of India.

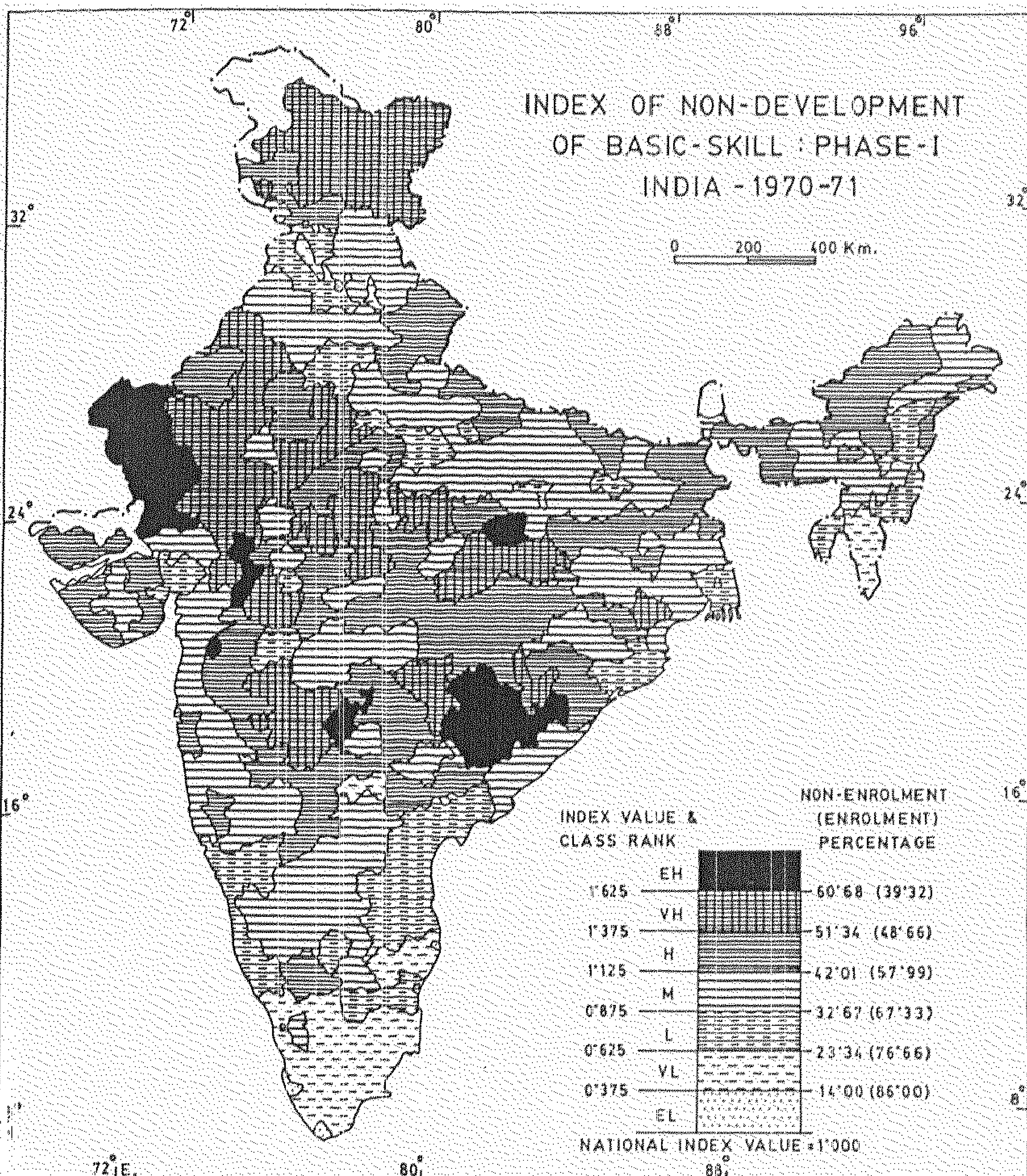
2.6.1 Non-development in the First Formative Phase of Human Resource Development : 1960-61, 1970-71

As stated already, the first formative sub-phase ought to receive with priority the maximum attention when we are concerned with the aspect of non-development of human resources (i.e., the absence of development towards equipping them with the minimum level of basic-skill). The spatial formal configurations as obtained on the aspect of non-development in this phase through the mapping of the index $L_{ij}(I)$ are available in Figures (2.1) and (2.2) respectively for 1960-61 and 1970-71 separately with, however, the same classification scheme for mapping. The background data on $L_{ij}(I)$ and the corresponding percentages of non-enrolled boys are available in the appendix Tables (A.1) and (A.2). On the basis of our spatial analysis



INDEX OF NON-DEVELOPMENT OF BASIC-SKILL : PHASE-I INDIA - 1960-61
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8° N.
72° E.
INDEX VALUE & CLASS RANK
NON-ENROLMENT (ENROLMENT) PERCENTAGE
EH
1'625
60'68 (39'32)
VH
1'375
51'34 (48'66)
H
1'125
42'01 (57'99)
M
0'875
32'67 (67'33)
L
0'625
23'34 (76'66)
VL
0'375
14'00 (86'00)
EL
NATIONAL INDEX VALUE =1'147

FIG. 21



INDEX OF NON-DEVELOPMENT
OF BASIC-SKILL : PHASE-I
INDIA - 1970-71
0 200 400 Km.
INDEX VALUE & CLASS RANK
NON-ENROLMENT (ENROLMENT) PERCENTAGE
EH
1·625
60·68 (39·32)
VH
1·375
51·34 (48·66)
H
1·125
42·01 (57·99)
M
0·875
32·67 (67·33)
L
0·625
23·34 (76·66)
VL
0·375
14·00 (86·00)
EL
NATIONAL INDEX VALUE = 1·000
72° E.
80°
88°
96°
32°
24°
16°
8°

FIG. 2·2

using statistical and cartographic tools, we record the following observations :

1) A first glance on Figure (2.1) relating to 1960-61, gives us an impression that the major areas of western, central and northern India suffer from severe non-development with practically very little scope of equipping boys, with basic-skill, in this very first phase. Thus broad regional groupings do emerge with severe non-development (EH and VH ranks of non-development) mostly in an extensive region covering practically whole of the dry Rajasthan State extending over most of the districts of hilly and forested Madhya Pradesh, then further down through hilly and forested parts of Orissa, and drier eastern part of Maharashtra. This extensive region practically covers almost whole of western and central India. In northern India, two broad regions of severe non-development occur — one in the mountainous Himalayan State in the extreme north and the other in the upper Gangetic belt, mainly in Uttar Pradesh, covering the mountainous and foot-hill areas of the Himalaya. Apart from these extensive and broad regions of severe non-development (EH and VH ranks in $L_{ij}(I)$), there are a few isolated districts with severe non-development (VH rank in $L_{ij}(I)$) here and there in the eastern India, mostly in Bihar and Assam.

On the other hand, the southern India, comprised of four southern most States of India, is devoid of such severe non-development problem, with the absence of EH and VH ranked districts therein. As such a broad regional grouping of districts showing significant development (with VL rank of non-development in $L_{ij}(I)$) occur in the southern most part of India covering major areas of Tamil Nadu and Kerala. There are a few isolated districts (very highly urbanised) which show either highly significant development (EL rank of non-development) in the first phase (actually, in Madras and Chandigarh) or significant development (VL rank of non-development) in the first phase (actually, in Bombay and Calcutta). However, from the core region of significant development, as we proceed northward through other parts of south India, the development ranks gradually deteriorate, with L-rank of non-development occuring in the northern parts of Tamil Nadu and Kerala, and with M-rank of non-development occuring in the dominant parts of Karnataka and Andhra Pradesh, and also with H-rank of non-development occuring in the northern part of south India covering most of the northern districts of Andhra Pradesh and the belt of north-eastern districts of Karnataka. This sort of transitional regions and areas with less and less severity of non-development (i.e. from EH and VH ranks to H and M ranks of non-development) has also occurred in between the extensive and broad regions of severe non-development and also in the major eastern India, lying to the east of those regions of severe non-development.

2) From a comparative spatial analysis, involving the Figure (2.1) relating to 1960-61, and the Figure (2.2) relating to 1970-71, we can infer that the spatial patterns with varying degrees of non-development relating to the first phase, have remained more or less similar, with however, a little reduced intensity of non-development generally -- signifying a general improvement over the decade. This finding can also be substantiated statistically, from the facts : (i) that the correlation between 1970-71 $L_{ij}(I)$'s and 1960-61 $L_{ij}(I)$'s is so strong as to give a positive correlation coefficient as very high as 0.929 and also (ii) that the all-India value of L(I) has reduced from 1.147 in 1960-61 to 1 (unity) in 1970-71. This general improvement is, however, not substantial, particularly in certain core areas of severe non-development. Thus, the extensive region of severe non-development in western and central India, and also the broad region in the mountainous Himalayan State in the extreme north of northern India, identified in 1960-61, have practically remained in tact in 1970-71. However, the other broad region of severe non-development, as identified in 1960-61 has shown considerable improvement in 1970-71 so that the VH-rank of non-development has no longer been exhibited in 1970-71 in any district in this region; it

has mostly shown lower ranks —— H-rank in its northern part and M-rank in its southern part.

On the other hand, the southern-most broad region of significant development has retained its 1960-61 rank in 1970-71 also (i.e., generally VL rank of non-development). The sign of improvement is however perceived from the fact that this broad region of significant development has extended its geographical coverage to its northern fringe. In eastern India some improvement is perceived, mostly in the State of Bihar changing its H-rank of non-development in 1960-61 to M-rank of non-development in 1970-71.

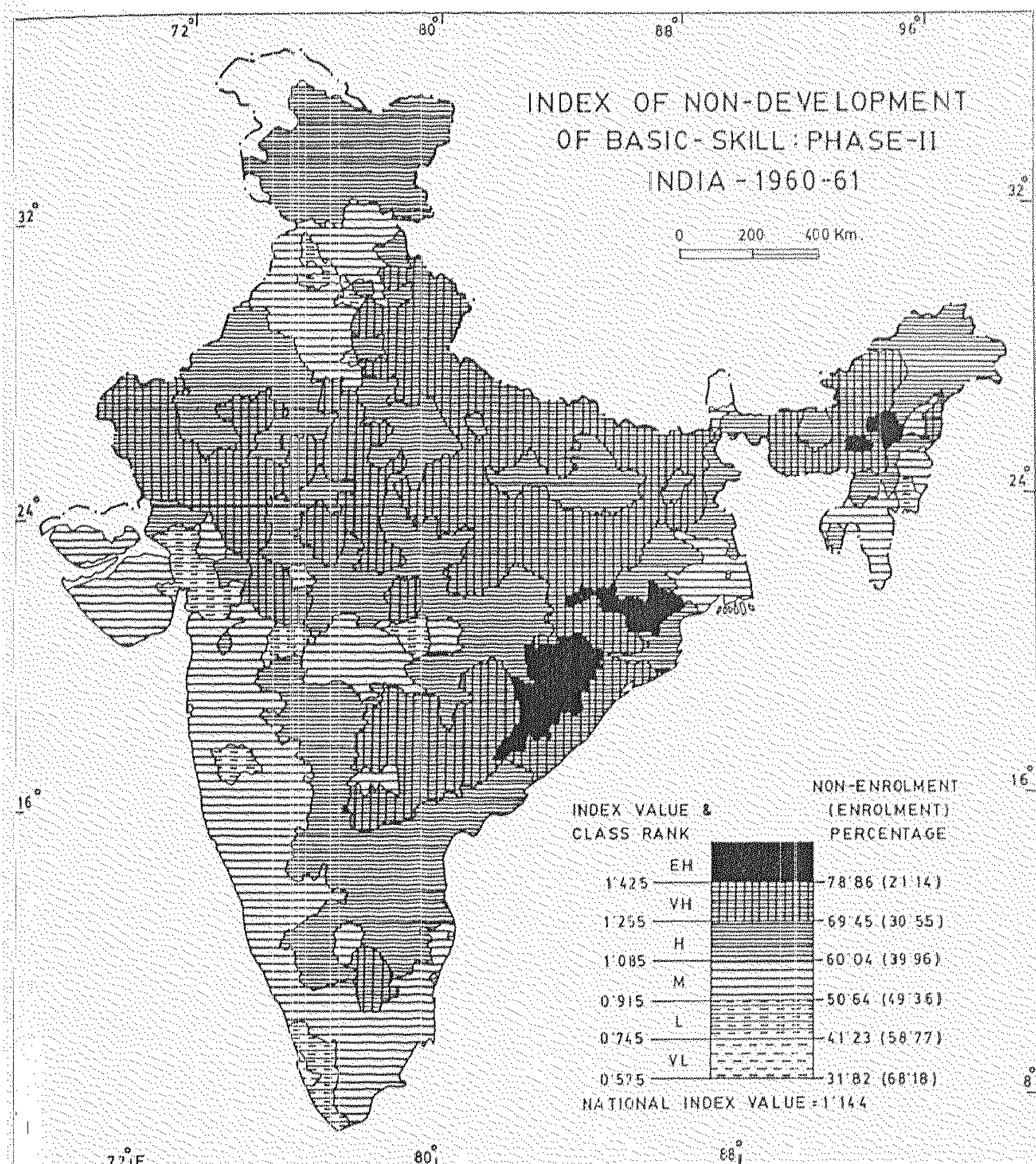
3) The general reduction in the intensity of non-development in the first phase over the decade gets aggregatively reflected in the comparative frequency distributions of districts by all class-ranks as shown in the last two columns of Table 2.9(a). The reduction in the severity of non-development could be well-understood from the fall in the frequencies of districts in 1970-71 compared with those in 1960-61 for the class-ranks : EH, VH and H only (27 to 11 in EH rank, 81 to 41 in VH rank and 120 to 87 in H rank). Complementarily, the improvement in the intensity of development, with lower ranks of non-development, could also be observed from the rise in the frequencies of districts in 1970-71 compared with those in 1960-61 for the class ranks (with reverse significance) EL, VL,

L and also M only. Over the decade, the modal class-rank has also shifted from H in 1960-61 to M in 1970-71.

2.6.2 Non-development in the Second Formative Phase of Human Resource Development : 1960-61, 1970-71

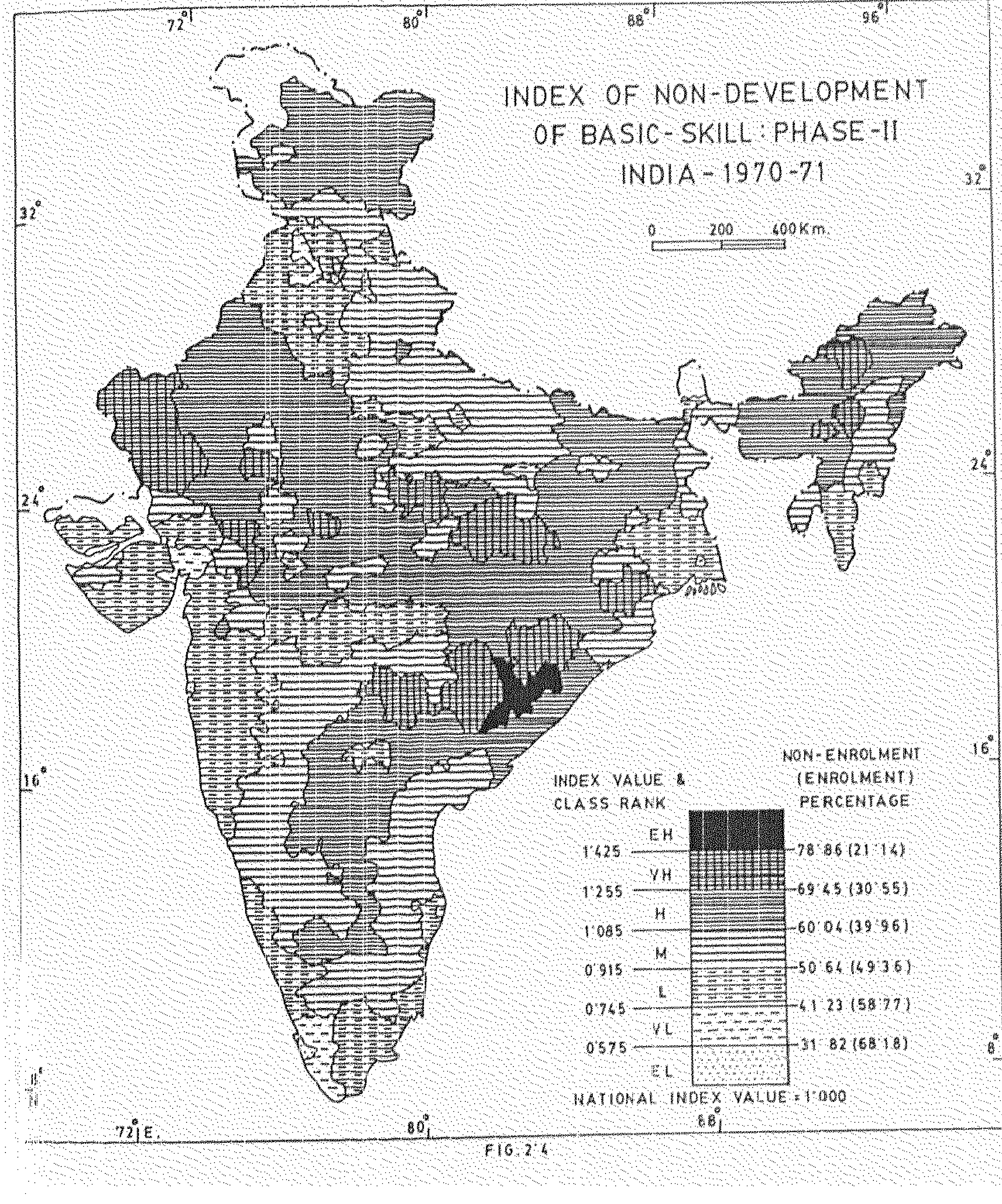
Although the second formative phase, with its position in the middle of the three progressively linked phases, is less important than the 1st phase, when our concern is on the aspect of non-development, it has an importance of its own in respect of its potentiality of creating illegal child labour (or premature labour) in the system of human resource utilisation of our economy. So this index of non-development in the middle phase also gains importance, when our attention is to be focussed on this undesirable aspect of illegal child labour formation. Here, the higher the class-ranks in the index $L_{ij}(II)$, the greater is the problem of child labour formation in the economy. The relevant formal spatial configurations are depicted in Figures (2.3) and (2.4), respectively for 1960-61 and 1970-71. The actual quantitative details by districts are available in the appendix Tables (A.1) and (A.2). From statistical and cartographic analyses of all these, we make the following observations :

1) The spatial pattern of severe non-development in the second formative phase (EH and VH ranks in $L_{ij}(II)$), as could be



INDEX OF NON-DEVELOPMENT OF BASIC-SKILL : PHASE-II INDIA - 1960-61
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72 E.
INDEX VALUE & CLASS RANK
NON-ENROLMENT (ENROLMENT) PERCENTAGE
EH
1·425 — 78·86 (21·14)
VH
1·255 — 69·45 (30·55)
H
1·085 — 60·04 (39·96)
M
0·915 — 50·64 (49·36)
L
0·745 — 41·23 (58·77)
VL
0·575 — 31·82 (68·18)
NATIONAL INDEX VALUE = 1·144

FIG. 2·3


INDEX OF NON-DEVELOPMENT
OF BASIC-SKILL : PHASE-II
INDIA - 1970-71
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72°E.
80°
88°
INDEX VALUE &
CLASS RANK
NON-ENROLMENT
(ENROLMENT)
PERCENTAGE
EH
1·425
78·86 (21·14)
VH
1·255
69·45 (30·55)
H
1·085
60·04 (39·96)
M
0·915
50·64 (49·36)
L
0·745
41·23 (58·77)
VL
0·575
31·82 (68·18)
EL
NATIONAL INDEX VALUE = 1·000
FIG. 2·4

depicted from Figure (2.3) relating to 1960-61 is somewhat comparable with that for phase I, showing, however, significant geographical extentions of such areas in the eastern India through Bihar and Assam and adjoining Union Territories and also to the northern fringe of southern India in the northern part of Andhra Pradesh. The core areas (with extensive EH ranked districts) of severe non-development is no longer that wide-spread as observed in phase I in the same time-point 1960-61, but have mostly concentrated in the State of Orissa. This means that improvements occurred with less drop-outs from phase I to phase II, particularly in the western side of the broad regions of severe non-development in phase I. The areas of severe non-development as occurred in phase I is no longer there in phase II in the northern most State of Jammu and Kashmir, in the northern part of Rajasthan and also in Maharashtra. The position of the two southern most States of India, (Tamil Nadu and Kerala) has, however, deteriorated in phase II as compared with phase I. The marked development in the phase I (with VL rank of non-development) shown in Tamil Nadu and Kerala is practically absent in phase II. Even an area (Salem and Dharampuri districts) of severe non-development (with VH rank) has appeared in Tamil Nadu in phase II. Thus one notices a general deterioration in phase II (as compared with phase I in 1960-61) in the eastern and southern India, while there is an improvement in the western side of the rest of India. Most areas of Uttar Pradesh and Madhya Pradesh showed similar kind of severity in non-development in both the phases in 1960-61.

2) Marked improvements can be observed in phase II, in the form of extensive reduction in the geographical coverage of the areas of severe non-development, when the Figure (2.3) relating to 1960-61, is compared with the Figure (2.4) relating to 1970-71. The areas of severe non-development (with EH and VH ranks) are now, in 1970-71, limited only in a few districts in the States of Orissa, Madhya Pradesh, Rajasthan and Andhra Pradesh mainly and also in some isolated districts in the Far-Eastern India. The two southern most States (Kerala and Tamil Nadu) have also improved its level of development in 1970-71 as compared with the level in 1960-61. Now, in 1970-71, the southern part of Kerala shows significant development (with VL rank of non-development). The improvements in the level of development is also quite considerable in the States of Punjab, Haryana, Gujarat, Maharashtra and West Bengal (with generally L-rank of non-development in 1970-71 in phase II). The improvements in the broad areas of severe non-development of 1960-61 has generally been accomplished through a reduction of class-rank -- from VH rank in 1960-61 to H rank in 1970-71. With all these improvements over the decade, in general, the spatial patterns with varying degrees of non-development relating to phase II, have remained somewhat similar,

with obviously a reduced intensity of non-development generally. This finding can also be substantiated statistically (not however with the same degree of determination as obtained in case of phase I analysis), from the facts :
(i) that the correlation between 1970-71 L_{ij}(II)'s and 1960-61 L_{ij}(II)'s is strong enough to have a correlation coefficient as high as 0.858 and also (ii) that the all-India value of L(II) has reduced from 1.144 in 1960-61 to 1 (unity) in 1970-71, signifying the general improvement over the decade.

3) The general reduction in the intensity of non-development or the general improvement in the level of development in phase II over the decade get aggregatively reflected in the comparative frequency distributions of districts by all class-ranks as shown in the last two columns of table 2.9(b). The marked reduction in the geographical coverage for the severity of non-development could be appreciated by noticing the fall in the frequencies of districts in 1970-71 compared with those in 1960-61 for the class-ranks EH, VH and H only [8 to only 1 in EH rank, 112 to only 24 in VH rank and 114 to 109 in H rank]. On the other hand, the marked improvement in the geographical coverage for the level of development could be visualised from the rise in the frequencies of districts in 1970-71 compared with those in 1960-61 for the lower order class-ranks of non-development (in reverse order of significance), namely EL, VL, L and M (0 to 3 in EL rank, only 4 to 13 in VL rank, only

24 to 85 in L rank and 87 to 114 in M rank). As in the first phase, here in the second phase also, the modal class rank has shifted from H in 1960-61 to M in 1970-71. But there is a marked difference in these two modal classes in respect of frequency distributions between 1970-71 and 1960-61. There has been a sharp fall in the frequency of H-class and also a sharp rise in the frequency of M-class, in 1970-71 as compared with 1960-61 for the first phase. But the sharpnesses in the fall and the rise of frequencies (respectively of H-and M-classes) for the second phase are much blunted with only a little change. It is also to be noted that 1960-61 all-India value falls in class-H and the 1970-71 all-India value in class-M. These two modal classes could, in fact, be identified as the transitional classes from the decreasing severity of non-development to the increasing level of development.

2.6.3 Non-development in the Third Formative Phase of Human Resource Development : 1960-61, 1970-71

While the first formative phase is most important, the 3rd formative phase is least important, when our concern is on the aspect of non-development. Complementarily, when our concern is on the development of basic-skill, it is the third phase which must be considered as most important, since the accomplishment of the enrolled boys therein has been through the entire formative phase of human resource development. So the lower ranks of non-development (in reverse sequence) gain importance for identification of the favourable areas of basic-skill development in the final phase III. Here, the spatial formal configurations obtained through the mapping of the index L_{ij}(III) are available in Figures (2.5) and (2.6), respectively for 1960-61 and 1970-71 separately with the same classification scheme for mapping. From the data (ref. to appendix Tables (A.1) and (A.2)) and the map analysis through statistical and cartographic tools, we make the following observations :

1) The main feature that draws our attention from an examination of Figure (2.5) is the preponderance of the severity of non-development (with EH and VH ranks) in the final phase III in 1960-61. Such areas of severe non-development are progressively increasing from the first phase to the second phase (noted already in subsection (2.6.2)) and then from the second phase to the third phase. The most striking feature is that the geographical extension of areas of severe non-development from the second phase to the third phase in 1960-61 has occured more pronouncedly in the eastern and also in the southern India. The spatial pattern of severe non-development in the third phase in 1960-61 can be depicted as follows. The areas of severe non-development has its node, as it were, in Orissa and Bihar, where from wide-spread extensions of such areas took place in several directions as described below : (i) from the core areas of severe

non-development in Orissa, an extension towards south-west first and then to south mostly through the districts of Andhra Pradesh (except the coastal districts in and around the Krishna-Godavari delta), (ii) from the nodal areas of severe non-development in Bihar, an extension towards east and far north-east through the northern districts of West Bengal, Assam, Meghalaya and Arunachal Pradesh, (iii) again, from the nodal areas of severe non-development in Bihar, a second extension towards north-west through most of the districts in Uttar Pradesh and finally to the northern most State of Jammu and Kashmir via the State of Himachal Pradesh in between the two States, with a little less severity of non-development, and finally, (iv) from the same Bihar node, a third extension towards west through northern Madhya Pradesh and southern Rajasthan (interspersed, however, with certain districts of less severe non-development in between areas of severe non-development in this extension). Another very important feature is that, practically we have no districts with significant development (with EL and VL ranks of non-development) in the third phase in 1960-61 (with the exceptions of highly urbanised districts of Bombay, Madras and Chandigarh).

2) Marked improvements can also be observed in the third phase, likewise what was observed in the second phase in the form of extensive reduction in the geographical coverage of the areas of severe non-development, when the Figure (2.5)

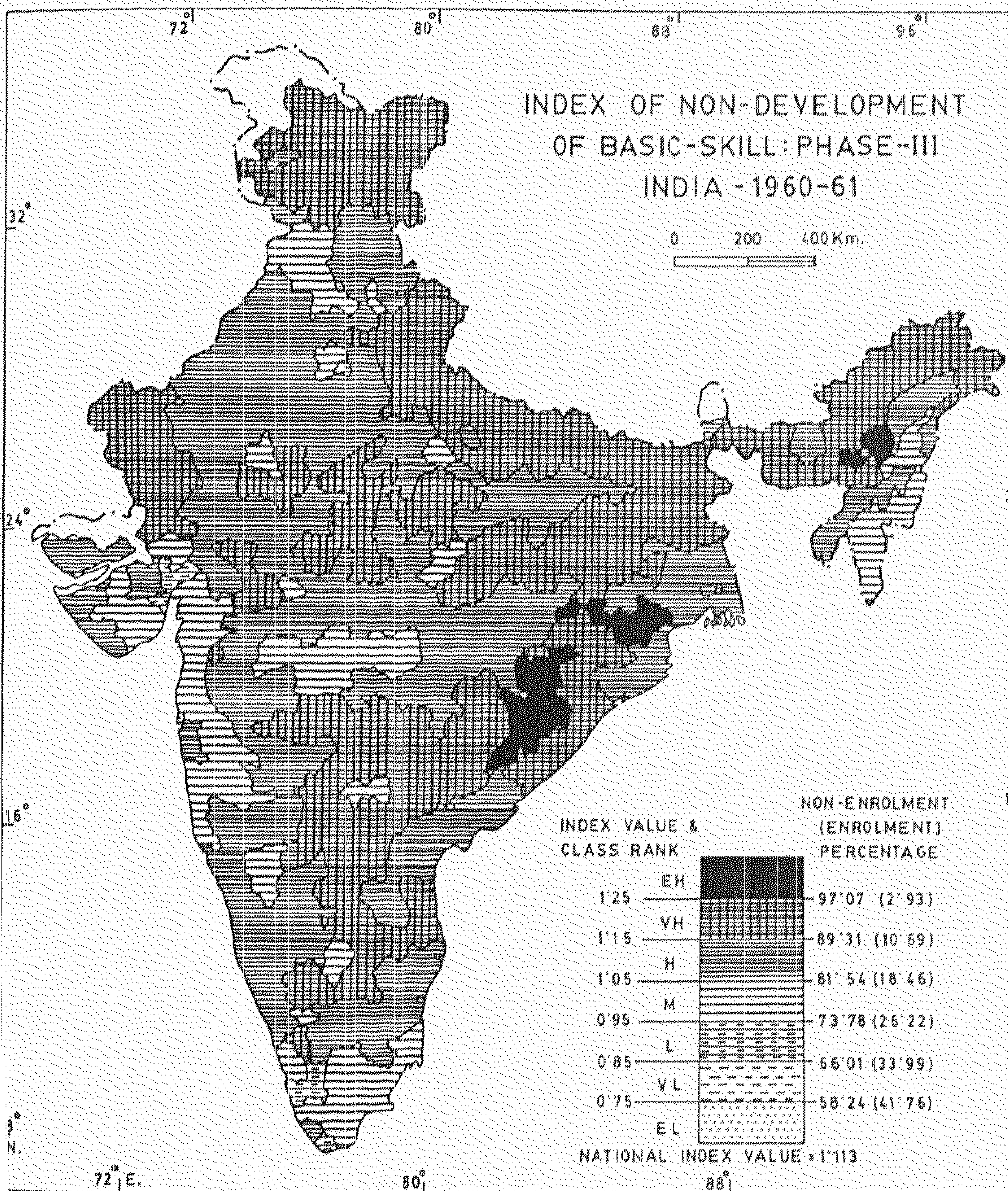

INDEX OF NON-DEVELOPMENT
OF BASIC-SKILL: PHASE-III
INDIA - 1960-61
0 200 400 Km.
INDEX VALUE &
CLASS RANK
NON-ENROLMENT
(ENROLMENT)
PERCENTAGE
EH
1'25
97'07 (2'93)
VH
1'15
89'31 (10'69)
H
1'05
81'54 (18'46)
M
0'95
73'78 (26'22)
L
0'85
66'01 (33'99)
VL
0'75
58'24 (41'76)
EL
NATIONAL INDEX VALUE = 1'113
72°
80°
88°
96°
32°
24°
16°
8° N.
72° E.

FIG. 2'5

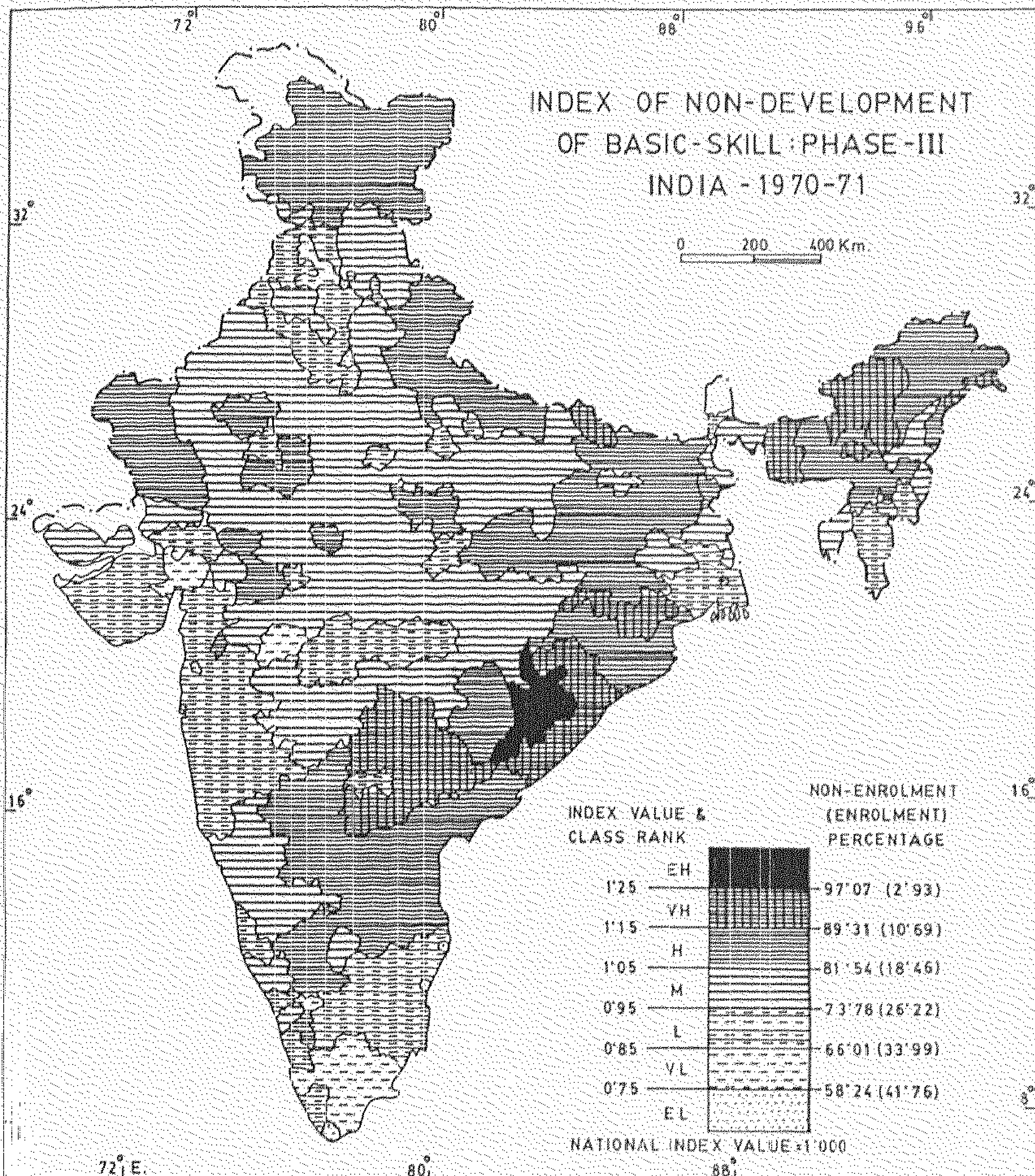

INDEX OF NON-DEVELOPMENT
OF BASIC-SKILL : PHASE-III
INDIA - 1970-71
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72° E.
INDEX VALUE & CLASS RANK
NON-ENROLMENT (ENROLMENT) PERCENTAGE
EH
1'25
97'07 (2'93)
VH
1'15
89'31 (10'69)
H
1'05
81'54 (18'46)
M
0'95
73'78 (26'22)
L
0'85
66'01 (33'99)
VL
0'75
58'24 (41'76)
EL
NATIONAL INDEX VALUE = 1'000

FIG. 2'6

relating to 1960-61, is compared with Figure (2.6) relating to 1970-71. The areas of severe non-development (with EH and VH ranks) are now, in 1970-71, limited mainly in two areas, the major one in the Orissa core with extensions towards south-west in the northern part of Andhra Pradesh, and the other in the far north-eastern region comprised of parts of Assam, Meghalaya and Arunachal Pradesh. The two southern most States (Kerala and Tamil Nadu) have also improved its level of development in 1970-71 as compared with the level in 1960-61 — with considerable areas of significant development (with EL and VL ranks of non-development) within them, and also with a little less development (L rank of non-development) in other areas of Tamil Nadu and most areas of Kerala. There are also some districts, showing significant development, in the States of Punjab, Gujarat and Maharashtra, Around these cores of significantly developed areas, we have broad areas, generally with a little less development — one in the northern region comprised of the States of Punjab and Haryana including the Union Territories of Chandigarh and Delhi, and the other in the western part in the States of Gujarat and Maharashtra. The improvements in the broad areas of severe non-development of 1960-61 has generally been accomplished through a reduction of class rank -- from VH rank in 1960-61 to H rank and at times even to M rank in 1970-71. With all these improvements over the decade, in general, the spatial patterns relating to the third phase, have remained broadly similar, comparable to that of second phase (but more marked in the third phase), with obviously a reduced intensity of non-development generally. This finding can be substantiated very well with the following statistical observations : (i) the correlation between 1970-71 L_{ij}(III)'s and 1960-61 L_{ij}(III)'s is quite strong to have a correlation coefficient as very high as 0.921, and (ii) the all-India value of L (III) has reduced from 1.113 in 1960-61 to 1.0 (unity) in 1970-71, signifying the general improvement over the decade.

3) The general reduction in the intensity of non-development or the general improvement in the level of development in the third phase over the decade by geographical coverages get aggregatively reflected in the comparative frequency distributions of districts by all class-ranks as shown in the last two columns of Table 2.9(c). The comparative changes in the frequency distributions between 1960-61 and 1970-71 in the third phase, have some kind of mixed patterns of the first and the second phases, as highlighted below.

The similarity in the comparative change in frequency distributions is noticed between the second and the third phases for higher and lower classes on either side of the two transitional (or modal) classes, i.e. H-class and M-class, while the said similarity exists between the first and the third phases for the two transitional classes (ref. to all three tables 2.9(a), 2.9(b) and 2.9(c)). However, for the third phase as such, the marked reduction in the severity of non-development could be appreciated by the fact of remarkable fall in the frequencies of districts in 1970-71 compared with those in 1960-61 for the class-ranks EH, VH and H only (7 to only 2 in EH rank, 127 to only 24 in VH rank and 149 to only 97 in H rank). On the other hand, the marked improvement in the level of development could be visualised from the rise in the frequencies of districts in 1970-71 compared with those in 1960-61 for the lower order class-ranks of non-development (in reverse order of significance), namely EL, VL, L and M (only 1 to 7 in EL rank, only 2 to 15 in VL rank, only 8 to 71 in L rank and only 55 to 133 in M-rank). Clearly, the sharpness of the fall of frequencies in H rank (modal class for 1960-61) and that of the rise of frequencies in M-rank (modal class for 1970-71) for the third phase are very much comparable to those in the first phase, but not to those in the second phase.

2.6.4 Composite Non-development of Basic-Skill in the Total Formative Phase for Human Resource Development : 1960-61, 1970-71

The spatial patterns of non-development having been diagnosed and the trend of their changes over the decade, evaluated by individual phases of basic-skill formation, we now make attempts to get a comprehensive picture on the spatial patterns of non-development and the trend of change for the total formative phase of basic-skill formation with the help of the composite index L_{ij} as evolved earlier in the subsection (2.4.4). The formal spatial configurations, as obtained through the mapping of this composite index L_{ij} by a statistically comparable scheme of classification with those of the three phasewise indices, have been presented separately for 1960-61 and 1970-71, respectively in Figures (2.7) and (2.8). The detail values of the composite index L_{ij} with the corresponding classified ranks by districts are available in Table (2.10). On the basis of spatial analysis done with the help of these figures and the detail data on L_{ij} through cartographic and statistical tools, and also making use of the results of preceding analyses for the three phases, we make the following synthetic observations :

1) As the total formative phase is composed of the three linked phases of basic-skill formation, strong similarities exist between the composite spatial pattern and the phasewise spatial patterns in some way or other. As regards the composite spatial pattern for 1960-61, which could be visualised from the spatial analysis of Figure (2.7), we observe that the composite spatial pattern of severe non-development in the total formative phase (EH and VH ranks in L_{ij}) has been largely the same with that of the first phase (in 1960-61) particularly in northern, western and central India, annexed with core areas

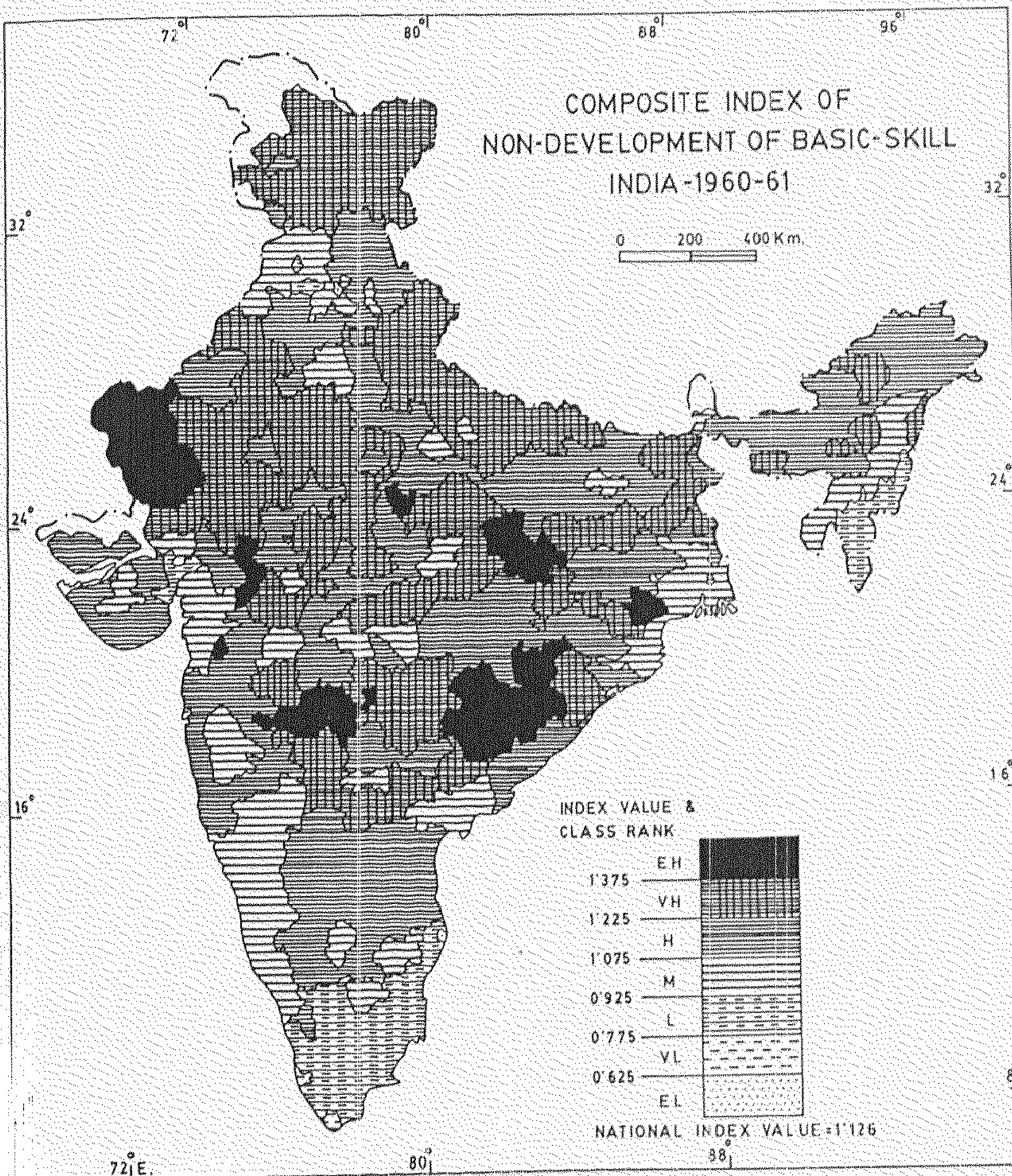

COMPOSITE INDEX OF
NON-DEVELOPMENT OF BASIC-SKILL
INDIA-1960-61
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72°E.
INDEX VALUE &
CLASS RANK
E.H
1·375
V.H
1·225
H
1·075
M
0·925
L
0·775
V.L
0·625
E.L
NATIONAL INDEX VALUE=1·126

FIG. 2·7

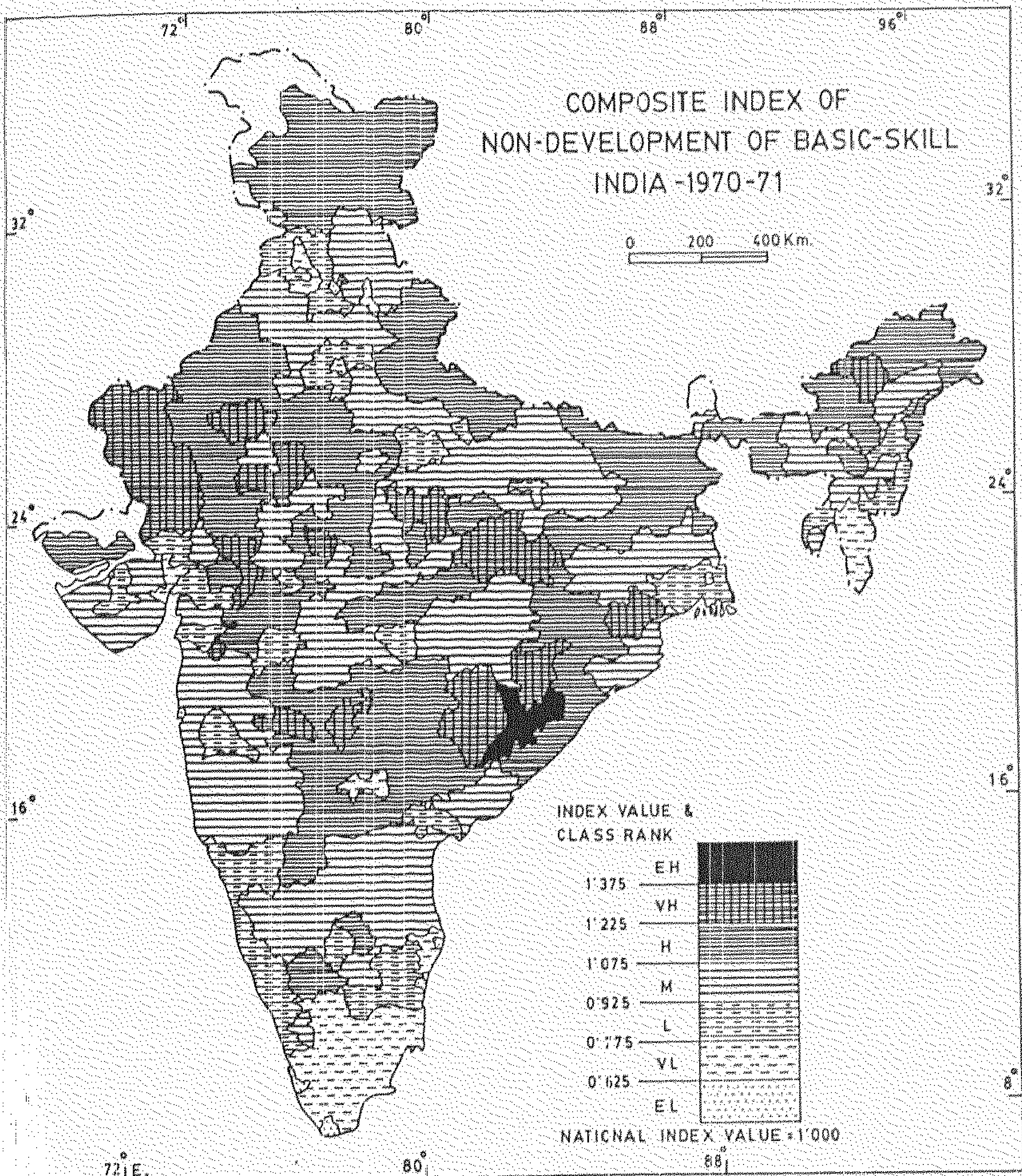

COMPOSITE INDEX OF
NON-DEVELOPMENT OF BASIC-SKILL
INDIA -1970-71
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72 E.
INDEX VALUE & CLASS RANK
EH
1.375
VH
1.225
H
1.075
M
0.925
L
0.775
VL
0.625
EL
NATIONAL INDEX VALUE = 1.000

FIG. 2.8

of non-development in Orissa in eastern India, and also with that of the second phase (in 1960-61) for the geographical extensions in the northern part of eastern India through southern and eastern Bihar and parts of West Bengal and far eastern States and Union Territories, and also in the northern part of south India through northern Andhra Pradesh, North-eastern tip of Karnataka including the adjoining areas beyond to its north, in Maharashtra and Madhya Pradesh. We have recorded earlier (ref. to Figures (2.1), (2.3) and (2.5)) that largely the States of Tamil Nadu (the State with most wide-spread urbanisation in India) and Kerala (the State largely inhabited by people with Christian religious culture particularly in its major southern part) have shown a significant level of development (with VL rank of non-development) in the first phase, followed by sharp deterioration in the second phase (with L and M ranks of non-development, generally) and also further deterioration in their northern parts in the third phase (with H rank of non-development). Naturally, the composite pattern for the total formative phase cannot be one of significant development in these two States in 1960-61. In fact, the composite picture in these States is one of some development, with L rank of non-development in most areas of these two States, barring a few districts in the northern fringe of these States where higher ranks of non-development occur. In the whole of India, the EL rank of non-development (signifying relatively high and significant development) has occurred only in the highly urbanised districts of Madras and Chandigarh, and the VL rank of non-development (signifying relatively significant development) has occurred in only four districts: in highly urbanised districts of Bombay and Calcutta, in the advanced port oriented district of Alleppey in Kerala, and also in the extreme southern district of Kanya Kumari where pilgrimage and tourism activities have flourished by virtue of its special geographical location.

2) From a comparative spatial analysis involving Figure (2.7) relating to 1960-61, and the Figure (2.8) relating to 1970-71, we can again infer for the total formative phase, likewise the three individual phases, that the composite spatial patterns with varying degrees of non-development have remained more or less similar, but with reduced intensity of non-development generally —— signifying a general improvement over the decade. Naturally the severity of non-development as perceived in 1960-61 is now considerably reduced in 1970-71 — generally the EH and VH ranks of non-development in 1960-61 reduced to VH and H ranks in 1970-71, and, on the other hand, the level of development as perceived in 1960-61 has now considerably improved in 1970-71, particularly in the two southern States of India —— generally the L rank of non-development in 1960-61 has improved to VL rank of non-development in 1970-71.

The similarity of the composite spatial patterns with reductions in the intensity of non-development over the decade can be well-substantiated statistically as follows : (i) the spatial correlation between 1970-71 L_{ij}'s and 1960-61 L_{ij}'s is so strong as to give a positive correlation coefficient as very high as 0.936, and, (ii) that the all-India value of the composite index for the total formative phase has reduced from a values of 1.126 in 1960-61 to 1.0 (unity) in 1970-71. The reduction in the intensity of non-development and also the improvement in the level of development over the decade, have become possible in general through reductions of respective class ranks by one step from 1960-61 to 1970-71. The composite spatial pattern, culminating in 1970-71, shows very limited areas of severe non-development, concentrating mainly in Orissa, Madhya Pradesh and Rajasthan. Large areas in the northern, western, central and eastern India have, however, considerable intensity of non-development with H rank. The patches of areas with lower ranks (generally M rank) occur in them to limited extent —— mainly in Punjab, Haryana and parts of Uttar Pradesh in northern India, in Gujarat and Maharashtra in western India, in the southern part of eastern India, specially in the deltaic West Bengal and far-eastern Union Territories, bordering Burma and also here and there in Madhya Pradesh. The H ranked districts are very limited in number in southern India —— occurring only in its northern fringe, mainly in northern Andhra Pradesh and the north-eastern districts of Karnataka. The level of development is thus relatively highest in southern India with large areas of significant (VL rank) and considerable (L rank) development (in relative sense), particularly in the States of Tamil Nadu and Kerala and also coastal Karnataka. Other small patches of developed areas (with VL or L ranks) occur (i) in Punjab, (ii) in areas around the capital city of Delhi, (iii) in areas around Ahmedabad in Gujarat, (iv) in areas around Calcutta, (v) in Mizoram (largely inhabited by Christian tribes) and its adjoining areas.

3) The general reduction in the intensity of non-development in the total formative phase over the decade can now be summarised by comparison of the frequency distributions of districts by all class-ranks as shown in the last two columns of Table 2.9(d). The comparative change in the two distributions for the total formative phase is somewhat more similar to those of the second phase and the third phase than that of the first phase. The marked reduction in the geographical coverage for the severity of non-development could be well appreciated by noticing the fall in the frequencies of districts in 1970-71 compared with those in 1960-61 for the class-ranks EH, VH and H only (17 to only 1 in EH rank, 106 to only 28 in VH rank and 129 to 113 in H rank). This pattern of fall in frequencies for the total formative phase is largely

comparable to that for the third phase (ref. to Table 2.9(b)). On the other hand, the marked improvement in the geographical coverage for the level of development could be appreciated from the rise in frequencies of districts in 1970-71 compared with those in 1960-61 for the lower order class-ranks of non-development (in reverse order of significance), namely, EL, VL, L and M (only 2 to 6 in EL rank, only 4 to 21 in VL rank, only 23 to 53 in L rank, and only 68 to 127 in M rank). This pattern of rise in frequencies for the total formative phase is largely comparable to that for the third phase (ref. to Table 2.9(c)).

4) The composite spatial pattern for the total formative phase ought to reflect the spatial patterns for the three constituent phases, and the way we have constructed our composite index, with the recognition of the decreasing importance of the constituent phases, this requirement has been largely fulfilled. The statistical correlation as already shown in equation systems (2.62) and (2.61) respectively for 1960-61 and 1970-71 corroborate this fact. Thus, the similarities of the comprehensive spatial pattern with different spatial patterns of the first, the second and the third phases get statistically established from the facts that (i) the correlation between L_{ij} and $L_{ij}(I)$ has been substantially strong to have values of correlation coefficients as very high as 0.970 in 1960-61 and 0.944 in 1970-71, (ii) the correlation between

L_{ij} and $L_{ij}(II)$ and also between L_{ij} and $L_{ij}(III)$ are also strong enough —— the values of the correlation coefficients for the relation with the second phase are 0.857 in 1960-61 and 0.888 in 1970-71, and those with the third phase are 0.846 in 1960-61 and 0.832 in 1970-71. It should be noted that the variance (or squared standard deviation) for L_{ij} has been practically same for both 1960-61 and 1970-71 —— in fact, the value of standard deviation is 0.155 for both the time-points. As such, the rates of change of $L_{ij}(\varphi)$ relative to L_{ij}, as brought out in the regression equations presented in the systems (2.62) and (2.61), are comparable for the two time-points. We shall term these rates as <u>the rates of spatial change in $L_{ij}(\varphi)$</u> (relative to L_{ij}). It could be observed that the rate of spatial change in $L_{ij}(I)$ has been 1.91 in 1960-61 which is reduced to a value of 1.65 in 1970-71. This means that the spatial changes in the pattern of $L_{ij}(I)$ have been comparatively much higher than the corresponding composite spatial changes in the pattern of L_{ij}. It also means that the spatial changes in the pattern of $L_{ij}(I)$ have reduced slightly in 1970-71 compared with those of 1960-61, signifying a slight reduction in regional disparities in respect of the non-development of basic-skill formation in the first phase over the decade. Again, it could be observed that the rate of spatial change in $L_{ij}(II)$ has remained practically the same (actually 0.942 in 1960-61 and 0.948 in 1970-71) over the decade. This means that the spatial changes in the pattern of L_{ij}(II) are practically of the same order as the composite spatial changes, both in 1960-61 and 1970-71. Also, it could be inferred that the regional disparity in respect of the non-development of basic-skill formation in the second phase has practically remained same over the decade (although the direction of skewness in the respective statistical distributions has changed from left handed skewness in 1960-61 to right handed skewness in 1970-71). Again, it could be observed that the rate of spatial change in L_{ij}(III) has been only 0.457 in 1960-61 and only 0.588 in 1970-71. This means that the spatial changes in the pattern of L_{ij}(III) are comparatively much lower than the composite spatial changes, both in 1960-61 and 1970-71. There is also an indication that the spatial changes in the pattern of L_{ij}(III) have increased considerably in 1970-71 compared with those of 1960-61, signifying a slight decadal increase in regional disparities in respect of the non-development of basic-skill formation in the third phase.

These features of (i) the slight reduction in spatial disparity (0.864 = 1.65/1.91) over the decade in the first phase, (ii) the retention of a similar nature of spatial disparity (1.006 = 0.948/0.942) over the decade in the second phase, and (iii) the considerable increase in spatial disparity (1.287 = 0.588/0.457) over the decade in the third phase, are broadly corroborated by the facts that the standard deviation has (i) slightly decreased over the decade for index $L_{ij}(I)$, (ii) remained almost the same over the decade for the index $L_{ij}(II)$, and (iii) considerably increased over the decade for the index $L_{ij}(III)$. These features of reversing the direction of change from the first phase to the third phase can be accounted by the following facts. There has been some sort of attention in the decade for improvement of facilities in the first phase (like, the opening of Primary Schools, particularly in the places where the Primary School-going boys did not have such facilities available within reasonable distance of their reach) over wide geographical areas (especially in the western side of India, and also in some remote areas in difficult terrains), as a result of which a slight reduction in spatial disparity in the non-development of basic-skill formation in this phase has taken place over the decade. But, in the second phase such extension of facilities (like, the opening of Middle Schools) could be possible only or largely in those areas where, there existed already some sort of formal base in the first phase, and not in new areas of extension of such facilities provided in the first phase. From our preceding analysis, it seems that such extension of facilities in the second phase took place in most of those possible areas in India, in general, more or less uniformly. As a result, the reduction in the spatial disparity of non-development of basic-skill formation in the second phase for areas of severe non-development got counter-balanced by a corresponding increase in such spatial disparity in areas of significant development, resulting into a similar kind of spatial disparity for India as a whole over the decade (corroborated by what already has been noted from the comparative change in spatial distribution, namely, that the decadal change in the statistical distribution is one of from left-sided skewness to right-sided skewness with practically little change in the modal or, transitional classes ranked H and M for the second phase index). In the third phase also, such extension of facilities (like, the opening of High and Higher Secondary Schools) could be possible only or largely in those areas where there existed already some sort of formal base in the second phase. But, from our preceeding analysis it seems that such facilities in the third phase in those possible areas of India did not take place uniformly; the attention for extension of such facilities seems to have been tilted more towards certain selected developed areas than non-developed areas, resulting into an increase in spatial disparity in non-development of basic-skill formation in the third phase over the decade.

5) We have already suggested that the regression equations given in equation systems (2.62) and (2.61) could be used to identify certain local peculiarities in terms of non-conformity of $L_{ij}(\varphi)$ values with the corresponding composite index values.

Combining all phases together we have identified some 28 (twenty eight) districts in India which show peculiarities by not conforming with the corresponding values of L_{ij}. These districts are recorded below with the summarised statements of their peculiarities.

i) <u>Lohit in Arunachal Pradesh</u>

Attention for improvement over the decade is in sight for the third phase where the situation was significantly bad in 1960-61. The first phase showed better position as compared with the general pattern in both 1960-61 and 1970-71, but significantly at the former time-point.

ii) <u>Banaskantha and The Dangs in Gujarat</u>

First phase remains very much neglected over the decade while considerable improvement is in sight for second and third phases.

iii) (a) <u>Bombay in Maharashtra</u>

This metropolitan district has remained developed in 1960-61. However, the first phase was not that developed in 1960-61, but improved over the decade. On the other hand, in the third phase it was quite developed in 1960-61, but deteriorated slightly over the decade.

iii) (b) Kolaba, Nasik, Dhulia, Ahmadnagar, Sholapur, Kolhapur, Aurangabad, Bhandara and Yeotmal in Maharashtra

In all these districts of Maharashtra, both in 1960-61 and 1970-71, second phase showed better level of development as compared with the general pattern, but significantly at the former time point.

iii) (c) Parbhani, Bhir, Osmanabad, Chandrapur and Nanded in Maharashtra

In these districts of Maharashtra, second phase showed significantly better level of development as compared with the general pattern in both 1960-61 and 1970-71. However, the district of Nanded showed significant deterioration over the decade in the first phase.

iv) Murshidabad and Malda in West Bengal

In the second phase these districts were at par with the general pattern in 1960-61, but showed significant improvement over the decade to rank significantly above the general pattern in 1970-71.

v) Chandigarh — the capital city district of Punjab and Haryana

Its pattern is same as that of the metropolitan district of Bombay as recorded earlier.

vi) Palghat in Kerala

In the third phase, the situation was significantly worse than the general pattern in 1960-61, but it has been considerably remedied with improvements over the decade, making it comparable with the general pattern in 1970-71.

vii) (a) North Arcot, South Arcot, Tiruchirapalli and Coimbatore in Tamil Nadu

The deterioration in the level of development in the second phase over the decade could be noticed, with the result that situation worsened significantly as compared with the general pattern in 1970-71.

vii) (b) Salem and Dharmapuri in Tamil Nadu

The deterioration in the level of development in the second phase over the decade could also be noticed in these two districts likewise the ones mentioned above; but, here in the third phase significant improvement in the level of development over the decade is in sight. The first phase was also quite developed here, and significantly so in 1960-61 unlike the other two phases in the same year.

6) In Table (2.11), we have recorded the actual values of the indices of non-development of basic-skill formation in 1960-61 and their percentage reduction in 1970-71 relative to 1960-61 by States of India. For the composite index, we have also recorded the 1970-71 values along with the 1960-61 values.

Table 2.11 : Values of the Indices of Non-development of Basic-Skill Formation in 1960-61 and Their Percentage Reduction in 1970-71 Relative to 1960-61 by States of India (with Stratified ordering)

State or State-group	Total Phase Composite Index : L_{oj}			First Phase Index : $L_{oj}(I)$		Second Phase Index : $L_{oj}(II)$		Third Phase Index : $L_{oj}(III)$	
	1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Orissa	1.238(VH)	1.149 (H)	7.19 (L)	1.274 (H)	10.44 (M)	1.413(VH)	14.79 (M)	1.216(VH)	5.10 (L)
2. Rajasthan	1.281(VH)	1.183 (H)	7.65 (L)	1.540(VH)	6.56 (L)	1.261(VH)	5.23 (L)	1.125 (H)	8.53 (M)
3. Jammu and Kashmir	1.245(VH)	1.148 (H)	7.79 (L)	1.399(VH)	8.22 (L)	1.184 (H)	9.29 (L)	1.153(VH)	7.54 (L)
4. Madhya Pradesh	1.241(VH)	1.114 (H)	10.23 (M)	1.420(VH)	9.51 (L)	1.251 (H)	7.11 (L)	1.134 (H)	10.75 (M)
5. Andhra Pradesh	1.132 (H)	1.083 (H)	4.33 (L)	1.071 (M)	8.78 (L)	1.210 (H)	4.55 (L)	1.169(VH)	1.97(VL)
6. Bihar	1.201 (H)	1.093 (H)	9.00 (M)	1.249 (H)	13.85 (M)	1.265(VH)	9.01 (L)	1.172(VH)	5.89 (L)
7. Uttar Pradesh	1.213 (H)	0.999 (M)	17.64 (H)	1.324 (H)	26.13(VH)	1.274(VH)	24.18(VH)	1.146 (H)	11.69 (M)
ALL-INDIA	1.126 (H)	1.000 (M)	11.19 (M)	1.147 (H)	12.82 (M)	1.144 (H)	12.59 (M)	1.113 (H)	10.15 (M)
8. Northern Far-East India (Arunachal Pradesh + Meghalaya + Assam)	1.115 (H)	1.071 (M)	3.95 (L)	1.041 (M)	3.75 (L)	1.256(VH)	7.16 (L)	1.160(VH)	4.14 (L)
9. Karnataka	1.090 (H)	1.015 (M)	6.88 (L)	1.043 (M)	7.09 (L)	1.085 (H)	3.41 (L)	1.118 (H)	6.71 (L)
10. Maharashtra	1.126 (H)	0.974 (M)	13.50 (M)	1.275 (H)	14.12 (M)	0.965 (M)	10.67 (M)	1.037 (M)	13.11 (H)
11. Himachal Pradesh	1.088 (H)	0.940 (M)	13.60 (M)	1.119 (M)	17.96 (H)	1.031 (M)	11.93 (M)	1.069 (M)	10.85 (M)
12. Southern Far-East India (Nagaland + Manipur + Tripura + Mizoram)	0.962 (M)	0.894 (L)	7.07 (L)	0.820 (L)	8.78 (L)	1.040 (M)	7.98 (L)	1.046 (H)	6.12 (L)
13. Gujarat (including Dadra and Nagar Haveli)	1.048 (M)	0.952 (M)	9.16 (M)	1.089 (M)	3.21 (L)	0.965 (M)	12.28 (M)	1.023 (M)	13.00 (H)
14. West Bengal	1.055 (M)	0.943 (M)	10.62 (M)	0.979 (M)	2.76(VL)	1.052 (M)	21.48 (H)	1.101 (H)	14.89 (H)
15. Goa	1.016 (M)	0.898 (L)	11.61 (M)	0.875 (M)	19.20 (H)	0.916 (M)	5.57 (L)	1.100 (H)	7.90 (M)
16. Punjab and Haryana (including Chandigarh)	1.035 (M)	0.867 (L)	16.23 (H)	1.036 (M)	20.27 (H)	0.958 (M)	14.20 (M)	1.035 (M)	13.82 (H)
17. Delhi	0.935 (M)	0.714(VL)	23.64(VH)	0.911 (M)	21.95 (H)	0.874 (L)	11.44 (M)	0.949 (L)	24.55(EH)
18. Kerala	0.896 (L)	0.785 (L)	12.39 (M)	0.662 (L)	17.67 (H)	0.878 (L)	12.41 (M)	1.037 (M)	10.41 (M)
19. Tamil Nadu (including Pondicherry)	0.879 (L)	0.746(VL)	15.13 (H)	0.584(VL)	5.48 (L)	1.004 (M)	9.56 (M)	1.055 (H)	18.29(VH)

The all-India estimates are also given in a central row of the table, and rows above and below are respectively for those States which have values higher than all-India value of 1960-61 composite index and otherwisé. Maintaining 1960-61 composite index class-rank, occuring in order as (i) VH rank, (ii) H rank above all-India value, (iii) H rank at or below all-India value, (iv) M rank and (v) L rank, the States (or State-groups) are arranged in ascending order of magnitude of the percentage reduction in composite index value in 1970-71 relative to 1960-61. The values of percentage reduction are also classified into ranks like VL, L, M, H, VH, EH, the boundary values between two consecutive classes, ranked differently, being those obtained by multiplying the respective all-India values of percentage reduction in composite or other indices with the following quantities in order : 0.25, 0.75, 1.25, 1.75 and 2.25. The class-ranks for any index and the corresponding percentage reduction over the decade are also presented in this table. There are altogether 19 States or State-groups on which the said data are recorded. Noticing the similarities in our detailed spatial patterns as described earlier, we have ascertained the following State-groups (or, the group of Union Territories, or, the group in mixed form) : (i) Northern Far-East India (Arunachal + Meghalaya + Assam), (ii) Southern Far-East India (Nagaland + Manipur + Tripura + Mizoram), (iii) Punjab and Haryana (including Chandigarh), (iv) Tamil Nadu (including Pondicherry).

The spatial patterns as depicted earlier in our observations made in subsections (2.6.1) through (2.6.4), are generally reflected in the State-level summary data, although details by districts (and some local peculiarities) are suppressed in these. Thus the occurrence of severe non-development for the total phase could be noticed in 1960-61 in the four States namely Orissa, Rajasthan, Jammu and Kashmir and Madhya Pradesh. Among these, the percentage reduction in the values of L_{oj} over the decade is highest (M rank) in Madhya Pradesh, while that is low in the other three States. The M rank in percentage reduction for Madhya Pradesh is really for the corresponding reduction in its third phase.

The 1960-61 non-development rank has been considerable also in the three following States with the values above the all-India value : Andhra Pradesh, Bihar and Uttar Pradesh, in ascending order of percentage reduction over the decade. Actually, the rank in percentage reduction is low in Andhra Pradesh, medium is Bihar and high in Uttar Pradesh. The medium reduction in Bihar is accounted by the corresponding rank in its first phase, whereas the spectacularly high reduction in Uttar Pradesh is accounted by the very high reductions in first and second phases and medium reduction in the third phase.

The next group of States with still high intensity of non-development in 1960-61 (at or below all-India level) are Northern

Far-East India, Karnataka, Maharashtra and Himachal Pradesh, again in ascending order of percentage reduction over the decade. Here the former two States (or, State-group) have L rank of reduction while the other two States have comparable M rank. But, while the M rank in Maharashtra has been from the H rank in the third phase accompanied by M ranks in others, the M rank in Himachal Pradesh is due to H rank in the first phase accompanied with M ranks in others.

The States with medium intensity of non-development in 1960-61, (or, rather, with some signs of development), are : (i) Southern Far-East India, (ii) Gujarat, (iii) West Bengal, (iv) Goa, (v) Punjab and Haryana, and (vi) Delhi, arranged in ascending order of magnitudes of percentage reduction over the decade. In this group, the highest improvement with VH rank in percentage reduction has been observed in the capital State of India, namely, Delhi. The next level of improvement with H rank in percentage reduction is associated with the neighbouring State of Haryana and Punjab. The VH rank of reduction in composite index in Delhi is contributed by the EH rank in its third phase, accompanied with H rank in its first phase and M rank in the second phase. The H rank of reduction in composite index in Haryana and Punjab is, however, from H rank of reduction in both the first and the third phases, accompanied with M rank in the second phase. The Southern Far-east India has low percentage reduction not only in total phase, but also in all phases. The remaining three States in this group has recorded M rank in percentage reduction. The medium rank of reduction in the composite index for West Bengal is due to utter neglect of its first phase, showing VL rank (the only State with VL rank in the first phase among all States) of reduction over the decade, while considerable attention was placed for improvement in second and third phases (H rank of reduction in both). Had the first phase not remained neglected in West Bengal, it would have definitely recorded an over-all H rank of percentage reduction instead of the present M rank. The over-all M rank of reduction in Goa is accounted mainly by the H rank of reduction in its first phase while that in Gujarat is accounted mainly by the H rank of reduction in its third phase.

Finally the States with low intensity of non-development in 1960-61 (or, rather, considerable level of development in basic-skill formation in the total phase) are only Kerala and Tamil Nadu, with increasing order of magnitude of percentage reduction over the decade. In this group, Tamil Nadu recorded H rank of reduction in composite index which is resulted from the significant attention placed in its third phase where there has been very high rank of percentage reduction. The other State recorded a little lower level of reduction (M rank) in composite index over the decade and this has been largely accounted by the H rank of reduction in its first phase accompanied with M-rank of reduction in others.

The summary picture just depicted for the States as regards the 1960-61 level of non-development in basic-skill formation and the revealed nature of official attention as reflected in the percentage reduction in the level of non-development in the subsequent decade can be further substantiated by the district frequencies by States as shown in the following two tables, entitled :

Table 2.12 : Statewise Frequencies of Districts by Intersection Classes of Non-development Intensity L_{ij}, 1960-61, and of Percentage Reduction in L_{ij}, 1960-61 to 1970-71

Table 2.13 : Comparisons of Statewise Frequencies of Districts by Classes of Non-development Intensity, L_{ij}, Between 1960-61 and 1970-71.

In these two tables, the arrangement of States is in the same order as in Table (2.11), with States of severe non-development at the beginning of the tables and those with considerable development at the bottom. From the frequency distributions of districts by States of the Table (2.12) it becomes clear that most of the districts in severely non-developed States have recorded least reduction in their non-development levels, whereas most of the districts of developed States have behaved oppositely with high reduction in non-development over the decade. Moreover, the

States in the neighbourhood of the capital city of Delhi, namely, Uttar Pradesh, Madhya Pradesh, Maharashtra and Bihar, have received much greater attention, recording VH, H and M rank of reduction in most of their districts (more pronouncedly in Uttar Pradesh). As such the all-India figures given at the bottom-line of Table (2.12) show that the frequency of severely non-developed districts (EH and VH rank of L_{ij} in 1960-61) decreases steadily from 51 in L + VL class of percent reduction to 29 in H + VH + EH class of percent reduction through 43 in M class of percent reduction. On the other hand, the picture is just the reverse for the districts with considerable development (M + L + VL + EL class of L_{ij} in 1960-61), showing a steadily increasing frequencies of districts from 20 in L + VL class of percent reduction to 44 in H + VH + EH class of percent reduction through 33 in M class of percent reduction. As some of the States in the neighbourhood of capital city received comparably greater attention like the most developed States, the frequencies of districts by States with reference to the index of non-development have altered significantly to a favourable direction in those States (ref. to Table (2.13)). However, as there has been a general improvement, the frequencies of districts in EH + VH class of L_{ij} have reduced considerably in most of the States, (all-India frequency being reduced from 123 to 29) and the frequencies of considerably developed districts (with L + VL + EL ranks of L_{ij}) have gone up significantly in quite a number of States, particularly in Uttar

Table 2.12 : Statewise Frequencies of Districts by Inter-Section Class of Non-development Index, L_{ij}, for 1960-61, and of Percentage Reduction in L_{ij} from 1960-61 to 1970-71

State (or State-group)	All classes of 1960-61 L_{ij}			EH+VH class of 1960-61 L_{ij}			H class of 1960-61 L_{ij}			M+L+VL+EL class of 1960-61 L_{ij}		
	Classes of Percent Reduction in 1970-71 L_{ij} over 1960-61 L_{ij}											
	VL+L	M	H+VH+EH	VL+L	M	H+VH+EH	VL+L	M	H+VH+EH	VL+L	M	H+VH+EH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Orissa	10	3	-	6	2	-	2	1	-	2	-	-
Rajasthan	18	8	-	17	5	-	1	3	-	-	-	-
Jammu and Kashmir	8	2	-	7	1	-	1	1	-	-	-	-
Madhya Pradesh	8	35	-	7	20	-	1	13	-	-	2	-
Andhra Pradesh	16	2	3	4	1	-	10	1	1	2	-	2
Bihar	6	11	-	1	5	-	4	6	-	1	-	-
Uttar Pradesh	-	2	52	-	2	27	-	-	22	-	-	3
Northern Far-East India	14	2	-	2	1	-	10	1	-	2	-	-
Karnataka	14	4	1	2	-	-	8	-	-	4	4	1
Maharashtra	1	14	11	-	5	2	1	7	5	-	2	4
Himachal Pradesh	1	5	4	-	1	-	1	3	3	-	1	1
Southern Far-East India	6	5	1	1	-	-	-	-	-	5*	5	1
Gujarat (including Dadra and Nagar Haveli)	9	10	1	2	-	-	3	6	-	4	4	1
West Bengal	4	10	2	2	-	-	2	5	-	-	5	2
Goa	-	1	-	-	-	-	-	-	-	-	1	-
Punjab+Haryana+Chandigarh	-	4	15	-	-	-	-	2	3	-	2	12
Delhi	-	-	1	-	-	-	-	-	-	-	-	1
Kerala	-	4	6	-	-	-	-	1	-	-	3	6
Tamil Nadu (including Pondicherry)	-	5	10	-	-	-	-	1	-	-	4	10
All-India	115	127	107	51	43	29	44	51	34	20	33	44

* Including four districts with N rank in percent reduction (all in Manipur).

N.B. : All-India L_{ij} value is in class H in 1960-61.

Table 2.13 : Comparisons of Statewise Frequencies of Districts by Classes of Non-development Index, L_{ij}, Between 1960-61 and 1970-71

State (or (State-group)	Total Number of Districts in the State	Classes of L_{ij} in 1960-61				Classes of L_{ij} in 1970-71			
		EH+VH	H	M	L+VL+EL	EH+VH	H	M	L+VL+EL
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Orissa	13	8	3	2	-	5	5	3	-
Rajasthan	26	22	4	-	-	10	13	3	-
Jammu & Kashmir	10	8	2	-	-	-	9	1	-
Madhya Pradesh	43	27	14	2	-	9	19	14	1
Andhra Pradesh	21	5	12	4	-	-	10	9	2
Bihar	17	6	10	1	-	-	10	7	-
Uttar Pradesh	54	29	22	3	-	-	16	31	7
Northern Far-East India	16	3	11	2	-	1	9	6	-
Karnataka	19	2	8	9	-	-	7	7	5
Maharashtra	26	7	13	5	1	2	6	14	4
Himachal Pradesh	10	1	7	2	-	-	1	6	3
Southern Far-East India	12	1	-	7	4	-	1	3	8
Gujarat (including Dadra & Nagar Haveli)	20	2	9	7	2	2	2	9	7
West Bengal	16	2	7	6	1	-	5	6	5
Goa	1	-	-	1	-	-	-	-	1
Punjab+Haryana+ Chandigarh	19	-	5	11	3	-	-	6	13
Delhi	1	-	-	1	-	-	-	-	1
Kerala	10	-	1	3	6	-	-	1	9
Tamil Nadu (including Pondicherry)	15	-	1	2	12	-	-	1	14
All-India	349	123	129	68	29	29	113	127	80

N B. : All-India L_{ij} value is in class H in 1960-61 and in class M in 1970-71.

Pradesh, Karnataka, Southern Far-East India, Gujarat, West Bengal, Punjab + Haryana + Chandigarh, including also Kerala and Tamil Nadu (all-India frequency being raised from 29 to 80). The improvement is spectacular in Punjab + Haryana + Chandigarh and also in Uttar Pradesh, which are in the neighbourhood of Delhi.

The above inter-State comparisons are definitely useful in clarifying our visions about the relative state of affairs as prevalent in this fundamental area of skill-formation so that the people inhabiting at different locations and areas are in a position to convert or equip themselves for manifestations of their abilities as useful human resources in Indian scenario of activities. The relative regional variations in the non-development of basic-skill formation are really meant to draw the official attention of the planning authorities concerned who are at the helm of affairs in this regard. As pointed out earlier, the planners' objective in a geographically vast country like India would be to take lessons from the more developed regions (with very low values of the index of non-development) and apply them towards improving the undesirable situations in less developed regions (with very high values of the index of non-development). In the federal set-up of Indian administrations, the inter-state comparisons made here, are necessary for the clarification of vision of the planning authorities of different States; but that is not sufficient without the detailed spatial knowledge within State, because the much needed planning measures for improvement in basic-skill formation are to be taken at different localities and small regions. As pointed out already, the necessary detailed information remains very much suppressed in State level figures. And, as such, our efforts have been towards obtaining the detailed districtwise picture. The regional analysis with the district level estimates of indices of non-development has already been accomplished. Further, to make the estimates more easily usable by education-planners we present at the end of this chapter the Table (2.15) for districts, in the same line as has been done for States in Table (2.11) with the identification of stratified ordering primarily by ranks of L_{ij} in 1960-61 and secondarily by ascending order in percentage reduction of L_{ij} in the subsequent decade.

Finally we conclude this section by analysing the frequency distribution of States by the figures of percentage reduction shown below in Table (2.14) and also the over-all pattern of differential improvement in basic-skill formation in different States of India.

It could be noticed from Table (2.14) that most of the States are with L and M ranks in phase II, for which the nature of spatial disparity remained more or less same over the decade. The slight reduction in spatial disparity as

Table 2.14 : The Frequency Distribution of States by Class-ranks of Percentage Reduction in the Indices of Non-development over the Decade 1960-61 to 1970-71

Class-rank of percentage reduction	Total phase composite index : L_{oj}	First phase index: $L_{oj}(I)$	Second phase index: $L_{oj}(II)$	Third phase index: $L_{oj}(III)$
(1)	(2)	(3)	(4)	(5)
VL	0	1	0	1
L	7	9	9	6
M	8	3	8	6
H	3	5	1	4
VH	1	1	1	1
EH	0	0	0	1

noticed for the first phase over the decade was largely due to (i) high or medium percentage of reduction in some States with considerable areas of non-development, particularly in the States like Uttar Pradesh, Himachal Pradesh, Bihar, Orissa, Maharashtra, and (ii) the generally low percentage reduction in more than half the number of States considered here. The frequency distribution of States in the third phase is more evenly distributed between the M-rank and the ranks above and below, but it seems that there has been more attention for improvement in more urbanised States like Delhi, Tamil Nadu, West Bengal, Punjab & Haryana, Maharashtra and Gujarat (with EH, VH and H rank of percentage reduction in the third phase), as a result of which the spatial disparity got considerably increased in the decade under consideration in the third phase.

Taking into consideration the total formative phase as a whole, it is now well-established that attentions for improvements in basic-skill formation have been on most of the States in the immediate neighbourhood of the capital State of Delhi, in the two traditionally developed southern-most States and also in some States with high urban character.

Table 2.15 : Values of the Indices of Non-development of Basic-Skill Formation in 1960–61 and Their Percentage Reduction in 1970–71 Relative to 1960–61 by States of India (with stratified ordering)

Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij}			First Phase: Index : $L_{ij}(I)$		Second Phase: Index : $L_{ij}(II)$		Third Phase: Index : $L_{ij}(III)$	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Subansiri	(8)	1.248(VH)	1.234(VH)	1.13(VL)	1.293 (H)	(-)1.47 (N)	1.304(VH)	2.70(VL)	1.221(VH)	2.77 (L)
2. Koraput	(1)	1.479(EH)	1.425(EH)	3.68 (L)	1.798(EH)	7.97 (L)	1.678(EH)	13.63 (M)	1.268(EH)	0.08(VL)
3. Karimnagar	(5)	1.235(VH)	1.190 (H)	3.72 (L)	1.247 (H)	7.42 (L)	1.305(VH)	3.79 (L)	1.230(VH)	1.47(VL)
4. Churu	(2)	1.230(VH)	1.182 (H)	3.83 (L)	1.443(VH)	0.31(VL)	1.221 (H)	2.14(VL)	1.101 (H)	6.60 (L)
5. Adilabad	(5)	1.264(VH)	1.215 (H)	3.85 (L)	1.294 (H)	7.57 (L)	1.329(VH)	3.86 (L)	1.245(VH)	1.52(VL)
6. Nalgonda	(5)	1.227(VH)	1.177 (H)	4.08 (L)	1.230 (H)	8.05 (L)	1.296(VH)	4.11 (L)	1.225(VH)	1.69(VL)
7. Khammam	(5)	1.226(VH)	1.176 (H)	4.14 (L)	1.230 (H)	8.15 (L)	1.296(VH)	4.16 (L)	1.225(VH)	1.73(VL)
8. Banaskantha	(13)	1.340(VH)	1.283(VH)	4.31 (L)	1.625(EH)	(-)3.71 (N)	1.179 (H)	9.19 (L)	1.170(VH)	11.00 (M)
9. Gulbarga	(9)	1.242(VH)	1.187 (H)	4.45 (L)	1.304 (H)	2.99(VL)	1.214 (H)	1.30(VL)	1.205(VH)	5.40 (L)
10. Ladakh	(3)	1.263(VH)	1.204 (H)	4.64 (L)	1.430(VH)	3.08(VL)	1.199 (H)	6.76 (L)	1.163(VH)	5.79 (L)
11. Jalore	(2)	1.416(EH)	1.350(VH)	4.68 (L)	1.800(EH)	1.99(VL)	1.364(VH)	2.97(VL)	1.186(VH)	7.13 (L)
12. Nagaur	(2)	1.316(VH)	1.250(VH)	5.01 (L)	1.606(VH)	2.35(VL)	1.288(VH)	3.15 (L)	1.141 (H)	7.25 (L)

NB : Ranking Symbols :-

i) For Composite Index, L_{ij}, ref. to Table (2.10)

ii) For Indices $L_{ij}(I)$, $L_{ij}(II)$, $L_{ij}(III)$, ref. to Table (A.2) in Appendix I

iii) For Percentage Reduction details are given below :

Percentage Reduction in L_{ij}

Range of Value	Symbol
Below 0.0	N
0.0 - 2.8	VL
2.8 - 8.4	L
8.4 - 14.0	M
14.0 - 19.6	H
19.6 - 25.2	VH
25.2 and above	EH

Percentage Reduction in $L_{ij}(I)$

Range of Value	Symbol
Below 0.0	N
0.0 - 3.2	VL
3.2 - 9.6	L
9.6 - 16.0	M
16.0 - 22.4	H
22.4 - 28.8	VH
28.8 and above	EH

Percentage Reduction in $L_{ij}(II)$

Range of Value	Symbol
Below 0.00	N
0.00 - 3.15	VL
3.15 - 9.45	L
9.45 - 15.75	M
15.75 - 22.05	H
22.05 - 28.35	VH
28.35 and above	EH

Percentage Reduction in $L_{ij}(III)$

Range of Value	Symbol
Below 0.0	N
0.0 - 2.5	VL
2.5 - 7.6	L
7.6 - 12.6	M
12.6 - 17.7	H
17.7 - 22.7	VH
22.7 and above	EH

N : no reduction; VL : very low; L : low; M : medium; H : high; VH : very high; EH : extremely high.

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))	Total Phase Composite Index : L_{ij} 1960-61	1970-71	% reduction in 1970-71 to 1960-61	First Phase Index : $L_{ij}(I)$ 1960-61	% reduction in 1970-71 to 1960-61	Second Phase Index : $L_{ij}(II)$ 1960-61	% reduction in 1970-71 to 1960-61	Third Phase Index : $L_{ij}(III)$ 1960-61	% reduction in 1970-71 to 1960-61
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
13. Baudh Khondmals (1)	1.287(VH)	1.221 (H)	5.15 (L)	1.360 (H)	7.01 (L)	1.460(EH)	13.20 (M)	1.243(VH)	3.92 (L)
14. Baramula (3)	1.285(VH)	1.218 (H)	5.17 (L)	1.470(VH)	3.96 (L)	1.216 (H)	7.19 (L)	1.174(VH)	6.07 (L)
15. Doda (3)	1.272(VH)	1.204 (H)	5.34 (L)	1.446(VH)	4.23 (L)	1.206 (H)	7.32 (L)	1.167(VH)	6.16 (L)
16. Kalahandi (1)	1.426(EH)	1.347(VH)	5.54 (L)	1.657(EH)	10.04 (M)	1.611(EH)	13.63 (M)	1.288(EH)	2.06(VL)
17. Tuensang (12)	1.233(VH)	1.163 (H)	5.63 (L)	1.267 (H)	6.25 (L)	1.290(VH)	6.41 (L)	1.212 (H)	5.25 (L)
18. Ganjam (1)	1.226(VH)	1.156 (H)	5.72 (L)	1.254 (H)	8.03 (L)	1.402(VH)	13.68 (M)	1.210(VH)	4.28 (L)
19. Jhabua (4)	1.461(EH)	1.374(VH)	5.96 (L)	1.838(EH)	2.96(VL)	1.423(VH)	3.77 (L)	1.235(VH)	8.64 (M)
20. Barmer (2)	1.430(EH)	1.344(VH)	6.00 (L)	1.827(EH)	4.06 (L)	1.374(VH)	4.00 (L)	1.192(VH)	7.79 (M)
21. Sirohi (2)	1.314(VH)	1.233(VH)	6.16 (L)	1.603(VH)	4.17 (L)	1.287(VH)	4.06 (L)	1.141 (H)	7.83 (M)
22. Ganganagar (2)	1.258(VH)	1.178 (H)	6.37 (L)	1.497(VH)	4.44 (L)	1.244 (H)	4.20 (L)	1.115 (H)	7.91 (M)
23. Jodhpur (2)	1.237(VH)	1.158 (H)	6.37 (L)	1.457(VH)	4.43 (L)	1.227 (H)	4.19 (L)	1.105 (H)	7.91 (M)
24. Udhampur (3)	1.280(VH)	1.198 (H)	6.42 (L)	1.461(VH)	5.99 (L)	1.212 (H)	8.18 (L)	1.171(VH)	6.74 (L)
25. The Dangs (13)	1.423(EH)	1.330(VH)	6.59 (L)	1.784(EH)	0.30(VL)	1.236 (H)	10.97 (M)	1.207(VH)	12.16 (M)
26. Keonjhar (1)	1.316(VH)	1.228(VH)	6.67 (L)	1.412(VH)	9.48 (L)	1.487(EH)	14.36 (M)	1.259(EH)	4.78 (L)
27. Bastar (4)	1.430(EH)	1.333(VH)	6.78 (L)	1.776(EH)	4.21 (L)	1.399(VH)	4.39 (L)	1.222(VH)	9.03 (M)
28. Punch (3)	1.279(VH)	1.191 (H)	6.83 (L)	1.473(VH)	7.56 (L)	1.197 (H)	7.39 (L)	1.162(VH)	6.27 (L)
29. Bidar (9)	1.244(VH)	1.158 (H)	6.88 (L)	1.307 (H)	7.08 (L)	1.215 (H)	3.40 (L)	1.206(VH)	6.75 (L)
30. Bhilwara (2)	1.356(VH)	1.260(VH)	7.09 (L)	1.683(EH)	5.69 (L)	1.319(VH)	4.82 (L)	1.159(VH)	8.32 (M)
31. Purnea (6)	1.254(VH)	1.164 (H)	7.16 (L)	1.343 (H)	10.75 (M)	1.311(VH)	7.35 (L)	1.200(VH)	4.75 (L)
32. Sawai Madhopur (2)	1.317(VH)	1.222 (H)	7.20 (L)	1.608(VH)	5.82 (L)	1.289(VH)	4.89 (L)	1.142 (H)	8.36 (M)
33. Banswara (2)	1.410(EH)	1.308(VH)	7.21 (L)	1.789(EH)	5.91 (L)	1.360(VH)	4.93 (L)	1.183(VH)	8.39 (M)
34. Anantanag (3)	1.282(VH)	1.187 (H)	7.37 (L)	1.464(VH)	7.53 (L)	1.214 (H)	8.93 (L)	1.172(VH)	7.25 (L)
35. Sidhi (4)	1.399(EH)	1.294(VH)	7.45 (L)	1.717(EH)	5.23 (L)	1.375(VH)	4.90 (L)	1.208(VH)	9.36 (M)
36. Udaipur (2)	1.311(VH)	1.213 (H)	7.47 (L)	1.597(VH)	6.24 (L)	1.294(VH)	5.10 (L)	1.139 (H)	8.50 (M)
37. Pali (2)	1.306(VH)	1.208 (H)	7.48 (L)	1.587(VH)	6.26 (L)	1.280(VH)	5.11 (L)	1.137 (H)	8.50 (M)
38. Bundi (2)	1.345(VH)	1.242(VH)	7.67 (L)	1.662(EH)	6.59 (L)	1.310(VH)	5.28 (L)	1.154(VH)	8.61 (M)
39. Bharatpur (2)	1.273(VH)	1.175 (H)	7.68 (L)	1.524(VH)	6.56 (L)	1.255(VH)	5.26 (L)	1.122 (H)	8.60 (M)
40. Jhalawar (2)	1.306(VH)	1.206 (H)	7.69 (L)	1.588(VH)	6.60 (L)	1.281(VH)	5.28 (L)	1.137 (H)	8.61 (M)
41. Dungarpur (2)	1.367(VH)	1.261(VH)	7.71 (L)	1.704(EH)	6.66 (L)	1.327(VH)	5.31 (L)	1.164(VH)	8.63 (M)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij}			First Phase: Index : $L_{ij}(I)$		Second Phase: Index : $L_{ij}(II)$		Third Phase: Index : $L_{ij}(III)$	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
42. Tonk	(2)	1.355(VH)	1.250(VH)	7.71 (L)	1.681(EH)	6.65 (L)	1.318(VH)	5.31 (L)	1.159(VH)	8.63 (M)
43. Mayurbhanj	(1)	1.394(EH)	1.286(VH)	7.73 (L)	1.552(VH)	11.06 (M)	1.559(EH)	15.11 (M)	1.299(EH)	5.34 (L)
44. Khargone	(4)	1.273(VH)	1.175 (H)	7.73 (L)	1.479(VH)	5.51 (L)	1.276(VH)	5.04 (L)	1.149 (H)	9.45 (M)
45. Dhar	(4)	1.311(VH)	1.208 (H)	7.86 (L)	1.551(VH)	5.76 (L)	1.307(VH)	5.17 (L)	1.167(VH)	9.53 (M)
46. Chhatarpur	(4)	1.352(VH)	1.244(VH)	7.95 (L)	1.627(EH)	5.96 (L)	1.339(VH)	5.27 (L)	1.186(VH)	9.59 (M)
47. Murshidabad	(14)	1.250(VH)	1.150 (H)	7.98 (L)	1.310 (H)	(-)1.03 (N)	1.217 (H)	19.94 (H)	1.213(VH)	13.82 (H)
48. Rajauri	(3)	1.310(VH)	1.204 (H)	8.12 (L)	1.521(VH)	8.93 (L)	1.228 (H)	8.95 (L)	1.184(VH)	7.49 (L)
49. Garo Hills	(8)	1.262(VH)	1.158 (H)	8.25 (L)	1.287 (H)	10.90 (M)	1.399(VH)	10.74 (M)	1.246(VH)	6.60 (L)
50. Surguja	(4)	1.385(EH)	1.269(VH)	8.37 (L)	1.690(EH)	6.65 (L)	1.365(VH)	5.62 (L)	1.202(VH)	9.81 (M)
51. Malda	(14)	1.272(VH)	1.166 (H)	8.39 (L)	1.350 (H)	(-)0.18 (N)	1.235 (H)	20.28 (H)	1.226(VH)	14.06 (H)
52. Alwar	(2)	1.270(VH)	1.161 (H)	8.60 (M)	1.520(VH)	8.01 (L)	1.255(VH)	6.15 (L)	1.120 (H)	9.07 (M)
53. Chamba	(11)	1.238(VH)	1.131 (H)	8.62 (M)	1.384(VH)	9.56 (M)	1.180 (H)	9.94 (M)	1.150(VH)	7.94 (M)
54. Panna	(4)	1.352(VH)	1.235(VH)	8.66 (M)	1.627(EH)	7.08 (L)	1.339(VH)	5.84 (L)	1.186(VH)	9.95 (M)
55. Champaran	(6)	1.302(VH)	1.188 (H)	8.72 (M)	1.429(VH)	13.16 (M)	1.353(VH)	8.61 (L)	1.225(VH)	5.61 (L)
56. Seoni	(4)	1.238(VH)	1.128 (H)	8.83 (M)	1.414(VH)	7.26 (L)	1.248 (H)	5.93 (L)	1.132 (H)	10.01 (M)
57. Gunna	(4)	1.304(VH)	1.188 (H)	8.84 (M)	1.536(VH)	7.33 (L)	1.301(VH)	5.96 (L)	1.164(VH)	10.03 (M)
58. Saharsa	(6)	1.273(VH)	1.160 (H)	8.88 (M)	1.378(VH)	13.54 (M)	1.328(VH)	8.79 (L)	1.210(VH)	5.70 (L)
59. Sikar	(2)	1.246(VH)	1.134 (H)	8.93 (M)	1.474(VH)	8.53 (L)	1.234 (H)	6.27 (L)	1.109 (H)	9.25 (M)
60. Tikamgarh	(4)	1.378(EH)	1.255(VH)	8.94 (M)	1.678(EH)	7.56 (L)	1.360(VH)	6.08 (L)	1.199(VH)	10.10 (M)
61. Shahdol	(4)	1.360(VH)	1.236(VH)	9.10 (M)	1.643(EH)	7.80 (L)	1.345(VH)	6.20 (L)	1.190(VH)	10.18 (M)
62. Santhal Parganas	(6)	1.272(VH)	1.156 (H)	9.12 (M)	1.375(VH)	13.89 (M)	1.327(VH)	9.00 (L)	1.210(VH)	5.88 (L)
63. Chittaurgarh	(2)	1.319(VH)	1.197 (H)	9.23 (M)	1.613(VH)	9.02 (L)	1.291(VH)	6.52 (L)	1.143 (H)	9.41 (M)
64. Yeotmal	(10)	1.234(VH)	1.118 (H)	9.43 (M)	1.475(VH)	7.58 (L)	1.038 (M)	7.28 (L)	1.089 (H)	10.93 (M)
65. Mandla	(4)	1.286(VH)	1.164 (H)	9.47 (M)	1.504(VH)	8.34 (L)	1.287(VH)	6.47 (L)	1.156(VH)	10.36 (M)
66. Jaisalmer	(2)	1.423(EH)	1.288(VH)	9.48 (M)	1.814(EH)	9.42 (L)	1.369(VH)	6.72 (L)	1.189(VH)	9.54 (M)
67. Rewa	(4)	1.254(VH)	1.135 (H)	9.50 (M)	1.444(VH)	8.35 (L)	1.261(VH)	6.48 (L)	1.140 (H)	10.36 (M)
68. Palamau	(6)	1.286(VH)	1.164 (H)	9.51 (M)	1.400(VH)	14.46 (M)	1.339(VH)	9.30 (L)	1.217(VH)	6.09 (L)
69. Jaipur	(2)	1.230(VH)	1.111 (H)	9.65 (M)	1.443(VH)	9.68 (M)	1.221 (H)	6.86 (L)	1.101 (H)	9.63 (M)
70. Mikir Hills	(8)	1.321(VH)	1.191 (H)	9.89 (M)	1.390(VH)	13.44 (M)	1.456(EH)	12.13 (M)	1.280(EH)	7.57 (L)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij} 1960-61	Total Phase: Composite Index : L_{ij} 1970-71	Total Phase: % reduction in 1970-71 to 1960-61	First Phase: Index : $L_{ij}(I)$ 1960-61	First Phase: % reduction in 1970-71 to 1960-61	Second Phase: Index : $L_{ij}(II)$ 1960-61	Second Phase: % reduction in 1970-71 to 1960-61	Third Phase: Index : $L_{ij}(III)$ 1960-61	Third Phase: % reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
71. Sundargarh	(1)	1.300(VH)	1.171 (H)	9.90 (M)	1.383(VH)	14.77 (M)	1.472(EH)	16.90 (H)	1.250(EH)	6.67 (L)
72. Hazaribagh	(6)	1.268(VH)	1.142 (H)	9.94 (M)	1.368 (H)	15.21 (M)	1.324(VH)	9.70 (M)	1.208(VH)	6.36 (L)
73. Mahbubnagar	(5)	1.232(VH)	1.110 (H)	9.98 (M)	1.240 (H)	17.74 (H)	1.302(VH)	9.31 (L)	1.228(VH)	5.28 (L)
74. Rajgarh	(4)	1.373(VH)	1.236(VH)	10.00 (M)	1.668(EH)	9.22 (L)	1.355(VH)	6.92 (L)	1.196(VH)	10.65 (M)
75. Dewas	(4)	1.226(VH)	1.103 (H)	10.03 (M)	1.393(VH)	9.21 (L)	1.238 (H)	6.92 (L)	1.126 (H)	10.64 (M)
76. Nanded	(10)	1.397(EH)	1.256(VH)	10.05 (M)	1.790(EH)	8.70 (L)	1.143 (H)	7.85 (L)	1.161(VH)	11.29 (M)
77. Raisen	(4)	1.311(VH)	1.180 (H)	10.05 (M)	1.551(VH)	9.28 (L)	1.307(VH)	6.96 (L)	1.168(VH)	10.67 (M)
78. Vidisha	(4)	1.314(VH)	1.181 (H)	10.13 (M)	1.556(VH)	9.41 (L)	1.309(VH)	7.02 (L)	1.169(VH)	10.71 (M)
79. Chhindwara	(4)	1.255(VH)	1.126 (H)	10.32 (M)	1.446(VH)	9.68 (M)	1.262(VH)	7.16 (L)	1.140 (H)	10.90 (M)
80. Morena	(4)	1.282(VH)	1.149 (H)	10.43 (M)	1.497(VH)	9.88 (M)	1.284(VH)	7.26 (L)	1.154(VH)	10.86 (M)
81. Kathua	(3)	1.235(VH)	1.106 (H)	10.47 (M)	1.379(VH)	12.57 (M)	1.178 (H)	11.44 (M)	1.149 (H)	8.97 (M)
82. Satna	(4)	1.250(VH)	1.119 (H)	10.50 (M)	1.437(VH)	9.98 (M)	1.258(VH)	7.32 (L)	1.138 (H)	10.90 (M)
83. Raigarh	(4)	1.268(VH)	1.134 (H)	10.59 (M)	1.470(VH)	10.13 (M)	1.272(VH)	7.39 (L)	1.147 (H)	10.95 (M)
84. Bolangir	(1)	1.377(EH)	1.230(VH)	10.69 (M)	1.521(VH)	15.82 (M)	1.544(EH)	17.41 (H)	1.290(EH)	7.06 (L)
85. Shivpuri	(4)	1.340(VH)	1.194 (H)	10.93 (M)	1.606(VH)	10.69 (M)	1.330(VH)	7.68 (L)	1.181(VH)	11.13 (M)
86. Shejapur	(4)	1.287(VH)	1.145 (H)	11.04 (M)	1.506(VH)	10.85 (M)	1.288(VH)	7.76 (L)	1.156(VH)	11.18 (M)
87. Betul	(4)	1.242(VH)	1.104 (H)	11.07 (M)	1.422(VH)	10.89 (M)	1.251 (H)	7.79 (L)	1.134 (H)	11.20 (M)
88. Chandrapur	(10)	1.339(VH)	1.190 (H)	11.16 (M)	1.678(EH)	10.41 (M)	1.107 (H)	8.72 (L)	1.136 (H)	11.85 (M)
89. Bhind	(4)	1.231(VH)	1.083 (H)	12.04 (M)	1.402(VH)	12.47 (M)	1.242 (H)	8.61 (L)	1.129 (H)	11.73 (M)
90. Bhir	(10)	1.400(EH)	1.230(VH)	12.19 (M)	1.796(EH)	11.99 (M)	1.145 (H)	9.52 (M)	1.162(VH)	13.37 (M)
91. Parbhani	(10)	1.390(EH)	1.220 (H)	12.27 (M)	1.776(EH)	12.11 (M)	1.139 (H)	9.58 (M)	1.158(VH)	12.41 (M)
92. Datia	(4)	1.274(VH)	1.110 (H)	12.83 (M)	1.481(VH)	13.71 (M)	1.277(VH)	9.26 (L)	1.150(VH)	12.15 (M)
93. Bahraich	(7)	1.307(VH)	1.135 (H)	13.20 (M)	1.497(VH)	18.94 (H)	1.355(VH)	20.55 (H)	1.194(VH)	8.88 (M)
94. Rampur	(7)	1.331(VH)	1.147 (H)	13.85 (M)	1.541(VH)	19.87 (H)	1.374(VH)	21.01 (H)	1.205(VH)	9.23 (M)
95. Osmanabad	(10)	1.356(VH)	1.161 (H)	14.38 (H)	1.709(EH)	15.35 (M)	1.117 (H)	11.27 (M)	1.143 (H)	13.50 (H)
96. Aurangabad	(10)	1.339(VH)	1.130 (H)	15.56 (H)	1.675(EH)	17.17 (H)	1.106 (H)	12.23 (M)	1.136 (H)	14.13 (H)
97. Bara Banki	(7)	1.311(VH)	1.105 (H)	15.67 (H)	1.503(VH)	22.74 (VH)	1.359(VH)	22.44(VH)	1.195(VH)	10.33 (M)
98. Bijnore	(7)	1.228(VH)	1.034 (M)	15.81 (H)	1.351 (H)	23.30(VH)	1.257(VH)	22.72(VH)	1.154(VH)	10.55 (M)
99. Gonda	(7)	1.310(VH)	1.100 (H)	16.03 (H)	1.501(VH)	23.30(VH)	1.257(VH)	22.72(VH)	1.195(VH)	10.55 (M)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase Composite Index : L_{ij}			First Phase Index : $L_{ij}(I)$		Second Phase Index : $L_{ij}(II)$		Third Phase Index : $L_{ij}(III)$	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
100. Kheri	(7)	1.320(VH)	1.108 (H)	16.10 (H)	1.521(VH)	23.37(VH)	1.366(VH)	22.76(VH)	1.200(VH)	10.58 (M)
101. Bareilly	(7)	1.291(VH)	1.078 (H)	16.56 (H)	1.467(VH)	24.19(VH)	1.341(VH)	23.17(VH)	1.186(VH)	10.90 (M)
102. Garhwal	(7)	1.329(VH)	1.108 (H)	16.64 (H)	1.536(VH)	24.16(VH)	1.373(VH)	23.15(VH)	1.204(VH)	10.88 (M)
103. Sitapur	(7)	1.293(VH)	1.078 (H)	16.69 (H)	1.471(VH)	24.38(VH)	1.343(VH)	23.26(VH)	1.187(VH)	10.97 (M)
104. Budaun	(7)	1.374(VH)	1.142 (H)	16.95 (H)	1.620(VH)	24.36(VH)	1.412(VH)	23.40(VH)	1.227(VH)	11.08 (M)
105. Moradabad	(7)	1.308(VH)	1.086 (H)	16.98 (H)	1.498(VH)	24.76(VH)	1.355(VH)	23.46(VH)	1.194(VH)	11.12 (M)
106. Nainital	(7)	1.370(VH)	1.136 (H)	17.05 (H)	1.613(VH)	24.62(VH)	1.406(VH)	23.38(VH)	1.224(VH)	11.06 (M)
107. Hardoi	(7)	1.258(VH)	1.039 (M)	17.36 (H)	1.406(VH)	25.57(VH)	1.313(VH)	23.87(VH)	1.169(VH)	11.44 (M)
108. Pilbhit	(7)	1.306(VH)	1.079 (H)	17.37 (H)	1.494(VH)	25.37(VH)	1.353(VH)	23.77(VH)	1.193(VH)	11.36 (M)
109. Banda	(7)	1.239(VH)	1.023 (M)	17.43 (H)	1.372 (H)	25.76(VH)	1.297(VH)	23.97(VH)	1.160(VH)	11.52 (M)
110. Gorakhpur	(7)	1.228(VH)	1.011 (M)	17.64 (H)	1.351 (H)	26.14(VH)	1.287(VH)	24.16(VH)	1.154(VH)	11.67 (M)
111. Shahjahanpur	(7)	1.313(VH)	1.079 (H)	17.80 (H)	1.507(VH)	25.99(VH)	1.360(VH)	24.09(VH)	1.197(VH)	11.61 (M)
112. Chamoli	(7)	1.353(VH)	1.112 (H)	17.80 (H)	1.581(VH)	25.83(VH)	1.392(VH)	24.00(VH)	1.216(VH)	11.54 (M)
113. Pithorgarh	(7)	1.348(VH)	1.106 (H)	17.98 (H)	1.573(VH)	26.11(VH)	1.389(VH)	24.15(VH)	1.214(VH)	11.65 (M)
114. Almora	(7)	1.363(VH)	1.116 (H)	18.12 (H)	1.601(VH)	26.27(VH)	1.401(VH)	24.23(VH)	1.221(VH)	11.72 (M)
115. Deoria	(7)	1.250(VH)	1.023 (M)	18.19 (H)	1.392(VH)	26.88(VH)	1.306(VH)	24.55(VH)	1.165(VH)	11.96 (M)
116. Basti	(7)	1.308(VH)	1.069 (M)	18.23 (H)	1.498(VH)	26.68(VH)	1.355(VH)	25.44(VH)	1.194(VH)	11.88 (M)
117. Unnao	(7)	1.261(VH)	1.027 (M)	18.58 (H)	1.412(VH)	27.42(VH)	1.316(VH)	24.82(VH)	1.171(VH)	12.18 (M)
118. Etah	(7)	1.240(VH)	1.009 (M)	18.60 (H)	1.374 (H)	27.56(VH)	1.298(VH)	24.90(VH)	1.160(VH)	12.24 (M)
119. Muzaffarnagar	(7)	1.240(VH)	1.006 (M)	18.90 (H)	1.374 (H)	28.02(VH)	1.298(VH)	25.14(VH)	1.160(VH)	12.42 (M)
120. Sultanpur	(7)	1.272(VH)	1.030 (M)	18.97 (H)	1.431(VH)	27.96(VH)	1.325(VH)	25.11(VH)	1.176(VH)	12.40 (M)
121. Faizabad	(7)	1.260(VH)	1.019 (M)	19.13 (H)	1.409(VH)	28.27(VH)	1.315(VH)	25.26(VH)	1.170(VH)	12.52 (M)
122. Rae Bareli	(7)	1.277(VH)	1.031 (M)	19.29 (H)	1.441(VH)	28.42(VH)	1.329(VH)	25.34(VH)	1.179(VH)	12.59 (H)
123. Pratapgarh	(7)	1.244(VH)	1.003 (M)	19.41 (H)	1.381(VH)	28.77(VH)	1.302(VH)	25.53(VH)	1.162(VH)	12.73 (H)
124. Kameng	(8)	1.212 (H)	1.198 (H)	1.15(VL)	1.230 (H)	(-)1.49 (N)	1.272(VH)	2.70(VL)	1.201(VH)	2.73 (L)
125. Tirap	(8)	1.181 (H)	1.167 (H)	1.22(VL)	1.177 (H)	(-)1.47 (N)	1.244 (H)	2.68(VL)	1.184(VH)	2.83 (L)
126. Siang	(8)	1.154 (H)	1.140 (H)	1.22(VL)	1.132 (H)	(-)1.45 (N)	1.220 (H)	2.70(VL)	1.168(VH)	2.77 (L)
127. Darrang	(8)	1.185 (H)	1.150 (H)	3.00 (L)	1.156 (H)	1.98(VL)	1.326(VH)	6.38 (L)	1.203(VH)	3.59 (L)
128. Medak	(5)	1.212 (H)	1.175 (H)	3.04 (L)	1.205 (H)	6.33 (L)	1.283(VH)	3.22 (L)	1.216(VH)	1.09(VL)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij} 1960-61	Total Phase: 1970-71	Total Phase: % reduction in 1970-71 to 1960-61	First Phase: Index : $L_{ij}(I)$ 1960-61	First Phase: % reduction in 1970-71 to 1960-61	Second Phase: Index : $L_{ij}(II)$ 1960-61	Second Phase: % reduction in 1970-71 to 1960-61	Third Phase: Index : $L_{ij}(III)$ 1960-61	Third Phase: % reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
129. Bellary	(9)	1.142 (H)	1.101 (H)	3.59 (L)	1.130 (H)	1.40(VL)	1.130 (H)	0.49(VL)	1.149 (H)	4.89 (L)
130. Warangal	(5)	1.207 (H)	1.162 (H)	3.77 (L)	1.197 (H)	7.57 (L)	1.279(VH)	3.86 (L)	1.214(VH)	1.53(VL)
131. Mysore	(9)	1.175 (H)	1.129 (H)	3.95 (L)	1.188 (H)	2.06(VL)	1.158 (H)	0.82(VL)	1.168(VH)	5.10 (L)
132. Srikakulam	(5)	1.196 (H)	1.147 (H)	4.12 (L)	1.178 (H)	8.18 (L)	1.268(VH)	4.18 (L)	1.207(VH)	1.74(VL)
133. Nizamabad	(5)	1.216 (H)	1.164 (H)	4.23 (L)	1.211 (H)	8.32 (L)	1.286(VH)	4.25 (L)	1.218(VH)	1.79(VL)
134. Goalpara	(8)	1.203 (H)	1.150 (H)	4.45 (L)	1.187 (H)	4.51 (L)	1.344(VH)	7.60 (L)	1.213(VH)	4.42 (L)
135. Raichur	(9)	1.220 (H)	1.159 (H)	4.99 (L)	1.265 (M)	3.89 (L)	1.195 (H)	1.75(VL)	1.193(VH)	5.69 (L)
136. Bikaner	(2)	1.154 (H)	1.094 (H)	5.20 (L)	1.303 (H)	2.39(VL)	1.160 (H)	3.17 (L)	1.064 (H)	7.26 (L)
137. Mandya	(9)	1.214 (H)	1.150 (H)	5.28 (L)	1.254 (H)	4.38 (L)	1.190 (H)	2.00(VL)	1.189(VH)	5.85 (L)
138. Cooch Behar	(14)	1.158 (H)	1.095 (H)	5.44 (L)	1.151 (H)	(-) 6.22 (N)	1.140 (H)	17.91 (H)	1.162(VH)	12.36 (M)
139. Vishakhapatnam	(5)	1.192 (H)	1.125 (H)	5.61 (L)	1.172 (H)	10.69 (M)	1.265(VH)	5.50 (L)	1.205(VH)	2.65 (L)
140. Kolar	(9)	1.157 (H)	1.084 (H)	6.36 (L)	1.157 (H)	6.19 (L)	1.143 (H)	2.94(VL)	1.158(VH)	6.45 (L)
141. Kutch	(13)	1.160 (H)	1.086 (H)	6.36 (L)	1.288 (H)	(-) 1.17 (N)	1.050 (M)	10.31 (M)	1.082 (H)	11.74 (M)
142. Panchmahals	(13)	1.222 (H)	1.141 (H)	6.65 (L)	1.402(VH)	(-) 0.39 (N)	1.096 (H)	10.66 (M)	1.114 (H)	11.96 (M)
143. Dhenkanol	(1)	1.177 (H)	1.098 (H)	6.70 (L)	1.168 (H)	9.76 (M)	1.353(VH)	14.49 (M)	1.182(VH)	4.88 (L)
144. Sambalpur	(1)	1.202 (H)	1.119 (H)	6.89 (L)	1.211 (H)	10.03 (M)	1.378(VH)	14.62 (M)	1.196(VH)	4.98 (L)
145. Lohit	(8)	1.174 (H)	1.092 (H)	6.96 (L)	1.050 (M)	(-) 1.52 (N)	1.175 (H)	2.66(VL)	1.248(VH)	11.24 (M)
146. Dhulia	(10)	1.201 (H)	1.116 (H)	7.06 (L)	1.413(VH)	3.71 (L)	1.016 (M)	5.36 (L)	1.073 (H)	9.71 (M)
147. Srinagar	(3)	1.203 (H)	1.116 (H)	7.17 (L)	1.320 (H)	7.20 (L)	1.152 (H)	8.77 (L)	1.132 (H)	7.14 (L)
148. Muzaffarpur	(6)	1.220 (H)	1.131 (H)	7.28 (L)	1.282 (H)	11.03 (M)	1.281(VH)	7.50 (L)	1.182(VH)	4.85 (L)
149. Saran	(6)	1.168 (H)	1.074 (M)	8.02 (L)	1.192 (H)	12.36 (M)	1.235 (H)	8.20 (L)	1.153(VH)	5.33 (L)
150. Bhagalpur	(6)	1.185 (H)	1.089 (H)	8.15 (L)	1.222 (H)	12.53 (M)	1.251 (H)	8.28 (L)	1.163(VH)	5.38 (L)
151. Darbhanga	(6)	1.219 (H)	1.116 (H)	8.44 (M)	1.281 (H)	12.92 (M)	1.281(VH)	8.49 (L)	1.181(VH)	5.53 (L)
152. Monghyr	(6)	1.194 (H)	1.090 (H)	8.65 (M)	1.236 (H)	13.34 (M)	1.258(VH)	8.71 (L)	1.168(VH)	5.68 (L)
153. Junagadh	(13)	1.131 (H)	1.031 (M)	8.80 (M)	1.236 (H)	2.87(VL)	1.023 (M)	12.12 (M)	1.068 (H)	12.93 (H)
154. Balaghat	(4)	1.149 (H)	1.047 (M)	8.92 (M)	1.252 (H)	7.32 (L)	1.174 (H)	5.96 (L)	1.087 (H)	10.03 (M)
155. Ratlam	(4)	1.180 (H)	1.074 (M)	8.93 (M)	1.308 (H)	7.37 (L)	1.200 (H)	5.98 (L)	1.103 (H)	10.04 (M)
156. Birbhum	(14)	1.147 (H)	1.040 (M)	9.35 (M)	1.132 (H)	0.83(VL)	1.131 (H)	20.69 (H)	1.156(VH)	14.35 (H)
157. Surendranagar	(13)	1.154 (H)	1.046 (M)	9.35 (M)	1.278 (H)	3.88 (L)	1.046 (M)	12.58 (M)	1.079 (H)	13.23 (H)
158. North Cachar Hills	(8)	1.202 (H)	1.085 (H)	9.72 (M)	1.184 (H)	13.44 (M)	1.344(VH)	12.14 (M)	1.213(VH)	7.54 (L)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij} 1960-61			First Phase: Index : $L_{ij}(I)$ 1960-61		Second Phase: Index : $L_{ij}(II)$ 1960-61		Third Phase: Index : $L_{ij}(III)$ 1960-61	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
159. Sirmaur	(11)	1.173 (H)	1.059 (M)	9.74 (M)	1.267 (H)	11.44 (M)	1.129 (H)	10.88 (M)	1.117 (H)	8.58 (M)
160. Jhunjhunu	(2)	1.179 (H)	1.062 (M)	9.94 (M)	1.349 (H)	10.15 (M)	1.180 (H)	7.10 (L)	1.077 (H)	9.78 (M)
161. Purulia	(14)	1.173 (H)	1.055 (M)	10.06 (M)	1.176 (H)	2.26 (VL)	1.153 (H)	21.26 (H)	1.170 (VH)	14.76 (H)
162. Jalpaiguri	(14)	1.209 (H)	1.084 (H)	10.32 (M)	1.239 (H)	2.90 (VL)	1.183 (H)	21.52 (H)	1.191 (VH)	14.95 (H)
163. Damoh	(4)	1.217 (H)	1.091 (H)	10.34 (M)	1.376 (VH)	9.71 (M)	1.231 (H)	7.18 (L)	1.122 (H)	10.81 (M)
164. West Dinajpur	(14)	1.222 (H)	1.095 (H)	10.35 (M)	1.261 (H)	3.02 (VL)	1.194 (H)	21.57 (H)	1.198 (VH)	14.98 (H)
165. Singhbhum	(6)	1.136 (H)	1.018 (M)	10.38 (M)	1.136 (H)	16.37 (H)	1.206 (H)	10.32 (M)	1.135 (H)	6.79 (L)
166. Bilaspur	(4)	1.197 (H)	1.072 (M)	10.42 (M)	1.339 (H)	9.83 (M)	1.214 (H)	7.24 (L)	1.112 (H)	10.85 (M)
167. Gaya	(6)	1.180 (H)	1.056 (M)	10.55 (M)	1.213 (H)	16.48 (H)	1.246 (H)	10.38 (M)	1.160 (VH)	6.83 (L)
168. Raipur	(4)	1.191 (H)	1.063 (M)	10.77 (M)	1.328 (H)	10.41 (M)	1.210 (H)	7.54 (L)	1.109 (H)	11.04 (M)
169. Ujjain	(4)	1.142 (H)	1.019 (M)	10.80 (M)	1.240 (H)	10.43 (M)	1.169 (H)	7.55 (L)	1.084 (H)	11.05 (M)
170. Kota	(2)	1.207 (H)	1.069 (M)	11.44 (M)	1.401 (VH)	12.53 (M)	1.203 (H)	8.34 (L)	1.090 (H)	10.59 (M)
171. Mandsaur	(4)	1.131 (H)	0.995 (M)	12.04 (M)	1.220 (H)	12.48 (M)	1.159 (H)	8.61 (L)	1.078 (H)	11.73 (M)
172. Ranchi	(6)	1.209 (H)	1.063 (M)	12.07 (M)	1.264 (H)	18.82 (H)	1.272 (VH)	11.64 (M)	1.176 (VH)	7.71 (M)
173. Narsimhapur	(4)	1.171 (H)	1.027 (M)	12.32 (M)	1.292 (H)	12.93 (M)	1.193 (H)	8.85 (L)	1.098 (H)	11.88 (M)
174. Sholapur	(10)	1.209 (H)	1.056 (M)	12.65 (M)	1.429 (VH)	12.70 (M)	1.021 (M)	9.89 (M)	1.077 (H)	12.61 (H)
175. Durg	(4)	1.212 (H)	1.058 (M)	12.66 (M)	1.366 (H)	13.48 (M)	1.227 (H)	9.14 (L)	1.119 (H)	12.07 (M)
176. Nasik	(10)	1.170 (H)	1.020 (M)	12.79 (M)	1.355 (H)	12.92 (M)	0.995 (M)	10.01 (M)	1.058 (H)	12.68 (H)
177. Hoshangabad	(4)	1.142 (H)	0.995 (M)	12.81 (M)	1.239 (H)	13.75 (M)	1.168 (H)	9.28 (L)	1.083 (H)	12.16 (M)
178. Jind	(16)	1.148 (H)	0.997 (M)	13.14 (M)	1.230 (H)	15.03 (M)	1.047 (M)	11.31 (M)	1.099 (H)	11.87 (M)
179. Jammu	(3)	1.146 (H)	0.992 (M)	13.45 (M)	1.219 (H)	17.55 (H)	1.107 (H)	14.01 (M)	1.102 (H)	10.73 (M)
180. Sagar	(4)	1.197 (H)	1.035 (M)	13.50 (M)	1.339 (H)	14.84 (M)	1.214 (H)	9.85 (M)	1.112 (H)	12.53 (M)
181. Ahmadnagar	(10)	1.170 (H)	1.011 (M)	13.57 (M)	1.355 (H)	14.18 (M)	0.995 (M)	10.66 (M)	1.058 (H)	13.11 (H)
182. Thana	(10)	1.142 (H)	0.987 (M)	13.58 (M)	1.304 (M)	14.20 (M)	0.976 (M)	10.67 (M)	1.045 (M)	13.11 (H)
183. Sangli	(10)	1.129 (H)	0.975 (M)	13.62 (M)	1.280 (H)	14.28 (M)	0.967 (M)	10.71 (M)	1.038 (M)	13.14 (H)
184. Kulu	(11)	1.188 (H)	1.025 (M)	13.67 (M)	1.301 (H)	18.28 (H)	1.077 (M)	9.05 (L)	1.120 (H)	10.46 (M)
185. Sehore	(4)	1.200 (H)	1.033 (M)	13.91 (M)	1.345 (H)	15.51 (M)	1.217 (H)	10.21 (M)	1.113 (H)	12.76 (H)
186. Kolhapur	(10)	1.158 (H)	0.997 (M)	13.93 (M)	1.334 (H)	14.76 (M)	0.987 (M)	10.96 (M)	1.053 (H)	13.30 (H)
187. Kolaba	(10)	1.217 (H)	1.041 (M)	14.46 (M)	1.445 (VH)	15.57 (M)	1.027 (M)	11.38 (M)	1.081 (H)	13.58 (H)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase Composite Index : L_{ij}			First Phase Index : $L_{ij}(I)$		Second Phase Index : $L_{ij}(II)$		Third Phase Index : $L_{ij}(III)$	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
188. Bhandara	(10)	1.161 (H)	0.992 (M)	14.52 (H)	1.339 (H)	15.69 (M)	0.989 (M)	11.45 (M)	1.054 (H)	13.62 (H)
189. Buldhane	(10)	1.141 (H)	0.969 (M)	15.07 (H)	1.302 (H)	16.60 (H)	0.975 (M)	11.92 (M)	1.044 (M)	13.93 (H)
190. Manipur South	(16)	1.148 (H)	0.972 (M)	15.40 (H)	1.230 (H)	18.73 (H)	1.047 (M)	13.25 (M)	1.099 (H)	13.17 (H)
191. Ghazipur	(7)	1.192 (H)	1.008 (M)	15.46 (H)	1.287 (H)	22.91(VH)	1.256(VH)	22.52(VH)	1.135 (H)	10.40 (M)
192. Mirzapur	(7)	1.208 (H)	1.020 (M)	15.53 (H)	1.315 (H)	22.95(VH)	1.270(VH)	22.54(VH)	1.143 (H)	10.41 (M)
193. Ballia	(7)	1.161 (H)	0.980 (M)	15.57 (H)	1.232 (H)	23.22(VH)	1.229 (H)	22.68(VH)	1.119 (H)	10.52 (M)
194. Nellore	(5)	1.134 (H)	0.951 (M)	16.14 (H)	1.073 (M)	28.23(VH)	1.211 (H)	15.28 (M)	1.170(VH)	9.49 (M)
195. Saharanpur	(7)	1.202 (H)	0.999 (M)	16.89 (H)	1.305 (H)	25.09(VH)	1.265(VH)	23.63(VH)	1.140 (H)	11.25 (M)
196. Azamgarh	(7)	1.224 (H)	1.016 (M)	16,97 (H)	1.344 (H)	25.13(VH)	1.284(VH)	23.65(VH)	1.152(VH)	11.26 (M)
197. Kinnaur	(11)	1.138 (H)	0.942 (M)	17.19 (H)	1.204 (H)	23.60(VH)	1.100 (H)	17.22 (H)	1.098 (H)	12.97 (H)
198. Tehri Garhwal	(7)	1.142 (H)	0.945 (M)	17.19 (H)	1.197 (H)	25.88(VH)	1.212 (H)	24.03(VH)	1.108 (H)	11.56 (M)
199. Farrukhabad	(7)	1.170 (H)	0.968 (M)	17.27 (H)	1.249 (H)	25.85(VH)	1.237 (H)	24.02(VH)	1.124 (H)	11.55 (M)
200. Mathura	(7)	1.141 (H)	0.943 (M)	17.39 (H)	1.197 (H)	26.19(VH)	1.211 (H)	24.19(VH)	1.108 (H)	11.69 (M)
201. Mainpuri	(7)	1.184 (H)	0.975 (M)	17.65 (H)	1.272 (H)	26.37(VH)	1.249 (H)	24.28(VH)	1.131 (H)	11.76 (M)
202. Hamirpur	(7)	1.222 (H)	1.003 (M)	17.89 (H)	1.341 (H)	26.56(VH)	1.282(VH)	24.38(VH)	1.151(VH)	11.83 (M)
203. Fatehpur	(7)	1.215 (H)	0.997 (M)	17.96 (H)	1.329 (H)	26.69(VH)	1.276(VH)	24.45(VH)	1.147 (H)	11.89 (M)
204. Jaunpur	(7)	1.179 (H)	0.966 (M)	18.08 (H)	1.264 (H)	27.07(VH)	1.245 (H)	24.64(VH)	1.128 (H)	12.04 (M)
205. Buland	(7)	1.208 (H)	0.985 (M)	18.47 (H)	1.316 (H)	27.53(VH)	1.270(VH)	24.88(VH)	1.144 (H)	12.22 (M)
206. Jhansi	(7)	1.172 (H)	0.954 (M)	18.63 (H)	1.251 (H)	27.97(VH)	1.238 (H)	25.11(VH)	1.124 (H)	12.40 (M)
207. Allahabad	(7)	1.172 (H)	0.953 (M)	18.68 (H)	1.252 (H)	28.03(VH)	1.239 (H)	25.14(VH)	1.125 (H)	12.43 (M)
208. Aligarh	(7)	1.180 (H)	0.960 (M)	18.70 (H)	1.266 (H)	28.02(VH)	1.246 (H)	25.13(VH)	1.129 (H)	12.42 (M)
209. Etawah	(7)	1.128 (H)	0.916 (L)	18.79 (H)	1.173 (H)	28.47(VH)	1.199 (H)	25.37(VH)	1.101 (H)	12.60(VH)
210. Meerut	(7)	1.140 (H)	0.924 (L)	18.91 (H)	1.195 (H)	28.58(VH)	1.210 (H)	25.43(VH)	1.107 (H)	12.65 (H)
211. Uttar Kashi	(7)	1.195 (H)	0.938 (M)	21.48(VH)	1.292 (H)	32.22(EH)	1.258(VH)	27.19(VH)	1.136 (H)	14.16 (H)
ALL-INDIA		1.126 (H)	1.000 (M)	11.19 (M)	1.147 (H)	12.82 (M)	1.144 (H)	12.59 (M)	1.113 (H)	10.15 (M)
212. Kamrup	(8)	1.084 (H)	1.050 (M)	3.05 (L)	0.987 (M)	2.00(VL)	1.226 (H)	6.39 (L)	1.141 (H)	3.59 (L)
213. Lakhimpur	(8)	1.088 (H)	1.048 (M)	3.75 (L)	0.995 (M)	3.25 (L)	1.231 (H)	6.99 (L)	1.144 (H)	4.00 (L)
214. Kurnool	(5)	1.100 (H)	1.048 (M)	4.72 (L)	1.017 (M)	9.46 (L)	1.179 (H)	4.85 (L)	1.150(VH)	2.20(VL)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))			Total Phase — Composite Index : L_{ij}			First Phase — Index : $L_{ij}(I)$		Second Phase — Index : $L_{ij}(II)$		Third Phase — Index : $L_{ij}(III)$	
			1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)			(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
215.	Nowgong	(8)	1.122 (H)	1.066 (M)	4.98 (L)	1.050 (M)	5.44 (L)	1.264 (VH)	8.05 (L)	1.165 (VH)	4.73 (L)
216.	United Khasi & Jaintia Hills	(8)	1.121 (H)	1.064 (M)	5.02 (L)	1.048 (M)	5.52 (L)	1.263 (VH)	8.09 (L)	1.164 (VH)	4.76 (L)
217.	Shahabad	(6)	1.122 (H)	1.062 (M)	5.37 (L)	1.114 (M)	8.03 (L)	1.194 (H)	5.95 (L)	1.128 (H)	3.79 (L)
218.	East Godavari	(5)	1.094 (H)	1.034 (M)	5.55 (L)	1.008 (M)	10.90 (M)	1.174 (H)	5.61 (L)	1.146 (H)	2.72 (L)
219.	Anantapur	(5)	1.115 (H)	1.048 (M)	6.02 (L)	1.042 (M)	11.63 (M)	1.193 (H)	6.00 (L)	1.159 (VH)	2.99 (L)
220.	Chitradurga	(9)	1.081 (H)	1.010 (M)	6.57 (L)	1.028 (M)	6.56 (L)	1.077 (M)	3.13 (VL)	1.113 (H)	6.58 (L)
221.	Hassan	(9)	1.098 (H)	1.022 (M)	6.90 (L)	1.056 (M)	7.14 (L)	1.092 (H)	3.43 (L)	1.123 (H)	6.77 (L)
222.	Tumkur	(9)	1.118 (H)	1.038 (M)	7.14 (L)	1.090 (M)	7.55 (L)	1.110 (H)	3.64 (L)	1.135 (H)	6.91 (L)
223.	Cuddapah	(5)	1.092 (H)	1.011 (M)	7.36 (L)	1.004 (M)	14.01 (M)	1.171 (H)	7.27 (L)	1.144 (H)	3.87 (L)
224.	Ongole	(5)	1.102 (H)	1.016 (M)	7.84 (L)	1.024 (M)	15.04 (M)	1.179 (H)	7.54 (L)	1.149 (H)	3.99 (L)
225.	Lahul and Spiti	(11)	1.093 (H)	1.005 (M)	8.01 (L)	1.133 (H)	9.24 (L)	1.005 (M)	4.14 (L)	1.069 (H)	7.22 (L)
226.	Khandwa	(4)	1.119 (H)	1.028 (M)	8.11 (L)	1.198 (H)	5.92 (L)	1.149 (H)	5.25 (L)	1.071 (H)	9.58 (M)
227.	Bankura	(14)	1.102 (H)	1.011 (M)	8.26 (L)	1.056 (M)	(-) 1.42 (N)	1.093 (H)	19.79 (H)	1.130 (H)	13.70 (H)
228.	Jamnagar	(13)	1.117 (H)	1.024 (M)	8.31 (L)	1.212 (H)	1.96 (VL)	1.018 (M)	11.71 (M)	1.060 (H)	12.66 (H)
229.	Amreli	(13)	1.082 (H)	0.989 (M)	8.60 (M)	1.149 (H)	2.31 (VL)	0.992 (M)	11.87 (M)	1.042 (M)	12.76 (H)
230.	Bhavnagar	(13)	1.089 (H)	0.990 (M)	9.05 (M)	1.161 (H)	3.12 (VL)	0.997 (M)	12.24 (M)	1.045 (M)	13.00 (H)
231.	Palghat	(18)	1.124 (H)	1.020 (M)	9.18 (M)	1.008 (M)	11.26 (M)	1.083 (M)	9.05 (L)	1.193 (VH)	8.12 (M)
232.	Puri	(1)	1.094 (H)	0.988 (M)	9.71 (M)	1.029 (M)	15.07 (M)	1.270 (VH)	17.05 (H)	1.133 (H)	6.79 (L)
233.	Ajmer	(2)	1.111 (H)	1.003 (M)	9.75 (M)	1.225 (H)	9.84 (M)	1.125 (H)	6.94 (L)	1.043 (M)	9.68 (M)
234.	Nadia	(14)	1.107 (H)	0.998 (M)	9.80 (M)	1.065 (M)	1.44 (VL)	1.097 (H)	20.93 (H)	1.132 (H)	14.52 (H)
235.	Mahasu	(11)	1.091 (H)	0.976 (M)	10.53 (M)	1.122 (M)	12.85 (M)	1.062 (M)	11.59 (M)	1.072 (H)	9.07 (M)
236.	Chittoor	(5)	1.116 (M)	0.995 (M)	10.87 (M)	1.044 (M)	19.77 (H)	1.194 (H)	10.43 (M)	1.160 (VH)	6.06 (L)
237.	Akola	(10)	1.081 (H)	0.960 (M)	11.23 (M)	1.192 (H)	10.36 (M)	0.933 (M)	8.69 (L)	1.014 (M)	11.84 (L)
238.	Dharmapuri	(19)	1.088 (H)	0.960 (M)	11.77 (M)	0.879 (M)	(-) 0.09 (N)	1.285 (VH)	10.68 (M)	1.213 (VH)	16.93 (H)
239.	Sabarkantha	(13)	1.120 (H)	0.982 (M)	12.31 (M)	1.216 (H)	8.78 (L)	1.020 (M)	14.84 (M)	1.062 (H)	14.73 (H)
240.	Dhanbad	(6)	1.110 (H)	0.973 (M)	12.33 (M)	1.092 (M)	19.70 (H)	1.182 (H)	12.09 (M)	1.120 (H)	8.02 (M)
241.	Bhatinda	(16)	1.109 (H)	0.972 (M)	12.41 (M)	1.161 (H)	13.86 (M)	1.017 (M)	10.69 (M)	1.078 (H)	11.47 (M)
242.	Gwalior	(4)	1.087 (H)	0.950 (M)	12.65 (M)	1.142 (H)	13.53 (M)	1.122 (H)	9.16 (L)	1.054 (H)	12.08 (M)
243.	Dadra and Nagar Haveli	(13)	1.078 (H)	0.934 (M)	13.37 (M)	1.167 (H)	7.37 (L)	0.958 (M)	14.51 (M)	1.025 (M)	17.46 (H)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase			First Phase		Second Phase		Third Phase	
		Composite Index : L_{ij}			Index : $L_{ij}(I)$		Index : $L_{ij}(II)$		Index : $L_{ij}(III)$	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
244. Wardha	(10)	1.104 (H)	0.947 (M)	14.19 (H)	1.234 (H)	15.21 (M)	0.949 (M)	11.20 (M)	1.026 (M)	13.46 (H)
245. Bilaspur	(11)	1.076 (H)	0.922 (L)	14.37 (H)	1.096 (M)	19.25 (H)	1.050 (M)	14.90 (M)	1.064 (H)	11.35 (M)
246. Mandi	(11)	1.097 (H)	0.934 (M)	14.93 (H)	1.133 (H)	20.11 (H)	1.068 (M)	15.35 (M)	1.076 (H)	11.66 (M)
247. Hisar	(16)	1.119 (H)	0.944 (M)	15.57 (H)	1.178 (H)	19.07 (H)	1.024 (M)	13.44 (M)	1.083 (H)	13.29 (H)
248. Ratnagiri	(10)	1.124 (H)	0.948 (M)	15.74 (H)	1.272 (H)	17.69 (H)	0.964 (M)	12.50 (M)	1.036 (M)	14.31 (H)
249. Karnal	(16)	1.122 (H)	0.939 (M)	16.30 (H)	1.184 (H)	20.25 (H)	1.027 (M)	14.07 (M)	1.085 (H)	13.72 (H)
250. Varanasi	(7)	1.088 (H)	0.904 (L)	16.92 (H)	1.105 (M)	25.73(VH)	1.164 (H)	23.95(VH)	1.079 (H)	11.50 (M)
251. Agra	(7)	1.125 (H)	0.933 (M)	17.04 (H)	1.168 (H)	25.73(VH)	1.197 (H)	23.95(VH)	1.099 (H)	11.50 (M)
252. Jalaun	(7)	1.105 (H)	0.902 (L)	18.39 (H)	1.134 (H)	27.97(VH)	1.179 (H)	25.11(VH)	1.088 (H)	12.40 (M)
253. Manipur West	(12)	1.010 (M)	1.014 (M)	(-) 0.36 (N)	0.893 (M)	(-) 4.84 (N)	1.086 (H)	1.31(VL)	1.081 (H)	1.87(VL)
254. Manipur North	(12)	1.004 (M)	1.007 (M)	(-) 0.32 (N)	0.883 (M)	(-) 4.79 (N)	1.080 (M)	1.34(VL)	1.077 (H)	1.88(VL)
255. Bharuch	(13)	0.969 (M)	0.946 (M)	2.30(VL)	0.952 (M)	(-) 9.71 (N)	0.903 (L)	6.60 (L)	0.979 (M)	9.32 (M)
256. Bijapur	(9)	1.065 (M)	1.033 (M)	3.05 (L)	1.002 (M)	0.31(VL)	1.064 (M)	(-) 0.06 (N)	1.103 (H)	4.54 (L)
257. Sibsagar	(8)	1.002 (M)	0.971 (M)	3.10 (L)	0.857 (L)	2.03(VL)	1.142 (H)	6.40 (L)	1.089 (H)	3.60 (L)
258. West Godavari	(5)	1.038 (M)	0.996 (M)	4.04 (L)	0.916 (M)	8.47 (L)	1.119 (H)	4.33 (H)	1.110 (H)	1.85(VL)
259. Cachar	(8)	1.070 (M)	1.022 (M)	4.46 (L)	0.965 (M)	4.53 (L)	1.212 (H)	7.61 (L)	1.132 (H)	4.43 (L)
260. Balasore	(1)	1.072 (M)	1.021 (M)	4.75 (L)	0.993 (M)	6.59 (L)	1.247 (H)	13.00 (M)	1.119 (M)	3.78 (L)
261. Krishna	(5)	1.029 (M)	0.980 (M)	4.77 (L)	0.903 (M)	9.78 (M)	1.111 (H)	5.02 (L)	1.105 (H)	2.32(VL)
262. Belgaum	(9)	1.067 (M)	1.003 (M)	6.01 (L)	1.005 (M)	5.57 (L)	1.065 (M)	2.62(VL)	1.104 (H)	6.25 (L)
263. Dharwar	(9)	0.938 (M)	0.878 (L)	6.40 (L)	0.797 (L)	6.25 (L)	0.949 (M)	2.96(VL)	1.023 (M)	6.47 (L)
264. Valsad	(13)	1.015 (M)	0.946 (M)	6.77 (L)	1.031 (M)	(-) 1.25 (N)	0.939 (M)	10.24 (M)	1.005 (M)	11.71 (M)

Table 2.15 (Continued)

	Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij} 1960-61	1970-71	% reduction in 1970-71 to 1960-61	First Phase: Index : L_{ij}(I) 1960-61	% reduction in 1970-71 to 1960-61	Second Phase: Index : L_{ij}(II) 1960-61	% reduction in 1970-71 to 1960-61	Third Phase: Index : L_{ij}(III) 1960-61	% reduction in 1970-71 to 1960-61
	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
265.	Surat	(13)	0.989 (M)	0.921 (L)	6.83 (L)	0.987 (M)	(-) 1.26 (N)	0.919 (M)	10.26 (M)	0.990 (M)	11.67 (M)
266.	Cuttack	(1)	1.074 (M)	0.988 (M)	8.02 (L)	0.997 (M)	12.26 (M)	1.250 (H)	15.68 (H)	1.121 (H)	5.77 (L)
267.	Patna	(6)	1.026 (M)	0.943 (M)	8.10 (L)	0.952 (M)	12.92 (M)	1.104 (H)	8.49 (L)	1.070 (H)	5.53 (L)
268.	Chikmagalur	(9)	1.071 (M)	0.984 (M)	8.11 (L)	1.011 (M)	9.26 (L)	1.068 (M)	4.53 (L)	1.107 (H)	7.48 (L)
269.	Satara	(10)	1.038 (M)	0.950 (M)	8.46 (M)	1.115 (M)	5.69 (L)	0.902 (L)	6.34 (L)	0.992 (M)	10.33 (M)
270.	Mokokchung	(12)	0.940 (M)	0.860 (L)	8.53 (M)	0.784 (L)	11.63 (M)	1.015 (M)	9.16 (L)	1.033 (M)	7.11 (L)
271.	West Tripura	(12)	1.002 (M)	0.911 (L)	9.00 (M)	0.881 (M)	12.33 (M)	1.076 (M)	9.52 (M)	1.074 (H)	7.36 (L)
272.	Mahesana	(13)	0.981 (M)	0.893 (L)	9.02 (M)	0.973 (M)	2.58(VL)	0.913 (L)	11.99 (M)	0.986 (M)	12.84 (H)
273.	North Tripura	(12)	1.000 (M)	0.910 (L)	9.03 (M)	0.878 (M)	12.37 (M)	1.074 (M)	9.53 (M)	1.073 (H)	7.39 (L)
274.	South Tripura	(12)	1.062 (M)	0.966 (M)	9.06 (M)	0.978 (M)	12.31 (M)	1.134 (H)	9.54 (M)	1.112 (H)	7.35 (L)
275.	Cannanore	(18)	0.942 (M)	0.856 (L)	9.14 (M)	0.728 (L)	11.51 (M)	0.920 (M)	9.12 (L)	1.070 (H)	8.17 (M)
276.	North Kanara	(9)	0.994 (M)	0.903 (L)	9.17 (M)	0.885 (M)	11.20 (M)	1.000 (M)	5.56 (L)	1.059 (H)	8.15 (M)
277.	Darjeeling	(14)	1.054 (M)	0.957 (M)	9.24 (M)	0.978 (M)	0.06(VL)	1.051 (M)	20.38 (H)	1.100 (H)	14.13 (H)
278.	Kohima	(12)	1.014 (M)	0.918 (L)	9.49 (M)	0.900 (M)	13.13 (M)	1.087 (H)	9.89 (M)	1.082 (M)	7.67 (M)
279.	Shimoga	(9)	1.062 (M)	0.959 (M)	9.64 (M)	0.996 (M)	11.92 (M)	1.060 (M)	5.95 (L)	1.101 (H)	8.40 (M)
280.	Vadodara	(13)	0.976 (M)	0.880 (L)	9.88 (M)	0.965 (M)	4.09 (L)	0.909 (L)	12.68 (M)	0.983 (M)	13.29 (H)
281.	Coorg	(9)	0.992 (M)	0.894 (L)	9.97 (M)	0.883 (M)	12.62 (M)	0.999 (M)	6.32 (L)	1.058 (H)	8.64 (M)
282.	Bangalore	(9)	0.979 (M)	0.877 (L)	10.35 (M)	0.861 (L)	12.32 (M)	0.986 (M)	6.70 (L)	1.049 (M)	8.89 (M)
283.	Amravati	(10)	1.063 (M)	0.952 (M)	10.45 (M)	1.160 (H)	9.05 (L)	0.920 (M)	8.03 (L)	1.005 (M)	11.41 (M)
284.	Burdwan	(14)	1.064 (M)	0.942 (M)	11.43 (M)	0.993 (M)	4.19 (L)	1.059 (M)	22.04 (H)	1.106 (H)	15.32 (H)
285.	Jabalpur	(4)	1.060 (M)	0.938 (M)	11.49 (M)	1,095 (M)	11.58 (M)	1.098 (H)	8.14 (L)	1.039 (M)	11.43 (M)
286.	Hooghly	(14)	0.981 (M)	0.868 (L)	11.50 (M)	0.858 (L)	3.87 (L)	0.985 (M)	21.91 (H)	1.054 (H)	15.23 (H)
287.	Goa	(15)	1.016 (M)	0.898 (L)	11.56 (M)	0.875 (M)	19.20 (H)	0.916 (M)	5.57 (L)	1.100 (H)	7.91 (M)
288.	Howrah	(14)	0.951 (M)	0.837 (L)	11.99 (M)	0.812 (L)	4.62 (L)	0.958 (M)	22.22(VH)	1.035 (M)	15.45 (H)
289.	Rajkot	(13)	1.027 (M)	0.902 (L)	12.15 (M)	1.052 (M)	8.27 (L)	0.949 (M)	14.60 (M)	1.012 (M)	14.57 (H)
290.	Indore	(4)	0.930 (M)	0.817 (L)	12.15 (M)	0.874 (L)	12.75 (M)	0.981 (M)	8.75 (L)	0.964 (M)	11.82 (M)
291.	Salem	(19)	0.965 (M)	0.847 (L)	12.25 (M).	0.700 (L)	(-) 0.15 (N)	1.291(VH)	20.64 (H)	1.124 (H)	16.88 (H)
292.	Midnapore	(14)	1.036 (M)	0.905 (L)	12.61 (M)	0.947 (M)	6.24 (L)	1.035 (M)	22.88(VH)	1.089 (H)	15.93(VH)
293.	Kangra	(11)	0.992 (M)	0.867 (L)	12.64 (M)	0.960 (M)	17.19 (H)	0.925 (M)	8.43 (L)	1.012 (M)	10.06 (M)
294.	Firozpur	(16)	1.067 (M)	0.927 (M)	13.08 (M)	1.087 (M)	15.04 (M)	0.984 (M)	11.31 (M)	1.055 (H)	11.87 (M)

Table 2.15 (Continued)

Name of District (State Number of Ref. Table (2.11))		Total Phase			First Phase		Second Phase		Third Phase	
		Composite Index : L_{ij}			Index : $L_{ij}(I)$		Index : $L_{ij}(II)$		Index : $L_{ij}(III)$	
		1960-61	1970-71	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61	1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
295. Amritsar	(16)	0.990 (M)	0.852 (L)	13.95 (M)	0.957 (M)	16.63 (H)	0.923 (M)	12.14 (M)	1.011 (M)	12.43 (M)
296. Kheda	(13)	0.937 (M)	0.805 (L)	14.10 (H)	0.899 (M)	11.48 (M)	0.877 (L)	16.11 (H)	0.960 (M)	15.58 (H)
297. Nagpur	(10)	1.027 (M)	0.882 (L)	14.11 (H)	1.095 (M)	15.14 (M)	0.894 (L)	11.16 (M)	0.986 (M)	13.43 (H)
298. 24-Parganas	(14)	1.009 (M)	0.866 (L)	14.12 (H)	0.903 (M)	8.93 (L)	1.010 (M)	23.99(VH)	1.072 (H)	16.74 (H)
299. Malappuram	(18)	0.978 (M)	0.838 (L)	14.30 (H)	0.782 (L)	20.90 (H)	0.953 (M)	14.01 (M)	1.095 (H)	11.47 (M)
300. Simla	(11)	1.024 (M)	0.871 (L)	14.87 (H)	0.978 (M)	17.98 (H)	0.980 (M)	13.18 (M)	1.051 (H)	13.13 (H)
301. Kapurthala	(16)	0.981 (M)	0.834 (L)	15.05 (H)	0.941 (M)	18.52 (H)	0.916 (M)	13.14 (M)	1.005 (M)	13.10 (H)
302. Ambala	(16)	0.969 (M)	0.823 (L)	15.11 (H)	0.922 (M)	18.69 (H)	0.906 (L)	13.19 (M)	0.998 (M)	13.12 (H)
303. Patiala	(16)	1.046 (M)	0.886 (L)	15.24 (H)	1.051 (M)	18.69 (H)	0.968 (M)	13.24 (M)	1.043 (M)	13.16 (H)
304. South Kanara	(9)	1.021 (M)	0.862 (L)	15.53 (H)	0.929 (M)	22.15 (H)	1.024 (M)	11.58 (M)	1.076 (H)	12.09 (M)
305. Kozikode	(18)	0.954 (M)	0.802 (L)	15.92 (H)	0.746 (L)	23.82(VH)	0.931 (M)	15.68 (M)	1.079 (H)	12.64 (H)
306. Lucknow	(7)	1.058 (M)	0.882 (L)	16.60 (H)	1.052 (M)	25.40(VH)	1.136 (H)	23.78(VH)	1.061 (H)	11.37 (M)
307. Guntur	(5)	1.047 (M)	0.873 (L)	16.63 (H)	0.932 (M)	29.67(EH)	1.128 (H)	16.14 (H)	1.116 (H)	10.10 (M)
308. Jalgaon	(10)	1.006 (M)	0.838 (L)	16.69 (H)	1.058 (M)	19.41 (H)	0.879 (L)	13.42 (M)	0.974 (M)	14.91 (H)
309. North Arcot	(19)	0.956 (M)	0.794 (L)	16.90 (H)	0.688 (L)	9.64 (M)	1.093 (H)	11.69 (M)	1.116 (H)	19.58(VH)
310. Poona	(10)	1.058 (M)	0.878 (L)	17.04 (H)	1.151 (H)	19.89 (H)	0.917 (M)	13.68 (M)	1.002 (M)	15.08 (H)
311. Gurdaspur	(16)	1.029 (M)	0.847 (L)	17.66 (H)	1.021 (M)	22.76(VH)	0.954 (M)	15.43 (M)	1.033 (M)	14.63 (H)
312. Ropar	(16)	0.966 (M)	0.795 (L)	17.71 (H)	0.916 (M)	23.09(VH)	0.904 (L)	15.66 (M)	0.996 (M)	14.74 (H)
313. Kanpur	(7)	1.024 (M)	0.837 (L)	18.31 (H)	0.995 (M)	28.35(VH)	1.105 (H)	25.31(VH)	1.042 (M)	12.56 (M)
314. Gurgaon	(16)	1.058 (M)	0.864 (L)	18.34 (H)	1.072 (M)	23.77(VH)	0.977 (M)	15.99 (H)	1.050 (H)	15.01 (H)
315. Dehradun	(7)	0.937 (M)	0.764(VL)	18.41 (H)	0.850 (L)	29.13(EH)	1.021 (M)	25.72(VH)	0.989 (M)	12.88 (H)
316. Mahendranagar	(16)	1.066 (M)	0.852 (L)	20.07(VH)	1.085 (M)	26.57(VH)	0.983 (M)	17.55 (H)	1.054 (H)	16.06 (H)
317. Rohtak	(16)	1.044 (M)	0.829 (L)	20.55(VH)	1.047 (M)	27.44(VH)	0.966 (M)	18.04 (H)	1.042 (M)	16.39 (H)
318. Hoshiarpur	(16)	0.958 (M)	0.742(VL)	22.57(VH)	0.903 (M)	31.19(EH)	0.897 (L)	20.18 (H)	0.991 (M)	17.86(VH)
319. Delhi	(17)	0.935 (M)	0.714(VL)	23.60(VH)	0.911 (M)	21.99 (H)	0.874 (L)	11.36 (M)	0.949 (L)	24.52(EH)
320. Hyderabad	(5)	0.940 (M)	0.695(VL)	26.05(EH)	0.765 (L)	45.59(EH)	1.022 (M)	26.24(VH)	1.046 (M)	17.47 (H)
321. Manipur East	(12)	0.859 (L)	0.859 (L)	(-)0.04 (N)	0.661 (L)	(-) 4.80 (N)	0.934 (M)	1.29(VL)	0.978 (M)	1.89(VL)
322. Manipur South	(12)	0.870 (L)	0.870 (L)	(-)0.03 (N)	0.676 (L)	(-) 4.83 (N)	0.945 (M)	1.32(VL)	0.986 (M)	1.95(VL)
323. Manipur Central	(12)	0.829 (L)	0.829 (L)	0.08(VL)	0.627 (L)	(-) 4.62 (N)	0.895 (L)	1.30(VL)	0.951 (M)	1.94(VL)

Table 2.15 (Concluded)

Name of District (State Number of Ref. Table (2.11))		Total Phase: Composite Index : L_{ij} 1960-61	1970-71	% reduction in 1970-71 to 1960-61	First Phase: Index : $L_{ij}(I)$ 1960-61	% reduction in 1970-71 to 1960-61	Second Phase: Index : $L_{ij}(II)$ 1960-61	% reduction in 1970-71 to 1960-61	Third Phase: Index : $L_{ij}(III)$ 1960-61	% reduction in 1970-71 to 1960-61
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
324. Gandhinagar	(13)	0.875 (L)	0.827 (L)	5.50 (L)	0.796 (L)	(-) 4.62 (N)	0.825 (L)	8.75 (L)	0.922 (L)	10.75 (M)
325. South Arcot	(19)	0.921 (L)	0.832 (L)	9.64 (M)	0.640 (L)	(-) 6.04 (N)	1.054 (M)	4.33 (L)	1.089 (H)	15.17 (H)
326. Trichur	(18)	0.897 (L)	0.791 (L)	11.80 (M)	0.663 (L)	16.61 (H)	0.878 (L)	11.76 (M)	1.037 (M)	9.95 (M)
327. Thanjavur	(19)	0.835 (L)	0.732(VL)	12.30 (M)	0.526(VL)	(-) 1.21 (N)	0.955 (M)	6.54 (L)	1.020 (M)	16.48 (H)
328. Kottayam	(18)	0.777 (L)	0.670(VL)	13.72 (M)	0.499(VL)	20.76 (H)	0.762 (L)	14.00 (M)	0.944 (L)	11.49 (M)
329. Ahmedabad	(13)	0.870 (L)	0.750(VL)	13.87 (M)	0.789 (L)	10.90 (M)	0.822 (L)	15.83 (H)	0.919 (L)	15.40 (H)
330. Tiruchirapalli	(19)	0.878 (L)	0.753(VL)	14.16 (H)	0.582(VL)	3.32 (L)	1.005 (M)	8.65 (L)	1.055 (H)	17.75(VH)
331. Ramanathpuram	(19)	0.838 (L)	0.713(VL)	14.93 (H)	0.530(VL)	4.65 (L)	0.959 (M)	9.28 (L)	1.023 (M)	18.12(VH)
332. Mizo	(12)	0.878 (L)	0.740(VL)	15.61 (H)	0.669 (L)	25.05(VH)	1.009 (M)	18.14 (H)	1.002 (M)	11.83 (M)
333. Madurai	(19)	0.841 (L)	0.709(VL)	15.66 (H)	0.533(VL)	6.26 (L)	0.962 (M)	10.05 (M)	1.025 (M)	18.59(VH)
334. Coimbatore	(19)	0.893 (L)	0.752(VL)	15.73 (H)	0.602(VL)	6.81 (L)	1.022 (M)	10.32 (M)	1.067 (H)	18.75(VH)
335. Tirunelveli	(19)	0.820 (L)	0.685(VL)	16.53 (H)	0.507(VL)	8.02 (L)	0.938 (M)	10.90 (M)	1.008 (M)	19.10(VH)
336. Ludhiana	(16)	0.911 (L)	0.760(VL)	16.54 (H)	0.826 (L)	21.34(VH)	0.858 (L)	14.66 (H)	0.962 (M)	14.07 (H)
337. Quilon	(18)	0.852 (L)	0.709(VL)	16.81 (H)	0.601(VL)	26.04(VH)	0.836 (L)	16.91 (H)	1.004 (M)	13.50 (H)
338. Jullunder	(16)	0.923 (L)	0.765(VL)	17.06 (H)	0.845 (L)	22.15(VH)	0.868 (L)	15.10 (M)	0.970 (M)	14.40 (H)
339. Ernakulam	(18)	0.852 (L)	0.704(VL)	17.46 (H)	0.601(VL)	27.21(VH)	0.836 (L)	17.58 (H)	1.004 (M)	13.96 (H)
340. Chingleput	(19)	0.924 (L)	0.747(VL)	19.16 (H)	0.645 (L)	14.14 (M)	1.058 (M)	13.91 (M)	1.092 (H)	20.94(VH)
341. Trivandrum	(18)	0.922 (L)	0.742(VL)	19.53 (H)	0.699 (L)	30.37(EH)	0.902 (L)	19.39 (H)	1.056 (H)	15.22 (H)
342. Nilgiris	(19)	0.839 (L)	0.668(VL)	20.36(VH)	0.531(VL)	16.33 (H)	0.960 (M)	15.02 (M)	1.024 (M)	21.61(VH)
343. Pondicherry	(19)	0.777 (L)	0.615(EL)	20.87(VH)	0.625 (L)	21.44 (H)	0.865 (L)	12.49 (M)	0.868 (L)	20.62(VH)
344. Madras	(19)	0.571(EL)	0.506(EL)	11.40 (M)	0.231(EL)	(-) 7.53 (N)	0.633(VL)	3.66 (L)	0.776(VL)	14.78 (H)
345. Chandigarh	(16)	0.601(EL)	0.514(EL)	14.43 (H)	0.372(EL)	18.61 (H)	0.576(VL)	13.23 (M)	0.738(EL)	13.16 (H)
346. Calcutta	(14)	0.745(VL)	0.633(VL)	15.00 (H)	0.510(VL)	9.46 (L)	0.759 (L)	24.22(VH)	0.886 (L)	16.91(VH)
347. Greater Bombay	(10)	0.720(VL)	0.611(EL)	15.19 (H)	0.586(VL)	17.41 (H)	0.654(VL)	12.35 (M)	0.800(VL)	14.21 (H)
348. Kanyakumari	(19)	0.748(VL)	0.597(EL)	20.24(VH)	0.419(VL)	15.75 (M)	0.853 (L)	14.73 (M)	0.946 (L)	21.43(VH)
349. Alleppey	(18)	0.754(VL)	0.584(EL)	22.46(VH)	0.469(VL)	37.04(EH)	0.739(VL)	23.34(VH)	0.924 (L)	18.02(VH)

Chapter 3

HUMAN RESOURCES IN THE ACTIVITY PHASE : THE GENERATION OF SPATIAL MEASURES ON THE INCIDENCES OF UNEMPLOYMENT AND THE EMPLOYMENT OPPORTUNITY AND THE RELATED REGIONAL ANALYSIS - 1961 TO 1971

3.1 Preamble

In the formative phase of human resource development, the all-India experience of escalating severity of the problem of non-development of basic-skill over consecutive phases is the direct outcome of the incidences of dropping out of schools at high rates. There is no specific answer availble to the question, why children drop out in such massive numbers. To quote from the " Challenge of Education - A Policy Perspective", prepared under the guidance of the Prime Minister of India, " Information in this regard is not available in sufficient detail" (ref. to the article by Mohinder Singh in the Statesman dated August 18, 1987). Despite the absence of full knowledge on the causes for drop-outs, some sort of common place explanation is often given - it is believed that pecuniary condition in poor families is so severe that they cannot indulge in the luxury of sparing their children for full-time engagement in schools, in the fear of loosing immediate earning possibilities, whatever little that may be. The dropped-out children are thus used either for income-generating activities or at least, for house chores, if not gainfully employed as child-labour. This could be a substantive reason, no doubt. Yet, there are also other factors for drop-outs, such as the inability to meet school expenses, indifference or negative attitude towards the schooling of girls, prevalent illiteracy condition in the family that fail to inspire the children for studies, in addition to the stated feature of abject poverty. Naik [1941], in his study, tried to assess objectively the relative weights for different causal factors of drop-outs, and he found that causes are mostly economic in origin for about two-third of the cases. The residual one-third is largely accounted by the factors associated with the inadequacies and unattractiveness of schooling systems and facilities. Blaug [1970] has further explained the economic implications of drop-outs and it goes in support of Naik's recommendation for improving people's economic condition as a remedy towards reducing the dropping-out incidences. Granting their observations, it seems that the necessary pre-requisites towards solving the problems of non-development of basic-skill in the formative phase are : 1) increase in the scopes for absorption of the mature youth and the adult people in gainful activities, and 2) provision of adequate schooling facilities with appropriately systematised education to all. In this chapter we propose to assess the present situation about the gainful occupation patterns of the adult males, so that we are in the position to know how the severity of the problem of non-development of basic-skill in the formative phase is associated in different areas with the degrees of adult unemployment and under-employment in their activity phase of life.

This necessitates the use of reliable and consistent statistics on unemployment and under-employment. Unfortunately, whatever little information is available in the Indian context, is not free from controversy in regards the reliability and the comparability over time and space dimensions (ref. to the Report of the Panel on the Assessment of the Extent of Unemployment and Under-employment [1972]). Again, the definition on the incidences of unemployment and under-employment itself has remained a moot point in the Indian context (ref. to Chaudhri [1974] and for further details Report of the Committee of Experts on Unemployment Estimates [1970], Dandekar and Rath [1971], Rajkrishna [1972], Report of the Committee on Unemployment [1973] and Sen [1973]). Use of different definitions at various time-points have complicated further the problem of assessing exactly the incidences of unemployment and under-employment on a comparable scale of measurement over time. This problem was observed by Pal et al. [1978], and to overcome this, they made a very important contribution in this regard through suggesting a rather objective method of revising the 1961 Census estimates of total workers, so as to make it comparable with the corresponding 1971 Census estimates, under more stringent definition of workers (as in 1971 Census). We, in fact, will be making use of the revised 1961 Census estimates of total workers, furnished by them, along with the corresponding actual 1971 Census estimates to meet our objectives, described in the next paragraphs.

As in the previous chapter, here too we have restricted our attention to male work-force participation only. In the traditional Indian societies the mature females normally remain busy for most part of a day in their respective duties. They are found contributing marginally in the day-to-day economic activities of their male counterpart only seasonally in some parts of a year in the rural side (mainly in the peak period of agricultural activities). In the urban side also a small segment of them could be regarded as regular workers. While female participation in the labour-force remains quite low (ref. to Chaudhri [1974]), about 80 percent of the labour-force have been males. Thus, this major segment of male population only has been taken within the scope of our present study. The time-span of our interest in the study has been the decade from 1960-61 to 1970-71 as the statistics on total workers available for these two Census years could be made comparable following Pal et al. [1978]. However, the methodologies proposed to be followed in the present study could as well be repeated for the female population also. The time-span of our study could have been also extended with the latest available data of the 1980-81 Census had the relevant data of 1980-81 Census been presented on a comparable basis with those of 1970-71 Census. But, as the Census definitions of workers varied from Census year to Census year from 1960-61 through 1980-81, we have been compelled to restrict our study only over the Census years, for which comparable data have been generated in the study of Pal et al. [1978].

The total phase of gainful utilisation of human resources through absorption in economic activities is spanned mainly over the age range from 19 to 60^+ years. Those who get absorbed in economic activities before attaining the age of 19 years are being considered in this study as child labourers. The focus of our attention in this chapter is mainly on the problem or the burden being created due to non-engagement of male human resources in the age range from 19 to 60^+ years. This phase of human resource utilisation, which in the present context may as well be called the <u>activity phase of adult males</u> may be divided broadly into two sub-phases according to the following broad age-groups : (1) 19 to 35^+ years of age, and, (2) 36 to 60^+ years of age. Keeping continuity with the definitions of various phases in the last chapter the phase corresponding to the former age range is identified as Fourth Phase (or, Phase IV) and the one corresponding to latter age range, as Fifth Phase (or, Phase V).

It might be noted that the fourth phase is the early stage of youthhood when the young males would transit from the formative phase of basic-skill development to the job-searching phase. While the fifth phase, starting from the age of 36 years, would be regarded as the matured stage of adulthood; mostly with family responsibilities, the men in this phase are expected to have certain job-orientation, under full-employment objective. The fourth phase being a transitional job-searching phase, a section of young males might still pursue their education and training at higher level for advanced skill formation. Naturally, in this phase the full-employment objective may not be achieved. In contrast, the segment pursuing higher studies or training, is almost absent in the fifth phase and thus, in this phase, full-employment objective should be a must. In the fifth phase people's mobility gets restricted as compared to fourth phase. In the fourth phase, people enter the job markets and in their endeavour to get absorbed in a satisfactory and duly paid job they search for different jobs, shift from one job to another and even migrate from one place to another for bettering their economic condition and having greater job-satisfaction / (ref. to Schwartz / 1976 /, Inoki & Suruga / 1981 /). The phase is significant also from the angle that people pass the most productive years in this phase, through concerted and energetic efforts for attaining one higher income level to another, before finally reaching a more or less stable avtivity level at an age around 40 years. As nature of activities have direct bearing on level of earning, stabilisation of activity level leads to a kind of stabilisation in the earning profile. The choice of 35 years as the boundary year between Phase IV and Phase V has been influenced by the findings on age-earning profiles given in Lydall [1968] and Blaug, Layard and Woodhall [1969]. As the job-change possibilities and mobility get restricted in the fifth phase, the employment and unemployment condition in this phase should best highlight the degree of achievement of the full-employment objective of the economy.

Thus, according to our interpretation, the fourth phase is the transitional job-searching phase, and will be referred at times as the Initial Activity Phase, and the fifth phase is the phase of job-settlement, which often be referred to as the Main Activity Phase. The two phases together form the Over-all Activity Phase. In this chapter our objective is to form a reliable data-base on the district-level incidences of non-engagement of adult males in various activities. Primarily we like to draw a comprehensive and detailed all-India picture of incidences of unemployment and for that we would be making use of appropriate statistical methods and techniques with the 1961 and 1971 Census data. On the basis of the generated data-base we would make attempts to identify the spatial configuration for subsequent regionalisation and regional analysis, and also to study the change in the spatial patterns on a comparable scale over the decade (1960-61 to 1970-71) under consideration in the present study.

Now, a State-level data-base on the age-specific incidences of the absence of engagement of adult males in various activities, could have been generated straight away if the gap between the single year age returns of all males and those of working males in any State were estimable. Unfortunately, detailed published data on the latter (i.e., on working males) are not available, though such data on the former (i.e. on all males) are at once available from the Census publications in the desired form. The only Census data that are available on age-distributions of working males, are only available in limited form by broad age-groups (ref. to General Economic Tables, Census of India, Vol. I, Part II-B(i) /1961/ and General Economic Tables, Census of India, Series 1, Part II-B(i) /1971/. In 1961 these broad age-groups were 0-14 years, 15-34 years, 35-59 years, and 60+ years, and in 1971 these were 0-14 years, 15-19 years, 20-24 years, 25-29 years, 30-39 years, 40-49 years, 50-59 years and 60^{+} years. We have already pointed out the presence of certain reporting errors and fluctuations even with the data on single year age returns while dealing with the theme of preceding chapter (ref. to subsection (2.2.1) particularly) in connection with the use of these data through appropriate statistical modeling. With the grouped-data on working males by age-groups, such irregularities and fluctuations are also likely to be present. To get rid, at least partially, of such possible reporting errors and fluctuations, we consider total working males in each age-group, not in absolute form, but as proportion with respect to the total males in the same age-group. Next, we try for appropriate statistical modeling of these proportions as function of corresponding representative ages. Using such model-based estimates of proportions in conjunction with single year age return estimates for males, we build up our requisite data-base at the State-level. The analytical details on the methods and models regarding it, have been discussed in the next section.

We have yet to build up the district-level data-base from the State-level data-base just suggested above. For this we have again used an appropriate indicator method, likewise what we used in the preceding chapter. In the next section we also describe the details of the present indicator method for generating the district-level data-base as breaks-up of the corresponding State-level data-base on working adult males. It is to be noted that the revised percentage estimates of total workers for 1960-61 comparable to the observed percentages of total workers in 1970-71, as worked out and reported in Pal et al. [1978], have been used in this connection to build up our comparable estimates of adult working males for both the time-points. The underlying assumptions that are consistent with the translation of Pal's comparable data-base for our use are the following. In view of the limited divergence between districts within a State because of the similar kinds of socio-political and cultural aspects as prevalent within a geographically small and linguistically almost uniform States under the federal set-up of Indian administration, we propose to make the following consistent assumption : the demographic age-structure (or, age-distribution pyramid) of all males has slightly differed from one State to another in India; but such structure in all the districts in a particular State has been taken to be almost same as that of the State. Other marginal assumptions made to achieve comparability of the data on adult working males between the two time-points will be discussed as and when required for building up the district-level data-base in this connection.

3.2 The Methods and Techniques for Establishing the Data-base on Working Adult Males

While suggesting appropriate methods and techniques (including those of necessary model-building) to establish the required data-base on working adult males (and, hence, the derived non-working adult males) in the two Census years, the problems that needed attention were : (i) comparability of Census-defined workers between the two time-points of

1960-61 and 1970-71, (ii) the limited availability of working males' age-distribution data, and (iii) the reporting discrepancy that crept in the 1970-71 data on working males by broad age-groups (but not in the 1960-61 data), because of the use of a very small sample over the total census count on these type of data, for final tabulation, on the ground, possibly, of cost minimisation. As referred to already at the preceding section, the first problem could mainly or largely be tackled through the use of previous work done already by Pal et al. [1978] with, however, certain necessary modifications that are needed for our purpose. In the work of Pal et al , the divergence in the definitions of workers between the two censuses, have been tackled and the comparable estimates of total workers have been generated on the basis of certain logical grounds and hypotheses related to the decadal growth of agricultural workers as contrasted to that of rural population in different geographical areas with different levels of over-all development.

The problem arising out of limited data availability by broad age-groups has been tackled by certain model formulation and statistical estimation procedure to be discussed shortly. The third problem arose due to use of sampling scheme for final tabulation of relevant data only in 1970-71, but not in 1960-61 (in fact, only 20% and 10% samples over total census count of people in urban and rural areas respectively, in 1971 have been considered, while such simplification was not done in 1960-61). As a result of this non-comparable approach of compilation of data at the two time-points, it comes to our notice that certain inconsistently abrupt decadal changes have often crept in with the data on age-distributions of male workers in relation to the age-distributions of all males in different States. The said decadal changes on male workers are not in conformity with such changes on total workers as could be depicted from the work of Pal et al [1978]. As such, here also we banked upon the data on Pal's work and made appropriate translation of figures from total workers to total male workers and subsequently to total adult male workers, through the use of certain ratios and proportions on broad age structures as could be estimated reliably with even the sample data of 1971 and with appropriate dovetailing of them with the relevant data available in Pal's work. In this connection we have also consulted for consistency checking and moderations, if necessary in some of the States, the Report of the Panel on the Assessment of the Extent of Unemployment and Underemployment [1972].

3.2.1 Statewise Age-distributions of Working and Non-working Males, 1960-61 and 1970-71 : Methods of Estimation

Here the scope of trying with various methods has been quite limited as the published age-distributions are available only over limited broad age-groups. While initial graphical analysis has helped us in understanding the nature of the distributions, our final attempt has been made more objective by statistical fitting of appropriate non-linear regression. Degrees of freedom being very much restricted (because of their presentations by broad age-groups), we have tried to formulate such a model that requires statistical estimation of very few parameters without sacrificing the necessary good fits and at the same time satisfies the necessary restriction that the estimate of total male workers must always be less than the estimate of total males, both at the same age in any particular time-point. Among different polynomial and exponential models, the following Model (B) of logit type (ref. to Pindyck and Rubinfeld [1981] and Amemiya [1981] for logit type models) has served our purpose the best.

Model (B) : $$\ln \frac{p_x}{1-p_x} = a + b \left(|x - k|^{s} / 10^{s_*} \right)$$

where p_x is the proportion of working males to total males of age x, a, b, k, s are parameters of the model, $|x - k|$ is the absolute difference between age x and the parameter k,

and 10^{s_*} is simply a scale changer, its index part s_* being actually the integer part of (s+1).

Corresponding to each broad age-group we have associated its middle value with the corresponding age-group-specific proportion of male workers. Thus, for the age-group of x_* to x_{**} years, the representative mid-value x is taken as $x = \frac{1}{2}(x_* + x_{**})$. In our calculations the last age-group has been taken to end at $x_{**} = 75$ years with given $x_* = 60$ years, so that the corresponding representative age x is equal to 67.5 years. Next, denoting by $(TM)_x$ and $(TMW)_x$ the total males and total male workers respectively in any age-group of x_* to x_{**} years, we estimate the proportion, $p_x = (TMW)_x / (TM)_x$ corresponding to the representative age x.

To specify the effective lower end $x_* = x_{min}$ years (say) of the first age-group of working males with non-zero frequency, we have followed an increasing age-sequential iterative procedure aiming at the maximum improvement in the statistical fit of the proposed Model (B); when the said maximum is achieved, the iteration stops, specifying the required $x_* = x_{min}$. It should be noted that, the first age-group being at one tail end of age-distribution, we are in a position to incorporate two observational points, namely, (i) the actual value of p_x for the first group corresponding to the representative middle age value $x = \frac{1}{2}(x_* + x_{**})$, where x_* is the effective lower end of the first group and the given upper end $x_{**} = 14$ years, and (ii) the interpolated p_x value corresponding to $x = x_*$, the effective lower end. This interpolation is done linearly taking into account the two boundary values, namely, $p_x = 0$ at $x = x_* - 1$, the age just preceding the effective lower end, and the actual given value of p_x, corresponding to the representative age $x = \frac{1}{2}(x_* + x_{**})$ of the first age-group. The pair of observational points, just mentioned above, has been used in addition to remaining others, in all the iterative statistical fits of our Model (B), with improved degrees of freedom to achieve increased efficiency of our statistical estimations.

In our method of increasing age-sequential iterative procedure, the inserted value of the effective lower end age x_* has been taken as 5 years in the first iteration and the value of x_* is increased sequentially by 1 year at every subsequent iteration, subject to condition that $x_* < x_{**} = 14$ years. In fact, the finally iterated value of x_* with the maximum improvement in the statistical fit, has been considerably below 14 years in actual empirical evaluations. This finally iterated value of x_* is taken as the desired x_{min}, the effective lower end of first age-group, as accepted. Further, in connection with the actual method of estimation for Model (B), it is to be noted that it is a non-linear model in which four parameters, k, s, a and b, (noting that s_* = integer part of (s + 1)), are to be determined. But, all four parameters cannot be estimated directly by the usual OLS fit. Here we have preassigned the values of k and s (and, hence s_*), at every iteration with observed variables (x, p_x), before going for the OLS fit for the estimations of the remaining parameters. The preassigned values of k and s have also been finally determined, again, by iterative regression procedure. The initial k value (in integral years) is taken as a central value in the range of age-variable x under consideration (this range changes with iterative values of x_*). The iterations on k-value have been done, changing it through integral values around the initial central value of k. Again, corresponding to a same age-range and the particular preassigned value of k, we iterate for values of s over positive real values, starting from 1. The values of s are iterated, correcting upto two places of decimal. Thus, it is to be noted that the simple correlation r between the two transformed variables $(\ln \frac{p_x}{1-p_x})$ and $(|x - k|^s/10^{s_*})$ has been estimated at each stage of the three-stage iterative regression procedure through changing values of x_*, k and s in the specified manner. Finally, the iteration stops when we arrive at the maximum value of r, determining the optimal estimates of x_* $(= x_{min})$, k and s, and also the corresponding OLS estimates of a and b. Our estimation of Model (B) is then complete with the estimates of parameters as obtained at the final stage of the iterative regression procedure. The iterated parameter s, taken in the model, is really to get at the appropriate curvilinear nature in the functional fit between the two variables p_x and x, whereas the other two iterated values of x_* and k permit useful economic interpretations, to be discussed later after the empirical evaluation of the Model (B).

Once the Model (B) is fitted, the model estimates of the proportions p_x at different values of age x years, have been used in conjunction with the single year age return estimates of total males to arrive at the initial estimates of working males at different years of age; these initial estimates have been finalised by tallying the total of such initial estimates over all years with the observed given total male workers that were already reported through the aggregation of grouped data. All these estimation and adjustment have been done for each State separately, and from the aggregation of State estimates the corresponding all-India estimates have been obtained. It is understood here that the comparability in the definition of workers have been in the fore front of our mind. In this respect, as already stated, we have used the 1971 census definition of workers. As such, while we have accepted the given estimates of male workers in 1970-71, as reported in the 1971 Census, we had to make necessary adjustments in the estimates of 1960-61, as reported in the 1961 Census, so that the adjusted 1960-61 estimates are made comparable with the corresponding 1970-71 estimates. To make these adjustments, we have used the revision done in this context in the work of Pal et al [1978]. The revised estimates of 1960-61 as given in Pal et al [1978] needed, however, certain translation from total workers to all male workers which has been attempted by use of requisite multiplier factors in the broad proportionate form as could be obtained from the observed data on the relative intensity of participation rates between the male workers and the total workers by States.

3.2.2 Estimation of Phasewise Indices of Incidences of Unemployment (IIU) for Males by States and the Generation of District-level Estimates by an Appropriate Indicator Method

After the finalisation as done above through the fitting of Model (B), with the necessary adjustments, the estimated single year age-distribution of total male workers is denoted by $\{\hat{M}_x\}$, where $\hat{M}_x$ is the estimated total male workers of age x years, the corresponding distribution $\{\hat{U}_x\}$ of total male non-workers, $\hat{U}_x$ being the total non-working males of age x, has been derived as residuals, as given below :

$$\hat{U}_x = \hat{P}_x - \hat{M}_x \qquad \ldots \quad (3.1)$$

where $\hat{P}_x$ stands for the estimate of total males at age x years (ref. to subsection (2.2.3)).

The break-ups of total adult male non-workers into two phases in the total activity span of our concern, namely the fourth (19 to 35^+ years) and the fifth (36 to 60^+ years), have been denoted respectively by $\hat{U}(IV)$ and $\hat{U}(V)$, and the corresponding total males by $\hat{P}(IV)$ and $\hat{P}(V)$. Thus, analytically, we have the following relations :

$$\left.\begin{aligned} \hat{U}(IV) &= \sum_{x=19}^{35} \hat{U}_x, & \hat{U}(V) &= \sum_{x=36}^{60} \hat{U}_x \\ \hat{P}(IV) &= \sum_{x=19}^{35} \hat{P}_x, & \hat{P}(V) &= \sum_{x=36}^{60} \hat{P}_x \end{aligned}\right\} \qquad \ldots (3.2)$$

And, denoting by $\hat{U}$ and $\hat{P}$ respectively the total estimated adult male non-workers and the total estimated adult males, we get

$$\left.\begin{aligned} \hat{U} &= \hat{U}(IV) + \hat{U}(V) \\ \text{and} \quad \hat{P} &= \hat{P}(IV) + \hat{P}(V) \end{aligned}\right\} \qquad \ldots (3.3)$$

Then, the percentages of non-working adult males in the two phases, denoted by u(IV) for Phase IV and by u(V) for Phase V, will be given by :

$$\left.\begin{aligned} u(IV) &= 100(\hat{U}(IV)/\hat{P}(IV)) \\ \text{and} \quad u(V) &= 100(\hat{U}(V)/\hat{P}(V)) \end{aligned}\right\} \qquad \ldots (3.4)$$

All these estimates as obtained above from the available raw-data through application of appropriate statistical models, are only for building up the State-level estimates of u(IV) and u(V) and the corresponding all-India estimates for the two phases as derived through proper aggregation of State-level estimates. As these broad estimates by States are too aggregated for any micro-level regional analysis, depicting the problem areas of inactivity for adult males, we need to devise some way out for the split of adult male non-workers as distributed spatially in different districts in a State (for each Phase IV and Phase V). For this, again we have tried to devise an appropriate indicator method as we did in the preceding chapter. Although the statistical treatment in the present application of the indicator method has been largely similar to that of the preceding chapter, there is yet certain departures regarding the choice of the indicator in the present situation and its proper analytic manipulations to obtain the best statistical consistency, fitting with the changed complex situation of the activity phase. To present the actual form of the indicator method as used here, we denote the all-India estimates by $\hat{U}(IV)$, $\hat{U}(V)$, $\hat{P}(IV)$ and $\hat{P}(V)$ corresponding to the estimates $\hat{U}_i(IV)$, $\hat{U}_i(V)$, $\hat{P}_i(IV)$ and $\hat{P}_i(V)$ for any areal unit, denoted by suffix i, varying for any geographical break-up of all-India, whether for States or for districts within any State of India.

The algebraic formulation of the relative location factor L_i^{UV} for a characteristic U relative to some other characteristic V has already been presented elsewhere (ref. to relation (2.6) in subsection (2.2.4)). The variables U and V for the present case have, however, to be specified for the present case. In this connection the following ratio estimates are required for quantifying the locational characteristic of non-activity of adult males.

$$\left.\begin{array}{ll} u_i(\varphi) = \hat{U}_i(\varphi)/\hat{P}_i(\varphi), \text{ for } \varphi = \text{IV and V} & \\ \qquad\qquad \text{(for i-th areal unit)} & \\ \text{and} \quad u(\varphi) = \hat{U}(\varphi)/\hat{P}(\varphi) \text{ (for all-India)} & \\ \qquad\qquad = \sum_j \hat{U}_j(\varphi)/\sum_j \hat{P}_j(\varphi), \text{ for } \varphi = \text{IV and V} & \end{array}\right\}, \quad (3.5)$$

To be specific, the notation $u(\varphi)$ stands for all-India estimate of the proportion of non-working adult males in phase φ, as built up from the aggregation of State-level estimates, shown by the summation with suffix j that varies over all States of India. To represent only the districts within a particular State (or, such broad geographical area) of India, we denote more specifically by $u_{ij}(\varphi)$ for the estimate of i-th district in j-th State related to the phase φ. With these notations, our location factors for non-working males relative to total males in the activity phase φ, can be represented analytically by :

$$\left.\begin{array}{l} L_{oj}(\varphi) = u_{oj}(\varphi)/u(\varphi),\ \varphi = \text{IV or V} \\ \quad \text{(the phasewise estimates for the j-th State)} \\ \text{and} \\ L_{ij}(\varphi) = u_{ij}(\varphi)/u(\varphi),\ \varphi = \text{IV or V} \\ \quad \text{(the phasewise estimates for the i-th} \\ \quad \text{district in j-th State)} \end{array}\right\} \quad \ldots(3.6)$$

Here afterwards, these location factors will be designated as the Indices of Incidences of Unemployment (IIU) for males in phases φ = IV and V. Clearly, these indices actually measure the degrees of local severity of the problem arising out of non-engagement in activities, or unemployment of adult males in the two phases of activity span of life. It is clear from the preceding discussions that we are now in a position to estimate directly the State-level indices $L_{oj}(\varphi)$. But, the estimates $L_{ij}(\varphi)$ for districts in any State are yet to be obtained and the indicator method of estimation for generating these $L_{ij}(\varphi)$'s is now discussed below.

The method of indicator when used in the preceding chapter for the three Phases I, II and III of basic-skill formation, we observed that those phases were linked sequentially with the progressive patterns of the educational system, transmitting to students the level of knowledge from one standard of basic-skill to next higher standard. For this sequential linkages therein, any presence of illiteracy in

Phase I is progressively carried over subsequent phases in more and more pronounced form and thereby reducing the divergence between districts in latter phases. As such, the incidence of over-all male illiteracy fitted very well as the indicator for district level data-base generation in Phase I, while for subsequent phases, the same indicator could be used fruitfully for our purpose, with some sort of functional power transformations, taking care of the reduced divergence in latter phases. Thus, the indicator of illiteracy could be used without any transformations for the Phase I, while adjustments on the divergence of the indicator had to be controlled for sequentially linked latter Phases II and III.

In the present case of the incidences of employment and unemployment, such sequential linkages between Phase IV and V are missing. Here, people's entrance to or quitting from the job markets are equally possible in any phase (this is contrasting to the preceding case of drop-outs in Phases I, II, III; the drop-outs of former phase cannot enter again for basic-skill formation in latter phases). Thus, a man may try for jobs at any phase, and, if already employed, can alter his job or quit the job market or even debarred from or accepted in the job market, depending on scope of activities available in the societies. Following this argument, it could be said that any indicator of unemployment is likely to be common for both the activity phases, although adjustments for the divergence between the phases might be needed. Anyway, the nature of adjustment need not necessarily be the one of reduction from Phase IV to Phase V (the reduction in divergence followed progressively from Phase I to Phase III in the preceding case).

Under these circumstances, we conceived that the variable on the percentage of total workers as available for districts in comparable form between 1960-61 and 1970-71 in the work of Pal et al [1978] could be suitably modified for deriving an appropriate indicator for our use. This modification has been needed to be considered from the following three angles :

(1) to derive appropriate State level multipliers for the translation of the percentages of total workers to that of male workers subject to checking through already estimated State-level data,

(2) to derive appropriate State-level correction factor for the coverage between the years 19 to 60^{+} by use of available State-level estimates of single year age-distribution of males and male workers by States,

(3) to incorporate the possible divergence of a district as contrasted with its parent State in respect of the participation rate of male workers relative to that of total workers; this has been done by making use of the relevant information in the form of relative ratios and proportions as could be calculated by districts from the data, reported in some publication of 1971 Census (ref. to Census of India, Series I, Part II-A(ii) [1971]), (here, the implicit assumption is that the relative participation rate has remained almost similar over the decade from 1960-61 to 1970-71).

The details of the modifications, needed for the formulation of the indicator, and its use in appropriately transformed forms for surrogating the incidices of incidences of unemployment for the two phases are discussed in the next section, dealing with the empirical evaluations. However, before the discussion on this generation and evaluation of the district-level data-base, we shall discuss first the empirical evaluations of the State-level data-base in the following subsection (3.3.1).

3.3.1 The Empirical Evaluation : The State-level Data-base

We follow here the same geographical coverage of States (or State-groups) of India as used earlier in Chapter 2 (ref. to subsection (2.3.1)). Naturally the relevant data on total workers, male workers etc., for the present study have been clubbed accordingly from the corresponding data which we have compiled initially for all States and Union Territories of India from the Census reports. Then, following the methods discussed in subsection (3.2.1) for the statistical fit of Model (B), the estimates of its parameters, together with the corresponding degrees of fit (as measured by the final correlation coefficients r) are obtained for the States of India and presented in Table (3.1.1) and (3.1.2) respectively for the two time-points of our consideration (i.e. for 1960-61 and 1970-71). It could be observed from the data of these tables, that the minimum values of the degrees of fit, r, of Model (B) for 1960-61 State-estimates and also for 1970-71 State-estimates have been respectively as high as 0.9976 (occured in Andhra Pradesh) and 0.9862 (occured in the combined State of Himachal Pradesh and Jammu & Kashmir). This shows that we have been quite successful in our choice of the model form for the depiction of age-distributions and the estimates of parameters incorporated in the model-form are quite meaningful.

Table 3.1.1 : Estimates of the Parameters of Model (B) by States of India : 1960-61

State/Union Territory	Estimates of Parameters				Correlation Coefficient(r)
	k	s	a	b	
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	45	2.66	3.5335	-0.3713	-0.9976
Assam	47	2.62	3.1288	-0.3915	-0.9993
Bihar	48	2.50	3.5760	-0.5927	-0.9992
Gujarat	44	2.46	3.2485	-0.8939	-0.9999
Himachal Pradesh and Jammu-Kashmir	47	2.93	3.1840	-0.1207	-0.9996
Mysore (Karnataka)	45	2.63	3.4382	-0.4256	-0.9993
Kerala	46	2.49	2.8223	-0.8068	-0.9999
Madhya Pradesh	46	2.79	3.7127	-0.2306	-0.9991
Maharashtra	45	2.43	3.4083	-0.9266	-0.9996
Orissa	46	2.88	3.2939	-0.1543	-0.9985
Punjab	46	2.53	3.0152	-0.5721	-0.9989
Rajasthan	44	2.65	3.3009	-0.4009	-0.9980
Tamil Nadu	45	2.42	3.3419	-0.9395	-0.9986
Tripura, Nagaland, Manipur and N.E.F.A. (Arunachal Pradesh)	49	2.56	3.2496	-0.4627	-0.9996
Uttar Pradesh	50	2.72	3.7835	-0.2447	-0.9998
West Bengal	46	2.58	2.7287	-0.4945	-0.9986
Delhi	45	2.22	3.0370	-2.3459	-0.9988

Table 3.1.2 : Estimates of the Parameters of Model (B) by States of India : 1970-71

State/Union Territory	Estimates of Parameters				Correlation Coefficient(r)
	k	s	a	b	
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	43	2.44	3.9532	-1.0669	-0.9935
Assam and Meghalaya	45	2.61	3.1522	-0.4968	-0.9972
Bihar	47	2.51	3.6961	-0.6719	-0.9982
Gujarat	43	2.53	3.6772	-0.8276	-0.9915
Himachal Pradesh and Jammu-Kashmir	45	2.75	3.5858	-0.3268	-0.9862
Karnataka (Mysore)	44	2.41	3.7259	-1.1217	-0.9936
Kerala	44	2.62	2.9725	-0.6250	-0.9950
Madhya Pradesh	44	2.79	3.6053	-0.2851	-0.9944
Maharashtra	44	2.36	3.5804	-1.4229	-0.9933
Orissa	44	2.48	3.8647	-0.8922	-0.9958
Punjab, Haryana and Chandigarh	43	2.62	3.5866	-0.5864	-0.9913
Rajasthan	43	2.69	3.6226	-0.4493	-0.9921
Tamil Nadu	43	2.34	3.7863	-1.6493	-0.9932
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A.)	47	2.58	3.3962	-0.5100	-0.9948
Uttar Pradesh	47	2.92	3.3261	-0.1455	-0.9979
West Bengal	45	2.50	2.8696	-0.7446	-0.9971
Delhi	43	2.22	3.6922	-2.9587	-0.9911

Next, for Phase IV and Phase V, we calculate the total males and total non-working adult males (using the comparable definition of workers for both 1960-61 and 1970-71) in each State for 1960-61, by applying the methods, described in sub-section (3.2.1), on the relevant data of both Tables (2.2.1) and (3.1.1). These estimates are then used to obtain the State and all-India percentages of non-working adult males, $u_{oj}(\varphi)$ and $u(\varphi)$ respectively, for both the phases. The final summary estimates for the States and all-India are presented in Table (3.3.1) for 1960-61.

It has already been noted that the reported estimates on male workers, all males, all workers, etc. take into account the fully enumerated primary data, both for the totality of age-range and also for its break-ups into selected age-groups, in 1961 Census, but not in 1971 Census. In 1971 Census, while the estimates on male-workers, all males, all workers etc. for the totality of age-range, were reported, taking full account of the census enumeration, its break-ups by selected age-groups were reported only on the basis of limited samples over the enumerated primary compilations. As such, the estimates of the age-specific proportions of male workers, i.e. p_x, as determined in our model fits are considered to be more dependable in 1960-61 than those in 1970-71, and that is why the 1960-61 estimates of p_x have been used above directly along with the corresponding age-specific distributions of all males (ref. to subsection (2.2.3) of Chapter 2), for the estimations of age-specific distributions of male-workers, but not the 1970-71 estimates of p_x directly. We have, however, used the 1970-71 model estimates of p_x indirectly in the form of age-interval-specific cross-ratios between two broad age-intervals as worked out from the model estimates of p_x. This is done because cross-ratios between broad age-intervals are likely to be more dependable estimates than the simple ratios of single age intervals, when they are determined from the sample based data. This sort of indirect use of the 1970-71 model estimates of p_x is being detailed below.

As the estimates of the proportions of total workers for the totality of age-range were based on the fully enumerated relevant data in both censuses, we consider that those estimates, as reported in the comparable form in Pal et al [1978] are quite dependable. With the use of these comparable estimates, we obtain first the estimates of percentages of total adult male workers for 1970-71. In this connection we introduce certain additional notations of age-interval specific proportion estimates :

$m^t(x,y)$ = the percentage of working males at time-point t for the age-interval (x,y) in years,

$w^t(x,y)$ = the percentage of total workers at time-point t for the age-interval (x,y) in years.

When the age-interval covers the totality of all ages, we shall simply drop the interval-range for the sake of brevity of notations, i.e., we shall denote, in short, w^t for w^t(all ages) and m^t for m^t (all ages).

Thus we get the dependable and comparable estimates of w^t, for t = '71 (i.e. 1970-71) and '61 (i.e. 1960-61), for States and also for districts of India directly from the work of Pal et al [1978]. When we like to specify the State proportions or district proportions, we shall use suffixes i and j for i-th district in jth State and accordingly our notations get modified as follows :

$m^t_{oj}(x,y)$ and $w^t_{oj}(x,y)$ refer to corresponding estimates of j-th State of India, and, $m^t_{ij}(x,y)$ and $w^t_{ij}(x,y)$, those of i-th district in j-th State. The unsuffixed notations $m^t(x,y)$ and $w^t(x,y)$ would then stand for the corresponding all-India estimates. We shall further use a cap (^) over a particular notation when the estimates are derived from the 1971 sample data based model estimates of p_x. Thus, $\hat{m}^{71}_{oj}(x,y)$, when derived from sample data based model estimates, will be specified as $\hat{m}_{oj}^{71}(x,y)$ and the uncapped notation $m_{oj}^{71}(x,y)$ will be reserved for the final estimates, as to be computed with the use of stated cross-ratios between two $\hat{m}_{oj}^{71}(x,y)$, with different lengths of age-intervals.

As workers are mostly concentrated in the age-interval of (10, 60) years, and in addition, as the ratios of total population to the population in the age-interval (10, 60) years have remained almost same in both 1961 and 1971, we can take $w_{oj}^{t}(10, 60)$ as proportional to w_{oj}^{t}, i.e.,

$$\frac{w_{oj}^{71}(10,\ 60)}{w_{oj}^{61}(10,\ 60)} = \frac{w_{oj}^{71}}{w_{oj}^{61}} \qquad \ldots (3.7)$$

for any j-th State of India.

Now, from the relevant estimated age-specific distributions, we can derive the estimates of $m_{oj}^{61}(10,60)$ and also the sample estimates of $\hat{m}_{oj}^{71}(10,60)$ and $\hat{m}_{oj}^{71}(19,60)$. Using the values of w_{oj}^{71} and w_{oj}^{61} and the relations (3.7) on the estimates $m_{oj}^{61}(10,60)$, we can determine the percentages of male workers in the age-interval (10, 60) years for 1971, as shown by relation (3.8) given below for any j-th State.

$$m_{oj}^{71}(10,60) = \frac{w_{oj}^{71}(10,60)}{w_{oj}^{61}(10,60)} \cdot m_{oj}^{61}(10,60)$$

$$= \frac{w_{oj}^{71}}{w_{oj}^{61}} \cdot m_{oj}^{61}(10,60) \qquad \ldots (3.8)$$

Next, using the cross-ratio of $\hat{m}_{oj}^{71}$ (19,60) to $\hat{m}_{oj}^{71}$ (10,60) on $m_{oj}^{71}(10,60)$, shown in relation (3.8), we determine the final estimate $m_{oj}^{71}(19,60)$. Thus, we have

$$m_{oj}^{71}(19,60) = m_{oj}^{71}(10,60) \times \frac{\hat{m}_{oj}^{71}(19,60)}{\hat{m}_{oj}^{71}(10,60)} \qquad \ldots (3.9)$$

It must be emphasized that we rely on the change in employment pattern as depicted by the ratio of w_{oj}^{71} to w_{oj}^{61} and the relations (3.8) and (3.9) are simply used in making the corrections respectively for (i) sex-specification, and (ii) age-interval change by States. Thus, the pattern depicted by the final estimate $m_{oj}^{71}(19,60)$ relative to $m_{oj}^{61}(19,60)$ would be very much in conformity with the pattern revealed in the estimate of w_{oj}^{71} relative to w_{oj}^{61} for different States — as ought to be the case — subject to, however, the due variations for the specifications of sex and age-intervals of our interest. It should be noted that had we used the direct model based estimate $\hat{m}_{oj}^{71}$ (19,60), rather than the indirectly estimated $m_{oj}^{71}(19,60)$, and compared it with the corresponding estimate $m_{oj}^{61}(19,60)$, the resulting decadal change pattern would not have been conformed with the corresponding observed patterns of relative changes from w_{oj}^{61} to w_{oj}^{71} which show general deteriorations in the employment situation over the decade. This explains why we do not use the sample data based model estimates $\hat{m}_{oj}^{71}$ (19,60) directly, and go indirectly for modified estimates m_{oj}^{71}(19,60) that depict the case of the general deteriorations in the employment situation over the decade.

The modified estimates m_{oj}^{71}(19,60) are for the entire activity span (19 to 60 years) of adult males and we have yet to obtain the corresponding estimates for the two subintervals of this activity span, namely, for (19, 35) years and (36, 60) years. To build up these break-up estimates we have still to use the model estimates of age-distributions for 1971 also. The divergences between our accepted estimate m_{oj}^{71}(19,60) and the model estimate $\hat{m}_{oj}^{71}$ (19,60) clearly reflect the presence of some sort of sampling errors in the parametric estimations of the age-distributions of adult males in 1971. As such before its use for break-up estimates by Phases IV and V, we would like to examine the nature of the parameters and their implications in changing the shape of the age-distribution curves, both from the theoretical and empirical standpoint.

Model (B) (ref. to subsection (3.2.1)) can be conveniently expressed as follows :

$$\frac{1 - p_x}{p_x} = A\, e^{B\,|x - k|^{s}}$$

i.e., $$p_x = 1/(1 + A\, e^{B\,|x - k|^{s}}) \qquad \ldots (3.10)$$

where $A = e^{-a}$, $B = -10^{-s_*} b$

In the final evaluations, we have always obtained negative values of b and also $2 < s < 3$ always. These yield

$$s_* = \text{integral part of } (1+s)$$
$$= 3 \text{ (a constant always)}$$

and $B = -10^{-3} b > 0$

Also, we have $A > 0$ always, irrespective of the sign of a.

Thus, granting that A and B to be always positive the shape of the model curve is mainly dependent on the other two parameters, s and k. Because of the incorporation of these two additional parameters, we could not use the ordinary least squares estimation procedure and had to resort to the presently used iterative least squares procedure. We had really used a three-stage iterative procedure to determine not only the additional parameters k and s, but also the threshold data, x_{min}, showing the effective lowest age-limit in the age-distribution of working males. Under compulsions of identifying correctly the shape of the model curve, matching with the available data, we incorporated these additional threshold data and parameters. with, however, the statistical sacrifice of unit loss in the degrees of freedom (in fact, two losses for k and s and a gain for x_{min}). We shall now analyse the importance of these parameters and the threshold data in the context of appropriateness of the present model form.

The threshold data of x_{min} helps not only in improving the statistical reliability of the estimations (by way of gaining an additional degree of freedom) but also in specifying the first possible age of entry to work-force, as consistent with the male workers' revealed age distribution. The empirical State-estimates of x_{min} have been 6 or 7 years (State-average 6.3) in 1961 and 6 years in all States in 1971. Thus, the first age of entry to work-force has remained same for both the time-points. This consistency in the value of threshold data would have been desirable, had it fallen at the beginning of the desirable activity span of 19 to 60 years. That being not the case, it contributes to our problem of child-labour generation. The revealed age-distribution thus depicts the depressing feature that the problem of child-labour might even start — draughting children to work-force in their formative phase of basic-skill formation — at so low an age as 6 or 7 years. The constancy of the estimates of x_{min} for both the time-points over all States reveals two things — first, the problem of child-labour seems to have been equally acute in all States and second, this situation did not change over the decade.

As regards the analysis on the importance of additional parameters s and k, refer back to the transformed model form shown in relation (3.10). As all estimated values of simple correlation coefficients r_{x,p_x} for our model fits have been very high (near unity), we can infer that the model form has empirically corroborated the following theoretical features.

1. We note that the slope of the curve of p_x (w.r.t. equation (3.10)) is given by

$$\frac{dp_x}{dx} = -\frac{d|x-k|}{dx} \cdot \frac{ABs|x-k|^{s-1} e^{B|x-k|^s}}{(1 + A e^{B|x-k|^s})^2}$$

Since $\frac{d|x-k|}{dx} = (-1)$ or $(+1)$, according as $x < k$ or $x > k$

$$\frac{d p_x}{dx} = \pm (ABs|x-k|^{s-1} e^{B|x-k|^s})/(1+Ae^{B|x-k|^s})^2, \quad \ldots(3.11)$$

in the right hand side (+)ve or (-)ve sign is applicable, according as $x < k$ or $x > k$.

Now, given that $s > 1$,

$$\frac{d p_x}{dx} = 0, \quad \text{only when } x = k$$

i.e. p_x is maximum at age $x = k$.

Then, from (3.10) we get

$$(p_x)_{max} = \frac{1}{1+A} \qquad \ldots (3.12)$$

2. Again as A, B, s are all positive always, the slope $\frac{d\ p_x}{dx}$ is (+)ve or (−)ve according as $x < k$ or $x > k$, i.e., in the age-interval, say, $x_{min} < x < x_{max}$, the slope is gradually decreasing from some high positive value through the zero value at $x = k$ and then switching to negative values. Thus, in the curves of equation (3.10), the value of p_x gradually increases in the interval $x < k$, attaining the maximum at $x = k$ and then gradually decreases in the interval $x > k$.

3. The proportion of male workers p_x is of equal magnitude for any pair of values of x, equidistant on either side of k in the age-interval $2k - x_{max} < x < x_{max}$. That is, the curve of p_x is equally falling on either side, equidistant from $x = k$ in the age-interval $(2k - x_{max}, x_{max})$ years. It is increasing in the half sub-interval $(2k - x_{max}, k)$ and decreasing in its complementary half sub-interval (k, x_{max}) (and stationary at $x = k$). For the nearness of the values of x from k the rates of fall are of lower magnitudes

in $(2k - x_{max}, x_{max})$, as compared with those in the residual age-interval $x_{min} < x < (2k - x_{max})$.
Granting that the activity span is limited to the maximum age of x_{max}, our curve (3.10) is really not defined for $x > x_{max}$ (where, we take $p_x = 0$). As such, we do not have any age-interval $x > x_{max}$, complementary to age-interval $(x_{min}, 2k - x_{max})$ for any occurrence of equal p_x with pairs of equidistant x from k. Thus, the range of p_x is single-valued in $x_{min} < x < 2k - x_{max}$, while it is double-valued in $2k - x_{max} < x < x_{max}$. In the latter interval with double-valued p_x, the central critical value is k.

4. The parameter s with its estimates lying much above unity, actually controls the nature of fall in the curve of p_x against x, on either side of k (the age of maximal p_x); the higher the value of s above unity, the steeper will be the curve. Thus, s depicts the nature of curvilinearity of the curve, as fitted with the data.

5. Using equation (3.10) in equation (3.11), it can be simplified to the following form

$$\frac{d\,p_x}{dx} = \pm\, B\,s\,\left|x-k\right|^{s-1} \cdot (1-p_x)\,p_x \qquad \ldots(3.13)$$

i.e. $$\frac{1}{(p_x-1)\,p_x} \cdot \frac{d\,p_x}{dx} = \mp\, B\,s\,\left|x-k\right|^{s-1} \qquad \ldots(3.14)$$

[(-) sign for $x < k$
& (+) sign for $x > k$]

Differentiating this equation w.r.t. x, we get,

$$\frac{1}{(p_x-1)\,p_x} \cdot \frac{d^2p_x}{dx^2} - \frac{2p_x-1}{(p_x-1)^2\,p_x^2}\left(\frac{d\,p_x}{dx}\right)^2 = Bs(s-1)\left|x-k\right|^{s-2}$$

[for both $x < k$ and $x > k$]

Using equation (3.14) in this and simplifying, we get

$$\frac{d}{dx}\left(\frac{d\,p_x}{dx}\right) = -\; Bs\left|x-k\right|^{s-2}(1-p_x)\,p_x\left[2Bs\left|x-k\right|^{s}(p_x-0.5) + (s-1)\right] \qquad \ldots(3.15)$$

(for both $x < k$ and $x > k$)

For stationary values of slope $\left(\frac{d\,p_x}{dx}\right)$ curve (ref. to (3.14)), we must have

$$\frac{d}{dx}\left(\frac{d\,p_x}{dx} = 0\right)$$

Thus, using this in equation (3.15), we can infer that the stationary values are likely to be attained by the slope curve (3.14) at the following values :

<u>case (i)</u> $x = k$

<u>case (ii)</u> $p_x = 1$

<u>case (iii)</u> $p_x = 0$

<u>case (iv)</u> $p_x = 0.5 - (s-1)/(2Bs\,|x-k|^s)$ . . . (3.16)

<u>Case (i)</u> : We have noted that the maximum $(p_x)_{max}$ has occurred at $x = k$ (derived from the considerations of the falling values of p_x on either side of the curve of p_x, referred to equation (3.10)). As $\frac{d^2p_x}{dx} = 0$ at $x = k$ for which $(p_x)_{max}$ occurred, also, at least the next odd ordered derivative of p_x must be zero, implying that the second derivative of the slope curve is zero. This means that the point $x = k$ refers to a possible point of inflexion of the slope curve (ref. to equation (3.14)) at which the maximum has occurred for the p_x curve (ref. to equation (3.10)). In fact, (dp_x/dx) has changed in the neighbourhood of this point from low positive values to low negative values through the zero value exactly at $x = k$. Thus, $x = k$ corresponds to the point of inflexion for the slope curve and at the same time it corresponds to the maximal point of the p_x curve.

<u>Case (ii)</u> : Theoretically, the perfect full employment condition is reflected in the condition

$p_x = 1$, but in reality, it is always the case that $p_x < 1$. In fact, the model form as developed here, for its application in an under-employed economy, does not accommodate this case of $p_x = 1$. For, if it were so, then we must have $1 = (p_x)_{max} = \frac{1}{1+A}$ (ref. to equation (3.12)) implying thereby that A = 0, which is impossible on two counts :

(1) *since A = 0 implies $p_x = 1$ at any age (ref. to* equation (3.10)) which is operationally meaningless,

(2) further A = 0 implies that the parameter a of our original model form, should be of infinitely large magnitude. But a must be finite in our model.

Therefore, this case for the stationary value of the slope curve is ruled out.

<u>Case (iii)</u> : The stationary value of the slope curve (ref. to equation (3.14)) is possible at a very early age when p_x itself is zero. In fact, we have already noted that in the age-range below 6 years, p_x is a constant zero and as such the slope must be zero beyond the problematic child-labour generating phase, discussed already. But this case of total unemployment condition ($p_x = 0$) does not fall within the

activity span under our consideration. Therefore, this case is also ruled out.

Case (iv) : We have already stated (ref. to feature (3)) that the function for p_x is really defined for $x \leq x_{max}$ and it is not defined for $x > x_{max}$ (where we take $p_x = 0$). In reality, x_{max} is the upper limit of our activity span under consideration and it is a point of discontinuity for the p_x curve at $x = x_{max}$, after which p_x changes abruptly, attaining very low values afterwards. Thus, beyond x_{max}, we have $p_x = 0$ only after some age span. In fact, in our estimation of State-models, we have always incorporated one observational point beyond x_{max} to depict the tail-end nature of our p_x curve. When such discontinuities are to be captured by a continuous nature of functional form it has always to be a turning point for changing slope in the fitted continuous curve form. . Thus we expect a stationary slope value to occur at some value very close to $x = x_{max}$. Yet, the inherent discrete discontinuity as present beyond $x = x_{max}$ would not be represented properly in the tail-end of the distribution, and, as such we are reluctant to use the functional form beyond the activity span ending with x_{max}, as ascertained from discrete distribution. (That is why, we say $p_x = 0$, above $x = x_{max}$). This critical point of the p_x-curve (ref. to equation (3.10)) really corresponds to the upper stationary value of the slope curve (ref. to equation (3.14)) at $x = x_{max}$, when we have, according to relation (3.16),

$$p_x = 0.5 - (s-1)/(2B\, s\, |x-k|^s)$$
$$\text{with } x = x_{max}.$$

As this value of p_x also occurs at $x = 2k - x_{max}$, hence we have really a pair of stationary values of the slope curve corresponding to the case (iv) (ref. to (3.16)), at $x = 2k-x_{max}$ and $x = x_{max}$. However, the nature of the two stationary slope values are different. At the point $x = 2k - x_{max}$, it is the case of maximum slope, and at the point $x = x_{max}$, it is the case of minimum slope. Both these points clearly correspond to two critical turning points in the nature of absorption to activities in our p_x-curve. Before the lower turning point $x = 2k-x_{max}$, the proportion of males absorbed in activities (p_x) is increasing with accelerated rate (i.e. increasing slope values) attaining the maximum positive value of slope at $x = 2k - x_{max}$. Then, between the two turning points $x = 2k - x_{max}$ and $x = x_{max}$, the values of slope $\left(\frac{d\,p_x}{dx}\right)$ starts declining and maintains the declining trend monotonically, first through positive slope values together with the increasing p_x values in the first half age-interval ($2k - x_{max}$, k), and then through negative slope values together with decreasing p_x values in the residual half age-interval (k, x_{max}). Since the slope values starts declining from $x=2k - x_{max}$, we call it a starting point of the saturation in the absorption of males to activities and this saturating phase is complete with maximal p_x value at $x = k$. As such, we can call the half age-interval ($2k - x_{max}$, k) as the <u>saturating half-phase</u>. Beyond $x = k$, upto $x = x_{max}$, both the slope values and the p_x values are declining monotonically and, as such, this residual half age-interval (k, x_{max}) will be called the <u>depleting half-phase</u>. Clearly the depleting p_x-path is an exact mirror image of the saturating p_x path, indicating existence of double p_x values in the age-interval ($2k - x_{max}$, x_{max}) only.

Further, on analysing the actual empirical estimates of the parameters for different State-level model fits, we have the following important observations to make :

6. We have already noted that $2 < s < 3$. In fact, the value of s must be greater than 2; otherwise the p_x curve would not have fallen to indicate the depletion

possibility due to biological factors, from some age x = some finite value of k. This is evident from the fact that the slope curve would not have yielded the point of inflexion at $x = k$ if $s = 2$ (ref. to equation (3.15)). Actually s varies (among States) from 2.22 to 2.93 in 1960-61 and from 2.22 to 2.92 in 1970-71. Thus, the variations of s among States fall within a narrow margin for both the time points and the range of values is almost identical for 1960-61 and 1970-71. These values with limited variations, being in the index of the age-gap $|x-k|$, control the nature of the change in the gradients of p_x corresponding to age x in almost a similar fashion on either side of the critical age k. Thus, because of these limited variations of s, the resulting age-distribution patterns for different States over the two time-points have been very much similar in nature.

7. The way we have made the interpretations of the parameter k in our earlier discussions, its values gain great significance in the empirically fitted model structures. In fact, k is the critical modal age, centering in the age-interval $(2k - x_{max}, x_{max})$ (ref. to features (3) and (5)). In the estimations of the 1960-61 State models based on the total count data, the values of this critical modal age k have

varied between 44 years and 50 years. Denoting these State values of k by k_j's and also the representative all-India value by k_0, we decide to determine the value of k_0 under the following pertinent consideration, befitting our model structures. Our k_0 is such value that yields minimum possible values of $|k_j - k_0|$ in the interval (44, 50) years. Clearly, $k_0 = 47$ years, the mid-value of the range of k_j's. Thus, this all-India value of k_0 could be taken as the single common central value of critical modal age. As the total activity span has been taken to be from 19 to 60 years of age, the value of x_{max} under consideration is 60 years. Then the equidistant age $(2k_0 - x_{max})$ relative to x_{max} from k_0 is 34 years (ref. to features (3) and (5) discussed already). Thus, in the age-interval (34, 60) years, any two equidistant ages x from the critical modal age k_0 correspond to same value of p_x. This means, as stated already in our theoretical discussions, that the curve for p_x against x between the age-interval (47, 60) years is a mirror image of that between the boundaries of the equi-length age-interval (34, 47) years, just preceding to the critical modal age of 47 years, as determined from the 1960-61 State-model estimations. Thus, empirically in the two halves of the interval (34, 60) years, the curve of p_x is similarly rising and falling with its peak in the middle. Recalling our definitions of Phase V, we note that the age-range of Phase V is almost the same as the age-interval (34, 60) years in which p_x is double-valued. As Phase V is accepted as the main activity phase, it is then characterised by the existence of double-valued p_x with similarly rising and falling values around the critical modal age k_0 in the middle. Further, as the empirical values of gaps $|x - k_0|$ are relatively small in this Phase V (36 to 60 years) as compared with that in the preceding Phase IV (19 to 35 years), the rates of gradual fall of p_x on either side of k_0 in Phase V are considerably limited as compared with that of preceding Phase IV, particularly for the values of associated index s (of $|x - k_0|$), as high as 2.22 to 2.93 (much above 2) (ref. to feature (4)). In this sense, empirically also a kind of stability in the absorption to activities has taken place in Phase V, justifying our claim of calling it the main activity phase. The first half of Phase V with gradually rising p_x, can be taken, as already pointed out, as the saturating half phase of absorption to activities, attaining the maximal p_x at

$x = k_0$, obtained as a by-product of socio-economic features as prevalent in the country. While the second half of Phase V, with gradually falling p_x, can be taken, as stated already, as the depleting complementary half-phase of activities, the depletion having been resulted mainly as a by-product of biological features like the longevity, health conditions, etc., as prevalent among the male workers and all males in the advanced age-interval.

On the other hand, the rate of absorption to activities is steeply rising from the initial very low or near-zero values to maximum value at the lower critical turning point $x = 2k - x_{max}$ (ref. to feature (5)), after which the phase of declining slope commences (in Phase V). As such, from our earlier discussions, we can take the Phase IV as a transitional job-searching phase.

All these empirical evidences, as obtained from a right kind of choice of our model structure, justify our dividing boundary age of 35 years between Phase IV and Phase V in the total activity span.

8. The above empirical characterisation of the Phases IV and V have been arrived at by use of estimations of 1960-61 State-models, but not with the sample

data based estimations of 1970-71 State-models. We have already noted in subsection (3.3.1) that as compared with the 1960-61 model based estimates m_{0j}^{61} (19, 60), the sample based 1970-71 model estimates $\hat{m}_{0j}^{71}$ (19, 60) have shown a reverse picture of what we get from the corrected 1970-71 estimates m_{0j}^{71} (19, 60) based on total count of 1970-71 data. Actually the sample-based 1970-71 estimates have reflected improvements over the decade in the absorption to activities in the total activity span of 19 to 60 years, while the corrected 1970-71 estimates has generally reflected employment deterioration for male workers. Because of this evidence of the presence of error in our 1970-71 sample data based estimations of the State models, we refrained from its use in the characterisation of Phases IV and V. However, we shall now discuss these sample-based parametric estimates of 1970-71 State models.

While the State values of k have varied in the range (44, 50) with the central representative value of k_0 = 47 years, in 1960-61, they varied in the range 43 to 47 years with the central representative value of k_0 = 45 years. Given the data, whatever be its nature, the statistical fits of the models have been equally very good in both 1960-61 and 1970-71. As the model estimates of 1970-71 relative to those of 1960-61 have shown over-all employment improvements in the total activity span, we infer that the estimates of k are likely to be lower in value at a forward time-point, if employment improvement has been accomplished in the forward time-path. Conversely, it follows that the estimates of k are likely to be higher in value at a forward time-point if employment deterioration has taken place in the forward time-path. On this line of argument, we can clearly note that, as employment deterioration has actually taken place in the decade (which is not reflected in the sample-based 1970-71 model evaluations), the model estimates of k in 1970-71 are a little under-estimated. Thus, a correct data-based estimate of k_0 for 1970-71 would probably have been above 47 years (the estimate for 1960-61). This is possible otherwise also on grounds of the limited absorption opportunities to activities, when employment deterioration has followed; people are then likely to get absorbed in activities at a later age, shifting the start of saturating half-phase or the start of declining slope in p_x-curve a little later. Further, on grounds of the improvements, accomplished in India over the decade, in biological factors like longevity, health conditions, etc., we expect the p_x-curve to be less falling in slopes in the depleting half-phase, commencing from $x = k_0$, than what we have presently obtained with the left-ward shift in k_0 value in 1970-71. All these mean that the shape of p_x-curve for the phase of advanced ages with monotonically declining slopes ought to have been more flat, had we been able to capture the truism of employment deterioration by the 1970-71 raw sample data. The presently available raw sample data have not reflected employment deterioration, but shown such parametric estimates as to reflect employment improvement with longer phase of monotonically declining slopes with steeper shape in p_x-curve. All these mean that there has been over-estimation of p_x-values in the main activity phase of advanced ages. However, in the transitional job-searching phase, when p_x-curve is just rising from very low values with increasing slopes, the path is not that deviated as it is in the advanced phase with quite high p_x-values (note that p_x is just near-zero at $x = 6$ years in both 1960-61 and in 1970-71). At any rate, the relative deviation in age gaps $|x - k|$ for a little right-ward shift in k-value is negligible when x is further from k than when x is nearer to k from the left. Thus, p_x-values are more prone to over estimations in Phase V as compared with Phase IV.

10. Further, it has already been noted that the estimates of the parameter s are more stable between the time-points for a State. That means, this parameter s which controls the broad pattern of the shape of p_x-curve has not been much affected by the sampling fluctuations. If we look back into equation (3.14), we note that the rate of change in p_x is influenced by the relative change for shifts in k values differently for different values of x; as (s-1) is just above unity in its factor $|x - k|^{s-1}$ in that expression (3.14), a more significant role is played by the change of value in k, (rather than s).

Again, as $B = -10^{-3}b$ is numerically small (from empirical evidences), with significant figures occurring after at least two places (and mostly three places) of decimals, its value is not affected much numerically for a corrected downward path of p_x-curve in 1970-71. Thus, the exponent $B\left|x-k\right|^s$ of e in the denominator of the expression for p_x, as in equation (3.10), is to be revised only in respect of the value of k for an upward value $k^* = k + \Delta$, so that the slope of the p_x-curve gets controlled for a corrected downward path. Since according to equation (3.12),

$$(p_x)_{max} = p_k = \frac{1}{1+A},$$

we must have $p_{k^*} = \frac{1}{1+A^*}$,

if $(p_x)_{max}$ is to occur at $x = k^*$ in the revised p_x-curve of 1970-71. Thus, in the revised p_x-curve of 1970-71, two parameters k and A would be revised to some k* and A* for its corrected path, in our attempts towards getting the break-ups of the over-all estimate (ref. to subsection (3.3.1)) of m_{0j}^{71} (19, 60) into revised estimates m_{0j}^{71}(19, 35) and m_{0j}^{71}(36, 60) respectively for Phases IV and V, in lieu of the corresponding unrevised estimates $\hat{m}_{0j}^{71}$ (19, 35) and $\hat{m}_{0j}^{71}$ (36, 60). We shall now describe an iterative procedure as applied to get the phasewise estimates m_{0j}^{71}(19, 35) and m_{0j}^{71}(36, 60) for 1970-71.

Procedure of 1970-71 phasewise estimations :

For this, we shall have to go first for revision of p_x-curve depicting the needed corrections just stated. The corrected values, $k^* = k + \Delta k$ ($\Delta k > 0$) and $A^* = e^{-a^*}$, for 1970-71 p_x-curve are obtained as follows.

We denote the unrevised (or sample data-based) 1970-71 path by (ref. to equation (3.10))

$$\hat{p}_x = 1/(1 + A\, e^{B|x-k|^s}) \qquad \ldots (3.17)$$

As the p_x-values are occurring in the top high range with much of sampling fluctuations, mainly in the main activity Phase V, these values dominate in the calculations of $\hat{m}_{0j}^{71}(19, 60)$. As such, it is quite consistent to take

$$\hat{p}_{k*} = [\, m_{0j}^{71}(19, 60) / \hat{m}_{0j}^{71}(19, 60)\,] \cdot \hat{p}_k \qquad \ldots (3.18)$$

to start with, and then for adjustment for k*, we take, consistent with the equation (3.17),

$$e^{B|k^* - k|^s} = (1 - \hat{p}_{k*})/A\,\hat{p}_{k*} \qquad \ldots (3.19)$$

$$\text{i.e. } k^* = k + \left[\frac{1}{B} \ln \left\{ (1-\hat{p}_{k*})/A\,\hat{p}_{k*} \right\} \right]^{\frac{1}{s}} \qquad \ldots (3.20)$$

It is to be noted that $\hat{p}_{k*}$ is an intermediary estimate before the revision of A for final A*.

For the revised 1970-71 path of p_x-curve, it is now assumed that $(p_x)_{max}$ occurs at $x = k^*$. This means that the revised 1970-71 path for p_x-curve is given by

$$p_x = 1/(1 + A^* \, e^{B \left| x-k^* \right|^{s}}) \qquad \dots (3.21)$$

so that the revised $(p_x)_{max}$ occurs at $x = k^*$, yielding (ref. to equation (3.12)) :

$$p_{k^*} = \frac{1}{1+A^*} \qquad \dots (3.22)$$

Thus, we have

$$A^* = (1 - p_{k^*})/p_{k^*}$$

Now we take the revision of intermediary estimate $\hat{p}_{k^*}$ to p_{k^*} by the relation

$$(1 - p_{k^*})/p_{k^*} = (1 - \hat{p}_{k^*})/A\,\hat{p}_{k^*}$$

so that we get the revised estimate :

$$A^* = (1 - \hat{p}_{k^*})/A\,\hat{p}_{k^*} \qquad \dots (3.23)$$

This adjustment is needed for the consistency of the revised model form. Thus, equations (3.20) and (3.23) give the revised estimates k^* and A^* on a consistent correcting assumption, as implicit in the relation (3.18).

Although the final revised p_x-curve (3.21) is now available, we shall use it only in the transitional job-searching phase IV, where the p_x-values are relatively lower (with negligible sampling divergences in the path of p_x-curve), for the closeness between the revised and the unrevised p_x-values in this phase. Thus, we have used the revised curve (3.21) for developing the revised estimate $m_{0j}^{71}(19, 35)$ only and the other counterpart $m_{0j}^{71}(36, 60)$ is simply derived algebraically from a calculation of the residual between m_{0j}^{71} (19, 60) and m_{0j}^{71} (19, 35), as shown in the following equation

$$m_{0j}^{71}(36,60) = \left[m_{0j}^{71}(19,60) - v_j m_{0j}^{71}(19,35) \right] / (1-v_j) \quad \ldots (3.24)$$

where v_j is the proportion of males in the age-group (19, 35) years to all males in the age-group (19, 60) years for j-th State.

Next, we make a check on the coefficient of $\hat{p}_k$ in the correcting assumption-based relation (3.18). If the above estimate of $m_{0j}^{71}(36, 60)$ is such that the following equality holds (correct upto certain specified places of decimal)

$$\frac{m_{0j}^{71}(36,60)}{\hat{m}_{0j}^{71}(36,60)} = \frac{m_{0j}^{71}(19, 60)}{\hat{m}_{0j}^{71}(19,60)} \quad \ldots (3.25)$$

then our estimates $m_{0j}^{71}(36,60)$ and $m_{0j}^{71}(19,35)$, from first iteration done above, are accepted as final. If there is a departure in the ratio estimates for the coefficient of $\hat{p}_k$ in relation (3.18), then we replace the equation (3.18) by the revised value as given in equation (3.26) below :

$$\hat{p}_{k*} = [m_{0j}^{71}(36,60) / \hat{m}_{0j}^{71}(36,60)] . \hat{p}_k \qquad \ldots (3.26)$$

And, then repeat all subsequent steps for the second iterative estimates to find the values of $m_{0j}^{71}(19,35)$ and $m_{0j}^{71}(36,60)$. We proceed in this way until we have no departures in the value of the coefficient of $\hat{p}_k$ of the equation (3.26).

Although we have obtained the revised model form (3.21), our main interest in it is for using it only to obtain adjusted estimates $m_{0j}^{71}(19,35)$ relating to the part of Phase IV and we have not at all used this model form for deriving the residual estimate $m_{0j}^{71}(36,60)$ relating to Phase V (ref. to relation (3.24)). Thus, for the overwhelmingly broad and large p_x-valued phase of main activities we have not directly taken into account the revised parametric estimations of k* and A*. As our main interests for subsequent work are only in the final iterative estimates of $m_{0j}^{71}(19,35)$ and $m_{0j}^{71}(36,60)$, in addition to the estimate $m_{0j}^{71}(19,60)$, we are not recording the data on the two revised parameters for the sake of brevity. Rather it would be of interest to note how these revised estimates stand in comparison with our sample data based unrevised model estimates,

$\hat{m}_{0j}^{71}(19,35)$, $\hat{m}_{0j}^{71}(36,60)$ and $\hat{m}_{0j}^{71}(19,60)$. This we do in the following manner.

Putting

$$\hat{m}_{0j}^{71}(x,y) = m_{0j}^{71}(x,y) + \Delta m_{0j}^{71}(x,y),$$

for any age-interval (x,y)

years and also denoting

$$E_{0j}^{71}(x,y) = \frac{\Delta m_{0j}^{71}(x,y)}{\Delta m_{0j}^{71}(19,60)},$$

we can deduce the following identity relation (3.27), by virtue of relations of the form (3.24),

$$1 = v_j \; E_{0j}^{71}(19,35) + (1 - v_j) \; E_{0j}^{71}(36,60) \qquad \ldots (3.27)$$

Thus, we have

$$E_{0j}^{71}(19,35) = \frac{\Delta m_{0j}^{71}(19,35)}{\Delta m_{0j}^{71}(19,60)}$$

$$= \frac{(\hat{m}_{0j}^{71}(19,35) - m_{0j}^{71}(19,35))}{(\hat{m}_{0j}^{71}(19,60) - m_{0j}^{71}(19,60))}$$

= relative error correction index for Phase IV, incorporated through the revision of 1970-71 model parameters

p.t.o.

and

$E_{0j}^{71}(36,60)$ = relative error correction index for Phase V (as residual of Phase IV)

$= (1 - v_j\ E_{0j}^{71}(19,35))/(1 - v_j)$

(from relation (3.27)).

Clearly, by the very definition of relative error correction index, we have for the over-all activity span,

$$E_{0j}^{71}(19,60) = 1$$

According to our discussion made already on the mode of revisions of 1970-71 model parameters for corrected downward paths of p_x-curve, the values of $E_{0j}^{71}(19,35)$ are likely to be below this over-all error correction index of unity and those of $E_{0j}(36,60)$, above unity. With the exception of a minor departure in the State of Tamil Nadu, this pattern has followed in all other States of India, as could be observed from the empirical estimates of the error correction indices for Phases IV and V shown in Table (3.2) below. Along with the error correction indices of 1970-71, we have also recorded in this table the followings :

i) 1970-71 corrected estimates $m_{0j}^{71}(19,60)$, $m_{0j}^{71}(19,35)$ and $m_{0j}^{71}(36,60)$

ii) 1960-61 model estimates $m_{0j}^{61}(19,60)$, $m_{0j}^{61}(19,35)$ and $m_{0j}^{61}(36,60)$.

It is to be noted that relative error corrections would have been the same unity for both Phases IV and V, had we followed simply the over-all pattern and not gone for the parametric corrections of the sample data based model structure of 1970-71. Further, from the scrutiny of the values of $E_{0j}^{71}(19,35)$ and $E_{0j}^{71}(36,60)$ in various States, it is revealed that the relative error corrections by Phases have shown quite large values for the following six States (or, State-groups).

1) Manipur + Nagaland + Tripura + Arunachal Pradesh
2) Jammu and Kashmir + Himachal Pradesh
3) Rajasthan
4) Andhra Pradesh
5) Kerala
6) West Bengal

Other estimates on the Statewise percentages of male workers by phases for both time-points form the basis of our corresponding calculations of the Statewise percentages of non-working adult males, $u_{0j}(\varphi)$, shown in Table (3.3.1) for 1960-61 and in Table (3.3.2) for 1970-71.

3.3.2 Empirical Evaluations : Statistical Analyses of the State Indices of Incidences of Unemployment Towards Generation of Similar District Indices by Appropriate Indicators

Making use of the State-level data-base for different phases, as established and presented already in Tables (3.3.1)

Table 3.2 : Phase-specific Age-intervalwise Percentages of Working Males in 1960-61 and 1970-71 and the Relative Error Correction Index Values in 1970-71 for States of India

State/Union Territory	Percentage of Working Males at Time-Point t in Different Phase-specific Age-intervals (x, y) years in j-th State						Relative Error Correction Index for 1970-71 by Phase-specific Age-intervals (x,y) years	
	t = 1960-61			t = 1970-71				
	$m_{0j}^{61}(19,35)$	$m_{0j}^{61}(36,60)$	$m_{0j}^{61}(19,60)$	$m_{0j}^{71}(19,60)$	$m_{0j}^{71}(36,60)$	$m_{0j}^{71}(19,35)$	$E_{0j}^{71}(19,35)$	$E_{0j}^{71}(36,60)$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	79.71	84.64	81.81	72.90	78.04	68.83	0.7376	1.3473
Assam and Meghalaya	77.81	87.40	81.85	65.00	72.89	59.80	0.9178	1.1301
Bihar	71.60	79.18	74.66	67.55	72.24	64.29	0.9063	1.1434
Gujarat	79.12	87.46	82.57	73.80	81.37	68.40	0.9929	1.0103
Himachal Pradesh and Jammu-Kashmir	66.78	72.24	69.26	65.56	68.50	63.14	0.7613	1.3200
Karnataka (Mysore)	79.68	85.58	82.24	74.00	80.86	68.83	0.9860	1.0192
Kerala	78.17	92.51	84.02	72.29	83.26	69.87	0.7020	1.4310
Madhya Pradesh	72.62	76.86	74.36	65.67	72.18	61.25	0.9638	1.0562
Maharashtra	77.14	84.98	80.56	75.25	79.97	71.59	0.9174	1.1116
Orissa	78.37	83.80	80.80	74.01	77.02	71.82	0.8980	1.1518
Punjab, Haryana and Chandigarh	80.58	91.13	85.04	78.42	81.83	75.86	0.9609	1.0550
Rajasthan	73.97	78.91	76.09	59.24	63.05	56.35	0.7088	1.4223
Tamil Nadu	83.50	91.60	87.32	77.68	86.34	70.66	1.0616	0.9224
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A)	67.93	78.62	72.30	62.57	67.78	58.52	0.6951	1.4173
Uttar Pradesh	79.67	87.31	83.02	79.06	83.30	75.78	0.8964	1.1398
West Belgal	74.20	86.45	79.12	72.55	79.28	67.45	0.8126	1.2559
Delhi	75.84	94.40	83.75	88.07	94.21	83.29	0.9664	1.0437

Table 3.3.1 : Total Number of Adult Males and Corresponding Unemployment Percentages by Phases for States of India : 1960-61

State/Union Territory	Fourth Phase Age group : 19-35+ years		Fifth Phase Age group : 36-60+ years		Over-all Phase Age group : 19-60+ years	
	Total adult males	Unemployment percentage u_{0j}(IV)	Total adult males	Unemployment percentage u_{0j}(V)	Total adult males	Unemployment percentage u_{0j}(S)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	4891025	20.29	3729849	15.36	8620874	18.19
Assam	1650672	22.19	1166469	12.60	2817141	18.15
Bihar	7045180	28.40	4520960	20.82	11566140	25.34
Gujarat	2811600	20.88	1916253	12.54	4727853	17.43
Himachal Pradesh and Jammu-Kashmir	701846	33.22	533797	27.76	1235643	30.74
Mysore (Karnataka)	3198619	20.32	2336624	14.42	5535243	17.76
Kerala	2321608	21.83	1575262	7.49	3896870	15.98
Madhya Pradesh	5056478	27.38	3187878	23.14	8244356	25.64
Maharashtra	5452153	22.86	4072724	15.02	9524877	19.44
Orissa	2351966	21.63	1802788	16.20	4154754	19.20
Punjab	2811497	19.42	2008315	8.87	4819812	14.96
Rajasthan	2801953	26.03	1956709	21.09	4758662	23.91
Tamil Nadu	4624114	16.50	3668287	8.40	8292401	12.68
Tripura, Nagaland, Manipur and N.E.F.A. (Arunachal Pradesh)	387841	32.07	256736	21.38	644577	27.70
Uttar Pradesh	10209627	20.33	7693931	12.69	17903558	16.98
West Bengal	5898012	25.80	3854515	13.55	9752527	20.88
Delhi	415676	24.16	304917	5.60	720593	16.25
All-India	62629867	22.90	44586014	14.81	107215881	19.53

Table 3.3.2 : Total Number of Adult Males and Corresponding Unemployment Percentages by Phases for States of India : 1970-71

State/Union Territory	Fourth Phase		Fifth Phase		Over-all Phase	
	Age group : 19-35+ years		Age group : 36-60+ years		Age group : 19-60+ years	
	Total adult males	Unemployment percentage u_{0j} (IV)	Total adult males	Unemployment percentage u_{0j} (V)	Total adult males	Unemployment percentage u_{0j} (S)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Andhra Pradesh	5893451	31.17	4452340	21.96	10345791	27.10
Assam	2352509	40.20	1489051	27.11	3841560	35.00
Bihar	8590592	35.71	5600785	27.76	14191377	32.45
Gujarat	3643792	31.60	2511550	18.63	6155342	26.20
Himachal Pradesh and Jammu-Kashmir	1112004	36.86	831938	31.50	1943942	34.44
Karnataka (Mysore)	3959978	31.17	2875245	19.14	6835223	26.00
Kerala	2962729	30.13	2048689	16.74	5011418	27.71
Madhya Pradesh	6361753	38.75	4103351	27.82	10465104	34.33
Maharashtra	7044229	28.41	5211900	20.03	12256129	24.75
Orissa	3330657	28.18	2240862	22.98	5571519	25.99
Punjab, Haryana and Chandigarh	3333690	24.14	2369636	18.17	5703326	21.58
Rajasthan	3544466	43.65	2438950	36.95	5983416	40.76
Tamil Nadu	5717771	29.34	4542498	13.66	10260269	22.32
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A.)	494980	41.48	361369	32.22	856349	37.43
Uttar Pradesh	12403551	24.22	9172904	16.70	21576455	20.94
West Bengal	6289878	32.55	4600425	20.72	10890303	27.45
Delhi	634544	16.71	482555	5.79	1117099	11.93
All-India	77670574	31.32	55334048	21.10	133004622	27.20

and (3.3.2), it is now possible to construct straight away (ref. to subsection (3.2.2)) the phasewise Indices of the Incidences of Unemployment (or, IIU), already designated as $L_{0j}(\varphi)$ and $L(\varphi)$ for φ = IV and V, for males by different States (varying over j) and also for India as a whole for the said two time-points. These indices $L_{0j}(\varphi)$ and $L(\varphi)$ have been calculated for both the time-points, by granting the common benchmark value of 1970-71 estimate of $u(\varphi)$, φ = IV and V, so that a time-path comparison on the magnitudes of $L_{0j}(\varphi)$ are possible. For any j-th State and also for India the estimates of these indices are recorded in Tables (3.4.1) and (3.4.2), respectively for 1960-61 and 1970-71.

Next we shall go for the generation of district-level indices of incidences of unemployment for males, in the light of our discussions already made in subsection (3.2.1). For this, we have already proposed to devise some appropriate indicator, common for both the phases IV and V, but to be applied with suitable power transformation as would seem appropriate for the two phases from our investigations with the presently available State-level data on proportions of all non-workers and non-working adult males.

For convenience in the present discourse, the notations $u_{0j}(\varphi)$ for time-point t (1960-61 or 1970-71) are redesignated more specifically by $u_{0j}^{t}(x,y)$, with the inclusion of suffix (here superscript) t and age-interval (x,y) in years for φ = IV or V or, say S, denoting the over-all activity phase (the combination of Phases IV and V), corresponding to $(x,y) = (19,35)$ or $(36,60)$ or $(19,60)$ years respectively. Following our earlier practices, the notations $u^t_{ij}(x,y)$ would denote the corresponding estimates in i-th district of j-th State and the notations $u^t(x,y)$, the corresponding all-India estimates. At times, for the sake of brevity, the age-interval symbol $(x,y) = (19,60)$ for the over-all activity phase, S, would be dropped, i.e., we may simply write, for example, u^t_{ij} for $u^t_{ij}(19,60)$ or $u^t_{ij}(S)$, while $u^t_{ij}(19,35)$ or $u^t_{ij}(IV)$ and also $u^t_{ij}(36,60)$ or $u^t_{ij}(V)$ would be reserved respectively for Phases IV and V.

Granting the same common benchmark of 1970-71 all-India estimate $u^{71}(19,60)$ for both time-points we can then calculate the State and all-India Location Factors of Unemployment for adult males in the over-all activity phase, S, from the following formulae.

$$F^t_{0j}(S) = u^t_{0j}(19,60)/u^t(19,60) \qquad \ldots\ldots (3.28)$$

= the location factor of unemployment for adult males in Phase S at time-point t, for j-th State,

$$F^t(S) = u^t(19,60)/u^{71}(19,60)$$

= the corresponding all-India location factor of unemployment (derived from the aggregation of State-level data appropriately).

Table 3.4.1 : Phasewise Indices of the Incidences of Unemployment (IIU) and Location Factor of Unemployment by States of India : 1960-61

State/Union Territory	Indices of the Incidences of Unemployment for		Location Factor of Unemployment F_{0j}(S)
	Fourth Phase L_{0j}(IV)	Fifth Phase L_{0j}(V)	
(1)	(2)	(3)	(4)
Andhra Pradesh	0.6478	0.7182	0.6689
Assam	0.7085	0.5888	0.6674
Bihar	0.9068	0.9729	0.9319
Gujarat	0.6667	0.5860	0.6410
Himachal Pradesh and Jammu-Kashmir	1.0607	1.2972	1.1304
Mysore (Karnataka)	0.6488	0.6743	0.6531
Kerala	0.6973	0.3495	0.5875
Madhya Pradesh	0.8742	1.0813	0.9428
Maharashtra	0.7299	0.7023	0.7146
Orissa	0.6906	0.7570	0.7059
Punjab	0.6200	0.4145	0.5502
Rajasthan	0.8311	0.9855	0.8791
Tamil Nadu	0.5268	0.3924	0.4663
Tripura, Nagaland, Manipur and N.E.F.A. (Arunachal Pradesh)	1.0239	0.9991	1.0187
Uttar Pradesh	0.6491	0.5930	0.6245
West Bengal	0.8238	0.6332	0.7678
Delhi	0.7714	0.2617	0.5974
All-India	0.7308	0.6916	0.7180

Table 3.4.2 : Phasewise Indices of the Incidences of Unemployment (IIU) and Location Factor of Unemployment by States of India : 1970-71

State/Union Territory	Indices of the Incidences of Unemployment for Fourth Phase $L_{Oj}(IV)$	Fifth Phase $L_{Oj}(V)$	Location Factor of Unemployment $F_{Oj}(S)$
(1)	(2)	(3)	(4)
Andhra Pradesh	0.9949	1.0262	0.9963
Assam and Meghalaya	1.2835	1.2668	1.2868
Bihar	1.1402	1.2972	1.1930
Gujarat	1.0086	0.8706	0.9634
Himachal Pradesh and Jammu-Kashmir	1.1769	1.4720	1.2663
Karnataka	0.9946	0.8944	0.9560
Kerala	0.9617	0.7822	1.0190
Madhya Pradesh	1.2366	1.3005	1.2623
Maharashtra	0.9068	0.9360	0.9099
Orissa	0.8997	1.0738	0.9557
Punjab, Haryana and Chandigarh	0.7708	0.8491	0.7934
Rajasthan	1.3934	1.7266	1.4985
Tamil Nadu	0.9368	0.6383	0.8205
Tripura, Nagaland, Manipur and Arunachal Pradesh (N.E.F.A.)	1.3244	1.5056	1.3762
Uttar Pradesh	0.7733	0.7804	0.7700
West Bengal	1.0393	0.9682	1.0092
Delhi	0.5335	0.2706	0.4385
All-India	1.0000	1.0000	1.0000

Clearly, from the very choice of the benchmark, $F^{71}(S) = 1$. The values of these location factors at State and all-India levels, have been recorded in the last column of Tables (3.4.1) and (3.4.2). It should be noted that all our indices and location factors are designed in such a way that they permit comparisons for both spatial and time-point variations, and the data of the above mentioned tables together are no exceptions. .

Recalling our formulations (3.8) and (3.9), it is clear that the State location factors for over-all phase, $F^{t}_{0j}(S)$, are generated ultimately from the comparisons of w^{71}_{0j} and w^{61}_{0j}, the percentages of total workers for the two time-points. As the comparable district-level estimates w^{71}_{ij} and w^{61}_{ij} are available which could form the basis of district estimates like $F^{t}_{ij}(S)$, our first task has been an examination of the State-estimates $F^{t}_{0j}(S)$ in relation to indices $L_{0j}(\varphi)$ (i.e., $L^{t}_{0j}(\varphi)$, if we be time-specific) for the two phases separately, for their suitability as indicator to surrogate for the indices of the two phases with, however, appropriate power transformations. Thus, with the State-level estimates, pooled over the two time-points, ($L_{0j}(\varphi)$ and $F_{0j}(S)$ representing pooled estimates of $L^{61}_{0j}(\varphi)$ and $L^{71}_{0j}(\varphi)$, and also of $F^{61}_{0j}(S)$ and $F^{71}_{0j}(S)$ respectively), the simple correlation coefficient between L(IV) and F(S) and also that between L(V) and F(S), over all j, become as high as 0.980 and 0.958 respectively.

This agreement is taken to justify that $F_{ij}^{t}(S)$ could be a common indicator, when formed appropriately with the use of w_{ij}^{61} and w_{ij}^{71}, to surrogate for both $L_{ij}^{t}(IV)$ and $L_{ij}^{t}(V)$.

The regression coefficients for these two pairs of correlated variables are, however, not of similar magnitudes. Actually, the regression coefficient for L(IV) on F(S) is 0.839 while that for L(V) on F(S) is 1.294. This means that the rate of change of F(S) with respect to L(IV) is considerably below unity, while that of F(S) with respect to L(V) is quite above unity. This feature is the reflection of the fact that the ranges of variation are lower for L(IV) and higher for L(V), as compared with that for F(S) (it is 0.87 for L(IV) and 1.46 for L(V) against 1.06 for F(S)).

The above observations in terms of the ranges of variations could be dealt more analytically in terms of the coefficients of variation. The below unity value of the regression coefficient is the reflection of the fact that L(IV) has a lower coefficient of variation compared with that of F(S) (it is 0.253 against 0.297). Again, the above unity value of the regression coefficient is the reflection of the fact that L(V) has a higher coefficient of variation compared with that of F(S) (it is 0.406 against 0.297). These departures of the values of regression coefficients from unity, or, alternatively stating, the relative divergences in the values of the coefficients of variations, do not allow us to use the variable F(S) in its untransformed form as surrogates for either of L(IV) and L(V). As L(IV) has a lower value of coefficient of variation as compared with that of F(S) (equivalently below unity value of regression coefficient of L(IV) on F(S)), an appropriate mode for condensing the variation of F(S) is to use its power transformed form $[F(S)]^{\alpha}$ with $0 < \alpha < 1$, so that the coefficient of variation of $[F(S)]^{\alpha}$ becomes matching with that of L(IV). On the other-hand, as L(V) has a higher value of coefficient of variation as compared with that of F(S) (equivalently above unity value of regression coefficient of L(V) on F(S)), an appropriate mode for enlarging the variation of F(S) is to use again its power-transformed form $[F(S)]^{\beta}$ with $\beta > 1$, so that the coefficient of variation of $[F(S)]^{\beta}$ is again made matching with that of L(V). After systematic searches for appropriate magnitudes of α and β, the estimates finally turned out to be $\alpha = 0.85$ and $\beta = 1.35$. Thus, $[F(S)]^{0.85}$ and $[F(S)]^{1.35}$ are finally obtained as appropriately transformed forms of F(S), which could be used respectively as surrogates for L(IV) and L(V). We have finally checked that the correlation coefficient between L(IV) and $[F(S)]^{0.85}$ and also between L(V) and $[F(S)]^{1.35}$ still remain in the very high range of values (actually 0.97 and 0.96 respectively), and both the regression coefficients practically turn out to be unity (actually 0.98 and 0.96 respectively).

Having obtained the appropriate surrogates for variables L(IV) and L(V), our next task is to find the appropriate district estimates $F_{ij}^{t}(S)$ (corresponding to variable F(S)), for any i-th district in j-th State at time-point t, so that their power transformed forms (with $\alpha = 0.85$ and $\beta = 1.35$) could be suitably used to give estimates of $L_{ij}^{t}(IV)$ and $L_{ij}^{t}(V)$. To arrive at the estimates of $F_{ij}^{t}(S)$, we have to first establish the estimates $m_{ij}^{t}(S)$ for all districts (all i's) in a particular j-th State, when the j-th State estimates $m_{oj}^{t}(S)$ are already available (ref. to Table (3.2)). This we do by use of some sort of district deflators relative to the parent j-th State, on $m_{oj}^{t}(S)$. The deflator is again the product of two location factors of districts within their particular parent State. One of them is for the conversion from State to district values in respect of the participation of total workers (i.e. (w_{ij}^{t}/w_{oj}^{t}) with our earlier notations). And, the other location factor of districts is for the conversion from State to district values in respect of the male workers' content in total work-force. The second location factor can be represented symbolically by the ratio (μ_{ij}/μ_{Oj}), where

μ_{ij} = proportion of male workers to total workers for i-th district in j-th State,

μ_{Oj} = the same proportion for j-th State.

Here we have not used the suffix t to indicate the time-point. Actually, on grounds of the absence of comparability, we have been forced to use the estimates of μ_{ij} and μ_{0j}, as could be computed from 1971 Census data, since our definition of workers as used here is what has been given in 1971 Census.

On the other hand, comparable estimates for the first location factor (w^t_{ij}/w^t_{0j}) could be had for both time-points 1960-61 and 1970-71 from the modified estimates as available in Pal et al [1978]. Thus, the final analytical expression for $m^t_{ij}(S)$ is as given below :

$$m^t_{ij}(S) = \left(\frac{w^t_{ij}}{w^t_{0j}} \cdot \frac{\mu_{ij}}{\mu_{0j}} \right) \cdot m^t_{0j}(S) \qquad \ldots\ldots (3.29)$$

Clearly the numerator in the deflator, shown within parentheses in the above expression, stands for the male workers' content in total population for any i-th district in the j-th State at time-point t, while the denominator stands for the same thing in respect of the parent j-th State. Thus, the deflator takes account of the divergence of the male workers' content between a district and its parent State with appropriate size correction through total population.

Once we have estimates $m^t_{ij}(S)$, we get its complementary part

$$u^t_{ij}(S) = 100 - m^t_{ij}(S),$$

giving the corresponding percentage of non-working adult males and then we are in a position to compute the location factors of unemployment $F_{ij}^{t}(S)$ for districts by States as shown below :

$$F_{ij}^{t}(S) = u_{ij}^{t}(S)/ u_{0j}^{t}(S) \qquad \text{..... (3.30)}$$

or, in abridged form (without specifying the time-point),

$$F_{ij}(S) = u_{ij}(S)/u_{0j}(S)$$

It should be noted that unity is the critical value for each j-th State at each time-point, in the above calculations of $F_{ij}^{t}(S)$, whereas the same critical value of unity stands for only India in 1970-71, i.e. $F^{71}(S) = 1$, in connection with the calculations of State estimates $F_{0j}^{t}(S)$ for both time-points.

These district-level indicators, $F_{ij}(S)$, varying within each State separately, are then used with appropriate power transformations to generate district estimates $L_{ij}(\varphi)$ from the already available State estimate $L_{0j}(\varphi)$. Thus, for a particular time-point the generating formulae could be taken as (using $\alpha = 0.85$ and $\beta = 1.35$) :

$$\left.\begin{aligned} L_{ij}(IV) &= L_{0j}(IV) [F_{ij}(S)]^{\alpha} \\ \text{and} \qquad & \\ L_{ij}(V) &= L_{0j}(V) [F_{ij}(S)]^{\beta} \end{aligned}\right\} \qquad \text{.....(3.31)}$$

These phasewise estimated values of $L_{ij}(\varphi)$ of both time-points, when multiplied by the common benchmark of 1970-71 estimate $u^{71}(\varphi)$, gives the corresponding district estimates $u_{ij}(\varphi)$ for both time-points. The districtwise empirical estimates, $L_{ij}(\varphi)$ and $u_{ij}(\varphi)$, for both time-points have finally been presented in Table (A.3) in Appendix , in which we have also recorded the individual State estimates $L_{0j}(\varphi)$ and $u_{0j}(\varphi)$, and all-India estimates $L(\varphi)$ and $u(\varphi)$ (shown by geographical coverages for original States and Union Territories as per the 1971 Census definition). All estimates of either $L_{ij}(\varphi)$ or $u_{ij}(\varphi)$, presented in this table, are comparable for both spatial variations and time-point variations.

3.3.3 Over-all Index of the Incidences of Unemployment by Districts : Direct Construction

In the preceding sub-section, we were concerned with the methods of estimation and the empirical evaluations of phasewise district percentages of non-working adult males $u^t_{ij}(\varphi)$ and the corresponding indices of the incidences of unemployment $L^t_{ij}(\varphi)$, which are connected by the relation (ref. to relation (3.6) of subsection (3.2.2)) :

$$u^t_{ij}(\varphi) = u^{71}(\varphi) \cdot L^t_{ij}(\varphi)$$

Our very basis of the generation of $u^t_{ij}(\varphi)$ rested on such estimate for the over-all activity phase S (i.e. on $u^t_{ij}(S)$, S representing the age-interval (19, 60) years), which could be obtained from the empirical formation of $m^t_{ij}(S)$ as shown in relation (3.29) (also using $u_{ij}^{t}(S) = 100 - m_{ij}^{t}(S)$). Since the age-interval representing over-all Phase S is constituted of the age-intervals for Phases IV and V, the phasewise and the over-all estimates satisfy the following relation :

$$u_{ij}^{t}(S) = v_{ij}^{t} \cdot u_{ij}^{t}(IV) + (1 - v_{ij}^{t})u_{ij}^{t}(V) \qquad \ldots\ldots (3.32)$$

where v_{ij}^{t} = the proportion of males in the age-group (19,35) years to all males in age-group (19,60) years in the i-th district of j-th State for the time-point t.

If the estimates v_{ij}^{t} are available, then we are in a position to compute the estimate, say, $\hat{u}_{ij}^{t}(S)$, by use of the right-hand expression of relation (3.32), and thereby a comparison between the starting direct estimate $u_{ij}^{t}(S)$ and the indirect estimate $\hat{u}_{ij}^{t}(S)$ could be made and checked for consistency in our estimation procedures of $u_{ij}^{t}(\varphi)$. In the absence of detailed districtwise data v_{ij}^{t}, we have still made a sort of comparison for consistency checking by substituting the parent j-th State value v_{j}^{t} (data of which are available) for all v_{ij}^{t}, i varying over all districts in j-th State only (assuming that, for the narrowness of geographical size, the variations of it within a State are negligible). Thus, our modified estimates of $u_{ij}^{t}(S)$ are computed from the formula

$$\hat{u}_{ij}^{t}(S) = v_{j}^{t}\, u_{ij}^{t}(IV) + (1 - v_{j}^{t})u_{ij}^{t}(V) \qquad \ldots\ldots (3.33)$$

and these estimates have been compared with direct estimate $u_{ij}^{t}(S)$. Our finding in these comparisons is that the divergence in the values between $\hat{u}_{ij}^{t}(S)$ and $u_{ij}^{t}(S)$ is very negligible (in fact, it is less than 10%). We can thus conclude safely that the procedure of estimation of $u_{ij}^{t}(\varphi)$ through surrogate variables did not yield any inconsistency in terms of relation (3.32). As such our estimates $u_{ij}^{t}(S)$ could be taken as the consistent aggregation of the corresponding phasewise estimates $u_{ij}^{t}(IV)$ and $u_{ij}^{t}(V)$.

It should be noted that the estimates $u_{ij}^{t}(IV)$ and $u_{ij}^{t}(V)$, although consistent with the over-all estimate $u_{ij}^{t}(S)$, are dependent on our mode of surrogation, while the direct estimate $u_{ij}^{t}(S)$ (through relation (3.29)), is free from any such surrogative assumptions. So it is worthwhile to summarise the unemployment situation among adult males through $u_{ij}^{t}(S)$, and the corresponding over-all index of the incidences of unemployment $L_{ij}^{t}(S)$, for depicting a sort of aggregate spatial patterns for $L_{ij}^{t}(IV)$ and $L_{ij}^{t}(V)$. Thus, referring back to relation (3.6) of subsection (3.2.2), we have :

$$L_{ij}^{t}(S) = u_{ij}^{t}(S)/u^{71}(S) \qquad \text{..... (3.34)}$$

Now, this could be equivalently expressed by the following relation (3.35) :

$$L_{ij}^{t}(S) = F_{ij}^{t}(S) \cdot F_{0j}^{t}(S) \qquad \text{..... (3.35)}$$

where $F_{ij}^{t}(S)$ and $F_{0j}^{t}(S)$ are already used, and given in relations (3.30) and (3.28) respectively.

The districtwise empirical estimates, $L_{ij}^{t}(S)$ and $u_{ij}^{t}(S)$, for both the time-points have been presented finally in Table (3.5), in which we have recorded also the individual State estimates $L_{0j}^{t}(S)$ and $u_{0j}^{t}(S)$ and all-India estimates $L^{t}(S)$ and $u^{t}(S)$ for both the time-points (shown by the same geographical coverage for original States and Union Territories as per 1971 Census definition). Here also, all the estimates of $L_{ij}(S)$ or $u_{ij}(S)$, presented in the table, are comparable for both spatial variations and time-point variations.

3.4 Classification of Indices of the Incidences of Unemployment

With an aim to identify the formal regional patterns of the incidences of unemployment through cartographic means, we now go for the classification of the generated data on the spatial variables L(IV), L(V) and L(S), varying over all districts of India. The mode of classification of these variables has been more or less same as what had been used earlier in subsection (2.2.6) in connection with the mapping of the indices of non-development of basic-skill. It should be noted that the inter-relations between these indices of unemployment are very strong as could be observed from the correlation matrics of indices for 1960-61 and 1970-71, shown in Table (3.6).

Table 3.5 : Comparison of Ranked Unemployment Indices (IIU) and Percentages (UP) between 1960-61 and 1970-71 and the Decadal Employment Deterioration Percentage

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	1960-61 UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	1970-71 UP** (u^{71})	Decadal Employment Deterioration (d)
(1)	(2)	(3)	(4)	(5)	(6)
INDIA	0.718 (L)	19.53	1.000 (M)	27.20	9.53 (MD)
ANDHRA PRADESH	0.669(VL)	18.19	0.996 (M)	27.10	10.89 (MD)
1. Srikakulam	0.510(VL)	13.86	1.009 (M)	27.44	15.88 (HD)
2. Vishakhapatnam	0.510(VL)	13.87	0.973 (M)	26.46	14.62 (HD)
3. East Godavari	0.632(VL)	17.18	0.997 (M)	27.12	12.00 (MD)
4. West Godavari	0.763 (L)	20.75	0.977 (M)	26.57	7.34 (MD)
5. Krishna	0.719 (L)	19.57	1.060 (M)	28.84	11.53 (MD)
6. Guntur	0.668(VL)	18.17	1.061 (M)	28.85	13.05 (HD)
7. Ongole	0.727 (L)	19.78	1.083 (M)	29.46	12.07 (MD)
8. Nellore	0.614(VL)	16.70	1.002 (M)	27.25	12.67 (MD)
9. Chittoor	0.487(VL)	13.24	0.905 (M)	24.61	13.10 (HD)
10. Cuddapah	0.459(VL)	12.49	0.961 (M)	26.13	15.58 (HD)
11. Anantapur	0.805 (L)	21.89	1.012 (M)	27.51	7.20 (MD)
12. Kurnool	1.030 (M)	28.02	1.106 (M)	30.07	2.85 (LD)
13. Mahbubnagar	0.926 (M)	25.20	0.946 (M)	25.74	0.73 (LD)
14. Hyderabad	0.772 (L)	21.00	1.227 (H)	33.37	15.66 (HD)
ANDHRA PRADESH (Contd.)					
15. Medak	0.834 (L)	22.70	0.897 (M)	24.41	2.21 (LD)
16. Nizamabad	0.629(VL)	17.11	0.969 (M)	26.36	11.16 (MD)
17. Adilabad	0.820 (L)	22.31	0.986 (M)	26.81	5.80 (LD)
18. Karimnagar	0.575(VL)	15.63	0.900 (M)	24.48	10.49 (MD)
19. Warangal	0.484(VL)	13.17	0.923 (M)	25.10	13.73 (HD)
20. Khammam	0.854 (L)	22.23	0.972 (M)	26.44	4.18 (LD)
21. Nalgonda	0.382(EL)	10.39	0.837 (L)	22.78	13.82 (HD)
ASSAM	0.667 (VL)	18.15	1.287 (H)	35.00	20.59(VHD)
1. Goalpara	0.616(VL)	16.76	1.230 (H)	33.44	20.04(VHD)
2. Kamrup	0.489(VL)	13.30	1.318 (H)	35.86	26.02(EHD)
3. Darrang	0.480(VL)	13.04	1.198 (H)	32.59	22.48(VHD)
4. Nowgong	0.854 (L)	23.23	1.222 (H)	33.24	13.04 (HD)
5. Sibsagar	0.392(EL)	10.68	1.416(VH)	38.51	31.16(EHD)
6. Lakhimpur	0.255(EL)	6.93	1.343(VH)	36.52	31.79(EHD)
7. Mikir Hills	0.182(EL)	4.96	1.021 (M)	27.78	24.01(VHD)
8. North Cachar Hills	0.850 (L)	23.11	0.798 (L)	21.70	-1.83 (LI)
9. Cachar	1.070 (M)	29.09	1.208 (H)	32.85	5.30 (LD)
10. Mizo	1.140 (H)	31.02	1.205 (H)	32.78	2.55 (LD)

* IIU & Rank : Index of the Incidences of Unemployment and Rank

** UP : Unemployment Percentage.

N.B. : Ranking Symbols of Unemployment Indices (L^{61} & L^{71}) and Employment Deterioration Percentage (d)

Unemployment Indices: Range of Value	Symbol
1.55 and above	EH
1.33 to 1.55	VH
1.11 to 1.33	H
0.89 to 1.11	M
0.67 to 0.89	L
0.45 to 0.67	VL
Below 0.45	EL

Employment Deterioration: Range of Value	Symbol
26.0% and above	EHD
19.5% to 26.0%	VHD
13.0% to 19.5%	HD
6.5% to 13.0%	MD
0.0% to 6.5%	LD
-6.5% to 0.0%	LI
Below -6.5%	MI

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	OVER-ALL PHASE 1960-61 UP** (u^{61})	OVER-ALL PHASE 1970-71 IIU & Rank* (L^{71})	OVER-ALL PHASE 1970-71 UP** (u^{71})	Decadal Employment Deterioration (d)
(1)	(2)	(3)	(4)	(5)	(6)
BIHAR	0.932 (M)	25.34	1.193 (H)	32.45	9.52 (MD)
1. Patna	1.066 (M)	29.00	1.295 (H)	35.23	8.78 (MD)
2. Gaya	1.004 (M)	27.30	1.324 (H)	36.01	11.98 (MD)
3. Shahabad	1.135 (H)	30.86	1.350(VH)	36.71	8.46 (MD)
4. Saran	1.287 (H)	34.99	1.517(VH)	41.25	9.63 (MD)
5. Champaran	1.146 (H)	31.17	0.982 (M)	26.71	-6.49 (LI)
6. Muzaffarpur	1.441(VH)	39.18	1.179 (H)	32.07	-11.69 (MI)
7. Darbhanga	1.138 (H)	30.95	1.206 (H)	32.80	2.68 (LD)
8. Monghyr	0.989 (M)	26.89	1.205 (H)	32.77	8.04 (MD)
9. Bhagalpur	0.892 (M)	24.26	1.188 (H)	32.32	10.64 (MD)
10. Saharsa	1.020 (M)	27.73	1.002 (M)	27.24	-0.68 (LI)
11. Purnea	0.918 (M)	24.98	0.966 (M)	26.28	1.74 (LD)
12. Santhal Parganas	0.415(EL)	11.30	1.070 (M)	29.11	20.08(VHD)
13. Palamau	0.836 (L)	22.74	1.182 (H)	32.15	12.18 (MD)
14. Hazaribagh	0.588(VL)	15.99	1.285 (H)	34.95	22.57(VHD)
15. Ranchi	0.645(VL)	17.55	1.183 (H)	32.17	17.73 (HD)
16. Dhanbad	0.382(EL)	10.39	0.814 (L)	22.13	13.10 (HD)
17. Singhbhum	0.684 (L)	18.59	1.176 (H)	32.00	16.47 (HD)
GUJARAT	0.641(VL)	17.43	0.963 (M)	26.20	10.61 (MD)
1. Jamnagar	0.580(VL)	15.78	1.012 (M)	27.52	13.95 (HD)
2. Rajkot	0.560(VL)	15.23	1.090 (M)	29.64	17.00 (HD)
3. Surendranagar	0.911 (M)	24.79	1.011 (M)	27.50	3.61 (LD)
4. Bhavnagar	0.556(VL)	15.13	1.080 (M)	29.38	16.79 (HD)
5. Amreli	0.362(EL)	9.85	1.003 (M)	27.28	19.33(VHD)
GUJARAT (Contd.)					
6. Junagadh	0.482(VL)	13.11	1.015 (M)	27.61	16.70 (HD)
7. Kutch	0.993 (M)	27.00	0.998 (M)	27.15	0.20 (LD)
8. Banaskantha	0.188(EL)	5.12	0.810 (L)	22.03	17.82 (HD)
9. Sabarkantha	0.520(VL)	14.15	1.023 (M)	27.82	15.92 (HD)
10. Mahesana	0.215(EL)	5.86	1.120 (H)	30.48	26.15(EHD)
11. Gandhinagar	0.293(EL)	7.96	0.944 (M)	25.69	19.26 (HD)
12. Ahmedabad	0.560(VL)	15.24	0.966 (M)	26.27	13.02 (HD)
13. Kheda	0.560 (M)	24.66	0.934 (M)	25.41	1.00 (LD)
14. Panchmahals	0.638(VL)	17.36	0.806 (L)	21.92	5.52 (LD)
15. Vadodara	0.794 (L)	21.59	0.851 (L)	23.15	2.00 (LD)
16. Bharuch	0.959 (M)	26.09	0.917 (M)	24.95	-1.54 (LI)
17. Surat	0.616(VL)	16.75	0.825 (L)	22.43	6.83 (MD)
18. Valsad	1.090 (M)	29.66	1.066 (M)	28.99	-0.95 (LI)
19. The Dangs	0.932 (M)	25.34	0.711 (L)	19.35	-8.03 (MI)
HARYANA	0.479(VL)	13.03	0.984 (M)	26.75	15.78 (HD)
1. Ambala	0.308(EL)	8.38	0.849 (L)	23.10	16.06 (HD)
2. Karnal	0.748 (L)	20.35	0.890 (M)	24.22	4.86 (LD)
3. Rohtak	0.405(EL)	11.01	1.267 (H)	34.47	26.36(EHD)
4. Gurgaon	0.374(EL)	10.16	1.012 (M)	27.54	19.34 (HD)
5. Mahendranagar	0.896 (M)	24.36	1.180 (H)	32.09	10.21 (MD)
6. Hisar	0.237(EL)	6.44	0.826 (L)	22.46	17.12 (HD)
7. Jind	0.754 (L)	20.52	0.957 (M)	26.04	6.94 (MD)

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank*	1960-61 UP**	1970-71 IIU & Rank*	1970-71 UP**	Decadal Employment Deterio-ration
	(L^{61})	(u^{61})	(L^{71})	(u^{71})	(d)
(1)	(2)	(3)	(4)	(5)	(6)
HIMACHAL PRADESH	1.175 (H)	31.95	1.310 (H)	35.64	5.42 (LD)
1. Chamba	0.976 (M)	26.54	0.992 (M)	26.98	0.61 (LD)
2. Kangra	1.392(VH)	37.86	1.404(VH)	38.18	0.52 (LD)
3. Mandi	1.208 (H)	32.86	1.320 (M)	35.91	4.54 (LD)
4. Kulu	0.760 (L)	20.66	0.956 (M)	26.01	6.74 (MD)
5. Lahul & Spiti	0.244(EL)	6.64	0.408(EL)	11.10	4.78 (LD)
6. Bilaspur	1.338(VH)	36.40	1.306 (H)	35.53	-1.37 (LI)
7. Mahasu	1.062 (M)	28.88	1.002 (M)	27.25	-2.29 (LI)
8. Simla	0.847 (L)	23.04	1.000 (M)	27.20	5.41 (LD)
9. Sirmaur	0.690 (L)	18.77	0.678(VL)	18.43	-0.42 (LI)
10. Kinnaur	0.393(EL)	10.68	0.623(VL)	16.94	7.01 (MD)
JAMMU & KASHMIR	0.886 (L)	24.11	1.221 (H)	33.22	12.00 (MD)
1. Anantanag	0.935 (M)	25.42	1.071 (M)	29.12	4.96 (LD)
2. Srinagar	0.594(VL)	16.16	1.213 (H)	33.00	20.08(VHD)
3. Baramula	0.792 (L)	21.54	1.049 (M)	28.52	8.89 (MD)
4. Ladakh	0.643(VL)	17.49	1.099 (M)	29.90	15.04 (HD)
5. Doda	0.851 (L)	23.14	1.081 (M)	29.39	8.13 (MD)
6. Udhampur	0.676 (L)	18.39	1.125 (H)	30.60	14.96 (HD)
7. Jammu	1.060 (M)	28.84	1.622(EH)	44.12	21.48(VHD)
8. Kathua	1.134 (H)	30.85	1.402(VH)	38.12	10.51 (MD)
9. Rajauri	1.403(VH)	38.15	1.314 (H)	35.73	-3.92 (LI)
10. Punch	1.355(VH)	36.84	1.267 (H)	34.46	-3.77 (LI)
KARNATAKA	0.653(VL)	17.76	0.956 (M)	26.00	10.02 (MD)
1. Bangalore	0.290(EL)	7.87	0.960 (M)	26.11	19.79(VHD)
2. Belgaum	0.766 (L)	20.84	0.890 (M)	24.22	4.27 (LD)
KARNATAKA (Contd.)					
3. Bellary	0.817 (L)	22.23	0.904 (M)	24.58	3.02 (LD)
4. Bidar	0.555(VL)	15.10	1.041 (M)	28.31	15.56 (HD)
5. Bijapur	0.805 (L)	21.89	0.966 (M)	26.26	5.59 (LD)
6. Chikmagalur	0.462(VL)	12.56	0.958 (M)	26.05	15.43 (HD)
7. Chitradurga	0.412(EL)	11.20	0.879 (L)	23.90	14.30 (HD)
8. Coorg	0.748 (L)	20.34	0.844 (L)	22.96	3.30 (LD)
9. Dharwar	0.892 (M)	24.26	0.829 (L)	22.55	-2.26 (LI)
10. Gulbarga	0.529(VL)	14.38	0.972 (M)	26.43	14.08 (HD)
11. Hassan	0.575(VL)	15.65	0.985 (M)	26.80	13.22 (HD)
12. Kolar	0.720 (L)	19.59	0.878 (L)	23.88	5.34 (LD)
13. Mandya	0.482(VL)	13.11	0.884 (L)	24.04	12.59 (MD)
14. Mysore	0.522(VL)	14.20	0.846 (L)	23.01	10.27 (MD)
15. North Kanara	0.625(VL)	17.00	1.041 (M)	28.30	13.62 (HD)
16. Raichur	0.912 (M)	24.80	0.858 (L)	23.35	-1.93 (LI)
17. Shimoga	0.531(VL)	14.45	1.060 (M)	28.83	16.81 (HD)
18. South Kanara	1.144 (H)	31.12	1.352(VH)	36.78	8.22 (MD)
19. Tumkur	0.429(EL)	11.67	0.865 (L)	23.52	13.42 (HD)
KERALA	0.588(VL)	15.98	1.019 (M)	27.71	13.96 (HD)
1. Cannanore	0.434(EL)	11.82	0.858 (L)	23.34	13.07 (HD)
2. Kozikode	0.609(VL)	16.58	1.034 (M)	28.12	13.83 (HD)
3. Malappuram	0.177(EL)	4.82	1.036 (M)	28.17	24.53(VHD)
4. Palghat	0.881 (L)	23.97	0.747 (L)	20.31	-4.82 (LI)
5. Trichur	0.807 (L)	21.94	1.283 (H)	34.90	16.60 (HD)
6. Ernakulam	0.493(VL)	13.41	0.861 (L)	23.43	11.57 (MD)
7. Kottayam	0.592(VL)	16.11	0.854 (L)	23.24	8.50 (MD)
8. Alleppey	0.577(VL)	15.70	1.016 (M)	27.65	14.17 (HD)
9. Quilon	0.599(VL)	16.30	1.037 (M)	28.20	14.22 (HD)
10. Trivandrum	0.681 (L)	18.53	0.871 (L)	23.68	6.33 (LD)

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	1960-61 UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	1970-71 UP** (u^{71})	Decadal Employment Deterio-ration (d)
(1)	(2)	(3)	(4)	(5)	(6)
MADHYA PRADESH	0.943 (M)	25.64	1.262 (H)	34.33	11.69 (MD)
1. Morena	0.906 (M)	24.65	1.197 (H)	32.57	10.50 (MD)
2. Bhind	1.188 (H)	32.32	1.270 (H)	34.55	3.29 (LD)
3. Gwalior	0.773 (L)	21.01	1.363(VH)	37.08	20.34(VHD)
4. Datia	0.630(VL)	17.15	1.230 (H)	33.45	19.67(VHD)
5. Shivpuri	0.647(VL)	17.59	1.067 (M)	29.03	13.88 (HD)
6. Gunna	1.058 (M)	28.78	1.197 (H)	32.55	5.30 (LD)
7. Tikamgarh	0.743 (L)	20.20	1.140 (H)	31.00	13.53 (HD)
8. Chhatarpur	0.772 (L)	20.98	1.051 (M)	28.60	9.64 (MD)
9. Panna	0.744 (L)	20.24	1.183 (H)	32.17	14.96 (HD)
10. Satna	1.151 (H)	31.31	1.309 (H)	35.61	6.26 (LD)
11. Rewa	1.291 (H)	35.12	1.435(VH)	39.02	6.01 (LD)
12. Shahdol	0.797 (L)	21.68	1.153 (H)	31.36	12.35 (MD)
13. Sidhi	1.097 (M)	29.83	1.227 (H)	33.36	5.03 (LD)
14. Mandsaur	1.017 (M)	27.67	1.219 (H)	33.16	7.59 (MD)
15. Ratlam	0.869 (L)	23.62	1.326(VH)	36.05	16.27 (HD)
16. Ujjain	0.722 (L)	19.65	1.342(VH)	36.51	20.98(VHD)
17. Jhabua	0.449(EL)	12.22	1.380(VH)	37.54	28.85(EHD)
18. Dhar	1.254 (H)	34.12	1.066 (M)	28.98	-7.80 (MI)
19. Indore	0.972 (M)	26.43	1.509(VH)	41.04	19.86(VHD)
20. Dewas	0.989 (M)	26.90	1.324 (H)	36.01	12.47 (MD)
21. Khargone	1.023 (M)	27.82	1.285 (H)	34.96	9.89 (MD)
22. Khandwa	1.079 (M)	29.36	1.396(VH)	37.95	12.17 (MD)
MADHYA PRADESH (Contd.)					
23. Shajapur	0.904 (M)	24.60	1.231 (H)	33.47	11.76 (MD)
24. Rajgarh	0.706 (L)	19.21	1.140 (H)	31.01	14.61 (HD)
25. Vidisha	0.977 (M)	26.57	1.126 (H)	30.61	5.50 (LD)
26. Sehore	0.503(VL)	13.69	1.285 (H)	34.94	24.62(VHD)
27. Raisen	0.989 (M)	26.89	1.211 (H)	32.93	8.26 (MD)
28. Hoshangabad	0.987 (M)	26.84	1.308 (H)	35.56	11.92 (MD)
29. Betul	1.136 (H)	30.91	1.261 (H)	34.31	4.92 (LD)
30. Sagar	0.783 (L)	21.30	1.242 (H)	33.78	15.86 (HD)
31. Damoh	0.921 (M)	25.06	1.310 (H)	35.64	14.13 (HD)
32. Jabalpur	0.800 (L)	21.76	1.400(VH)	38.07	20.85(VHD)
33. Narsimhapur	1.258 (H)	34.20	1.414(VH)	38.46	6.47 (LD)
34. Mandla	1.255 (H)	34.14	1.250 (H)	34.00	-0.21 (LI)
35. Chhindwara	1.012 (M)	27.51	1.303 (H)	35.44	10.93 (MD)
36. Seoni	1.144 (H)	31.11	1.254 (H)	34.11	4.36 (LD)
37. Balaghat	0.986 (M)	26.82	1.169 (H)	31.79	6.79 (MD)
38. Surguja	0.301(EL)	8.18	1.027 (M)	27.94	21.52(VHD)
39. Bilaspur	1.062 (M)	28.89	1.271 (H)	34.57	8.00 (MD)
40. Raigarh	0.687 (L)	18.68	1.134 (H)	30.84	14.95 (HD)
41. Durg	1.272 (H)	34.59	1.281 (H)	34.83	0.37 (LD)
42. Raipur	1.157 (H)	31.47	1.327(VH)	36.08	6.73 (MD)
43. Bastar	0.515(VL)	14.01	1.176 (H)	31.97	20.89(VHD)

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	UP** (u^{71})	Decadal Employment Deterio-ration (d)
(1)	(2)	(3)	(4)	(5)	(6)
MAHARASHTRA	0.715 (L)	19.44	0.910 (M)	24.75	6.59 (MD)
1. Greater Bombay	0.001(EL)	0.04	0.235(EL)	6.39	6.61 (MD)
2. Thana	0.427(EL)	11.62	0.742 (L)	20.17	9.67 (MD)
3. Kolaba	1.257 (H)	34.19	1.248 (H)	33.94	-0.38 (LI)
4. Ratnagiri	1.467(VH)	39.90	1.433(VH)	38.98	-1.53 (LI)
5. Nasik	0.713 (L)	19.40	0.973 (M)	26.48	8.78 (MD)
6. Dhulia	0.992 (M)	26.98	0.998 (M)	27.15	0.23 (LD)
7. Jalgaon	0.933 (M)	25.37	1.096 (M)	29.80	5.94 (LD)
8. Ahmadnagar	0.777 (L)	21.14	1.016 (M)	27.62	8.22 (MD)
9. Poona	0.663(VL)	18.02	1.056 (M)	28.72	13.05 (HD)
10. Satara	0.905 (M)	24.62	1.349(VH)	36.70	16.02 (HD)
11. Sangli	0.871 (L)	23.68	1.023 (M)	27.83	5.44 (LD)
12. Sholapur	0.667(VL)	18.15	0.951 (M)	25.86	9.42 (MD)
13. Kolhapur	0.670 (L)	18.21	0.982 (M)	26.71	10.39 (MD)
14. Aurangabad	0.693 (L)	18.86	0.933 (M)	25.37	8.02 (MD)
15. Parbhani	0.689 (L)	18.75	0.850 (L)	23.13	5.39 (LD)
16. Bhir	0.511(VL)	13.90	0.944 (M)	25.69	13.69 (HD)
17. Nanded	0.572(VL)	15.55	0.898 (M)	24.44	10.52 (MD)
18. Osmanabad	0.513(VL)	13.94	0.968 (M)	26.34	14.41 (HD)
19. Buldhana	1.147 (H)	31.19	0.921 (M)	25.04	-8.94 (MI)
20. Akola	1.115 (H)	30.32	0.924 (M)	25.13	-7.44 (MI)
21. Amravati	1.127 (H)	30.65	0.926 (M)	25.20	-7.86 (MI)
MAHARASHTRA (Contd.)					
22. Yeotmal	0.959 (M)	26.07	0.846 (L)	23.02	-4.12 (LI)
23. Wardha	1.065 (M)	28.97	0.957 (M)	26.02	-4.16 (LI)
24. Nagpur	0.288(EL)	7.83	1.007 (M)	27.40	21.23(VHD)
25. Bhandara	0.695 (L)	18.89	0.840 (L)	22.84	4.86 (LD)
26. Chandrapur	0.564(VL)	15.33	0.808 (L)	21.97	7.84 (MD)
MANIPUR	1.348(VH)	36.65	1.682(EH)	45.74	14.35 (HD)
1. Manipur North	0.878 (L)	23.87	1.361(VH)	37.02	17.27 (HD)
2. Manipur West	1.420(VH)	38.63	1.532(VH)	41.66	4.94 (LD)
3. Manipur South	1.159 (H)	31.53	1.712(EH)	46.57	21.97(VHD)
4. Manipur Central	1.422(VH)	38.68	1.734(EH)	47.17	13.84 (HD)
5. Manipur East	1.476(VH)	40.15	1.644(EH)	44.70	7.60 (MD)
MEGHALAYA	1.302 (H)	35.40	1.115 (H)	30.33	-7.85 (MI)
1. Garo Hills	1.282 (H)	34.87	1.186 (H)	32.26	-4.01 (LI)
2. United Khasi and Jaintia Hills	1.314 (H)	35.75	1.068 (M)	29.05	-10.43 (MI)
NAGALAND	0.476(VL)	12.95	1.084 (M)	29.47	18.98 (HD)
1. Kohima	0.425(EL)	11.56	0.917 (M)	24.94	15.13 (HD)
2. Mokokchung	0.809 (L)	22.01	1.404(VH)	38.17	20.72(VHD)
3. Tuensang	0.208(EL)	5.67	0.950 (M)	25.85	21.39(VHD)

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	1960-61 UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	1970-71 UP** (u^{71})	Decadal Employment Deterio-ration (d)
(1)	(2)	(3)	(4)	(5)	(6)
ORISSA	0.706 (L)	19.20	0.956 (M)	25.99	8.40 (MD)
1. Sambalpur	0.086(EL)	2.33	0.685 (L)	18.63	16.69 (HD)
2. Sundargarh	0.079(EL)	2.15	0.898 (M)	24.41	22.75(VHD)
3. Keonjhar	0.843 (L)	22.93	1.004 (M)	27.30	5.67 (LD)
4. Mayurbhanj	0.625(VL)	17.01	0.980 (M)	26.65	11.62 (MD)
5. Balasore	1.118 (H)	30.42	1.176 (H)	31.98	2.24 (LD)
6. Cuttack	1.138 (H)	30.95	1.150 (H)	31.29	0.50 (LD)
7. Dhenkanol	0.689 (L)	18.74	0.960 (M)	26.11	9.07 (MD)
8. Baudh Khondmals	0.307(EL)	8.34	0.765 (L)	20.80	13.60 (HD)
9. Bolangir	0.523(VL)	14.22	0.696 (L)	18.93	5.49 (LD)
10. Kalahandi	0.715 (L)	19.44	0.751 (L)	20.43	1.22 (LD)
11. Koraput	0.299(EL)	8.14	0.705 (L)	19.17	12.01 (MD)
12. Ganjam	0.549(VL)	14.94	1.168 (H)	31.78	19.80(VHD)
13. Puri	1.094 (M)	29.74	1.013 (M)	27.54	-3.13 (LI)
PUNJAB	0.681 (L)	18.53	0.661(VL)	17.99	-0.66 (LI)
1. Gurdaspur	0.753 (L)	20.48	0.915 (M)	24.88	5.53 (LD)
2. Amritsar	0.728 (L)	19.82	0.645(VL)	17.55	-2.83 (LI)
3. Firozpur	0.507(VL)	13.79	0.547(VL)	14.88	1.26 (LD)
4. Ludhiana	0.756 (L)	20.57	0.598(VL)	16.28	-5.40 (LI)
5. Jullunder	0.862 (L)	23.44	0.862 (L)	23.44	0.00 (LD)
6. Kapurthala	0.861 (L)	23.42	0.774 (L)	21.06	-3.08 (LI)
7. Hoshiarpur	1.043 (M)	28.36	0.952 (M)	25.88	-3.47 (LI)
PUNJAB (Contd.)					
8. Ropar	0.792 (L)	21.54	0.741 (L)	20.16	-1.75 (LI)
9. Patiala	0.730 (L)	19.86	0.623(VL)	16.93	-3.66 (LI)
10. Sangrur	0.586(VL)	15.94	0.384(EL)	10.45	-6.53 (MI)
11. Bhatinda	0.192(EL)	5.23	0.449(EL)	12.22	7.38 (MD)
RAJASTHAN	0.879 (L)	23.91	1.499(VH)	40.76	22.14(VHD)
1. Ganganagar	1.202 (H)	32.70	1.486(VH)	40.40	11.45 (MD)
2. Bikaner	1.067 (M)	29.01	1.624(EH)	44.18	21.37(VHD)
3. Churu	1.060 (M)	28.82	1.656(EH)	45.05	22.80(VHD)
4. Jhunjhunu	1.032 (M)	28.08	1.847(EH)	50.24	30.81(EHD)
5. Alwar	0.929 (M)	25.28	1.622(EH)	44.10	25.19(VHD)
6. Bharatpur	1.024 (M)	27.86	1.470(VH)	39.97	16.79 (HD)
7. Sawai Madhopur	0.648(VL)	17.63	1.421(VH)	38.65	25.52(VHD)
8. Jaipur	0.551(VL)	14.99	1.545(EH)	42.04	31.82(EHD)
9. Sikar	0.910 (M)	24.74	1.775(EH)	48.27	31.26(EHD)
10. Ajmer	0.880 (L)	23.95	1.522(VH)	41.40	22.95(VHD)
11. Tonk	0.751 (L)	20.44	1.399(VH)	38.05	21.13(VHD)
12. Jaisalmer	0.421(EL)	11.44	1.300 (H)	35.36	27.00(EHD)
13. Jodhpur	1.166 (H)	31.71	1.550(EH)	42.16	15.30 (HD)
14. Nagaur	1.171 (H)	31.86	1.549(VH)	42.12	15.06 (HD)
15. Pali	0.936 (M)	25.46	1.525(VH)	41.49	21.50(VHD)
16. Barmer	0.790 (L)	21.49	1.302 (H)	35.42	17.74 (HD)

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	UP** (u^{71})	Decadal Employment Deterioration (d)
(1)	(2)	(3)	(4)	(5)	(6)
RAJASTHAN (Contd.)					
17. Jalore	1.038 (M)	28.23	1.418(VH)	38.55	14.39 (HD)
18. Sirohi	1.034 (M)	28.12	1.530(VH)	41.60	18.75 (HD)
19. Bhilwara	0.548(VL)	14.92	1.127 (H)	30.66	18.51 (HD)
20. Udaipur	0.763 (L)	20.75	1.425(VH)	38.76	22.72(VHD)
21. Chittaurgarh	0.683 (L)	18.57	1.244 (H)	33.85	18.76 (HD)
22. Dungarpur	0.723 (L)	19.66	1.681(EH)	45.72	32.44(EHD)
23. Banswara	0.744 (L)	20.22	1.627(EH)	44.24	30.11(EHD)
24. Bundi	0.758 (L)	20.62	1.347(VH)	36.63	20.17(VHD)
25. Kota	0.618(VL)	16.80	1.463(VH)	39.79	27.63(EHD)
26. Jhalawar	0.766 (L)	20.84	1.416(VH)	38.52	22.33(VHD)
TAMIL NADU	0.466(VL)	12.68	0.820 (L)	22.32	11.04 (MD)
1. Madras	0.974 (M)	26.48	1.077 (M)	29.29	3.82 (LD)
2. Chingleput	0.477(VL)	12.98	0.855 (L)	23.26	11.81 (MD)
3. North Arcot	0.438(EL)	11.92	0.824 (L)	22.40	11.90 (MD)
4. South Arcot	0.452(VL)	12.30	0.761 (L)	20.71	9.58 (MD)
5. Dharmapuri	0.176(EL)	4.80	0.743 (L)	20.21	16.19 (HD)
6. Salem	0.275(EL)	7.49	0.612(VL)	16.65	9.90 (MD)
7. Coimbatore	0.128(EL)	3.47	0.574(VL)	15.61	12.57 (MD)
8. Nilgiris	0.676 (L)	18.38	1.038 (M)	28.22	12.06 (MD)
9. Madurai	0.890 (M)	24.20	0.845 (L)	22.98	-1.62 (LI)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	UP** (u^{71})	Decadal Employment Deterioration (d)
(1)	(2)	(3)	(4)	(5)	(6)
TAMIL NADU (Contd.)					
10. Tiruchirapalli	0.333(EL)	9.06	0.744 (L)	20.22	12.28 (MD)
11. Thanjavur	0.631(VL)	17.15	0.870 (L)	23.67	7.87 (MD)
12. Ramanathpuram	0.553(VL)	15.03	0.991 (M)	26.96	14.04 (HD)
13. Tirunelveli	0.434(EL)	11.79	0.994 (M)	27.04	17.29 (HD)
14. Kanyakumari	0.617(VL)	16.79	1.089 (M)	29.61	15.41 (HD)
TRIPURA	0.962 (M)	26.18	1.410(VH)	38.34	16.47 (HD)
1. West Tripura	1.299 (H)	35.33	1.579(EH)	42.96	11.80 (MD)
2. North Tripura	0.844 (L)	22.94	1.306 (H)	35.52	16.32 (HD)
3. South Tripura	0.844 (L)	22.97	1.432(VH)	38.95	20.75(VHD)
UTTAR PRADESH	0.624(VL)	16.98	0.770 (L)	20.94	4.77 (LD)
1. Uttar Kashi	0.064(EL)	1.73	0.089(EL)	2.42	0.70 (LD)
2. Chamoli	0.606(VL)	16.47	0.878 (L)	23.87	8.87 (MD)
3. Tehri Garhwal	0.639(VL)	17.37	1.184 (H)	32.20	17.95 (HD)
4. Garhwal	0.711 (L)	19.35	1.353(VH)	36.81	21.65(VHD)
5. Pithorgarh	1.065 (M)	28.96	1.177 (H)	32.00	4.28 (LD)
6. Almora	0.959 (M)	26.09	1.256 (H)	34.15	10.90 (MD)
7. Nainital	0.080(EL)	2.19	0.531(VL)	14.43	12.51 (MD)
8. Bijnore	0.603(VL)	16.40	0.807 (L)	21.95	6.64 (MD)
9. Moradabad	0.398(EL)	10.84	0.687 (L)	18.69	8.80 (MD)

Table 3.5 (Continued)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	UP** (u^{71})	Decadal Employment Deterioration (d)
(1)	(2)	(3)	(4)	(5)	(6)
UTTAR PRADESH (Contd.)					
10. Budaun	0.220(EL)	5.98	0.431(EL)	11.71	6.09 (LD)
11. Rampur	0.320(EL)	8.70	0.535(VL)	14.55	6.41 (LD)
12. Bareilly	0.321(EL)	8.73	0.548(VL)	14.90	6.76 (MD)
13. Pilbhit	0.237(EL)	6.46	0.423(EL)	11.50	5.39 (LD)
14. Shahjahanpur	0.088(EL)	2.39	0.331(EL)	9.02	6.79 (MD)
15. Dehradun	0.075(EL)	2.05	0.427(EL)	11.60	9.76 (MD)
16. Saharanpur	0.333(EL)	9.07	0.638(VL)	17.35	9.10 (MD)
17. Muzaffarnagar	0.342(EL)	9.29	0.756 (L)	20.56	12.42 (MD)
18. Meerut	0.392(EL)	10.67	0.869 (L)	23.62	14.50 (HD)
19. Bulandshahr	0.740 (L)	20.14	0.975 (M)	26.51	7.98 (MD)
20. Aligarh	0.790 (L)	21.48	0.870 (L)	23.65	2.77 (LD)
21. Mathura	0.511(VL)	13.90	0.904 (M)	24.57	12.39 (MD)
22. Agra	0.646(VL)	17.56	0.910 (M)	24.76	8.73 (MD)
23. Etah	0.877 (L)	23.86	0.735 (L)	20.00	-5.07 (LI)
24. Mainpuri	0.927 (M)	25.22	0.817 (L)	22.22	-4.02 (LI)
25. Farrukhabad	0.839 (L)	22.82	0.661(VL)	17.97	-6.28 (LI)
26. Etawah	0.949 (M)	25.82	0.894 (M)	24.32	-2.03 (LI)
27. Kanpur	0.405(EL)	11.01	0.740 (L)	20.11	10.22 (MD)
28. Fatehpur	0.537(VL)	14.60	0.748 (L)	20.34	6.73 (MD)
29. Allahabad	0.444(EL)	12.08	0.916 (M)	24.91	14.59 (HD)
30. Jhansi	0.392(EL)	10.67	0.822 (L)	22.39	13.12 (HD)
31. Jalaun	0.649(VL)	17.66	0.869 (L)	23.63	7.25 (MD)
32. Hamirpur	0.256(EL)	6.97	0.763 (L)	20.76	14.83 (HD)
33. Banda	0.653(VL)	17.75	0.688 (L)	18.73	1.19 (LD)
34. Kheri	0.067(EL)	1.82	0.277(EL)	7.54	5.83 (LD)
35. Sitapur	0.062(EL)	1.68	0.422(EL)	11.49	9.98 (MD)
36. Hardoi	0.128(EL)	3.49	0.498(VL)	13.55	10.43 (MD)
37. Unnao	0.786 (L)	21.36	0.717 (L)	19.49	-2.38 (LI)
38. Lucknow	0.239(EL)	6.51	0.744 (L)	20.22	14.66 (HD)
39. Rae Bareli	0.634(VL)	17.24	0.780 (L)	21.23	4.82 (LD)
40. Bahraich	0.324(EL)	8.80	0.188(EL)	5.12	-4.04 (LI)
41. Gonda	0.432(EL)	11.74	0.368(EL)	10.00	-1.98 (LI)
42. Bara Banki	0.513(VL)	13.94	0.376(EL)	10.24	-4.30 (LI)
43. Faizabad	0.549(VL)	14.94	0.809 (L)	22.00	8.31 (MD)
44. Sultanpur	0.921 (M)	25.06	0.907 (M)	24.68	-0.51 (LI)
45. Pratapgarh	0.810 (L)	22.04	1.128 (H)	30.68	11.08 (MD)
46. Basti	0.338(EL)	9.21	0.516(VL)	14.04	5.32 (LD)
47. Gorakhpur	0.447(EL)	12.15	0.817 (L)	22.23	11.47 (MD)
48. Deoria	0.907 (M)	24.66	0.921 (M)	25.05	0.51 (LD)
49. Azamgarh	0.852 (L)	23.18	1.200 (H)	32.63	12.31 (MD)

Table 3.5 (Concluded)

Districts by States and Union Territories	OVER-ALL PHASE 1960-61 IIU & Rank* (L^{61})	1960-61 UP** (u^{61})	1970-71 IIU & Rank* (L^{71})	1970-71 UP** (u^{71})	Decadal Employment Deterioration (d)
(1)	(2)	(3)	(4)	(5)	(6)
UTTAR PRADESH (Contd.)					
50. Jaunpur	0.931 (M)	25.31	1.262 (H)	34.33	12.08 (MD)
51. Ballia	1.010 (M)	27.47	1.241 (H)	33.75	8.66 (MD)
52. Ghazipur	0.864 (L)	23.49	1.141 (H)	31.04	9.87 (MD)
53. Varanasi	0.402(EL)	10.93	1.051 (M)	28.59	19.82(VHD)
54. Mirzapur	0.618(VL)	16.80	0.774 (L)	21.05	5.11 (LD)
WEST BENGAL	0.768 (L)	20.88	1.009 (M)	27.45	8.30 (MD)
1. Darjeeling	0.496(VL)	13.48	0.991 (M)	26.96	15.58 (HD)
2. Jalpaiguri	0.625(VL)	17.01	0.953 (M)	25.93	10.75 (MD)
3. Cooch Behar	0.474(VL)	12.89	0.909 (M)	24.71	13.57 (HD)
4. West Dinajpur	1.177 (H)	32.00	0.928 (M)	25.24	-9.95 (MI)
5. Malda	0.902 (M)	24.54	1.050 (M)	28.55	5.31 (LD)
6. Murshidabad	1.067 (M)	29.01	1.140 (H)	31.00	2.81 (LD)
7. Nadia	1.291 (H)	35.12	1.216 (H)	33.07	-3.16 (LI)
8. 24-Parganas	0.735 (L)	19.99	1.099 (M)	29.89	12.36 (MD)
9. Howrah	0.576(VL)	15.68	1.000 (M)	27.19	13.65 (HD)
10. Calcutta	0.043(EL)	1.17	0.086(EL)	2.33	1.17 (LD)
WEST BENGAL (Contd.)					
11. Hooghly	0.783 (L)	21.29	1.128 (H)	30.68	11.92 (MD)
12. Burdwan	0.690 (L)	18.76	1.040 (M)	28.28	11.72 (MD)
13. Birbhum	1.131 (H)	30.77	1.154 (H)	31.39	0.89 (LD)
14. Bankura	0.882 (L)	23.98	1.150 (H)	31.28	9.60 (MD)
15. Midnapore	1.211 (H)	32.94	1.178 (H)	32.04	-1.34 (LI)
16. Purulia	0.038(EL)	1.03	0.940 (M)	25.57	24.80(VHD)
ARUNACHAL PRADESH	0.671 (L)	18.25	0.716 (L)	19.48	1.50 (LD)
1. Kameug	0.297(EL)	8.07	0.346(EL)	9.41	1.46 (LD)
2. Subansiri	0.806(EL)	21.93	0.854 (L)	23.23	1.66 (LD)
3. Siang	0.791 (L)	21.52	0.831 (L)	22.61	1.39 (LD)
4. Lohit	0.476(VL)	12.96	0.530(VL)	14.41	1.66 (LD)
5. Tirap	0.863 (L)	23.48	0.903 (M)	24.55	1.40 (LD)
CHANDIGARH	0.214(EL)	5.83	0.394(EL)	10.72	5.19 (LD)
DELHI	0.597(VL)	16.25	0.438(EL)	11.92	-5.17 (LI)
DADRA & NAGAR HAVELI	0.688 (L)	18.72	0.867 (L)	23.59	6.00 (LD)
GOA	0.698 (L)	18.99	0.966 (M)	26.27	8.99 (MD)
PONDICHERRY	0.661(VL)	17.97	0.888 (L)	24.14	7.52 (MD)

Table 3.6 : Correlation Matrices of Unemployment Indices, 1960-61 and 1970-71

1960-61				1970-71		
L(IV)	L(V)	L(S)		L(IV)	L(V)	L(S)
1.0000	0.9433	0.9900	L(IV)	1.0000	0.9324	0.9876
	1.0000	0.9805	L(V)		1.0000	0.9771
		1.0000	L(S)			1.0000

Among these indices, as L(V) depicts the character of the main activity phase we have primarily gone for the classification of L(V) by the procedure adopted in subsection (2.2.6) and the comparable classification schemes for the other two indices have been derived through regression estimates of class-interval lengths. These regression estimates are derived with the use of only 1970-71 data. This has been done because (i) the year 1970-71 has already been chosen as benchmark in the calculation of indices, and, (ii) correlations are of same high order in both 1970-71 and 1960-61. For achieving comparability of data between two time-points, the same classification scheme for an index has, however, been used for both 1960-61 and 1970-71. In all these classifications, likewise the preceding practices, the central critical value of unity for every index has been centered in the class of medium values, ranked by the symbol, M. On either side of this class we have equi-length classes of higher and lower index values, except the two tail-end classes, which are open on one side. As usual, these classes with descending magnitudes of indices are assigned the qualitative class-ranks as given below : EH (extremely high), VH (very high), H (high), M (medium), L (low), VL (very low), EL (extremely low). Common boundaries between two consecutive classes in terms of L(IV), L(V) and L(S) can be expressed equivalently in terms of u(IV), u(V) and u(S) respectively since these are proportional with the constant of proportionality being 1971 all-India estimates u^{71}(IV), u^{71}(V) and u^{71}(S) respectively (for the district level variation of the variables). Again, since $m_{ij}^{t}(\varphi) = 100 - u_{ij}^{t}(\varphi)$, for φ = IV, V and S, so the class-boundaries of $u(\varphi)$ can be easily converted into those of class-boundaries of $m(\varphi)$ with opposite qualitative notations for class-ranks (i.e., lower ranks get redesignated as higher ranks and vice versa). So mapping on each index gives simultaneously three impressions with respect to $L(\varphi)$, $u(\varphi)$ and $m(\varphi)$. The maps on the classified values of the indices, for 1960-61 and 1970-71, have been shown in Figures (3.1) to (3.6). The defining class-boundaries and its qualitative ranks for $L(\varphi)$, $u(\varphi)$ and $m(\varphi)$, φ = IV, V and S, are presented respectively in Tables 3.7(a), 3.7(b) and 3.7(c). Frequencies of districts in all these classes, for both time-points, have been summarised in the subsequent Table (3.8).

Table 3.7 : Boundary Values for the Classification of Unemployment Indices with the Corresponding Class-ranks

(a) Fourth Phase Index of the Incidences of Unemployment : L(IV)

Class-intervals (defining) for L(IV)	Class-ranks of L(IV) & u(IV)	Alternative class-intervals by percentage of adult males		Class-ranks of m(IV)
		u(IV)	m(IV)	
(1)	(2)	(3)	(4)	(5)
1.50 and above	EH	46.99 and above	below 53.01	EL
1.30 to 1.50	VH	40.72 to 46.99	53.01 to 59.28	VL
1.10 to 1.30	H	34.46 to 40.72	59.28 to 65.54	L
0.90 to 1.10	M	28.19 to 34.46	65.54 to 71.81	M
0.70 to 0.90	L	21.93 to 28.19	71.81 to 78.07	H
0.50 to 0.70	VL	15.66 to 21.93	78.07 to 84.34	VH
below 0.50	EL	below 15.66	84.34 and above	EH

(b) Fifth Phase Index of the Incidences of Unemployment : L(V)

Class-intervals (defining) for L(V)	Class-ranks of L(V) & u(V)	Alternative class-intervals by percentage of adult males		Class-ranks of m(V)
		u(V)	m(V)	
(1)	(2)	(3)	(4)	(5)
1.75 and above	EH	37.45 and above	below 62.55	EL
1.45 to 1.75	VH	31.03 to 37.45	62.55 to 68.97	VL
1.15 to 1.45	H	24.61 to 31.03	68.97 to 75.39	L
0.85 to 1.15	M	18.19 to 24.61	75.39 to 81.81	M
0.55 to 0.85	L	11.77 to 18.19	81.81 to 88.23	H
0.25 to 0.55	VL	5.35 to 11.77	88.23 to 94.65	VH
below 0.25	EL	below 5.35	94.65 and above	EH

Table 3.7 (concluded)

(c) The Over-all Index of the Incidences of Unemployment : L(S)

Class-intervals (defining) for L(S)	Class-ranks of L(S) & u(S)	Alternative class-intervals by percentage of adult males: u(S)	Alternative class-intervals by percentage of adult males: m(S)	Class-ranks of m(S)
(1)	(2)	(3)	(4)	(5)
1.55 and above	EH	42.16 and above	below 57.84	EL
1.33 to 1.55	VH	36.17 to 42.16	57.84 to 63.83	VL
1.11 to 1.33	H	30.19 to 36.17	63.83 to 69.81	L
0.89 to 1.11	M	24.21 to 30.19	69.81 to 75.79	M
0.67 to 0.89	L	18.22 to 24.21	75.79 to 81.78	H
0.45 to 0.67	VL	12.24 to 18.22	81.78 to 87.76	VH
below 0.45	EL	below 12.24	87.76 and above	EH

Table 3.8 : Frequency of Districts by Class-ranks of L(φ), u(φ) and m(φ) in 1960-61 and 1970-71

Class-rank of L(φ) or u(φ)	φ = IV Frequency 1960-61	φ = IV Frequency 1970-71	φ = V Frequency 1960-61	φ = V Frequency 1970-71	φ = S Frequency 1960-61	φ = S Frequency 1970-71	Class-rank of m(φ)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EH	0	7	2	19	0	14	EL
VH	5	37	17	33	9	37	VL
H	21	86	45	76	35	80	L
M	69	121	65	119	66	117	M
L	93	62	96	75	89	67	H
VL	90	19	81	20	81	16	VH
EL	71	17	43	7	69	18	EH
Total	349	349	349	349	349	349	

3.5 Analyses on the Incidences of Unemployment and the Findings

To measure the regional variations on the incidences of unemployment, we have now three indices, $L^t(IV)$, $L^t(V)$ and $L^t(S)$ for (a) the job-searching (or, initial activity) Phase IV, (b) the main activity Phase V, and (c) the over-all activity Phase S, at two time-points t = 1960-61 and 1970-71. As these indices are connected in some way or other, strong spatial associations or inter-relations are likely to exist among them. So, before going for detailed regional analyses we shall first attempt relevant statistical analyses that would help subsequent regional analyses for identifying regional patterns on the incidences of unemployment.

3.5.1 Statistical Analysis with Indices on the Incidences of Unemployment

With indices on the incidences of unemployment, varying over the districts at two time-points, the following OLS regressions have been empirically worked out :

$L^{61}(IV) = 0.1015 + 0.8507\ L^{61}(S)$;

correlation coefficient : $r = 0.990$, ...(3.36)

$L^{71}(IV) = 0.1661 + 0.8516\ L^{71}(S)$; $r = 0.988$, ...(3.37)

$L^{61}(V) = -0.2029 + 1.2975\ L^{61}(S)$; $r = 0.981$, ...(3.38)

$L^{71}(V) = -0.2626 + 1.2840\ L^{71}(S)$; $r = 0.977$, ...(3.39)

Above regressions indicate that both Phase IV and Phase V indices have extremely high positive spatial correlations with the over-all index at both the time-points 1960-61 and 1970-71. Moreover, the spatial rate of change of $L^t(IV)$ with respect to $L^t(S)$, as reflected by the corresponding regression coefficients, has remained almost same (around the value 0.85) for both the time-points. Again, the spatial rate of change of $L^t(V)$ with respect to $L^t(S)$ has maintained more or less the same value (around the value of 1.29) for both the time-points. With such high values of correlation coefficients, the spatial rates of change (or, the regression coefficients) turn out to be almost identical with the relative spatial divergences that could be measured by the corresponding standard deviation ratios. Thus, we have the following comparable values :

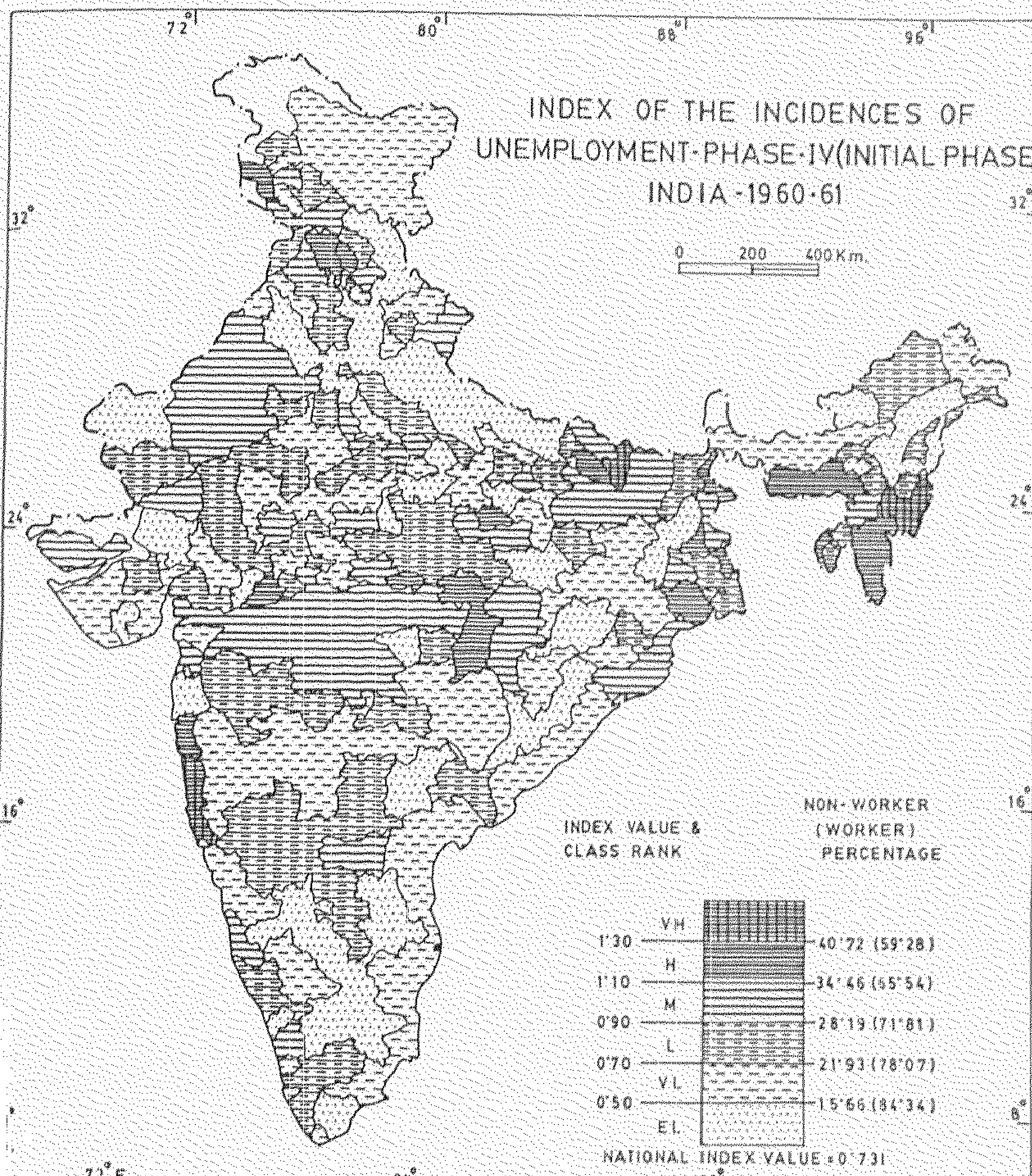
	$L^t(IV)$ with respect to $L^t(S)$		$L^t(V)$ with respect to $L^t(S)$	
	t=1961	t=1971	t=1961	t=1971
Spatial rate of change	0.8507	0.8516	1.2975	1.2840
Relative spatial divergence	0.8593	0.8642	1.3234	1.3142

Thus, we notice that the spatial rate of change (or, the relative spatial divergence) of L(IV) or L(V) has remained same at both the time-points, for any Phase IV or V with respect to the spatial variations of the over-all IIU. The slight changes observed in the intercept parameter in the regressions (3.36) and (3.37), and also, (3.38) and (3.39) are merely due to adjustments of mean values, which are very close to all-India values of the indices as recorded below :

Year	All-India values of indices		
t	$L^t(IV)$	$L^t(V)$	$L^t(S)$
1960-61	0.731	0.692	0.718
1970-71	1.000	1.000	1.000

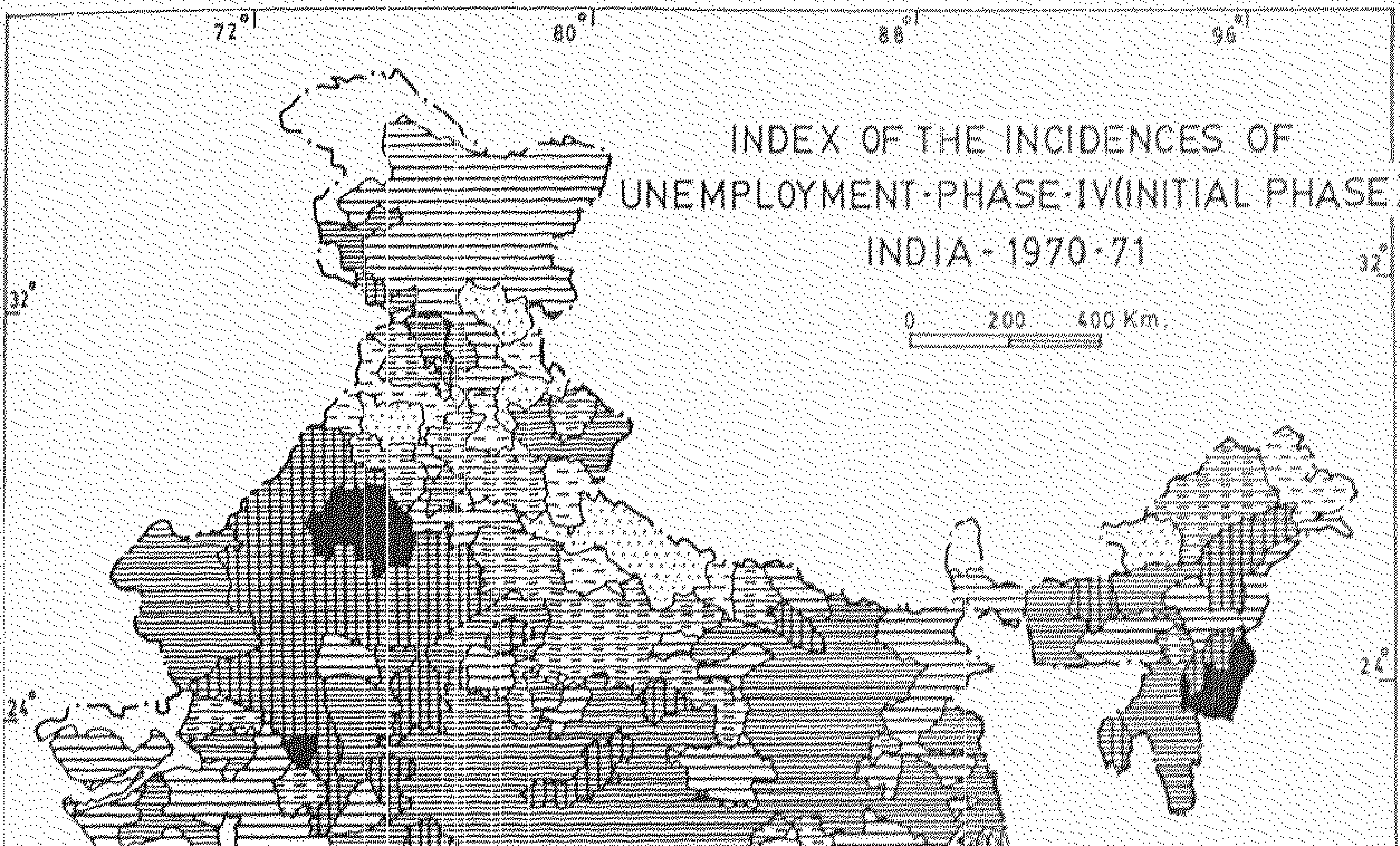
These all-India critical value of unity has remained same for all three indices in 1970-71 for our choices of benchmark values at 1970-71. Also, the all-India values for 1960-61 are almost of same magnitude for the three indices (between 0.69 and 0.73), although these values are much lower as compared with those of the 1970-71 critical value (showing a similar kind of deterioration in employment situation over the decade by any of the indices). As it stands now, the spatial rates of change with respect to the spatial variations of the over-all index have remained same for both the time-points. Their magnitudes, however, are lower than unity (around 0.85) for Phase IV and higher than unity (around 1.29) for Phase V. These features as accounted now by the district-level variations of the variables, are practically similar to what are already observed in connection with our search for phasewise surrogates through indices $F^t_{0j}(S)$ on State-level data.

All these show a strong corroboration of phasewise features of spatial variations at both time-points with what could be depicted by both the district-level variations as well as the State-level variations of the over-all index $L^{61}(S)$ or $L^{71}(S)$. Thus, the spatial patterns as get depicted empirically through the cartographic analysis of $L^{61}(S)$ or $L^{71}(S)$, would largely be similar to that of any phase at the corresponding time-point. This could be further supported from the fact that the relative spatial divergences over the decade of say, 1971 index with respect to 1961 index, are of the same magnitude empirically for all the phases (actually, 0.9311 for Phase IV, 0.9215 for Phase V and 0.9280 for the over-all Phase S). The spatial correlation between the variations of any one of the indices over two time-points has also been of the same order (with value of the correlation coefficient between 0.60 and 0.65). But this correlation coefficient, although positive, is not of very high magnitude for any index. As such there must be some differences in the spatial patterns between 1971 and 1961. Moreover, all-India values of $L^t(IV)$, $L^t(V)$ and $L^t(S)$, although have remained more or less same for any particular time-point t, there has been significant deteriorations in the employment situation over the decade. Thus, we have to examine the



INDEX OF THE INCIDENCES OF UNEMPLOYMENT-PHASE-IV(INITIAL PHASE) INDIA-1960-61
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72° E.
80°
88°
INDEX VALUE & CLASS RANK
NON-WORKER (WORKER) PERCENTAGE
V.H.
1'30
40'72 (59'28)
H
1'10
34'46 (65'54)
M
0'90
28'19 (71'81)
L
0'70
21'93 (78'07)
V.L.
0'50
15'66 (84'34)
E.L.
NATIONAL INDEX VALUE = 0'731

FIG. 3'1



INDEX OF THE INCIDENCES OF UNEMPLOYMENT-PHASE-IV(INITIAL PHASE) INDIA-1970-71
0 200 400 Km
72°
80°
88°
96°
32°
24°
16°
8°
72° E.
80°
88°
INDEX VALUE & CLASS RANK
NON-WORKER (WORKER) PERCENTAGE
EH
1'50
46'99 (53'01)
VH
1'30
40'72 (59'28)
H
1'10
34'46 (65'54)
M
0'90
28'19 (71'81)
L
0'70
21'93 (78'07)
VL
0'50
15'66 (84'34)
EL
NATIONAL VALUE = 1'000

FIG. 3'2

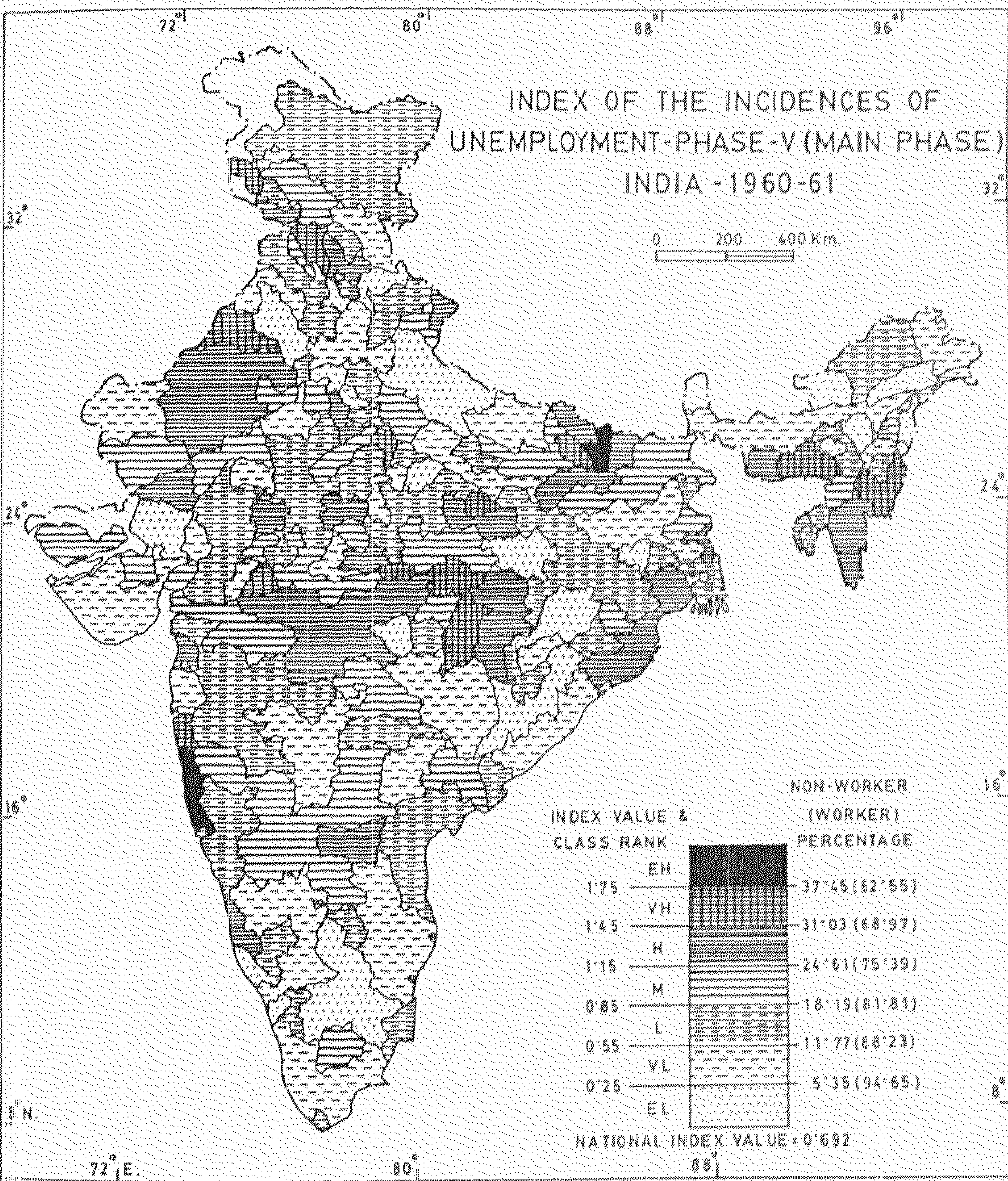

INDEX OF THE INCIDENCES OF
UNEMPLOYMENT-PHASE-V (MAIN PHASE)
INDIA - 1960-61
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8° N.
72° E.
INDEX VALUE & CLASS RANK
NON-WORKER (WORKER) PERCENTAGE
EH
1·75
37·45 (62·55)
VH
1·45
31·03 (68·97)
H
1·15
24·61 (75·39)
M
0·85
18·19 (81·81)
L
0·55
11·77 (88·23)
VL
0·25
5·35 (94·65)
EL
NATIONAL INDEX VALUE = 0·692

FIG. 3·3

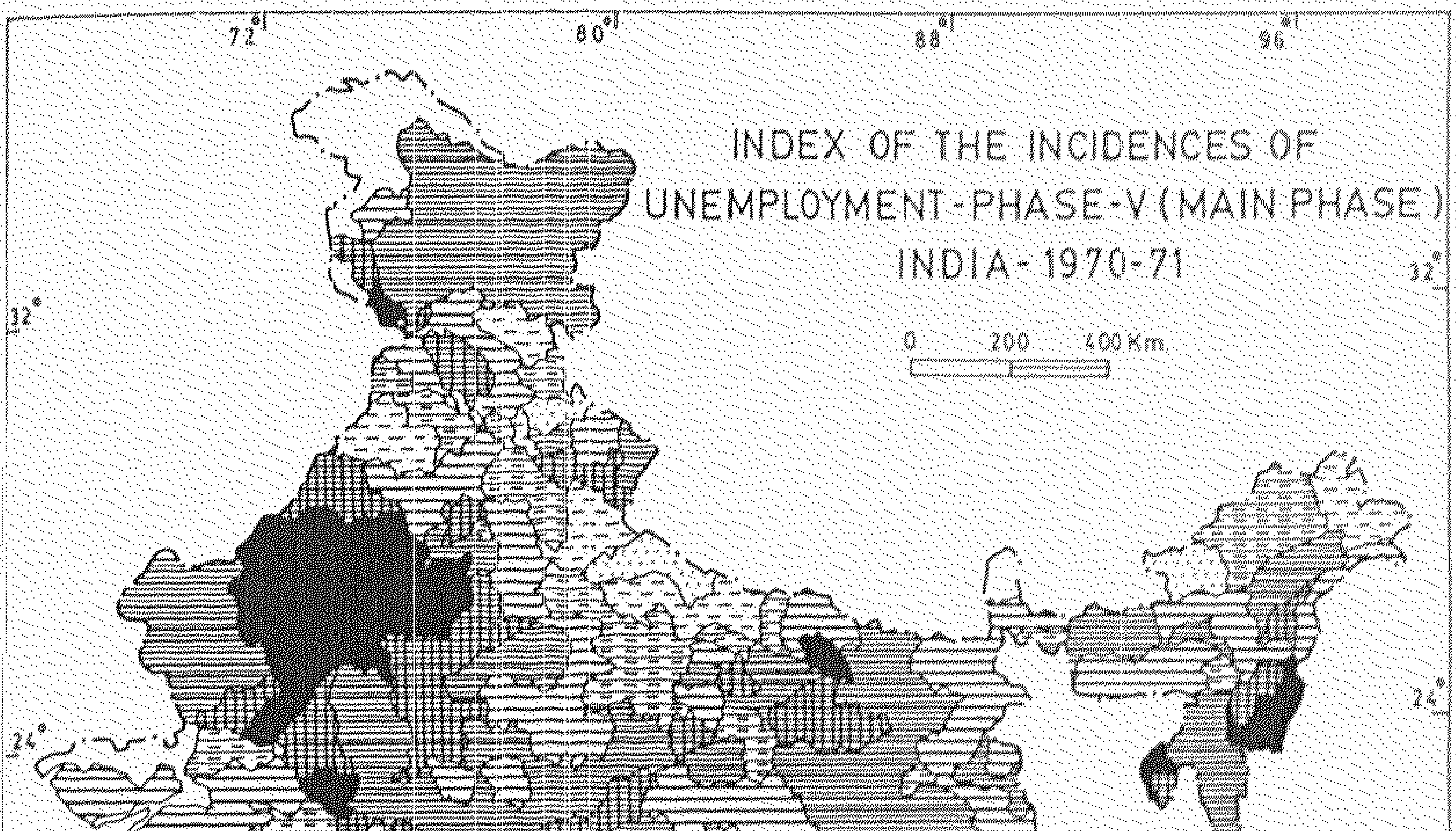

INDEX OF THE INCIDENCES OF
UNEMPLOYMENT-PHASE-V (MAIN PHASE)
INDIA-1970-71
0 200 400 Km.
INDEX VALUE &
CLASS RANK
NON-WORKER
(WORKER)
PERCENTAGE
EH
1'75
37'45(62'55)
VH
1'45
31'03(68'97)
H
1'15
24'61(75'39)
M
0'85
18'19(81'81)
L
0'55
11'77(88'23)
VL
0'25
5'35(94'65)
EL
NATIONAL INDEX VALUE=1'000

FIG. 3'4

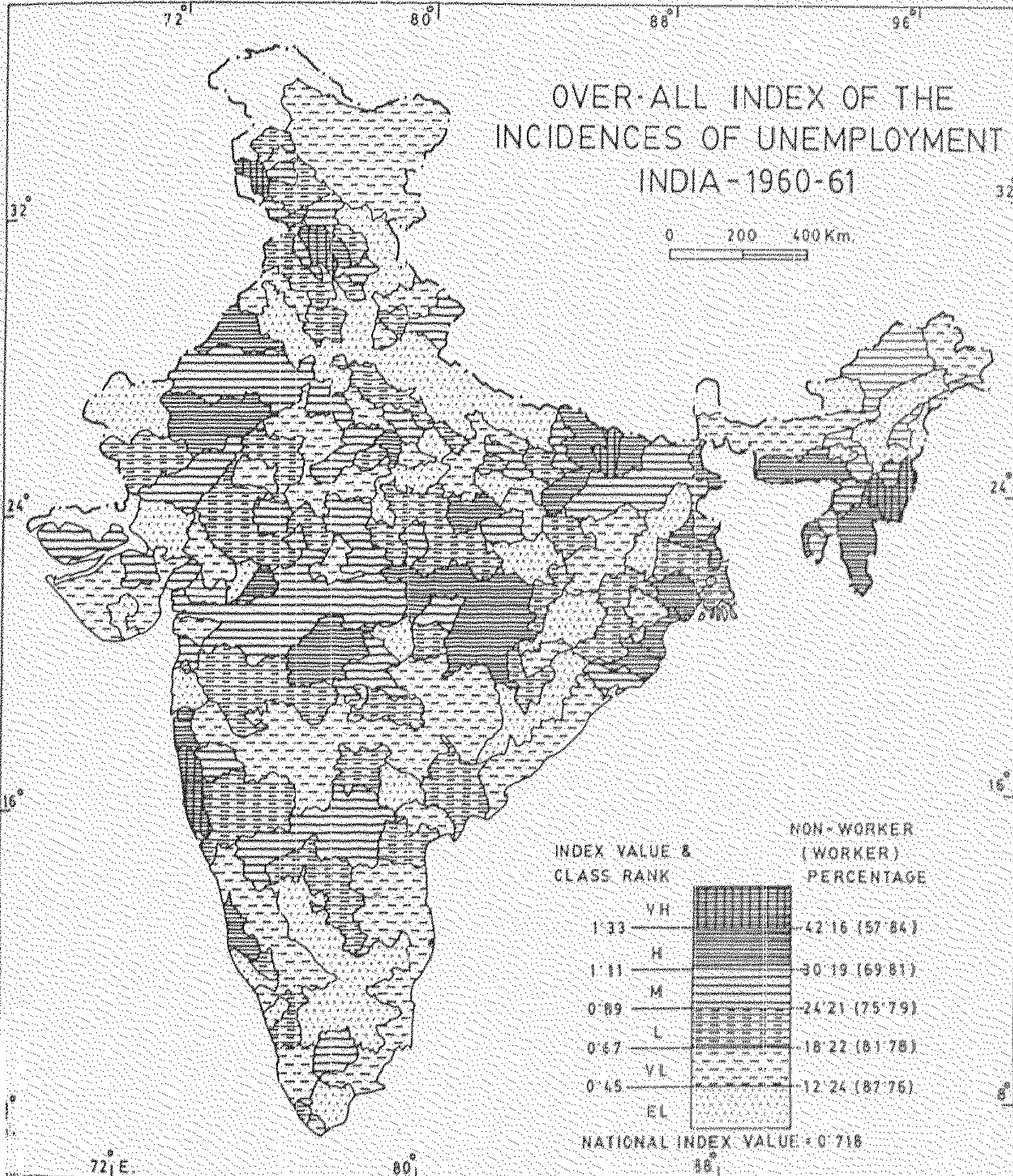

OVER-ALL INDEX OF THE
INCIDENCES OF UNEMPLOYMENT
INDIA - 1960-61
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8°
72 E.
INDEX VALUE &
CLASS RANK
NON-WORKER
(WORKER)
PERCENTAGE
VH
1·33
42·16 (57·84)
H
1·11
30·19 (69·81)
M
0·89
24·21 (75·79)
L
0·67
18·22 (81·78)
VL
0·45
12·24 (87·76)
EL
NATIONAL INDEX VALUE = 0·718

FIG. 3·5

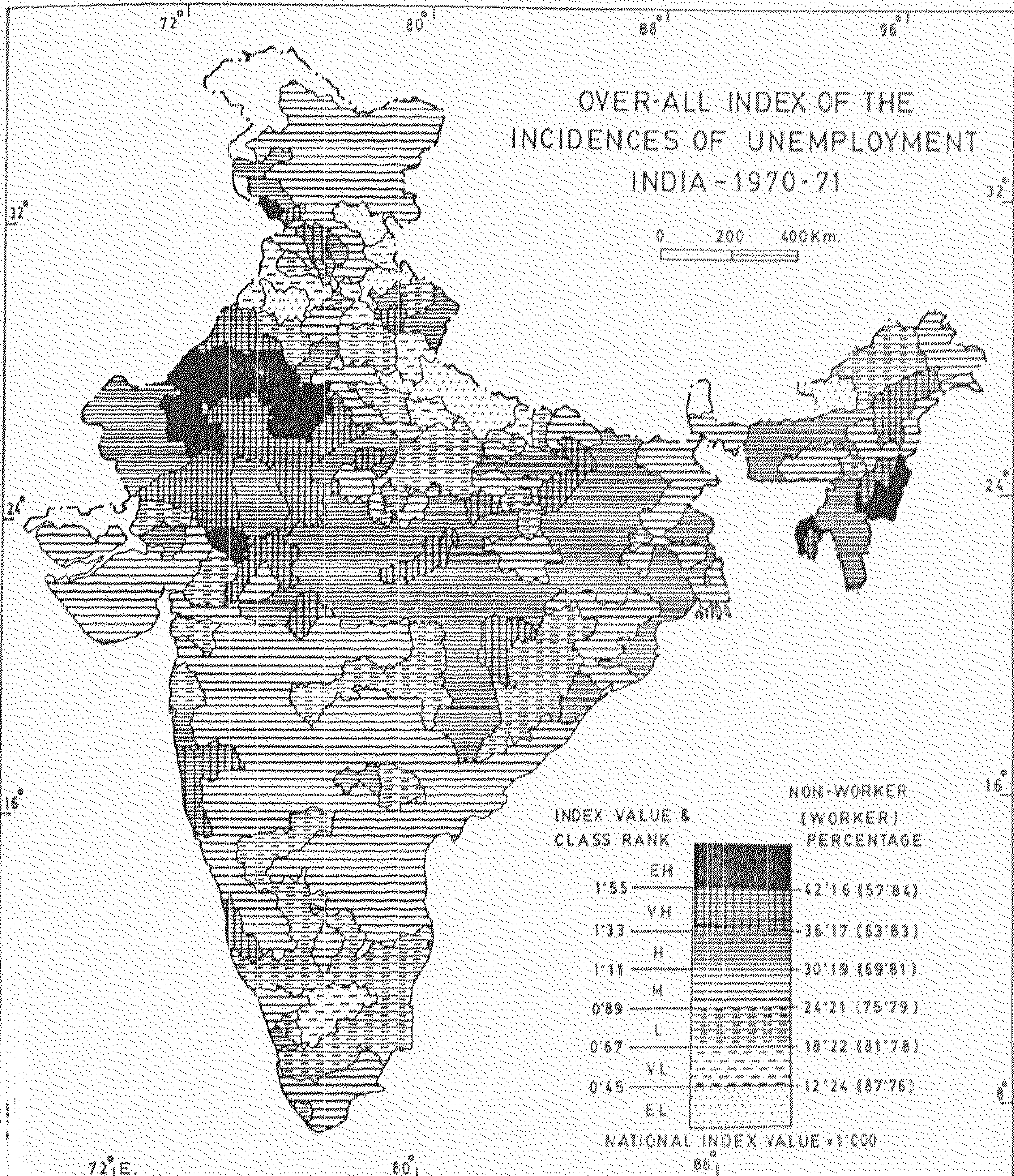

OVER-ALL INDEX OF THE
INCIDENCES OF UNEMPLOYMENT
INDIA - 1970-71
0 200 400Km.
72°
80°
88°
96°
32°
24°
16°
8°
72°E.
INDEX VALUE &
CLASS RANK
NON-WORKER
(WORKER)
PERCENTAGE
EH
1'55
42'16 (57'84)
VH
1'33
36'17 (63'83)
H
1'11
30'19 (69'81)
M
0'89
24'21 (75'79)
L
0'67
18'22 (81'78)
VL
0'45
12'24 (87'76)
EL
NATIONAL INDEX VALUE = 1'000

FIG. 3'6

spatial patterns at both time-points to understand the differential nature of deteriorations on space over the decade. But, it looks, as though, it is good enough to study a single index, say, the over-all index $L^t(S)$ (and not necessarily all the three $L^t(S)$, $L^t(IV)$ and $L^t(V)$) for the purpose of the evaluations of the spatial patterns and relative deteriorations on space.

Then the question arises : why have we taken all these troubles for generating $L^t(IV)$ and $L^t(V)$ as well through complicated statistical procedures, when $L^t(S)$ could be obtained by relatively easy means, as done already ? Its answer lies in the fact that although Phase IV and Phase V indices as such would not likely to portray much on the spatial patterns, over and above what could be obtained from the over-all index, the differential changes in the incidences of unemployment from the job-searching Phase IV to the main activity Phase V would certainly expose certain factual conditions on the employment opportunities as prevalent in different areas at the two time-points. Thus, the split of the over-all Phase S, done in the form of the job-searching Phase IV and the main activity Phase V, is not really unnecessary, and we shall discuss in the next subsection how fruitfully we could use the two phasewise incidences of unemployment in the context of evaluation of prevalent employment opportunities. But before that, we shall conclude this subsection with a brief analysis of district frequencies by class-ranks of indices on the incidences of unemployment, so that we can get certain preliminary views on the dimensions of deterioration in the employment situation over the decade.

The district frequencies by class-ranks of indices L(IV), L(V) and L(S) are already presented in Table (3.8) for both time-points 1960-61 and 1970-71. The class-ranks are based on the decreasing classified values of indices, designated as EH, VH, H, M, L, VL and EL, with the critical all-India value of unity at 1970-71 falling in the central class ranked M for each index. The 1971 all-India critical value corresponds actually to the benchmark values of 31.33% unemployed males for Phase IV, 21.40% unemployed males for Phase V, and 27.20% unemployed males for the over-all Phase S. For the sake of comparability between time-points, the same classification scheme has been used for both time-points 1960-61 and 1970-71 for each of the indices. With aggravating unemployment situation, 1961 all-India index values 0.731, 0.692 and 0.718 for Phases IV, V and S respectively, do not fall in the central class M, but do in the next lower class, ranked L. Thus, L-ranked class could be considered as the central class by 1961 all-India standards, while it is the class M by 1971 all-India standards. So, relative to both the standards, the significantly low incidences of unemployment (equivalently, the significantly high incidences of employment) are to be identified by class-ranks (EL + VL), and, on the other hand, the significantly high incidences of unemployment (equivalently, significantly low incidences of employment) are to be indicated by class-ranks (EH + VH + H). Our initial classification, with about a third of total frequency count in the central class M in 1971, has been made on the index L(V), related to the main activity phase. It could be noticed that with reference to the same index L(V), the class-ranks (EL + VL) account again for about a third of total frequency count in 1960-61 (actually 124 out of 349). Thus, with reference to the index L(V), about a third (124 districts) of the total number of districts in India have experienced significantly low incidences of unemployment in 1960-61, while about a third (128 districts) of the total number of districts in India have recorded significantly high incidences of unemployment in 1970-71. But the district frequencies in the favoured class-ranks (EL + VL) have reduced from 124 in 1961 to only 27 in 1971, while the district frequencies in the disfavoured class-ranks (EH+VH+H) have increased from 64 in 1961 to 128 in 1971 (with reference to index L(V)). Thus, favoured districts are drastically reduced in number, and on the other extreme, the disfavoured districts have become double in number within the short span of the single decade considered. Clearly, these signify an wide-spread deterioration in the employment situation over the decade.

The class-rank L shows the pattern, transitional to the favoured class-ranks (EL + VL), with the falling district frequencies in the time-path from 1961 to 1971 (but not that drastically; actually it is 96 in 1961 reduced to 75 in 1971). On the other hand, the class-rank M shows the pattern, transitional to the disfavoured class-ranks (EH + VH + H), with the rising district frequencies from 1961 to 1971 (more or less in a similar manner; actually it is 65 in 1961, increased to 119 in 1971). As the better employment situation is our desirable objective, we have implicitly used above the terminologies, " favoured" and " disfavoured" in the relative sense with respect to the all-India employment standards at the two time-points. In concrete terms, this means that the favoured districts are those which have less than 11.8% unemployed males in the main activity Phase V (upper boundary of class ranks EL + VL) at any time-point. On the other hand, the disfavoured districts are those which have more than 24.6% unemployed males in the main activity Phase V (lower boundary of class-ranks EH + VH + H). We shall treat the class-rank L as the transitionally favoured (or favoured by single 1971 standard) class-rank, while the class-ranks EL and VL as distinctly favoured class-ranks. On the other hand, the class-rank M will be treated as the transitionally disfavoured (or, disfavoured by single 1961 standard) class-rank, while the class-ranks EH, VH and H are considered as distinctly disfavoured class-ranks. Thus, the favoured class-ranks, distinctly or transitionally, have shown the characteristic of falling district frequencies from 1961 to 1971 and the disfavoured class-ranks, distinctly or transitionally, have shown the characteristic of increasing district frequencies from 1961 to 1971. These characteristic features are exhibited not only by the index L(V), relating to the main activity phase, but also by the index L(IV), relating to the job-searching phase, and hence by the overall index L(S), relating to the total activity phase (for details, ref. to figures given in Table (3.8)).

Thus, a drastic reduction in the frequency of districts over the decade in the distinctly favoured class-ranks (EL + VL), with a value as high as 78%, has been recorded uniformly by any index, L(V), L(IV) or L(S), showing an alarmingly significant and wide-spread deterioration in employment situation in the short time-span, even in areas considered favourable in 1961. It is to be noted that the favourable areas of employment situation have reduced in the same proportion (in number of districts) over the decade in both Phase IV and Phase V — implying, as though, the favourable areas are equally affected, in respect of both Phases IV and V, under deteriorating employment situation over the decade. But this is not so with the disfavoured (or, relatively unfavourable) areas; the relatively unfavourable areas have enlarged over the decade much more in the job-searching Phase IV than in the main-activity Phase V — resulting ultimately into correspondingly wide-spread disfavoured areas in 1971 for both the phases. Thus, when the number of districts in the distinctly disfavoured class-ranks (EH + VH + H) has ultimately been of the same high order (about one-third, or, more specifically about 37% of total number of districts in India) in 1971, by any index L(IV) or L(V) (and hence L(S)), the frequency of distinctly disfavoured districts in 1971 has been as high as five times the corresponding frequency in 1961 in respect of index L(IV), and it has been double in respect of index L(V) as already noted elsewhere. This means that the districts which were not in the extreme category of distinctly disfavoured class in 1961, enter into this category in 1971 and this happens much more in the job-searching phase than in the main activity phase. Thus, the adverse effect of the deteriorating scope of employment in the relatively unfavourable areas has been much more in the job-searching phase than in the main activity phase. In summary, all these empirical features signify that under the deteriorating scope of employment, the p_x-curve (i.e. the curve for the age-specific proportion of male employment) becomes more steep. Conversely, under the improving scope of employment, the p_x-curve becomes less steep. As the employment situation was better in 1961 (as compared with that of 1971), we have relatively less steep p_x-curve in 1961 than in 1971. This means that in view of the general under-employment situation of Indian economy at both time-points, the peaks of p_x-curve, falling in Phase V, are quite close at both time-points, and the curves fall apart with falling age (with 1961 p_x-curve lying above the 1971 p_x-curve). Thus, as compared with the Phase V, the Phase IV is likely to be more sensitive to changes in employment situation in an underemployed economy. That is why under a better employment situation in 1961 (as compared with that of 1971), the distinctly favoured districts are more in number in Phase IV than in Phase V and at the same time the distinctly disfavoured districts are again less in number in Phase IV than in Phase V (ref. to Table (3.8)).

3.5.2 Employment Opportunity Index : the construction, classification and frequency analysis

The Construction of Employment Opportunity Index : As already proposed in the preceding subsection, we shall now discuss on the possible comparative use of the two phase-wise indices $L^t(IV)$ and $L^t(V)$ (derived from the corresponding percentages of adult male employment $m_{ij}^t(IV)$ and $m_{ij}^t(V)$), towards the construction of an index of employment opportunity. We can redesignate the two phasewise percentages $m_{ij}^{t}(IV)$ and $m_{ij}^{t}(V)$ as follows :

$m_{ij}^{t}(V)$ = average saturated level of employment in main activity phase under the over-all unemployment condition for adult males reflected by $u_{ij}^{t}(= 100 - m_{ij}^{t}(S))$,

$m_{ij}^{t}(IV)$ = average unsaturated level of employment in job-searching phase under the over-all unemployment condition for adult males, reflected by u_{ij}^{t}.

Then we can define

$$G_{ij}^{t} = m_{ij}^{t}(V) - m_{ij}^{t}(IV) \qquad \ldots\ldots (3.40)$$

= employment growth for saturation in employment level, or, in short, the <u>saturating employment growth</u>, under the over-all unemployment condition for adult males, reflected by u_{ij}^{t}.

Now, let us denote

ε_{ij}^{t} = employment opportunity index variable for i-th district of j-th State at time-point t;

(this gives the revealed scope of absorption to activities for adult males).

Next we take into account the following two types of logically consistent variations (or, covariations) :

1. Under the same " unemployment condition" as reflected by the numerical value of u_{ij}^{t}, it is quite consistent to take that

   ε_{ij}^{t} varies directly as G_{ij}^{t} .

2. Again, under the same " saturating employment growth", as reflected by the numerical value of G_{ij}^{t}, it is also quite consistent to take that

   ε_{ij}^{t} varies inversely as u_{ij}^{t} .

   Combining these two types of variation, we can take it granted that

   ε_{ij}^{t} varies jointly as G_{ij}^{t} and $(1/u_{ij}^{t})$.

   Hence, we can write

$$\varepsilon_{ij}^{t} = C(G_{ij}^{t} / u_{ij}^{t}) \qquad \ldots\ldots (3.41)$$

where C is the 'constant of variation'. We choose the value of C as to be such that the 1971 all-India value of the 'employment opportunity index', denoted by ε^{71}, equals the critical value of unity. Thus, we have

$$1 = C\ (G^{71}/u^{71}) \qquad \text{..... (3.42)}$$

where $G^{71} = m^{71}(V) - m^{71}(IV)$
(i.e. the 1971 all-India value for the saturating employment growth)

and u^{71} = the 1971 all-India percentage of over-all adult male unemployment.

Now, eliminating C from the above two relations (3.41) and (3.42), we get the employment opportunity index formulation as follows :

$$\varepsilon^{t}_{ij} = \frac{(G^{t}_{ij} / u^{t}_{ij})}{(G^{71} / u^{71})} \qquad \text{..... (3.43)}$$

In this formulation we have really made the comparative use of the phasewise percentages of adult male employment $m^{t}_{ij}(IV)$ and $m^{t}_{ij}(V)$ in the form shown in relation (3.40). It should be noted that we have the following inequalities :

$$0 < m^{t}_{ij}(IV) < m^{t}_{ij}(V) < 100$$

This means that $G^{t}_{ij} > 0$ always. Clearly we have $u^{t}_{ij} > 0$. Thus, ε^{t}_{ij} always assume positive values. Again, recalling the nature of our p_x-curve, we can note that $m_{ij}(IV)$ and $m_{ij}(V)$ correspond to some values of p_x for certain representative ages x in the two Phases IV and V. The age-intervals (19, 35) years and (36, 60) years represent these two phases. Considering the nature of p_x-curve, particularly its equally falling nature in the advanced Phase V around the maximal p_x value at age x around 47 years (ref. to the discussions in subsection (3.3.1)), we can take something like, $m_{ij}(IV) = p_h$ and $m_{ij}(V) = p_s$ corresponding to representative ages h (say, some age around 28 years) and s (say, some age around 42 years) respectively in the monotonic increasing part of the p_x-curve, before attaining the maximal p_x-value (denoted earlier by p_k). Thus, we can take

$$G_{ij} = m_{ij}(V) - m_{ij}(IV)$$

$$= p_s - p_h = \left(\frac{p_s - p_h}{s - h}\right) \cdot (s - h)$$

$$= \begin{pmatrix}\text{gradient of the} \\ \text{chord of } p_x\text{-curve} \\ \text{between } x = h \text{ and } s\end{pmatrix} \times \begin{pmatrix}\text{difference between} \\ \text{the representative} \\ \text{ages } x = h \text{ and } s\end{pmatrix}$$

Thus, if the difference (s - h) remains constant, the saturating employment growth G_{ij} can be taken as proportional to the gradient of the p_x-curve for the changes of the representative ages from h to s years. Now, granting this interpretation of G_{ij}, we can now justify clearly the first type of variation of ε_{ij} as follows :

> The steeper the p_x-curve, the greater is the magnitude of the said gradient, and hence the higher would be the value of ε_{ij}.

Thus, this justifies our acceptance of the direct variation between ε_{ij} and G_{ij}.

With the 1971 all-India value (G^{71}/u^{71}) as benchmark, the critical value $\varepsilon^{71} = 1$. With this standardisation of the 1971 all-India employment opportunity, $\varepsilon_{ij}^{t} < 1$ implies a lower level of employment opportunity available in i-th district of j-th State at time-point t, and conversely $\varepsilon_{ij}^{t} > 1$ implies a higher level. In the present case of Indian situation, we are dealing with an under-employed economy, although our planning objective is for a full-employment target. For attaining such an objective, the ε_{ij}-value has to be sufficiently large, with our present standardisation for the unit index value. Taking tentatively an economy very near to the full-employment target, as reflected by the tentative values, say, $m_{ij}(V) = 95\%$, $m_{ij}(IV) = 80\%$ and $u_{ij} = 10\%$, the corresponding value of ε_{ij} turns out to be at the order of 4. Thus, the value of ε_{ij} at the order of 4 or above may be taken as sufficiently large, signifying an employment level near to the full-employment target. However, in our present employment situation this value could hardly be achieved in any district. Anyway, we have constructed this index of employment opportunity only to identify the spatial pattern and some other spatially varying characteristics. For this purpose we need to classify the empirical data on ε_{ij} for cartographic presentation.

Mode of classification of ε_{ij} : As in the cases of other indices, we classify the data of ε_{ij} for 1970-71, and use the same classification scheme for the data of ε_{ij} at the preceding time-point 1960-61. The index $L_{ij}(S)$ is proportional to u_{ij} and in accordance with the second type of variation between ε_{ij} and u_{ij}, the index $L_{ij}(S)$ is expected to have strong negative correlation with ε_{ij}. Thus, we go for a comparable classification for ε_{ij} in relation to $L_{ij}(S)$ by making a divergence correction on the class-interval length of $L_{ij}(S)$. In analytic term we take

$$\Delta\varepsilon = (\Delta L \cdot \sigma_{\varepsilon}) / \sigma_L$$

where $\Delta\varepsilon$ and ΔL are class-interval lengths for data on ε_{ij} and $L_{ij}(S)$ respectively, and, σ_{ε} and σ_L denote the respective standard deviations.

The value of $\Delta\varepsilon$ thus obtained has a magnitude of about 0.35, and we round it up to the lower even number of 0.34 in its two digited value. Thus, taking this interval length 0.34 and placing the 1971 all-India critical value of unity as the mid-value in the central class of medium values, we have the following classification for ε_{ij} by equi-length intervals, given in Table (3.9). In this table we have also shown the usual nomenclature for class-ranks in increasing magnitudes of class-boundaries. Under this classification scheme, the district frequencies have been worked out, both with the data of 1961 and 1971, and presented in the same Table (3.9).

Table 3.9 : Details of Classification of the Employment Opportunity Index (ε_{ij}) and Classwise District-frequencies

Class-ranks	Class-intervals of ε_{ij}	District-frequencies	
		1960-61	1970-71
VL	below 0.49	54	46
L	0.49 to 0.83	78	82
M	0.83 to 1.17	59	118
H	1.17 to 1.51	60	61
VH	1.51 to 1.85	35	24
EH	1.85 and above	63	18

It is to be noted that, by the above mode of classification, we have about one-third of total number of districts in the medium class, ranked M, in 1971, corroborating our usual principle of classification with a third of total frequency in the central class.

Comparative frequency analysis : We conclude this subsection with a comparative analysis of class-wise district frequencies for the two time-points. It should be noted that the 1960-61 all India value, $\varepsilon^{61} = 1.14$ (when $\varepsilon^{71} = 1.00$). Thus, the all-India values for both the time-points fall in the M-ranked central class, and thus, the class-ranks (EH+VH+H) can be considered as the distinctly favoured ranks and the class-ranks (VL + L) as the distinctly disfavoured ranks, relative to both all-India standards of 1971 and 1961. It is interesting to note that the number of districts in the disfavoured class-ranks (VL + L) has remained same one-third (actually 37 to 38% of total number of districts) at both time-points. This means that the disfavoured districts remain similarly wide-spread at both time-points. On the other hand, there has been a substantial reduction (about 57%) in the frequency of highly favoured districts of class-ranks (EH + VH). The frequency of ordinarily favoured districts of rank H (with values just above 1960-61 all-India standard) has, however, remained same at both time-points. Thus, highly favoured areas of employment opportunities in 1960-61 have undergone significant areal shrinkage over the decade. Our immediate inference is that the feature of employment deterioration over the decade has affected more adversely the highly favourable areas of employment opportunities. The differential changes in the employment opportunities by districts could be observed from the empirical data on ε_{ij} presented for both the time-points in the Table (3.10). The class-ranks of districts have also been identified for both the time-points and recorded along with the empirical data in Table (3.10). These classified data have been cartographically presented in Figures (3.7) and (3.8) respectively for 1960-61 and 1970-71.

3.5.3 Regional Pattern Identification on the 1970-71 Incidences of Unemployment

Under the general situation of employment deterioration over the decade under consideration, the 1970-71 incidences of unemployment have been found to be relatively more severe during the period, and we propose to analyse the regional patterns of 1970-71 incidences. The related index here is $L^{71}(S)$, which has been mapped and shown in Figure (3.6). From the examination of this map it can be noticed that broad regional groupings of districts did emerge in the 1970-71 incidences of unemployment. Our observations in this respect are as follows.

1) Relative to the 1970-71 all-India situation the areas which are better-off or favourable (with EL + VL + L ranks of the incidences of unemployment) are concentrated in a major region around the capital State of Delhi, extending in the north-west (mostly in Punjab State) and also in the north and the east (mostly in western and central Uttar Pradesh).

Table 3.10 : Employment Opportunity Index for Adult Males : Estimates and Classified Ranks, for Districts of India in 1960-61 and 1970-71

Districts by States and Union Territories	Employment Opportunity Index (ε_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
INDIA	1.136 (M)	1.000 (M)
ANDHRA PRADESH	0.743 (L)	0.932 (M)
1. Srikakulam	1.078 (M)	0.911 (M)
2. Vishakhapatnam	1.077 (M)	0.963 (M)
3. East Godavari	0.814 (L)	0.931 (M)
4. West Godavari	0.572 (L)	0.956 (M)
5. Krishna	0.649 (L)	0.855 (M)
6. Guntur	0.744 (L)	0.852 (M)
7. Ongole	0.636 (L)	0.829 (L)
8. Nellore	0.849 (M)	0.926 (M)
9. Chittoor	1.137 (M)	1.052 (M)
10. Cuddapah	1.205 (H)	0.978 (M)
11. Anantapur	0.504 (L)	0.912 (M)
12. Kurnool	0.193 (VL)	0.803 (L)
13. Mahbubnagar	0.329 (VL)	0.996 (M)
14. Hyderabad	0.558 (L)	0.666 (L)
15. Medak	0.455 (VL)	1.062 (M)
16. Nizamabad	0.819 (L)	0.967 (M)
17. Adilabad	0.483 (VL)	0.945 (M)
18. Karimnagar	0.932 (M)	1.057 (M)
19. Warangal	1.139 (M)	1.027 (M)
20. Khammam	0.425 (VL)	0.961 (M)
21. Nalgonda	1.425 (H)	1.146 (M)
ASSAM	1.479 (H)	1.040 (M)
1. Goalpara	1.543 (VH)	1.081 (M)
2. Kamrup	1.800 (VH)	0.997 (M)
3. Darrang	1.821 (VH)	1.113 (M)
4. Nowgong	1.157 (M)	1.088 (M)
ASSAM (Contd.)		
5. Sibsagar	2.036 (EH)	0.910 (M)
6. Lakhimpur	2.516 (EH)	0.974 (M)
7. Mikir Hills	2.764 (EH)	1.302 (H)
8. North Cachar Hills	1.163 (M)	1.583 (VH)
9. Cachar	0.878 (M)	1.103 (M)
10. Mizo	0.798 (L)	1.105 (M)
BIHAR	0.821 (L)	0.672 (L)
1. Patna	0.654 (L)	0.570 (L)
2. Gaya	0.730 (L)	0.544 (L)
3. Shahabad	0.570 (L)	0.513 (L)
4. Saran	0.407 (VL)	0.360 (VL)
5. Champaran	0.562 (L)	0.917 (M)
6. Muzaffarpur	0.255 (VL)	0.687 (L)
7. Darbhanga	0.571 (L)	0.661 (L)
8. Monghyr	0.745 (L)	0.660 (L)
9. Bhagalpur	0.876 (M)	0.680 (L)
10. Saharsa	0.707 (L)	0.892 (M)
11. Purnea	0.841 (M)	0.937 (M)
12. Santhal Parganas	1.771 (VH)	0.809 (L)
13. Palamau	0.956 (M)	0.686 (L)
14. Hazaribagh	1.375 (H)	0.581 (L)
15. Ranchi	1.267 (H)	0.683 (L)
16. Dhanbad	1.863 (EH)	1.145 (M)
17. Singhbhum	1.199 (H)	0.692 (L)

NB : Ranking Symbols for the Employment Opportunity Index

Range of Value	Symbol
1.85 and above	EH
1.51 to 1.85	VH
1.17 to 1.51	H
0.83 to 1.17	M
0.49 to 0.83	L
below 0.49	VL

Table 3.10 (Continued)

Districts by States and Union Territories	Employment Opportunity Index (ϵ_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
GUJARAT	1.313 (H)	1.357 (H)
1. Jamnagar	1.428 (H)	1.298 (H)
2. Rajkot	1.471 (H)	1.210 (H)
3. Surendranagar	0.887 (M)	1.299 (H)
4. Bhavnagar	1.477 (H)	1.221 (H)
5. Amreli	1.965 (EH)	1.309 (H)
6. Junagadh	1.638 (VH)	1.294 (H)
7. Kutch	0.778 (L)	1.314 (H)
8. Banaskantha	2.581 (EH)	1.556 (VH)
9. Sabarkantha	1.552 (VH)	1.285 (H)
10. Mahesana	2.522 (EH)	1.176 (H)
11. Gandhinagar	2.194 (EH)	1.380 (H)
12. Ahmedabad	1.468 (H)	1.353 (H)
13. Kheda	0.893 (M)	1.392 (H)
14. Panchmahals	1.317 (H)	1.565 (VH)
15. Vadodara	1.057 (M)	1.500 (H)
16. Bharuch	0.821 (L)	1.414 (H)
17. Surat	1.359 (H)	1.535 (VH)
18. Valsad	0.657 (L)	1.237 (H)
19. The Dangs	0.860 (M)	1.702 (VH)
HARYANA	1.951 (EH)	0.465 (VL)
1. Ambala	2.513 (EH)	0.675 (L)
2. Karnal	1.588 (VH)	0.616 (L)
3. Rohtak	2.269 (EH)	0.140 (VL)
4. Gurgaon	2.351 (EH)	0.443 (VL)
5. Mahendranagar	1.381 (H)	0.257 (VL)
6. Hisar	2.746 (EH)	0.712 (L)
7. Jind	1.579 (VH)	0.517 (L)
HIMACHAL PRADESH	0.345 (VL)	0.283 (VL)
1. Chamba	0.677 (L)	0.740 (L)
2. Kangra	0.208 (VL)	0.289 (VL)
3. Mandi	0.399 (VL)	0.372 (VL)
4. Kulu	0.989 (M)	0.785 (L)
5. Lahul and Spiti	2.279 (EH)	1.798 (VH)
6. Bilaspur	0.262 (VL)	0.386 (VL)
7. Mahasu	0.570 (L)	0.726 (L)

Districts by States and Union Territories	Employment Opportunity Index (ϵ_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
HIMACHAL PRADESH (Contd.)		
8. Simla	0.854 (M)	0.729 (L)
9. Sirmaur	1.109 (M)	1.210 (H)
10. Kinnaur	1.769 (VH)	1.309 (H)
JAMMU AND KASHMIR	0.752 (L)	0.459 (VL)
1. Anantanag	0.732 (L)	0.645 (L)
2. Srinagar	1.286 (H)	0.484 (VL)
3. Baramula	0.937 (M)	0.669 (L)
4. Ladakh	1.193 (H)	0.610 (L)
5. Doda	0.851 (M)	0.633 (L)
6. Udhampur	1.133 (M)	0.581 (L)
7. Jammu	0.572 (L)	0.113 (VL)
8. Kathua	0.483 (VL)	0.292 (VL)
9. Rajauri	0.215 (VL)	0.384 (VL)
10. Punch	0.246 (VL)	0.426 (VL)
KARNATAKA	0.912 (M)	1.270 (H)
1. Bangalore	1.864 (EH)	1.262 (H)
2. Belgaum	0.706 (L)	1.352 (H)
3. Bellary	0.630 (L)	1.334 (H)
4. Bidar	1.111 (M)	1.165 (M)
5. Bijapur	0.650 (L)	1.254 (H)
6. Chikmagalur	1.332 (H)	1.264 (H)
7. Chitradurga	1.466 (H)	1.368 (H)
8. Coorg	0.741 (L)	1.414 (H)
9. Dharwar	0.510 (L)	1.436 (H)
10. Gulbarga	1.171 (H)	1.247 (H)
11. Hassan	1.067 (M)	1.231 (H)
12. Kolar	0.789 (L)	1.358 (H)
13. Mandya	1.280 (H)	1.361 (H)
14. Mysore	1.186 (H)	1.412 (H)
15. North Kanara	0.966 (M)	1.165 (M)
16. Raichur	0.481 (VL)	1.395 (H)
17. Shimoga	1.163 (M)	1.143 (M)
18. South Kanara	0.174 (VL)	0.839 (M)
19. Tumkur	1.417 (H)	1.386 (H)

Table 3.10 (Continued)

Districts by States and Union Territories	Employment Opportunity Index (e_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
KERALA	2.461(EH)	1.326 (H)
1. Cannanore	2.726(EH)	1.552(VH)
2. Kozikode	2.428(EH)	1.310 (H)
3. Malappuram	3.373(EH)	1.334 (H)
4. Palghat	2.064(EH)	1.708(VH)
5. Trichur	2.141(EH)	1.083 (M)
6. Ernakulam	2.617(EH)	1.547(VH)
7. Kottayam	2.456(EH)	1.503 (H)
8. Alleppey	2.475(EH)	1.356 (H)
9. Quilon	2.446(EH)	1.307 (H)
10. Trivandrum	2.319(EH)	1.535(VH)
MADHYA PRADESH	0.455(VL)	0.873 (M)
1. Morena	0.507 (L)	0.937 (M)
2. Bhind	0.145(VL)	0.863 (M)
3. Gwalior	0.710 (L)	0.776 (L)
4. Datia	0.961 (M)	0.903 (M)
5. Shivpuri	0.931 (M)	1.077 (M)
6. Gunna	0.309(VL)	0.938 (M)
7. Tikamgarh	0.757 (L)	0.998 (M)
8. Chhatarpur	0.711 (L)	1.094 (M)
9. Panna	0.756 (L)	0.953 (M)
10. Satna	0.200(VL)	0.827 (L)
11. Rewa	0.030(VL)	0.710 (L)
12. Shahdol	0.670 (L)	0.984 (M)
13. Sidhi	0.254(VL)	0.906 (M)
14. Mandsaur	0.360(VL)	0.915 (M)
15. Ratlam	0.561 (L)	0.810 (L)
16. Ujjain	0.792 (L)	0.794 (L)
17. Jhabna	1.364 (H)	0.761 (L)
18. Dhar	0.071(VL)	1.079 (M)
19. Indore	0.418(VL)	0.649 (L)
20. Devas	0.396(VL)	0.813 (L)
21. Khargone	0.347(VL)	0.849 (M)
22. Khandwa	0.283(VL)	0.748 (L)
23. Shajapur	0.507 (L)	0.903 (M)
24. Rajgarh	0.821 (L)	0.997 (M)
25. Vidisha	0.411(VL)	1.013 (M)
26. Sehore	1.230 (H)	0.849 (M)
27. Raisen	0.392(VL)	0.922 (M)
28. Hoshangabad	0.398(VL)	0.829 (L)
29. Betul	0.216(VL)	0.873 (M)
30. Sagar	0.692 (L)	0.890 (M)
MADHYA PRADESH (Contd.)		
31. Damoh	0.487(VL)	0.826 (L)
32. Jabalpur	0.664 (L)	0.741 (L)
33. Narsimhapur	0.084(VL)	0.731 (L)
34. Mandla	0.071(VL)	0.882 (M)
35. Chhindwara	0.367(VL)	0.833 (M)
36. Seoni	0.208(VL)	0.881 (M)
37. Balaghat	0.395(VL)	0.966 (M)
38. Surguja	1.807(VH)	1.123 (M)
39. Bilaspur	0.304(VL)	0.864 (M)
40. Raigarh	0.856 (M)	1.003 (M)
41. Durg	0.070(VL)	0.855 (M)
42. Raipur	0.181(VL)	0.809 (L)
43. Baster	1.204 (H)	0.960 (M)
MAHARASHTRA	1.107 (M)	0.928 (M)
1. Greater Bombay	8.226(EH)	2.476(EH)
2. Thana	1.713(VH)	1.179 (H)
3. Kolaba	0.399(VL)	0.532 (L)
4. Ratnagiri	0.168(VL)	0.338(VL)
5. Nasik	1.108 (M)	0.846 (M)
6. Dhulia	0.692 (L)	0.811 (L)
7. Jalgaon	0.777 (L)	0.697 (L)
8. Ahmadnagar	1.003 (M)	0.793 (L)
9. Poona	1.197 (H)	0.739 (L)
10. Satara	0.814 (L)	0.433(VL)
11. Sangli	0.859 (M)	0.779 (L)
12. Sholapur	1.189 (H)	0.875 (M)
13. Kolhapur	1.185 (H)	0.832 (M)
14. Aurangabad	1.143 (M)	0.898 (M)
15. Parbhani	1.149 (M)	1.012 (M)
16. Bhir	1.507 (H)	0.880 (M)
17. Nanded	1.374 (H)	0.945 (M)
18. Osmanabad	1.503 (H)	0.849 (M)
19. Buldhana	0.503 (L)	0.913 (M)
20. Akola	0.552 (L)	0.910 (M)
21. Amravati	0.538 (L)	0.906 (M)
22. Yeotmal	0.736 (L)	1.017 (M)
23. Wardha	0.610 (L)	0.867 (M)
24. Nagpur	2.154(EH)	0.800 (L)
25. Bhandara	1.139 (M)	1.029 (M)
26. Chandrapur	1.392 (H)	1.076 (M)

Table 3.10 (Continued)

Districts by States and Union Territories	Employment Opportunity Index (ε_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
MANIPUR	0.697 (L)	0.415(VL)
1. Manipur North	1.237 (H)	0.695 (L)
2. Manipur West	0.643 (L)	0.540 (L)
3. Manipur South	0.901 (M)	0.404(VL)
4. Manipur Central	0.642 (L)	0.376(VL)
5. Manipur East	0.593 (L)	0.448(VL)
MEGHALAYA	0.628 (L)	1.197 (H)
1. Garo Hills	0.648 (L)	1.124 (M)
2. United Khasi & Jaintia Hills	0.615 (L)	1.250 (H)
NAGALAND	1.730(VH)	0.951 (M)
1. Kohima	2.040(EH)	1.183 (H)
2. Mokokchung	1.316 (H)	0.654 (L)
3. Tuensang	2.698(EH)	1.139 (M)
ORISSA	0.775 (L)	0.549 (L)
1. Sambalpur	3.130(EH)	0.967 (M)
2. Sundargarh	3.214(EH)	0.630 (L)
3. Keonjhar	0.554 (L)	0.489(VL)
4. Mayurbhanj	0.928 (M)	0.516 (L)
5. Balasore	0.166(VL)	0.286(VL)
6. Cuttack	0.172(VL)	0.314(VL)
7. Dhenkanol	0.806 (L)	0.543 (L)
8. Baudh Khondmals	1.775(VH)	0.832 (M)
9. Bolangir	1.149 (M)	0.947 (M)
10. Kalahandi	0.763 (L)	0.855 (M)
11. Koraput	1.799(VH)	0.934 (M)
12. Ganjam	1.088 (M)	0.294(VL)
13. Puri	0.222(VL)	0.478(VL)
PUNJAB	1.625(VH)	0.937 (M)
1. Gurdaspur	1.580(VH)	0.576 (L)
2. Amritsar	1.618(VH)	1.017 (M)
3. Firozpur	2.022(EH)	1.216 (H)
4. Ludhiana	1.577(VH)	1.108 (M)
5. Jullunder	1.425 (H)	0.653 (L)
6. Kapurthala	1.426 (H)	0.790 (L)
7. Hoshiarpur	1.201 (H)	0.532 (L)
8. Ropar	1.525(VH)	0.846 (M)
9. Patiala	1.615(VH)	1.061 (M)
10. Sangrur	1.861(EH)	1.629(VH)
11. Bhatinda	3.041(EH)	1.447 (H)

Districts by States and Union Territories	Employment Opportunity Index (ε_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
RAJASTHAN	0.566 (L)	0.451(VL)
1. Ganganagar	0.168(VL)	0.466(VL)
2. Bikaner	0.309(VL)	0.342(VL)
3. Churu	0.322(VL)	0.318(VL)
4. Jhunjhunu	0.364(VL)	0.185(VL)
5. Alwar	0.499 (L)	0.353(VL)
6. Bharatpur	0.366(VL)	0.476(VL)
7. Sawai Madhopur	0.950 (M)	0.522 (L)
8. Jaipur	1.149 (M)	0.410(VL)
9. Sikar	0.526 (L)	0.237(VL)
10. Ajmer	0.568 (L)	0.434(VL)
11. Tonk	0.767 (L)	0.540 (L)
12. Jaisalmer	1.467 (H)	0.634 (L)
13. Jodhpur	0.192(VL)	0.406(VL)
14. Nagaur	0.202(VL)	0.411(VL)
15. Pali	0.485(VL)	0.428(VL)
16. Barmer	0.704 (L)	0.632 (L)
17. Jalore	0.349(VL)	0.523 (L)
18. Sirohi	0.354(VL)	0.424(VL)
19. Bhilwara	1.154 (M)	0.813 (L)
20. Udaipur	0.748 (L)	0.518 (L)
21. Chittaurgarh	0.887 (M)	0.690 (L)
22. Dungarpur	0.816 (L)	0.307(VL)
23. Banaswara	0.781 (L)	0.349(VL)
24. Bundi	0.757 (L)	0.589 (L)
25. Kota	1.010 (M)	0.484(VL)
26. Jhalawar	0.742 (L)	0.524 (L)
TAMIL NADU	1.743(VH)	1.922(EH)
1. Madras	0.857 (M)	1.615(VH)
2. Chingleput	1.715(VH)	1.878(EH)
3. North Arcot	1.824(VH)	1.923(EH)
4. South Arcot	1.777(VH)	2.007(EH)
5. Dharmapuri	2.748(EH)	2.034(EH)
6. Salem	2.354(EH)	2.253(EH)
7. Coimbatore	3.034(EH)	2.306(EH)
8. Nilgiris	1.307 (H)	1.658(VH)
9. Madurai	0.970 (M)	1.891(EH)
10. Tiruchirapalli	2.116(EH)	2.032(EH)
11. Thanjavur	1.391 (H)	1.862(EH)
12. Ramanathpuram	1.545(VH)	1.711(VH)
13. Tirunelveli	1.837(VH)	1.709(VH)
14. Kanyakumari	1.417 (H)	1.603(VH)

Table 3.10 (Concluded)

Districts by States and Union Territories	Employment Opportunity Index (ε_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
TRIPURA	1.098 (M)	0.644 (L)
1. West Tripura	0.757 (L)	0.500 (L)
2. North Tripura	1.284 (H)	0.746 (L)
3. South Tripura	1.283 (H)	0.631 (L)
UTTAR PRADESH	1.234 (H)	0.985 (M)
1. Uttar Kashi	3.424 (EH)	3.173 (EH)
2. Chamoli	1.270 (H)	0.824 (L)
3. Tehri Garhwal	1.208 (H)	0.432 (VL)
4. Garhwal	1.076 (M)	0.275 (VL)
5. Pithorgarh	0.560 (L)	0.440 (VL)
6. Almora	0.705 (L)	0.371 (VL)
7. Nainital	3.456 (EH)	1.435 (H)
8. Bijnore	1.276 (H)	0.928 (M)
9. Moradabad	1.758 (VH)	1.125 (M)
10. Budaun	2.416 (EH)	1.676 (VH)
11. Rampur	2.001 (EH)	1.425 (H)
12. Bareilly	1.998 (EH)	1.397 (H)
13. Pilbhit	2.334 (EH)	1.698 (VH)
14. Shahjahanpur	3.189 (EH)	1.964 (EH)
15. Dehra Dun	3.304 (EH)	1.688 (VH)
16. Saharanpur	1.962 (EH)	1.215 (H)
17. Muzaffarnagar	1.930 (EH)	1.008 (M)
18. Meerut	1.778 (VH)	0.835 (M)
19. Bulandshahr	1.026 (M)	0.693 (L)
20. Aligarh	0.947 (M)	0.835 (M)
21. Mathura	1.446 (H)	0.783 (L)
22. Agra	1.193 (H)	0.778 (L)
23. Etah	0.811 (L)	1.042 (M)
24. Mainpuri	0.747 (L)	0.913 (M)
25. Farrukhabad	0.869 (M)	1.172 (H)
26. Etawah	0.718 (L)	0.800 (L)
27. Kanpur	1.716 (VH)	1.035 (M)
28. Fatehpur	1.414 (H)	1.022 (M)
29. Allahabad	1.636 (VH)	0.766 (L)
30. Jhansi	1.778 (VH)	0.902 (M)
31. Jalaun	1.186 (H)	0.837 (M)
32. Hamirpur	2.234 (EH)	0.997 (M)
33. Banda	1.180 (H)	1.123 (M)
34. Kheri	3.661 (EH)	2.167 (EH)
35. Sitapur	3.721 (EH)	1.699 (VH)
36. Hardoi	2.876 (EH)	1.508 (H)
37. Unnao	0.954 (M)	1.073 (M)
38. Lucknow	2.325 (EH)	1.028 (M)
39. Rae Bareli	1.215 (H)	0.970 (M)
40. Bahraich	1.994 (EH)	2.581 (EH)
41. Gonda	1.668 (VH)	1.854 (EH)
42. Bara Banki	1.469 (H)	1.826 (VH)

Districts by States and Union Territories	Employment Opportunity Index (ε_{ij})	
	1960-61	1970-71
(1)	(2)	(3)
UTTAR PRADESH (Contd.)		
43. Faizabad	1.386 (H)	0.925 (M)
44. Sultanpur	0.755 (L)	0.782 (L)
45. Pratapgarh	0.912 (M)	0.496 (L)
46. Basti	1.935 (EH)	1.467 (H)
47. Gorakhpur	1.629 (VH)	0.910 (M)
48. Deoria	0.775 (L)	0.763 (L)
49. Azamgarh	0.852 (M)	0.429 (VL)
50. Jaunpur	0.737 (L)	0.345 (VL)
51. Ballia	0.639 (L)	0.386 (VL)
52. Ghazipur	0.832 (M)	0.480 (VL)
53. Varanasi	1.748 (VH)	0.596 (L)
54. Mirazapur	1.247 (H)	0.980 (M)
WEST BENGAL	1.609 (VH)	1.183 (H)
1. Darjeeling	2.093 (EH)	1.204 (H)
2. Jalpaiguri	1.831 (VH)	1.251 (H)
3. Cooch Behar	2.140 (EH)	1.309 (H)
4. West Dinajpur	1.112 (M)	1.284 (H)
5. Malda	1.425 (H)	1.134 (M)
6. Murshidabad	1.230 (H)	1.034 (M)
7. Nadia	1.000 (M)	0.953 (M)
8. 24-Parganas	1.657 (VH)	1.080 (M)
9. Howrah	1.916 (EH)	1.194 (H)
10. Calcutta	4.570 (EH)	3.836 (EH)
11. Hooghly	1.585 (VH)	1.047 (M)
12. Burdwan	1.729 (VH)	1.146 (M)
13. Birbhum	1.158 (M)	1.019 (M)
14. Bankura	1.451 (H)	1.022 (M)
15. Midnapore	1.077 (M)	0.994 (M)
16. Purulia	4.712 (EH)	1.268 (H)
ARUNACHAL PRADESH	1.471 (H)	1.409 (H)
1. Kameng	2.392 (EH)	2.270 (EH)
2. Subansiri	1.338 (H)	1.268 (H)
3. Siang	1.358 (H)	1.300 (H)
4. Lohit	1.936 (EH)	1.817 (VH)
5. Tirap	1.258 (H)	1.202 (H)
CHANDIGARH	2.930 (EH)	1.601 (VH)
DELHI	3.132 (EH)	2.512 (EH)
DADRA & NAGAR Haveli	1.103 (M)	1.297 (H)
GOA	0.820 (L)	1.251 (H)
PONDICHERRY	1.234 (H)	1.816 (VH)

2) This relatively better-off region around the Capital, is surrounded by the areas which are distinctly unfavourable (with EH + VH + H ranks of the incidences of unemployment) — mostly in the southern and the eastern parts with broad regional groupings, and also in the northern part in a small regional grouping. Thus, the most unfavoured areas are extended in a major central part of India stretching from the western border to the eastern border through Rajasthan, Madhya Pradesh, Bihar, Southern West Bengal, Coastal Orissa mostly and then through Assam, Manipur, Mizoram and Tripura in the far-eastern India. The major core of this disfavoured region lies in Rajasthan and adjoining areas in Madhya Pradesh with extremely high or very high incidences of unemployment. Western part of Assam, Manipur and most of Tripura are also forming a highly disfavoured core areas in the Far-eastern India.

3) Between the above mentioned two regions or areas of opposite character, we have the patches here and there of transitionally disfavoured areas (with rank M). The distinctly disfavoured areas are also interspersed with transitionally disfavoured areas, particularly in parts of Jammu and Kashmir in the extreme north and also in parts of Bihar, Orissa, West Bengal and the Far-eastern India (excluding the sparsely populated Arunachal Pradesh, where the

incidences of unemployment is of rank lower than the all-India rank, M). However, the transitionally disfavoured areas (with rank M) form a broad regional grouping in the south of the above mentioned distinctly disfavoured region of India, stretching through Gujarat, Maharashtra, Andhra Pradesh and also in considerable areas of Karnataka (including Goa). This shows a relative improvement in the employment situation in the southward direction after a steep fall in the distinctly disfavoured region of Central India from the favoured northern region around the capital.

4) This pace of improvement in the southward direction continues and changes to favourable ranks of L and VL incidences of unemployment in farther South — in the Southern part of Karnataka, major northern part of Tamil Nadu and parts of Kerala, forming a major regional grouping.

5) To the south of this favoured region we have again a small areal grouping of transitionally disfavoured districts in the extreme southern tip of India.

3.5.4 The 1970-71 Incidences of Unemployment in Relation to Employment Situation Prevailing in 1960-61

The regional patterns as just identified on the incidences of unemployment refer to the terminal year of the decade under our consideration. At the beginning of

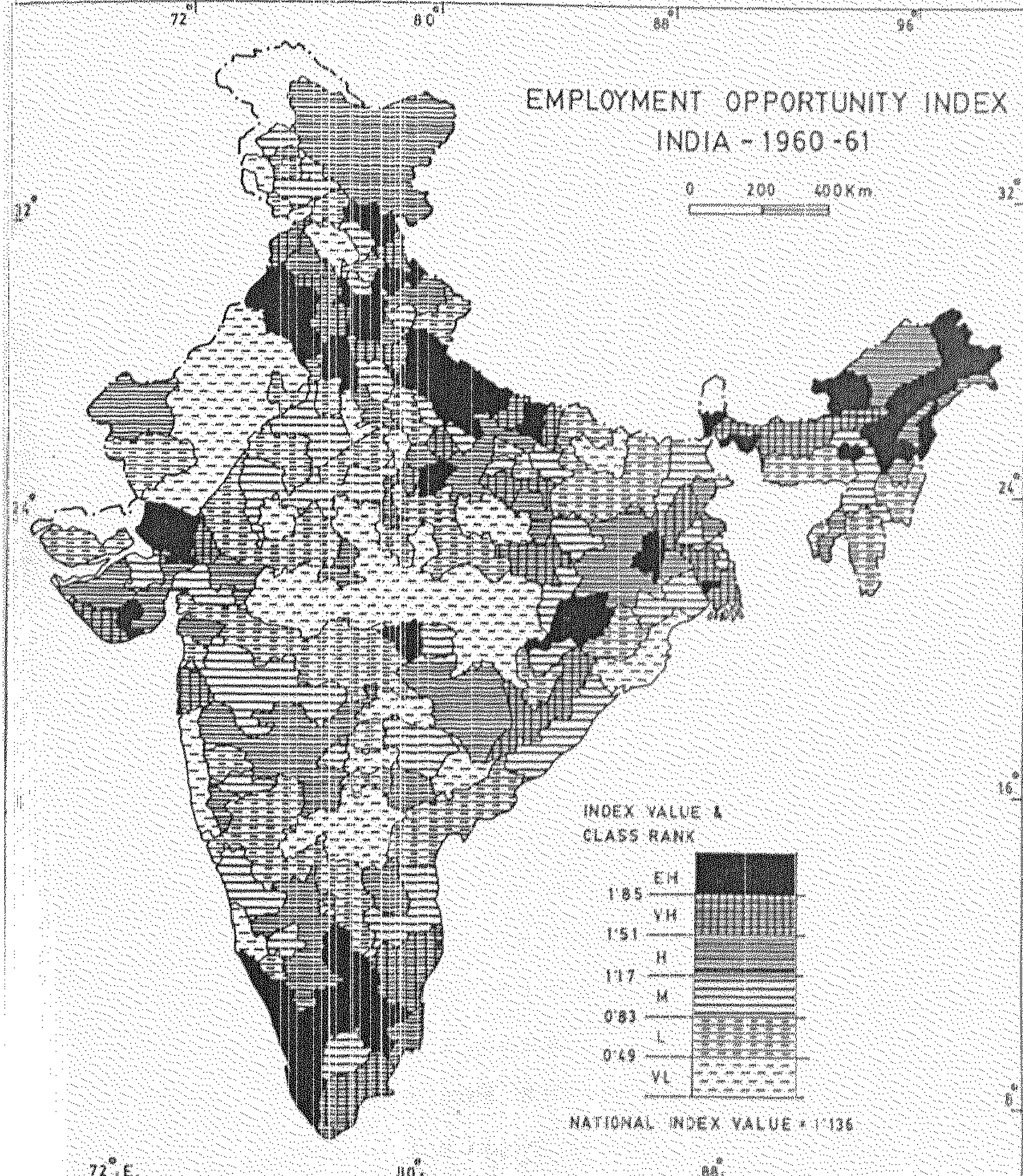

EMPLOYMENT OPPORTUNITY INDEX
INDIA - 1960-61
0 200 400 Km
72°
80°
88°
96°
32°
24°
16°
8°
72° E.
80°
88°
INDEX VALUE &
CLASS RANK
EH
1'85
VH
1'51
H
1'17
M
0'83
L
0'49
VL
NATIONAL INDEX VALUE = 1'136

FIG. 1'7

the decade, two national Five Year Plans were completed and the third Five Year Plan (1961-66) was also completed during the first half of the decade. Certain planning measures were incorporated in these three plans towards increased production in primary and secondary sectors mainly. During the decade, certain new agricultural strategy was also initiated towards self-sufficiency in food production, which started yielding results towards the end of the decade. Facilities were also substantially increased towards the spread of education, particularly for primary education. Despite all these, the additional activities that were generated in view of increased levels of production were not sufficient to cope up with the increased population growth. The result has obviously been reflected in the deteriorating employment situation with diversified regional patterns as in 1970-71.

Now the question arises : is this pattern an unabated culmination of the past employment situation uniformly over all regions or areas, or, is it moderated by any way in the planning process of activity generation through increased productive measures? With a view to throw some light on this question, we propose now to examine the index $L^{71}(S)$ interacted with the past employment situation as prevalent at the beginning of the decade of our concern, measured by our revealed employment opportunity index ε^{61}. We shall also examine how the past pattern of incidences of unemployment, as focussed by $L^{61}(S)$, changes to culminate into such regional patterns as identified for 1970-71 with so widely spread areas showing similar kinds of incidences of unemployment. In this connection, our statistical findings on spatial co-associations and relative divergences are as follows.

(1) There has been a high spatial co-association between the initial year (1960-61) employment situation as revealed by the employment opportunity index ε^{61} and the terminal year (1970-71) incidences of unemployment as reflected by the index $L^{71}(S)$. Expectedly, the spatial co-association was negative; the corresponding OLS correlation coefficient has been estimated to be of magnitude -0.62, when calculated for district level variations. Thus, it has followed generally that the greater the employment opportunities in the initial year, the lower has been the incidences of unemployment in a district in the terminal year and vice versa. Although the co-association is highly negative it is not that very highly negative as to expect almost correspondingly similar spatial patterns between ε^{61} and $L^{71}(S)$. So there have to be many occurrences of local peculiarities, violating the stated general pattern of spatial co-association.

(2) The spatial divergence of the employment situation in the initial year was, however, much higher than that of

the incidences of unemployment in the terminal year. In fact, the relative divergence ratio of ε^{61} to $L'^{71}(S)$ (measured by the ratio of the standard deviations of the indices) is as very high as of magnitude 2.9. This means that there has been a strong spatial disparity in employment opportunities in the initial year itself, much more than what we have for the incidences of unemployment in the terminal year. The much lower spatial disparity for the incidences of unemployment is, however, possible under a generally deteriorating employment situation, by virtue of labour mobility, induced at least locally by the attractive forces of areas with high employment opportunities and the repulsive forces of areas with low or no employment opportunities.

(3) Granting this mobility of labour for availing of employment opportunities, at least locally within short distances, we do not expect identical spatial patterns on the incidences of unemployment at the two time-points 1970-71 and 1960-61. Yet, the terminal year pattern cannot be totally independent of the initial pattern within the short span of a decade. In fact, the spatial co-association between $L^{71}(S)$ and $L^{61}(S)$ has not been very high or extremely high (near unit value of the correlation coefficient), yet it may be considered high, the value of the correlation coefficient between $L^{71}(S)$ and $L^{61}(S)$ being about 0.63. Incidentally this magnitude is almost same as the absolute value of what

we have obtained earlier in connection with the spatial co-association between $L^{71}(S)$ and ε^{61}. So, here also, although we have the general agreement between the spatial patterns of $L^{71}(S)$ and $L^{61}(S)$, there must be many occurrences of local peculiarities, violating the general agreement between the two patterns. As such, we expect atleast some sort of change in the spatial pattern on the incidences of unemployment between the two end-points of the decade.

(4) However, the spatial divergence of the incidences of unemployment has reduced only slightly, under moderating effect of labour mobility for deteriorating employment situation. In fact, the relative divergence ratio of $L^{71}(S)$ to $L^{61}(S)$ is of magnitude 0.93 (very near unity, signifying close similarity of divergences). This shows that except for incidences of only local mobility within short distances, the over-all mobility pattern has not undergone any large scale change between the two time-points.

All these statistical observations are meant for identifications of broad features valid globally for India; the details of actual spatial patterns can be evaluated only through map analysis, by which locational configuration of districts with various directions of changes in values of a spatial variable could be directly observed. So we shall go now for map analysis with $L^{61}(S)$ and ε^{61} (ref. to Figures

(3.5) and (3.7)) and compare them with our findings on regional patterns as identified by index $L^{71}(S)$. In this connection it should be noted that, as expected, we have a high spatial association also between the indices ε^{61} and $L^{61}(S)$ (the correlation coefficient is about -0.795, corroborating the hypothesis of inverse variation between ε^{61} and $L^{61}(S)$, apart from other type of variation of ε^{61}). This spatial co-association, although bettered as compared with that between ε^{61} and $L^{71}(S)$, is quite below unity, and as such we do not get much of close resemblance in the spatial patterns between ε^{61} and $L^{61}(S)$ under these factual circumstances. We propose to take up simultaneously the cartographic analysis of both maps related to ε^{61} and $L^{61}(S)$ and contrast it with the map of $L^{71}(S)$ for resemblance or otherwise in the spatial co-association in different areas. Our observations on this simultaneous cartographic analysis are the following :

(5) At a first glance on these three maps (Figures (3.6), (3.5) and (3.7)), one gets an impression that the kind of broad and wide regional groupings that have emerged with varied incidences of unemployment in 1970-71 (ref. to the map of $L^{71}(S)$ in Figure (3.6)) were hardly present in the maps of ε^{61} and $L^{61}(S)$ (ref. to Figures (3.7) and (3.5) respectively), depicting the past employment situation. The past employment situation in 1960-61 within each of those

broad regional groupings of 1970-71, appeared to be, in some way, diversified, both in terms of employment opportunities and incidences of unemployment. Thus, the patterns of employment situation for the initial year 1960-61, do not seem to be as patterned as it have been in the terminal year 1970-71, which have emerged under the distressing pressure of employment deteriorating situations, affecting differentially the different areas over the decade.

(6) Yet, it has to be kept in mind that under the pressure of employment deteriorating situations over the decade, the average all-India rank of the incidences of unemployment has an upward move, generally by one step —— from L-rank in 1960-61 to M-rank in 1970-71. Had this one step upward movement been uniformly present in all districts, there would not have been any difference between the initial year and the terminal year patterns, except for one-step upward revision of rank over the decade. But, violating this general pattern, we often have the situations where, (i) some districts have undergone no rank movement over the decade (or, even rank movements in the reverse direction for some limited number of districts, mostly in isolated areas, signifying non-deteriorating employment situations, and, on the other hand, (ii) some districts have shown more than one-step rank movement, signifying severe employment deterioration over the decade. As a result, the regional patterns as get depicted

on the maps of ε^{61} and $L^{61}(S)$ are not coincident with what have emerged through the map of $L^{71}(S)$.

(7) A large region around the capital of India, extending in all neighbouring States, was highly or distinctly favoured in the initial year 1960-61 in terms of both employment opportunities (ε^{61} values mostly of EH + VH + H rank) and incidences of unemployment ($L^{61}(S)$ values mostly of EL + VL + L rank). It is this region around the capital of India which has withstood the general pressure of employment deteriorating situation over the decade and retained more or less its nature as the most favoured area in employment situation in the terminal year, 1970-71 (values of $L^{71}(S)$ mostly of EL + VL + L rank). In this region, the capital of India (Delhi) has recorded even improved employment situation over the decade (note the reverse shift from VL-rank of $L^{61}(S)$ to EL-rank of $L^{71}(S)$). Apart from this major region some sparsely populated hilly and mountainous areas, such as the districts of Arunachal Pradesh, have shown similar characteristics with their undeteriorated employment situations.

(8) The other major region with somewhat favoured employment situation (VL + L ranks of $L^{71}(S)$) in 1970-71 is located in the south of India, extending over parts of Karnataka, Tamil Nadu and Kerala. But the districts comprising this region have generally suffered employment deterioration

of normal or severe type with one or more shifts of rank in the incidences of unemployment over the decade. The employment opportunity also has been favourable generally in 1960-61, particularly in Kerala and Tamil Nadu. But despite this, the decadal employment deterioration could not be withstood in this southern region, although it could still be ranked as favoured region according to 1970-71 employment situation with, however, considerable reduction in size in the two southern-most States of India particularly, where population pressure on land has been tremendous. Some sparsely populated tribal people-inhabited, hilly and forested areas, such as districts in the northern Orissa or in its neighbourhood, also have similar characteristic, showing still a favoured employment situation, despite employment deterioration. In all these areas the deterioration could be largely accounted by the increasing population pressure on land.

(9) The most wide-spread and distinctly disfavoured region in employment situation extends in the central part of India from Rajasthan in the West to Assam and some Union Territories in the Far-eastern India (ref. to Figure (3.6) for $L^{71}(S)$) in the terminal year, 1970-71. As hinted already from statistical findings, this wide-spread disfavoured region of the terminal year could have diverse patterns of employment situation in 1960-61. Indeed this has been

found to be exactly the situation from our map analyses also, by which we are now in a position to pin-point the exact nature of differentiation within the wide-spread region. We notice that the employment deterioration is most severe in the districts, located mostly in Rajasthan in the western India, and in Assam and in its neighbourhood in far-eastern India. As a result, the major core of the 1970-71 incidences of unemployment (with EH + VH ranks of $L^{71}(S)$) falls in Rajasthan where employment opportunities in the initial year, 1960-61, had remained distressingly low in most of its districts (note here the limited agricultural employment opportunities because of the prevailing desert condition in the State). A minor core area of the incidences of unemployment tends to develop by 1970-71 in the far-eastern part of India, but it could not turn into a major core because of highly favourable employment opportunities prevalent in 1960-61 in the fertile Brahmaputra Valley and in the adjoining areas, having most of the tea-industries in the foot-hills around. Here the severe employment deterioration, from the highly favoured (EL + VL) ranks of $L^{61}(S)$ to distinctly disfavoured (VH + H) ranks of $L^{71}(S)$, could be accounted largely by the migration and infiltration possibilities from outside India, particularly from Bangladesh (note that Indo-Pakistan and Indo-China disputes took place in this decade, culminating into some sort of War-situations in 1962 and 1965 respectively).

In the remaining part of the distinctly disfavoured region of Central India in 1970-71, the 1960-61 employment situation was of mixed variety, for example, the southern Bihar or the northern fringe of Madhya Pradesh had some districts with more favourable employment situation in 1960-61 than their geographical counterpart within the respective States. To be specific, in most districts of Madhya Pradesh and in northern Bihar, the employment opportunities had been in disfavoured positions (with extreme (EL + VL) ranks mostly in southern Madhya Pradesh and in a few districts of northern Bihar and also some areas of L-rank elsewhere in ε^{61}). On the other hand, employment opportunities were in favoured positions (with EH + VH + H ranks in ε^{61}) in the mining belt of southern Bihar and adjoining areas. But the areas of disfavoured employment situation as in 1960-61, have extended almost over the whole State of Madhya Pradesh and Bihar, by the end of the decade, naturally more severely in those parts where employment opportunities were relatively better — suggesting in-migration possibilities therein.

(10) The transitionally disfavoured region in 1970-71 employment situation (with M-rank in $L^{71}(S)$) extends over the States of Gujarat, Maharashtra, Andhra Pradesh and northern Karnataka mainly. Here the 1960-61 employment situation had been generally favourable in many districts with (EL + VL + L) ranks in $L^{61}(S)$, but the employment opportunities were

generally in disfavoured positions (with (VL + L) ranks in ε^{61}) in 1960-61, except some industrial areas, such as the core textile industry belt in Gujarat and the neighbourhood including Bombay district, where it were in favoured positions (with (EH + VH + H) ranks in ε^{61}).

Thus the employment opportunity position has been largely responsible for the general deterioration in employment situation over the decade. In the cotton textile industry belt in Gujarat and its neighbourhood, the employment deterioration has been quite severe over the decade, despite favourable employment opportunity situation; it might be for the excessive migration possibilities into the industrial belt.

3.5.5 Effects of Decadal Employment Deterioration in Shaping the Spatial Pattern of 1970-71 Incidences of Unemployment under Revealed Employment Opportunities : The Statistical Analyses

From our analyses and findings of the preceding subsection, it becomes quite clear that the 1970-71 pattern of the incidences of unemployment has been in many ways different from that of the 1960-61 pattern. Even the employment opportunity pattern that existed in 1960-61 could not explain or account for the differential spatial changes on the incidences of unemployment over the decade. Thus, statistically speaking, the explained spatial variations of index $L^{71}(S)$

could not be much improved while getting explained jointly by both ε^{61} and $L^{61}(S)$, over what has been done already by either ε^{61} or $L^{61}(S)$; the stated OLS multiple correlation coefficient has been only 0.661, which is just above the simple correlation coefficients of magnitudes 0.621 and 0.631 respectively with ε^{61} and $L^{61}(S)$. In fact, we have already noted a strong inter-relationship (correlation coefficient = 0.795) between ε^{61} and $L^{61}(S)$, and as such, the effect of $L^{61}(S)$ has been already accommodated in the employment opportunity index ε^{61} to explain for the spatial variations of $L^{71}(S)$. Hence not much improvement is realised in the joint effect of both ε^{61} and $L^{61}(S)$ on $L^{71}(S)$. But, as already revealed in our foregoing analysis in the preceding subsection, the employment deterioration has definitely followed differentially over different areas, and in consequence to that, regions with distinct patterns in the incidences of unemployment have taken shape in 1970-71. The differential nature of employment deterioration has, however, been caused by various factors, such as, the differential natural increase of population, the differential migration incidences, the differential planning measures and other efforts for the generation of new or enhanced level of activities, and so on, apart from the employment opportunity and resource distribution patterns as existed already. Without going into the details of all these various causal factors, we can, however, measure their joint effect in an aggregate sense by an appropriate measure of employment deterioration that has followed actually over the decade.

With a view to construct this measure of decadal employment deterioration, we recall the measure of over-all adult male employment percentages m_{ij}^{t}, giving the employment level of i-th district in j-th State at t-th time-point. In conformity to the situation of employment deterioration we have generally $m_{ij}^{61} > m_{ij}^{71}$, (all-India values being $m^{61} = 80.47\%$ and $m^{71} = 72.8\%$). Thus, we can take the percentage reduction of employment level from 1960-61 to 1970-71 as our measure of decadal employment deterioration, to be designated by d_{ij} for i-th district in j-th State, and can be written explicitly as follows :

$$d_{ij} = 100(m_{ij}^{61} - m_{ij}^{71}) / m_{ij}^{61} \qquad \ldots\ldots (3.44)$$

The empirical estimates of d_{ij} along with State estimates d_{0j} for j-th State, have been recorded in the last column of Table (3.5). The corresponding all-India value is calculated to be of magnitude 9.53%. It should be noted that negative values of d_{ij} (i.e. negative employment deterioration) signify improvements in the employment level over the decade. Thus, $d_{ij} = 0$ signifies a critical turning point from deterioration to improvement in the employment level. As such this point has been given a very special recognition in our classification scheme that we are going to discuss below for the purpose of mapping with the data on d_{ij}.

It should be noted that the time-point specific spatial variables have been all presented in index form as well, along with the actual proportionate magnitudes, with 1970-71 all-India values as the benchmarks for comparison. But, here we do not like to present the data on d_{ij} in a similar kind of index form (which could have been done simply by taking the quotient of d_{ij} over the all-India value of 9.53%), simply because the absolute proportionate deterioration can be more meaningfully comprehended. Anyway, for the purpose of comparative classification of d_{ij} with the indices, we have made the appropriate divergence corrections through the comparison of standard deviation estimates of d_{ij} and $L_{ij}^{71}(S)$ (the index, terminally connected with d_{ij}), and evolved the class-interval length of d_{ij} comparable to that of $L_{ij}^{71}(S)$. In this way, our estimated value of class-interval length of d_{ij} becomes 6.5%. We have already pointed out that zero is the critical turning value signifying the cases from employment deterioration (positive d_{ij}) to improvement (negative d_{ij}). Thus, we recognise 0 (zero) as the boundary value between the classes showing deterioration and those showing improvement. The details of classification on either side of zero have been arrived at by the principle of equi-lengthed class formation with class-length 6.5%. These class-intervals and the qualitative nomenclature of different class-ranks have been given in the following Table (3.11). In this, the nomenclature of moderate deterioration (MD) in employment has been ascribed to the class in which the all-India value of 9.53% falls (more or less at its centre) and other nomenclatures have been appropriately decided in relation to this class of moderate values of d_{ij}.

Table 3.11 : Classification Scheme for the Measure of Employment Deterioration, d_{ij}, and the District Frequency by Classes

Class-rank	Class-interval of d_{ij}	Qualitative nomenclature of decadal change in employment	District frequency
EHD	26.0% and above	Extremely High Deterioration	13
VHD	19.5% to 26.0%	Very High Deterioration	38
HD	13.0% to 19.5%	High Deterioration	77
MD	6.5% to 13.0%	Moderate Deterioration	98
LD	0.0% to 6.5%	Low Deterioration	75
LI	-6.5% to 0.0%	Low Improvement	39
MI	below — 6.5%	Moderate Improvement	9

According to this classification scheme the class-ranks have been identified for all districts and recorded along with the empirical data of d_{ij} in the last column of Table (3.5). The classified ranks of d_{ij} have finally been mapped and shown in Figure (3.9).

It should be noted that the measure d_{ij} defined in relation (3.44) can be equivalently expressed as :

$$d_{ij}\ (\frac{100}{u^{71}} - L_{ij}^{61}) = 100\ (L_{ij}^{71} - L_{ij}^{61})$$

Thus, it is clear that the spatial variables d_{ij}, L_{ij}^{71} and L_{ij}^{61} are algebraically interdependent. As such, we do not consider all the three variables simultaneously into our consideration for our subsequent analysis. As our present analysis is for finding out the effects of decadal employment deterioration in shaping the 1970-71 spatial patterns of incidences of unemployment under revealed employment opportunities, our obvious choice becomes the inclusion of only the two spatial variables d_{ij} and $L_{ij}^{71}(S)$, together with the opportunity indices, for our present analysis. Our observations based on relevant statistical analyses are recorded below :

(1) It has been already noted that the spatial variations of $L^{71}(S)$ is explained by the initial year employment opportunity index ε^{61} to that extent as to yield a negative correlation coefficient of absolute magnitude 0.621, and the extent of explanation improves only marginally by the inclusion of $L^{61}(S)$, the initial year spatial patterns of the incidences of unemployment, as additional explanatory variable (yielding the multiple correlation coefficient of magnitude 0.661 only). This has happened simply

because of the existence of a strong inter-relation between ε^{61} and $L^{61}(S)$ as noted already. But it is interesting to observe that the implicit causal factors influencing the spatial variation of d (with its observed values as d_{ij}'s) have not been, or, could not be expected to be inter-related with the initial employment opportunity index as to yield a strong correlation between ε^{61} and d. In fact, the OLS correlation coefficient between ε^{61} and d is so low as to show a magnitude of 0.186 only. Thus, the problem of multicollinearity is practically absent if $L^{61}(S)$ is replaced by d as an additional explanatory variable for explaining the spatial variation of $L^{71}(S)$. The simple correlation coefficient between $L^{71}(S)$ and d has also been quite considerable (showing a moderate value of 0.426), justifying its inclusion. With this replacement of explanatory variable, the explanation of the spatial variation of $L^{71}(S)$ becomes so very highly improved as to show a multiple correlation coefficient of magnitude 0.830. The corresponding multiple linear regression has been as shown below :

$$\underline{L}^{71} = -0.7257\, \underline{\varepsilon}^{61} + 0.5610\, \underline{d} \quad \ldots\ldots \ (3.45)$$

where the underlined variables $\underline{L}^{71}$, $\underline{\varepsilon}^{61}$ and $\underline{d}$ stand respectively for variables L^{71}, ε^{61} and d in standardised form.

The means and standard deviations of the unstandardised variables, in above order, are the following :

mean : 1.0309, 1.2411, 9.65%

standard deviation : 0.3027, 0.8756, 8.93%

The squared multiple correlation coefficient is about 0.69. Thus, about 69.0% of total spatial variation of L^{71} is now explained by only two variables ε^{61} and d. The relative shares of squared regression coefficients of the equation (3.45) being respectively 62.6% (about two-third) and 37.4% (about one-third), we can say that the explanatory variables ε^{61} and d have explained respectively about two-third and one-third of the total explained variation of L^{71}. This gives the relative importance of the two explanatory variables in explaining the spatial variation of L^{71}. Thus, we infer that the role of the revealed employment opportunities of the past has remained predominant relative to that of the causal factors effecting employment deterioration, in shapping the 1970-71 spatial patterns of the incidences of unemployment. The negative sign for the regression coefficient of ε^{61} implies that the higher the initial year employment opportunities on space, the lower has been the incidences of unemployment in the terminal year. On the other hand, the positive sign for the regression coefficient of d implies that the greater the adverse effect of causal factors, leading to greater decadal employment deterioration, the higher has been the incidences of unemployment in the terminal year.

It is to be emphasized that the two explanatory variables have not been much inter-dependent and yet interacted jointly in various combinations at various location in such a conformal way as to explain the total spatial variation of L^{71} much more substantially than what each could explain singly (about 38.6% of total variation of L^{71} explained by ε^{61} singly and about 18.1%, by d singly, contrasted to 69.0% of total variation of L^{71} explained jointly by both). This shows the importance of the effect of causal factors leading to different degrees of employment deterioration, over and above the role played by the past employment opportunity situation, in shaping the 1970-71 spatial patterns of the incidences of unemployment.

(2) We have noted that the past employment opportunity pattern has largely been responsible, jointly with the decadal employment deterioration, in shaping the 1970-71 pattern of the incidences of unemployment. But, the employment opportunity patterns have

undergone differential changes on space over the decade, (we have already noted, from out frequency study in this respect, that the favoured districts have been less wide-spread in the terminal year). From our data, as available presently, we are not in a position to examine the detailed year by year changing patterns of employment opportunities over the decade. However, in addition to the initial year employment opportunity patterns, depicted by ε^{61}, we have also the knowledge of the terminal year employment opportunity patterns depicted by ε^{71}. The two employment opportunity measures, having been of the same variety qualitatively with chronological connections, cannot be so independent as ε^{61} and d have been. In fact, the relationship between ε^{61} and ε^{71} is of moderate nature (with correlation coefficient about 0.60). The relationship between ε^{71} and d has been again of poor nature (with correlation coefficient equal to -0.256). And, L^{71} and ε^{71} have been quite highly related (correlation coefficient = 0.756). All these imply, on the one hand, that there is a case for the inclusion of ε^{71} as an explanatory variable for L^{71} over and above ε^{61} and d, and, on the other hand, the interdependences among the three explanatory variables might not be very surmounting, particularly because of the existence of much higher order relationship of ε^{71} with L^{71} than with any of the other explanatory variables. The two employment opportunity indices ε^{61} and ε^{71} (to be called specifically " the past" and " the current" employment opportunity indices with reference to the year 1970-71) would now jointly reflect both past patterns and the implicit divergences between the patterns of employment opportunities over the decade. Thus, with the inclusion of ε^{71} as another explanatory variable, in addition to ε^{61} and d, the explained spatial variation of L^{71} gets further improved. The multiple correlation coefficient, now, is marginally increased to a magnitude of 0.867 (from the preceding value of 0.830). This implies that the total variation of L^{71}, now explained, is increased to 75.1% (from the preceding 69.0%). The improved multiple linear regression is empirically the following :

$$\underline{L}^{71} = -0.4881\,\underline{\varepsilon}^{61} + 0.4263\,\underline{d} - 0.3527\,\underline{\varepsilon}^{71} \quad \ldots (3.46)$$

where $\underline{L}^{71}$, $\underline{\varepsilon}^{61}$, $\underline{d}$ and $\underline{\varepsilon}^{71}$ stand respectively for variables L^{71}, ε^{61}, d and ε^{71} in standardised form as before.

The mean and standard deviation of the last variable ε^{71} are respectively 1.0 and 0.4786. The explanatory variables ε^{61}, d and ε^{71} have now explained respectively about 43.8%, 33.4% and 22.8% of the total variation of L^{71}. The two employment indices together, now account for an explanation of 66.6% of the total variation of L^{71}. As against this, the single opportunity index, ε^{61}, alone explained about 62.6% of the same total variation. Thus, the role of the past employment opportunity pattern is now played, as if, by both the past and the current employment opportunity patterns, in explaining the pattern, depicted by L^{71}, while the nature of the decadal employment deterioration pattern influences L^{71} more or less in a similar fashion in both situations (i.e. the situations considering two and three explanatory variables).

In absolute term the contribution of d has been 25.8% (= 0.374 x 69.0%) out of the total accounted variation of 69.0% of L^{71} in the case involving the two explanatory variables, and that of the same d has been 25.1% (= 0.334 x 75.1%) out of the total accounted variation of 75.1% of L^{71} in the case involving the three explanatory variables. Thus, the contribution of d in absolute term, has remained same in both the cases for explanation of L^{71}. The residual of 43.2% (= 69.0% - 25.8%) has been contributed singly by ε^{61}, while the residual of 50.0% (= 75.0% - 25.0%)

has been contributed jointly by ε^{61} and ε^{71}, keeping in mind that the role of ε^{61} has also been quite effective in shaping the pattern of ε^{71} also (showing moderate interrelationship), the little improvement from 43.2% to 50.0%, as contrasted for the case of ε^{61} singly against the case of ε^{61} and ε^{71} jointly, may be taken as an absolute contribution to the explained variation of L^{71}, due really to the divergence between the patterns of employment opportunity over the decade. Granting this sort of interpretation of the joint consideration of ε^{61} and ε^{71} as explanatory variables, it could now be said that the stated decadal divergence in the employment opportunity patterns has contributed really 6.8% (= 50.0% - 43.2%) in absolute value out of the total accounted variation of 75.1% of L^{71} in the case involving three explanatory variables. This means the said decadal divergence has explained additionally about 9.0% of the total variation of L^{71}. And, as such, the role of ε^{61} still remains predominant (explaining, say 66.6% - 9.0% = 57.6%) in explaining the spatial variation of L^{71}. Thus, the past revealed employment opportunity pattern and the nature of decadal employment deterioration can be considered to be good enough in shaping the current spatial pattern of the incidences of unemployment.

(3) In the foregoing analysis, we have really taken the past employment opportunity pattern as the primary factor influencing not only L^{71} but also ε^{71}, while the joint consideration of both the employment opportunity indices, ε^{61} and ε^{71}, serves as to reflect a minor secondary factor, measuring the divergence in the patterns over the decade, in explaining L^{71}. Although this derives its support from the chronological consideration, there is a case for a statistical evaluation on the question : which of ε^{61} and ε^{71}, individually, has acted as the primary factor in explaining L^{71} ? For an answer to this reasonable query, we have simply replaced ε^{61} by ε^{71}, and taken it in conjunction with d as explanatory variables for L^{71}. The corresponding multiple correlation coefficient is now found to be of magnitude 0.793. Contrasting it with the corresponding value of the multiple correlation coefficient before replacement, i.e. 0.830, it becomes apparent that ε^{61}, in conjunction with d, has an edge over ε^{71}, in conjunction with d, in explaining L^{71} (contrast the deterioration in the total explained variation of L^{71} from 69.0% to 63.0% for the replacement of ε^{61} by ε^{71}). This shows that our choice of the past employment opportunity pattern as the primary factor influencing L^{71}, instead of the

current pattern, is justified. This is also evident simply from the fact that people intending to enter into the job market are more exposed to the revealed past employment opportunity pattern, and the current pattern remains largely unknown, as it is simply an after effect of what they collectively achieve currently in their attempt to enter the job market (according to our hypotheses used in its calculation). Moreover, the nature of decadal employment deterioration pattern is likely to have a bearing on ε^{71} in the forward time-path when it is treated jointly with ε^{61}. But, it is not meaningful to expect any logical bearing of d and ε^{71} jointly on ε^{61} in the backward time-path. Even statistical evidence is not in support of the latter case; the multiple correlation coefficient of ε^{61} on ε^{71} and d (in the backward time-path) is lower than that of ε^{71} on ε^{61} and d (in the forward time-path). We shall conclude this paragraph by examining statistically the role of d jointly with ε^{61} in explaining ε^{71}. We have noted already that ε^{71} is moderately inter-related with ε^{61}. In fact, the corresponding correlation coefficient is about 0.603 (explaining about 36.3% variation of ε^{71} by ε^{61}). With the incorporation of d as additional explanatory variable, along with ε^{61}, the multiple correlation coefficient increases to a value of 0.710 (explaining about 50.4% variation of ε^{71} jointly by ε^{61} and d). The corresponding linear regression equation is obtained to be

$$\underline{\varepsilon}^{71} = 0.6738\, \underline{\varepsilon}^{61} - 0.3818\, \underline{d} \qquad \ldots\ldots (3.47)$$

The signs of the regression coefficients suggest that the current employment opportunity pattern still maintains certain similarity with the past employment opportunity pattern (note the positive sign of the regression coefficient of ε^{61}), despite the adverse effect on it by the nature of the decadal employment deterioration pattern (note the negative sign of the regression coefficient of d). From the relative magnitudes of the squared regression coefficients we can further infer that the past employment opportunity has played a highly predominant role in explaining the spatial variation of the current employment opportunity (note that ε^{61} explains about 75.7% of the total explained variation of ε^{71}, while the residual of only 24.3% is explained by d).

As a matter of statistical rigour, we have tested all the regression and correlation coefficients as quoted earlier and found all to be statistically significant (at 5% level of chance). We have, however, not found it necessary to quote the test results, as, with the present district-level spatial variations, the dimensions of the regression and the correlation coefficients as also the degrees of freedom are so high that the rejection of the hypotheses on their insignificance becomes certain.

In the foregoing statistical analyses, the past pattern on the incidences of unemployment (L^{61}) could not be incorporated along with d and L^{71} simultaneously simply because of their algebraic inter-dependence. Also, our interest therein have been to note the effect of d in shaping the spatial pattern of L^{71}, and hence we dropped L^{61} in favour of L^{71} along with d for our analysis. But, there is also the question : how has the nature of employment deterioration pattern has been associated with the past pattern of the incidences of unemployment ? In order to investigate on this question, the possible course, opened to us, is to drop the variable L^{71} and include L^{61} for study of its interaction with d under the past revealed employment situation. This type of analysis, we propose to take up in the next subsection.

3.5.6 The Nature of Employment Deterioration Pattern Associated with 1960-61 Employment Situation

As mentioned already, we shall now consider the spatial variables d, L^{61} and ε^{61} for spatial co-association study, both statistically and cartographically, with a view to identify how favoured and unfavoured areas of employment situation have suffered from the nature of employment deterioration on space. We present below our statistical findings, as obtained through a sort of sequential interaction study.

1) Here we propose to depict the extent of prevalent spatial co-association by the simple correlation coefficients between any two consecutive variables in the following sequence, the actual magnitudes of the correlation coefficients having been placed on the arrows connecting pairs of consecutive variables :

$$\varepsilon^{61} \xrightarrow{-0.795} L^{61} \xrightarrow{-0.427} d$$

In the above sequential ordering, the first variable, namely the 1960-61 employment opportunity pattern, characterises largely the pattern of contemporary incidences of unemployment, and for this reason we have placed L^{61} immediately after ε^{61}. The measure of decadal employment deterioration d is then placed next to L^{61}, since the measure is for the decade following the time-point at which the incidences of unemployment are being considered. Now, the correlation coefficient between ε^{61} and L^{61}, having been of quite high magnitude, our contention that L^{61}

pattern gets largely characterised by ε^{61} pattern gets justified. Here the negative value of the coefficient is also fully justified. This means that the areas of higher employment opportunities are generally associated with the areas of lower incidences of unemployment in 1960-61 and vice versa. However, as the magnitude of the correlation coefficient (-0.795) is considerably different from -1 , signifying perfect relation, we would still expect some local departures from the general pattern of association; some of such cases of departures we will identify during cartographic analysis, to be attempted later.

2) However, the sign and the magnitude of the correlation coefficient, depicting the nature of association between L^{61} and d , seems paradoxical for the following reasons. Generally we would expect that areas with lower incidences of unemployment together with the higher employment opportunity characteristics, should have lower employment deteriorations. In contrast, under ceteris paribus assumption, we would also expect that areas with higher incidences of unemployment together with the lower employment opportunity characteristics, should have higher employment deteriorations over the decade. Had this expected patterns of spatial association followed, we would

have then obtained a positive correlation between L^{61} and d. As our estimated correlation coefficient turns out to be negative, the emergent pattern of spatial co-associations, in general, between L^{61} and d looks to be paradoxical. There must be reasons for this paradoxical co-association and that has to be looked into.

Again as the correlation coefficient is only of moderate magnitude (-0.427 only, much different from -1) the general pattern of paradoxical co-association must have been violated much, at least, in quite some areas, where the pattern might have been what we expected and mentioned earlier. This means, for example, that the lower incidences of unemployment together with the higher employment opportunity characteristics have been associated with both the lower and the higher employment deteriorations in different areas. In fact, the occurrences of both lower and higher employment deteriorations in different areas, having same sort of employment characteristics, is also paradoxical.

To sort out where and how these paradoxical associations have occurred, we shall now attempt a comparative cartographic analysis with the three spatial variables (ref. to Figures (3.7), (3.5)

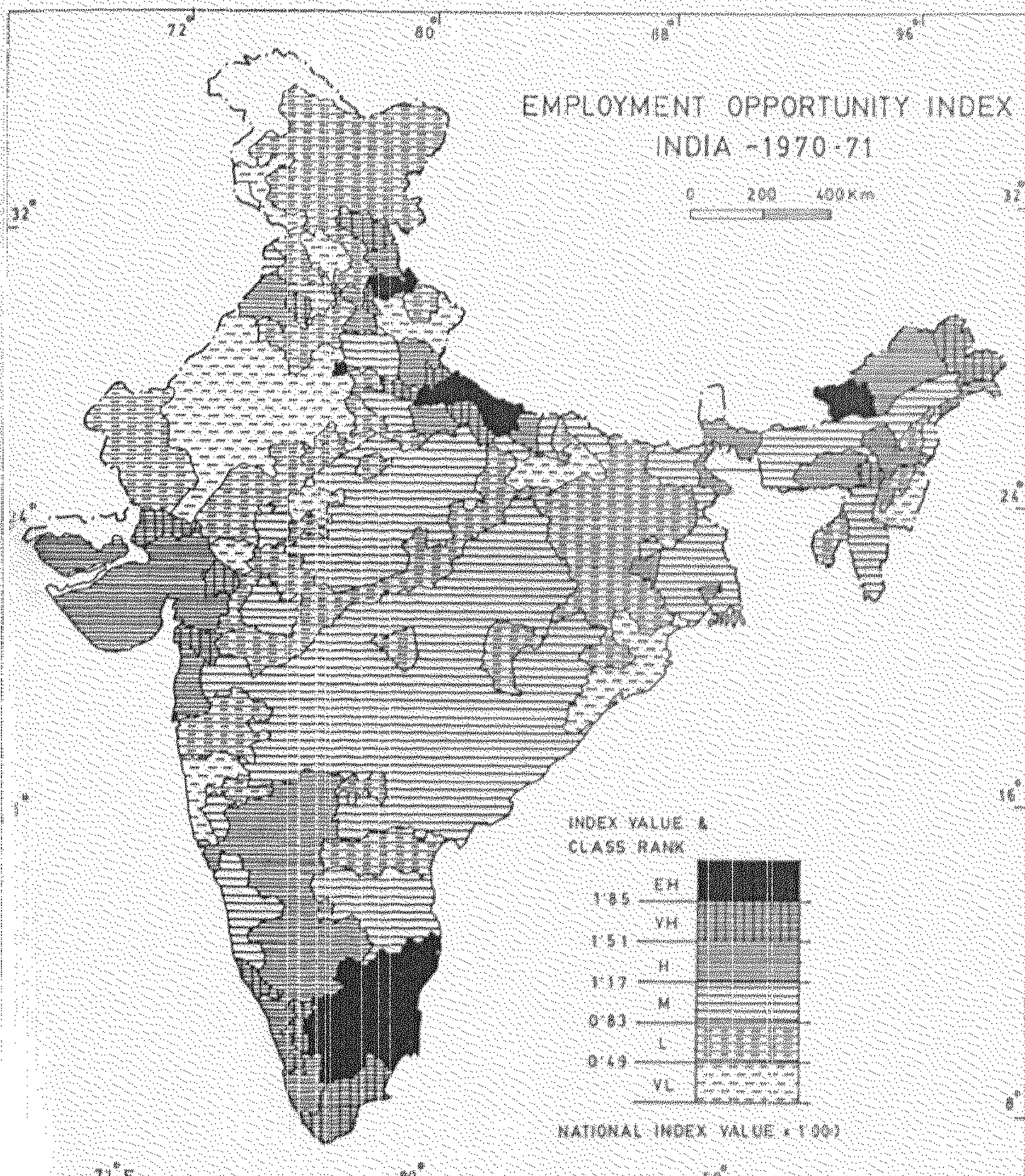

EMPLOYMENT OPPORTUNITY INDEX
INDIA -1970-71
0 200 400Km
INDEX VALUE &
CLASS RANK
EH
1·85
VH
1·51
H
1·17
M
0·83
L
0·49
VL
NATIONAL INDEX VALUE = 1·00
72° E.
80°
88°
96°
32°
24°
16°
8°

FIG. 1·8

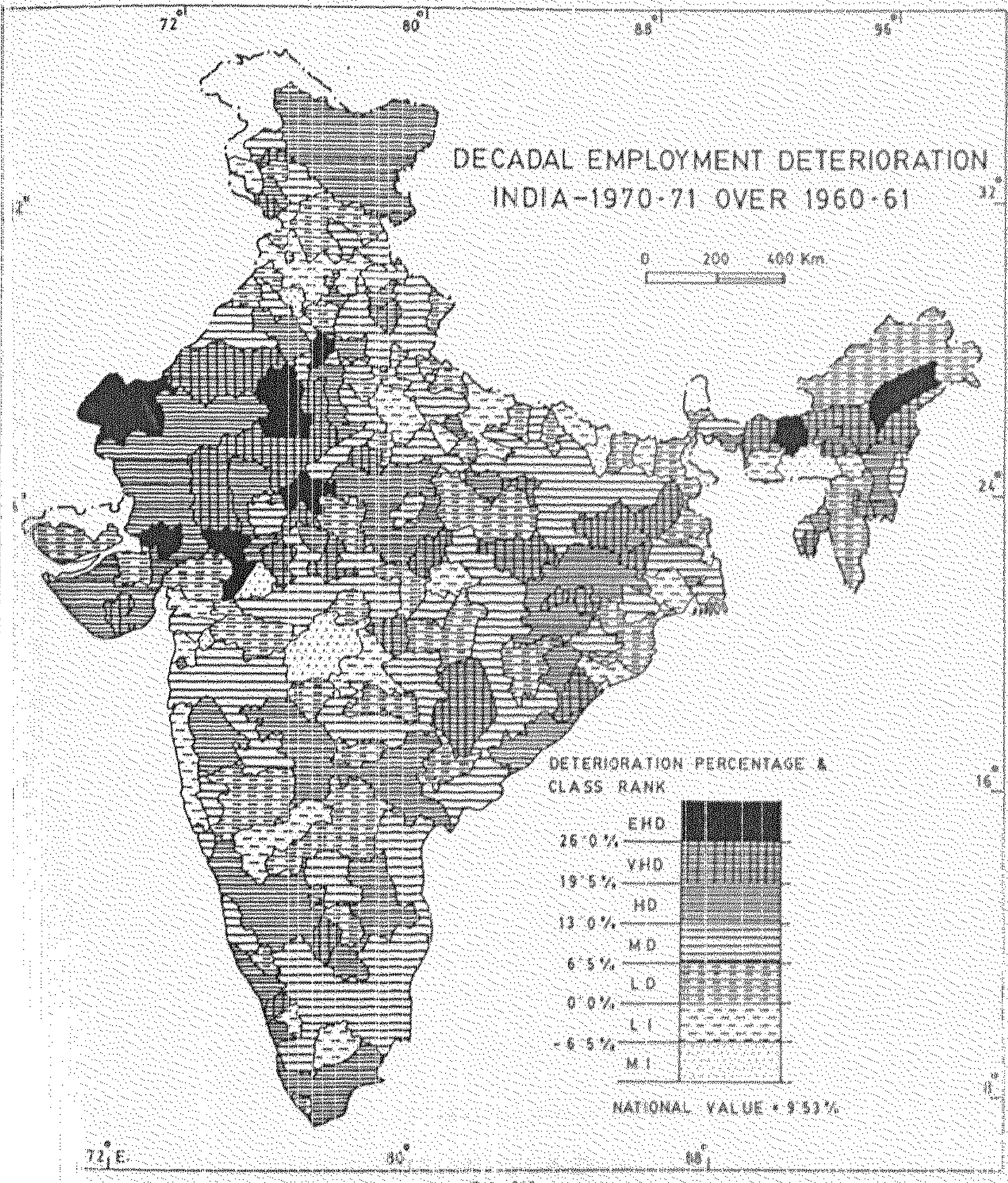

DECADAL EMPLOYMENT DETERIORATION
INDIA-1970-71 OVER 1960-61
0 200 400 Km.
DETERIORATION PERCENTAGE &
CLASS RANK
EHD
26·0 %
VHD
19·5 %
HD
13·0 %
MD
6·5 %
LD
0·0 %
LI
-6·5 %
MI
NATIONAL VALUE = 9·53 %
72°
80°
88°
96°
32°
24°
16°
8°
72° E.

FIG. 3·9

and (3.9)). Our findings in this context are the following.

3) In conformity with the paradoxical negative association, we have the following major areal groupings :

i). Areas having favourable employment characteristics /‾EL + VL (and at times, L) rank of L^{61} together with EH + VH (and at times, H) rank of ε^{61}, mainly _7 associated with very significant employment deterioration /‾EHD + VHD + HD (and at times, MD) rank of d _7 are mainly the following broad groupings of districts :

(a) Major areas of Assam along the Brahmaputra valley and adjoining areas,

(b) the industrial belt of southern Bihar and neighbouring areas in eastern Madhya Pradesh, northern Orissa and southern West Bengal,

(c) most part of Kerala, Tamil Nadu and southern parts of Karnataka Plateau,

(d) cotton textiles, sugarcane and oil industry base industrial areas in Maharashtra (i.e., its coastal area adjoining Gujarat and south-eastern part), Gujarat (in major areas around Ahmedabad) and also in Nagpur district in the eastern fringe of Maharashtra, occurring in isolation.

ii) Just in the neighbourhood of the above mentioned favourable areas of employment characteristics, experiencing significant employment deterioration, there are areal patches comprised of a few districts where we have insignificant or even no employment deterioration (LD + LI + MI rank of d) despite the fact that these areal patches had unfavourable employment characteristics [EH + VH + H (and at times, M) rank of L^{61} together with VL + L (and at times, M) rank of ε^{61}].

This also conforms the paradoxical negative association between L^{61} and d in a sense complementary to the situation elaborated in 3(i) above. Such complementarily conforming paradoxical association has occurred in the following areal patches mainly :

(e) Meghalaya and Mizoram (to the south of Assam,

(f) northern fringe of Bihar, the most part of coastal Orissa adjoining West Bengal, and few districts in south-eastern Madhya Pradesh,

(g) the Rayalaseema area (dry area) in West-central part of Andhra Pradesh and adjoining districts in northern Karnataka,

(h) sizable areal grouping of districts in eastern Maharashtra (to the West of Nagpur) and also a few coastal districts of Maharashtra (to the south of Bombay),

(i) the south-western fringe of Himachal Pradesh (adjoining Punjab State-border), extending to its north-west to some districts in the south-western fringe of Jammu and Kashmir.

4) On the other hand, districts not following the above mentioned paradoxical association, or more specifically, following the expected positive association, from the following major areal conglomeration of districts :

A) The positive association of favourable employment characteristics [EL + VL (and at times, L) rank of L^{61} together with EH + VH (and at times, H) rank of ε^{61}, mainly) with very insignificant or even no employment deterioration (LD + LI + MI rank of d) has occurred in

(j) quite a wide-spread area in the Indo-Gangetic plain (having substantial agro-industrial base), mostly in Punjab and Uttar Pradesh, around and in the capital of Delhi, and also in

(k) Arunachal Pradesh, bordering China.

B) The positive association (in complementary form to case (A) above) of distinctly unfavourable employment characteristics (EH + VH + H rank of L^{61} together with EL + VL + L rank of ε^{61}) with very significant employment deterioration (EHD + VHD + HD rank of d) has occurred in

(l) a large tract of Rajasthan and also in the northern Madhya Pradesh above a tentative boundary line connecting the southern most points of Rajasthan and Uttar Pradesh, more or less along the course of river Narmada, and also in

(m) a small patch in the far-eastern India located in Manipur,

Thus, broadly speaking, the major portion of north India including Uttar Pradesh, northern Madhya Pradesh, Rajasthan and other northern States (except the small north-western patches of both Himachal Pradesh and Jammu & Kashmir) and also the State of Arunachal Pradesh have exhibited the positive association between L^{61} and d, while the rest of India have followed more or less the general negative association of paradoxical nature. This broad geographical division of India according to two contradictory association patterns between L^{61} and d is itself another paradox (apart from the paradoxical negative association as exhibited in the major part of India).

5) The situation that leads to the paradox of negative association has been observed and analysed first by Todaro [1969] in the context of his study on " labour migration and urban unemployment in less developed countries". This paradox is now well-recognised as " Todaro Paradox" (for details ref. to Harris and Todaro [1970], Todaro [1976], Arellano [1981] and Takagi [1984]). According to Todaro, in a less-developed economy with problems of employment generation, an increase in job creation not only promotes employment level of the locally increasing job searchers in favourable areas of employment characteristics, but also encourages in-migration of job-searchers into these areas from less favourable areas around, wherefrom people out-migrate for job-opportunity prospects in favourable areas. It should, however, be noted Todaro really compared between urban

and rural settlements, corresponding to our more general terminology of favourable and less-favourable or unfavourable areas of employment characteristics. When the effect of in-migration is greater than that of employment promotion in a favourable area, the employment level gets much deteriorated instead of being uplifted as could have been expected according to the motive of job creations, and this is what is known as " Todaro Paradox". Thus, when this Todaro paradox situation prevails, we could expect the paradoxical negative association between L^{61} and d effected by the type of in-migration as referred to above. It should also be noted that such in-migration may be effected by people's out-migration from less-favourable areas around, and in this process of out-migration the employment level of less-favourable areas might get improved, leading to similar paradoxical negative association between L^{61} and d in the complementary form (for less-favourable areas in complement to favourable areas, following Todaro paradox).

Thus, the prevalent Todaro Paradox as operative in cases (a), (b), (c), (d) of 3(i) in our study, gets explained by highly possible in-migration incidences therein (over and above the local population growth). Again in cases (e), (f), (g), (h), (i) of 3(ii) in our study, supporting Todaro Paradox in a complementary form, gets largely explained by the out-migration possibilities from the less-favourable areas. But it should be clearly understood that the favourable areas with in-migration incidences and the less-favourable areas with out-migration incidences are not getting attention similarly in respect of activity generation locally, even though they both conform Todaro Paradox.

6) On the other hand, Todaro Paradox situation will not be operative when the effect of employment promotion is greater than the effect of in-migration into a favourable area. Then the employment level either gets uplifted or remains almost undeteriorated, as could be expected according to the motive of job creation. In such a situation, we would expect positive association between L^{61} and d. We would expect such positive association for unfavourable areas also where either there has not been adequate efforts for job creation or the scope of job creation has been very limited because of the presence of adverse resource endowment. In these areas the out-migration incidences might not have been enough as to show improvements in employment situation. This contrasting case of positive association between

L^{61} and d goes outside the realm of Todaro Paradox situation. Actually, in either of these two cases of positive association, the employment promotional effort is at one of the two extremes —— either extraordinarily high or extraordinarily low. Thus, in our study, the areas identified in cases (j) and (k) of 4(A) must have received extraordinarily high attention in employment promotion. It is quite plausible in areas identified in (j) because of its proximity to the capital of Delhi, and also in areas identified in (k) because of extraordinary attention received by this area for militarily strategic reasons after the Indo-China dispute of 1962 during the decade. On the other hand, the area identified in (l) and (m) of 4(B) must have received scant attention for employment promotion.

3.5.7 The Consequential Emergence of Employment Opportunity Pattern in 1970-71

The paradoxical relation that emerged empirically between the spatial patterns of employment characteristics as evaluated for 1960-61, and the employment deterioration that followed in the subsequent decade, could largely be explained by the migration possibilities between areas within India, or, partly atleast by the immigration (or, infiltration) possibilities from the then East Pakistan (now, Bangladesh) mainly.

On the face of the general Todaro Paradox situation, as could be expected in a less developed economy with problems of employment generation, the emergence of certain favourable areas, not following the Todaro Paradox, could also be explained by the extraordinary attention received from the central planning and policy decisions. Thus, on the basis of occurrence or non-occurrence of Todaro Paradox in two types of areas, with or without much favourable employment characteristics, we get really four types of areas with combined characteristics as summarised below :

Type I : Areas with favourable employment characteristics, not following the Todaro Paradox —— implying low or no employment deterioration over the decade.

Here the efforts for activity generation have been, in general, extraordinarily high (relative to average national efforts) influencing differential immigration possibilities into the areas under the general atmosphere of under-employment situation as prevalent in a less-developed economy.

Type II : Areas with favourable employment characteristics, following the Todaro Paradox —— implying significant employment deterioration over the decade.

Here the efforts for activity generation, although have not been extraordinarily high, but could be considered as very high or high, influencing also the immigration possibilities differentially in different areas, depending upon the prevalent employment situations in the neighbourhood.

Type III : Areas with unfavourable employment characteristics, following also the Todaro Paradox in complementary form —— implying insignificant employment deterioration over the decade.

Here the activity generation possibilities and/or efforts, might have been generally very low or low. Consequently, differential levels of out-migration from the areas, might have taken place, if favourable areas had existed in the neighbourhood.

Type IV : Areas with unfavourable employment characteristics, also not following the Todaro Paradox, in the above complementary form —— implying significant employment deterioration over the decade.

Here the activity generation possibilities might have been extremely limited and/or the efforts for activity generation have been practically very low or nil; the out-migration possibilities from these areas might not have been comparably that high as to arrest the trend of very significant employment deterioration therein.

Thus, the employment situations of four above mentioned types of areas have been differently influenced by the nature of employment deterioration, together with the migration possibilities, as influenced by the varieties of employment characteristics, following or not following the Todaro Paradox. As a result, we have already noticed how the 1960-61 spatial pattern on the incidences of unemployment (L^{61}) have undergone a sea-change to give rise to broad regional groupings of districts, with less divergences between neighbouring areas, in the incidences of unemployment in 1970-71 (L^{71}). However, the employment situation is exhibited not only by the incidences of unemployment, but also by the employment opportunity conditions. We have not yet examined how the 1960-61 employment opportunity conditions (ε^{61}) have undergone changes over the decade by the influence of the differential nature of decadal employment deterioration and the implicit migration possibilities, over and above the natural population growth locally. This we shall do now through cartogrophic analysis of the spatial pattern of ε^{71} as shown in Figure (3.8). Our observations are as follows :

1) We have noted that a wide-spread areas in the Indo-Gangetic plain (ref. to case (j) of 4(A) in subsection (3.5.6)) has the Type I characteristics. It is implicit with this type of characteristics that these areas have remained still favoured in 1970-71 in terms of the incidences of unemployment. But the employment opportunities have changed or deteriorated differentially in different

parts of the Indo-Gangetic plain by the differential nature of migration possibilities. The maximum deterioration in employment opportunities has followed in the Indus plain, largely in Punjab and Haryana, where considerable in-migrations have taken place both from the unfavourable areas in neighbouring States and also from the neighbouring nation in the West (particularly at the time of Indo-Pak military dispute of 1965). This deterioration might not have been so high or could have been avoided even, if these areas had quite wide-spread urban functional activity base together with its agro-industrial base as in Tamil Nadu. Generally, in the areas of relatively dominant urban-industrial economy, we observe the men to remain occupied in advanced education and skill formation beyond the age of 19 years (i.e. the starting age of the job-searching phase IV) and as such the employment opportunities increase for them with the result that saturating employment growth $[m_{ij}(V) - m_{ij}(IV)]$ increases significantly. But, the areas under our present concern, are not of this type; rather, people here join the labour force in significant numbers much earlier, before the age of 19^{+} years, and under in-migration pressure this must have occurred more definitely. The result is significant fall in employment opportunities over the decade in these areas. Thus, the Indus plain no longer remains that favourable in respect of employment opportunities in 1970-71. The international migration possibilities, that affected the Indus plain, has not affected the Gangetic plain so much. As such, we have still a large tract of favourable areas in respect of employment opportunities in 1970-71, particularly in the central part of Uttar Pradesh (the core sugar-producing areas). However, the in-migration incidences together with the natural population growth have considerably deteriorated over the decade the level of employment opportunities in the otherwise favourable employment scenario.

The other area of Type I characteristics is the hilly areas and mountainous tract of Arunachal Pradesh (case (j) of 4(A) in subsection (3.5.6)). Here the employment opportunity condition has remained more or less undeteriorated, because of the dearth of economic activities in this sparsely populated harsh terrain, and also because of certain militarily strategic restrictions on immigration.

2) The areas of Type II characteristics are (a) the Brahmaputra Valley in Assam and its adjoining areas, (b) the industrial belt of southern Bihar including areas in neighbouring States, (c) most of Kerala, Tamil Nadu and southern parts of Karnataka Plateau, and (d) Gujarat and neighbouring coastal districts upto Bombay in Maharashtra

and also in the interior south-eastern part of Maharashtra mainly (ref. 3(i) of subsection (3.5.6)). Of these, first two areas (a) and (b), falling in the neighbourhood of the then East Pakistan (now Bangladesh), which were earlier placed favourably in employment characteristics, have undergone significant deterioration over the decade not only in terms of the employment condition, but also in terms of the available employment opportunities, effected considerably by in-migrations (actually, including both in-migrations and infiltrations) mostly from the neighbouring nation, over and above the impact of the natural population growth and internal migration.

In the Type II area (c) in south India, in-migration possibilities could not have been from all sides, by virtue of its large sea-coast orientation (possibilities of migration from Ceylon to southern Tamil Nadu is not however ruled out). Despite that, the State of Kerala in this area, being the most populated State of India with narrow coastal belt of plain areas, has tremendous population pressure on land. As such, very high employment deterioration has followed here, together with quite high deterioration in employment opportunities, over the decade. Thus, Kerala has suffered a high deterioration in terms of available employment opportunities because of its own population growth and pressure (although considerable ...

out-migration has taken place from this State). Despite this deterioration in the level of employment opportunities, this State could still be considered as favoured relative to all-India situation. On the other hand, in the remaining parts of Type II area (c), falling in Tamil Nadu and the southern parts of Karnataka Plateau, the extent of employment opportunities has remained either same or slightly improved, although there has been considerable employment deterioration over the decade by virtue of natural population growth. It should be noted that Tamil Nadu is the State where urban functional activity base is quite wide-spread together with its agro-industrial base. The in-migration possibilities also have been limited in this area. Thus, one could expect that efforts for activity generation must have been there, despite the employment deterioration. Generally the decadal deterioration in the employment level tend to deteriorate the employment opportunities. But, advanced education and skill formation, beyond the age of 19 years (starting age of the job-searching phase IV), characterises significantly the areas of relatively dominant urban-industrial economy, and, as such the employment opportunities increase for them with the result that the saturating employment growth $[m_{ij}(V) - m_{ij}(IV)]$ increase significantly. Thus, the improvement in the bulk of employment opportunities from ε^{61} to ε^{71} has been possible in some urban and industrial areas of Tamil Nadu.

Similar features could also be observed in Gujarat and its neighbouring areas in coastal Maharashtra under Type II characteristics, having the prominent Textile industrial base of national importance. Here also, the employment opportunities remain more or less undiminished or even improve in some parts, over the decade. In-migration possibilities are there, but not in large magnitude by virtue of its limited in-land border (same as Tamil Nadu and Kerala). In many ways, this area and Tamil Nadu have considerable similarities including the revealed efforts of activity generations. As such the similarities between these areas could be noticed with the undeteriorated employment opportunities, despite some deterioration in employment level for natural population growth. However, deterioration in the employment opportunities has generally followed in other areas of Maharashtra under Type II (d).

3) The areas of Type III characteristics are those marked by (e), (f), (g), (h) and (i) under 3(ii), mentioned in the preceding subsection (3.5.6). As the out-migrations have generally followed from these unfavourable areas of employment characteristics, not only the decadal employment deterioration has been generally low in these

areas, but also the employment opportunities have generally improved or remained unchanged over the decade, particularly in areas where population pressure on land has not been high. Thus, in areas (e), (g), (h), we noticed improvements in employment opportunities generally. However, in areas (f) (northern Bihar) and (i) (south-western part of Himachal Pradesh and Jammu & Kashmir), where the incidences of influx of population from the neighbouring nation (East and West Pakistan) could not be ruled out during the decade, we notice no improvement in the employment opportunity. The areas of unfavourable employment opportunities which were concentrated more or less in northern Bihar only in 1960-61 have become much more widespread in 1970-71, extending into eastern Uttar Pradesh, southern Bihar and further south and south-east of it, right upto the coastal Orissa and southern West Bengal. In these extended unfavourable areas influx of population from the neighbouring nation must have been extra-ordinarily high to alter significantly the scenario in employment opportunities.

4) Lastly, we note that a large tract of Rajasthan and also in the neighbouring northern Madhya Pradesh (above the course of the river Narmada) (marked (l) in 4(B) of subsection (3.5.6)) and also in Manipur (marked (m) in 4(B) of subsection (3.5.6)) have the Type IV characteristics.

The employment characteristics as implicit in this type, have been the worst such possible, and any improvement, not only in employment level, but also in the employment opportunities could hardly be expected in general. Thus, these areas remain, as it were, perpetually unfavourable in employment opportunity condition, particularly in Rajasthan.

5) Thus, under the varieties of forces as implicit in the above mentioned four characteristic types of exhibited employment responses, not only the spatial patterns of the incidences of unemployment but also the spatial patterns of the employment opportunities have undergone sea-changes over the decade moderating the divergence between neighbouring areas to form well-defined broad regions. This moderation to broad regionalisation has been even much more pronounced in respect of employment opportunities ε^{71} than in respect of incidences of unemployment L^{71}, particularly in the major portion of India following Todaro Paradox. Thus, for example, the areas in the vast central part of India with Type III and at times with Type II characteristics, have undergone significant moderations over the decade in terms of employment opportunities under the dominating migratory forces implicit in Todaro Paradox.

Now, referring back to the spatial pattern of employment opportunities as emerged in 1970-71, it seems, we have a very bleak future ahead in the time-path in employment situation, if the exhibited shrinkages of favourable areas of employment opportunities as effected by the deteriorating activity generation (not matching with the requirements) are any guide for the future. The favourable areas of employment opportunities have, (1) completely vanished from the industrial bases of eastern India, comprised of southern parts of Bihar and West Bengal and some adjoining districts of neighbouring States, and also of the Brahmaputra valley in Assam (Tea-based mainly), and, (2) substantially vanished from the agro-industry based Indo-Gangetic plain i.e. in large parts of Punjab, Haryana and Uttar Pradesh. Again, significant deterioration in employment opportunities has taken place in Kerala, although it is still ranked as a favourable area of employment opportunities. The emerging employment opportunity situation in 1970-71 has become so bad that almost entire north-western part of India has been ranked as distinctly unfavourable, (barring a few districts in Punjab, sparsely populated Himachal Pradesh and the capital of Delhi). Again, a large tract in eastern India is now ranked distinctly as unfavourable in respect of ε^{71} which was much smaller in size in respect of ε^{61}. And the transitionally unfavourable areas (of M-rank in employment opportunities) have become so wide-spread as to form a major region in the central part of India in 1970-71, as compared with its 1960-61 position.

3.5.8 Ranking of States by Composite Unemployment Characteristics : 1970-71

We have just completed the regional analysis on the spatial pattern of incidences of unemployment L^{71}, examined how this pattern could be explained by the past employment opportunity pattern and the preceding decade's employment deterioration pattern, and finally we have seen the effect of employment deterioration pattern on the current employment opportunity pattern ε^{71}, as emerged at the end of the decade. In that analysis, we have noticed that the characterisation L^{61} by the revealed opportunity pattern ε^{61} has been very useful in explaining the pattern of changes in employment level in the following decade. At the end of the decade, under consideration, we have also the knowledge of the pattern of L^{71} and the corresponding opportunity pattern ε^{71}, as emerged. Thus, one can use ε^{71} for further characterisation of L^{71}, and together these could be used to form some composite unemployment characteristics for future guidance to control the pattern of changes in employment levels in the forward time-path.

The relationship between ε^{61} and L^{61} was neither perfect (correlation coefficient -0.795, different from -1), nor it is perfect currently between ε^{71} and L^{71} (correlation coefficient -0.756). Rather, by differential exhibition of Todaro Paradox situation in different areas, the employment deteriorations have manifested themselves in different areas in so diversified manner that it is not surprising that the current relationship has become relatively less perfect than what the past relationship implied. As it is now less perfect the role of the saturating employment growth from the job searching Phase IV to the main activity phase V could be more diversified, not following the general pattern of negative relationship between ε^{71} and L^{71}. It may be recalled that our revealed opportunity pattern ε^{71} is directly proportional to the saturating employment growth, while it is inversely proportional to the incidences of unemployment, and their joint interactions have manifested themselves differently in different areas to shape finally the employment opportunity level ε^{71}. Thus, it is necessary to note or incorporate the effect of ε^{71} on L^{71} in getting the proposed measure of composite unemployment characteristics. We shall now describe our logic for the formulation of such unemployment characteristics and subsequently use it only for ranking the States in respect of composite unemployment characteristics, although the same formulation could have been derived with the use of district level variations of ε^{71} and L^{71} and used for ranking of districts.

Formulation of the measure of composite unemployment characteristics : As ε^{71} and L^{71} are negatively correlated, the deviations of employment opportunities from the national value of unity are negatively associated with the corresponding deviations of the incidences of unemployment. Adjusting for scale corrections between the two deviations by the relative divergence ratio (i.e. ratio of standard deviations) we can write the estimated deviations $(\hat{L}^{71} - 1)$ corresponding to the other deviations as follows :

$$\hat{L}^{71} - 1 = (1 - \varepsilon^{71})\ \sigma_L / \sigma_\varepsilon \qquad \ldots\ldots (3.48)$$

Clearly, these deviations are negative when $\varepsilon^{71} > 1$ and positive when $0 < \varepsilon^{71} < 1$. It should be noted that areas with relatively favourable employment opportunities (say, $\varepsilon^{71} > 1$), by its own momentum, would have a further potential to moderate the present level of incidences of unemployment. Thus, areas with higher and higher values of $\varepsilon^{71} > 1$, would likely to decrease the level of L^{71} by their prevalently more and more favourable employment opportunity effects. On the other hand, areas with lower and lower values of $\varepsilon^{71} < 1$, would likely to increase the level of L^{71} by their prevalently more and more unfavourable employment opportunity effects. Thus, equation (3.48) can be used for measuring employment opportunity effect adjustment factor on the incidences of unemployment L^{71} and we can take the moderated measure of composite unemployment characteristics, designated by $\pounds^{71}$, as :

$$\pounds^{71} = L^{71} + (\hat{L}^{71} - 1)$$

$$\text{i.e.} \quad \pounds^{71} = L^{71} + (1 - \varepsilon^{71}) \frac{\sigma_L}{\sigma_\varepsilon} \qquad \ldots\ldots (3.49)$$

However, in the general Todaro Paradox situation as prevalent in less-developed economies, we cannot expect the very highly favourable areas of employment opportunities to reduce the level of L^{71} as expected through equation (3.49) by the linear adjustment factor $(1 - \varepsilon^{71}) \frac{\sigma_L}{\sigma_\varepsilon}$, because of the in-migration possibilities therein for their employment opportunity potentials. Thus, we need some sort of moderation in the upper tail-end of ε^{71}. We propose to do it by the following geometric adjustment factor, replacing the linear factor $(1 - \varepsilon^{71}) \frac{\sigma_L}{\sigma_\varepsilon}$ in the upper tail. Thus, accounting for the employment opportunity effect adjustment factor together with the upper tail-end moderations, we finally take the measure $\pounds^{71}$ as follows :

$$\pounds^{71} = L^{71} + (1 - \delta)(1 - \varepsilon^{71}) \frac{\sigma_L}{\sigma_\varepsilon}$$

$$- \delta \left\{ (\varepsilon^* - 1) \frac{\sigma_L}{\sigma_\varepsilon} + \left(e^{-\varepsilon^{71} \sigma_L / \sigma_\varepsilon} - e^{-\varepsilon^* \sigma_L / \sigma_\varepsilon} \right) \right\} \ldots (3.50)$$

where the tail-end commencing value ε^* is decided from the solution of the equation

$$(\varepsilon^* - 1)\ \frac{\sigma_L}{\sigma_\varepsilon} = e^{-\varepsilon^* \sigma_L/\sigma_\varepsilon} \quad ; \quad \varepsilon^* > 1 \qquad \ldots\ldots (3.51)$$

and the dummy variable δ is defined as follows :

$$\begin{aligned} \delta &= 1 \quad \text{if } \varepsilon^{71} > \varepsilon^* \\ &= 0 \quad \text{otherwise} \end{aligned}$$

It should be noted that the way we have estimated the critical boundary value ε^* by equation (3.51), the curve for $\pounds^{71}$, dictated by (3.50), remains continuous all through, even at the turning point from linear to geometric adjustments.

The value of $(\sigma_L/\sigma_\varepsilon)$ is estimated to be equal to 0.6325 (for district level variation). As such we get

$$\varepsilon^* = 1.5813$$

This value is just a little more than 1.51 which defines the lower boundary of very highly or more favourable class-ranks (EH + VH) for employment opportunity. With these estimates, the final empirical form of equation (3.50) becomes

$$\pounds^{71} = L^{71} + (1-\delta)\left\{0.6325(1-\varepsilon^{71})\right\} - \delta e^{-0.6325\varepsilon^{71}} \quad \ldots (3.52)$$

$$\begin{aligned} \text{where } \delta &= 1 \quad \text{if } \varepsilon^{71} > 1.5813 \\ &= 0 \quad \text{otherwise} \end{aligned}$$

Under the prevailing employment opportunity situation, the measure $\pounds^{71}$ is taken as the composite measure of unemployment characteristics to be reckoned for future policy decisions towards activity generations in the forward time-path in different areas for reducing incidences of unemployment.

The estimated values of $\pounds^{71}$ by States have been presented in Table (3.12). These values have been used also to rank the States in descending order of magnitudes of this measure of composite unemployment characteristics. From the mode of construction of $\pounds^{71}$, we again get its central all-India value equal to unity (as we have for L^{71}), but the divergence of $\pounds^{71}$ relative to L^{71} has got almost doubled (in terms of their standard deviations). The class-interval length of L^{71} has been 0.22, and hence the same of $\pounds^{71}$ would be about 0.40, after making necessary relative divergence correction. Thus, we have the following class-ranks for $\pounds^{71}$, designated by EH, VH, H, M, L and VL, in composite unemployment characterisation, demarcated by the boundary values between consecutive classes as 2.00, 1.60, 1.20, 0.80 and 0.40, in order. These qualitative class-ranks have also been recorded along with the empirical findings on $\pounds^{71}$. After having xax ranked the States on arranging them in descending values of $\pounds^{71}$, we have also incorporated the detailed empirical findings on $\varepsilon^{t}(S)$, $L^{t}(S)$, $L^{t}(IV)$, $L^{t}(V)$ for both the time-points t = 1960-61 and 1970-71 and also the decadal employment deterioration d, in the same Table (3.12). Our observations on the position of different States in unemployment characteristics are recorded below :

1) Despite moderations of the district-level variations in the aggregated State-level variations the broad features are largely depicted in State-values as well, tallying with our results obtained from various preceding analyses. The composite unemployment characterisation has particularly helped us to bring forth more or less similar kinds of pattern as observed earlier from the simultaneous consideration of both opportunity index and the index of the incidences of unemployment. Thus, the State pattern in a nut-shell is that it could be classified in three distinct categories : (i) the most disfavoured employment situations, (ii) transitional between the disfavoured and the favoured employment situations, and (iii) the most favoured employment situation, in relative sense. The States which fall under these three categories are also identified and recorded in Table (3.12).

2) The two States (or, State-groups) which showed very high employment deterioration are Rajasthan and the Northern Far-east India, comprised mainly of Assam and Arunachal Pradesh. As noted earlier, Rajasthan has the worst possible employment situation, and if is corroborated by its top position in our listing of States by the composite ranking. The other State had mixed unemployment situation averaging the feature of the sparsely

Table 3.12 : Indices of Employment Situation for States or State-groups Stratified by Composite Unemployment Characteristics

State/State-group	Composite unemployment characteristics ϵ^{71}	Indices of Unemployment/Employment Characteristics: Year : 1970-71				Year : 1960-61				Decadal employment deterioration d
		$L^{71}(S)$	$\epsilon^{71}(S)$	$L^{71}(V)$	$L^{71}(IV)$	$L^{61}(IV)$	$L^{61}(V)$	$\epsilon^{61}(S)$	$L^{71}(S)$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Distinctly disfavoured :										
1. Rajasthan	1.846	1.499 (VH)	0.451 (VL)	1.727 (VH)	1.393 (VH)	0.831 (L)	0.986 (M)	0.566 (L)	0.879 (L)	22.14 (VHD)
2. Himachal Pradesh	1.764	1.310 (H)	0.283 (VL)	1.594 (VH)	1.206 (H)	1.089 (M)	1.406 (H)	0.345 (VL)	1.175 (H)	5.42 (LD)
3. Southern Far-East India	1.653	1.422 (VH)	0.635 (L)	1.573 (VH)	1.361 (VH)	1.013 (M)	1.033 (M)	0.950 (M)	1.024 (M)	15.02 (HD)
4. Jammu and Kashmir	1.563	1.221 (H)	0.459 (VL)	1.404 (H)	1.137 (H)	0.860 (L)	0.950 (M)	0.752 (L)	0.886 (L)	12.00 (MD)
5. Bihar	1.400	1.193 (H)	0.672 (L)	1.297 (H)	1.140 (H)	0.907 (M)	0.973 (M)	0.821 (L)	0.932 (M)	9.52 (MD)
6. Madhya Pradesh	1.342	1.262 (H)	0.873 (M)	1.300 (H)	1.237 (H)	0.874 (L)	1.081 (M)	0.455 (VL)	0.943 (M)	11.69 (MD)
7. Orissa	1.241	0.956 (M)	0.549 (L)	1.074 (M)	0.900 (M)	0.691 (VL)	0.757 (L)	0.775 (L)	0.706 (L)	8.40 (MD)
8. Northern Far-East India	1.212	1.246 (H)	1.054 (M)	1.216 (H)	1.246 (H)	0.649 (VL)	0.552 (L)	1.395 (H)	0.614 (VL)	20.63 (VHD)
Transitionally disfavoured :										
9. Andhra Pradesh	1.039	0.996 (M)	0.932 (M)	1.026 (M)	0.995 (M)	0.648 (VL)	0.718 (L)	0.743 (L)	0.669 (VL)	10.89 (MD)
10. Punjab + Haryana + Chandigarh	0.987	0.794 (L)	0.695 (L)	0.864 (M)	0.765 (L)	0.650 (VL)	0.475 (VL)	1.742 (VH)	0.591 (VL)	6.58 (MD)
11. Maharashtra	0.956	0.910 (M)	0.928 (M)	0.936 (M)	0.907 (M)	0.730 (L)	0.702 (L)	1.107 (M)	0.715 (L)	6.59 (MD)
12. West Bengal	0.893	1.009 (M)	1.183 (H)	0.968 (M)	1.039 (M)	0.824 (L)	0.633 (L)	1.609 (VH)	0.768 (L)	8.30 (MD)
13. Kerala	0.813	1.019 (M)	1.326 (H)	0.782 (L)	0.962 (M)	0.697 (VL)	0.350 (VL)	2.461 (EH)	0.588 (VL)	13.96 (HD)
14. Goa	0.807	0.966 (M)	1.251 (H)	0.905 (M)	1.001 (M)	0.683 (VL)	0.734 (L)	0.820 (L)	0.698 (L)	8.99 (MD)
Transitionally favoured :										
15. Karnataka	0.785	0.956 (M)	1.270 (H)	0.894 (M)	0.995 (M)	0.649 (VL)	0.674 (L)	0.912 (M)	0.653 (VL)	10.02 (MD)
16. Uttar Pradesh	0.779	0.770 (L)	0.985 (M)	0.780 (L)	0.773 (L)	0.649 (VL)	0.593 (L)	1.234 (H)	0.624 (VL)	4.77 (LD)
17. Gujarat + Dadra & Nagar Haveli	0.737	0.963 (M)	1.357 (H)	0.871 (M)	1.009 (M)	0.667 (VL)	0.586 (L)	1.313 (H)	0.641 (VL)	10.61 (MD)
18. Tamil Nadu + Pondicherry	0.525	0.821 (L)	1.922 (EH)	0.640 (L)	0.937 (M)	0.528 (VL)	0.395 (VL)	1.743 (VH)	0.468 (VL)	10.99 (MD)
Distinctly favoured :										
19. Delhi	0.235	0.439 (EL)	2.510 (EH)	0.271 (VL)	0.534 (VL)	0.771 (L)	0.262 (VL)	3.132 (EH)	0.597 (VL)	-5.16 (LI)
All-India	1.000	1.000 (M)	1.000 (M)	1.000 (M)	1.000 (M)	0.731 (L)	0.692 (L)	1.136 (M)	0.718 (L)	9.53 (MD)

populated, hilly and mountainous State of Arunachal Pradesh and the migration problem—ridden State of Assam containing the major part of the Brahmaputra Valley. As such it is at the bottom of the distinctly disfavoured group of States. We have noted earlier these areas in cases (l) and (m) of 4(B) in subsection (3.5.6). These are not following Todaro Paradox even in complementary sense and the efforts for activity generation have been the least in these areas. The areas in case (l) is really in the State of Rajasthan, while the other areas in case (m) fall in the Southern Far-east India which is ranked 3rd in the disfavoured group of States, and where high employment deterioration is recorded. But, the status of Himachal Pradesh with its second position in the disfavoured group of States, is worse in employment situation as compared with the Southern Far-east India, which also has been comparably hilly and mountainous with isolated primitive agricultural bases for possible activities. In 1960-61 itself the position of Himachal Pradesh was at highly disfavoured level and as such high employment deterioration was not possible from that rock-bottom condition. The other States in order according to our scale of disfavour are the hilly and mountainous and also sparsely populated State of Jammu & Kashmir (4th rank), the problem State of Bihar, despite large mining and other industrial bases (5th rank), the centrally placed Madhya Pradesh (6th rank) and the Coastal State of Orissa in areal contiguity to Bihar and West Bengal (7th rank); all these States recorded medium employment deterioration. It is interesting to note that the paradoxical type of improvement in employment opportunities in the State of Madhya Pradesh is largely caused by out-migration as implicit in Todaro Paradox situation in unfavourable areas. Here we have the highest opportunity improvement amidst the general opportunity deterioration over the decade. Thus, the shift of employment opportunity level from VL-rank in 1960-61 to M-rank in 1970-71 is largely artificial in the sense that much of job-opportunities have not actually been created locally to support its naturally growing population. Its marginally better rank, compared to that of Bihar, even in the scale of distinct disfavour, has to be taken thus with a grain of salt.

3) The transitional States in order are Andhra Pradesh (7th rank), Punjab + Haryana + Chandigarh (10th rank), Maharashtra (11th rank), West Bengal (12th rank), Kerala (13th rank) and Goa (14th rank). Among all these, only Kerala has recorded high employment deterioration over the decade, while all others have been showing medium employment deterioration. We have already analysed the special

feature of Kerala during our detailed regional analysis. This State, although its employment opportunity-wise rank is still high, is ridden with substantial unemployment problem due to high population pressure on limited available land. The southern State of Andhra Pradesh, in areal contiguity with the State of Madhya Pradesh (which is in the disfavoured group, already discussed) and also the small State of Goa have recorded high improvements in employment opportunities over the decade, causal factor being again more or less the same out-migration incidences as discussed in connection with the analysis on Madhya Pradesh. As such, here also the improvement in employment opportunities from L-rank in 1960-61 to M-rank in 1970-71 in Andhra Pradesh is again artificial and hence should not be treated with much hope in terms of activity generations, particularly in the Rayalaseema (dry areas) part in Central Andhra. Other three States, namely, Punjab + Haryana + Chandigarh, Maharashtra and West Bengal are in many ways advanced, but are problem-ridden. Each of these is comprised of mixed sorts of areas in employment situation. For example, the combined Punjab + Haryana + Chandigarh State has the transitional rank, but its Punjab part is more advanced than Haryana, and if we calculate separately the measure ϵ^{71} then Punjab should have been included in the favoured group as far as its composite unemployment characteristic is concerned (here the value of $\pounds^{71}$ = 0.701) and the State of Haryana should have been included in the distinctly disfavoured group (with value of $\pounds^{71}$ = 1.322). This fact has also been recorded in our earlier analysis with district level data. Anyway, we have already noted that the State West Bengal and the State group of Punjab and Haryana have suffered from the excessive influx of population from neighbouring nations. Maharashtra, however, has heavy concentration of activities in coastal areas from Bombay northward and in the adjoining areas only, **but** in large parts in the eastern and north-eastern Maharashtra, the conditions are similar in many ways with that of neighbouring areas in Madhya Pradesh.

4) The relatively favoured States with low composite unemployment characterisation ($\pounds^{71}$ below 0.80) in order are Karnataka (15th rank), Uttar Pradesh (16th rank), Gujarat (including Dadra and Nagar Haveli) (17th rank), Tamil Nadu and Pondicherry (18th rank) and the capital State of Delhi (19th rank). Among these the most favoured State is Delhi with very low rank of $\pounds^{71}$. This is the only State (in fact, the capital State) which has even recorded low improvement in employment level over the decade. Its extreme position, because of extra-ordinary attentions bestowed, by virtue of its elite

position, could be expected. After the State reorganisation in 1956 and enlargement of boundary areas from the initial Princely State of Mysore to present Karnataka (taking parts of Maharashtra and Nizam's Hyderabad State), its pace of activity generation has tended to gain momentum and as such its employment opportunity level has improved substantially from VL-rank in 1960-61 to H-rank in 1970-71. As such this State is now justifiably considered as favoured in employment situation. It is already revealed in our detailed district level analysis that the other three favoured States with substantial urban-industrial or agro-industrial activity base have yet substantial areas of favourable employment characteristics, and as such the ranking of these States as favoured, even by the aggregate State values, justifies our contentions made earlier.

Chapter 4

ESTIMATION OF LABOUR ABSORPTION FUNCTIONS FOR AGRICULTURE AND MANUFACTURING ACTIVITY-BASES, THE FORMULATION AND CHARACTERISATION OF MANUFACTURING LABOUR-ABSORPTIVE EFFICIENCY AND THE SPATIAL ANALYSIS

4.1 The Need for the Evaluation of Labour Absorbing Capacities of Different Economic Activity-Bases

Amid large scale variation in the incidences of unemployment, it has been made amply clear in the last chapter that the problem of unemployment is actually getting further complicated by the labour mobility in the over-all deteriorating employment situation over time. Obviously, any effort for creation of new activities (implicit in improvement in production levels over time) must have been upset by the mounting population growth adding to already high numerical bulk of unemployed population in the over-all activity phase. This implies that we have to find ways and means to create or generate much more activities than what we had as a by-product of enhanced production planning, as currently practised. In other words, we have to maximise the employment generation directly and not indirectly as a by-product of our national objective of maximisation of productions. Also, it is not desirable to have limited number of spatially distributed urban-industrial bases with good employment prospects and vast areas with unfavourable employment situation. We have seen already how migratory forces operate in such situations to effect higher rate of employment deterioration in areas with favourable employment characteristics. While migration is most unlikely to occur (or, at least, should not be encouraged) in mass-scale, particularly in situation where people are yet unskilled generally and also economically weak, the migration possibilities of skilled, educated or economically better off people, seeking better employment scopes in areas with better activity bases, are not ruled out.

We have seen earlier that certain favourable areas with distinctly better employment situation have still exhibited their relatively favoured status, despite sufficient employment deterioration caused by the incidences of in-migration there. It means that these distinctly favoured areas have generated sufficient jobs to cope up with the external pressure caused by the in-migration, over and above its own population growth. While such areas might be taking advantage of the localisation economy for enhancement of urban-based industrial activities, other major areas with mainly primary agricultural activities do not have such growth promoting advantages. Yet, sufficient growth promoting activities are to be generated in those vast agricultural tract locally, so that the native idle work-force could really be used as resources, instead of becoming burdens to the economy.

Actually, in a labour surplus economy, our attempt should be to maximise absorption of labour directly through judiciously chosen combinations of productive and other associated activities that are labour intensive. Also, our attempt should be for proper geographical distributions of jobs and activities to be created or generated. For this, we have to have enough prior knowledge about how the level of labour absorption gets technically determined by other factors of production in different types of activities and how pattern of labour absorption on space differ from one type of activity to another, effected by certain spatial features or characteristics. It is in this context, Pathak and Saha [1986] introduced the concept of Spatial Labour Absorption Function and evaluated it empirically for all manufacturing industries together with the use of appropriate statistical methods.

Historically speaking, India is a predominantly agricultural country and its industrial base is still nascent (as compared with that in many advanced industrial nations). As such a major share of activities are still generated in the primary agricultural sector. But this sector has reached a kind of saturation, because of the limitations of the basic resources of land available for agricultural activities. As such the problem of surplus labour has become so acute in the sector that there should be some avenues for their absorption into non-agricultural activities. The exploration for an expansion of job-opportunities in the industrial and allied sectors thus gains importance. In the absence of creations of sufficient opportunities in non-agricultural sectors, the incidences of unemployment is more pronounced in rural areas which are predominantly agricultural. This problem, however, is not unknown to national planners and in fact, some sort of process of syphoning out surplus labour on agricultural land and transfering them to more productive industrial and other sectors has already started, (as evident from the Todaro-type out-migration incidences), in the post-independence era of Indian national planning. But their efforts are still meagre as compared with the needs of this gigantic problem of unemployment. Moreover, the necessary resources for proper industrial growth and expansion have also been severely limited. But, even then, the necessary background knowledge for an appropriate approach towards scientific tackling of this gigantic problem is still not in sight. To clarify our visions towards finding such an appropriate approach, Pathak and Saha [1987] initiated the study on labour absorption functions by industries, the details of which are dealt below with further modifications for improved analysis in the present context.

In the study on the spatial patterns of labour absorption by major and broad industrial activities, the spatial units (here, the districts) are characterised for its industrial bases by the absolute concentrations of aggregate productive capital-stock, and that renders the necessary background information on what could be the possible activity levels in an area by different industries. The actual activity level, however, does not become fully known by the information on productive capital-stock; rather, it gets determined by the level of utilisation of the productive capital-stock. The utilisation level gets best assessed by the actual level of industrial output. So, the detailed activity characteristics of work-force by industries, as might get revealed through labour absorption levels in different areas, should technically be ascertained by the industrial activity-base to be measured through the combined concentrations of both capital and output. The spatial patterns of industrial labour absorption should also get influenced by localisation economy or diseconomy as could be determined by locational advantages and disadvantages in respect of proximity of required resources including raw-materials and skilled and/or semi-skilled labour, existing infrastructural facilities, etc. Granting all these, we propose to enquire here : given the broad activity-bases (or, characteristics) of different areas, what have been the spatial patterns of labour absorption in different areas (or, districts) by industries. It should be clearly understood that our approach here is again to evaluate the spatial patterns of labour absorption under the given activity-bases as existing on space, and not to look for spatial patterns of production under the given levels of capital and labour (as factor inputs).

Although our major thrust is on the study of labour absorptions by manufacturing industries, we shall also make an incidental attempt for a comparable evaluation of the labour absorption in the totality of all agricultural activities. This attempt is simply for identifying very tentatively those areas that are more prone to agricultural labour-surplus problems. In this study on agricultural labour absorption, the agricultural activity-base of an area would be determined by the quality-corrected land-soil, as available for the main agricultural activities (used as a variable comparable to productive capital stock of manufacturing industries), in addition to the actual agricultural output level. Before going for the empirical evaluations of all these, we first discuss in the next section, on the concept of labour absorption function as has been introduced first by Pathak and Saha [1987].

4.2 The Labour Absorption Function

In our attempt to explain the level of labour absorption in some production activities technically, in terms of certain factors of production, Dhrymes' [1969] concept of Employment Function, though introduced in an altogether different context, has been enlightening. The employment function was derived from the marginal productivity conditions and Dhrymes contended that the time-path of actual employment should lead ultimately to the level of optimal employment through an explicit and logical adjustment process with some lag structure. He showed that the level of employment at some time-point is determined by the four factors, namely,

1) the histories of production performance in terms of output,

2) the product-wage till the time-point of reference,

3) the histories of capital investments till the last time-point, and,

4) the histories of labour employment till the last time-point.

In the context of India's labour surplus economy it is not realistic to go by the marginal productivity conditions since these are violated in most cases due to excessive employment of manpower at an inconcievably low wage rate under heavy labour pressure and due to restricted investment and un-utilisation or under-utilisation of capital for lack of financial resources, other resources, fuel, etc. Besides, our study being based on all-India district-level data at a single time-point (as available from the official surveys where there have not been much care for time-path comparability of compiled data) it is not very relevant to talk about changes or movements of the factors of production over time and the related technical change. Here, instead of the movements of factors of production over time, the spatial variations in the specialisation of regional characteristics, like the localisations of resource-based industries, infrastructural facilities, settlements of labour with characteristic skills, etc., have greater impacts on productive activities and the associated labour absorptions. What we really gain from Dhrymes work is the conviction that broadly the level of labour absorption should get determined, at least in a short time span, by the internal technology factors namely the prevailing levels of working capital and production.

In fact, this initial conviction as derived from Dhrymes work, gets further substantiated from our empirical work with Indian data, as done by the present author in collaboration with Saha (Pathak and Saha [1987]). In our study, we have, however, replaced the " working capital" (used by Dhrymes) by " productive capital-stock" , under the compulsions of non-availability of the data on the former. However, by using even the productive capital-stock data, we could establish, likewise Saha [1984], that the logarithmically transformed spatial variables of labour, capital and output are strongly inter-related linearly or multicollinear. In such situation, Saha established different production relations following the conventional line of thinking that given the level of capital and the level of absorbed labour, the production level gets well-determined. Actually, in a situation like this, one really cannot claim with definiteness which factors are fixed first and the others next, or, in other words, it is difficult to classify the factors as dependent and independent. When these are really interactive we might as well think that given the level of capital-stock and the output level that is feasible with the capital-stock, there should be some appropriate level of labour absorption commensurate with the technology implicit in the joint levels of capital and output. Thus, the concept of the labour absorption function could as well as introduced in this alternative logical line, and this could be more useful in the context of providing or modifying industrial activity-bases for decisions on levels of labour absorption. It should be noted that while the knowledge of production functions could be used for direct production planning, the knowledge of labour absorption functions would be necessary for direct labour absorption (or, employment) planning.

On the question of appropriate functional form of labour absorption level in an area in terms of capital and output levels, providing the industrial base of the area, we are dictated by the fact that there exists strong multicollinearity among the logarithmically transformed spatial observations on labour, capital and production. It means that these transformed variables are likely to hold linear relationship among themselves, provided the transformed variables have more or less similar statistical distributions. The strong linear relationships between any pair or logarithmically transformed variables practically confirms that these variables are likely to have similar statistical distributions. Even then we have checked that these log-transformed variables have similar statistical distributions. All these together suggest that we can accept log-labour as a linear function of log-capital and log-output. Over and above this, we take further support on this functional form from the previous studies made by Pal and Saha [1981] and Saha [1984], in connection with their fits for aggregate production functions with spatial variations in India. In their empirical studies they have established statistically that the fits for production function in Cobb-Douglas form, (equivalent to log-output as a linear function of log-capital and log-labour), become most appropriate with almost all industries. An algebraic transposition on their form clearly supports our contention that log-labour is a linear function of log-capital and log-output. Thus, we go for labour absorption function in Cobb-Douglas (C-D) form with arguments as capital and output.

The labour absorption function in our initial study (ref. to Pathak and Saha [1987]) also conforms to the C-D functional form. This functional form can be presented analytically as follows for any particular industry at a particular time-point.

$$L = \gamma K^{\alpha} Y^{\beta} \qquad \ldots (4.1)$$

where γ , α, β are parameters to be determined.

Clearly, this is a homogeneous function of K and Y with degree $(\alpha + \beta)$. Putting $\alpha + \beta = \mu_o$, the degree of homogeneity, the functional form (4.1) can be conveniently written as shown below :

$$L = \gamma X_o^{\mu_o} \qquad \ldots (4.2)$$

where $X_o = K^{\delta} Y^{1-\delta}$ ... (4.3)

is the geometric mean value of K and Y with complementary distributive indices δ and $(1 - \delta)$ respectively.

In this geometric mean value, δ is called the <u>distribution parameter</u> (attached to K). It should be noted further that there can be different combinations of K and Y for a particular constant (or same) level of mean value X_o with a given δ, and, as such, X_o will be called the <u>industry-specific iso-activity-base</u> of the spatial/areal unit. In the reformulated form (4.2) now, the parameter $\mu_o = (\partial \log L / \partial \log X_o)$, and is called the <u>scale parameter</u> for the level of labour absorption. The other parameter γ is simply the <u>adjustment parameter</u> for relative measurement units of the variables involved; it is decided by the hypothesis that the central value of X_o would correspond to the central value of L. If we combine the forms (4.2) and (4.3), we get the form (4.1) where $\alpha = \delta\mu_o$ and $\beta = (1-\delta)\mu_o$. Taking the logarithmically transformed form of (4.1) and using these values of α and β, we get the following form which conforms to our original functional form that log-labour is a linear function of log-capital and log-output :

$$\ln L = \ln \Upsilon + \mu_o \delta \ln K + \mu_o (1-\delta) \ln Y \quad \ldots (4.4)$$

It is in this form we shall estimate the regression parameters $\ln \Upsilon$, $\mu_o\delta$ and $\mu_o(1-\delta)$ by the usual statistical procedures, from the empirical data. The parameters δ, μ_o and Υ related to the forms (4.3) and (4.2) could then be easily derived from the above mentioned estimates of the regression parameters.

4.3 Agricultural Labour Absorption Function : Estimation and its Use for Identifying Areas of Excessively Surplus Agricultural Labour

4.3.1 Explanatory Variables and the Estimation of the Function :

In a predominantly agricultural country like India with labour surplus economy, it is almost a truism that the labour pressure on agricultural land is immense and most wide-spread. Yet, there has been variation in the degree of labour pressure depending upon the agricultural activity-base of areas. It is already proposed in section (4.1) that the agricultural activity-base of any area is to be measured by the combination of quality corrected land-soil, available for agricultural activities, and the actual agricultural output level. The implicit technology as used for agricultural operation in the cropped lands of different areas would be largely reflected in the factor to be used for the quality correction of land-soil. Thus, even though there is not much scope for increasing the magnitude of agricultural land in an area, we can think of possible changes in the magnitude of quality corrected land-soil for agricultural activities by the changes in technology for agricultural operations. The agricultural output variable can also get affected by the technology change, apart from other reasons. Thus, the agricultural activity-base to be measured by the combinations of above mentioned two spatial variables are changeable with the changes in implicit agricultural technology over time and space. The quality of land-soil for agricultural activities with varying technologies, used locally in different areas, has been measured by the actual response of the land-soil in the yield of five main cereal crops, namely, paddy, wheat, jowar, maize and bajra. The quality correction factor for the land-soil is taken in the form of an index, to be called the land productivity index (for cereal crops).

Analytically the land productivity index for cereal crops, Q_{ij} (referring to i-th areal unit in j-th State), can be defined, following Pal [1963], as follows :

$$Q_{ij} = \sum_{k=1}^{5} w_{ijk} \left(\frac{y_{ijk}}{y_k}\right), \qquad \ldots (4.5)$$

with $\sum_{k=1}^{5} w_{ijk} = 1$ (for each of i-th areal unit in j-th State),

where w_{ijk} = proportion of cropped land under k-th cereal crop to total cropped land under all five cereal crops, for i-th areal unit in j-th State,

y_{ijk} = yield rate per acre for k-th crop in i-th areal unit of j-th State,

and y_k = all-India yield rate per acre for k-th crop,

the suffix k varying over all five cereal crops.

The logic of construction of Q_{ij} is as follows : The factor w_{ijk} assesses the local importance of k-th cereal crop among all five cereal crops and the factor (y_{ijk}/y_k) gives the response of land-soil for k-th crop in an areal unit, relative to corresponding national value. So the index Q_{ij} is the relative aggregate response of land-soil on cereal crops, weighted by their respective local importance. Here it is understood that the five main cereal crops have been taken as representative crops for the quality correction of land-soil.

The data base : For the estimation of agricultural labour absorption function, we shall mainly depend on the raw data-base as compiled in a study made by Pal and Mukhopadhyay [1989] by district-groups, about 151 in number, covering the geographical areas of India with reference to the time-point 1980-81. The original sources of agricultural data, used therein, have been, however, the official sources as available in Government publications, mainly the following :

a) Agricultural Situation in India,
b) Estimates of Area and Production of Principal Crops in India,
c) General Population Tables, Census of India,
d) Coffee Statistics,
e) Tea Statistics.

In that study, the data have been compiled by contiguous district-groups within each State, and not by districts. The details of districts included in different district-groups are available in that paper by Pal and Mukhopadhyay [1989]. As we have used the necessary relevant raw data from their compilations, this part of our present analysis is based on the spatial variations by those 151 district-groups of India for the particular time-point 1980-81. On the average a district-group now includes mostly two to three districts occurring in geographical contiguity within a State. For our present purpose of fitting the agricultural labour absorption function, this abridging in the number of observations on spatial agricultural variables does not alter in any substantive way the statistical fit, since the number of observations still remains very high for such statistical estimation.

Further the coverage of agricultural activities has been limited to only the major field crops of India, 26 in number, in their analysis, and as such, the total agricultural output considered in our study refer to the value of output of these 26 crops only. These crops are the following :

1) rice, 2) wheat, 3) maize, 4) gram, 5) tur,
6) sesamum, 7) sugarcane, 8) dry chillies,
9) jowar, 10) bajra, 11) ragi, 12) barley,
13) groundnut, 14) mustard and rapeseed,
15) linseed, 16) potato, 17) turmeric, 18) cotton,
19) castor seed, 20) mesta, 21) dry ginger,
22) tobacco, 23) jute, 24) black pepper, 25) tea
and 26) coffee.

The above mentioned coverage is, however, the major part of all primary activities, for the total of which the data on workers engaged are available from the population census sources. As most of primary workers involved in cultivation of field-crops are also simultaneously engaged in other primary activities it is difficult to apportion their working hours, used exclusively for the cultivation of field-crops. This limitation of inexact matching of agricultural (primary) workers (or, rather working hours) and the agricultural output levels can hardly be avoided in any detailed analysis on agricultural field-crops, both for the total as well as individual crops. It is for this reason, we do not have any scope for fitting agricultural labour absorption function for each individual field-crop (contrasting to what we are in a position to do for individual manufacturing industry). Thus, we have simply made an attempt to fit the agricultural labour absorption function only for the totality of all field-crops considered, with the understanding that the total agricultural activities, involved in the cultivation of all these crops, constitute predominantly the major working hours of the primary workers in quite wide-spread rural areas where, at least, the cultivation of field-crops has been the main occupation of the people.

Granting the limitations stated above, we have fitted with the above mentioned data, the following agricultural labour absorption function of the comparable form (4.4) as to be used for manufacturing industries.

$$\ln W = \ln \gamma + \mu_o \delta \ln S + \mu_o (1 - \delta) \ln V \quad \ldots (4.6)$$

where W = agricultural work-force (cultivators + agricultural workers),

S = $Q.A$ = quality-corrected land soil, where A = gross cropped area (in hectare) under cultivation of 26 crops, and,

Q = land-productivity index for the five representative cereal crops of paddy, wheat, jowar, maize and bajra, used for quality correction of land-soil, as referred to already in its formulation given in (4.5),

V = value (in Rupees) of agricultural outputs of 26 major field-crops considered,

and finally, μ_o, δ and γ are the parameters with comparable interpretations as in form (4.4).

The estimated values of these parameters and the multiple correlation coefficient R for the OLS fit of the form (4.6) are as follows :

$$\mu_o = 0.752, \quad \delta = 0.537, \quad \gamma = 3.5663 \text{ and } R = 0.834$$

It needs special mention here that γ has been worked out from the central values of arithmetic means $\bar{W}$, $\bar{S}$ and $\bar{V}$ (and not the corresponding geometric means as usually done for log-linear form (4.6)) satisfying the equivalent functional form without the logarithmic transformations,

$$\text{i.e.} \quad \gamma = \bar{W} \,/\, [\, (\bar{S})^{\mu_o \delta} \; (\bar{V})^{\mu_o (1 - \delta)} \,]$$

The degree of fit as depicted by the near unity value of R can be considered very high (with 151 observations on the variables). Perhaps it would have improved further had we had the information on exact apportioning of man-hours worked by the agricultural workers for the cultivation of the field-crops. However, our contention that the agricultural workers are mostly engaged in agricultural activities related to the crops considered, gets substantiated even by this very high degree of fit as obtained with the present data.

4.3.2 Statistical Findings and Use of the Function

Our findings on the empirical fit of agricultural labour absorption function are as follows :

1) The estimate of the scale parameter μ_o (= 0.752) has been tested for its statistical significance, and it is found to be very significantly below unity (t-statistic = 6.03, with d.f. = 148), implying thereby that the scale of labour absorption is diminishing with the improvements in agricultural activity-base measured by the mean value of S and V (ref. to comparable definition as in (4.3)),

$$X_o = S^{\delta} V^{1-\delta} \qquad \ldots (4.7)$$

This means that the core areas of agricultural activities with more and more concentrations of agricultural land-soil and value-outputs of field-crops, employ relatively less and less labour. This means that agricultural productivity per unit labour in areas of advanced agricultural activity-base is relatively better than the areas of less advanced agricultural activity-base, possibly through the application of advanced agricultural technology, like the use of more of chemical inputs and mechanised devices, which might have reduced the level of labour absorption (some sort of similar observations have been made also by Bose [1990]). In fact, under the prevalent national strategy of output maximisation, without the due emphasis on improvement of the employment situation, the above mentioned findings on diminishing return to scale of labour absorption is a distinct possibility.

2) It should be noted that the values of δ and $(1 - \delta)$ are both almost near 0.5 and as such we have tested statistically the null hypothesis on the difference of regression coefficients in the form : $\mu_o \delta - \mu_o(1 - \delta) = 0$. Our test result goes in favour of the acceptance of the null hypothesis (t-statistic = 0.392, with d.f. = 148), meaning thereby that in setting the agricultural activity base, $X_o = S^{\delta} V^{1-\delta}$, as responded to by the agricultural labour absorption level W,

both the quality corrected land-soil S, and the agricultural output level V, are found to be equally important (in terms of the distribution parameter, δ).

Further, as proposed in the beginning, we now go for an use of the agricultural labour absorption function in identifying the areas of excessively surplus agricultural labour.

3) The fitted agricultural labour absorption function shows the expected spatial pattern of the agricultural labour absorption corresponding to actually observed agricultural activity-base X_o. The expected spatial pattern, given by :

$$\hat{W} = \gamma X_o^{\mu_o}$$

is likely to differ from the actual observed pattern of W in various degrees from one area to another, depending upon the local peculiarities under the prevalent employment situation. As the degree of fit of the agricultural labour absorption function is not that extremely high as to show a near-perfect fit with unit magnitude of the correlation coefficient, the deviation of the actually observed W from the corresponding expected value $\hat{W}$ would likely to be quite high for many areal units. We have pointed out elsewhere that if the employment situation is so distressing that local people do not have alternative employment opportunities in activities other than agriculture, they are likely to over-burden the agricultural activities, resulting in the incidences of excessively surplus manpower. Here the excessively high positive values of the difference or deviation of the expected value $\hat{W}$ from the actual value W, could be taken as an indication of the concentration of excessively surplus manpower in the agricultural activities. As the fitted function is in the log-linear form (4.6), we would, in fact, consider their logarithmic deviation D, given by

$$D = \ln W - \ln \hat{W}$$

The squared estimate of the standard error, $\hat{\sigma}^2$, of the fit of the relation (4.6), gives an estimate of the variation of D. Under the assumption of normal distribution of D as implicit in the OLS procedure of estimation of (4.6), about a middle one-third values of D should get accommodated in the range $(-0.43\,\hat{\sigma}\ ,\ 0.43\,\hat{\sigma})$, showing negligible departures from the expected spatial trend-path of the functional fit.

Now, relative to this central class of areal units, following most closely the spatial trend-path of functional fit for the agricultural labour absorption corresponding to available agricultural activity-base, the two classes of areal units on either side of the above class with values of $D > 0.43\,\hat{\sigma}$ and $D < -0.43\,\hat{\sigma}$ could be considered respectively as the upper class with excessively high labour concentration and the lower class with excessively low labour concentration in agricultural operations. These two classes are also likely to accommodate each about one-third of all areal units under the usual normality assumption on D as implicit in the OLS estimation theory. However, in practice, with discrete distributions, the two tail-end classes with values of D above and below the central band of spatial trend-path, may accommodate different shares of areal units, depending upon the degree of fit and the incidences of spatial peculiarities actually present in agricultural operations. However, for the classification purpose, we would follow the boundaries as prescribed above to accommodate theoretically equal numbers in each of the three classes —— upper, central and lower. These three classes, in order, will be designated as of rank H, M and L in terms of corresponding labour concentration patterns in agricultural operations, provided by the available activity-bases.

It should, however, be noted that for an activity-base the extent of land-soil S is the essential prerequisite for the agricultural output generation level V, and, as such, the two spatial variables are strongly correlated (in fact, it is as high as to have a correlation coefficient = 0.961, under logarithmic transformation). As these variables together provide, with almost equal distributive importance, the agricultural activity-base X_o, the increasing X_o implies increasing output level V. Again, as the diminishing scale of labour absorption is prevailing, an increasing proportional rise in output level V means a relatively less proportional rise in labour absorption. The result is that the agricultural labour productivity, (V/W), might be generally increasing with improvement in agricultural activity-base, but the agricultural labour absorption level might not be that increasing comparably. This has been actually the general pattern. However, there must be deviations from this general pattern, and the improvement or deterioration of agricultural labour productivity need not always be associated with the improvement or deterioration in the level of agricultural activity-base. As such, it is better to examine explicitly the agricultural labour productivity variable (V/W), to further qualify the areal units in the labour concentration classes H, M and L, as identified from the classification of $D = (\ln W - \ln \hat{W})$. The labour productivity variable, designated by p, is taken in an index form, by dividing the value of each areal unit with the corresponding all-India value of agricultural labour productivity. Thus, we have

$$p_{ij} = \frac{V_{ij} / W_{ij}}{(V/W)} \qquad \ldots (4.8)$$

where the numerator (V_{ij}/W_{ij}) gives agricultural labour productivity of the i-th areal unit of j-th State and the denominator (V/W) is the corresponding all-India value. The all-India value of p is thus unity. We next classify the values of this variable p by taking about one-third of all areal units in the central class with medium values of p around unity. The class interval for this central class-interval has thus turned out to be (0.835 , 1.165). The two classes of p on either side of this central class have been considered as the classes of higher and lower labour productivities, respectively with values of $p \geq 1.165$ and $p < 0.835$. The three classes of high, medium (or, average all-India type) and low agricultural labour productivities will be designated by class-ranks h , m and l respectively.

In view of our observations made earlier, in connection with the diminishing return to scale of labour absorption, we would generally expect the association of the lower level of labour concentration L with the higher level of labour productivity h , and also on the other extreme, the association of the higher level of labour concentration H with the lower level of labour productivity l . The combination of (H , l) for the pair of variables (D , p) should really be considered as to mark the class of excessively high labour surplus areas, which we aim to identify by a double variable mapping of (D , p) as shown in Figure (4.1). The argument behind taking the combination (H , l) for marking excessively high labour surplus areas is that the available activity-base is not sufficient enough to support so high a concentration of agricultural labour, with the result of low labour productivity. Even the areas with the combination (M , l) in respect of the pair (D , p) could be considered as the high labour-surplus areas in view of the association of low labour productivity level in it, although these areas follow the expected spatial trend-path of labour absorption corresponding to available activity-base. Thus, we shall make use of the combination of not only (H , l), but also (M , l), in respect of variable pair (D , p), for marking respectively the excessively high labour-surplus areas and the high labour-surplus areas on the map. On the other extreme, we would also be in a position to identify the agriculturally advanced tract with the combination (L , h) in respect of the variable pair (D, p), signifying practically the absence or negligible presence of agricultural labour-surplus problem. Areas under other combinations of ranks could also be identified on the map, although our main interest is on the identification of excessively high and high labour-surplus areas with the observed agricultural activity-bases.

4) Before actually locating the excessively high and high agricultural labour-surplus areas, we shall note the summary picture on the occurrences of different areal units in the different combinations of ranked classes in respect of the variable pair (D , p) and also give the equivalent district frequencies by those rank combinations. The frequency distributions by rank combinations are tabulated below :

Table 4.1 : Frequency Distributions of Areal Units (District-groups) and Equivalently of Districts by Rank Combinations of Variable Pairs (D, p) Related to Agricultural Activities : 1980-81

(A) Frequencies of areal Units

		Class-ranks of p			Total
		h	m	l	
Class-ranks of D	H	0	4	34	38
	M	12	35	33	80
	L	24	9	0	33
Total		36	48	67	151

(B) Frequencies of districts

		Class-ranks of p			Total
		h	m	l	
Class-ranks of D	H	0	12	75	87
	M	34	84	77	195
	L	48	19	0	67
Total		82	115	152	349

From the frequency distribution tables we observe the occurrence of zero frequencies for both class-rank combinations (H, h) and (L, l). This corroborates our expected general association patterns along the combinations (H, l), (M, m) and (L, h) with diminishing order of labour-surplus problem. The corresponding classes generally have accommodated high frequency values in each of them. The labour-surplus problem is clearly aggravated in the combination class (M, l) as compared with that in the class (M, m). As the class-rank combination (M, m) signifies the medium level of agricultural labour-surplus problem as prevailing in the average all-India situation, we have taken the class (M, l) as to mark the high agricultural labour-surplus problem areas, and the class (H, l) as to mark the excessively high agricultural labour-surplus problem areas. The frequency of the combination class (M, l) is almost equally as high as that of the combination class (H, l), and these two classes together account for nearly half the total number areal units or districts in India. Thus, the areal coverage of these incidences of high labour-surplus situation in agricultural activities must be quite wide-spread. Other marginal combination classes of (H, m), (M, h) and (L, m) have quite low frequencies, much lower than that of combination class (L, h), marking the lowest order in the incidences of agricultural labour-surplus situation. The areas which have exhibited agricultural progress in the two decades prior to 1980-81, with the use of advanced agricultural technologies (mainly in Punjab, Haryana, Western Uttar Pradesh and in the neighbourhood) have fallen into this combination class of (L, h).

5) We shall now identify the excessively high and high agricultural labour-surplus areas by the combination classes, ranked (H, l) and (M, l), (1970-71 Census definition of district-boundaries have been followed here).

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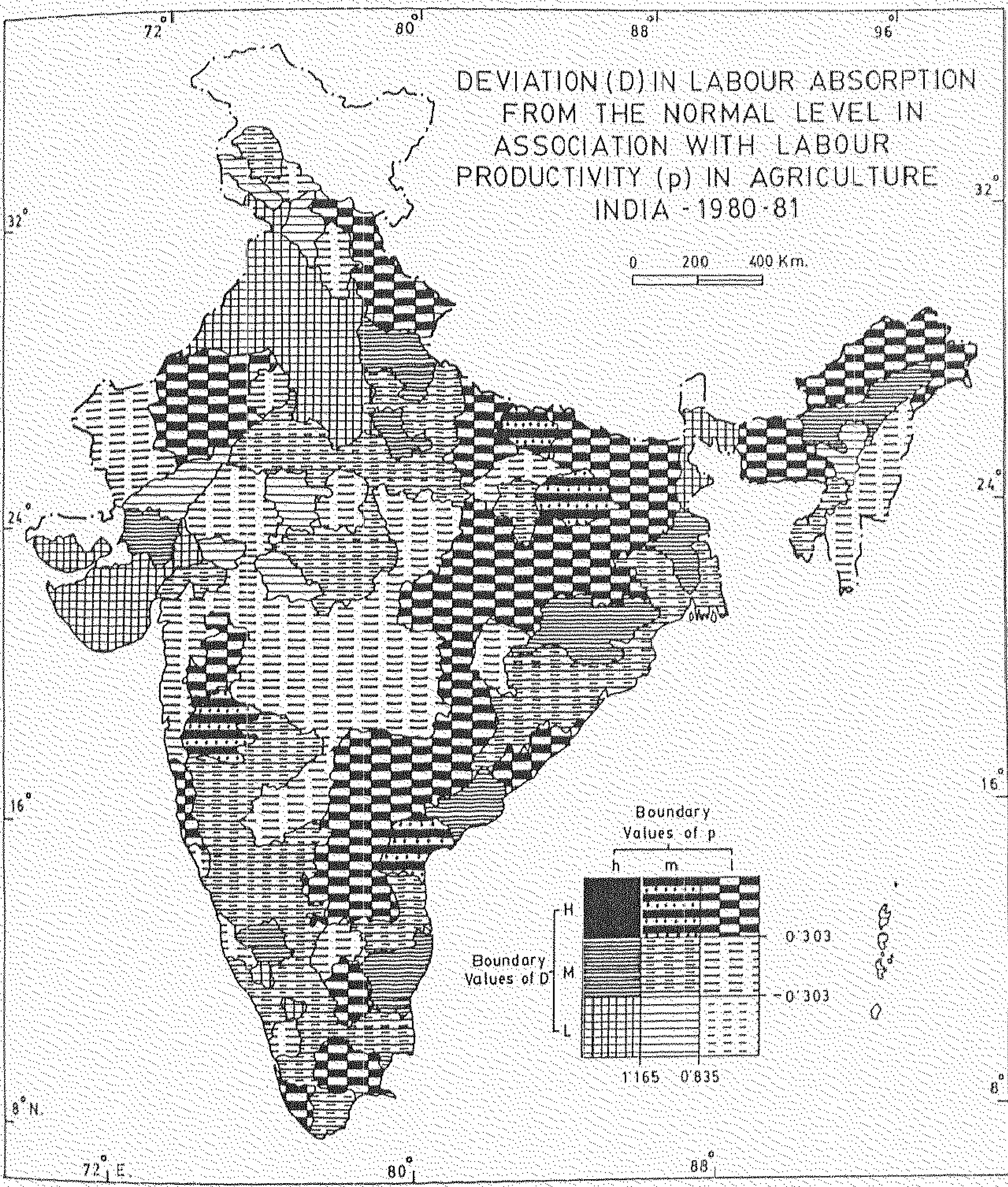

DEVIATION (D) IN LABOUR ABSORPTION FROM THE NORMAL LEVEL IN ASSOCIATION WITH LABOUR PRODUCTIVITY (p) IN AGRICULTURE INDIA - 1980-81
0 200 400 Km.
Boundary Values of p
h
m
l
H
M
L
Boundary Values of D
0·303
-0·303
1·165
0·835
72°
80°
88°
96°
32°
24°
16°
8° N.
72° E.

FIG. 4·1

(A) Excessively high agricultural labour-surplus areas

ANDHRA PRADESH

(a) Srikakulam + Vishakhapatnam, (b) Cuddapah + Anantapur, (c) Kurnool + Mahbubnagar, (d) Hyderabad + Medak, (e) Nizamabad + Karimnagar, (f) Warangal + Khammam + Nalgonda

ASSAM

Goalpara + Kamrup

BIHAR

(a) Saran + Champaran, (b) Muzaffarpur + Darbhanga, (c) Monghyr + Bhagalpur, (d) Saharsa + Purnea, (e) Santhal Parganas + Dhanbad, (f) Hazaribagh + Palamau, (g) Ranchi + Singhbhum

HIMACHAL PRADESH

Kinnaur + Lahul & Spiti

KERALA

Alleppey + Quilon + Trivandrum

MADHYA PRADESH

(a) Rewa + Sidhi, (b) Surguja + Shahdol, (c) Bilaspur + Raigarh, (d) Mandla + Seoni, (e) Durg + Balaghat, (f) Bastar

MAHARASHTRA

(a) Dhulia + Nasik, (b) Ratnagiri

MEGHALAYA

Garo Hills + United Khasi & Jayantia Hills

RAJASTHAN

(a) Bikaner + Churu, (b) Nagaur + Jodhpur

TAMIL NADU (including PONDICHERRY)

(a) Salem + Dharampuri, (b) Ramanathapuram + Madurai

UTTAR PRADESH

(a) Uttar Kashi + Tehri Garhwal + Garhwal, (b) Chamoli + Almora + Pithorgarh, (c) Bahraich + Gonda + Barabanki, (d) Pratapgarh + Rae Bareli + Sultanpur + Faizabad

ARUNACHAL PRADESH

Kameng + Subansiri + Siang + Lohit + Tirap.

(B) High agricultural labour-surplus areas

ANDHRA PRADESH

Adilabad

HIMACHAL PRADESH

(a) Bilaspur + Kulu + Mandi, (b) Mahasu + Simla + Sirmaur

GUJARAT (including DADRA & NAGAR HAVELI)

(a) Dangs + Valsad + DADRA & NAGAR HAVELI,

(b) Surat + Bharuch + Vadodara

JAMMU & KASHMIR

Doda + Udhampur

KARNATAKA

(a) Bidar + Gulbarga + Bijapur, (b) South Kanara,

(c) Kolar + Bangalore

KERALA

Palghat + Trichur

MADHYA PRADESH

(a) Tikamgarh + Chhatarpur, (b) Panna + Satna,

(c) Raipur, (d) Chhindwara + Betul + Narsimhapur,

(e) Khargone + Khandwa, (f) Dhar + Jhabna + Ratlam,

(g) Guna + Shivpuri, (h) Damoh + Jabalpur, (i) Mandsaur

MAHARASHTRA

(a) Jalgaon + Aurangabad, (b) Buldhana + Akola + Amravati, (c) Wardha + Nagpur, (d) Bhandara + Chandrapur, (e) Yeotmal + Nanded + Parbhani, (f) Thana + Kolaba + Greater Bombay

RAJASTHAN

(a) Jhunjhunu + Sikar, (b) Jaisalmer + Barmer,

(c) Udaipur + Bhilwara + Chitaurgarh

UTTAR PRADESH

(a) Allahabad + Jaunpur, (b) Azamgarh + Ghazipur + Ballia

MANIPUR & NAGALAND

Manipur North + Manipur West + Manipur South + Manipur Central + Manipur East, and, Kohima + Mokokchung + Tuensang

GOA

Goa, Daman & Diu

MIZORAM

Mizoram.

Thus we have the following major regional or areal groups of districts with excessively high or acute agricultural labour-surplus situations (ref. to Figure (4.1)).

5.1 Eastern Acute Agricultural Labour-Surplus Region :
Most of Bihar (except Patna, Gaya and Sahabad) and eastern part of Madhya Pradesh.

5.2 Southern Acute Agricultural Labour-Surplus Region :
Most of non-coastal Andhra Pradesh and adjoining Bastar district of Madhya Pradesh.

5.3 Acute Agricultural Labour-Surplus Area of Rajasthan :
In the districts of Bikaner, Churu, Nagaur and Jodhpur in northern Rajasthan.

5.4 Acute Agricultural Labour-Surplus Areas in the Northern Hilly Tract : In the districts of Kinnaur and Lahul & Spiti in Himachal Pradesh and in the districts of Uttar Kashi, Tehri Garhwal, Garhwal, Chamoli, Almora and Pithorgarh in Uttar Pradesh.

5.5 Acute Agricultural Labour-Surplus Areas in the Eastern Uttar Pradesh : The districts are Bahraich, Gonda, Barabanki, Pratapgarh, Rae Bareli, Sultanpur and Faizabad.

5.6 Acute Agricultural Labour-Surplus Areas in Western Assam and Meghalaya : In the districts of Goalpara and Kamrup in Assam and the whole of Meghalaya.

5.7 Acute Agricultural Labour-Surplus Areas in the Far-Eastern Hilly Tract : This is the whole of Arunachal Pradesh.

5.8 Isolated Incidences of Acute Agricultural Labour-Surplus : Few district-groups in different States viz. Maharashtra, Tamil Nadu and Kerala.

4.3.3 Remarks on the Statistical Estimation Procedure of Agricultural Labour Absorption Function

In the statistical estimation of the agricultural labour absorption function, W (the agricultural labour) as

(i) The VLS regression technique does not pre-suppose the absence of multicollinearity among variables, whereas the OLS procedure does. As such in a multicollinear situation VLS technique is more appropriate. In fact, the presence of multicollinearity is often helpful in getting VLS conformal regressions, whereas it violates the basic premises implicit in the OLS regression procedure.

(ii) For the regression fit, the minimisation of the sum of squared divergences of the scatter of points in all-variable space is done along the lines parallel to the particular axis of dependent variable in the OLS procedure, without any regards as to how this axis is inclined with the regression line of closest fit through the scatter of points, whereas the same minimisation is done along the lines vertical to the central axis of closest fit through the scatter of points, determined without any bias towards any particular axis of a variable in the VLS technique. Thus, if there are n number of multicollinear variables, one can fit n different regression equations with all different choices of the dependent variable, along which the minimisation is done by the OLS procedure, whereas in the other case, one has to fit one and only one central axis in all-variable space and VLS regression equations can be obtained through mathematical projections of the same central axis onto various axes. As the OLS procedure starts with a bias towards a particular axis for minimisation, all n OLS regression equations, determined through different choices of the axis of dependence, are not really comparable; but, as all n VLS regression equations are obtained from the same central axis of closest fit, without any pre-imposed bias towards any particular axis of a variable, these can be compared in terms of the relative degrees of fit. Moreover, as the VLS procedure does not suffer from any axis-bias, in a multicollinear situation, the regression coefficients are more appropriately determined in the VLS regression, and not in the OLS regression.

Thus, because of the discordant choice of a particular axis as a direction for minimisation in a multicollinear situation, the OLS regression procedure could be considered as less efficient as compared to the VLS regression technique, in which no question of discordance arises. However, as the OLS regression is biased towards the axis of dependent variable, the correlation coefficient for the OLS regression fit gets over-estimated as compared with the VLS regression fit (except for the two-variable case where there is only one explanatory variable). If the multicollinearity disturbance is not too great for the OLS fit, the correlation coefficient of the OLS fit will be very close to that of the VLS fit, and in such a situation, even the OLS regression fit could be acceptable in a multicollinear situation.

Thus, in our present case of the regression fit for the agricultural labour absorption function in a multicollinear situation, the OLS procedure seems to be in-appropriate at a first glance. However, we are yet to examine how the OLS fit compares with the corresponding VLS fit, and whether the two fits are close enough to justify the acceptance of the OLS fit, determined already in the present context. Pending the theoretical details of the VLS regression estimation procedure, (to be discussed in the next section), we present below the estimates of both OLS and VLS regression fits for the parameters of interest, in the present context of the agricultural labour absorption function :

	Parameter description		OLS fit	VLS fit
1)	correlation coefficient (R)	:	0.83392	0.83389
2)	distribution parameter (δ)	:	0.537	0.508
3)	scale parameter (μ_0)	:	0.752	0.845

In the above mentioned empirical estimates, we have the following observations :

1) The correlation coefficient of the OLS fit is almost the same as that of the VLS fit, and as such, we infer that

the multicollinear situation is not disturbing in the present OLS fit.

2) The distribution parameter for the OLS fit has been checked to be statistically not different from 0.5; the VLS estimate confirms this finding with its magnitude closer to 0.5.

3) The estimates of the parameter μ_o show diminishing scale of absorption of agricultural labour relative to the activity-base available, in both OLS and VLS fits; however, the VLS estimate is a little above the OLS estimate, showing a possibility of slight under-estimation of the scale parameter in the OLS procedure. But, this under-estimation is not considerable enough to change our qualitative inferences drawn already on the basis of the OLS fit of the agricultural labour absorption function.

Thus from the above review, despite the multicollinear situation, we can safely accept the OLS fit of the agricultural labour absorption function and the qualitative inferences drawn already from the said fit.

4.4 Statistical Details of VLS Regression : a brief review

Though the difference between the OLS and the VLS regressions in the context of agricultural labour absorption function, is not that significant as to change significantly the conclusions drawn through statistical map analysis, in many multicollinear situations the difference come out to be rather prominent (for examples see Pal [1986]) and the choice goes in favour of estimation by VLS technique. In the course of estimation of various manufacturing industrial labour absorption functions, elaborated in the next sections, we would in fact notice that the axis-bias OLS, favouring the dependent variable, in the event of the presence of strongly multicollinear explanatory variables, does pose certain inconsistency problems, which could be eliminated by the use of more appropriate VLS regression technique. Before undertaking actual empirical details, we briefly review here the statistical details of VLS regression technique.

Vertical Least Squares Regression : In a situation of strong multicollinearity among variables, a priori choice of a dependent variable, the variation of which is taken to be explained by the other variables, is not at all appropriate if we are to favour this variable for the minimisation of the sum of squared divergences along its axis, as done in the OLS regression procedure, simply because it creates a discordant preference among more or less parallel variables. Even if we have theoretical support in favour of the choice of a particular variable as the dependent variable, despite the existence of strong multicollinearity, we should not, if possible, design our statistical estimation procedure of the regression in such a way as to give an impression of high degree of fit as would be implicit by the axis-bias OLS evaluation, favouring the dependent variable chosen a priori. We should rather allow the mutual inter-connectedness of variables to be taken as granted, without any bias towards any particular axis, in optimal accounting first for the total variations of all variables together and then find how the totality of accounted variation co-associates with the variation of any individual variable and finally decide for the dependent variable depending on the strength of individual co-association. This is what is done in the VLS regression technique. The approach for the analytical deductions of the VLS regressions can be summarised as follows.

In this approach we first get a linear combination of variables to represent a central axis in the n-dimensional Euclidian-space of total n variables considered. This linear combination is so constructed as to account for the maximum of total variation of all n variables. The basic premises for the statistical construction of the linear combination of variables from a given set of n initial variables are as follows :

i) Similar or almost similar statistical distributions of the variables need to be effected, if necessary, by use of proper mathematical transformations on the initial variables, so that the inter-relationships or inter-connectedness between pairs of variables can be correctly depicted by the linear correlation coefficients as usually recorded in their correlation matrix.

ii) The presence of considerable inter-correlations between variables is taken for granted so that the observation-points in the (possibly transformed) n-dimensional variable-space, form a scatter along a central line which could be the line of closest fit and taken as the central axis here, determined by the vertical least squares principle.

If $z_1, z_2, \ldots\ldots, z_n$ denote the observations on variables $Z_1, Z_2, \ldots\ldots, Z_n$ (in the transformed form, if necessary) in their standardised forms, then any line through the mean point $\underset{\sim}{O} = (0, 0, \ldots\ldots, 0)$ of the variables can be written as

$$\frac{x_1}{l_1} = \frac{x_2}{l_2} = \ldots\ldots = \frac{x_n}{l_n} \qquad \ldots\ldots (4.7)$$

for any current point $(x_1, \ldots\ldots, x_n)$ on the line, with l_i representing the direction-cosine of the line with the axis of i-th variable. If $P_j = (z_{1j}, z_{2j}, \ldots\ldots, z_{nj})$ denote the j-th observation point and $F_j = (x_{1j}, x_{2j}, \ldots \ldots, x_{nj})$ denote the corresponding foot of perpendicular of P_j on the line (4.7), then the length of the line P_jF_j gives the vertical distance (or, divergence) of the point P_j from the line (4.7). In the vertical least squares principle, we minimise the sum of squared divergences, S, where

$$S = \sum_{j=1}^{N} (P_jF_j)^2 \qquad \ldots (4.8)$$

N being the total number of observation-points, and this determine the magnitudes of unknown l_i's while affixing the line of closest fit through the scatter of observation-points. Once it is determined, it can be proved that the length of vector $\overrightarrow{OF_j}$ is given by the linear combination

$$OF_j = \sum_{i=1}^{n} l_i z_{ij} .$$

which is considered to be the best approximation of the original observation point vector $\overrightarrow{OP_j}$. Thus, the linear combination

$$\sum_{i=1}^{n} l_i z_i \qquad \ldots (4.9)$$

denotes the distance along the central axis from the mean observation point to the foot of perpendicular on the central axis, from any observation point $P = (z_1, z_2, \ldots\ldots, z_n)$. Now, if we denote by r_k the correlation coefficient between any variable Z_k and the linear combination of variables, $\sum_{i=1}^{n} l_i Z_i$, then it can be shown that

$$l_k = \frac{r_k}{\sqrt{n}\,\rho} \qquad \ldots (4.10)$$

$$\text{where } n\rho^2 = \sum_{i=1}^{n} r_i^2$$

Then it could be deduced that the linear combination $\sum_{i=1}^{n} l_i Z_i$ has mean zero and standard deviation $(\sqrt{n}\,\rho)$. It is to be noted that, in the terminology of index formulation, referred to already in subsection (2.2.4), the parameter r_k is called the specific representation of the k-th constituent variable in the said linear combination, and ρ is called the aggregate representation of all constituent variables in the linear combination. Using the relation (4.10), the linear combination in standardised form, denoted by Z_o, turns out to be as:

$$Z_o = \frac{1}{n\rho^2} \sum_{i=1}^{n} r_i Z_i \qquad \ldots (4.11)$$

This variable Z_o now accounts for the maximum of total variations of all variables ($n\rho^2$ in magnitude, for all n variables), which has already been referred to as the Kendall's index (in standardised form) in the subsection (2.2.4). It is to be emphasized that the statistical estimation of Z_o is not accomplished with any bias towards any particular axis.

The error S (ref. to relation (4.8)) related to the linear combination Z_0 is comprised of errors in all variables implicitly, with due recognition of the inter-connectedness of the variables, and as such the minimisation of S implies the minimisation of errors in all inter-connected variables. It is to be noted that the minimisation of S implies the maximisation of $n\rho^2$ (i.e. squared aggregate representation, ρ^2), which could be proved easily.

Thus, the axis of Z_0 is the central axis, passing centrally through the scatter of observation points, with maximum aggregate representation $n\rho^2$. The determination of Z_0 without any bias towards any variable axis, forms the basic statistical step towards final determination of the VLS regression of any variable Z_j in terms of the remaining (n-1) variables. We have noted that the degree of co-association of Z_j with Z_0 (or, the specific representation of Z_j in Z_0) is r_j which is proportional to l_j, the direction-cosine of the central axis with the j-th variable axis. If $\hat{Z}_j$ denotes the VLS regression estimate of Z_j, obtained by regressing Z_j on the remaining (n-1) variables by VLS technique, it can be shown that for given maximised $n\rho^2$ determining Z_0, the higher the VLS correlation coefficient, $r_{Z_j\hat{Z}_j}$, the higher is the value of r_j and hence that of l_j, for varying j. This means that, given the maximised $n\rho^2$ determining Z_0, the smaller is the angle of inclination of Z_j with Z_0, the higher will be the value of VLS correlation coefficient $r_{Z_j\hat{Z}_j}$. Thus, if r_k is the maximum of all r_j's, then $r_{Z_k\hat{Z}_k}$ is the maximum value of VLS correlation coefficient among all $r_{Z_j\hat{Z}_j}$'s for a given set of n-variables. As the minimisation of the sum of squared divergences, S, is done along the directions vertical to the central axis in the VLS principle, the central axis is uniquely formulated in relation to any axis of a constituent variable, and as such, the corresponding $r_{Z_j\hat{Z}_j}$'s are comparable without any bias or preference to any particular axis.

We have yet to go for the determination of $\hat{Z}_j$, from the basic step of statistical estimation of Z_0. This has been done (ref. to Pal and De [1979]) by two-stage projection, first from any observation point, $P = (z_1, z_2, \ldots, z_j, \ldots, z_n)$ vertically on the Z_0Z_j-plane, and second from the foot, P^*, of this projection on the central axis Z_0 along the direction parallel to Z_j-axis to obtain the point $\hat{P}$ on the central axis corresponding to point P. Now the j-th coordinate of $\hat{P}$, namely, $\hat{z}_j$, is taken as the regression estimate of z_j, the j-th coordinate of P, (as well as of P^*). On the basis of this approach for the determination of VLS regression, the actual analytical expression for $\hat{Z}_j$ and $r_{Z_j\hat{Z}_j}$, as worked out by Pal and De [1979] and Pal [1986] are given below.

The VLS Regression

$$\hat{Z}_j = \left(\frac{r_j}{n\rho^2 - r_j^2} \right) \sum_{\substack{i=1 \\ i \neq j}}^{n} r_i Z_i \qquad \ldots (4.12)$$

The VLS Correlation Coefficient

$$r_{Z_j \hat{Z}_j} = 1 \Big/ \left[1 + \left(\frac{n\,\rho^2}{n\rho^2 - 1} \right)^2 \left(\frac{1}{r_j^2} - 1 \right) \right]^{\frac{1}{2}} \qquad \ldots (4.13)$$

It should be noted that for n = 2, we do not have any problem of multicollinearity among the explanatory variables, simply because there is only one explanatory variable, either Z_1 or Z_2 for explaining Z_2 or Z_1 respectively. In this case it can be shown that

$$\left. \begin{aligned} r_1 = r_2 = \rho &= \sqrt{\tfrac{1}{2}(1 + r_{12})}, \text{ if } r_{12} \text{ is positive,} \\ &= \sqrt{\tfrac{1}{2}(1 - r_{12})}, \text{ if } r_{12} \text{ is negative} \\ \text{and } r_{Z_1 \hat{Z}_1} = r_{Z_2 \hat{Z}_2} &= r_{12}, \text{ if } r_{12} \text{ is positive,} \\ &= -r_{12}, \text{ if } r_{12} \text{ is negative.} \end{aligned} \right\} \ldots (4.14a)$$

Thus, the absolute magnitudes of the OLS and the VLS correlation coefficients are same in the 2-variable space (i.e. n = 2), (indicating the absence of multicollinearity). However, the question of axis-bias estimation of OLS regression is still there and as such it differs from the corresponding VLS regression. Thus, while we have the OLS regression

$$\hat{Z}_1 = r_{12} Z_2, \qquad \text{or,} \quad \hat{Z}_2 = r_{12} Z_1,$$

the corresponding VLS regressions are given by

$$\left.\begin{array}{ll} \hat{Z}_1 = Z_2 \quad \text{or} \quad \hat{Z}_2 = Z_1, & \text{if } r_{12} \text{ is positive} \\ \text{and} \quad \hat{Z}_1 = -Z_2 \quad \text{or} \quad \hat{Z}_2 = -Z_1, & \text{if } r_{12} \text{ is negative.} \end{array}\right\} \ldots (4.14b)$$

Because of the implicit vertical least squaring in the determination of VLS regressions, the regression line through the mean point passes more centrally through the scatter of observation-points in the VLS regression than in the corresponding OLS regression.

Pal and De [1979] have also deduced analytically the condition under which any VLS estimate $\hat{Z}_j$, will have maximum likelihood properties. When such condition is satisfied, they suggest, by using the concept of Fisher's Z-test, a test function of the VLS multicollinearity of $\hat{Z}_j$. This test function is quite useful to check whether the regression for $\hat{Z}_j$, or, in other words, the associated regression coefficients are all right without any multicollinearity disturbance. The special power of VLS technique in estimating the regression coefficients free from multicollinearity disturbance makes it all the more acceptable in multicollinear situations, than the usual OLS. Besides, the technique possesses in addition, some sort of discriminatory power (ref. to both Pal and De [1979] and Pal [1986]) for identifying the really important explanatory variables in any VLS regression. Thus, whenever some variables having insignificant or no contribution towards explaining $\hat{Z}_j$, are included in the VLS regression as regressors, the corresponding magnitude of correlation coefficient has been noted to be lower than that, obtained by exclusion of such redundant or unimportant variables. This distinctive plus point of VLS technique is, however, not there with the OLS method in which the multiple correlation coefficient goes on increasing, or at least, decreases never with inclusion of additional variables in the set of explanatory variables. This identification of redundant explanatory variables for explaining a dependent variable is helpful in finding the optimal combination of possibly a smaller set of explanatory variables with highest degree of VLS regression fit for a particular dependent variable from among the totality of variables considered at the very outset. At times we may have the possibility of getting two dependent variables that are almost equally explained by a common set of explanatory variables. In such situation the two variables are very strongly inter-related with very high magnitude of linear correlation coefficient. If both the variables, together with all their explanatory variables are subjected to VLS treatment for finding the best regressand, we may not be in a position to find a unique dependent variable that could be considered as distinctly superior in respect of the degree of statistical fit. In such a situation, often the VLS correlation coefficients for the best and the next best dependent variables might be even lower in magnitude than their linear correlation coefficient. If such a situation arises, we can go for VLS treatment for the two variables separately with the common set of explanatory variables and find out which one is best explained by the explanatory variables. The best explained variable can be considered the primary dependent variable and the other one, the secondary dependent variable, possibly connected also in a sequence with the primary one. Thus, by the VLS mode of discrimination, we may, at times, be in a position to decide on the sequential ordering of more than one dependent variables that are explained almost equally by a common set of explanatory variables.

Thus, the main superiority features of the VLS regression technique over the OLS can be summarised as follows :

(i) The estimations of the VLS regression coefficients do not suffer from the multicollinearity distortions, since the presence of multicollinearity is taken here for granted in the estimation procedure, without any contradiction in the basic premises (contrary to the case of OLS estimation procedure in which multicollinearity violates the basic premises of the orthogonality assumption on explanatory variables). It should be noted that the possible presence of distortions due to multicollinearity in the OLS regression coefficients are not due to the multicollinearity among explanatory variables alone; the distortions get generated for the associated OLS estimation procedure of least squaring along the direction parallel to the axis of dependent variable, which is not in conformity with the multicollinearity among all the inter-connected variables. In fact, the presence of multicollinearity among all involved variables (inclusive of the dependent variable) does not really permit us to take any other mode of least squaring of aggregate error of estimation, apart from that along the vertical direction to the line passing centrally through the scatter of points. Of course, for the ultimate VLS regression, one has to go again for a projection along the direction of a chosen dependent variable mathematically, but in that direction the least squaring has really not been done for the final regression line, and thus axis-biased least squaring has been avoided.

(ii) Absence of the bias towards any axis in the optimal accounting for the total variation of all variables, in which the role of each constituent variable is implicitly determined on granting existence of multicollinear situation empirically, does not allow us to over-estimate the degree of VLS fit for any particular choice of a dependent variable, (contrary to the case of axis-biased OLS procedure of least squaring along the axis of dependent variable, favouring the estimation of OLS correlation coefficient on the higher side).

(iii) All possible VLS regressions involving all n variables, could be worked out relative to a unique central axis, determined by a common error-minimisation procedure along directions perpendicular to the central axis. As a result of this, the corresponding VLS correlation coefficients with subsequent selections for dependent variables, become comparable and thus the assessment for the best fit dependent variable by the highest VLS correlation coefficient becomes meaningful. In this process of finding the best fit dependent variable, the optimal combination of explanatory variables can also be assessed by changing the set of variables, either by the elimination of redundant variables, or, by incorporation of some other important variables for the VLS treatment. If, however, there exists possibly more than one dependent variable, ranked almost equally best in a common pool, explained by a common set of explanatory variables, it is then possible to order sequentially those dependent variables as primary, secondary, etc., through the VLS mode of discrimination, stated already. In contrast to above situation, all possible OLS regression estimations for linear dependence, involving the same n variables, determined by error-minimisation along n orthogonal directions of the axes, make the comparisons of the OLS correlation coefficients difficult for the absence of any common direction (or, hypothesis) for error minimisation.

Review of Related Work : The least squaring of distances for a scatter of points from a line (if the scatter has a linear orientation), used by both Kendall [1939] and Pal & De [1979], respectively for the optimal index formulation (comparable to the central axis) and estimation of the VLS regression, is the normal approach for error minimisation, since by distances we really mean perpendicular distances of points from the line. In fact, even before Kendall, this concept of vertical distance minimisation has been used by K. Pearson as early as in 1901 in his work, entitled " On lines and planes of closest fit to systems of points in space" (ref. to Pearson [1901]). That is, the idea of fitting the line of closest fit through a scatter of points in n-dimensional space by vertical least squaring has originated from K. Pearson. However, in the context of linear regression, where the variation of the dependent variable is tried to be explained by a set of explanatory variables, the concept of converting Pearson's line of closest fit to a VLS regression fit through necessary mathematical projections of points with the final feet of projections on the closest fit central axis and the associated statistical tests, etc. have been first introduced by Pal and De [1979].

Incidentally, the minimisation of aggregate error in the direction vertical to the line of closest fit is equivalent to the maximisation of total explained variation of all variables by the linear combination of all variables represented by the central axis. As the VLS regression fit is based on this central axis, the intention of explaining the total variation of all variables at the maximum is implicit in it, with the hypothesis, however, of the presence of error in all inter-correlated variables. In fact, it can be shown that the central axis is comparable also to the first principal component axis (ref. to Hotelling [1933]) which has been designed to explain to the maximum extent the total variation of all variables involved.

In fact, the interpretation of the first principal component of Hotelling as given by Girshick [1936] that it is the linear combination of variables having the maximum sum of squared correlation coefficients with the constituent variables, which is, in fact, equal to the total variation explained by the first principal component, is more meaningful in the context of the use of central axis for the formulation of VLS regression. Hotelling, however, has not used any starting hypothesis of the existence of multicollinearity among variables, and, as such, to explain all of the total variation of n variables, his formulation has been designed to have n number of mutually orthogonal principal components, each explaining a part of the total variation in a sequentially decreasing order of magnitudes, with the first principal component explaining the maximum of the total variation and the last or n-th principal component explaining the minimum of the total variation of all variables. While K. Pearson's line of closest fit (through the mean observation point), likewise the central axis of Kendall and also Pal & De, coincides with the first principal component axis, the normal line to K. Pearson's [1901] plane (or, hyperplane) of closest fit (through the mean observation point) is the n-th or last principal component axis of Hotelling.

The analytical connections among all these associated works may be comprehended in the following way :

We have already noted in (4.8) that the sum of squared divergences of all observation points P_j's from the line with direction cosine vector $(l_1, l_2, \ldots\ldots, l_n)$ and passing through the scatter of points, is given by

$$S = \sum_{j=1}^{N} P_j F_j^2 = \sum_j (OP_j^2 - OF_j^2)$$

$$\text{i.e.}\quad S = \sum_{i=1}^{N} \left[\sum_{i=1}^{n} z_{ij}^2 - \left(\sum_{i=1}^{n} l_i z_{ij}\right)^2 \right] \qquad \ldots (4.15)$$

$$\text{where}\quad \sum_{i=1}^{n} l_i^2 - 1 = 0, \qquad \ldots (4.16)$$

$P_j = (z_{1j}, z_{2j}, \ldots\ldots, z_{nj})$

= j-th observation-point on standardised variables,

$O = (0, 0, \ldots\ldots, 0)$

= mean observation point,

$F_j = (x_{1j}, x_{2j}, \ldots\ldots, x_{nj})$

= the foot of perpendicular of the point P_j on the line with l_i's, $i = 1, 2, \ldots, n$, as direction-cosines,

For extreme values of S subject to the condition (4.16), we have to find the stationary values of φ as given below :

$$\varphi = S + N\lambda \left(\sum_{i=1}^{n} l_i^2 - 1 \right), \qquad \ldots\ldots (4.17)$$

where λ is a Lagrange multiplier.

Applying the necessary conditions for the stationary values and simplifying, we get:

$$S = \sum_j \sum_i z_{ij}^2 - N\lambda \qquad \ldots\ldots (4.18)$$

and $$\sum_i l_i r_{ki} = \lambda l_k, \quad k = 1, 2, \ldots, n, \qquad \ldots\ldots (4.19)$$

where r_{ki}, denoting the correlation coefficient between k-th and i-th variables, takes the value 1 for $k = i$.

Comparing equations (4.15) with (4.18), we may write

$$N\lambda = \sum_{j=1}^{N} \left(\sum_{i=1}^{n} l_i z_{ij} \right)^2 \qquad \ldots (4.20)$$

If we denote the linear combination of variables representing the line OF_j by χ_j

$$\text{i.e. if} \quad \chi_j = \sum_{i=1}^{n} l_i z_{ij} \qquad \ldots (4.21)$$

then we can show by use of relation (4.19) or, directly from relation (4.20) that the variance of χ is given by

$$\sigma_\chi^2 = \lambda \qquad \ldots (4.22)$$

Again, we can also show, by use of relation (4.19), that the correlation coefficient between χ and its i-th constituent variable Z_i is given by :

$$\left.\begin{aligned} r_i &= \sqrt{\lambda}\, l_i \\ \text{so that,} \quad n\rho^2 &= \sum_i r_i^2 = \lambda \end{aligned}\right\} \qquad \ldots (4.23)$$

Thus, χ is that linear combination of all variables in which its i-th constituent variable z_i is represented with correlation coefficient $r_i = \sqrt{\lambda}\, l_i$, and explaining thereby the total variation, $\sum_i r_i^2 = n\rho^2 = \lambda$ of all its constituent variables.

Now referring back to equation (4.18), we can infer that the minimisation of S corresponds to the maximisation of variance λ, and on the other extreme, the minimisation of λ implies the maximisation of S.

For the solution of the equation system (4.19), we denote the correlation matrix $\{(r_{ki})\}$ by R, which is of order (n x n), and the column vector of direction-cosines l_j's by L, and express the system of equations (4.19) in matrix notation as follows :

$$RL = \lambda L, \text{ or, } (R - \lambda I)\, L = 0, \qquad \dots (4.24)$$

where I is the identity matrix of order (n x n).

For the non-trivial solution of L, we must have

$$\det\,(R - \lambda I) = 0 \qquad \dots (4.25)$$

i.e.

$$\begin{vmatrix} (1-\lambda) & r_{12} & \dots\dots\dots & r_{1n} \\ r_{12} & (1-\lambda) & \dots\dots\dots & r_{2n} \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ r_{1n} & r_{2n} & \dots\dots\dots & (1-\lambda) \end{vmatrix} = 0$$

This is an n-th degree equation in λ. Although we have n roots of this equation (4.25), only its maximum and minimum values, say, λ_1 and λ_n, respectively, give the two extreme values of S (by virtue of relation (4.18)). These two extremes of S correspond to K. Pearson's [1901] line of closest fit to the scatter and the line of remotest fit to the scatter. The line of remotest fit is really normal to the (n-1) dimensional hyperplane of closest fit to the scatter — both solving for the same direction-cosine vector L, by minimising λ (or, equivalently maximising S). It should be noted that this hyperplane of closest fit to the scatter contains again K. Pearson's line of closest fit to the scatter. Other λ_j's are intermediary values between λ_1 (maximum) and λ_n (minimum), sequentially in decreasing order of magnitudes.

If the different linear combinations of the form χ are denoted by $\chi^{(j)}$ corresponding to the use of λ_j for λ, then $\chi^{(j)}$'s can be shown to be mutually orthogonal, and the part of total variation of all constituent variables which get explained by $\chi^{(j)}$ is λ_j, so that the total variation $\sum_j \lambda_j$ for all such n linear combinations $\chi^{(j)}$'s is equal to the total variation of their common constituent variables. All these $\chi^{(j)}$'s correspond to Hotelling's [1933] principal component axes which explain sequentially in decreasing order of magnitudes of λ_j's the total variation of common constituent variables.

Hotelling [1933] developed the orthogonal principal component axis system by choosing at any j-th step that $\chi^{(j)}$ which explained maximally the residual variation, obtained on removing sequentially all the variations explained by the preceding components $\chi^{(1)}$, $\chi^{(2)}$, ..., $\chi^{(j-1)}$ from the total variation of all constituent variables. Now, denoting the correlation coefficient of i-th variable z_i with the j-th principal component axis $X^{(j)}$, by $r_i^{(j)}$, we can write the relations (4.23) for the j-th principal component as follows :

$$\left.\begin{aligned} r_i^{(j)} &= \sqrt{\lambda_j}\; l_i \\ \text{and} \quad n(\rho_j)^2 &= \sum_j \left[r_i^{(j)} \right]^2 = \lambda_j \end{aligned}\right\} \quad \ldots (4.26)$$

ρ_j denoting the aggregate representation of all constituent variables in the particular j-th principal component. These relations (4.26) are connected with Girshick's [1936] interpretation of principal components in terms of their interrelationships with the constituent variables. It should be further noted in this connection that

$$\left.\begin{aligned} \sum_j (r_i^{(j)})^2 &= \sigma_i^2, \text{ (variance of i-th variable)}, \\ &= 1, \text{ (for all standardised variables)} \\ & \quad i = 1, 2, \ldots\ldots, n \end{aligned}\right\} \quad \ldots (4.27)$$

so that

$$\left.\begin{aligned} \sum_j \lambda_j = \sum_i \sigma_i^2 &= \sum_i \sum_j (r_i^{(j)})^2 \\ &= \text{total variation of all variables} \\ &= n \text{ (when variables are all standardised)} \end{aligned}\right\} \quad \ldots (4.28)$$

Now, since the VLS regression line, say, $\hat{Z}_1$-axis, for a particular dependent variable Z_1 (without any loss of generality) is coincident with the central axis of closest fit to the scatter of points in n-variable space, it could be easily noticed that (i) Pal and De's VLS regression line, (ii) the axis related to Kendall's index, and (iii) Hotelling's first principal component axis $X^{(1)}$, are all coincident with K. Pearson's line of closest fit through the scatter, whereas Hotelling's last or n-th principal component axis $X^{(n)}$ is normal to K. Pearson's hyperplane of closest fit to the scatter. It could be further noticed that K. Pearson's (n-1) dimensional hyperplane of closest fit contains all the mutually orthogonal principal component axes except the last, and the feet of perpendiculars dropped from the scatter points on this hyperplane are now oriented around the first (n-1) principal component axes on this hyperplane (of (n-1) sub-space) with degrees of concentration (of the feet) varying according to importance in terms of λ_j's, j = 1, 2, ..., (n-1).

While Pal and De's VLS regression [1979] is based on K. Pearson's line of closest fit, Malinvaud [1980] defines what he calls " orthogonal regression (of first order) ", following K. Pearson's hyperplane of closest fit. In fact, the direction-cosines of n-th principal component, $l_i^{(n)}$'s, are also the direction-cosines of the normal to the hyperplane of closest fit, and as such Malinvaud minimises λ to get λ_n

and $l_i^{(n)}$'s through the orthogonal principal component factorisation of Hotelling. Analytically speaking, if $P = (z_1, z_2, \ldots, z_n)$ denotes an observation point in n-dimensional variable-space, the variables being in standardised form so that the mean observation point coincides with the origin, O, and if $P^* = (y_1, y_2, \ldots, y_n)$ denote the foot of perpendicular corresponding to point P on a hyperplane through the mean point having the direction-cosines l_i's for its normal, then the projection of OP on the normal through O is given by $\sum_i l_i z_i$ which is equal to χ (ref. to (4.21)) and the variance of χ is given by λ (ref. to (4.22)).

Now, the distance PP^* is equal to this value χ i.e. Malinvaud actually minimises

$$\sum_{j=1}^{N} (P_j P_j^*)^2 = \sum_{j=1}^{N} \chi_j^2 = \sum_{j=1}^{N} \left(\sum_{i=1}^{n} l_i z_{ij} \right)^2 = N\lambda \text{ (ref. to (4.20))}$$

in the set up of orthogonal principal component factorisation. As such, he gets $\lambda = \lambda^{(n)}$. And, for this, he has the direction-cosines $l_i^{(n)}$'s and $\chi_j^{(n)} = \sum_{i=1}^{n} l_i^{(n)} z_{ij}$

or, in short,

$$\chi^{(n)} = \sum_{i=1}^{n} l_i^{(n)} z_i \qquad \ldots (4.29)$$

which gives the perpendicular distance of any observation point P from the hyperplane of closest fit. We have already noted that the total variation of all n standardised variables (ref. to (4.28)) :

$$n = \lambda_1 + \lambda_2 + \ldots\ldots + \lambda_n ,$$

in which λ_1 is maximum, λ_2, the next maximum and so on, and ultimately λ_n is the minimum explained variation of the total variation of all variables (for example, from Malinvaud's own empirical illustration (as reported in pp. 34 of Malinvaud [1980]) in the context of "orthogonal regression", based on time-series data on imports, gross domestic production, stock formation and consumption, $r_1^{(4)} = -0.00629$, $r_2^{(4)} = -0.02424$, $r_3^{(4)} = 0.00006$, $r_4^{(4)} = 0.02092$ in 4-variable space where $\Sigma [r_i^{(4)}]^2 = \lambda_4 = 0.001$ only, while $\lambda_1 = 3.057$, $\lambda_2 = 0.924$ and $\lambda_3 = 0.018$). We have also noted from (4.26) and (4.27) that

$$\left.\begin{aligned} &\sum_{i=1}^{n} [\, r_i^{(n)}]^2 = \lambda_n \\ \text{and} \quad &\sum_{j=1}^{n} [\, r_i^{(j)}]^2 = 1, \quad \text{for } i = 1, 2, \ldots, n \end{aligned}\right\} \quad \ldots (4.30)$$

where the correlation coefficient of i-th variable with j-th principal component $X^{(j)}$ is given by

$$\left.\begin{aligned} &r_i^{(j)} = \sqrt{\sum_{k=1}^{n} [\, r_k^{(j)}]^2} \cdot l_i^{(j)} , \\ &\text{and in particular,} \\ &r_i^{(n)} = \sqrt{\sum_{k=1}^{n} [\, r_k^{(n)}]^2} \cdot l_i^{(n)} \end{aligned}\right\} \quad \ldots (4.31)$$

In Malinvaud's approach, as λ_n is the minimised value of λ, he equates $\lambda_n = 0$, and this implies (ref. to (4.20)) $\chi^{(n)} = 0$, i.e. by equation (4.29), we have

$$\sum_{i=1}^{n} l_i^{(n)} z_i = 0, \qquad \ldots (4.32a)$$

for each observation point $P = (z_1, \ldots\ldots, z_n)$. By virtue of relation (4.31), the relation (4.32a) can be equivalently expressed as (4.32b), given below :

$$\sum_{i=1}^{n} r_i^{(n)} z_i = 0 \qquad \ldots (4.32b)$$

Malinvaud changes the observation point P having coordinates in terms of z_i's in n-space, by the corresponding foot of perpendicular P^* having coordinates in terms of y_i's in (n-1)-subspace, where y_i's are really the values of z_i's after shunting off the corresponding divergences in all variables. Thus, he takes equation (4.32a) or its equivalent (4.32b) as the equation of the plane

$$\sum_i l_i^{(n)} y_i = 0 \qquad \ldots (4.33a)$$

or its equivalent,

$$\sum_i r_i^{(n)} y_i = 0 \qquad \ldots (4.33b)$$

Coincidence between (4.32) and (4.33) is really incidental for equating λ_n to zero, while in reality it is not so for any data matrix universally. The equation (4.32) holds only when $\lambda_n = 0$, but equation (4.33) holds in general irrespective of the value of λ_n. Granting this to hold in restricted sense with very small positive value of λ_n, its implication from relation (4.30) is $\sum_i [r_i^{(n)}]^2$ is also very small. This means, any $[r_i^{(n)}]^2$ is also correspondingly small, near or equal to zero. Thus, some of the $r_i^{(n)}$ could be zero and others could be very small positive or negative fraction, near to zero. Since Malinvaud takes equation (4.32) as the implicit form of the so-called " orthogonal regression", for expressing subsequently any one of the n variables as a linear function of the rest, it might lead to following inconsistencies :

(i) As for minimised value of λ_n, some $r_i^{(n)}$ can be zero or near so, one cannot express the corresponding variable Z_i as dependent variable, denoted by $\hat{Z}_i$, from the stated " orthogonal regression" .

(ii) Even for the maximum $r_i^{(n)}$, for varying (i), say, for i = k, by virtue of relation (4.30), we have

$$\sum_{j=1}^{n} [r_k^{(j)}]^2 = 1$$

$$\text{i.e.} \quad \sum_{j=1}^{n-1} [r_k^{(j)}]^2 = 1 - [r_k^{(n)}]^2$$

and the corresponding residual part $(1 - [r_k^{(n)}]^2)$ of the total variation of k-th variable might be often quite large as compared with the explained part $[r_k^{(n)}]^2$, since $[r_k^{(j)}]^2$ is the contribution of k-th variable in the explained part λ_j of the total variation of all variables and λ_n is the minimum of all λ_j's. As such, the "orthogonal regression" by the closest fit hyperplane expressed for $\hat{Z}_k$ might not be able to account for most of the variation of actual Z_k, even for the k-th variable for which $[r_k^{(n)}]^2$ is maximum of all $[r_i^{(n)}]^2$. Thus, by this procedure of "orthogonal regression", the purpose of accounting maximally the variation of the dependent variable by the linear combination of the rest, as generally the purpose of other regression techniques, has really not been served.

(iii) Again any regressand $\hat{Z}_k$ for Z_k is such that the correlation coefficient between Z_k and $\hat{Z}_k$ must be non-negative. But the signs of $[r_i^{(n)}/(-r_k^{(n)})] = [l_i^{(n)}/(-l_k^{(n)})]$ for all i , $i \neq k$, might be such that the relation between $\hat{Z}_k$ and Z_k becomes negative. Such an example we have been able to locate in Malinvaud's own empirical illustration in the context of "orthogonal regression", based on time-series data on imports, gross domestic production, stock-formation and consumption. In the case involving the first three of the afore-mentioned variables, the regression equation of stock-formation on imports and gross-domestic products, worked out from the so-called " orthogonal regression" of first order, gives negative correlation coefficient ($r_{Z_3 \hat{Z}_3}$ = -0.185) between the observed and the estimated stock-formation, while the corresponding OLS estimate of the correlation coefficient $r_{Z_3 \hat{Z}_3}$ = 0.371 (comparable to corresponding value of the multiple correlation coefficient, R, reported in Malinvaud [1980]).

(iv) It should be noted that the observed variable axes Z_i's are taken mutually orthogonal in mathematical sense in n-variable space, although they are statistically not so. Hotelling's purpose of orthogonal principal component factorisation is to get the principal component axes $X^{(j)}$'s which are mutually orthogonal in both mathematical and statistical senses, so that the entire information embodied in the data matrix of Z_i's could be captured in the principal component axes system of $X^{(j)}$'s. In particular, if the initial correlation matrix of Z_i's is the identity matrix, then both axes systems of Z_i's and $X^{(j)}$'s do coincide with all λ_j's as unities. However, we may have also a situation when λ_j's are very slowly decreasing sequentially, with λ_n slightly less than unity. In such a situation it is possible to have one particular $r_s^{(n)}$ is near unity while all other $r_i^{(n)}$'s are near zero. In that case we are again in difficulties to take the hyperplane of closest fit as to represent different regressand $\hat{Z}_i$ explicitly as a function of remaining variables Z_j's , for both i = s and $j \neq s$.

(v) In fact, corresponding to any j-th principal component axis (through mean observation point O) :

$$\chi^{(j)} = \sum_{i=1}^{n} l_i^{(j)} z_i ,$$

the associated hyperplane normal to this axis, through the mean observation point O , is given by

$$\Sigma\, l_i^{(j)} u_i = 0 , \qquad \ldots (4.34)$$

with current point $(u_1, u_2, \ldots, u_n)$ on it.

If $P^* = (y_1, y_2, \ldots, y_n)$ is the foot of perpendicular on this hyperplane corresponding to point $P = (z_1, z_2, \ldots, z_n)$, then the coordinates of these points are connected by the following relations :

$$\left.\begin{aligned} y_s &= z_s - l_s^{(j)} \sum_i l_i^{(j)} z_i \\ \text{i.e.}\quad y_s &= z_s - l_s^{(j)} \cdot \chi^{(j)} \end{aligned}\right\} \qquad \ldots (4.35)$$

$s = 1, 2, \ldots, n$

With this relation, we get

$$\sum_i l_i^{(j)} Y_i = \sum_i l_i^{(j)} (z_s - l_i^{(j)} \chi^{(j)})$$

$$= \sum_i l_i^{(j)} z_s - \chi^{(j)} \sum_i (l_i^{(j)})^2$$

$$= \chi^{(j)} - \chi^{(j)}$$

i.e. $\Sigma l_i^{(j)} Y_i = 0,$ ... (4.36)

which implies that points P^* lie on the hyperplane, given by (4.34).

Clearly, as Z_i's are standardised variables, Y_s (the variable corresponding to s-th coordinate of P^*) has the mean zero and the variance of Y_s is given by

$$\sigma_{Y_s}^2 = E \left[Z_s^2 + (l_s^{(j)})^2 (\chi^{(j)})^2 - 2 l_s^{(j)} Z_s \chi^{(j)} \right]$$

$$= 1 + (l_s^{(j)})^2 \lambda_j - 2 l_s^{(j)} \lambda_j l_s^{(j)}$$

$$= 1 - (r_s^{(j)})^2, \qquad \text{... (4.37a)}$$

and, in particular for $j = n$, we have

$$\sigma_{Y_s}^2 = 1 - (r_s^{(n)})^2 \qquad \text{... (4.37b)}$$

Also, the correlation coefficient between Y_s and Z_s is given by

$$r_{Y_s Z_s} = \frac{1}{\sqrt{1 - (r_s^{(j)})^2}} \cdot E \left[Z_s \left(Z_s - l_s^{(j)} \ \chi^{(j)} \right) \right]$$

$$= \frac{1}{\sqrt{1 - (r_s^{(j)})^2}} \left[1 - (l_s^{(j)})^2 \lambda_s \right]$$

i.e. $$r_{Y_s Z_s} = \sqrt{1 - (r_s^{(j)})^2} \qquad \ldots (4.38)$$

and in particular for $j = n$, we have

$$r_{Y_s Z_s} = \sqrt{1 - (r_s^{(n)})^2}$$

Thus, the points $P^* = (y_1, y_2, \ldots\ldots, y_n)$ are points on the hyperplane of closest fit :

$$\sum_i l_i^{(n)} u_i = 0,$$

satisfying $\sum_i l_i^{(n)} y_i = 0$,

which are feet of perpendiculars of observation points $P = (z_1, z_2, \ldots\ldots, z_n)$. Thus, the system of observation variables Z_s's, having zero mean and unit variance, is now reduced to the system of variables Y_s's, having zero mean and variance equal to $\left[1 - (r_s^{(n)})^2 \right]$. As $(r_s^{(n)})^2$ is likely to be very near zero for the n-th or last principal component, we have hardly explained our data matrix from changing Z_i's to Y_i's, and we have still the problem of finding a regressand $\hat{Z}_s$ which is to be explained as much as possible by the linear combination of all original variables Z_i's (and not Y_i's) except Z_s. Mere finding of the hyperplane of closest fit to scatter of observational points, in which their feet with coordinates y_i's lie, is actually not enough for regression, even though the projections of original scatter points are taken orthogonally to this hyperplane.

(vi) Malinvaud has really put

$$\hat{Z}_s = \sum_{i \neq s} \left(- \frac{l_i^{(n)}}{l_s^{(n)}} \right) z_i \qquad \ldots (4.39)^*$$

as regressor of Z_s.

Now, from relation (4.35) we have

$$y_s = z_s - l_s^{(n)} \sum_{i=1}^{n} l_i^{(n)} z_i$$

$$\text{or,} \quad \frac{y_s}{(l_s^{(n)})^2} = \left[\frac{1}{(l_s^{(n)})^2} - 1 \right] z_s + \sum_{i \neq s} \left(- \frac{l_i^{(n)}}{l_s^{(n)}} \right) z_i$$

and using the relation (4.36), we get

$$\hat{z}_s = \frac{y_s}{(l_s^{(n)})^2} - \left(\frac{1}{(l_s^{(n)})^2} - 1 \right) z_s \qquad \ldots (4.40)^*$$

Thus, $\hat{z}_s$ is neither the s-th coordinate of P^* not that of the observation point P. It, however, lies on the line PP^*, but not between P and P^* (since $(l_s^{(n)})^2 < 1$). So, Malinvaud's use of equation (4.39)*, in view of the relation (4.36), has resulted into a situation where $\hat{z}_s$ is not the s-th coordinate of the point P^* lying in the hyperplane of closest fit (4.34).

(vii) So long we have been discussing Malinvaud's so called " orthogonal regression" of first order in which only the hyperplane (through mean point) related to the last principal component is involved. He has also gone for suggesting " orthogonal regression" of m-th order, $m < n$, in which the last m hyperplanes, all through the mean observation point O and orthogonal to the last m principal components, are involved. He thus gets m equations of the form (4.34) for $j = (n-m+1), \ldots\ldots, (n-1), n$, with different feet of perpendiculars $P^{*(j)}$ on these hyperplanes dropped from the observation point P. Then he equates all coordinates of $P^{*(j)}$'s to those of P to get

$$\sum_i l_i^{(j)} z_i = 0 \qquad \ldots (4.41)^*$$

$$\text{for } j = (n-m+1), \ldots, (n-1), n,$$

eliminates (m-1) variables of his choice, and selects any particular variable among the remaining ones as the regressand, say, $\hat{Z}_s$ corresponding to Z_s, which is finally expressed as a function of other (n-m) variables, and call it an " orthogonal regression" of order m.

The observations we already made for m=1, stand for this sort of m-th order " orthogonal regression" too in

$(n-m)$-subspace. Additionally, two more points are to be noted : (1) when we are aiming ultimately at the regressand $\hat{Z}_s$ as a linear combination of $(n-m)$ variables, there is no justification of the initial inclusion of $(m-1)$ variables and subsequent elimination in the ultimate form, (2) each of the hyperplanes of the form (4.34) contains mathematically the conglomeration of infinite points $(u_1, u_2, \ldots, u_n)$, out of which only a finite number of discrete points $P^{*(j)} = (y_1, y_2, \ldots, y_n)$, relating to the feet of perpendiculars of $P = (z_1, z_2, \ldots, z_n)$ lie on the particular hyperplane. It should be noted that in the process of elimination of $(m-1)$ variables out of m equations of the form (4.34), we may get mathematical intersection in $(n-m)$-space on which some of the common points $(u_1, u_2, \ldots\ldots, u_n)$ lie, but may not contain any common point of all points $P^{*(j)}$, belonging to different hyperplanes, $(n-m)$ in number. So the mathematical intersection need not necessarily have any relevance with the selected discrete points in the concerned hyperplanes.

(viii) In Malinvaud's representation of " orthogonal regression" of any order he has not shown any concern towards indicating how to measure the degree of fit of his so-called " orthogonal regression", and as such he has been in a blind spot while comparing the goodness of fit of different regressions, he himself illustrated, for example with $n = 4$ and $m = 1$ and 2.

(ix) He has had a confusion in geometrical presentation and hence on related inferences made in his illustration with n=2 and m=1. In this, (n-1) hyperplane is a line in two dimensional space which coincides with the first principal component axis, while its normal is the second principal component axis. He determines λ_2, the smaller eigen value, and infers that this corresponds to the hyperplane containing the first principal component axis, explaining the maximum of total variation of the two variables. But, in reality, it is λ_1, the higher eigen value that relates to the maximum of explained variation. In consequence, his attempt for this particular case by $\varphi^2 = \frac{\lambda_1}{\lambda_1 + \lambda_2} = 1 - \frac{\lambda_2}{\lambda_1 + \lambda_2}$, for the explained variation by the " orthogonal regression" of first order appears to have received a reverse interpretation. After all, he has the knowledge on λ_2 through the second principal component (where, in fact,

$$\lambda_2 = 1 - r_{12}, \text{ if } r_{12} \text{ is positive,}$$
$$= 1 + r_{12}, \text{ if } r_{12} \text{ is negative;}$$

while

$$\lambda_1 = 1 + r_{12}, \text{ if } r_{12} \text{ is positive,}$$
$$= 1 - r_{12}, \text{ if } r_{12} \text{ is negative}$$

where r_{12} is the correlation coefficient between Z_1 and Z_2). Moreover, $(l_1^{(2)}, l_2^{(2)})$, related to λ_2, have only been determined to define the hyperplane, which in reality, being the first principal component, ought to have been determined by $(l_1^{(1)}, l_2^{(1)})$ in conjunction with λ_1 = the residual of total variation (i.e., $\lambda_1 + \lambda_2 = 2$), after eliminating λ_2.

Thus, we notice that this "orthogonal regression" of Malinvaud is not comparable to either the OLS regression or the VLS regression of Pal and De [1979]. The connection between the OLS and the VLS regressions is that the regression axis, in either case, is a line in the n-dimensional space through the scatter points, which is of closest fit to the scatter by vertical least squaring in the case of VLS regression, while it is of closest fit in another respect, achieved through ordinary least squaring, in the case of OLS regression. In the next sections, with multicollinear factors of manufacturing industries' production, we would bank more upon the estimation procedure by VLS least squaring, and at times we may even compare the fits with the OLS fits to illustrate the difficulties arising from multicollinearity and axis-biased least squaring.

4.5 Comparison of Estimation Procedures for the Statistical Fits of Industrial Labour Absorption Function

The industrial manufacturing activities which have been considered in our study for obtaining industry-specific fits of the labour absorption functions in the log-linear form (4.4), have been the following. The listing gives alongside the two digited industry codes under the NIC (National Industrial Classification) of India and also the abbreviated industry names, for ready reference subsequently.

Industry Code	Industry Name	Abbreviation
20 + 21	Food & Food Products	Fd.
22	Beverages	Bv.
23	Cotton Textiles	Ctex.
24	Wool, Silk, Synthetics	Wss
25	Jute Textiles	Jtex.
26	Textile Products	Tex.
27	Wood, Timber	WT
28	Paper	Pr.
29	Leather	Lr.
30	Rubber, Plastics, Petroleum, Coal	RPPC
31	Chemicals	Ch.
32	Non-metallic Minerals	Nmtl.
33	Basic Metal, Alloy	Bmtl-Al.
34	Metal Products	Mtl.
35	Non-electrical Machinery	Nel.
36	Electrical Machinery	El.
37	Transport Equipment	Tr.
38	Miscellaneous Manufacturing	Mscl.
40 + 41	Electricity Generation, Distribution of Water and Gas	EWG
97	Miscellaneous Repairs	Mscl-R.

The industry-specific manufacturing acticity-bases for different districts in India have been measured, as stated already, by the concentrations of the productive capital K (in Rs. 100) and the current output level Y (in Rs. 100) in the year 1975-76, and the corresponding industrial labour concentration L (in man-hours) by districts have been tried to be explained by the functional fits of the form (4.4) by specific industries. The districtwise values of K, Y and L have all been obtained by the aggregation over all the manufacturing factories or establishments, each employing 50 or more workers, in any of the total 317 such industrialised districts of India for any of the above listed specific industries. In our preliminary exploratory work, we tried for the OLS fits of the functional form (4.4) for each industry (ref. to Table (4.2)). In that we have obtained sometimes inconsistent estimates of the parameters, particularly for the distribution parameter δ. It should be noted that this parameter is used to obtain the mean value for the over-all manufacturing activity-base (here, industry-specific), $X_0 = K^{\delta}Y^{1-\delta}$, in which δ is a proper positive fraction. Thus, a negative estimate of δ cannot be considered as consistent in our model for measuring the over-all activity-base, X_0. Such inconsistency of negative δ has particularly occurred for industries coded by 22, 35 and 36 (ref. to Table (4.2)).

It should be noted that while L and Y are current flow-variables, K is a stock-variable (and not a current stock-variable). If some locations of an industry retain

Table 4.2 : Estimates of Parameters of the Original Labour Absorption Function

Industry Code & Abbreviated Name	No. of Observed Spatial Units (districts)	OLS Correlation Coefficient	OLS Estimates of Parameters		|t| Value to Test: $H_0 : \mu'_0 = \mu_0$	VLS Estimates of Parameters		VLS Correlation Coefficient
			δ'_0	μ'_0		μ_0	δ_0	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
20+21 Fd.	219	0.8546	0.360	0.704	2.885	0.789	0.506	0.8582
22 Bv.	104	0.7360	-0.152	0.544	0.923	0.590	0.391	0.6915
23 Ctex.	163	0.9389	0.464	0.859	1.585	0.899	0.514	0.9397
24 Wss	58	0.9052	0.212	0.708	1.025	0.754	0.488	0.9019
25 Jtex.	17	0.9797	0.417	1.082	1.081	1.167	0.584	0.9771
26 Tex.	42	0.8628	0.339	0.658	1.246	0.737	0.514	0.8654
27 WT	66	0.8128	0.350	0.619	1.785	0.720	0.503	0.8192
28 Pr.	125	0.9322	0.009	0.671	0.678	0.687	0.477	0.9201
29 Lr.	19	0.9115	0.741	0.803	0.237	0.826	0.548	0.9111
30 RPPC	63	0.8734	0.393	0.540	1.371	0.594	0.510	0.8773
31 Ch.	143	0.8783	0.243	0.651	1.352	0.692	0.460	0.8773
32 Nmtl.	147	0.9094	0.231	0.656	1.754	0.700	0.491	0.9060
33 Bmtl-Al.	121	0.9206	0.216	0.701	0.908	0.726	0.472	0.9168
34 Mtl.	78	0.9118	0.158	0.745	0.614	0.769	0.467	0.9065
35 Nel.	98	0.9289	-0.014	0.692	0.176	0.697	0.462	0.9104
36 El.	62	0.9245	-0.157	0.763	0.628	0.737	0.446	0.8944
37 Tr.	83	0.9171	0.088	0.743	0.912	0.776	0.472	0.9024
38 Mscl.	48	0.9253	0.108	0.697	0.469	0.717	0.461	0.9084
40+41 EWG	75	0.9192	0.641	0.717	1.771	0.792	0.450	0.9183
97 Mscl-R.	204	0.9089	0.230	0.730	0.922	0.752	0.439	0.9018

enough idle capital-stock, not in use in the current industrial activities, then such inconsistencies in δ could emerge in the OLS mode of minimising regression error along the axis of the dependent variable alone; in the OLS mode of estimation, the presence of error in the explanatory variables K and Y, which is possible in the situation of general multi-collinearity among all variables, has to be ignored. As such the relative values of regression coefficients, as implicit in the distribution parameter δ, do get estimated in a distorted way in the OLS regression fit. But, this parameter is vital in the proper assessment of the activity-base $X_0 = K^{\delta} Y^{1-\delta}$, and therefore its evaluation has to be sought by some other suitable method of estimation. The VLS technique of regression fit is an appropriate alternative in this connection, since the VLS mode of minimisation takes for granted the presence of errors in all inter-dependent variables. It should be noted, however, that for any homogeneous function,

$$L = f(K, Y)$$

of degree μ_0, it can be shown by Euler's theorem for homogeneous functions (ref. to pp. 287 in Apostol [1969]), that

$$K \cdot \frac{\partial L}{\partial K} + Y \cdot \frac{\partial L}{\partial Y} = \mu_0 \cdot L$$

$$\text{i.e.} \quad \frac{\partial (\ln L)}{\partial (\ln K)} + \frac{\partial (\ln L)}{\partial (\ln Y)} = \mu_0$$

In any fit of ln L on ln K and ln Y, the left hand side gives the sum of regression coefficients. Thus we have always :

the sum of regression coefficients = μ_0,

(which is the scale factor in the labour absorption L), whatever be the functional form. If K and Y are not linearly independent variables, then also the degree of homogeneity does not change for the functional form. In fact, the values of both $\frac{\partial(\ln L)}{\partial(\ln K)}$ and $\frac{\partial(\ln L)}{\partial(\ln Y)}$ get distorted, although their over-all sum μ_0 does not get affected significantly (since the function is of degree μ_0 still, despite the inter-dependence between K and Y). With all these, we argue in favour of our observation that the OLS mode of estimation of μ_0 could be acceptable, eventhough such mode of estimation for the relative values of regression coefficients, as implicit in δ, is not acceptable.

In any regression for a dependent variable, whatever be the mode of least squaring (OLS or VLS), we have ultimately to take the projection of any observation point, P, in such a way that the final point $\hat{P}$, lying on the regressand-axis (corresponding to the best-fit line) of final estimates on the dependent variable, must be the foot of projection along the line parallel to the axis of the dependent variable. In the OLS mode of regression, the minimisation of error is done along the axis of the dependent variable, for reasons of one's interest in explaining the dependent variable at its maximum (this, in fact, could not be totally over-looked), while in the VLS mode of regression, we emphasise on the presence of error in all inter-dependent variables (this also is important in a multicollinear situation), and as such the degree of explanation of the dependent variable is of secondary consideration in it. Thus, we have to make some sort of compromise between the two interests :

(i) the recognition of the presence of error in all variables, at least for the estimation of relative magnitudes of regression coefficients as implicit in the distribution parameter δ,

and (ii) the maximum possible explanation of the dependent variable, even if we have to go for certain restriction to accomplish our interest (i).

These interests could be served through some appropriately combined use of both the VLS and the OLS regression techniques in succession. As δ can only be determined properly by the use of VLS technique alone, we have to use the VLS technique first for its estimation, satisfying our interest quoted in (i) above. Once δ is determined, we can generate the single variable X_0 as the activity-base variable (in lieu of the original two variables K and Y). Then we have to go for the regression of (ln L) on (ln X_0) only. When it is the question of simple linear regression involving only two variables, we have noted that the corresponding OLS correlation coefficient is exactly identical with the VLS correlation coefficient. Thus, if there is no explanatory variable other than X_0, our interest, quoted in (ii) above, is served fully by the acceptance of the VLS regression estimate for the regression coefficient μ_0. But, in case we are to incorporate any other explanatory variables, in addition to the previously determined X_0, our interest (ii) will not be served unless we make a subsequent use of the OLS regression technique (since the correlation coefficient, involving more than two variables, becomes maximum only by using the OLS regression technique). Thus, before incorporation of any other explanatory variable, we shall determine the estimate of δ and μ_0 by the VLS regression technique, satisfying both the interests, quoted in (i) and (ii). However, if we need to incorporate any other explanatory variable, in addition to X_0, we shall first determine the VLS estimate of δ and then go for the OLS estimates of all other regression parameters, so that both the interests are satisfied. This last mentioned mix-use of techniques will here afterwards be referred to as " VLS-δ Constrained OLS" procedure.

In the next section, we shall discuss on certain need for incorporation of an additional variable to qualify the activity-base X_0 and there we shall have the justification for the applicability of " VLS-δ Constrained OLS" regression procedure. We conclude this section with a discussion on the empirical justifications, as observed below, in favour of the use of VLS regression technique, before the said incorporation :

(a) The distribution parameter δ, involved in the industrial activity-base $X_0 = K^{\delta}Y^{1-\delta}$, is expected to have a value near 0.5 in the background that the defining variables K and Y (for X_0) have almost equally strong relationships with L, besides their own mutual inter-dependence of very high degree. We have noted that the VLS estimates of δ is relatively more stable over different industrial activity-bases, and these estimates are more or less in the range from 0.4 to 0.5, corroborating our expectations of a value of δ near 0.5 (ref. to the VLS estimates of δ in Table (4.2)). Contrary to this situation, the OLS estimates of δ are widely different, often much below 0.5, and at times these are inconsistently of negative or very low positive magnitudes (ref. to the OLS estimates of δ in Table (4.2)).

(b) From our detailed statistical test results given in Table (4.2), we can infer that the OLS estimate of the labour absorption-scale parameter μ_0 (say, μ_0') is not significantly different (at 5% level of significance) from the corresponding VLS estimate of μ_0 (denoted by μ_0 itself) for any manufacturing activity-base — for all 20 but one manufacturing activities examined, (the single exception is for the heterogeneously combined food industry, coded 20 + 21).

Thus, from the observation (a) above, we derive our justification in using the VLS estimate of δ , abandoning the unrestricted OLS estimate of δ that could not have proper empirical evaluation for possible relative magnitude against $(1 - \delta)$. From the observation (b) above, as the VLS estimate of μ_0 is not significantly different from the corresponding OLS estimate μ'_0 , we can derive the justification of using the VLS estimate μ_0 itself a good enough parametric estimate for the over-all scale of labour absorption. The use of μ_0 , instead of μ'_0 , is all the more appropriate, since it is already derived in association with δ by the same regression technique that has to be used under the compulsion of estimating δ properly.

4.6 Quality Correction of Manufacturing Activity-Base by Localisation Performance Factor and the Modified Labour Absorption Function

The quality of performance related to an activity-base X_0 for the corresponding labour absorption L has so long been assumed to be same, irrespective of any consideration for the degree of specialisation of the activity achieved in different regions of India. Two areas, located in differently specialised regions in respect of the activity, having the same intensity of activity-base $X_0 = K^{\delta}Y^{1-\delta}$, need not necessarily have the same performance in respect of labour absorption. The performance of an area in a highly specialised region of the activity is likely to be superior with relatively more of labour absorption capacity for its activity X_0 as contrasted to another area in less specialised region. Thus, the localisation of areas in different regions with varying degrees of specialisation for the activity, affects differently their performance in terms of labour absorption, L. So, the quality of the activity-base level X_0 is different with different localisation performance of the activity-base, occurring in various specialised regions of the activity. Granting this, we may think of a localisation performance factor, Q, for any manufacturing activity which could be used in certain appropriate functional form for quality correction of the level of activity-base. Before deciding for an appropriate measure of the localisation performance factor (or, localisation factor, in short), Q, we shall go for an appropriate analytical modification of the labour absorption function for L. Recalling our original form as given in (4.2), we can write our modified form as :

$$L = \gamma X^{\mu} \qquad \dots (4.39)$$

where X = quality corrected value of the activity-base level X_0, to be ascertained by use of the localisation performance factor, Q,

μ = labour absorption-scale parameter corresponding to quality corrected activity-base level X; according to our assertions made earlier (both theoretically and empirically), μ is comparable to μ_0, which will be tested statistically afterwards,

and the interpretation of Υ remains same as before.

We have now to ascertain the actual functional form of X in terms of X_0 and Q. Since the labour absorption-scale parameter is not supposed to change for our modification from (4.2) to (4.39), the functional form of X in terms of X_0 and Q should be homogeneous of degree unity. With this consideration the most appropriate form for X could be taken as follows :

$$X = X_0 \left(\frac{Q}{X_0}\right)^c \qquad \ldots (4.40)$$

As the degree of homogeneity of X is unity, we should have the restriction : $c < 1$, for the consistence in this modification (4.40). It should also be noted that this form (4.40) has also the following logical justification :

The variable (Q/X_0) measures the localisation performance per unit level of activity-base. The higher the magnitude of (Q/X_0), the more specialised is the manufacturing activity in the associated location or area. The parameter c is introduced to take care of the following three possibilities of localisation economy, related to the manufacturing activity :

(i) $c = 0$, implying absence of localisation performance (with $X = X_0$),

(ii) $1 > c > 0$, implying different levels of localisation performance economy, favouring labour absorptions, for different manufacturing activities, as could be expected in a labour-surplus national economy,

(iii) $c < 0$, implying different levels of localisation performance diseconomy, disfavouring labour absorption, for different manufacturing activities, as could be expected theoretically in a labour-shortage national economy (in which quality of activity-base is allowed to improve by substitutions in lieu of labour).

With the use of the functional form (4.40) the modified labour absorption function (4.39) can now be written as follows :

$$L = \gamma X_0^{\mu_*} Q^s , \qquad \ldots (4.41)$$

where $\mu_* = (1 - c)\,\mu$

= scale of manufacturing activity-base,

$s = c\mu$

= scale of localisation performance,

so that $\mu = \mu_* + s$

= over-all scale of labour absorption.

Thus, the model (4.2) is now changed to its more generalised form (4.41) through the quality correction of the manufacturing activity-base, as shown by the relation (4.40). The statistical fit for the generalised form (4.41) helps us not only in ascertaining whether or not there is a need for the modification to model (4.41) over the model (4.2) (through the statistical testing of the null hypothesis : $c = 0$), but also in identifying the actual extent of localisation performance economy or diseconomy, if any, that is operating in relation to different manufacturing activities (for different possibilities of non-zero estimates of c).

The role of the localisation performance factor Q, gains importance only when our estimates of c are tested to be non-zero. Out of the three possible values, (i) $c = 0$, (ii) $1 > c > 0$ and (iii) $c < 0$, we are, however, expecting to get positive values of c for different manufacturing activities, operating in our labour-surplus national economy. Pending the actual empirical evaluations, we shall presume that an appropriate incorporation of the localisation performance factor Q is necessary, at least for our explicit understanding on the role of localisation economy or diseconomy or its absence. It is to be emphasized here that the incorporation of the localisation performance factor Q is for qualifying the manufacturing activity-base $X_0 = K^{\delta} Y^{1-\delta}$ for correct or more appropriate evaluation of its capacity to absorb labour, L. The important role that an appropriate localisation performance factor Q plays in spatial analysis, was first highlighted with both theoretical reasonings and strong empirical support, by Pal and Saha [1981] in connection with their study on spatial production functions. In that, an appropriate localisation performance factor is used, in more or less analogical fashion, for qualifying the relevant technology-base (defined as a mean value of input factors of labour and capital) for a correct evaluation of its capacity to generate output. It could be deduced from relations shown under (4.41) that $\mu > \mu_*$ when $0 < c < 1$. Without the incorporation of the localisation performance factor Q, the overall scale of labour absorption μ is expected to be of same magnitude as μ_0, in which we do not get its break-ups into μ_* and s ($\mu = \mu_* + s$). We have already noted, for spatial labour absorption functions, that μ_0 (comparable to μ) have values less than unity for all manufacturing activities. Naturally, if s turns out to be positive (corresponding to $0 < c < 1$), then the contribution of the manufacturing activity-base towards labour absorption-scale is really of lower magnitude, μ_*, and not μ_0 (which is comparable to μ). As the localisation performance factor, Q, is related to the manufacturing activity-base X_0, which is being qualified by Q, the absence of explicit incorporation of Q is taken care alone by X_0. Thus, the non-incorporation of Q does not let us get the true contribution, μ_*, of the activity-base towards the labour absorption-scale. However, in our case for labour absorption function, both μ_0 (comparable to μ) and μ_* (with the expectation that $0 < c < 1$) are less than unity for different manufacturing activities. But, in the case of production function (ref. to Pal and Saha [1981]), while the estimates of μ_* (the contribution of technology-base towards the scale of output-return) have been generally below unity for different industries, the estimates of μ_0 (comparable to μ, the over-all scale of output-return) have been above unity. That is, for spatial production functions the increasing scale of output-return operates generally for different industries. Likewise Pal and Saha [1981], many others, Minasian [1961], Fuchs [1963], Minhas [1962 and 1963], Solow [1964], Hildebrand [1965], Nerlove [1967], etc., to quote a few, have observed that the increasing scale of output-return is a common feature when production functions are fitted statistically to cross-section or spatially varying data. This feature of increasing scale of output-return has been contrary to the normal expectation of diminishing scale of output-return as often experienced in time-series analysis of production functions.

In fact, under certain restricted market conditions, the pure marginal productivity theories lend support to the possibility of a value of the homogeneity or scale parameter less than or equal to unity. Yet, under unrestricted market conditions, the possibility of above unity magnitude of the homogeneity parameter is not entirely ruled out even with time-series data. In fact, if the agglomeration economy operates favourably with the increased intensity or bulk of technology-base, the above unity value of the homogeneity parameter is more likely for production function analyses with both cross-section and time-series data. For the spatial production function analysis with cross-section data, the localisation economy becomes an explicit component of the agglomeration economy, which operates largely due to regional technology specialisations, leading to increasing scale of output-return, and, as such for the forces of localisation of manufacturing activities, there is a component of the homogeneity parameter of the spatial production function. This sort of explanation, with the existence of the forces of localisation economy, was put forward, particularly by Shefer [1973], Carlino [1979], Pal and Saha [1981] in connection with the spatial production function analysis. However, as consistent with this sort of explanation, the explicit incorporation of the localisation performance factor for qualifying the technology-base was first attempted by Pal and Saha [1981] in spatial analysis for resolving the controversy on non-diminishing scale of return from technology-base (empirically μ_0 against μ_* without and with the stated incorporation). For the production function analysis with time-series data, if the agglomeration economy operates favourably, it might also lead to, as stated already, the above unity value of the homogeneity parameter (μ_0), which poses difficulty in contrast to the normal expectation of below, or at best, equal to unity value as is expected through the support of marginal productivity theories under restricted market conditions. This difficulty was, however, attempted to be removed by accepting the time-series production function either with the imposition of a restriction of unit homogeneity parameter (ref. to Arrow et al [1961]), or, with the incorporation of a technological progress factor, measured by a time-series variable as in Solow's technological change model (ref. to Solow [1957]) and Arrow's " learning by doing hypothesis" model (ref. to Arrow [1962]), or with both. In the time-series production function with technological progress hypothesis, the additional time-series variable, like " time", " cumulated gross-investment", or the like, takes care of the residual component of the scale of output-return (comparable to $(\mu_0 - \mu_*)$), over and above the true contribution of the technology-base to the scale of output-return (comparable to μ_*).

Thus, both regional technology specialisation and temporal technological progress could be viewed on the same footing in terms of the prevalent agglomeration economy with two types of variation, over space (with cross-section data) and over time (with time-series data), and both could be taken to induce quality change in technological base. As such, a suitable variant of Solow's and Arrow's models with proper replacement of their technological progress factor, by an appropriate localisation performance factor, was considered useful by Pal and Saha [1981] in analysing the regional technology specialisation and localisation economy, and thereby they could remove successfully the contradiction of the estimates $\mu_0 > 1$ against the true contribution $\mu_* < 1$ of the technology-base to the scale of output-return. Some attempts made earlier in the direction by Shefer [1973] and Carlino [1979] were, however, not successful, the detailed critical arguments of which have already been put forward by Pal and

Saha /‾1981_7 in connection with their work on spatial production functions with the incorporation of the localisation performance factor Q.

Finally Pal and Saha /‾1981_7 selected, for empirically and theoretically validated reasons, the " location factor of energy-use" as the localisation performance variable Q for qualifying the technology-base of input-factors for a proper evaluation of the return from the technology-base in terms of the output generation. As the technology-base is being qualified for its output-return, the localisation performance variable Q is to be characterised, according to Pal and Saha, by the presence of a strong relationship with the output variable and at the same time it should influence the quality of utilisation of factor-inputs (i.e. K and L) determining the technology-base. Their choice of energy-use has fitted very well with these specifications, in the perspective of their objective of qualifying the technology-base for its return in terms of output-generation. However, the same choice obviously does not fit with our present objective of qualifying manufacturing activity-base for its capacity of absorbing labour within. We have searched for several alternatives of Q, including the energy-use variable, which might satisfy the specifications, comparable to those of Pal and Saha, that it should have a strong relationship with L, in our case, and also it should influence the quality of utilisation of basic factors K and Y, generating the manufacturing activity-base (ref. to our relevant collaborative work, Pathak and Saha [1986]). Finally, the " location factor of wage-payment" (wage in Rs. 100) has been identified to be the most suitable Ω, satisfying our objective. The choice is also supported by both empirical and theoretical evidences that labour migration to activity sites for certain manufacturing activity is largely induced by the wage-differentials that prevail between sites (ref. to Sjaastad [1960], Raimon [1962], Harvey [1967]), over and above the potentialities of absorption in the manufacturing activity-base. From our exploratory work with various choices of Ω, we have found that, though with the choice of the location factor of energy-use as Ω, we obtain good statistical fits of the modified labour absorption functions, the best statistical fits are obtained with the location factor of wage-payment as the choice for Ω, the degrees of fit being always superior with the latter choice.

It should be noted that, while the principal variables L and X_0 (taken in terms of K and Y) are measuring respectively the bulks of labour absorption and the manufacturing activity-base (or, its constituent basic factors) for different areal units of observation, the localisation performance variable Ω, qualifying the activity-base, is taken in the form of a location factor and not as a variable measuring the bulk of wage-payment. A bulk-measuring variable, varying over areal units of observation, is a variable measuring aggregate level within each areal units of observation, without any consideration for the size variations of areal units in terms of its geographical coverages. But, a localisation performance variable, Q, characterises the areal units, permitting comparability between areal units in absolute sense, so that it can be used as a localisation qualifier of the areal units for the manufacturing activity and not as a bulk-measurer of the manufacturing activity-base likewise its constituents K and Y, or the labour absorption variable, L. By definition, the quotient obtained on dividing the areal-unit share (here, district-share) of an item's all-India total by the corresponding share of geographical area is the location factor of the item (here, wage-payment in a particular manufacturing activity) for the areal unit (for details, referred to Pal [1971], also quoted here in the subsection (2.2.4)).

Thus, we would go for the statistical fits of the modified labour absorption functions for different manufacturing activities, in the form (4.41), in which the location factor of wage-payment is used as the localisation performance variable Q for qualifying the activity-base, X_0. In the analytical form (4.41), the parameters of our interest are $\mu_* = (1 - c)\mu$ and $s = c\mu$, and their sum $\mu_* + s = \mu$. We have already mentioned that if the functional form is fitted without the incorporation of Q (i.e. with $s = 0$), the corresponding over-all scale of labour absorption would have been μ_0, the value of which would be comparable to μ. In fact, we shall also establish it statistically with our empirical data. On the basis of these parameters, we now define below two derived coefficients. We have already mentioned that μ_0 and μ_* are respectively the scales of manufacturing activity-base without and with the incorporation of the localisation performance factor. As such, following Pal and Saha [1981] analogically, we can take the ratio (μ_0 / μ_*) as to represent the "degree of localisation economy", operating for labour absorption in the manufacturing activity. As noted already, this ratio is comparable in magnitude with the ratio (μ / μ_*). Now, from the relations, already shown under the formulation (4.41), we may deduce

$$\frac{\mu}{\mu_*} = 1 + c \cdot \frac{\mu}{\mu_*} = 1 + \frac{s}{\mu_*}$$

We shall finally use this derived coefficient as an estimate of the "degree of localisation economy", to be denoted by α_*. Thus, we have

$$\alpha_* = \frac{\mu}{\mu_*} = 1 + c \cdot \frac{\mu}{\mu_*} = 1 + \frac{s}{\mu_*} \qquad \ldots (4.42)$$

Now, by virtue of the relation (4.42) between α_* and c (or, s), we have the following three cases :

Case (i) : $c = 0$ (i.e. $s = 0$) corresponds to $\alpha_* = 1$, implying the absence of localisation performance,

Case (ii) : $c > 0$ (i.e. $s > 0$) corresponds to $\alpha_* > 1$, implying the degree of localisation performance economy, favouring labour absorption in the manufacturing activity,

Case (iii) : $c < 0$ (i.e. $s < 0$) corresponds to $\alpha_* < 1$, implying the degree of localisation performance diseconomy, disfavouring labour absorption in the manufacturing activity.

Thus, even though we have termed α_* generally as the " degree of localisation economy", it accommodates all the three cases, namely, the absence of both localisation economy and diseconomy ($\alpha_* = 1$), the presence of localisation economy ($\alpha_* > 1$), and also, the presence of localisation diseconomy ($\alpha_* < 1$). So the critical boundary value between localisation economy and diseconomy, for α_* is unity. Clearly, the strength or power of localisation performance economy for labour absorption is determined by the excess of the value of α_* over unity, i.e., by the difference $(\alpha_* - 1)$. We shall denote this difference by α, and call it the " power of localisation performance". From relation (4.42) it follows that

$$\alpha = \frac{s}{\mu_*} = c \cdot \frac{\mu}{\mu_*} = c\alpha_* \qquad \ldots (4.43)$$

So the degree of localisation economy, α_*, and the power of localisation performance, α, are connected by the relation shown in (4.43). Again, as $\alpha_* = 1 + \alpha$, by definition, the critical boundary value of α between favourable and disfavourable localisation performance is zero (implying neutral performance), with $\alpha > 0$ implying favourable performance, and with $\alpha < 0$ implying disfavourable performance towards labour absorption.

With the introduction of the derived coefficients α_* (= degree of localisation economy, or, in short, localisation degree parameter) and α (= power of localisation performance, or, in short, localisation power parameter), we shall now re-construct the modified labour absorption function, equivalent to the form (4.39), with a meaningful restructuring of X (or, X_0) in terms of these parameters. In the modification of the labour absorption function (4.2) into the form (4.39), we presumed that the homogeneity (or, the overall scale of labour absorption) parameter, denoted by μ_0 and μ respectively, is of same or comparable magnitude. In consequence to this, both X and X_0 have been of degree unity in their respective formulations in terms of their constituent variables (ref. to (4.40) and (4.3)). However, the scale of manufacturing activity-base turns out to be μ_*, after the incorporation of the localisation performance variable Q for qualifying X_0. Thus the scale of manufacturing activity-base changes from μ_0 to μ_* with this incorporation of the localisation performance factor. As μ is comparable to μ_0, μ_* is expected to be different from μ, and these are connected by the following relation (ref. to (4.42))

$$\mu = \alpha_* \mu_*$$

With the use of this relation, the functional form (4.39) can be equivalently written as

$$L = \gamma (X_*)^{\mu_*}, \qquad \dots (4.44)$$

$$\text{where } X_* = X^{\alpha_*} \qquad \dots (4.45)$$

Thus, X_* may be interpreted as the <u>localisation degree adjusted X</u>, where X is the quality-corrected activity-base, X_0. To express X_* directly in terms of X_0 and Q, we refer back to the equation (4.40) and make the following deductions :

$$
\begin{aligned}
X_* &= X^{\alpha_*} \\
&= X_0^{(1-c)\alpha_*} Q^{c\alpha_*} \\
&= X_0^{\alpha_*-\alpha} Q^{\alpha}, \text{ using relation (4.43),}
\end{aligned}
$$

and since $\alpha_* = 1 + \alpha$, we have finally

$$
\left.
\begin{aligned}
X_* &= X_0 \cdot Q^{\alpha} \\
&= K^{\delta} Y^{1-\delta} Q^{\alpha} \\
&= (KQ^{\alpha})^{\delta} (YQ^{\alpha})^{1-\delta} \\
&= K_*^{\delta} Y_*^{1-\delta}, \text{ where } K_* = KQ^{\alpha} \text{ and } Y_* = YQ^{\alpha}
\end{aligned}
\right\} \qquad \dots (4.46)
$$

Consequently, X_* , K_* and Y_* may equivalently be interpreted as the localisation power modified activity-base X_0 , capital-component K and output-component Y respectively. Granting this modification to X_* from X_0 , as in (4.46), we notice that the role played by X_0 in the original form (4.2), is now played by X_* in the modified labour absorption function of the form (4.44), with the corresponding change in the scale parameter from μ_0 (comparable to μ) to μ_* . Now replacing X_* in the form (4.44), by using relation (4.46), we get the following equation :

$$L = \gamma X_0^{\mu_*} Q^{\alpha \mu_*} \qquad \ldots (4.47)$$

Since $\alpha \mu_* = c \alpha_* \mu_* = c \mu = s$ (ref. to relation (4.43) and (4.42)), the form (4.47) is exactly the same as the estimating equation (4.41).

As already noted in the preceding section that the use of " VLS-δ Constrained OLS" regression technique would be appropriate with the incorporation of the variable Q for the final estimation of the modified labour absorption function (4.41) or (4.47) in log-linear form. This means that without the incorporation of Q, we shall determine δ , μ_0 and corresponding correlation coefficient by the VLS regression procedure. Then, with the use of this δ we shall generate the variable $X_0 = K^{\delta} Y^{1-\delta}$, and finally go for the OLS fit of (ln L) on (ln X_0) and (ln Q) to determine μ_* , $s = \alpha \mu_*$ (and hence, $\mu = \mu_* + s$) and the corresponding correlation coefficient of improved magnitude over the precedingly determined VLS correlation coefficient. As we have the hypothesis that μ_0 is not significantly different from μ, used in our theoretical discussion in connection with the incorporation of Q for qualifying X_0, this hypothesis has to be subjected to statistical tests with empirical estimates. If the test results are for acceptance of the hypothesis, we can then use μ, instead of μ_0, in our subsequent discussion related to the labour absorption function before modification. In that case, we are then using the " VLS-δ Constrained OLS" regression estimates of all estimable parameters μ (for μ_0), μ_*, s and γ (i.e. OLS estimates of these, with the use of only VLS-δ). In the next subsection, we shall develop the concepts of labour-absorptive efficiencies of manufacturing activity-bases, with the use of labour absorption function.

4.7 Labour Absorptive Efficiency of Manufacturing Activity-Bases : Concepts and the Formulation of Indices

We define in the usual manner, the labour-absorptivity and scaled labour-absorptivity as follows :

$\lambda = \frac{L}{X_0} =$ over-all labour-absorptivity of the activity-base X_0,

.../-

$A'_k = \frac{L}{K}$ = over-all labour-absorptivity of the capital component K,

$A'_y = \frac{L}{Y}$ = over-all labour absorptivity of the output component Y,

$A'_* = \frac{L}{X_*}$ = modified labour-absorptivity of the activity-base,

$A'_{k*} = \frac{L}{K_*}$ = modified labour-absorptivity of the capital component,

$A'_{y*} = \frac{L}{Y_*}$ = modified labour-absorptivity of the output component.

First three labour-absorptivity measures refer to the over-all activity-base and its components, and the last three measures refer to the modified activity-base and its components. Clearly the relations between the over-all labour-absorptivities and the corresponding modified labour-absorptivities are given by :

$$A' = A'_* Q^{\alpha}, \quad A'_k = A'_{k*} Q^{\alpha} \quad \text{and} \quad A'_y = A'_{y*} Q^{\alpha} \qquad \ldots (4.48)$$

Now from the modified labour absorptions functions, we have

$$\frac{\partial \ln L}{\partial \ln X_*} = \mu_* \qquad \ldots (4.49)$$

Then we have either $\partial\left(\frac{1}{\mu_*} \ln L\right) = \partial(\ln X_*)$

i.e. changes for $\left(\frac{1}{\mu_*} \ln L\right) = \ln\left(L^{1/\mu_*}\right)$ and $\ln X_*$ are same, or, $\partial(\ln L) = \partial(\mu_* \ln X_*)$

i.e. changes for ln L and $(\mu_* \ln X_*) = \ln (X_*^{\mu_*})$ are same.

We shall call $(L^{1/\mu_*}, X_*)$, or, alternatively $(L, X_*^{\mu_*})$ as the scale-adjusted pair of labour & activity-base, or, in short, scaled labour L relative to X_*.

Now, if we put $a_* = \dfrac{L^{1/\mu_*}}{X_*}$

and $A_* = a_*^{\mu_*} = \dfrac{L}{X_*^{\mu_*}}$,

then for $\mu_* = 1$, we get $A_* = a_* = A'_*$. Thus, either the measure a_* or its power-transform $A_* = a_*^{\mu_*}$ could be used to define what can be called the scaled labour-absorptivity of the modified activity-base. However, in the event of having a magnitude of μ_* below unity, it is better to take A_* as the scaled labour-absorptivity of the modified activity-base, because L is not inflated in this and at the same time A_* has a lower range of variations as compared with $a_* = A_*^{1/\mu_*}$.

We can thus define :

$$A_* = \frac{L}{X_*^{\mu_*}} = \left(\frac{L^{1/\mu_*}}{X_*}\right)^{\mu_*}$$

= modified scaled labour-absorptivity of the activity-base

(The following should be noted in support of our nomenclature :

unit-scaled labour-absorptivity of the modified activity-base = labour-absorptivity of the modified activity-base = A'_*)

Again, from the relation (4.49), we can deduce

$$\partial (\ln L) = \mu_* (\partial \ln X_*) = \partial \ln (X_*^{\mu_*})$$

$$= \partial \ln (X_O^{\mu_*} Q^{\alpha \mu_*})$$

$$= \partial \ln (X_O^{\mu_*}) + \partial \ln (Q^S)$$

or, $\partial \ln (L/Q^S) = \partial \ln (X_O^{\mu_*})$

i.e. changes for $\ln(L/Q^S)$ = changes for $\ln(X_O^{\mu_*})$ ... (4.50)

Originally, (4.49) gave rise to the ratio

$$\frac{L}{X_*^{\mu_*}} = A_*$$

and now its equivalent form (4.50) gives rise to the ratio

$$\frac{1}{Q^S} \cdot \frac{L}{X_O^{\mu_*}} = \frac{1}{Q^S} \cdot A$$

where $A = \frac{L}{X_O^{\mu_*}}$.

Thus, $A_* = \frac{1}{Q^S} \cdot A$, or, $A = A_* Q^S$ ... (4.51)

Comparing this relation with the first relation shown in (4.48), we can analogically define A in the following way :

$$A = \frac{L^{\mu_*}}{X_0} = \text{over-all measure of scaled labour-absorptivity of the activity-base, or, the over-all scaled labour-absorptivity, in short.}$$

Thus, here A and A_* are scale-adjusted with the same scale parameter μ_* corresponding to the unadjusted measures A' and A'_* respectively.

We can further define the <u>over-all</u> and the <u>modified scaled labour-absorptivities</u> of the components of activity-base as follows :

$$A_k = \frac{L^{\mu_*}}{K} = \text{over-all scaled labour-absorptivity of capital,}$$

$$A_Y = \frac{L^{\mu_*}}{Y} = \text{over-all scaled labour-absorptivity of output,}$$

$$A_{k*} = \frac{L^{\mu_*}}{K_*} = \text{modified scaled labour-absorptivity of capital,}$$

$$A_{Y*} = \frac{L^{\mu_*}}{Y_*} = \text{modified scaled labour-absorptivity of output.}$$

All the measures defined above relate to the modified labour absorption function. In case we use the original labour absorption function, for which we have

$$\frac{\partial \ln L}{\partial \ln X_O} = \mu_O \qquad \ldots (4.52)$$

where μ_O is of comparable magnitude with

$\mu = \mu_* + s = \mu_* + \alpha\mu_*$,

we can derive a third set of scaled labour-absorptivities, say, (A_O , A_{kO} , A_{yO}) which can be similarly derived as the set of modified scaled labour-absorptivities (A_* , A_{k*} , A_{y*}) with the replacements of X_* by X_O and μ_* by μ_O . (Note that the modified labour absorption function reduces to the original labour absorption function when s = 0 , implying $\mu = \mu_* = \mu_O$ when s = 0 , implying $\mu = \mu_* = \mu_O$ with X_O standing for X_*). Thus, we have also

$A_O = \frac{L^{\mu_O}}{X_O}$ = scaled labour-absorptivity of the activity-base,

$A_{kO} = \frac{L^{\mu_O}}{K}$ = scaled labour-absorptivity of capital,

$A_{yO} = \frac{L^{\mu_O}}{Y}$ = scaled labour-absorptivity of output.

Now, following the compositions of X_O and X_* in terms of respective components, shown respectively in relations (4.3) and (4.46), we can easily deduce the following relations :

$$\left.\begin{aligned} A &= A_k^{\delta} A_y^{1-\delta} \\ A_* &= A_{k*}^{\delta} A_{y*}^{1-\delta} \\ \text{and} \quad A_O &= A_{kO}^{\delta} A_{kO}^{1-\delta} \end{aligned}\right\} \qquad \ldots (4.53)$$

Again, from the composition of X_*, K_* and Y_*, each in terms of X_0 and Q, shown in relations (4.46), we can easily derive the following relations between the set of over-all measures (A, A_k, A_y) and the set of modified measures (A_*, A_{k*}, A_{y*}):

$$A = A_* \, Q^s, \quad A_k = A_{k*} Q^s \text{ and } A_y = A_{y*} Q^s \qquad \ldots (4.54)$$

These relations likewise the first one, derived already in relation (4.51), justify the nomenclature of any of A, A_k and A_y as the over-all measures, following the same arguments as already shown in respect of A. We have already noted that the set of modified measures (A_*, A_{k*}, A_{y*}) is somehow comparable to the set of measures (A_0, A_{k0}, A_{y0}). Further specific relationships that exist between the two sets would be discussed later, after developing below the concepts of labour-absorptive efficiencies.

Concepts and Measures of Labour-Absorptive Efficiency : As the analytical expressions, mutatis mutandis, for the modified labour absorption function :

$$L = \gamma X_*^{\mu_*} \; ; \quad X_* = K_*^{\delta} Y_*^{1-\delta} ,$$

and the original labour absorption function :

$$L = \gamma X_0^{\mu_0} \; ; \quad X_0 = K^{\delta} Y^{1-\delta} ,$$

are similar, it is sufficient to develop the concept of labour-absorptive efficiency with the use of any of the functional form. We shall develop this below, with the use of the modified function.

We put $Z_* = \frac{X_*^{\mu_*}}{L} = A_*^{-1}$,

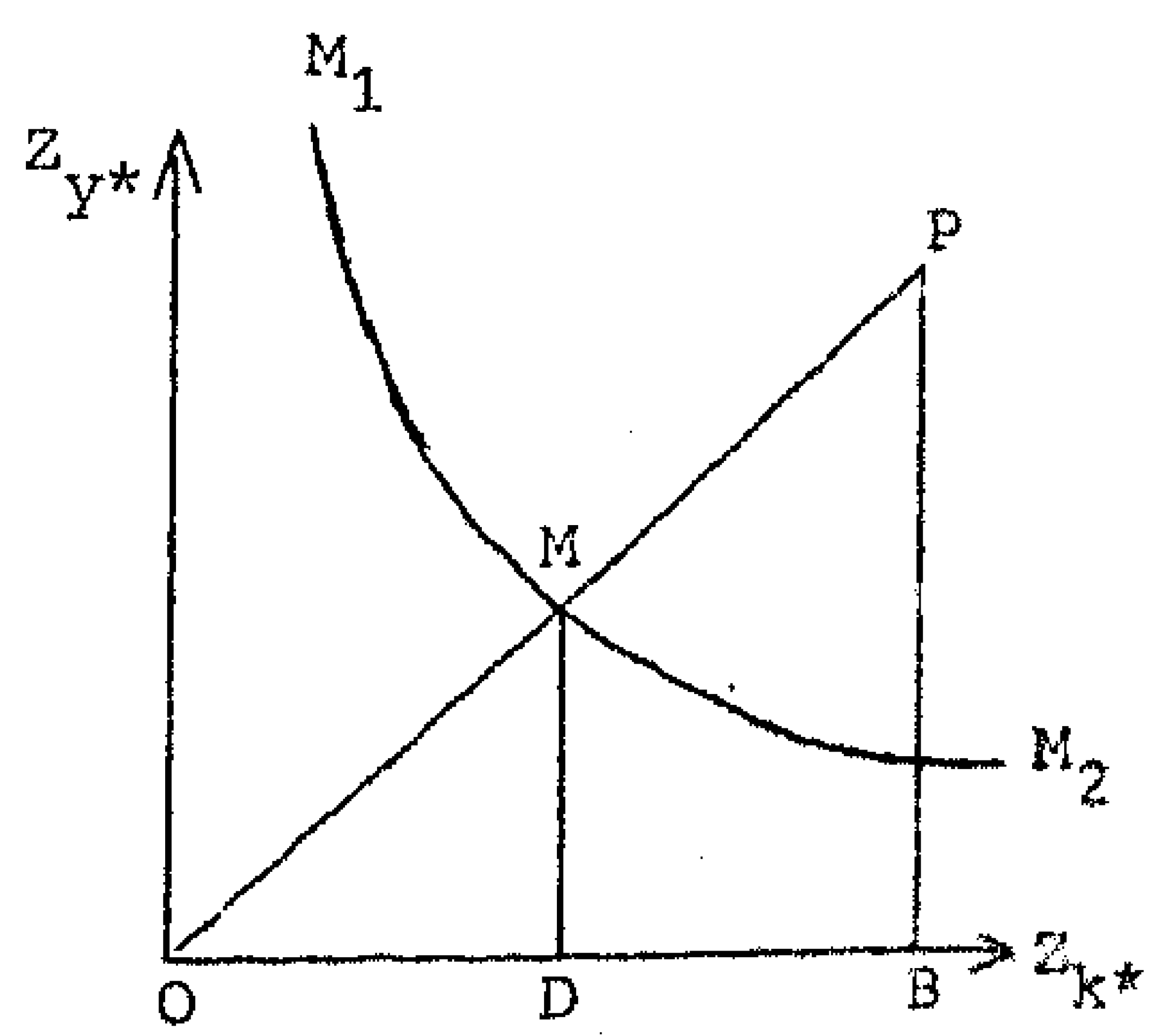
$$Z_{k*} = \frac{K_*^{\mu_*}}{L} = A_{k*}^{-1}$$

and $Z_{y*} = \frac{Y_*^{\mu_*}}{L} = A_{y*}^{-1}$.

Then the modified labour absorption function can be written as

$$1 = \Upsilon Z_* = \Upsilon (Z_{k*})^{\delta} \; (Z_{y*})^{1-\delta} \qquad \ldots (4.55)$$

With reference to this form (4.55) of the modified labour absorption function, we have represented the unit labour absorption iso-curve in $(Z_{k*} - Z_{y*})$-plane by M_1M_2 in the graph shown below :



In this graph, $P = (Z_{k*}, Z_{y*})$ is any arbitrary observation point and the line joining the point P and the origin O intersects (or, meets) the curve M_1M_2 at the point $M = (\hat{Z}_{k*}, \hat{Z}_{y*})$. The lines P B and M D are perpendiculars drawn respectively from P and M on the Z_{k*}-axis. Following Pal and Saha's [1981b] generalisation on Farrel's [1957] concept of technical efficiency (i.e. productive efficiency) an analogous concept of labour-absorptive efficiency of modified activity-base, denoted by E_*, can be written as

$$E_* = \frac{OM}{OP}$$

Since, from the diagram shown in the preceding graph, we have

$$\frac{OM}{OP} = \frac{OD}{OB} = \frac{MD}{PB}$$

We can write

$$E_* = \frac{\hat{Z}_{k*}}{Z_{k*}} = \frac{\hat{Z}_{y*}}{Z_{y*}} \qquad \ldots (4.56)$$

From this relation, we also get

$$\frac{\hat{Z}_{k*}}{\hat{Z}_{y*}} = \frac{Z_{k*}}{Z_{y*}} \qquad \ldots (4.57)$$

As $(\hat{Z}_{k*}, \hat{Z}_{y*})$ is a point on the curve M_1M_2, it satisfies the relation (4.55). Then we have

$$1 = \Upsilon \hat{Z}_{y*} \left(\frac{\hat{Z}_{k*}}{\hat{Z}_{y*}} \right)^{\delta}$$

$$= \Upsilon \hat{Z}_{y*} \left(\frac{Z_{k*}}{Z_{y*}} \right)^{\delta} \qquad \text{(using (4.57))}$$

$$= \left(\frac{\hat{Z}_{y*}}{Z_{y*}} \right) \cdot \Upsilon Z_{y*} \left(\frac{Z_{k*}}{Z_{y*}} \right)^{\delta}$$

$$= E_{*} \cdot \Upsilon Z_{k*}^{\delta} \, Z_{y*}^{1-\delta} \qquad \text{(using (4.56))}$$

$$= E_{*} \cdot \Upsilon Z_{*} \qquad \text{(using relation (4.55))}$$

i.e. $E_{*} = \dfrac{1}{\Upsilon Z_{*}} = \dfrac{L}{\Upsilon X_{*}^{\mu_{*}}}$

Now if $\hat{L} = \Upsilon X_{*}^{\mu_{*}} = \Upsilon (K_{*}^{\delta} \, Y_{*}^{1-\delta})^{\mu_{*}}$

$$= \Upsilon (K^{\delta} Y^{1-\delta} \, Q^{\alpha})^{\mu_{*}}$$

denotes the value of statistical fit on the modified labour absorption function, we have then for any point (K, Y, Q),

$$E_{*} = \frac{L}{\Upsilon X_{*}^{\mu_{*}}} = \frac{L}{\hat{L}}$$

Again from our log-linear statistical fit, we have

$$\Upsilon = \frac{\tilde{L}}{\tilde{X}_{*}^{\mu_{*}}}, \quad \text{where } \tilde{L} = \text{geometric mean of L}$$

$$\text{and } \tilde{X}_{*} = \text{geometric mean of } X_{*}.$$

Then the equation for E_{*} can be rewritten as :

$$E_{*} = \frac{L}{\hat{L}} = \frac{L}{\Upsilon X_{*}^{\mu_{*}}} = \left(\frac{L}{X_{*}^{\mu_{*}}} \right) \Big/ \left(\frac{\tilde{L}}{\tilde{X}_{*}^{\mu_{*}}} \right) = \frac{A_{*}}{\tilde{A}_{*}} \qquad \ldots (4.58)$$

Thus, E_* can be taken as to be a kind of index of modified scaled labour-absorptivity of the activity-base, which is really proportional to the modified scaled labour-absorptivity A_*. In the original Farrel's [1957] work, the concept of E_* is developed with the implicit restriction of $s = \alpha \mu_* = 0$ and $1 = \mu_0$, which imply $\mu_* = \mu = \mu_0 = 1$. In Pal and Saha's [1981b] generalised development, with the removal of above restrictions, μ_* is an analogous scale parameter, different from 1, as used here. Thus, the index of modified labour-absorptive efficiency of the activity-base, $E_* = L/\hat{L}$, is same as the modified scaled labour-absorptivity index $(A_*/\tilde{A}_*)$.

Next, with reference to the original labour absorption function, we can develop, in an analogous manner as before, the index of labour-absorptive efficiency of activity-base, E_0, given by

$$E_0 = \frac{L}{\hat{L}} = \frac{L}{\gamma X_0^{\mu_0}} = \left(\frac{L}{X_0^{\mu_0}}\right) \Big/ \left(\frac{\tilde{L}}{\tilde{X}_0^{\mu_0}}\right) = \frac{A_0}{\tilde{A}_0} \qquad \ldots (4.59)$$

Thus, the index of labour-absorptive efficiency of the activity-base, $E_0 = \frac{L}{\hat{L}}$, is again the same as the scaled labour-absorptivity index $(A_0/\tilde{A}_0)$.

For both the forms of labour absorption functions, the indices of scaled labour-absorptivity are obtained by dividing the corresponding measure of scaled labour-absorptivity with a kind of its central value. Here the central values have been the corresponding geometric means as dictated by the average condition, prescribed for the empirical evaluations of the intercept parameter ln γ, which takes care of the differential measurement units of the variables involved in the functional forms. We could, however, alter the average condition for the empirical evaluation of γ, and in consequence to this, the resulting central values of scaled labour-absorptivities could be differently formulated. But, as the central value is a constant, whatever be its mode of formulation, the changing of central values in the formulation of an index of scaled labour-absorptivity does not alter practically the nature of variation to be depicted by the empirical values of the index. Thus, whatever be the mode of empirical evaluation of the central values of any scaled labour-absorptivity, the related index of scaled labour-absorptivity can always be taken for granted conceptually as the corresponding index of labour-absorptive efficiency. We shall, however, now continue to use the central values for index formulations, until otherwise stated.

Now, granting this interpretation that the indices of labour-absorptive efficiency are the corresponding indices of scaled labour-absorptivity, we can define further the over-all labour-absorptive efficiency index, E , corresponding to over-all scaled labour-absorptivity A, and also the other efficiency indices for the components of activity-bases as follows :

$$\left.\begin{aligned} E &= \frac{A}{\tilde{A}} &&= \text{index of over-all labour-absorptive efficiency of the activity-base,} \\ E_k &= \frac{A_k}{\tilde{A}_k} &&= \text{index of over-all labour-absorptive efficiency of capital,} \\ E_y &= \frac{A_y}{\tilde{A}_y} &&= \text{index of over-all labour-absorptive efficiency of output,} \end{aligned}\right\} \quad \ldots (4.60)$$

$$\left.\begin{aligned} E_{k*} &= \frac{A_{k*}}{\tilde{A}_{k*}} &&= \text{index of modified labour-absorptive efficiency of capital,} \\ E_{y*} &= \frac{A_{y*}}{\tilde{A}_{y*}} &&= \text{index of modified labour-absorptive efficiency of output,} \\ E_{kO} &= \frac{A_{kO}}{\tilde{A}_{kO}} &&= \text{index of labour-absorptive efficiency of capital,} \\ E_{yO} &= \frac{A_{yO}}{\tilde{A}_{yO}} &&= \text{index of labour-absorptive efficiency of output.} \end{aligned}\right\} \quad \ldots (4.61)$$

By virtue of the fact that the labour-absorptive efficiency indices are scaled labour-absorptivity indices, we can establish the following relations, by use of relation (4.53)

$$\left.\begin{aligned} E &= (E_k)^{\delta} \; (E_y)^{1-\delta} \\ E_* &= (E_{k*})^{\delta} \; (E_{y*})^{1-\delta} \\ E_0 &= (E_{k0})^{\delta} \; (E_{y0})^{1-\delta} \end{aligned}\right\} \quad \ldots \; (4.62)$$

Next, it should be noted that the structures of both E_0 and E_* are of the same form, $(L/\hat{L})$, (ref. to (4.58) and (4.59) where $\hat{L}$ denotes the functional estimate of L derived respectively from the statistical fits of the original and the modified labour absorption functions). In both the functional fits, the spatial variations of L are to be explained maximally by that of $\hat{L}$, and all point estimates $\hat{L}$ relative to L are likely to be in the same ratio for both the forms, particularly when the degrees of fit for both the forms are high enough and close. As such the estimated values of the two sets (E_*, E_{k*}, E_{y*}) and (E_0, E_{k0}, E_{y0}) are likely to be correspondingly comparable in magnitudes. Thus, the latter set of efficiency measures (E_0, E_{k0}, E_{y0}) does not practically give any additional information over and above of what could possibly be depicted by the set (E_*, E_{k*}, E_{y*}). However, it is to be noted that the measures (E_0, E_{k0}, E_{y0}) really give the localisation-free efficiency measures. As the modified efficiency measures (E_*, E_{k*}, E_{y*}) are in comparable magnitudes with the localisation-free efficiency measures (E_0, E_{k0}, E_{y0}), these modified efficiency measures do really stand for the localisation free efficiency measures.

As the measures (E_*, E_{k*}, E_{y*}) are proportional respectively to the modified scaled labour-absorptivities (A_*, A_{k*}, A_{y*}), which, in turn, are connected with the over-all scaled labour-absorptivities (A, A_k, A_y), (ref. to equations in (4.54)) we would prefer to take these modified efficiency measures as the localisation-free efficiency measures (instead of the other alternative). In fact, we can establish the relations between the over-all efficiency measures (E, E_k, E_y) and the modified (or, localisation-free) efficiency measures (E_*, E_{k*}, E_{y*}) on the basis of relations between the corresponding measures of scaled labour-absorptivities as shown in (4.54). To do that we first define the index of localisation power, Q_*, as follows

$$Q_* = Q^s / \tilde{Q}^s \qquad \ldots (4.63a)$$

It should be noted that the localisation performance variable Q is already in an index form whose central value is the critical unit value. So the central measure ($\tilde{Q}^s$) of (Q^s) will be unity or very close to unity. If, however, ($\tilde{Q}^s$) is not close to unity, we can replace this original Q, say Q', by a new $Q = (Q'/\tilde{Q}')$, so that the geometric mean of Q (and hence of Q^s) turns out to be unity. As the new Q plays the same role as Q', we have no qualitative difference in our modified labour absorption function with the new Q, except the revision of the intercept parameter $\ln \Upsilon$ to accommodate the change. Then we shall always have

$$Q_* = Q^S \qquad \ldots (4.63b)$$

and the defining relation (4.63a) gets changed to (4.63b) with this algebraic treatment (if not by approximation).

Now, by virtue of relations shown in (4.54) and with the definition of the index of localisation power Q^*, as in the final form (4.63b), we can deduce the following relations connecting the over-all measures of efficiency with the corresponding modified measures of efficiency :

$$E = E_* Q_* \ , \ E_k = E_{k*} Q_* \ , \ E_y = E_{y*} Q_* \qquad \ldots (4.64)$$

These are identity relations, and one can use the predetermined estimates of E_*, E_{k*}, E_{y*} and Q_* to get empirical estimates of E, E_k and E_y. We have already noted that the modified efficiency indices (E_*, E_{k*}, E_{y*}) may be interpreted as the localisation-free efficiency indices, whereas the measures (E, E_k, E_y) are interpreted as the over-all efficiency indices. The identity relations established in (4.64) reveal that the over-all efficiency indices can be split into two components — one is the localisation-free component of efficiency, and the other is the localisation component of efficiency. Thus, the index of localisation power Q_* can be called the localisation component of labour-absorptive efficiency index.

We have already noted from statistical considerations of functional fits for both the modified and the original labour absorption functions that the modified efficiency measures (E_*, E_{k*}, E_{y*}) and the localisation-free efficiency measures (E_0, E_{k0}, E_{y0}) are likely to be correspondingly comparable in magnitudes. As such the measures E_*, E_{k*} and E_{y*} occurring in the three relations of (4.64) could be replaced respectively by E_0, E_{k0} and E_{y0}. This can otherwise be established as follows :

While presenting our mode of developing the modified labour absorption functional variables from the original labour absorption functional variables, we have noted (ref. to (4.39)) that $X_0^{\mu_0}$ is replacable by X^{μ}, in which μ_0 and μ are of comparable magnitudes, and the functional forms of both X_0 and X are of degree unity, so that they play the same explanatory role for L. As μ is comparable in magnitude with μ_0, we can as well compute A_0, A_{k0}, A_{y0} with the replacement of μ_0 by μ in their formulations. Now, with the replacement of μ_0 by μ, the variable X_0 is replacable comparably by the variable X. Thus, we can put

$$X_0^{\mu_0} \simeq X^{\mu}.$$

.../-

Now, from the defining relations (4.40) we have

$$X = X_0 \left(\frac{Q}{X_0}\right)^c = X_0^{1-c} Q^c$$

$$= (X_0 Q^{c/(1-c)})^{(1-c)}$$

$$= (X_0 Q^{\alpha})^{\mu_*/\mu}$$

$$= X_0^{\mu_*/\mu} \; Q^{s/\mu}$$

$$\therefore \quad X_0^{\mu_0} \simeq X^{\mu} = X_0^{\mu_*} \; Q^s$$

Hence

$$\frac{1}{Q^s} \cdot A = \frac{1}{Q^s} \left(\frac{L}{X_0^{\mu_*}} \right) = \frac{L}{X^{\mu}} \simeq \frac{L}{X_0^{\mu_0}} \simeq \frac{L}{X_0^{\mu}} = A_0$$

In the same manner, or, otherwise from the first and the third relations of (4.53), we can establish this sort of relations in general for activity-components also. Thus, we can practically write :

$$A = A_0 Q^s \; , \quad A_k = A_{k0} Q^s \; , \quad A_y = A_{y0} Q^s \qquad \ldots (4.65)$$

These relations are comparable to what we have established in (4.54). As such, the modified scaled labour-absorptivities (A_*, A_{k*}, A_{y*}) and the scaled labour-absorptivities (A_0, A_{k0}, A_{y0}) are of correspondingly comparable magnitudes. We have already suggested this, which is now established firmly. Once the relations (4.65) are established, we can easily derive that

$$E = E_0 Q_* , \quad E_k = E_{k0} Q_* , \quad E_y = E_{y0} Q_* \qquad \ldots (4.66)$$

Again, these relations are comparable to what we have already established in (4.64). As such, it is also firmly established that the modified labour-absorptive efficiency indices (E_*, E_{k*}, E_{y*}) and the localisation-free labour-absorptive efficiency indices (E_0, E_{k0}, E_{y0}) are of correspondingly comparable magnitudes.

From all the above discussions, it is clear that we can never get the over-all measures of efficiency (E, E_k, E_y) from the original statistical fit for $\hat{L}$ by

$$X_0^{\mu_0} = K^{\delta\mu_0} Y^{(1-\delta)\mu_0}$$

without the incorporation of Q. Even with the incorporation of Q, it is also not sufficient to get $\hat{L}$ alone by the modified statistical fit by the equivalent

$$X^{\mu} = K^{\delta\mu_*} Y^{(1-\delta)\mu_*} Q^s ,$$

(since (E_0, E_{k0}, E_{y0}) and (E_*, E_{k*}, E_{y*}) are of correspondingly comparable magnitudes). Rather, we have to get the important parametric value of s also, so that this could be used in conjunction with Q to get the localisation component of efficiency Q_*. Only then we can determine the over-all efficiency measures (E, E_k, E_y) from the relations given in (4.64) or its variant (4.66). As the parameter s can be determined only from the statistical fit of the modified labour absorption function, the over-all efficiency measures can be estimated only from the modified functional fit. This justifies the importance of going for the modified labour absorption function with the incorporation of the localisation performance variable Q.

With the above developments of the concepts and the formulations of labour-absorptive efficiency measures, we shall now establish statistically in the next section some important comparative properties of the three activity-based efficiency measures.

4.8 Comparative Properties of Activity-Based Labour-Absorptive Efficiency Measures

For establishing the comparative properties of the three efficiency measures E_0, E_* and E and also of the localisation component of efficiency Q_*, we shall prove first the following four Lemmas for establishing the individual properties of each efficiency measure and also the cross-relations that exist between them. On the basis of these Lemmas, we shall then make our comparative observations and evaluate the comparative properties, stated in the form of Propositions.

Lemma 1 : For the statistical (VLS regression) fit of the original labour absorption function (log-transformed) we have the following :

I) $\sigma_{\ln \hat{L}} = \sigma_{\ln L}$

II) $\sigma_{\ln E_0} = \sigma_{\ln L} \cdot \sqrt{2(1 - r_{\ln L, \ln X_0})}$

III) $r_{\ln E_0, \ln L} = \sqrt{(1 - r_{\ln L, \ln X_0})/2} = - r_{\ln E_0, \ln X_0}$

Proof : From the relation (4.59), we have

$$\ln E_0 = \ln L - \ln \hat{L} \qquad \ldots(4.67)$$

and $$\ln \hat{L} = \ln Y + \mu_0 \ln X_0 \qquad \ldots(4.68)$$

where $\ln X_0 = \delta \ln K + (1 - \delta) \ln Y$.

It is implicit in the VLS regression that all variables involved in the fit contain errors and the aggregate of errors contained by constituent explanatory variables of $\ln \hat{L}$ for $\ln L$ is same as the error in $\ln L$. As such, denoting the variable V in standardised form by Z_V, the resulting form can be written as

$$Z_{\ln \hat{L}} = Z_{\ln L} \qquad \ldots(4.69)$$

so that $\sigma^2_{\ln \hat{L}} = \sigma^2_{\ln L}$, i.e., $\sigma_{\ln \hat{L}} = \sigma_{\ln L}$ $\qquad \ldots..(1\text{-}I)$

Then (4.69) reduces to

$$\ln \hat{L} - \overline{\ln \hat{L}} = \ln L - \overline{\ln L}$$

($\overline{\ln \hat{L}}$ and $\overline{\ln L}$ are mean values of $\ln \hat{L}$ and $\ln L$ respectively).

Again, $\overline{\ln \hat{L}} = \overline{\ln L}$, since the mean point is taken to lie on any functional fit. Thus from (4.67), $\overline{\ln E_0} = 0$. From (4.69) and (4.68), it immediately follows that

$$Z_{\ln L} = Z_{\ln \hat{L}} = Z_{\ln X_0} \qquad \ldots (4.70)$$

and hence $r_{\ln \hat{L},\, \ln L} = r_{\ln X_0,\, \ln L}$ ... (4.71)

Next, from (4.67) we have, $\ln E_0 = \sigma_{\ln L} Z_{\ln L} - \sigma_{\ln \hat{L}} Z_{\ln \hat{L}}$.

Using (1 - I), $\ln E_0 = \sigma_{\ln L} (Z_{\ln L} - Z_{\ln \hat{L}})$.

Using (4.70), $\ln E_0 = \sigma_{\ln L} (Z_{\ln L} - Z_{\ln X_0})$.

$$\therefore \sigma^2_{\ln E_0} = 2\, \sigma^2_{\ln L} (1 - r_{\ln L,\, \ln X_0})$$

$$\text{or,} \quad \sigma_{\ln E_0} = \sigma_{\ln L} \sqrt{2(1 - r_{\ln L,\, \ln X_0})} \qquad \ldots (1\text{-}II)$$

Then the equation for $\ln E_0$ reduces to

$$\sigma_{\ln E_0} Z_{\ln E_0} = \sigma_{\ln L} (Z_{\ln L} - Z_{\ln X_0}) \qquad \ldots (4.72)$$

Hence, $\sigma_{\ln E_0}\, r_{\ln E_0,\, \ln X_0} = \sigma_{\ln L} (r_{\ln L,\, \ln X_0} - 1)$

or, $r_{\ln E_0,\, \ln X_0} = -\frac{1}{2} (\sigma_{\ln E_0} / \sigma_{\ln L})$, using (1 - II).

Again, from (4.72) we can derive

$$\sigma_{\ln E_0}\, r_{\ln E_0,\ \ln L} = \sigma_{\ln L}(1 - r_{\ln L,\ \ln X_0}),$$

and using (1 - II) we get

$$r_{\ln E_0,\ln L} = \sqrt{(1 - r_{\ln L,\ln X_0})/2} = \frac{1}{2} \cdot \frac{\sigma_{\ln E_0}}{\sigma_{\ln L}} = - r_{\ln E_0,\ln X_0}$$

.....(1 - III)

This completes the proof of Lemma 1. Now from (1 - III), the following Proposition 1 follows readily :

<u>Proposition 1</u> : The localisation - free efficiency measure E_0 is not much related (in log-transformed form) to either the activity-base X_0, or the labour L, and the degrees of relationship approach zero similarly (from negative and positive sides of zero respectively) with the increasing degree of fit of the original labour absorption function.

<u>Lemma 2</u> : For the statistical (VLS-δ Constrained OLS regression) fit of the modified labour absorption function (log-transformed), we have the following :

I) $\sigma_{\ln \hat{L}} = R\, \sigma_{\ln L}$, where R is the correlation coefficient of the OLS fit, given that $\ln X_0 = \delta \ln K + (1 - \delta) \ln Y$, with previously determined VLS estimate of δ

II) $\sigma_{\ln E_*} = \sigma_{\ln L} \cdot \sqrt{1 - R^2}$

III) $r_{\ln E_*, \ln L} = \sqrt{1 - R^2}$

IV) $r_{\ln E_*, \ln X_*} = 0$

V) $r_{\ln E_*, \ln X_0} = 0$

VI) $r_{\ln E_*, \ln Q_*} = 0$

Proof : From the relation (4.58), we have

$$\ln E_* = \ln L - \ln \hat{L} \qquad \ldots (4.73)$$

and
$$\left.\begin{aligned} \ln \hat{L} &= \ln \Upsilon + \mu_* \ln X_* \\ &= \ln \Upsilon + \mu_* \ln X_0 + s \ln Q \end{aligned}\right\} \qquad \ldots (4.74)$$

It is implicit in the OLS regression that only the dependent variable $\ln L$ contains error and the constituent explanatory variables of $\ln \hat{L}$ (ref. to any of (4.74)) for $\ln L$ do not contain any error. As such the resulting form can be written as :

$$Z_{\ln \hat{L}} = R\, Z_{\ln L} \qquad \ldots (4.75)$$

so that $\sigma^2_{\ln \hat{L}} = R \cdot \sigma^2_{\ln L}$,

$$\text{i.e. } \sigma_{\ln \hat{L}} = R\, \sigma_{\ln L} \qquad \ldots (2\text{-I})$$

Then (4.75) reduces to

$$\ln \hat{L} - \overline{\ln \hat{L}} = R^2 (\ln L - \overline{\ln L})$$

implying that $\overline{\ln \hat{L}} = \overline{\ln L}$,

and from (4.73), $\overline{\ln E_*} = 0$.

From (4.75) and (4.74) it immediately follows that

$$R \cdot Z_{\ln L} = Z_{\ln \hat{L}} = Z_{\ln X_*} \qquad \ldots (4.76)$$

and hence, $R = r_{\ln \hat{L},\, \ln L} = r_{\ln X_*,\, \ln L}$ ... (4.77)

Now, from (4.73) we can write

$$\ln E_* = \sigma_{\ln L} Z_{\ln L} - \sigma_{\ln \hat{L}} Z_{\ln \hat{L}} .$$

Using (2-I), $\ln E_* = \sigma_{\ln L} (Z_{\ln L} - R\, Z_{\ln \hat{L}})$,

and using (4.76), $\ln E_* = \sigma_{\ln L}(Z_{\ln L} - R\, Z_{\ln X_*})$.

$$\therefore \quad \sigma^2_{\ln E_*} = \sigma^2_{\ln L}(1 + R^2 - 2R\, r_{\ln L,\, \ln X_*})$$

$$= \sigma^2_{\ln L}(1 - R^2), \text{ using (4.77)}$$

$$\text{i.e.} \quad \sigma_{\ln E_*} = \sigma_{\ln L} \sqrt{1 - R^2} \qquad \ldots (2\text{-II})$$

Then the above equation for $\ln E_*$ reduces to

$$\sigma_{\ln E_*} Z_{\ln E_*} = \sigma_{\ln L}(Z_{\ln L} - R\, Z_{\ln X_*}) \qquad \ldots (4.78)$$

or, $\sigma_{\ln E_*} r_{\ln E_*,\, \ln L} = \sigma_{\ln L}(1 - R\, r_{\ln L,\, \ln X_*})$

i.e. by using (4.77) and (2 - II), we get

$$r_{\ln E_*,\, \ln L} = \sqrt{1 - R^2} \qquad \ldots (2\text{-III})$$

Further, from (4.78) we get

$$\sigma_{\ln E_*} \; r_{\ln E_*, \; \ln X_*} = \sigma_{\ln L} \; (r_{\ln L, \; \ln X_*} - R),$$

and using (4.77), we get

$$r_{\ln E_*, \; \ln X_*} = 0 \qquad \ldots (2\text{-IV})$$

Now from the form of $\ln \hat{L}$, given in equation (4.74) for the OLS fit of $\ln L$, the related normal equations are given by :

$$\text{COV} \; [(\ln L - \mu_* \ln X_0 - s \ln Q), \; \ln X_0] = 0 \qquad \ldots (4.79)$$

and $\text{COV} \; [(\ln L - \mu_* \ln X_0 - s \ln Q) \, , \ln Q] = 0$ ...(4.80)

From (4.79), $\text{COV} \; [(\ln L - \ln \hat{L}), \; \ln X_0] = 0$,

$$\text{i.e.} \quad \text{COV} \; (\ln E_*, \; \ln X_0) = 0 \qquad \ldots (4.81)$$

$$\text{which implies} \quad r_{\ln E_*, \; \ln X_0} = 0 \qquad \ldots (2\text{-V})$$

Again, from (4.80), $\text{COV} \; [(\ln L - \ln \hat{L}), \; s \ln Q] = 0$, i.e.,

$$\text{COV}(\ln E_*, \; \ln Q_*) = 0 \qquad \ldots (4.82)$$

which implies

$$r_{\ln E_*, \; \ln Q_*} = 0 \qquad \ldots (2\text{-VI})$$

This completes the proof of Lemma 2.

Now from the last four parts of Lemma 2, the following Proposition 2 readily follows :

Proposition 2 : The localisation-free modified efficiency measure E_* is not at all related (in log-transformed forms) to either the activity-base X_0, or, the modified activity-base, X_*, and it is also not related to the localisation component of efficiency, Q_*. It is, however, very poorly related to the labour, L, and the log-linear relationship approaches zero with increasing degree of fit of the modified labour absorption function.

Lemma 3 : For the statistical fits of both the original and the modified labour absorption functions (i.e., $\ln \hat{L}_0 = \ln \hat{L} = \ln \Upsilon + \mu_0 \ln X_0$, and, $\ln \hat{L}_* = \ln \hat{L} = \ln \Upsilon + \mu_* \ln X_*$, only), we have the following :

I) $r_{\ln X_*, \ln X_0} = R$, where R is the correlation coefficient of the OLS fit of the modified function,

II) $r_{\ln E_0, \ln X_*} = 0$

III) $r_{\ln E_0, \ln E_*} = \dfrac{\sigma_{\ln E_*}}{\sigma_{\ln E_0}} = \sqrt{\dfrac{1 - R^2}{2(1 - r_{\ln L, \ln X_0})}}$

Proof : Before going for the proof, it is to be emphasized that the purpose of this Lemma is to find the relationship between the original and the modified labour absorption functions only, evaluating the relative behaviour patterns of efficiency measures E_* and E_0. As such, only for this limited purpose, we shall make the cross-use of both the fits with the results shown in Lemma 1 and 2. It should be noted that $\ln X_0$ and $\ln L$ are the identical variables used in both the functional fits. However, $\ln L$ is to be eliminated to look for the mathematical linkages between $\ln E_0$ and $\ln E_*$. Also, $\ln X_0$ is a constituent of $\ln X_*$ for construction of $\ln E_*$. So, after the elimination of $\ln L$, we are not in a position to make re-uses of $Z_{\ln X_0}$ (as a constituent part of $Z_{\ln X_*}$) and $Z_{\ln E_0}$ and also $Z_{\ln L}$, for any further deductions in conjunction with the eliminated formulations, shown below in (4.83) and (4.84). We now go for the formal proof.

From the formulation shown in (4.72) of Lemma 1, we have :

$$\sigma_{\ln E_0} Z_{\ln E_0} = \sigma_{\ln L}(Z_{\ln L} - Z_{\ln X_0}),$$

and from the formulation shown in (4.78) of Lemma 2, we have

$$\sigma_{\ln E_*} Z_{\ln E_*} = \sigma_{\ln L}(Z_{\ln L} - R Z_{\ln X_*})$$

Eliminating $Z_{\ln L}$ from both, and using the results (1 - I) and (2 - I) of the two Lemmas, we get

$$\sigma_{\ln E_0} Z_{\ln E_0} = \sigma_{\ln E_*} Z_{\ln E_*} + \sigma_{\ln L}(R Z_{\ln X_*} - Z_{\ln X_0}) \quad ...(4.83)$$

Again, from the relation (4.75) of Lemma 2, we get

$$Z_{\ln \hat{L}_*} = R Z_{\ln L}$$

and from the relation (4.69) of Lemma 1, we get

$$Z_{\ln \hat{L}_0} = Z_{\ln L}.$$

Eliminating $Z_{\ln L}$ from both, we get

$$\left.\begin{aligned} Z_{\ln \hat{L}_*} &= R\, Z_{\ln \hat{L}_0} \\ \text{i.e.} \quad Z_{\ln X_*} &= R\, Z_{\ln X_0} \end{aligned}\right\} \qquad \ldots (4.84)$$

This implies that

$$r_{\ln \hat{L}_*,\, \ln \hat{L}_0} = r_{\ln X_*,\, \ln X_0} = R \qquad \ldots (3\text{-I})$$

Then from the formulation (4.83), we can derive

$$\sigma_{\ln E_0} \cdot r_{\ln E_0,\ln X_*} = \sigma_{\ln E_*} \cdot r_{\ln E_*,\, \ln X_*} + \sigma_{\ln L} (R - r_{\ln X_0,\ln X_*})$$

and by virtue of property (2 - IV) and (3 -I), we get

$$r_{\ln E_0,\ln X_*} = 0 \qquad \ldots (3\text{-II})$$

Again, from the formulation (4.83), we can also derive

$$\sigma_{\ln E_0} \cdot r_{\ln E_0,\, \ln E_*} = \sigma_{\ln E_*} + \sigma_{\ln L} (R \cdot r_{\ln X_*,\, \ln E_*} - r_{\ln X_0, \ln E_*}),$$

and by virtue of property (2 - IV) and (2 - V) of Lemma 2, we get

$$r_{\ln E_0,\, \ln E_*} = \sigma_{\ln E_*} / \sigma_{\ln E_0},$$

and using the properties (1 - II) and (2 - II), we get

$$r_{\ln E_0,\, \ln E_*} = \frac{\sigma_{\ln E_*}}{\sigma_{\ln E_0}} = \sqrt{\frac{1 - R^2}{2\,(1 - r_{\ln L,\, \ln X_0})}} \qquad \ldots (3\text{-III})$$

This completes the proof of Lemma 3.

Now from the comparison of the relevant results of the three Lemmas just proved, we can observe the following similarities between the efficiency measures E_0 and E_* :

Observation 1 : The relationships of both $\ln E_0$ and $\ln E_*$ with $\ln L$ stand for accounting the respective unaccounted part of the two functional fits of the original and the modified models, which are of comparably small magnitudes when the degrees of the two functional fits are good.

Observation 2 : The log-linear relationships of the modified activity-base X_* is not only zero with the modified efficiency measure E_*, but also the same with the original efficiency measure E_0. Thus, the role of both the efficiency measures E_0 and E_* are alike with reference to even the changed activity-base X_*, after the modification over the original activity-base X_0.

Observation 3 : The result (3 - III) of Lemma 3 can be expressed alternatively as follows :

$$r_{\ln E_0, \ln E_*} = \sqrt{\left(\frac{1+R}{2}\right)\left(1 - \frac{R - r_{\ln L, \ln X_0}}{1 - r_{\ln L, \ln X_0}}\right)} \quad \ldots(4.85)$$

Now, $r_{\ln L, \ln X_0}$ is more or less comparable, but of marginally lower magnitude with R for a high degree of fit of the original labour absorption function (here, both positive for the types of fit). Both the factors shown under the radical sign of (4.85) above are below unity each. Thus, we can notice from the above expressions that the log-linear relationship between the two efficiency measures, E_0 and E_*, is of quite high magnitude and $r_{\ln E_0, \ln E_*}$ tends to $\sqrt{\frac{1+R}{2}}$ when $r_{\ln L, \ln X_0}$ tends to R.

From the above observations made from the results of Lemmas 1, 2 and 3, we have established the following Proposition 3.

<u>Proposition 3</u> : The effective role of the modified efficiency measure E_*, after the modification of the activity-base from X_0 to X_* is similar to that of the localisation-free efficiency measure E_0 with reference to the modified activity-base X_*.

<u>Lemma 4</u> : For the statistical (VLS-δ Constrained OLS regression) fit of the modified labour absorption function (log-transformed), we have the following properties :

I) $\sigma^2_{\ln E} = \sigma^2_{\ln E_*} + \sigma^2_{\ln Q_*} = (1 - R^2)\ \sigma^2_{\ln L} + \sigma^2_{\ln Q_*}$

II) $r_{\ln E, \ln Q_*} = \sigma_{\ln Q_*} / \sigma_{\ln E}$

$$= 1 / \sqrt{1 + (1 - R^2)\ \sigma^2_{\ln L} / \sigma^2_{\ln Q_*}}$$

IIIa) $r_{\ln E,\ \ln E_*} = \sigma_{\ln E_*} / \sigma_{\ln E}$

$$= 1 / \sqrt{1 + \sigma^2_{\ln Q_*} / [(1 - R^2)\ \sigma^2_{\ln L}]}$$

IIIb) $r_{\ln E,\ \ln E_*} = \sqrt{1 - r^2_{\ln E,\ \ln Q_*}}$

IV) $r_{\ln Q_*,\ \ln X_0} \simeq (\mu - \mu_*)\ \sigma_{\ln X_0} / \sigma_{\ln Q_*}$

Va) $r_{\ln E,\ \ln X_0} = r_{\ln E,\ \ln Q_*} \cdot r_{\ln Q_*,\ \ln X_0}$

$$= \frac{r_{\ln Q_*,\ \ln X_0}}{\sqrt{1 + (1 - R^2)\ \sigma^2_{\ln L} / \sigma^2_{\ln Q_*}}}$$

Vb) $r_{\ln E,\ln X_0} \simeq (\mu - \mu_*)\ \sigma_{\ln X_0} / \sqrt{(1-R^2)\,\sigma^2_{\ln L} + \sigma^2_{\ln Q_*}}$

VI) $r_{\ln E,\ln L} = \sqrt{(1-R^2)(1-r^2_{\ln E,\ln Q_*})} + r_{\ln E,\ln Q_*} \cdot r_{\ln Q_*,\ln L}$.

Proof : From the relation (4.64), we have

$$\ln E = \ln E_* + \ln Q_* \qquad \ldots(4.86)$$

Since $\overline{\ln Q_*} = 0$ (ref. to arguments put forward in the context of relations (4.63a) and (4.63b)) and $\overline{\ln E_*} = 0$, we have $\overline{\ln E} = 0$, and we may write

$$\ln E = \sigma_{\ln E_*}\ Z_{\ln E_*} + \sigma_{\ln Q_*}\ Z_{\ln Q_*}$$

$$\therefore\ \sigma^2_{\ln E} = \sigma^2_{\ln E_*} + \sigma^2_{\ln Q_*} + 2\ \sigma_{\ln E_*}\ \sigma_{\ln Q_*}\ r_{\ln E_*,\ \ln Q_*},$$

and by use of the results (2 - VI) and (2 - II) of Lemma 2,

we get

$$\left.\begin{aligned}\sigma^2_{\ln E} &= \sigma^2_{\ln E_*} + \sigma^2_{\ln Q_*} \\ &= (1 - R^2)\ \sigma^2_{\ln L} + \sigma^2_{\ln Q_*}\end{aligned}\right\} \quad \ldots(4\text{-I})$$

Then the equation for $\ln E$ may be written as :

$$\sigma_{\ln E}\ Z_{\ln E} = \sigma_{\ln E_*}\ Z_{\ln E_*} + \sigma_{\ln Q_*}\ Z_{\ln Q_*} \qquad \ldots(4.87)$$

Then we can deduce that

$$\sigma_{\ln E} \cdot r_{\ln E,\ \ln Q_*} = \sigma_{\ln E_*} \cdot r_{\ln E_*,\ \ln Q_*} + \sigma_{\ln Q_*}\ ,$$

and using the result (2 - VI) and (4 - I), we get

$$\left.\begin{aligned} r_{\ln E,\ \ln Q_*} &= \sigma_{\ln Q_*} / \sigma_{\ln E} \\ &= 1 / \sqrt{1 + (1 - R^2)\ \sigma^2_{\ln L} / \sigma^2_{\ln Q_*}}\end{aligned}\right\} \quad \ldots(4\text{-II})$$

Again, from (4.87) we can also deduce

$$\sigma_{\ln E} = \sigma_{\ln E_*} \cdot r_{\ln E,\ \ln E_*} + \sigma_{\ln Q_*} \cdot r_{\ln E,\ \ln Q_*}\ ,$$

i.e., $$r_{\ln E,\ \ln E_*} = \frac{\sigma_{\ln E}}{\sigma_{\ln E_*}} - \frac{\sigma_{\ln Q_*}}{\sigma_{\ln E_*}} \cdot r_{\ln E,\ \ln Q_*}$$

$$= \frac{\sigma_{\ln E}}{\sigma_{\ln E_*}} - \frac{\sigma^2_{\ln Q_*}}{\sigma_{\ln E_*}\,\sigma_{\ln E}}\ , \text{ by use of (4-II)}$$

$$= \frac{\sigma^2_{\ln E_*}}{\sigma_{\ln E_*}\ \sigma_{\ln E}} = \frac{\sigma_{\ln E_*}}{\sigma_{\ln E}}\ , \text{ by use of (4-I).}$$

Thus, by use of (4 - I) further, we have

$$\left.\begin{aligned} r_{\ln E,\ \ln E_*} &= \sigma_{\ln E_*} / \sigma_{\ln E} \\ &= 1/\sqrt{1 + \sigma^2_{\ln Q_*} / [(1-R^2)\ \sigma^2_{\ln E}]} \end{aligned}\right\} \quad \ldots(4\text{-IIIa})$$

Also, comparing relations (4-I) and (4-II) with it, we can also show that

$$r_{\ln E,\ \ln E_*} = \sqrt{1 - r^2_{\ln E,\ \ln Q_*}} \quad \ldots(4\text{-IIIb})$$

Next it is to be noted that X_0, used in both the original and the modified functional fits, is identical in structure (both VLS-δ based). However, as the additional variable Q, used in the modified fit, is not there in the original fit, the resulting $\hat{L}$, used in the definitions of E_0 and E_* (and hence E), are not exactly the same. However, we have already noted that for good fits of the original functional form, the scale parameter μ_0 is not significantly different from $\mu = (\mu_* + s)$. Now, if we replace μ_0 by μ in the definition of the localisation-free efficiency measure E_0, the resulting measure will be denoted by $\hat{E}_0$.

Replacing μ_* by $[\mu + (\mu - \mu_*)]$ in the result (4.80) of Lemma 2, and simplifying, we get

$$\text{COV}(\ln Q_*,\ \ln X_0) = (\mu - \mu_*)\ \sigma^2_{\ln X_0} + \text{COV}(\ln \hat{E}_0,\ \ln X_0)$$

$$\text{or,}\quad \sigma_{\ln Q_*} r_{\ln Q_*, \ln X_0} = (\mu - \mu_*)\ \sigma_{\ln X_0} + \sigma_{\ln \hat{E}_0} \cdot r_{\ln \hat{E}_0, \ln X_0} \quad \ldots(4.88)$$

From the results of Lemma 1 we have the value of comparable last term :

$$\sigma_{\ln E_0} \; r_{\ln E_0,\, \ln X_0} = -(1 - r_{\ln L,\, \ln X_0}) \cdot \sigma_{\ln L} ,$$

which is of small magnitude when the original fit is very good.

Had we used instead the " VLS-& Constrained OLS" estimate of μ_0, we would have got

$$r_{\ln E_0,\, \ln X_0} = 0$$

comparable to the result (2 - V) of Lemma 2, namely,

$$r_{\ln E_*,\, \ln X_0} = 0$$

Now, as $\hat{E}_0$ (the changed measure of E_0 obtained by replacing μ_0 by its comparable measure μ) is comparable to E_*, we can approximate

$$r_{\ln \hat{E}_0,\, \ln X_0} \simeq r_{\ln E_*,\, \ln X_0} = 0 \qquad \ldots(4.89)$$

and (4.88) reduces to

$$r_{\ln Q_*,\, \ln X_0} \simeq (\mu - \mu_*)\, \sigma_{\ln X_0} \,/\, \sigma_{\ln Q_*} \qquad \ldots(4\text{-IV})$$

Again, from the result (4.81) of Lemma 2, we have

$$\mathrm{cov}\,(\ln E_*,\, \ln X_0) = 0 ,$$

and using the relation (4.86) and simplifying, we get

$$\text{COV}(\ln E\,,\ \ln X_0) = \text{COV}(\ln Q_*\,,\ \ln X_0)$$

i.e. $r_{\ln E,\ \ln X_0} = (\sigma_{\ln Q_*} / \sigma_{\ln E}) \cdot r_{\ln Q_*,\ \ln X_0}$

and using (4-II) we get

$$\left. \begin{aligned} r_{\ln E,\ \ln X_0} &= r_{\ln E,\ \ln Q_*} \cdot r_{\ln Q_*,\ \ln X_0} \\ &= \frac{r_{\ln Q_*,\ \ln X_0}}{\sqrt{1 + (1-R^2)\ \sigma^2_{\ln L}/\sigma^2_{\ln Q_*}}} \end{aligned} \right\} \quad \ldots(4\text{-Va})$$

And further using the approximate result (4-IV), we also get the following approximation :

$$r_{\ln E,\ln X_0} \simeq (\mu - \mu_*)\,\sigma_{\ln X_0} \Big/ \sqrt{(1-R^2)\ \sigma^2_{\ln L} + \sigma^2_{\ln Q_*}} \quad ..(4\text{-Vb})$$

Again, from equation (4.87) we can deduce

$$r_{\ln E,\ln L} = \frac{\sigma_{\ln E_*}}{\sigma_{\ln E}} \cdot r_{\ln E_*,\ln L} + \frac{\sigma_{\ln Q_*}}{\sigma_{\ln E}} \cdot r_{\ln Q_*,\ln L}$$

...(4.90)

Then, by use of results (2 - II) of Lemma 2 and also the results (4-IIIa), (4-IIIb) and (4-II), just obtained, we get

$$r_{\ln E,\ \ln L} = \sqrt{(1-R^2)(1-r^2_{\ln E,\ \ln Q_*})} + r_{\ln E,\ \ln Q_*} \cdot r_{\ln Q_*,\ln L}$$

...(4-VI)

This completes the proof of Lemma 4.

Now, from the comparisons of relevant results of the Lemma 2 and 4, we can make further observations as stated below :

<u>Observation 4</u> : The difference of μ over μ_* actually gives the factor s, which is reflective of the labour-absorptive localisation power of the activity-base X_0. From the result (4 - IV) of Lemma 4, we note that

> the stronger the log-linear relationship between the localisation performance factor Q with the activity-base X_0, the higher will be the value of <u>over-all labour absorptive scale</u> μ over the <u>localisation-accounted labour-absorptive scale</u> μ_* of the activity-base.

Thus, the degree of log-linear relationship $r_{\ln Q_*, \ln X_0}$ gives really <u>the extent of presence of the labour-absorptive localisation economy</u>, (the positivity, the neutrality or the negativity of the relationship, reflecting respectively the presence of localisation economy, its total absence, or the presence of localisation diseconomy).

<u>Observation 5</u> : From the result (4-Va) of Lemma 4, and the Observation 4, we can infer that the extent of presence of the localisation economy, as gets depicted

by the degree of log-linear relationship $r_{\ln Q_*,\ \ln X_0}$ is transmitted in the log-linear relation between the over-all efficiency measure E and the activity-base X_0, with a marginal reduction through the factor $r_{\ln E,\ \ln Q_*}$ on $r_{\ln Q_*,\ \ln X_0}$. From the alternative result (4 - Vb), we also get the corroboration that

> the higher the value of over-all labour-absorptive scale μ over the localisation-accounted labour-absorptive scale μ_* of the activity-base, the stronger will be the log-linear relationship of the activity-base X_0 with the over-all efficiency measure E.

Again from the result (4 - Va), we can deduce :

$$r_{\ln E,\ \ln Q_*} > r_{\ln E,\ \ln X_0} \qquad \ldots (4.91)$$

Thus, the extent of presence of the localisation economy, as to be depicted by the degree of log-linear relationship $r_{\ln Q_*,\ \ln X_0}$ is also transmitted in the log-linear relation between the over-all efficiency measure E with the localisation component of efficiency Q_*.

Observation 6 : It is to be noted that even though Q is a variable in the form of an index (location factor with central value adjusted to unity), its logarithmic form $\ln Q$ is an aggregate spatial density variable (origin shifted) with variance $\sigma^2_{\ln Q} = \sigma^2_{\ln Q_*}/s^2$, likewise the logarithmically transformed variable $\ln X_0$, with variance $\sigma^2_{\ln X_0}$, so that $\sigma^2_{\ln Q_*}$ and $\sigma^2_{\ln X_0}$ are of comparable dimension. Moreover, $\ln Q$ is an explanatory variable, a constituent of $\ln \hat{L}$, where $\sigma^2_{\ln \hat{L}} = R^2 \sigma^2_{\ln L}$ (the accounted part of the variation of $\ln L$ by $\ln \hat{L}$). In contrast, $\sigma^2_{\ln E_*} = (1 - R^2) \sigma^2_{\ln L}$ is the unaccounted part of the variation of $\ln L$. Thus, when the degree of fit R is high enough, we are likely to get a relatively small value of $[(1 - R^2) \sigma^2_{\ln L} / \sigma^2_{\ln Q_*}]$, occurring in the expression for $r_{\ln E,\ \ln Q_*}$, shown in the result (4 - II) of Lemma 4. Thus, from this expression, we can infer that $r_{\ln E,\ \ln Q_*}$ is likely to be of relatively high magnitude, when the degree of fit of the modified function is quite high.

Observation 7 : From our arguments already given on the nature of Q as a localisation qualifying variable for labour-absorptive activity-base, it could be taken for granted that both $r_{\ln Q,\ \ln X_0} = r_{\ln Q_*,\ \ln X_0}$, and $r_{\ln Q,\ \ln L}$ $(= r_{\ln Q_*,\ \ln L})$ must be quite high. Now from the result (4 - Va), it follows that the extent to which $r_{\ln Q,\ \ln X_0}$ is below unity, $r_{\ln E,\ \ln X_0}$ will be below $r_{\ln E,\ \ln Q_*}$ $(= r_{\ln E,\ \ln Q})$ exactly to that extent multiplicatively. Given that the fit of the modified labour absorption function is very good, $r_{\ln E, \ln Q_*}$ is likely to be quite high (Observation 6) and consequently $r_{\ln E, \ln X_0}$ is likely to be of high magnitude, marginally lower than $r_{\ln E, \ln Q_*}$, if $r_{\ln Q_*, \ln X_0}$ is strong enough, reflecting a high degree of presence of the labour-absorptive localisation economy. Again, under the same condition that the modified functional fit is very high, $r_{\ln E, \ln Q_*}$ is likely to be quite high (Observation 6) and consequently, from the result (4 - VI), $r_{\ln E, \ln L}$ is likely to be of high magnitude, comparable with $r_{\ln Q_*, \ln L}$, if $r_{\ln Q, \ln L}$ itself is high enough, reflecting again a high degree of presence of the labour-absorptive localisation economy. Thus, as the presence of high localisation economy gets transmitted in the log-linear relationship between E and Q_* (Observation 5), it is also transmitted in the log-linear relationship between E and L.

Observation 8 : Again, as $r_{\ln E, \ln Q_*}$ is likely to be high (Observation 6), we can infer from the result (4-IIIb) that the log-linear relationship between the over-all efficiency measure E and the localisation-free modified efficiency measure E_* is likely to be poor. Now from Observations (4), (5) and (7) and also from the results (2 - III), (2 - V) and (2 - VI) of Lemma 2, we have established the following Proposition 4 :

Proposition 4 : The extent of presence of the labour-absorptive localisation economy, measured by the excess of over-all labour-absorptive scale μ over the localisation-accounted scale μ_*, is transmitted in the over-all efficiency measure E, reflected in the degree of its log-linear relationship with both localisation component of efficiency Q_* and the activity-base X_O and also with labour L, absorbed, whereas it is not transmitted at all in the localisation-free modified efficiency measure E_*.

Next, from Observations (6), (7) and (8) and also from the results (2-III), (2-V) and (2-VI) of Lemma 2, we have established further the Propositions 5 and 6, stated below.

Proposition 5 : When the degree of fit of the modified labour absorption function is very high and the extent of presence of the labour-absorptive localisation economy is high enough, the over-all efficiency measure E and the localisation-free modified efficiency measure E_* will have poor log-linear relation.

Proposition 6 : When the degree of fit of the modified labour absorption function is very high and the extent of presence of the labour-absorptive localisation economy is high enough, both the localisation component of efficiency Q_* and the activity-base X_0 and also the labour L, absorbed, will have high log-linear relationship with the over-all efficiency measure E. In contrast, irrespective of the presence of labour-absorptive localisation economy, both Q_* and X_0 have no log-linear relationship with the localisation-free efficiency measure E_*, and the log-linear relationship of L with E_* becomes insignificant.

Thus from all the above Observations, we have the following conclusive Proposition 7, established already.

Proposition 7 : While the efficiency measure E_0 derived from the original labour absorption function, and the modified efficiency measure E_*, derived from the modified labour absorption function, are of the same variety, reflecting only the localisation-free labour-absorptive efficiency, the over-all efficiency measure E, composed of the localisation-free efficiency measure E_* and the localisation component of efficiency Q_*, is of completely different variety, reflecting the over-all localisation-accounted labour-absorptive efficiency.

What we have attempted so long to establish formally in all preceding Lemmas, Observations and Propositions, is that the labour-absorptive localisation-free efficiency measure of the variety E_0 or its comparable E_*, formulated analogically on the prevalent concept of technical or productive efficiency (ref. to Farrel [1957]) has to be nothing but some sort of random fluctuations at any moving point of average expansion path of activity-base ——— original or modified. Farrel has, however, not compared from the average expansion path, but taken instead some sort of ideally maximal expansion path, related to production technology, called the frontier, which is parallel to the average path. This means that the measure E_0 (as defined by Farrel with the restriction $\mu_0 = 1$), when constituted with the benchmark of average expansion path, will differ from his original frontier efficiency (or, absolute efficiency) only by a constant. So the deviation of frontier efficiency from this constant (some sort of central value of absolute efficiency) will again be random around the central value. Arrow, Chennery, Minhas & Solow [1961] has, however, used the average expansion path related to the production technology in connection with their formulation of the CES (Constant Elasticity of Substitution) Production Function (with the restriction on scale, $\mu_0 = 1$, same as in Farrel's work) and the related empirical study for International comparisons between countries on technical (or, productive) efficiency level. This restriction was really removed in Pal and Saha [1981b] and they formulated the generalised measure, not only of the type E_0, but also of the type E_* and E with the incorporation of the localisation performance factor Q. In fact, much of our conclusions made here in the context of labour-absorptive efficiencies, are based very much on Pal and Saha's [1981b] work, with, however, necessary modifications and improvements on the mode of treatments in analytical formulations and their theoretical evaluations. Thus, it is rather the ingenuity of Pal and Saha who devised first the over-all productive efficiency measure of the type E and shown its difference from the comparable measures E_0 and E_*.

In our analogical study on labour-absorptive efficiency formulations, we have, however, established on a much more firm-footing with more rigourous analytical treatment, that, despite incorporation of the localisation performance factor Q, the modified efficiency measure E_* is nothing but the original efficiency measure E_0, obtained from the original labour-absorption function without the incorporation of Q. The varieties of scaled labour-absorptivity, which are shown to be proportional to the different measures of labour-absorptive efficiency, have been first introduced in our study. This has helped us not only to formulate theoretically the efficiency measures of the components of activity-base, but also to establish on a firm-footing why the scaled labour-absorptivities,

$$A_O = \frac{L}{X_O^{\mu_O}} \simeq \frac{L}{X^{\mu}}$$

and $$\frac{L}{X^{\mu}} = \frac{L}{X_*^{\mu_*}} = A^* ,$$

proportional to the efficiency measures E_O and E_* respectively, are comparable and are really associated with the localisation-free efficiency measures, with over-all labour-absorptive scale μ_O (associated with X_O) or μ (associated with X of comparable degree with X_O), and the localisation accounted scale μ_* (associated with $X_* = X_O^{\alpha_*}$ = the localisation degree-adjusted X_O). Clearly, the over-all scaled labour-absorptivity, $A = \frac{L}{X^{\mu_*}}$, proportional to over-all labour-absorptive efficiency E, is obtained by setting the degree of localisation economy parameter α^* at the neutral level (i.e., $\alpha^* = 1$) leading to the change of X_* to X_O only in A_*, and keeping in tact the localisation-accounted labour-absorptive scale μ_*, so that the localisation-neutral activity-base X_O coupled with the localisation-accounted scale μ_* could measure effectively the over-all efficiency in relation to neutral activity-base, which could then take into account really the advantage of the labour-absorptive localisation-economy, (ref.

to (4.64) where we get $E = E_* Q_*$). We have also established this fact formally through the Lemmas, proved already.

Thus with the presence of labour-absorptive localisation economy associated with the activity-base (the consequence of differential regional activity-specialisations), one can never get the true over-all efficiency measure E unless one introduces a suitable localisation performance factor Q qualifying the activity-base X_0 and evaluates the localisation-accounted scale parameter μ_* ($= \mu - s$) *instead of* μ_0 ($\simeq \mu$). *Granting this importance of our presently devised over-all efficiency measurement* E, we would rather bank on E than on E_* or E_0 in our empirical analyses to follow. The effect of the localisation component of efficiency Q_* is also transmitted into E in terms of their complex interactions with X_0 and L through the modified labour absorption function, from which necessary localisation-accounted scale μ_* and the over-all scale μ are derived. However, this complexity of interactions is reflected only in the measure E, but not in Q_*, simply because the spatial variations to be depicted by $Q_* = Q^s$, would be similar to what could be depicted by Q alone without the parameter s, and Q is a variable not obtained through the process of functional fit, while the efficiency measure E (or, E_*) is. As such it is better to go for the spatial analysis of efficiency through the measure E. We have already established in our various Lemmas that

$$r_{\ln L,\ \ln E} > r_{\ln L,\ \ln E_*},\ r_{\ln L,\ \ln E} > r_{\ln L,\ \ln E_0}$$

and $r_{\ln E_*,\ \ln E_0}$ is of generally high magnitude. This also establishes the superiority of E over E_* or E_0 in respect of its power of explaining the spatial variation of the labour absorption level L by the activity-base. Although E_* and E_0 are the measures of the same variety, yet there are certain subtle distinctions between them, simply because E_* is really associated with the modified activity-base while E_0 is, with the original activity-base only. Thus, there could be some distinctions between their relative role in explaining the spatial variation of the labour absorption level L. This we shall now discuss below in some details.

We have already noted that the log-linear correlation of E_* and E_0 with L have been derived already (ref. to results (1-III) and (2-III) of Lemmas 1 and 2) and these are

$$r_{\ln E_0,\ \ln L} = \sqrt{(1 - r_{\ln L,\ \ln X_0})/2}$$

and $$r_{\ln E_*,\ \ln L} = \sqrt{1 - R^2}$$

As the measure E_0 is connected with the activity-base X_0, and the measure E_*, with the modified activity-base X_*, for which

$$R = r_{\ln L,\ \ln \hat{L}_*}$$
$$= r_{\ln L,\ \ln X_*} = r_{\ln L,\ \ln X} > r_{\ln L,\ \ln X_0} = r_{\ln L,\ \ln \hat{L}_0},$$

We would have

$$r_{\ln E_*,\ \ln L} = \sqrt{1-R^2} \geqq \sqrt{(1-r_{\ln L,\ln X_0})/2} = r_{\ln E_0,\ \ln L}\ ,$$

if the modified functional fit is not very widely apart from the original functional fit (permitting the switch over from the VLS to VLS-δ Constrained OLS),

i.e. so long, $R \leqq \sqrt{\frac{1}{2}\,(1 + r_{\ln L,\ \ln X_0})}$

= (the average of original fit and the perfect fit)$^{\frac{1}{2}}$,

given that the original functional fit is very good, resulting into a very high value of $r_{\ln L,\ \ln X_0}$.

The justification for setting the above mentioned upper limit of R is as follows : we have,

$1 - r^2_{\ln L,\ \ln X_0}$ = total unaccounted variation of the original functional fit (the same, whether the fit is by the VLS or the VLS-δ Constrained OLS procedure),

and, $r^2_{\ln E_0,\ \ln L} = \frac{1}{2}(1 - r_{\ln L,\ln X_0})$, (ref. to (1-III) of Lemma 1)

= the proportion of variation of ln L accounted by $\ln E_0$ (= the residual, $\ln L - \ln \hat{L}$, for the original functional fit by the VLS procedure).

Now, if $r_{\ln L, \ln X_0} < R \leq \sqrt{\frac{1}{2}(1 + r_{\ln L, \ln X_0})}$,

then $\sqrt{1 - r^2_{\ln L, \ln X_0}} > \sqrt{1 - R^2} \geq \sqrt{\frac{1}{2}(1 - r_{\ln L, \ln X_0})}$,

and by use of result (2-III) of Lemma 2, we have

$$r_{\ln \hat{E}_0, \ln L} > r_{\ln E_*, \ln L} \geq r_{\ln E_0, \ln L},$$

i.e. (value by VLS-δ Constrained OLS fit of original function) > (value by VLS-δ Constrained OLS fit of modified function) ≥ (value by the presently used VLS fit of original function)

We have $r_{\ln \hat{E}_0, \ln L} > r_{\ln E_*, \ln L}$ always, when both the fits are by the VLS-δ Constrained OLS procedure. But as the switch over to VLS procedure sets the lower limit of $r_{\ln \hat{E}_0, \ln L}$ to $r_{\ln E_0, \ln L}$, it is reasonable that $r_{\ln E_*, \ln L}$ should not go beyond these limiting values, for the sake of comparability and consistency in the switch-over. Thus the upper limit of $R \leq \sqrt{\frac{1}{2}(1 + r_{\ln L, \ln X_0})}$ is considered as to be the permissible limit for a switch-over from VLS (for original functional fit) to VLS-δ Constrained OLS procedure (for modified functional fit).

It is to be emphasized here that the result of our judicious switch-over has been the rational expectation of getting

$$r_{\ln E_*, \ln L} \geq r_{\ln E_0, \ln L}.$$

This could clearly be expected to hold on the theoretical grounds that E_* is really based on $X = X_0^{\frac{1}{1+\alpha}}\,\Omega^{\frac{\alpha}{1+\alpha}}$ (which is of same degree as X_0, used in the formulation of E_0, so that X and X_0 have the comparable labour-absorptive scales μ and μ_0 respectively) that takes into account the favourable interaction possibilities of X_0 and Ω (granting their high positive relation), and as such it ought to give rise to a higher $r_{\ln E_*,\ \ln L}$ than $r_{\ln E_0,\ \ln L}$. Had we used the same VLS-§ Constrained OLS procedure for the fits of both the functions, we would have never got this rational expectation satisfied.

Thus the results obtained above can now be put in the form of Proposition 8, stated below :

<u>Proposition 8</u> : If $r_{\ln L,\ \ln X_0} < R \leq \sqrt{\frac{1}{2}\,(1 + r_{\ln L,\ \ln X_0})}$,

then we have

$$r_{\ln E_*,\ \ln L} \geqq r_{\ln E_0,\ \ln L}$$

and

$$\sqrt{1 - r^2_{\ln L,\ \ln X_0}} > r_{\ln E_*, \ln L} \geqq \sqrt{\tfrac{1}{2}(1 - r_{\ln L, \ln X_0})}$$

Now, from the results of Proposition 8, the following Proposition 9 immediately follows :

<u>Proposition 9</u>: When the localisation economy is so pronounced (depending upon the magnitude of $r_{\ln \Omega,\ \ln L}$) that the

degree of modified functional fit, R, tends to the upper limit $\sqrt{\frac{1}{2}(1 + r_{\ln L,\ \ln X_0})}$, then $r_{\ln E_*,\ \ln L}$ tends to coincide with $r_{\ln E_0,\ \ln L}$.

4.9 Internal Productive-efficiency and the Productive-Scale of the Activity-Base

Apart from the localisation-free labour-absorptive efficiency measures E_0 and E_* (or, the over-all efficiency measure E), the activity-base X_0 (or, the modified activity-base $X_* = X_0\ Q^{\alpha}$) has its own internal productive or technological efficiency. We shall denote the internal productive-efficiency index of the activity-base by T_*, which can be simply formulated as follows :

$$T_* = T/\tilde{T}$$

where $T =$ productivity of activity-base

$$= Y/X_0 = (Y/K)^{\delta} = (Y_*/K_*)^{\delta} = Y_*/X_*$$

and $\tilde{T} =$ geometric mean of T.

Clearly, higher the value of T_*, the higher will be the productive-efficiency of the activity-base.

Thus the activity-base X_0 is associated with two types of efficiency measures, namely,

.../-

E_0 (or, E_*) = localisation-free labour-absorptive efficiency of the activity-base

and T_* = internal productive efficiency of the activity-base.

While $r_{\ln E_0,\ \ln L}$ (or, $r_{\ln E_*,\ \ln L}$) gives the degree of spatial association between the localisation-free labour-absorptive efficiency E_0 (or, E_*) with L, it does not help in understanding whether or not the internal productive efficiency of activity-base is in anyway inducing the spatial variation in the labour absorption level L (favourably, neutrally or unfavourably, whatever may be the case). To understand this role of the internal productive efficiency of the activity-base, we have not only to examine the relationship, $r_{\ln T_*,\ \ln L}$, but also to assess how the labour-absorptive scale μ_0 ($\simeq \mu$) compare with the productive scale, say, λ_0, of the same activity-base X_0. We shall now deduce below the analytical formulae for computations of λ_0 (VLS-estimate, comparably with what we applied for the estimation of μ_0), and $r_{\ln T_*,\ \ln L}$.

We have $\ln X_0 = \delta \ln K + (1-\delta) \ln Y$, so that

$$\sigma_{\ln X_0} z_{\ln X_0} = \delta\, \sigma_{\ln K}\, z_{\ln K} + (1-\delta)\, \sigma_{\ln Y}\, z_{\ln Y} \quad \ldots(4.92)$$

Then we can deduce

$$\left.\begin{aligned} \sigma_{\ln X_0} &= (1-\delta)\,\sigma_{\ln Y}\sqrt{1+\Psi^2+2\,\Psi\, r_{\ln K,\ \ln Y}}\,' \\ \text{where } \Psi &= \frac{\delta\,\sigma_{\ln K}}{(1-\delta)\,\sigma_{\ln Y}} \end{aligned}\right\} \quad \ldots(4.93)$$

The VLS estimate of the productive-scale of the activity-base, λ_0, is then given by

$$\lambda_0 = \frac{\sigma_{\ln Y}}{\sigma_{\ln X_0}} = \frac{1}{(1-\delta)\sqrt{1+\Psi^2+2\,\Psi\, r_{\ln K,\ \ln Y}}} \quad \ldots(4.94)$$

The corresponding degree of fit is given by :

$$r_{\ln Y,\ \ln X_0} = \frac{1+\Psi\, r_{\ln K,\ \ln Y}}{\sqrt{1+\Psi^2+2\,\Psi\, r_{\ln K,\ \ln Y}}} \quad \ldots(4.95)$$

Again, we can deduce

$$\ln T_* = \delta\,[\,\sigma_{\ln Y} z_{\ln Y} - \sigma_{\ln K} z_{\ln K}\,] \text{ and } \overline{\ln T_*} = 0$$

Then,

$$\sigma_{\ln T_*} = \delta\sqrt{\sigma^2_{\ln K} + \sigma^2_{\ln Y} - 2\,\sigma_{\ln K}\,\sigma_{\ln Y}\, r_{\ln Y,\ \ln K}}$$

so that

$$z_{\ln T_*} = \frac{\sigma_{\ln Y}\, z_{\ln Y} - \sigma_{\ln K}\, z_{\ln K}}{\sqrt{\sigma^2_{\ln Y} + \sigma^2_{\ln K} - 2\,\sigma_{\ln Y}\,\sigma_{\ln K}\, r_{\ln Y,\ln K}}} \quad \ldots(4.96)$$

Then,

$$r_{\ln L,\ln T_*} = \frac{\sigma_{\ln Y}\, r_{\ln Y,\ln L} - \sigma_{\ln K}\, r_{\ln K,\ \ln L}}{\sqrt{\sigma^2_{\ln Y} + \sigma^2_{\ln K} - 2\,\sigma_{\ln Y}\,\sigma_{\ln K}\, r_{\ln Y,\ln K}}} \quad \ldots(4.97)$$

Clearly,

$$r_{\ln L,\ \ln T_*} > , = , < 0 ,$$

according as : $\sigma_{\ln Y} r_{\ln Y,\ \ln L} > , = , < \sigma_{\ln K} r_{\ln K, \ln L}$

i.e. according as : $COV(\ln Y, \ln K) > , = , < COV(\ln K, \ln L)$

We shall examine the actual values of $\sigma_{\ln L,\ \ln T_*}$ empirically for different manufacturing activity-bases. We shall also compare and contrast the two scales of the avtivity-base ——— the labour-absorptive, μ_0, and the productive, λ_0, for drawing qualitative inferences on the conformity or non-conformity of μ_0 with λ_0 under labour-abundant state of our general national economy.

Thus, in summary, from our foregoing discussions, we are likely to get the following inequality relations :

$$r_{\ln E,\ \ln L} > r_{\ln E_*,\ \ln L} \geq r_{\ln E_0,\ \ln L}$$

if the localisation economy is favourably operative with the activity-base. As the efficiency measure $E = E_* Q_*$, which accommodates the interaction of both E_* and Q_*, gives the over-all labour-absorptive efficiency, showing the best sort of relationship for the labour-absorption level L, the nature of its spatial variation is of great interest in the context of labour absorption possibilities on space. Thus, the variation of E has been depicted cartographically in Figure (4.2), while the other relevant relationships between indices and variables have been compared and analysed statistically in a following section (4.9).

4.10 Empirical Evaluation of the Modified Labour Absorption Function and the Statistical Tests and Preliminary Analyses on Parameters

The theoretical expositions of the statistical method and the related variables proposed to be employed for empirical evaluations of the modified labour absorption functions have already been made (ref. to section (4.3)). Results of our actual empirical evaluations are recorded here in Table (4.3) for the totality of all 20 manufacturing activity-bases as per NIC, used in the official Annual Survey of Industries (1975-76). In this table, we have not only presented the parameters of the modified functional fits, but also recorded again those relevant parameters of the original functional fits which need to be compared with the corresponding estimates of the modified functional fits. Thus, the original VLS estimates of $r_{\ln L,\ \ln X_0}$, δ, and μ_0 are requoted in this table; while the estimates of δ are essential to construct the activity-base variable X_0 for use in the evaluations of modified functional parameters, the other two original functional parameters are for comparisons with the corresponding parameters R and μ of the modified functional fits (by VLS-δ

Table 4.3 : Estimates of Parameters of the Original and the Modified Labout Absorption Function and the Relevant Statistical Tests

Industry Code & Abbreviated Name	Parameters of the Original Function (VLS fit)			Parameters of the Modified Function (VLS-δ Constrained OLS fit)					Values of |t| Statistic to Test	
	$r_{\ln L,\ \ln X_0}$	δ	μ_0	μ	μ_*	s	γ	R	$H_0 : \mu = \mu_0$	$H_0 : s = 0$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
20 + 21 Fd.	0.8582	0.506	0.789	0.772	0.403	0.369	97.8386	0.9008	0.667	9.897
22 Bv.	0.6915	0.391	0.588	0.594	0.142	0.452	869.6889	0.8023	0.127	6.402
23 Ctex.	0.9397	0.514	0.899	0.847	0.578	0.270	20.6219	0.9541	2.388	7.224
24 Wss	0.9019	0.488	0.754	0.737	0.376	0.361	77.7276	0.9316	0.436	4.978
25 Jtex.	0.9771	0.584	1.166	1.118	1.010	0.108	0.1657	0.9780	0.655	0.822
26 Tex.	0.8654	0.514	0.737	0.685	0.463	0.222	25.5075	0.8917	0.921	3.259
27 WT	0.8192	0.503	0.720	0.705	0.443	0.262	26.9370	0.8655	0.291	4.882
28 Pr.	0.9201	0.477	0.686	0.705	0.432	0.273	36.5983	0.9515	0.871	8.938
29 Lr.	0.9111	0.548	0.826	0.837	0.577	0.260	7.7771	0.9405	0.145	2.852
30 RPPC	0.8773	0.510	0.594	0.608	0.239	0.369	209.2792	0.9317	0.457	6.961
31 Ch.	0.8773	0.460	0.692	0.690	0.373	0.317	66.0991	0.9190	0.080	8.628
32 Nmtl.	0.9060	0.491	0.700	0.741	0.370	0.370	115.1041	0.9407	1.852	9.304
33 Bmtl-Al.	0.9168	0.472	0.726	0.754	0.409	0.344	78.9611	0.9484	1.183	8.547
34 Mtl.	0.9065	0.467	0.769	0.728	0.457	0.271	21.5516	0.9401	1.310	6.573
35 Nel.	0.9104	0.462	0.697	0.726	0.421	0.304	44.6976	0.9395	1.059	6.849
36 El.	0.8944	0.446	0.735	0.739	0.422	0.317	43.0715	0.9312	0.053	5.675
37 Tr.	0.9024	0.472	0.775	0.772	0.343	0.430	116.7164	0.9576	0.152	10.192
38 Mscl.	0.9084	0.461	0.717	0.694	0.515	0.179	11.3567	0.9255	0.544	3.347
40 + 41 EWG	0.9183	0.450	0.791	0.846	0.468	0.378	34.1637	0.9468	1.552	6.274
97 Mscl-R.	0.9018	0.439	0.752	0.730	0.413	0.316	56.1068	0.9374	1.142	10.782

Constrained OLS procedure, as stated). The estimate of the over-all labour-absorptive scale μ is, however, a derived parameter from its constituents μ_* and s, the contributions to the over-all scale respectively by the activity-base X_0 and the localisation performance factor Ω. These two constituent scale-parameters of the modified functional fits, together with the intercept parameter γ, are also presented in this table. We shall now make brief comparative tests and analyses on the parameters presented in this Table (4.3).

4.10.1 Comparisons of Correlation Coefficients $r_{\ln L,\ \ln X_0}$ and R for the Two Functional Fits

We have noted in Lemma 2 that R gives the log-linear correlation coefficient $r_{\ln L,\ \ln X_*}$, between the labour absorption level and the modified activity-base X_*, whereas $r_{\ln L,\ \ln X_0}$ is that between the labour absorption level and the original activity-base X_0. From our theoretical discussions made earlier on the VLS fit, it is clear that when $r_{\ln L,\ \ln X_0}$ gives correlation coefficient between $\ln L$ and $\ln X_0$, the central axis, passing centrally through the scatter of points ($\ln L$, $\ln X_0$), is equally related with both $\ln L$ and $\ln X_0$ with correlation coefficient (or, specific representation) $\sqrt{\frac{1}{2}\,(1 + r_{\ln L,\ \ln X_0})}$. Now, the improved correlation coefficient $r_{\ln L,\ \ln X_*}$, **if obtained by the** " VLS-δ

Constrained OLS" procedure of construction of the modified activity-base X_*, should not be such that $\ln X_*$ would be better related than the VLS-fit central axis, with the labour absorption level L ; this is necessary in order to maintain the comparability and consistency between the two modes of functional fits (as argued already in connection with the Proposition 8 in section (4.5)). Thus, if the localisation economy is favourably operative on labour absorption by the activity-base, the modification of the activity-base to X_* must give improved values of $R = r_{\ln L,\ \ln X_*}$ as compared with $r_{\ln L,\ \ln X_0}$, but the regressand axis-biased least squaring, implicit in the evaluation of the regressand-axis for $\ln X_*$ should not be allowed to over-ride the axes-neutral vertical least squaring, implicit in the evaluation of the central axis, and as such, the upper limit of R is restricted to the value of $\sqrt{\frac{1}{2}(1 + r_{\ln L,\ \ln X_0})}$. Now, from the empirical estimates on $r_{\ln L,\ \ln X_0}$ and R, reported in Table (4.3), it can be easily verified that estimates of R for all manufacturing activity-bases have shown improvements over $r_{\ln L,\ \ln X_0}$, corroborating the presence of favourable labour-absorptive localisation-economy, and at the same time these are well below the permissible upper limit $\sqrt{\frac{1}{2}(1 + r_{\ln L,\ln X_0})}$, (computations not shown in the table, but can be easily verified), showing the compatibility between the axes-neutral "VLS" and the regressand-axis biased "VLS-δ Constrained

OLS" modes of the two functional fits. The absolute magnitudes of R are generally very high for practically all manufacturing activity-bases (with a little less value for only the manufacturing industry of "beverages", coded by the number 22, which has largely a heterogeneous coverage of industries like alcohol, tea, coffee, tobacco, etc. Thus, all the modified functional fits can generally be considered as very good.

4.10.2 Nature of the Labour Absorption Responsive Distribution Parameter in the Formulation of Activity-Base

It has been argued already that for the presence of almost equally strong multicollinearities between variables $\ln L$, $\ln K$ and $\ln Y$, it is expected that both $\ln K$ and $\ln Y$ would be more or less similarly responsive to $\ln L$, so that we have

$$\frac{\partial \ln L}{\partial \ln K} : \frac{\partial \ln L}{\partial \ln Y} = \delta : (1 - \delta) \simeq 1$$

and thus the derived log-activity-base variable

$$\ln X_O = \delta \ln K + (1 - \delta) \ln Y$$

are more or less the equally weighted linear combination of $\ln K$ and $\ln Y$. This expectation is more or less fulfilled with our empirical estimates of δ as quoted in the present Table (4.3), which show a very narrow range of its variation, between 0.39 and 0.58, with most of the values around the central value of 0.50. Thus, our estimates of δ can be regarded as to be more or less very near to 0.50, implying almost the equality of δ and $(1 - \delta)$, for all manufacturing activity-bases. However, the lowest value of $\delta = 0.39$ has occurred again for the "beverage" industry (code no. 22) and the highest and the second highest values of δ are 0.58 and 0.55 for the "jute" industry (code no. 25) and "leather" industry (code no. 29) respectively. This means that with the increasing capital concentration in core areas of activity-bases, the relative response of capital to labour absorption is least increasing in case of "beverage" industry (out of all manufacturing industries), and it is most and next to most increasing in cases of "jute" and "leather" industries respectively.

4.10.3 Comparisons of the Over-all Labour-Absorptive Scales μ_0 and μ, as Evaluated from the Two Functional Fits and Their Classification

Our contention has been that the over-all labour-absorptive scale must be almost similar, irrespective of the explicit incroporation of the effect of localisation factor with the activity-base. Even in the absence of explicit incorporation of the localisation factor, it is believed that its role in the labour-absorptive scale is taken care of by the activity-base alone, because of the implitcit inter-connections that exist between them. This means that the over-all scale μ_O, as evaluated from the original labour-absorption function, is expected to be of similar magnitude with μ, derived from the modified labour absorption function. Thus, for the validity of our contention, we have statistically tested the null hypothesis : $\mu_O - \mu = 0$, for all manufacturing activity-bases. Our test results (values of Student's t-statistic quoted below the estimates of μ in Table (4.3)) go in favour of acceptance of the null hypothesis in every case (at 5% level of significance for all manufacturing activity-bases, except for " cotton textile" (code no. 23) for which the null hypothesis is accepted at 1% level of significance), meaning thereby that μ_O is not significantly different from μ generally for any particular manufacturing activity-base. However, from an examination of empirical estimates, we notice an wide range of variation of μ (or, μ_O) over different manufacturing activity-bases. As such, we would like to classify the different manufacturing activity-bases in terms of their over-all labour-absorptive scales, μ. The constant (i.e. neither increasing nor decreasing) labour-absorptive scale is signified by the value of μ equal to unity. To identify the cases of distinctly increasing and distinctly diminishing labour-absorptive scales, we would form a class with values of μ around unity. This class, called the class of near-constant labour-absorptive scale, is taken as to be the interval (0.93 to 1.07).

Other classes are formed taking class-intervals of equal lengths, and identified as follows :

$\mu > 1.07$	:	increasing scale,
$0.93 \leq \mu \leq 1.07$	:	near-constant scale,
$0.79 \leq \mu < 0.93$	:	diminishing scale,
$0.65 \leq \mu < 0.79$	:	highly diminishing scale
$\mu < 0.65$	:	very highly diminishing scale

On the basis of this classification scheme on μ (or, μ_0), the different manufacturing activity-bases can be characterised as follows, (classified and arranged in decreasing order of magnitude of μ) :

1) <u>increasing scale of labour absorption for</u>
Jute Textile (code no. 25) only,

2) <u>diminishing scale of labour absorption for</u>
Cotton Textile (code no. 23), distributive industry of Electricity, Gas and Water (code no. 40+41) and leather industry (code no. 29),

3) <u>highly diminishing scale of labour absorption for</u>
Food (code no. 20+21), Transport Equipment (code no. 37), Metal and Alloy (code no. 33), Non-metal (code no. 32), Electric Machinery (code no. 36), Wool, Silk and Synthetic Textiles (code no. 24), Miscellaneous Repairs (code no. 97), Metal Products (code

no. 34), Non-electrical Machinery (code no. 35), Wood & Timber (code no. 27), Paper (code no. 28), Miscellaneous Manufacturing (code no. 38), Chemicals (code no. 31) and Textile Products (code no. 26),

4) very highly diminishing scale of labour absorption for Petroleum, Coal, Rubber and Plastic (code no. 30) and Beverages (including alcohol, tea, coffee, tobacco, etc.) (code no. 22).

Thus, it is clear that most of the manufacturing activity-bases show highly diminishing scale of labour absorption with " beverages" and " petroleum etc." showing distinctly lowest values of μ (or, μ_0). On the other extreme, only " jute" industry distinctly stands out as the only manufacturing activity-base showing the increasing scale of labour absorption.

4.10.4 Statistical Tests on the Presence of Localisation Economy

Although the two over-all labour-absorptive scales μ_0 and μ are of comparable magnitudes, we are not in a position to have any knowledge on the presence or absence of localisation economy for the activity-bases, unless we go for the modified functional fit with the explicit incorporation of the localisation factor Q (together with the activity-base X_0) and determine the relative contribution s of the localisation factor in the over-all scale μ (= $\mu_* + s$). As such the original functional fit is not of much use in the context of assessing the specific role of localisation economy on the activity-base for labour absorption. Thus the modified labour absorption function is absolutely essential in this kind of assessment. From the empirical estimates of s given in Table (4.3), it is clear that the values are positive for all manufacturing activity-bases, showing the presence of localisation economy only (out of the three possibilities referred to in section (4.3) earlier). Yet a few values are not much above zero and as such we have to test statistically how significant is the presence of localisation economy with the different manufacturing activity-bases. For the test we have to set the null hypothesis as : $\alpha^{*} - 1 = 0$, which is equivalent to : $\alpha = 0$, i.e. $s = 0$. Our test results on s (values of Student's t-statistic quoted below the estimates of s in Table ((4.3)) show that, the null hypothesis has been violated for all manufacturing activity-bases except for " jute" (code no. 25). This means that the localisation economy has acted favourably on all activity-bases (with the exception of " jute"), in general, for labour absorption function.

It is interesting to note that the increasing over-all labour-absorptive scale of the only manufacturing activity-base of " jute" industry has not been contributed much from the localisation economy; the activity-base alone has been almost responsible for the favourable labour-absorptive scale above unity. Another point of interest is : it is usually taken for granted that the localisation economy, which is a form of spatial agglomeration economy, generally induces an increasing productive scale of technology-bases (ref. to Shefer [1973], Carlino [1979], Pal and Saha [1981b], etc.); but, despite the favourable presence of localisation economy for activity-bases, the over-all labour-absorptive scale has been, in most of the cases, highly or very highly diminishing, which is certainly not conformal with the labour-abundant conditions of our national economic scenario. We shall examine this aspect on non-compatibility of the labour-absorptive scale and the productive scale of the activity-bases in a subsequent section (4.9) among other relevant matters. In the next section (4.8), we shall make attempt for evaluation of the inter-active characteristics of labour-absorptive efficiency measures and the localisation economy.

4.11 Evaluations of the Inter-active Characteristics of Labour-Absorptive Efficiency Measures and the Localisation Economy

We have the two labour-absorptive efficiency measures of the same kind, E_0 and E_*, given by $L/\hat{L}$, when $\hat{L}$ are the functional estimates of the labour absorption level L, obtained respectively from the statistical fits of the original and the modified labour absorption functions. The modification on the explanatory variable of the activity-base X_0, has, however, been done by its interaction with the labour-absorptive localisation factor Q, so that the modified activity-base X_* assumes the final form : $X_* = X_O Q_*$, where $Q_* = Q^\alpha$, with the estimation of the localisation power parameter α accomplished from only the modified functional fit. The characterisation of Q as a labour-absorptive localisation factor for the activity-base presupposes that Q would have a strong interaction on the activity-base, resulting into a stronger interaction possibly with the labour absorption level L. Thus, if this condition is satisfied on Q, the localisation economy is likely to act favourably on the activity-base, with a positive value of localisation power parameter α. In fact, we have already noted that α ($= s/\mu_*$) is positive for all manufacturing activity-bases, and it is significantly above zero for practically all activity-bases (with the exception of that related to " jute" industry). Thus, we can take that the labour-absorptive localisation economy is acting favourably on the activity-bases and also we can expect the occurrences of high positive values of the log-linear relationship $r_{\ln Q_*,\ \ln L}$. However, the way the efficiency measures E_O and E_* are formulated, we do not expect to have very high magnitudes of $r_{\ln E_O,\ \ln L}$ and $r_{\ln E_*,\ \ln L}$, as already established im Lemma 1 and 2, for very good functional fits. Also, for the method of formulation and evaluation of E_*, we notice that E_* is independent of Q_*, with $r_{\ln Q_*,\ \ln E_*} = 0$

always, as established in Lemma 2. Thus the effect of localisation economy on the labour absorption level L, as depicted by the localisation component Q_*, is not fully carried in the efficiency measure E_* (or E_0 even). As such, the over-all efficiency measure E has been evolved on modifying the efficiency measure E_* by Q_* (i.e. $E = E_* Q_*$), which takes into account the effect of localisation economy on the labour absorption level. We have already noted in section (4.5), on theoretical grounds, that

$$r_{\ln E,\ \ln L} > r_{\ln E_*,\ \ln L} \geq r_{\ln E_0,\ \ln L},$$

and also that $r_{\ln E,\ \ln L}$ is likely to be very high (ref. to results of Lemma 4).

All these are some sort of summarisation of our detailed discourse presented in the preceding section on theoretical grounds. Now we go for empirical evaluations of some important inter-active characteristics of labour-absorptive efficiency measures and the localisation economy, with reference to different manufacturing activity-bases.

4.11.1 Characteristics of the Localisation-free Efficiency Measures E_0 and E_*

We have already noted that $r_{\ln Q_*,\ \ln E_*} = 0$ always. We shall now examine first the inter-active characteristics between $\ln Q_*$ and $\ln E_0$, although E_0 is formulated without the explicit incorporation of the labour-absorptive localisation factor Q. As Q is supposed to influence favourably the local labour absorption level L, we are likely to get quite high log-linear inter-relationships of Q with both L and the activity-base X_0, as has been argued already, together with possibly the following inequality relation :

$$r_{\ln Q,\ \ln L} = r_{\ln Q_*,\ \ln L} \geq r_{\ln Q_*,\ \ln X_0} = r_{\ln Q,\ \ln X_0}$$

Although Q is not explicitly incorporated in the original functional fit, from which the efficiency measure E_0 is derived, the original activity-base X_0 itself takes care of the localisation factor Q to some extent (granting that Q has really a strong interaction on the activity-base X_0, resulting into a stronger inter-action with the labour absorption level). So some amount of log-linear relationship exists between the efficiency measure E_0 and the localisation factor Q, i.e. $r_{\ln E_0,\ \ln Q_*}$ is expected to be of some low positive magnitude. In fact, it can be derived from the result (4.72) of Lemma 1 that

$$r_{\ln Q_*, \ln E_0} = (r_{\ln Q_*, \ln L} - r_{\ln Q_*, \ln X_0}) / \sqrt{2(1-r_{\ln L, \ln X_0})}$$

Thus the inter-relationship $r_{\ln Q_*,\ \ln E_0}$ is normally different from zero, unless $r_{\ln Q_*,\ \ln L} = r_{\ln Q_*,\ \ln X_0}$. Again, from the above relation, it follows :

< The level of the original functional fit (i.e. $r_{\ln L,\ \ln X_0}$) remaining same, the higher the favourable interaction of $\ln Q$ on $\ln L$ compared with that on $\ln X_0$, the stronger will be the relationship $r_{\ln Q_*,\ \ln E_0}$.>

We have actually given the empirical estimates of $r_{\ln E_0,\ \ln Q_*}$ in Table (4.4), together with the estimates of $r_{\ln Q_*,\ \ln X_0}$ and $r_{\ln Q_*,\ \ln L}$. From this set of estimates, we can really notice that both $r_{\ln Q_*,\ \ln X_0}$ and $r_{\ln Q_*,\ \ln L}$ are of high magnitudes, satisfying $r_{\ln Q_*,\ \ln L} > r_{\ln Q_*,\ \ln X_0}$, generally for all manufacturing activity-bases, implying that the localisation factor Q is quite appropriately identified to depict the labour-absorptive localisation economy. As a result of this, we are likely to get the positive values of $r_{\ln Q_*,\ \ln E_0}$, which also get corroborated generally with our empirical estimates shown in Table (4.4), particularly when the original functional fit is very good. Thus, even though E_0 is identified as the localisation-free efficiency measure, its relationship with the labour-absorptive localisation factor Q is not entirely zero generally, rather it is very near to zero. However, the log-linear relationships have been always zero between E_* and Q. Granting this slight departure in the relationship with Q, the similarity of formulations of E_0 and E_* gets substantiated largely by the presence of generally high

Table 4.4 : Estimates of Inter-relations Between Labour-Absorptive Efficiency Measures and Variables Associated with Different Manufacturing Activity-Bases

Industry Code & Abbreviated Name	Correlation Coefficient for						
	$\ln Q_*$ & $\ln X_0$	$\ln Q_*$ & $\ln L$	$\ln E_0$ & $\ln Q_*$	$\ln E_0$ & $\ln E_*$	$\ln E$ & $\ln X_0$	$\ln E$ & $\ln Q_*$	$\ln E$ & $\ln E_*$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
20+21 Fd.	0.7824	0.8487	0.1245	0.8153	0.5752	0.7352	0.6778
22 Bv.	0.7638	0.7908	0.0344	0.8166	0.5654	0.7402	0.6724
23 Ctex.	0.8752	0.9042	0.0835	0.8627	0.6683	0.7636	0.6457
24 Wss	0.8636	0.8995	0.0810	0.8210	0.6908	0.7998	0.6002
25 Jtex.	0.9300	0.9306	0.0028	0.9740	0.4822	0.5185	0.8551
26 Tex.	0.7434	0.7971	0.1035	0.8728	0.4571	0.6149	0.7886
27 WT	0.6038	0.7339	0.2164	0.8328	0.3689	0.6109	0.7917
28 Pr.	0.7762	0.8699	0.2344	0.7699	0.6128	0.7895	0.6138
29 Lr.	0.6910	0.8029	0.2654	0.8065	0.4849	0.7017	0.7125
30 RPPC	0.8312	0.9068	0.1526	0.7334	0.7071	0.8507	0.5256
31 Ch.	0.7791	0.8603	0.1639	0.7963	0.5911	0.7587	0.6514
32 Nmtl.	0.8302	0.8964	0.1527	0.7817	0.6741	0.8120	0.5837
33 Bmtl-Al.	0.8262	0.8967	0.1728	0.7776	0.6727	0.8142	0.5806
34 Mtl.	0.7860	0.8702	0.1947	0.7884	0.6093	0.7752	0.6317
35 Nel.	0.8008	0.8715	0.1670	0.8098	0.6099	0.7616	0.6481
36 El.	0.7828	0.8654	0.1797	0.7964	0.5986	0.7647	0.6444
37 Tr.	0.8214	0.9261	0.2370	0.6517	0.7352	0.8951	0.4459
38 Mscl.	0.7415	0.7989	0.1341	0.8846	0.4431	0.5976	0.8018
40+41 EWG	0.8206	0.8879	0.1665	0.7976	0.6489	0.7908	0.6121
97 Mscl-R.	0.8104	0.8840	0.1661	0.7857	0.6425	0.7928	0.6095

inter-relations $r_{\ln E_0,\ \ln E_*}$, between E_0 and E_* for practically all manufacturing activity-bases, the direct empirical estimates of which are shown in Table (4.4). These direct estimates of $r_{\ln E_0,\ \ln E_*}$ are almost equal to (correct upto 2 or 3 places of decimals) what we would have obtained theoretically by application of result (3-III) of the Lemma 3, already established. Thus it is also empirically established that the log-linear relationships of the efficiency measures E_0 and E_* are quite high generally, and also that between E_0 and the localisation component Q_* are generally very low (often very near zero), implying that the localisation component, Q_*, is tending to be independent of E_0 (comparable to the fact of its independence from E_*). Broadly speaking, the role of localisation economy is not carried in both the efficiency measures E_0 and E_*, which are themselves highly co-associated.

4.11.2 Characterisation of the Over-all Efficiency Measure E

We have already noted that the over-all efficiency measure E is constitued of the two multiplicative components Q_* and E_* which are themselves independent log-linearly. For the localisation-free efficiency measure, we have already established through Lemma 2 that

$$r_{\ln E_*,\ \ln L} > r_{\ln E_*,\ \ln X_0} = 0$$

Again from various results and propositions established in and after Lemma 4 we are also likely to get, given a very good modified functional fit, the following relations theoretically.

$$r_{\ln E,\ \ln L} > r_{\ln E,\ \ln X_0} > 0$$

In this subsection we would like to examine first the contrast of the interactive characteristic of E against E_* in respect of the activity level. In other words, we shall analyse the empirical values of $r_{\ln E,\ \ln X_0}$, presented in Table (4.4), and examine how different these are from zero value which is attained always by $r_{\ln E_*,\ \ln X_0}$. On examination of the empirical estimates, we find that the values of $r_{\ln E,\ \ln X_0}$ occur within the range of 0.44 to 0.74 for different manufacturing activity-bases (except "wood and timber" (code no. 27), where it is a little lower). Thus, the log-linear relationship between E and X_0 can be considered as to be of moderate to high magnitude, considerably above zero. Thus, with the increasing level of activity-base, the over-all efficiency measure E is also increasing always, although the localisation-free efficiency measure E_* has been indifferent always to the changing level of activity-base. This contrasting fact also establishes the difference between E and E_* in relation to the spatial variations of the activity-bases.

Secondly, as both Q_* and E_* are the multiplicative constituents of the over-all efficiency measure E, and also, as we have the following complementarity relationship (established already in Lemma 4) :

$$r^2_{\ln E, \ln Q_*} + r^2_{\ln E, \ln E_*} = 1$$

both the constituents of E are likely to be co-associated with E itself. We have also established in Lemma 4 that $r_{\ln E, \ln X_0} = r_{\ln E, \ln Q_*} \cdot r_{\ln Q_*, \ln X_0}$. From this it is clear that both $r_{\ln E, \ln Q_*}$ and $r_{\ln Q_*, \ln X_0}$ are greater in magnitudes than $r_{\ln E, \ln X_0}$. As we have just verified empirically that $r_{\ln E, \ln X_0}$ are of moderate to high magnitudes, we could expect to get not less than high values (say, not less than 0.60 generally) for both $r_{\ln E, \ln Q_*}$ and $r_{\ln Q_*, \ln X_0}$ with different manufacturing activity-bases; of course, if the initial relation $r_{\ln Q_*, \ln X_0}$ ($= r_{\ln Q, \ln X_0}$) happens to be predominant, then its complementary relation $r_{\ln E, \ln Q_*}$ would obviously be not one of high values. We have already come across the empirical estimates of $r_{\ln Q_*, \ln X_0}$ in the preceding subsection (4.8.1) in connection with our discussion on $r_{\ln E_0, \ln Q_*}$. There we have noted that $r_{\ln E_0, \ln Q_*}$ is generally of low magnitude near zero and the least value has occurred for the activity-base of " jute" (code no. 25) together with the almost equal values of $r_{\ln Q_*, \ln X_0}$ and $r_{\ln Q_*, \ln L}$ with a predominant magnitude as high as 0.93. For all other activity-bases, the values of $r_{\ln Q_*, \ln X_0}$ are within the range from 0.60 to 0.875 (i.e. high to very high magnitude). As a result, with the moderate to high values of $r_{\ln E,\ \ln X_O}$ the values of $r_{\ln E,\ \ln Q_*}$ have also turned out to be high to very high, generally in the range from 0.60 to 0.895, except for " jute" for which it is of moderate magnitude (= 0.52) and for which we have already noted that the labour-absorptive localisation economy is not at all significantly operative on its activity-base.

Now, since the magnitudes of $r_{\ln E,\ \ln Q_*}$ are generally within the range from 0.60 to 0.895, we must have, by the complementarity relationship, stated already, the magnitude of $r_{\ln E,\ \ln E_*}$ generally within the range from 0.45 to 0.80, with the exception, however, for the activity-base of " jute" for which the value is higher (actually 0.855). Thus, while the relationship of E with the localisation component, $r_{\ln E,\ \ln Q_*}$, has been of high to very high magnitudes, the relationship of E with the complementary component of over-all efficiency, $r_{\ln E,\ \ln E_*}$, has been of moderate to high magnitude (≤ 0.80), but not very high except for " jute" which does not have significant localisation economy operative on the activity-base. It should be emphasized here that although $r_{\ln E,\ \ln E_*}$ is of moderate to high magnitude generally, the magnitude of $r_{\ln E_O,\ \ln E_*}$ happens to be considerably higher, mostly significantly, even for the activity-base of " jute". This again establishes that the efficiency measure E_* is of closer variety to E_0 than to E. Thus it also gets empirically confirmed that the over-all efficiency measure, E, takes into account not only the spatial variations of localisation component Q_*, but also the spatial variations of the localisation-free component of efficiency, E_*, although the components are not of the same variety as E.

4.12 Responses of Labour-Absorptive and Productive Efficiencies on the Labour Absorption Levels under Localisation Economy and the Comparative Performances of the Manufacturing Activity-Bases

We have now come to the most important part of statistical analysis on our empirical findings over the main issue of labour absorptions by different manufacturing activity-bases. In doing so, we would like to make comparative assessments of (i) on the one hand, the responses of different labour-absorptive efficiency measures on labour absorption levels and the way the responses get influenced under varying degrees of localisation economy, prevalent in different manufacturing activity-bases, and (ii) on the other hand, the role of internal productive efficiency measure, if any, on the labour absorption level, in contrast to that of the over-all labour-absorptive efficiency measure. The formulation of productive efficiency measure T_* has already been discussed in section (4.6). Additionally we shall analyse the comparative performances of any given activity-base in respect of its dual functions : production and labour absorption. We would like to do this by a comparative analysis between the productive scale and the labour-absorptive scale of the activity-base, particularly from the point of view of their compatibility in the event of prevalent labour-abundant scenario of our national economy. For the sake of comparability of the over-all productive scale parameter λ_0 and the over-all labour-absorptive scale parameter μ_0, the statistical fit for the production level Y as a function of the activity-base X_0 has been attempted by the same method and with the use of same X_0 as used already in our original functional fit for the labour-absorption level L. The details of estimation procedures of λ_0 and the degree of fit $r_{\ln Y,\ \ln X_0}$ have already been formulated in section (4.6). The empirical estimates relevant to our analyses in this section are presented in Table (4.5).

4.12.1 Responses of Labour-Absorptive Efficiencies on Labour Absorption Levels and the Influence of Localisation Economy

In the concluding phase of section (4.5), we have established on theoretical grounds that we are likely to get the following inequality relations :

$$r_{\ln L,\ \ln E_0} \leq r_{\ln L,\ \ln E_*} < r_{\ln L,\ \ln E}\ ,$$

depicting the comparative responses of the efficiency measures E_O, E_* and E to the spatial variations in the labour absorption level, L. From the actual empirical estimates, presented in Table (4.5), we like to find out more specifically the exact nature and relative magnitude of their responses. Our findings are summarised below :

1) It has been established in Proposition 1 through Lemma 1 that the localisation-free efficiency measure E_O is not much responsive to the spatial variations in L, so that $r_{\ln L,\ \ln E_O}$ is likely to be of low magnitude generally for the manufacturing activity-bases, particularly for good statistical fits of the original labour absorption functions. The empirical estimates of $r_{\ln L,\ \ln E_O}$ corroborate with that more or less. The range of variation of $r_{\ln L, \ln E_O}$ is between 0.17 and 0.30 for all activity-bases, except for that of "jute" (code no. 25) and "beverages" (code no. 22) [for which the degrees of fit of original functions are the highest and the lowest (values of $r_{\ln L, \ln X_O}$ are about 0.98 and 0.69), yielding the lowest and the highest values of $r_{\ln L, \ln E_O}$ —— 0.11 and 0.39 respectively.

2) From the results of Lemma 1, 2 and 3, we can easily deduce the following relation :

$$r_{\ln L, \ln E_*} = 2\, r_{\ln E_O, \ln E_*} \cdot r_{\ln L, \ln E_O}$$

Table 4.5 : Estimates of Localisation Power, Relations of Labour Absorption Level with Different Efficiency Measures of the Activity-Base and Comparisons Between Labour-Absorptive and Productive Scales

Industry Code & Abbreviated Name	α	Correlation Coefficient for					λ_0	μ_0	$\lambda_0-\mu_0$
		$\ln E_0$ & $\ln L$	$\ln E_*$ & $\ln L$	$\ln E$ & $\ln L$	$\ln L$ & $\ln T_*$	$\ln Y$ & $\ln X_0$			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
20+21 Fd.	0.916	0.2662	0.4342	0.9178	0.1273	0.9659	1.056	0.790	0.266
22 Bv.	3.183	0.3928	0.5969	0.9876	0.0376	0.9463	0.918	0.588	0.330
23 Ctex.	0.467	0.1736	0.2995	0.8831	0.1607	0.9831	1.047	0.899	0.148
24 Wss	0.960	0.2215	0.3635	0.9374	0.0356	0.9795	1.005	0.754	0.251
25 Jtex.	0.107	0.1070	0.2086	0.6567	0.6450	0.9740	1.243	1.166	0.077
26 Tex.	0.479	0.2594	0.4526	0.8470	0.1928	0.9734	1.064	0.737	0.326
27 WT	0.591	0.3007	0.5009	0.8449	0.1277	0.9514	1.071	0.720	0.351
28 Pr.	0.633	0.1999	0.3076	0.8753	-0.0220	0.9845	0.981	0.686	0.295
29 Lr.	0.450	0.2108	0.3398	0.8054	0.3250	0.9818	1.121	0.826	0.295
30 FFPC	1.541	0.2476	0.3632	0.9622	0.1435	0.9844	1.039	0.594	0.445
31 Ch.	0.852	0.2477	0.3942	0.9093	-0.1396	0.9709	0.964	0.692	0.272
32 Bmtl.	1.000	0.2168	0.3392	0.9258	0.0716	0.9762	1.016	0.700	0.315
33 Bmtl-Al.	0.841	0.2040	0.3171	0.9139	-0.1018	0.9784	0.976	0.726	0.250
34 Mtl.	0.592	0.2162	0.3409	0.8898	-0.1266	0.9799	0.966	0.769	0.197
35 Mcl.	0.722	0.2116	0.3425	0.8854	-0.0562	0.9790	0.965	0.697	0.263
36 El.	0.751	0.2297	0.3645	0.8959	-0.1351	0.9811	0.938	0.735	0.203
37 Tr.	1.254	0.2209	0.2881	0.9570	0.0408	0.9714	0.993	0.775	0.218
38 Mscl.	0.348	0.2140	0.3787	0.7808	0.0102	0.9642	0.984	0.717	0.267
40+41 EMG	0.807	0.2021	0.3218	0.8988	-0.4770	0.9793	0.924	0.791	0.133
97 Mscl-R.	0.766	0.2215	0.3483	0.9130	-0.1338	0.9498	0.957	0.752	0.205

The numerical coefficient 2 on the right hand side, enters in the above relation, because of our judicious inter-mingling and switch-over between the 'VLS' regression and the 'VLS-δ Constrained OLS' regression for estimation of the normal expansion paths, $\hat{L}$, of labour absorption, used in the calculations of E_O and E_*. If the 'VLS-δ Constrained OLS' regression were used in both the functional fits for $\hat{L}$, the numerical coefficient would have been replaced by unity, and then clearly we would have had $r_{\ln L, \ln E_*} < r_{\ln L, \ln E_O}$, violating our expectations on relative responses of E_O and E_* (as discussed already in section (4.5)). As we have noted already in section (4.8), that the estimates of $r_{\ln E_O, \ln E_*}$ are always very high or high, never falling below 0.65, with the present estimates on different activity-bases (ref. to Table 4.4)), we must have $r_{\ln L, \ln E_*}$ greater than $r_{\ln L, \ln E_O}$ for all activity-bases. However, as the estimates of $r_{\ln L, \ln E_O}$ are generally of low magnitudes, the improvement in the responses of E_* to the spatial variations of L will be marginally higher. In fact, the range of variations of $r_{\ln L, \ln E_*}$ is from 0.29 to 0.50 for all the activity-bases except for again that of " jute" and " beverages" for which the values are respectively the lowest (0.21, actually) and the highest (0.60, actually). Thus, the values of $r_{\ln L, \ln E_*}$ can be said to be of low to moderate magnitudes, satisfying

$$r_{\ln L, \ln E_O} < r_{\ln L, \ln E_*}$$

always for any activity-base. It is rather inconceivable that this inequality relation will be violated, even after the explicit incorporation of the localisation factor Q in the evaluation of normal expansion path $\hat{L}$ for labour absorption, used in the calculation of E_*. Thus, our choices on the methods of estimation have gone in line with the nature of relative responses as to be expected for an individual activity-base. Yet, after the incorporation of the localisation factor Q, the response of the efficiency measure E_* to the spatial variations in labour absorption level, L, still remains low to moderate. This shows the inadequacy of even the localisation-free modified efficiency measure E_* to capture the said response to a substantial extent.

3) Above mentioned observation on the relative responses of E_* over E_0 is true of any activity-base, and we have only noted the empirical range of variation in the responses of E_0 and E_* for all the manufacturing activity-bases. Additionally, we should also study the pattern of covariation which might exist between the responses of E_0 and E_*. Thus, we have tried for an OLS regression fit of $r_{\ln L, \ln E_*}$ on $r_{\ln L, \ln E_0}$, granting variations of different activity-bases, and found an extremely good fit of the following :

$$r_{\ln L, \ln E_*} = 0.0327 - 1.4566\, r_{\ln L, \ln E_0} \qquad \ldots (4.98)$$

with correlation coefficient = 0.958.

Thus the response of E_* is very strongly and positively associated with the response of E_0 in the context of spatial variation in labour absorption, L, for changing activity-bases. The regression coefficient signifies that the marginal rate of change in the response of E_* relative to that of E_0 is about 1.46. This means that when the depiction of response by E_0 is increased between activity-bases, the depiction of response by E_* is increased more, about 1.46 times the former increment. Thus, E_* turns out to be more sensitive than E_0 in capturing the said response, although both are of the same variety of localisation-free efficiency measure. This justifies our acceptance of the modified functional fit even for the kind of localisation-free efficiency measure, formulated by the ratio, $(L/\hat{L})$, which is in turn proportional to the scaled labour-absorptivity measure, $(L/X_*^{\mu_*})$, for E_*, as referred to in the section (4.4).

4) The type of formulation of E_* as the ratio, $(L/\hat{L})$, cannot capture the response of the localisation economy (as prevalent with the activity-base, X_0) on the spatial variation of labour absorption level L, simply because the very mode of evaluation of the normal expansion path $\hat{L}$ for L makes E_* log-linearly independent of the localisation factor Q (i.e., $r_{\ln Q, \ln E_*} = r_{\ln Q_*, \ln E_*} = 0$). Thus, the formulation of efficiency measure $E = E_* Q_*$, comes into the picture as the final localisation-accounted over-all efficiency measure.

The effect of this multiplicative formulation is to set the localisation economy at a neutral level (i.e. $\alpha_* = 1$, or equivalently $\alpha = 0$) in the scaled labour-absorptivity proportional to E_*, so that E turns out to be proportional to the localisation-accounted scaled labour-absorptivity measure, $(L/X_0^{\mu_*})$. Again, from the results of Lemma 2 and 4, we can get the following identity relation :

$$r_{\ln E,\ln L} = r_{\ln E,\ln Q_*} \cdot r_{\ln Q_*,\ln L} + r_{\ln E,\ln E_*} \cdot r_{\ln E_*,\ln L}$$

$$= r_{\ln E,\ln L}(Q_*) + r_{\ln E,\ln L}(E_*), \text{ say,}$$

where we may call

$r_{\ln E,\ln L}(Q_*)$ = part of $r_{\ln E,\ln L}$, transmitted through Q_*

and

$r_{\ln E,\ln L}(E_*)$ = part of $r_{\ln E,\ln L}$, transmitted through E_*.

Clearly we get, $r_{\ln E,\ln L}(Q_*) < r_{\ln Q_*,\ln L}$, with the reduction factor $r_{\ln E,\ln Q_*}$ having high to very high fractional value below unity (ref. to section (4.8)).

Also, we get $r_{\ln E,\ln L}(E_*) < r_{\ln E_*,\ln L}$, with the reduction factor $r_{\ln E,\ln E_*}$ having moderate to high fractional value below unity (ref. to section (4.8)).

Now, the values of $r_{\ln Q_*,\ln L}$ being generally of very high magnitude (ref. to the estimates in Table 4.4)), while those of $r_{\ln E_*, \ln L}$ are of low to moderate magnitude (ref. to the estimates in Table (4.5)), we expect that the part of $r_{\ln E, \ln L}$, transmitted through Q_* is substantially above that transmitted through E_*, and together, these would make the values of $r_{\ln E, \ln L}$ to be of very high to predominantly high magnitude. We have given the direct estimates of $r_{\ln L, \ln E}$ in Table (4.5)). These empirical estimates tally exactly (correct upto third place of decimal) with our theoretical estimates as the sum of $r_{\ln L, \ln E}(Q_*)$ and $r_{\ln L, \ln E}(E_*)$, stated above. From an examination of the empirical estimates, we notice that the responses of E to the spatial variations in the labour absorption level, are generally very high to predominantly high indeed. Barring the activity-base of " jute" (for which the localisation power parameter α is of insignificantly lowest magnitude, resulting into distinctly least value of $r_{\ln L, \ln E} = 0.66$), and all other activity-bases have values of $r_{\ln L, \ln E}$ in the range of 0.78 to 0.99. The average values of $r_{\ln L, \ln E}$ and also of $r_{\ln L, \ln E}(Q_*)$ and $r_{\ln L, \ln E}(E_*)$ turn out to be about 0.88, 0.64 and 0.24 respectively. Thus, on the average, the parts of $r_{\ln L, \ln E}$ as transmitted through Q_* and E_* are in the ratio 8 : 3, showing a predominant role of the localisation component Q_* over the localisation-free efficiency component E_* in the over-all response of E for capturing the spatial variation of L. Thus the localisation-accounted over-all efficiency measure E has been quite adequately responsive in capturing most of the spatial variations of labour absorption level L, for practically all activity-bases (except that of " jute").

5) Since much of the responses of E to the spatial variations of L are induced by the localisation economy, prevalent with different activity-bases, we could expect to have some sort of inter-connections between the degree of localisation economy α_* (or, equivalently, the localisation power, $\alpha = \alpha^* - 1$) and the degree of response $r_{\ln L, \ln E}$ as depicted for different activity-bases. To explore this possibility we have first examined the data graphically in search of the nature of association for α against not only $r_{\ln L, \ln E}$, but also $r_{\ln L, \ln E_*}$ and $r_{\ln L, \ln E_0}$. This exploration helped us in finding a possible functional fit of the type of a rectangular hyperbola between α and $r_{\ln L, \ln E}$, but there has been practically randomness of scatter points $(r_{\ln L, \ln E_*}, \alpha)$ and $(r_{\ln L, \ln E_0}, \alpha)$ on the respective graphs. Thus, we only fitted by OLS procedure a linear-transform of the functional association of the type

$$(a - r_{\ln L, \ln E})\ \alpha = b$$

where a and b are unknown parameters to be determined. As expected from our initial graphical exploration, the statistical fit has been extremely good, the details of which are presented below :

$$(1.01109 - r_{\ln L, \ln E})\ \alpha = 0.07819, \qquad \ldots(4.99)$$

the correlation coefficient = 0.99975.

The statistical fit is thus near-perfect. This shows that when α is increasing, $r_{\ln L, \ln E}$ is also increasing non-linearly along a rectangular hyperbolic path, with its central point at (α = 0.8842, $r_{\ln L, \ln E}$ = 0.9227), and also passing through the point (α = 0.6172, $r_{\ln L, \ln E}$ ≃ 0.8844) at the mean value of $r_{\ln L, \ln E}$. For the occurrence of near-perfect fit between $r_{\ln L, \ln E}$ and α, we are now fully justified to infer that the response of the over-all efficiency measure E to labour-absorption level, L, is very strongly influenced by the degree of localisation economy as prevalent with different activity-bases.

4.12.2 <u>The Role of Internal Productive Efficiency Measure of Activity-Bases on the Labour Absorption Levels</u>

Our concluding inference just drawn in the preceding subsection is that the response of E to the labour absorption level, L, is very strongly influenced by the presence of localisation economy with the activity-base. This is more or less true of the activity-base of " jute", although its localisation economy is not significantly above the neutral level. And consequently, its degree of response $r_{\ln L, \ln E}$ is distinctly of lowest magnitude, (it is recalled that when all other activity-bases ~~have the~~ magnitudes between 0.78 and

0.99, it is only 0.66 for " jute"). Thus, a substantial part of the spatial variation of L could not be accounted by E alone, at the same time it is only the activity-base of " jute" which shows the increasing over-all labour-absorptive scale (ref. to subsection (4.7.3)). Naturally, the question arises how this distinctive value of increasing labour-absorptive scale could be achieved, if the labour-absorptive efficiency measure E is not that responsive to labour absorption level L for " jute" ? With this query in mind, we have attempted to evaluate the role, if any, of internal productive efficiency measure T_* of activity-bases on the spatial variation of labour absorption level, L. Our findings in this respect are summarised below :-

1) We have presented the empirical estimates of the log-linear relationship, $r_{\ln L, \ln T_*}$, between L and T_* for different activity-bases in Table (4.5). An examination of these estimates reveals the following facts. Except for the activity-base of " jute" (code no. 25), " electricity, gas and water" generation and distribution (code no. 40+41) and " leather" (code no. 29), all other activity-bases have shown practically insignificantly positive or negative values of $r_{\ln L, \ln T_*}$ around the zero value (in the range from -0.14 to 0.19), implying that there has been practically very insignificant influence of the productive efficiency measure T_* on

the spatial variation of labour absorption, L. Contrary to this general situation, the magnitude of $r_{\ln L, \ln T_*}$ has attained the highest value, as high as about 0.65 (this is almost equal to $r_{\ln L, \ln E} = 0.66$). Thus, the explanation that we are seeking comes through this highly influencing positive role of the productive efficiency measure T_* on labour absorption level, L, in the particular activity-base of " jute". The only other activity-base for which the role of T_* on L is quite distinctly positive, though not that significant as observed for " jute" , is " leather". For " leather" , $r_{\ln L, \ln T_*} = 0.33$, although its labour-absorptive scale has been a diminishing one. However, this $r_{\ln L, \ln T_*}$ is of low magnitude and the labour-absorptive efficiency measure, E, has already accounted substantially the spatial variation of L. But it is interesting to note that the productive efficiency measure T_* has played a negative role of moderate magnitude ($r_{\ln L, \ln T_*} = -0.48$) on the spatial variation of L for the distributive type of activity-base of " electricity, gas and water" (code no. 40+41). This means that with the increasing productive efficiency for the activity-base of " electricity, etc." the labour absorption level is moderately falling. This negative role of productive efficiency measure thus erodes considerably the gain effected by the localisation economy towards increasing labour absorption level for the activity-base of " electricity, etc. ".

2) Overlooking the aspect of insignificant magnitudes (around zero value), the values of $r_{\ln L, \ln T_*}$ have been negative for about eight activity-bases, of which six activity-bases (code nos. 40+41, 31, 33, 34, 36 and 97) show values below -0.10, and also the values have been positive for remaining twelve activity-bases, of which again six activity-bases (code nos. 20+21, 23, 26, 27, 29 and 25) show values above 0.10. From our analytical expositions shown in section (4.6), it is clear that the magnitude of $r_{\ln L, \ln T_*}$ turns out to be positive or negative according as :

$$\text{COV}(\ln L, \ln Y) >, \text{or}, < \text{COV}(\ln L, \ln K).$$

We have already referred to the presence of strong multicollinearity among $\ln L$, $\ln Y$ and $\ln K$. This means that with the increase in the spatial concentration of a particular activity, all three spatial variables L, Y and K are increasing generally. However, with the increase in L, if the increment of K is not correspondingly reflective in the increment of Y, then we are likely to have the possibility of

$$\text{COV}(\ln L, \ln Y) > \text{COV}(\ln L, \ln K)$$

resulting into the positive values of $r_{\ln L, \ln T_*}$. Thus, it is possible that capital accumulation (through modernisation of capital-structure or holding un-utilised capital stock, etc.) might have taken place in the 'core' areas of those activity-bases showing negative values of $r_{\ln L, \ln T_*}$, but the accumulated capital has not either yielded sufficient output or been utilised fully or appropriately for matching output. At least the activity-base of "electricity, gas and water", showing the most negative value of $r_{\ln L, \ln T_*}$, conforms to this characterisation (it is to be noted that the time-point of reference, namely 1975-76, is in the continuing phase of severe "energy-crisis" situation, related particularly to the generation and distribution of electricity in India). On the other hand, certain traditional activity-bases, related to, say, "jute" and "leather" industries, have not improved much the capital-structure (through modernisation of capital-structure or replacement of old capital-structure, etc.) even in their "core" areas with higher concentrations of productive activities, and the improvement in production from these activity-bases has been attempted much through increasing level of labour absorption, resulting into "highest" and "next to highest" positive role of capital-based productive efficiency measure T_* on the labour absorption level L. This inference is also supported from the findings of some studies made independently by Chattopadhyay et al [1986 & 1990] for industries in West Bengal. Although their universe of study has been only the State of West Bengal, the activity-base of "jute" being more or less entirely concentrated in this State, this coverage in the all-India context may practically be taken as complete. So, at least for " jute" , their findings that there has been practically a total absence of necessary modernisation of capital structure (since independence of India) in " jute" industry, goes in support of our characterisation that increament of K for " jute" has not been in tune with the increments in Y and L. Naturally this particular feature of static condition of capital-structure can be taken as the real reason for getting the most positive role of the capital-based productive efficiency measure T_* on the labour absorption level L. In turn, this has induced in dampening the role of localisation economy to an insignificant minimum ($\alpha = 0.107$, for " jute"), so that the response of the over-all labour-absorptive efficiency measure E to the labour absorption level L goes to the bottom for " jute" (as compared with that of all other activity-bases).

4.12.3 Comparative Performances of the Activity-Bases on Their Dual Functions of Production and Labour Absorption, and the Association with Localisation Economy

The distinctive performance of the activity-base of " jute" on labour absorption, as reflected by its increasing over-all labour-absorptive scale μ_0 (comparable to μ) has got explained sufficiently from our analysis in the preceeding subsection. However, it has got explained ultimately in a sort of negative way, in the sense that a static condition of capital-structure is prevailing at least for this activity-base.

The distribution parameter δ, as associated with capital in the formulation of activity-base X_0, has also been the highest ($\delta = 0.58 > 0.50$) for " jute" and it signifies that the component of capital in the activity-base has played a greater role (although in a negative sense as interpreted above) than the component of output level, in generating the increasing over-all labour-absorptive scale. The optimising objectivity of labour absorption suggests that under the condition of increasing labour-absorptive scale μ_0, with the distribution parameter δ (related to capital) greater than its counterpart $(1-\delta)$, should improve upon capital-use, provided the productive scale (denoted by λ_0) of the same activity-base is comparably increasing. Thus, here is a case for comparison between λ_0 and μ_0.

The increasing labour-absorptive scale ($\mu_0 > 1$) is, however, not the feature exhibited by any of the activity-bases other than " jute". The second highest value of δ has occurred for the activity-base of " leather" (code no. 29, for which $\delta = 0.55 > (1-\delta)$), but its labour-absorptive scale is diminishing (unlike that of " jute"), although likewise " jute", here also the productive efficiency measure T_* has played a considerable positive role on labour absorption, L. Here also there is a case of comparison between λ_0 and μ_0, so that we are in a position to examine why we have $\mu_0 < 1$, despite the stated similarities in some other respects between

" leather" and " jute". Not only for these two activity-bases but also for all others, we should have a comparative analysis between μ_0 and λ_0. This is because the entrepreneurial objective has been generally for optimising output generation. Under welfare considerations (that must be imposed in a labour-abundant national economy), this optimising objective should have to be modified, so that there is some amount of parity between the productive scale and the labour-absorptive scale for any given activity-base. Apart from this, we have to examine also the performance of the activity-bases in respect of output generation (i.e. whether or not λ_0 is increasing), in order to understand the nature of functioning of different activity-bases towards fulfilling the usual output optimising objective. Thus on one hand, we are to examine the gap $(\lambda_0 - \mu_0)$ and, on the other hand, we have to compare this gap with the nature of λ_0. The estimated values of λ_0 and $(\lambda_0 - \mu_0)$ are already presented in Table (4.5). We shall now record below our findings, on the basis of these and other relevant estimates :

1) Using the same classificatory scheme for λ_0, as used earlier for μ_0 (ref. to subsection (4.7.3)), most of the activity-bases have exhibited near-constant (around the value of unity) values of the productive scale λ_0, except for " jute" ($\lambda_0 = 1.243$) and " leather" ($\lambda_0 = 1.121$), for which the

productive scales are distinctly increasing, and also for " electricity, gas and water" (λ_0 = 0.924) and " beverages" (λ_0 = 0.918) for which the productive scales are distinctly diminishing. Granting that the near-constant values signify the normally desirable functioning of the activity-bases, the two activity-bases of " jute" and " leather" exhibit above-normal functioning for output generation, and on the other extreme, the activity-bases of " electricity, etc." and " beverages" exhibit below-normal functioning for output generation. As the distribution parameter δ, associated with capital, is on the higher side than its counterpart $(1-\delta)$ for both " jute" and " leather", there seems to be enough scope for labour absorptions in these two activity-bases through proper improvements in the capital-structures. On the other hand, the utilisation of the capital-structure does not seem to be going on properly, resulting into the below-normal functioning of the activity-bases of " electricity, etc." and " beverages" for output generation, particularly for " beverages" for which the distribution parameter δ, related to capital, is the lowest (of magnitude 0.391).

2) In many ways the behaviour patterns of " beverages" and " jute" are, as already noted, at the two extremes (among all activity-bases), particularly in respect of parameters λ_0, μ_0 (or, μ), δ, α, etc. The lowest δ (comparably

much below its counterpart) and the highest α (much above unity, signifying the predominant role of localisation factor Q over activity-base X_0 with the over-all scale μ) as associated with the activity-base " beverages" portray the picture that its capital-structure has not been properly geared or utilised for the normal functioning as regards the output generation, resulting into the poorest labour-absorptive scale, and that too contributed predominantly by the localisation economy and not much by its activity-base itself.

3) The variation in the labour-absorptive scale, μ_0, of the activity-bases is much wider than that in the productive scale, λ_0. As a result of this, the gap, $(\lambda_0 - \mu_0)$, has also been quite varying over different activity-bases. Thus, the gap has been found to vary from the minimum value of 0.077 for " jute" (code no. 25) to the maximum value of about 0.445 for the activity-base of " petroleum, coal, rubber, plastics" (code no. 30). Thus the two scales have been both increasing with a minimum gap of negligible magnitude only for the activity-base of " jute". As such, on the question of parity between the two scales, " jute" only can be considered as having the activity-base with negligible disparity. The disparity with downward labour-absorptive scale would be naturally higher for all other activity-bases. Keeping in mind that the activity-base of " petroleum, etc." (code no. 30)

exhibits a sort of distinctively highest magnitude of $(\lambda_0 - \mu_0)$ on the other extreme, we make the following qualitative classification on the gap between the two scales, $(\lambda_0 - \mu_0)$:

$0.00 \leqq \lambda_0 - \mu_0 \leqq 0.12$: negligible disparity of scales,

$0.12 < \lambda_0 - \mu_0 \leqq 0.24$: considerable disparity of scales,

$0.24 < \lambda_0 - \mu_0 \leqq 0.36$: substantial disparity of scales,

$0.36 < \lambda_0 - \mu_0$: very substantial disparity of scales.

Clearly, as the disparity of scales increases, the performance of the activity-base tends more towards output optimising objective with comparatively less attention for labour absorption. Thus, according to this qualitative classification, the activity-base of "petroleum, etc.", showing very substantial disparity of scales, has exhibited the least attention for labour absorption, particularly when its productive scale tends to be increasing ($\lambda_0 = 1.04$). It is to be noted that both "petroleum, etc." and "beverages" have shown the distinctly lowest value of the labour-absorptive scale with $\mu_0 = 0.59$, (the only two activity-bases in the category of very highly diminishing labour-absorptive scale). However, while "petroleum, etc." has exhibited normal functioning of the capital component of its activity-base ($\delta = 0.51$), "beverages" has the sort of worst and sub-standard functioning of the capital component of its activity-base ($\delta = 0.39$) with the result of below-normal functioning of its activity-base for even output generation ($\lambda_0 = 0.918$). As such, " beverage " industry falls in the category of activity-bases showing 'substantial disparity of scales', just the next lower category as compared with the position of " petroleum, etc.". But, the similarity in their values of μ_0, ranks both the activity-bases more or less in the same level on the question of attention paid for labour absorption. It should be noted that most of the activity-bases, about 12 in number out of the total of 20 considered, have fallen in the category showing 'substantial disparity of scales' (same as that of " beverages"), while remaining 6 activity-bases (apart from " petroleum, etc." and " jute") are in the category showing 'considerable disparity of scales'. Thus, on the question of attention paid for labour absorption, most of the activity-bases are on the same boat with " beverages". Again, " leather" (code no. 29) and " jute" (code no. 25) which have much of similar behaviour in respect of productive scale, λ_0, and distribution parameter, δ, have been wide apart in respect of the question on attention paid for labour absorption. Unlike " jute" the activity-base of " leather" shows a 'substantial disparity of scales', although its labour-absorptive scales, μ_0, though diminishing, is not that diminishing as observed for other activity-bases of this category. The labour-absorptive scale of " leather" can possibly be improved by proper improvement of the capital-structure of its activity-base, when its productive scale and distribution parameter (associated with capital component) are almost similarly favourable as those of " jute" .

4) We would now conclude our present analysis by showing a summary classification, rather cross-classification, of activity-bases taking into account the localisation power parameter, α, together with the disparity of scales, $(\lambda_0 - \mu_0)$. It may be recalled that α is strongly reflective of the responses of the over-all efficiency parameter E to the spatial variations of labour absorption level, L. From the data on α and also of $(\lambda_0 - \mu_0)$ shown in Table (4.5), it can be noticed that we do not have any regular type of correspondences between their magnitudes. As such a cross-classification by taking into account both α and $(\lambda_0 - \mu_0)$, would be useful to understand the classified associations between localisation economy and the disparity between the two scales of activity-bases. As regards the classification of α, we proceed as follows. The parameter α being the ratio (s/μ_*), the values of $\alpha > 1$ signify the predominance of the localisation factor Ω, over the activity-base, λ_0, in respect of their contributions to over-all scale μ (comparable to μ_0). Thus, taking into account this critical value of unity for α, we make the following qualitative classification for α :

.../-

$1.00 > \alpha$	:	predominantly operative localisation economy,
$0.67 < \alpha \leq 1.00$	:	highly operative localisation economy,
$0.34 < \alpha \leq 0.67$	:	moderately operative localisation economy,
$0.34 \leq \alpha$	:	insignificantly operative localisation economy.

On the basis of the classification, given above for α and also that given earlier for $(\lambda_0 - \mu_0)$, we present the cross-classification of the activity-bases, as tabulated in Table (4.6).

In the Table (4.6), the activity-base of " jute" in the cell (4, 4) (positioned by row and column numbers respectively) placed diagonally at bottom, has exhibited the maximum attention for labour absorption, with localisation economy operative at the minimum. As we proceed diagonally upward from cell (4, 4), though cells (3, 3) and (2, 2), to cell (1, 1), the attention for labour absorption is gradually diminishing, although the advantage of localisation economy is becoming more and more effective. Ultimately, the activity-base of " petroleum, etc." in the diagonally top cell (1, 1) has exhibited the minimum attention for labour absorption with predominantly operative localisation economy ($\alpha = 1.54$) and also with the increasing tendency of its productive scale ($\lambda_0 = 1.04$). The activity-base of " cotton textile" (code no. 23) in the cell (3, 3) is really next best to " jute" in respect of the desirable attention for labour absorption with the increasing tendency of its productive scale ($\lambda_0 = 1.047$) along with marginally diminishing labour-absorptive scale ($\mu_0 = 0.899$). The activity-base of " metal products" (code no. 34) is also clubbed in the same cell (3, 3) with " cotton textile" having just comparable but a little higher value of ($\lambda_0 - \mu_0$). The activity-bases, placed above " cotton textile" in column (3) of Table (4.6), show gradually diminishing productive scale, λ_0, as we move our attention upward, till λ_0 attains the minimum value ($\lambda_0 = 0.928$) in the column (3) for " electricity, etc.", placed at the top of the cell (2, 3), and then further up, switches over to almost constant productive scale ($\lambda_0 = 0.993$) for " transport equipments" (code no. 37) with more effective localisation economy ($\alpha = 1.25$). Thus, from " cotton textile" upward in column (3) upto " electricity etc.", the functioning of the activity-base for output generation is gradually deteriorating, possibly for improper functioning of the capital-structure of the activity-bases, although their localisation economy has been highly operative. The activity-bases of the cell (3,2) placed to the left of " cotton textile" (or, cell (3, 3)), have shown less favourable attention to labour absorption as compared with " cotton textile". Among these activity-bases, while " paper" (code no. 28), and " miscellaneous manufacturing" (code no. 38) have almost constant productive scale ($\lambda_0 = 0.98$); others in

Table 4.6 : Cross-classification of Activity-bases by the Disparity of Productive to Labour-absorptive Scales and the Operative Localisation Economy

Localisation power α	Distribution of (NIC code numbered) Manufacturing Activity-bases — Disparity of scales : $(\lambda_0 - \mu_0)$: very substantial $\lambda_0-\mu_0>0.36$	substantial $0.24<\lambda_0-\mu_0\leq 0.36$	considerable $0.12<\lambda_0-\mu_0\leq 0.24$	negligible $0<\lambda_0-\mu_0\leq 0.12$
predominantly operative $\alpha > 1$	30. Petroleum, Coal, Plastic and Rubber	22. Beverages	37. Transport Equipment	—
highly operative $0.67<\alpha\leq 1$	—	31. Chemicals 35. Non-electrical Machinery 33. Metals and Alloys 24. Textile : Wool, Silk & Synthetics 32. Non-metals 20+21. Food and Food Products	40+41. Generation and Distribution of Electricity, Gas and Water 36. Electrical Machinery 97. Misc. Repairing & Services Industries	—
moderately operative $0.34<\alpha\leq 0.67$	—	28. Paper 38. Misc. Manufactures 26. Textile Products 27. Wood & Timber 29. Leather	34. Metal Products 23. Cotton Textile	—
insignificantly operative $0<\alpha\leq 0.34$	—	—	—	25. Jute Textile

N.B. In each cell above, the activity-bases are arranged downward with increasing values of productive scale λ_0.

the cell, namely " textile products" (λ_0 = 1.06), " wood and timber" (λ_0 = 1.07) and "leather" (λ_0 = 1.12) have marginally or distinctly increasing productive scale, better than λ_0=1.04, associated with " cotton textile". So for these three activity-bases the deterioration in the attention for labour absorption has been the result of both improved productive scale, λ_0, and the deteriorated labour-absorptive scale, μ_0.

The values of the productive scale λ_0 of all activity-bases in cells (2,2) and (2, 1) are all gradually falling, as we move our attention upward in column (2). However, the " food and food products" (λ_0 = 1.06) ranks above " cotton textile" (λ_0 = 1.04) in productive scale, and others show lower values of λ_0 from almost constant λ_0 = 1.016 for " non-metals" to the minimum λ_0 = 0.918 for " beverages". Here again, an improper functioning of the capital-structure of activity-base is noticed, particularly in most acute form for " beverages", although its localisation economy is predominantly operative.

4.13 The Over-all Manufacturing Labour-Absorptive Efficiency : the Composite Measure and Its Use for Ranking of Districts Stratified by Intensity of Production

From our fore-going comparative analysis, it is clear that most of the activity-bases exhibited much better performances in terms of their functions of production than that of labour absorption. The productive efficiency has been practically independent of labour absorption level with most of the activity-bases. As our measure of productive efficiency is capital-based, we suspect that the utilisation of capital-structure, implicit in an activity-base, has not been very often conducive of a better labour-absorptive performance of the activity-base. At times, it has not been conducive of also the productive performance of at least some of the activity-bases, as discussed already in the preceding sub-sections. However, the localisation factor, depicting the advantages of regional production specialisation or the localisation economy, particularly in core areas of activities, has not only induced strongly the labour-absorptive efficiency, but also enhanced the production level much more strongly, so that the productive scale turns out to be always superior to the labour-absorptive scale of the same activity-base. It should be remembered in this connection that the over-all labour-absorptive efficiency measure E, as related to the localisation-accounted activity-base, has been very strongly related in log-linear form with the labour absorption level L, practically for all activity-bases (ref. to estimates of $r_{\ln E, \ln L}$ in Table (4.5). Again, we have noted (ref. to estimates $r_{\ln Y, \ln X_O}$ in Table(4.5) that the spatial variation in output level Y, is strongly reflective of that in the localisation economy-influenced level of related activity-base. However, as the localisation economy-influenced activity-base often exhibit substantial disparity of scales (productive in excess of labour-absorptive), the same labour-absorptive efficiency measure is likely to have different absolute responses to labour absorption level, L, in areas with different intensities of production. Again in our Indian Economy, with predominance of agricultural activities, the manufacturing activities are still in their infancies. Because of this fact, coupled with the fact that our manufacturing activity-bases are mostly localisation economy-influenced, the two digited manufacturing activities have been highly localised in nature. In consequence, most of Indian districts show complete absence of a particular manufacturing activity with no intensity of production at all. This feature can be substantiated from the empirical evidence as tabulated below in Table (4.7).

<u>Stratification of Districts by Intensities of Productions</u> :

What all we have discussed above, suggests that the comparability of labour-absorptive efficiency measure will be more meaningful among districts having some sort of comparable intensity of manufacturing production. Thus, we go for a kind of broad stratification of districts by intensity measures of manufacturing productions, the details of which are given below. For convenience, we redesignate the

Table 4.7 : Extent of Manufacturing Activity-Spread and its Absence in Districts of India : 1975-76

Srl. no.	Two-digited NIC code (i)	Name of Manufacturing Activity	Number of districts having the activity (N_i)	Percentage of number of districts without the activity
(1)	(2)	(3)	(4)	(5)
1.	20+21	Food and Food Products	219	40.8
2.	22	Beverages	104	71.9
3.	23	Cotton Textile	163	55.9
4.	24	Textile : Wool, Silk, Synthetics	58	84.3
5.	25	Jute Textile	17	95.4
6.	26	Textile Products	42	88.6
7.	27	Wood and Timber	66	82.2
8.	28	Paper	125	66.2
9.	29	Leather	19	94.9
10.	30	Petroleum, Coal, Plastics, Rubber	63	83.0
11.	31	Chemicals	143	61.4
12.	32	Non-metal	147	60.3
13.	33	Metal and Alloy	121	67.3
14.	34	Metal Products	78	78.9
15.	35	Non-electrical Machinery	98	73.5
16.	36	Electrical Machinery	62	83.2
17.	37	Transport Equipments	83	77.6
18.	38	Miscellaneous Manufacturing	48	87.0
19.	40 + 41	Generation and Distribution of Electricity, Gas & Water	75	79.7
20.	97	Miscellaneous Repair & Services	204	44.9
All Manufacturing Activities			317 (= N)	14.3

variables of output or production more specifically and define the relevant intensity measures as follows :

Y_{ij} = value of output for i-th two-digited manufacturing activity in j-th district,

$Y_j = \sum_{i=1}^{20} Y_{ij}$ = value of aggregate manufacturing output in j-th district,

$\bar{Y}_i = \frac{1}{N_i} \sum_{j=1}^{N_i} Y_{ij}$, with N_i = number of districts of India having the non-null values of i-th manufacturing activity,

and $\bar{Y} = \frac{1}{N} \sum_{j=1}^{N} Y_j$, with N = number of districts of India having the non-null values of aggregate manufacturing activities.

Then the intensity measures of production $\hat{Y}_{ij}$ and $\hat{Y}_j$ are defined as follows :

for i-th manufacturing activity : $\hat{Y}_{ij} = Y_{ij}/\bar{Y}_i$,

$i = 1, 2, \ldots\ldots, 20$;

for aggregate manufacturing activities : $\hat{Y}_j = Y_j / \bar{Y}$.

Our stratification scheme of Indian districts, on the basis of these intensity measures, are as formulated below :

Intensity of Production for i-th Manufacturing Activity		Defining Interval of Intensity Measures
substantial (H+VH+EH)	:	$\{\hat{Y}_j > 0.35 \text{ and } \hat{Y}_{ij} > 1.20\}$
considerable (M + L)	:	$\{\hat{Y}_j > 0.35 \text{ and } 0.35 < \hat{Y}_{ij} \leq 1.20\}$
negligible (VL)	:	$\{0 < \hat{Y}_j \leq 0.35\} \cup \{\hat{Y}_j > 0.35 \text{ and } \hat{Y}_{ij} \leq 0.35\}$

Intensity of Production for Aggregate Manufacturing Activities		Defining Interval of Intensity Measure
substantial (H + VH + EH)	:	$\{\hat{Y}_j > 1.20\}$
considerable (M + L)	:	$\{0.35 < \hat{Y}_j \leq 1.20\}$
negligible (VL)	:	$\{0 < \hat{Y}_j \leq 0.35\}$
nil (i.e. total absence of manufacturing activity)	:	$\{\hat{Y}_j = 0\}$

Use of the Stratification Scheme in Ranking of Districts for Labour-Absorptive Efficiencies :

Now, as the picture of labour absorption levels for different activity-bases could be sufficiently depicted by the labour-absorptive efficiency measure, E, we would like to identify how the different districts of India figure in respect of labour-absorptive efficiency ranks for different manufacturing activity-bases. And in this ranking of districts, we would use the above mentioned stratification of districts in order to differentiate them by their intensities of manufacturing productions. Now, this kind of stratified ranking of districts, in terms of the labour-absorptive efficiency measure E, can easily be done for any individual activity-base considered. However, we would be more interested in such ranking of districts for the totality of all manufacturing activities together. But, this cannot be done very easily. Unlike the labour-absorptive efficiency of an individual industrial activity-base, the over-all manufacturing labour-absorptive efficiency for the totality of all two-digited manufacturing activities cannot be measured appropriately by a direct calculation of E from a modified labour absorption function fitted on the data corresponding to the aggregate manufacturing activity-base in which there is so much heterogeneity of activities. Moreover, because of the non-linearities of functional forms, the labour absorption expansion path as could be fitted directly for the aggregate manufacturing activity-base, would not correspond to any sort of reasonable aggregation of different labour absorption expansion paths ($\hat{L}$), already fitted and accepted for different two-digited activity-bases for estimation of their labour-absorptive efficiency E $(=Q_* \cdot \frac{L}{\hat{L}})$. As such, we have not fitted directly any modified labour absorption function to the aggregate data of all manufacturing activities together, and the measurement of over-all manufacturing labour-absorptive efficiency has been accomplished by taking the output-weighted average labour-absorptive efficiency of different manufacturing activity-bases (to be denoted by $\bar{\bar{E}}$), the detailed formulation of which is given below :

<u>Over-all Manufacturing Labour-Absorptive Efficiency Measure, $\bar{\bar{E}}$</u> :

Before giving the analytical formulation of $\bar{\bar{E}}$, we would like to make revision of measurement scales for E related to an individual activity-base. We have noted that $E = Q_* \cdot E_*$, where Q_* $(= Q^s)$ is in the form of location factor already, but not E_*. Our original E_* is given by $(L/\hat{L})$, in which geometric means of L and $\hat{L}$ have been the same, as per our functional fit for a particular activity-base. We revise E_* as follows

$$E_* = \frac{L/\Sigma L}{\hat{L}/\Sigma \hat{L}} ,$$

so that E_* is now in the form of a location factor like Q_*. With this revision of measurement scale, we have

$$E = Q_* \cdot \left(\frac{L/\Sigma L}{\hat{L}/\Sigma \hat{L}} \right) ,$$

which is just proportional to our original E. Here afterwords, we would refer only to the magnitudes of this revised E and call it the labour-absorptive efficiency index for any activity-base. With this revision, the over-all manufacturing labour-absorptive efficiency, $\bar{\bar{E}}$, can be formulated as follows :

$$\bar{\bar{E}}_j = \sum_{i=1}^{20} w_{ij} E_{ij} ,$$

where E_{ij} and $\bar{\bar{E}}_j$ stand respectively for the values of labour-absorptive efficiency, E, in j-th district for i-th activity-base ($i = 1, 2, \ldots, 20$) and for the aggregate manufacturing activities together,

$$w_{ij} = Y_{ij} \Big/ \sum_{i=1}^{20} Y_{ij} ,$$

with $\sum_{i=1}^{20} w_{ij} = 1$ for each $j = 1, 2, \ldots, N$,

and Y_{ij} = the value of output of i-th activity-base in j-th district.

In the above analytical formulation, E_{ij} gives the importance of j-th district in respect of the labour-absorptive efficiency of i-th activity-base relative to corresponding national value (of unity), and w_{ij} gives local importance of i-th activity-base in its function of production as exhibited in j-th district. Thus, the composite measure $\bar{\bar{E}}_j$ has been derived by combining the exhibited efficiencies of activity-bases with due weights by their productive performances.

Efficiency Ranking for Tabular Presentation :

We have already given the stratification scheme for districts. Now, for districts having negligible intensity of manufacturing production, the labour-absorptive efficiency ranks have not been recorded for different two-digited activity-bases and also for the totality of all manufacturing activities, taken together. This is done simply because of the facts that the labour-absorptive efficiencies are mostly low or very low in this stratum of 'negligible' intensity of production, and at the same time the activity-bases with negligible (or, no) intensity of manufacturing production are not capable of inducing much of manufacturing labour absorptions. The labour-absorptive efficiency ranks of those districts which have 'substantial' intensity of production are shown with starred marks, while un-starred labour-absorptive efficiency ranks refer to those districts with 'considerable' intensity of production only. We have recorded the estimates of $\overline{\overline{E}}_j$, and the classified ranks for $\overline{\overline{E}}_j$ and E_{ij}, only for the districts stratified as having 'substantial' and 'considerable' intensities of production, in Table(4.8). The classified ranks for $\overline{\overline{E}}_j$ have also been presented cartographically in Figure (4.2). In that figure, districts having 'negligible' or 'nil' (i.e. absence of any) intensity of manufacturing production have also been marked separately.

Thus the classified rank-symbols and the corresponding intervals of values of $\bar{E}_j$ and E_{ij} (the corresponding spatial variable to be denoted by $\bar{E}$ and E_i respectively), $i = 1, 2, \ldots, 20$, are specified uniformly as follows :

Qualitative rank Symbols for		Interval of values of $\bar{E}$ and any E_i, $i = 1, 2, \ldots, 20$
Substantial intensity of production	Considerable intensity of production	
EH*	EH	above 3.20
VH*	VH	above 2.00 to 3.20
H*	H	above 1.20 to 2.00
M*	M	above 0.80 to 1.20
L*	L	above 0.35 to 0.80

The frequency of districts by these ranks of labour-absorptive efficiencies for different strata of production intensities are summarised in Table (4.9) for different two-digited manufacturing activity-bases and the aggregate.

Regional Patterns of Over-all Manufacturing Labour-Absorptive Efficiency :

Based on the labour-absorptive efficiency ranks of aggregate manufacturing activity-base and also of each of its constituent activity-bases, as shown in Table (4.8) and also from the cartographic configuration as presented for the aggregate in Figure (4. 2), we shall now make attempts to identify the spatial

Table 4.8 : Ranking of Districts by Labour-Absorptive Efficiency Index for Different Manufacturing Activities

Districts by States and Union Territories	Over-all Index (E)		Ranks of Activity-specific Indices (E_i) for Manufacturing Activities with codes (i)																			
	Value	Rank	20+21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
RAJASTHAN																						
Jaipur	2.738	VH*	M*		M			H								H	H*	H		L	EH*	H
Ajmer	2.699	VH			H																	EH*
Bhilwara	0.791	L			M	L																
Udaipur	0.511	L												M*	L							
Kota	1.440	H*				VH*							L*					M				VH*
PUNJAB																						
Amritsar	2.077	VH	L	M		EH*													VH			H
Ludhiana	1.359	H*	L*		L	VH*		L*									H		VH		L	
Jullunder	1.647	H	L													EH				VH		
Kapurthala	1.061	M	M		H																	
Ropar	0.888	M	L	M						H			M*			H	L			H		L
Patiala	2.538	VH*	M*	L	M										L			L	H		EH*	
Faridkot	0.384	L	L		L											L						
HARYANA																						
Ambala	1.353	H*	M*	M					VH	VH*				M			H*			H	L*	EH*
Gurgaon	2.382	VH*			M*	H		L		H*		EH*	M	VH*	H	VH*	VH*	VH*	EH*	M		L
Hisar	1.130	M			M*										L							
Sonepat	1.270	H													L	H			VH			
DELHI																						
Delhi	1.862	H*	M*	H*	VH*	H		VH*	M	EH*			H*	VH	H	H*	H	VH	VH	H	L*	VH*

Table 4.8 (Continued)

Districts by States and Union Territories	Over-all Index (Ē)		Ranks of Activity-specific Indices (E_i) for Manufacturing Activities with codes (i)																			
	Value	Rank	20+21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
UTTAR PRADESH																						
Bareilly	2.091	VH	H										VH*									
Dehra Dun	1.420	H											H									
Saharanpur	1.984	H*	VH*							H*								H*				
Muzaffarnagar	2.908	VH	VH*																			
Meerut	1.977	H*	VH*	EH*	H*	L*				H		H	M	VH*	H*	H*	H	H	M	H		L
Aligarh	1.092	M	L*													VH						
Agra	2.119	VH	L*											EH*								H
Kanpur	1.840	H*	L*		VH*	EH					VH		L*			H						H
Allahabad	1.872	H								VH					L		L	VH*				H
Kheri	1.883	H	H*																			
Lucknow	5.243	EH*			L					EH				L					EH		EH*	EH*
Gorakhpur	1.989	H	VH										M									EH*
Deoria	3.896	EH	EH*																			
Varanasi	1.226	H						H				L							H*			H
Mirazapur	1.211	H											M*	H*	H						L	
MADHYA PRADESH																						
Gwalior	1.164	M			H*	M*																
Satna	1.323	H												VH*				L				
Shahdol	0.773	L								M*												
Ujjain	1.544	H*	L		VH*	H*							H*		L		L					
Indore	1.867	H	L		VH*											L						M
Khandwa	1.127	M	L		H					H*												
Jabalpur	3.453	EH*		H										EH*				VH			EH*	M
Durg + Rajnandgaon	3.318	EH*												H*	EH*							
Bhopal	2.593	VH*							H*	H								VH*				M

Table 4.8 (Continued)

Districts by States and Union Territories	Over-all Index ($\bar{E}$) Value	Rank	Ranks of Activity-specific Indices (E_i) for Manufacturing Activities with codes (i) 20+21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
BIHAR																						
Patna	5.979	EH*								H	H*										EH*	VH
Rohtas	2.034	VH								EH*				M*								H
Begusarai	1.741	H*										H*										
Monghyr	2.451	VH		VH*						L												
Giridih	2.742	VH*										EH*	H*	VH*							M*	
Dhanbad	3.912	EH*										EH*	EH*	EH*	EH*		L					
Ranchi	1.577	H*												H	H*		H*	M				
Singhbhum	4.777	EH*												H*	EH*		M	H	EH*			
ORISSA																						
Sambalpur	1.666	H								EH*				H*	L							
Sundargarh	3.117	VH*											M*	VH*	EH*		M					
Cuttack	1.468	H			H					VH*				H	L							
WEST BENGAL																						
Jalpaiguri	5.037	EH	EH*						L													
24-Parganas	5.102	EH*	VH*	EH*	EH*	EH*	H*	H*	H	EH*	EH*	EH*	EH*	EH*	EH*	EH*	EH*	EH*	EH*	VH*	EH*	VH*
Howrah	3.104	VH*	L*		VH*		H*	EH*		EH*			H		EH*	EH*	VH	VH*	EH*			H
Calcutta	1.909	H		H*						VH*						H						EH
Hooghly	3.428	EH*	L	M	H*	H	H*	H		M*		EH*	VH*	H*	H*		M		EH*			
Burdwan	5.341	EH*	M	M						H*		VH	H	EH*	EH*		VH*	M*	EH*		M*	VH
Midnapur	1.444	H*										L							EH			EH*
ASSAM																						
Kamrup	1.597	H										H*									VH	
Darrang	3.013	VH	VH*																			
Sibsagar	3.904	EH	EH*						VH*													
Dibrugarh + Lakhimpur	3.856	EH*	EH*						EH*			VH*	H									

Table 4.8 (Continued)

Districts by States and Union Territories	Over-all Index ($\bar{E}$) Value	Rank	Ranks of Activity-specific Indices (E_i) for Manufacturing Activities with codes (i) 20+21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
ANDHRA PRADESH																						
Vishakhapatnam	1.001	M*	M				M	H				L*	L*		L		H*		VH*			
East Godavari	1.259	H	H						M	H*												
West Godavari	1.350	H	H*										L									H
Krishna	1.258	H	H*							M				L								VH*
Guntur	13.049	EH*		EH*	L								L	L								H
Ongole	20.837	EH		EH*																		
Kurnool	1.392	H	L*										H*									H*
Hyderabad	3.628	EH*	H*	EH*	M				H	VH*			VH*	VH*	M	H	EH*	VH*	EH	VH*	EH*	EH*
Medak	1.717	H	VH															H*				
Nizamabad	3.483	EH	VH*	EH																		
Adilabad	2.575	VH				EH				VH*				M								
TAMIL NADU																						
Madras	3.988	EH*	L*	M	M			H	EH	EH*			H			VH*	EH*	VH	EH*			EH*
Chingleput	3.579	EH*	M*		L			EH	L	M*	H	EH*	H*	VH*	VH*	VH*	H*	VH*	EH*	VH*		M
North Arcot	2.298	VH*	L		L						VH*		VH	L								
South Arcot	1.643	H*	H*		H*								H	H								
Salem	1.099	M*	H		M*					M*			H	H*	L	M						L*
Coimbatore	2.640	VH*	H*		VH*	VH*			M	M*				H*			EH*	EH	M			L*
Nilgiris	1.431	H	M										H									
Madurai	1.703	H*	M	H	H*	H				H		EH										H*
Tiruchirapalli	1.594	H*	M		M						L			H*			H*		EH	H		M
Thanjavur	0.792	L	M	H																		H*
Ramanathpuram	5.222	EH			M					H			EH	M*								
Tirunelveli	2.298	VH*			H*					M			EH*	L*								M*

Table 4.8 (Continued)

Districts by States and Union Territories	Over-all Index ($\bar{E}$)		Ranks of Activity-specific Indices (E_i) for Manufacturing Activities with codes (i)																				
	Value	Rank	20+21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
KERALA																						
Kozikode	1.315	H	VH						VH	M*			L	EH								L
Trichur	1.227	H			M			H*	H													L
Ernakulam	1.533	H*	L		L	L			M	M		M*	VH*		L*	L	H	H				VH
Kottayam	0.958	M							H*	L		M		L								L
Quilon	12.080	EH*	EH*						H*	H				VH		L				M		L
GUJARAT																						
Jamnagar	2.718	VH	H*			H							EH	H*								
Rajkot	1.014	M	M		L								L	H			H			H		M
Bhavnagar	0.909	M	L		H								M	H*								H
Junagadh	1.477	H*	H*		M	M							H*									M
Mehsana	0.706	L			M*								L*									L
Ahmedabad	3.509	EH*	M*		EH*	VH*			L	VH*			H	VH*	H*	VH	EH*		H		L*	VH*
Kheda	1.146	M*	M	VH	M									H*		M	M					M
Vadodara	2.374	VH*	L*	H*	H	H						H*	VH*	VH*	M	H	VH*	VH*			VH*	H
Surat	1.728	H*	L*		M*	EH*				L*			H*			H					L	M
Valsad	1.582	H*			M*			M		H*			VH*			M						

Table 4.8 (Concluded)

Districts by States and Union Territories	Over-all Index ($\bar{E}$) Value	Rank	Ranks of Activity-specific Indices (E_i) for Manufacturing Activities with codes (i) 20+21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
MAHARASHTRA																						
Greater Bombay	6.228	EH*	VH*	EH*	EH*	EH*		EH*	H*	EH*	VH*	EH*	EH*	EH*	EH*	EH*	EH*	EH*	EH*	VH*	M*	EH*
Thane	4.302	EH*	L*			EH*		VH*	M	H*		VH	EH*	H*	H*	VH*	EH*	VH*	H*	H*	VH*	VH*
Kolaba	0.874	M*	L	L						L			H*	M	L*							
Nasik	1.066	M	M*							L			L			H			H	VH		H
Dhulia	0.916	M	M*																			
Jalgaon	0.754	L	L*		H																	
Ahmednagar	2.028	VH*	H*	EH																		M
Pune	2.714	VH*	M*	L	M			H*		H*			H*	H*	M*	VH*	EH*	VH*	VH*	H*		H*
Satara	1.192	M	M*														VH					
Sangli	1.028	M	L*		M												H*					L
Sholapur	2.141	VH	M*	EH*	H*																	
Kolhapur	1.135	M*	H*		L																	H*
Nagpur	1.238	H	L*		H*					VH					M							H
Chandrapur	1.692	H							H	VH*				M*								
KARNATAKA																						
Bangalore	4.216	EH*	M*	EH*	H*			EH	EH*	VH*			L	VH*	H	H*	VH*	EH*	VH*	VH*	VH*	H*
Chitradurga	1.292	H	L		H												H					
Mysore	2.291	VH			M				H*	H									EH			
Shimoga	2.403	VH							H	M*					VH*							
Mandya	0.976	M	M*							L												
Belgaum	1.061	M	H*		H				H						L*							
Dharwar	1.269	H	L		M								M				M					H*
Gulbarga	1.375	H												H*			H					
GOA																						
Goa	0.664	L										L	L*						H			L

Table 4.9 : Distribution of Spatial Units (Districts) by Labour-Absorptive Efficiency Ranks for Different Manufacturing Industries

Rank Symbols Classified According to Output Intensity	All Manu-facturing	Two-digited Industry Code									
		20+21	22	23	24	25	26	27	28	29	30
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EH*	20	5	8	3	5	–	2	2	7	1	7
VH*	12	7	1	5	4	–	2	1	8	2	1
H*	18	11	3	9	1	3	3	5	8	1	3
M*	5	12	–	6	1	–	–	–	7	–	1
L*	–	13	–	–	1	–	1	–	1	–	1
Total 'substantial'	55	48	12	23	12	3	8	8	31	4	13
EH	6	–	2	–	2	–	2	1	1	–	1
VH	13	3	1	–	–	–	–	2	2	1	2
H	27	3	3	9	6	–	5	6	8	1	1
M	15	9	6	14	1	1	1	5	3	–	1
L	8	14	3	9	2	–	1	3	5	1	3
Total 'considerable'	69	29	15	32	11	1	9	17	19	3	8
Total 'negligible'	193	142	77	108	35	13	25	41	75	12	42

Table 4.9 Contd.../-

Table 4.9 (Concluded)

Rank Symbols Classified According to Output Intensity	All Manu-facturing	Two-digited Industry Code									
		31	32	33	34	35	36	37	38	40+41	97
(1)	(2)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
EH*	20	5	6	8	3	8	3	9	–	7	8
VH*	12	6	10	2	5	4	9	3	5	3	7
H*	18	8	14	5	3	7	1	2	2	–	7
M*	5	3	4	1	–	–	2	–	–	3	1
L*	–	5	1	3	–	–	–	–	–	3	2
Total 'substantial'	55	27	35	19	11	19	15	14	7	16	25
EH	6	2	1	–	1	–	1	5	–	–	1
VH	13	1	2	–	2	2	3	4	2	1	3
H	27	10	4	3	8	7	4	4	6	–	14
M	15	5	3	3	3	5	2	2	2	–	10
L	8	6	5	10	4	4	2	–	1	3	10
Total 'considerable'	69	24	15	16	18	18	12	15	11	4	38
Total 'negligible'	193	92	97	86	49	61	35	54	30	55	141

patterns of the labour-absorptive efficiency. From the related frequencies of districts as shown in Table (4.9), we already have the knowledge on the distribution of districts by different efficiency ranks. It may be noticed from the frequency estimates that a vast majority of districts do not have any manufacturing activity-base. This is distressing in the sense that the surplus labour, as yet captivated in agricultural sector, could hardly find an alternative outlet for absorptions to manufacturing activity-bases in the neighbourhood over quite an wide-spread areas of India.

We have barely 55 districts with 'substantial' production intensity, and 69 districts with 'considerable' production intensity for the aggregate manufacturing activity-base, out of a total of 370 districts in India (ref. to Table (4.9). For the individual two-digited activity-bases, the numbers of districts in the two strata of production intensities are even much less. Naturally, spatial distribution of districts in respect of labour-absorptive efficiency ranks in the strata of 'substantial' and 'considerable' production intensities are such that we can hardly depict any major regional grouping of districts, all having only one type of efficiency rank.

It has been, however, noticed that all districts (except Kolaba in Maharashtra) in the category of 'substantial' production intensity have exhibited the labour-absorptive efficiency ranks above the critical national value of unity. Imposing patterns of the labour-absorptive efficiency. From the related frequencies of districts as shown in Table (4.9), we already have the knowledge on the distribution of districts by different efficiency ranks. It may be noticed from the frequency estimates that a vast majority of districts do not have any manufacturing activity-base. This is distressing in the sense that the surplus labour, as yet captivated in agricultural sector, could hardly find an alternative outlet for absorptions to manufacturing activity-bases in the neighbourhood over quite an wide-spread areas of India.

We have barely 55 districts with 'substantial' production intensity, and 69 districts with 'considerable' production intensity for the aggregate manufacturing activity-base, out of a total of 370 districts in India (ref. to Table (4.9). For the individual two-digited activity-bases, the numbers of districts in the two strata of production intensities are even much less. Naturally, spatial distribution of districts in respect of labour-absorptive efficiency ranks in the strata of 'substantial' and 'considerable' production intensities are such that we can hardly depict any major regional grouping of districts, all having only one type of efficiency rank.

It has been, however, noticed that all districts (except Kolaba in Maharashtra) in the category of 'substantial' production intensity have exhibited the labour-absorptive efficiency ranks above the critical national value of unity. Imposing this lower limiting value of unity for the category of 'substantial' production intensity, and a slightly higher value of 1.2 (accommodating the class-ranks H, VH and EH) as the lower limiting value for the category of 'considerable' production intensity, we considered grouping of efficiency ranks generally around H* and above, and also at H and above, so that some sort of regional groupings could emerge with above national-average ranking of labour-absorptive efficiency. With this sort of broad above national-average ranking, we can, however, find some regional groupings of districts, particularly around the major metropolises of Bombay, Calcutta, Madras and Delhi, which have the leadership roles in the macro-regions of Western, Eastern, Southern and Northern India. Thus, on the map of labour-absorptive efficiency for aggregate manufacturing activity-base, we can identity the following sizable regional and areal groupings, apart from a few isolated districts (clustered in pair or singly) scattered all over the geographical areas of India :

R.1 Dominant Regional Grouping of Western India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Greater Bombay (EH*), 2. Thana (EH*), 3. Pune (VH*), 4. Ahmednagar (VH*), 5. Sholapur (VH), 6. Valsad (H*), 7. Surat (H*).

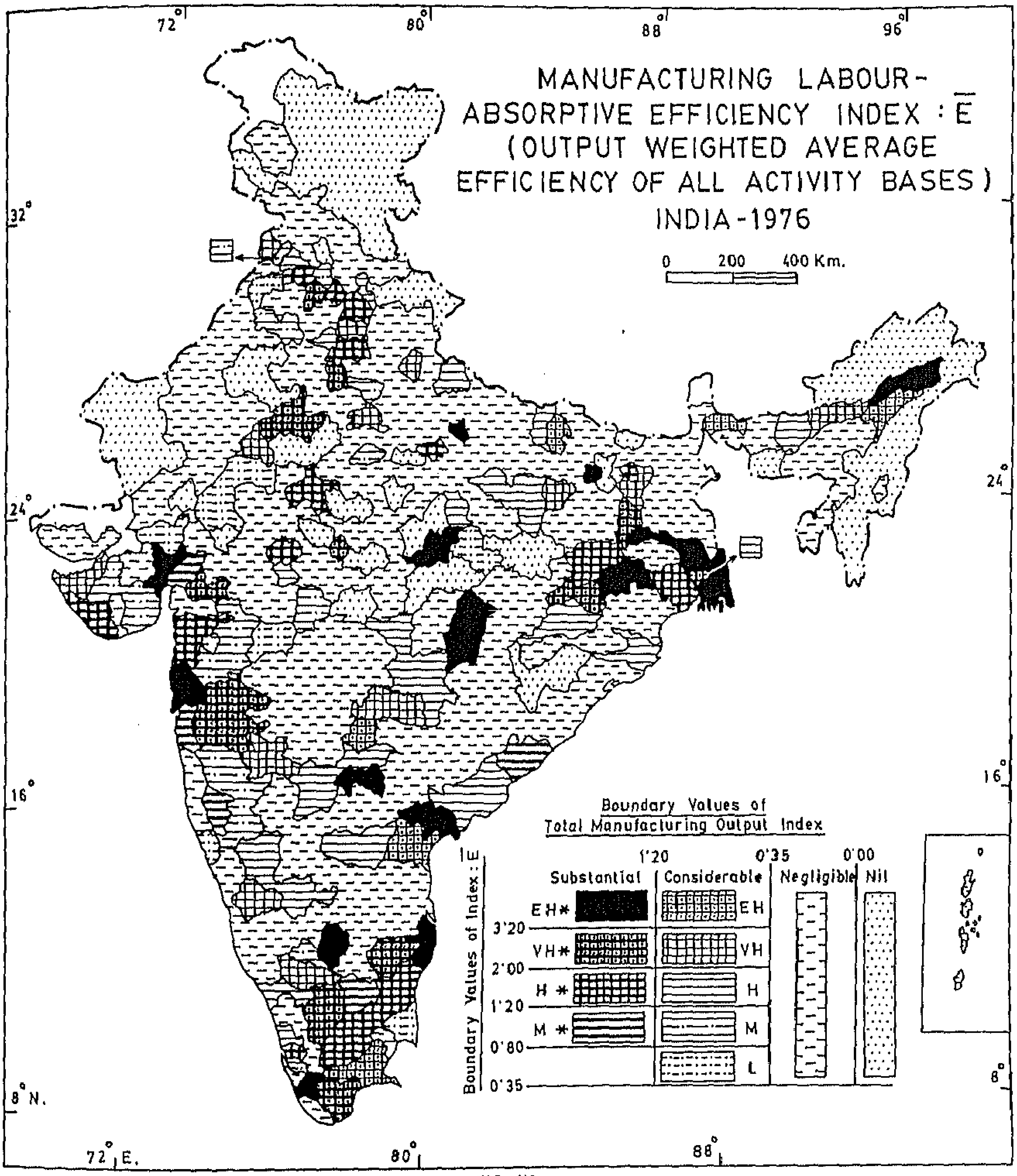

MANUFACTURING LABOUR-
ABSORPTIVE EFFICIENCY INDEX : E
(OUTPUT WEIGHTED AVERAGE
EFFICIENCY OF ALL ACTIVITY BASES)
INDIA-1976
0 200 400 Km.
72°
80°
88°
96°
32°
24°
16°
8° N.
72° E.
Boundary Values of
Total Manufacturing Output Index
1'20
0'35
0'00
Substantial
Considerable
Negligible
Nil
EH*
VH*
H *
M *
EH
VH
H
M
L
3'20
2'00
1'20
0'80
0'35
Boundary Values of Index : E

FIG. 4'2

R.2 Dominant Regional Grouping of Eastern India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Calcutta (H), 2. Twenty Four Parganas (EH*), 3. Howrah (VH*), 4. Hooghly (EH*), 5. Burdwan (EH*), 6. Midnapore (H*), 7. Singhbhum (EH*), 8. Sundargarh (EH*), 9. Sambalpur (H), 10. Ranchi (H*), 11. Giridih (VH*), 12. Dhanbad (EH*), 13. Monghyr (VH), 14. Begusarai (H*).

R.3 Dominant Regional Grouping of Southern India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Madras (EH*), 2. Chingleput (EH*), 3. North Arcot (VH*), 4. South Arcot (H*), 5. Tiruchirapalli (H*), 6. Salem (M*, with $\bar{\bar{E}}$ = 1.10), 7. Coimbatore (VH*), 8. The Nilgiris (H), 9. Madurai (H*), 10. Ramanathpuram (EH), 11. Tirunelveli (VH*), 12. Quilon (EH*).

R.4 Dominant Regional Grouping of Northern India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Delhi (H*), 2. Gurgaon (VH*), 3. Sonepat (H), 4. Meerut (H*), 5. Muzaffarnagar (VH), 6. Saharanpur (H*), 7. Dehra Doon (H), 8. Ambala (H*), 9. Patiala (VH*), 10. Ludhiana (H*), 11. Jullunder (H).

A.1 Moderate Areal-Grouping in South-Central India with Above National-Average Ranks of Labour-Absorptive efficiency :

1. Hyderabad (EH*), 2. Gulbarga (H), 3. Medak (H), 4. Nizamabad (EH), 5. Adilabad (VH), 6. Chandrapur (H), 7. Nagpur (H), 8. Durg + Rajnandgaon (EH*).

A.2 Moderate Areal-Grouping in South-Eastern India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Guntur (EH*), 2. Ongole (VH), 3. Kurnool (H), 4. Krishna (H), 5. East Godavari (H), 6. West Godavari (H), 7. Vishakhapatnam (M*, with $\bar{\bar{E}} > 1.00$).

A.3 Moderate Areal-Grouping in Western India with Above Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Ahmedabad (EH*), 2. Kheda (M*, with $\bar{\bar{E}} = 1.15$), 3. Vadodara (VH*).

A.4 Moderate Areal-Grouping in Northern Far-East India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Dibrugarh + Lakhimpur (EH*), 2. Sibsagar (EH), 3. Darrang (VH), 4. Kamrup (H).

.../-

A.5 Moderate Areal-Grouping in Eastern India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Rohtas (VH), 2. Varanasi (H), 3. Mirazapur (H), 4. Allahabad (H).

A.6 Moderate Areal-Grouping in Southern India with Above National-Average Ranks of Labour-Absorptive Efficiency:

1. Shimoga (VH), 2. Dharwar (H), 3. Chitradurga (H).

Small Patches of Isolated Districts in India with Above National-Average Ranks of Labour-Absorptive Efficiency :

1. Bangalore (EH*) + Mysore (VH),
2. Ernakulam (H*) + Trichur (H),
3. Kozikode (H),
4. Kolhapur (M*, with $\bar{\bar{E}}$ = 1.14),
5. Junagadh (H*) + Jamnagar (VH),
6. Jaipur (VH*) + Ajmer (VH),
7. Amritsar (VH),
8. Bareilly (VH),
9. Kheri (H),
10. Deoria (EH) + Gorakhpur (H),
11. Lucknow (EH*),
12. Kanpur (H*),
13. Agra (VH),
14. Kota (H*),

15. Ujjain (H*) + Indore (H),
16. Bhopal (VH*),
17. Jabalpur (EH*) + Satna (H),
18. Patna (EH*),
19. Cuttack (H),
20. Jalpaiguri (EH).

We shall next make some brief observations on the salient features of these labour-absorptive efficiency regions and areas on the basis of detailed efficiency ranks as tabulated in Table 4.9.

Dominant Labour-Absorptive Efficiency Region of Western India, R.1 :

This is the most important manufacturing region of diversified activities. Its core, comprised of Greater Bombay, Thana and Pune, has practically most of the activities (except 'jute textile') concentrated within, with practically extremely high or very high efficiency ranks for most of the activities. The contribution of this region to the total national value of manufacturing outputs has been overwhelmingly large (it is to be noted that, except Sholapur, all the districts in this region fall in the category of 'substantial' production intensity).

.../-

Dominant Labour-Absorptive Efficiency Region of Eastern India, R.2 :

It is the second most important region of manufacturing activities in India in terms of production intensities. The labour-absorptive efficiency is extremely high here over quite a wide-spread area in the three States in which this region falls. This is also a multi-manufacturing activity region with its core constituted around Calcutta with hinterland spread in Twenty Four Parganas, Howrah and Hooghly districts. This region has the predominance of engineering production ('metal' and 'alloy'-based) in addition to production of 'coal' and 'jute textile'. In the northern fringe of this region the district of Begusarai shows 'substantial' production intensity for the existence of 'petroleum' refinery activities (code no. 30) at Barauni; but the labour-absorptive efficiency rank is not very high unlike its southern neighbours in the region.

Dominant Labour-Absorptive Efficiency Region of Southern India, R.3 :

This is the third most important region of manufacturing activities in India in terms of production intensities. This is also a multi-manufacturing activity region with predominance of certain types of engineering productions, 'chemical' industry-based productions and also 'textile' productions. The labour-absorptive efficiency ranks is a little lower in this region as compared with that of the dominant region, R.2 , of eastern India. This region has really three core areas : the more important one is at Madras + Chingleput with a bias towards engineering industries, 'paper' and 'chemicals', the second one is at Coimbatore with a bias towards 'textiles' and 'machinery' industry-based activities, and the third one is at Quilon with a bias towards the activity-bases of " food and food-products" and " wood and timber" products.

Dominant Labour-Absorptive Efficiency Region of Northern India, R.4 :

Among the four dominant labour-absorptive efficiency regions of India, this region has the lowest labour-absorptive efficiency ranks, generally only high, with however some very high values; but, it is no-where upgraded to extremely high efficiency rank in any district of this region. The core of this region is at the southern fringe of it around Delhi. This region is not yet that productive in absolute intensity as compared with any of the other three dominant regions. It is also not that multi-manufacturing activity-based as the other three dominant regions are. However, its core (at Delhi + Gurgaon) has good multi-manufacturing activities, with a bias toward engineering type of activities, particularly at Gurgaon, and also with practically all types of activities (except " jute" , " leather" , " petroleum etc.") concentrated in the capital city-district of Delhi. In the northern part of this region in Punjab, the activity-bases of " textile : Wool, silk, synthetics" and " transport equipments" gain prominence while in the eastern part of this region in Uttar Pradesh, the activity-bases of " food and food-products", " beverages" and " cotton textile" become important.

Moderate Areal-Grouping with Labour-Absorptive Efficiency

A.1 In South-Central India :

This area has developed as a sort of linear belt with its core in Hyderabad in the south and its subsidiary core at Durg + Rajnandgaon in the north. While the subsidiary core has developed because of Bhilai Steel Plant, located in it, the Hyderabad core has developed for its multi-manufacturing activities with high labour-absorptive efficiencies of " paper", " metal and alloy", " non-metal", " machinery" and " beverage" industries. What is worth mentioning in particular, is this area's speciality in respect of labour-absorptive efficiency in " paper" and " machinery" industries.

A.2 In South-Eastern India :

This area, spread along a linear belt in the south-eastern coast through Krishna-Godavari Delta, is not only substantially productive in tobacco industry-oriented activity-bases of " beverages", with its core at and around Guntur, but it is also highly efficient in respect of labour absorption. Vishakhapatnam, however, gains prominence for the labour-absorptive efficiency of " non-electrical machinery" and " transport equipments" (ship-building) industries within it.

A.3 <u>In Western India</u> :

Even though this area is geographically moderate in size, it, however, has quite diverse activity-bases with 'substantial' output intensity level. Ahmedabad forms the core of various activity-bases in this areal grouping. While both " cotton" and " wool, silk and synthetics" textile industries exhibit very high or high labour-absorptive efficiencies, " non-metal" , " chemicals" , " petroleum" , etc. industries also have high efficiencies of labour absorption.

A.4 <u>Northern Far-East India</u> :

Here Dibrugarh + Lakhimpur forms the core of various manufacturing activities. Though the activities are limited, output intensity level of it is 'substantial'. " Food" (tea-based), " wood and timber" and " petroleum, etc." are the only few in this area which are characterised by high labour-absorptive efficiencies. Its labour-absorptive efficiency is, however, not that high as of A.3 .

.../-

A.5 Eastern India :

The labour-absorptive efficiency level for this areal-grouping is lower than even what has been observed for A.4. While Rohtas' efficiency, in this context, has been observed for the "non-metal" (cement-based) and "paper" industries within it, the other districts' efficiencies in labour-absorption have been noted for the activity-bases of "paper" and "machinery" industries, and also to some extent for "metal" and "non-metal" industries.

A.6 Southern India :

This areal-grouping is characterised by 'considerable' output intensity level, and the particular manufacturing industries that have moderate labour-absorptive efficiencies are "paper", "non-metal" and "metal", (it may be mentioned that Bhadrabati Iron and Steel is in Shimoga).

Isolated patches with high labour-absorptive efficiencies have developed actually in various parts of the country because of the presence of certain locational advantages therein. Details of their efficiency ranks and the related important activity-combinations can be directly comprehended from our tabular data presented in Table (4.8). Even the dominant regions and other areal groupings have not developed industrially in a uniform way everywhere within the respective regions or areas, the reason being that the activities are often localised and localisation economy induced. Those varying details within each region and each area can also be comprehended from our tabular presentation in Table (4.8).

Chapter 5

SYNTHETIC REGIONAL ANALYSIS

In the preceding chapters, we have made regional analyses on the details of human resource development and utilisation, with particular emphasis on their short-falls from desired objectives, as regards their patterns and structures, growth or change over time, nature of change in spatial disparity, inter-connections between sub-phases within the formative phase or the activity phase of human life-span, etc. We have also examined the performance patterns of the existing productive activity-bases of agriculture and different manufacturing industries in respect of human labour absorption. However, the formative phase and the activity phase of life-span for human resources and also the labour-absorptive performance patterns of existing productive activity-bases are dealt separately in different chapters, without any synthetic analysis among these. We have, however, made the detailed as well as some sort of partial synthetic analyses with different spatial variables and indices as generated within the scope of each individual chapter. But, the over-all synthetic regional analysis with the totality of all spatial variables and indices related to all the phases and sub-phases of human life-span has yet to be done, and this is attempted in the following sections.

5.1 The Formulation and Estimation of Synthetic Liability Index of Non-engaged Human Resources

In the context of our investigations on the formative period of human life-span, made in Chapter 2, we have formulated the three fundamental indices of non-development of basic-skill through formal education, denoted by L(I), L(II) and L(III) — relating to three phases (actual sub-phases of the total formative phase) of education : I. Primary, II. Middle and III. Secondary/Higher Secondary. These phases are inter-connected sequentially in the forward time-path with increasing age, so that the question of attaining, say, the education level III, practically does not arise without the completion of preceding level or levels. Because of the heterogeneity of education levels in the three sequentially connected phases, we did not think it wise to formulate a single index of non-development for the total formative phase, although we had to formulate a composite index L for the three phasewise indices in order to have a synthetic spatial ranking of districts and accomplish other related analyses on the question of over-all state of affairs in respect of basic-skill formation. Again, in the context of our investigation on the activity period of human life-span subsequent to the formative period, we have formulated, in all, the three fundamental indices on the incidences of unemployment, denoted by L(IV), L(V) and L(S), relating to the job-searching activity phase IV, the main activity phase V and the over-all activity phase S. Here, unlike the total formative phase, the heterogeneity in the incidences of unemployment in economic activities is not in question, and, as such L(S) could be formulated for the over-all activity phase, which is comprised of the other two activity phases (rather, sub-phases of the over-all activity phase) on simple algebraic logic. In fact, we have obtained the estimating model formulation of L(S) first, which is statistically more precise from the empirical point of view, and subsequently its split into L(IV) and L(V) has been statistically designed, based on certain types of less precise empirical data (of sample-count nature). Thus, for the entire human life-span of our interest, we have really six fundamental indices relating to the development of basic-skill and utilisation in economic activities. We shall first deal with these fundamental indices for our over-all synthetic analysis on the human resource development and utilisation.

All these fundamental spatial indices or spatial variables are not, however, independent statistically. We have already observed the internal inter-connections between indices within the each of the two counterparts of formative and activity periods of human life-span. We now present below in Table (5.1) the entire correlation matrix of all six spatial variables relating to the reference year 1970-71.

Table 5.1 : Correlation Matrix of Spatial Indices on Human Resource Non-development and Non-utilisation : 1970-71

L(I)	L(II)	L(III)	L(IV)	L(V)	L(S)
1.0000	0.7552	0.6018	0.2096	0.2703	0.2457
0.7552	1.0000	0.8778	0.2663	0.2833	0.2839
0.6018	0.8778	1.0000	0.0521	0.1135	0.0841
0.2096	0.2663	0.0521	1.0000	0.9324	0.9876
0.2703	0.2833	0.1135	0.9324	1.0000	0.9771
0.2457	0.2839	0.0841	0.9876	0.9771	1.0000

It should be noted here that as the enrollments and non-enrollments relative to phases I, II and III, and also, as the incidences of employment and unemployment related to phases IV, V and S are complementarily connected, i.e. as the enrollments are linear functions of respective non-enrollments and also as employments are linear functions of respective unemployments, the above correlation matrix, calculated for the indices of non-development and unemployment, also stands for the corresponding complementary indices of development (or, proportionate enrollment) and utilisation (or, proportionate employment in activities) of human resources. This correlation matrix brings out the following two features : (1) the phase-wise indices within each of formative and activity periods of human life-span are highly or very highly inter-correlated, and, (2) the cross inter-correlations between any index of formative period or phase and any index of activity period or phase are generally of negligible or low magnitudes. The feature (1) is the revealed facts as have been expected and already discussed in Chapters 2 and 3, under the prevailing situation of internal inter-connections within the sub-phases of each broad phase of life. The feature (2) can also be explained in the context of our present situation of attitude towards education by the vast poverty-stricken people, generally of rural origin, in the context of the predominance of agricultural activity-base throughout India.

Granting this feature of low inter-connections between the two broad phases, any synthetic formulation for spatial analysis should be so designed as to depict these features in the best possible way without ignoring its relevance, however low may be the present magnitude of their relationship. Statistically speaking, if we treat all the six spatial indices simultaneously for some kind of composite formulation and spatial evaluation, our treatment should not be such as to dilute or over-shadow the presence of low inter-correlations between the two broad phases by the predominance of strong inter-correlations as present within each of the two broad phases. In this composite formulation, our main objective is to get a comprehensive existing picture of both non-development and non-utilisation of human resources, with a view to depict the prevailing spatial variations of over-all social liability, needing different priorities in planning attentions on different areas. From the nature of the correlation matrix, it appears that, to depict most of spatial variations of all six indices, we have to consider at least two sub-phase indices, one for each broad phase, and make use of these sub-phase indices in a bivariate way for spatial grouping of areal units. Naturally, these two sub-phase indices would again end up with low spatial association between them, leading to difficulties in mapping by the usual superposing technique of cartography. Moreover, even if the bivariate mapping could be accomplished in some way or other (say, for example, by considering only a limited number of classes for each sub-phase index, so that the number of bivariate classes becomes limited), it would not be possible to have a unified spatial ranking in a uni-dimensional scale if we go for joint consideration of both the sub-phase indices. Naturally we have to find some way out for the formulation of a single composite index of liability that would give prominance to the cross inter-correlation and at the same time depict both the spatial variations, relating to non-development and non-utilisation of human resources. This we accomplish in the following way.

It has already been shown in Chapter 2 that the aggregate representation maximising central axis (Kendall's formulation) of the three phasewise indices of non-development is most positively related with the middle level formative sub-phase index L(II), with its specific representation as high as to have the near-unity value of 0.9666 (the corresponding magnitudes of specific representation in the central axis by L(I) and L(III) are 0.8548 and 0.9113 respectively). This means that the index L(II) could be singled out as the best possible sub-phase index, out of the three fundamental non-development indices, to represent most of the spatial variations implicit in the scatter of points in the relevant three-dimensional Euclidian space. Similar computations, performed for the three indices on the incidences of unemployment, L(IV), L(V) and L(S), show that their aggregate representation maximising central axis is most positively related with the over-all index of the incidences of unemployment L(S) with its specific representation very close to unity, about 0.9997 (the corresponding magnitudes of specific representation in the central axis by L(IV) and L(V) are 0.9847 and 0.9810 respectively). Thus, L(S) could also be singled out as the best possible index, out of the three non-utilisation indices of the activity phase, that represents most of the spatial variations implicit in the scatter of points in the corresponding three-dimensional Euclidian space. Thus, on the basis of the above mentioned optimality criterion of finding a single representative index for each of the two broad phases, we may select L(II) and L(S), which have incidentally the highest magnitude of all cross inter-correlations that exist between any pair of indices, chosen one each from the two broad phases.

Now, from the economic standpoint, these two indices can also be considered as the meaningful representative indices for the two broad phases of non-development and non-utilisation of human resources. Keeping in mind the problem of child-labour, with its crippling impact on our economy, the index L(II) could be easily taken as an indicator of not only the incidences of child-labour (revealed or disguised) but also the future generation of the bulk of labour force devoid of the minimum level of basic-skills; it is obvious that the boys who remain non-enrolled even at the middle-level education phase II, do not have any scope for future improvement in the level of their basic-skills through formal avenues. Thus, L(II) could be taken as a right kind of relative measure of liability for non-engaged human resources in the formative phase. Again, as L(S) is the over-all index of non-utilisation of human resources (in the form of incidences of unemployment in the entire activity phase), we have all the justifications in accepting it as the representative measure of liability for the non-engaged human resources in the activity phase.

Thus, on the strength of our arguments from both statistical and economic standpoints, we shall now make use of only the indices L(II) and L(S) to formulate a synthetic or composite liability index of non-engaged human resources. This approach of selecting only a single representative index, from among the indices of each of the broad phases, has been quite effective in order to avoid any consideration of the overwhelmingly high magnitudes of internal correlation coefficients at the initial stage of formulation of a single synthetic index, representing the features of spatial variation of both formative and activity phases; those internal correlation coefficients of overwhelmingly high magnitudes have now no chance of over-shadowing or diluting any cross inter-correlation of comparably low magnitude to be reckoned in the synthetic formulation. The presence of the highest cross inter-correlation between the selected representative spatial variables, L(II) and L(S), has also made our approach more meaningful in the sense that the best sort of between-phase (broad) inter-connection could be brought into focus in the synthetic formulation, through the choices of these constituent variables. This is, however, just a coincidence. Anyway, the elimination of the overwhelmingly high valued internal correlation coefficients from our consideration during formulation of a synthetic liability index does not, however, mean that the importance of the strong within-phase (broad) inter-connections among the sub-phases are being totally overlooked in synthetic regional analysis. Once the synthetic formulation of liability index is accomplished by the above mentioned approach, a follow-up statistical analysis on the nature of spatial associations of the synthetic index with all the fundamental phasewise (sub-phase) indices must be pursued for a comprehensive understanding of the nature of synthetic index so formulated. This we shall do in a subsequent section (5.3).

Now we turn our attention to actual statistical formulation and empirical evaluation of the synthetic liability index to be constituted by the two phase-representative indices, L(II) and L(S). As it is now a question of composite index formulation out of only two constituent variables (indices), we have no problem of selection on the method of formulation. We have already discussed on the varieties of statistical methods of composite index formulation, existing or evolved in connection with our index formulation in Chapter 2. It has been already noted that the optimal index formulation (Kendall's, by the aggregate representation maximising principle) and the equity index formulation (Pal's, by the specific representation equalising principle) become coincident when the constituent variables are only two in number, and as such, we have only the single choice of this coincident mode of formulation. Again, as these methods are coincident, the other methods of formulation (discussed or evolved in Chapter 2) that are intermediaries between these two formulations, are also coincident with them. Thus the statistical formulation, constituted of the two said spatial variables, retaining its central critical value at unity (likewise that of both L(II) and L(S)), can be expressed analytically as follows :

$$\xi = \left(\frac{\sigma_S}{\sigma_{II} + \sigma_S}\right) L(II) + \left(\frac{\sigma_{II}}{\sigma_{II} + \sigma_S}\right) L(S) \quad \ldots (5.1)$$

where ξ = the liability index of non-engaged human resources,

and σ_{II}, σ_S are standard deviations of the spatial indices L(II) and L(S) respectively.

The common specific representation of L(II) and L(S) in ξ, here coincident with the maximised aggregate representation ρ, is given by

$$\rho = \sqrt{\frac{1}{2}\,(1 + r_{II,S})}\,, \quad \ldots (5.2)$$

where $r_{II,S}$ denotes the correlation coefficient between L(II) and L(S).

On the basis of these analytical formulations, the empirical expression of ξ and the estimated value of ρ work out to be as follows :

$$\xi = 0.64356\ L(II) + 0.35644\ L(S) \quad \ldots (5.3)$$

and $\rho = 0.80122$

This value of ρ can be considered as just very high. Thus the synthetic liability index ξ turns out to be very highly and also equally representative of the constituent spatial indices L(II) and L(S), with the correlation coefficient with each of magnitude 0.80122 (= ρ), and this is the maximum possible representation in any linear combination of L(II) and L(S) that can be formulated.

We have recorded the districtwise empirical estimates of the synthetic liability index of non-engaged human resources, ξ, in Table (5.3). Now we shall go for the qualitative ranking of districts and the identification of regional patterns, if any, with the values just estimated on the liability index of non-engaged human resources.

5.2 The Ranking of Districts and the Identification of Regional Patterns by the Liability Index of Non-engaged Human Resources : 1970-71

For qualitative ranking of districts by the liability index of non-engaged human resources, ξ, we have to classify the corresponding empirical estimates under selected class-intervals. The qualitative ranks to these class-intervals could then be assigned, depending upon the quantitative levels of defining boundary values of the intervals. As ξ is constituted of L(II) and L(S), which have been already classified in sections (2.5) and (3.4) of Chapter 2 and 3 respectively, we can now proceed with a comparable classification of ξ by using the class-interval lengths of L(II) and L(S) (of magnitudes 0.17 and 0.22 respectively) and also the empirical relation (5.3). In this way, we find the interval length of ξ as to be of magnitude 0.19. With the use of this interval length the whole range of variation of ξ has been divided into class-intervals of equal length, with the middle class containing the critical index value of unity at its centre. Details of this classification of ξ together with the corresponding qualitative ranks and district frequencies are shown below in Table (5.2). In this table we have also shown the boundary values corresponding to different qualitative ranks by both percentage of non-enrolled boys in the middle education phase II (same as that, shown in Table (2.9)) and percentage of unemployed males in the over-all activity phase S (same as that, shown in Table (3.7)).

In Table (5.3) we have recorded these qualitative ranks of districts according to actual magnitudes of the liability index, ξ , together with the actual estimates of the percentage of boys non-enrolled in the middle education phase II and also the percentage of males unemployed in the over-all acticity phase S.

Table 5.2 : Ranked Classification of the Liability Index, ξ, Corresponding District Frequencies and the Comparable Class-Boundaries by Percent Boys Non-enrolled in Phase II and Percent Males Un-employed in Phase S

Qualitative rank	Defining boundaries by ξ	District frequencies for ξ	Boundaries corresponding to ranks by	
			% of boys non-enrolled in Phase II	% of males unemployed in Phase S
VH	1.285 and above	20	above 69.45	above 36.17
H	1.095 to 1.285	117	60.05 to 69.45	30.19 to 36.17
M	0.905 to 1.095	115	50.64 to 60.05	24.21 to 30.19
L	0.715 to 0.905	90	41.23 to 50.64	18.22 to 24.21
VL	0.525 to 0.715	4	31.82 to 41.23	12.24 to 18.22
EL	below 0.525	3	below 31.82	below 12.24

The qualitative ranks of districts, just evaluated and shown in Table (5.3), are presented cartographically in Figure (5.1). On an examination of this figure, we notice that broad regional patterns, with extensively contiguous groupings of districts, did emerge with varying intensities of the non-engaged human resource liability, needing attentions in both formative and activity phases. Thus, in terms of falling intensities of liability, we can identify the following broad regions with the broad quantitative characterisations in terms of dimensions of non-development in the formative phase II of middle education and of non-utilisation in the over-all activity phase S. In this connection, percentage of boys non-enrolled in phase II, is denoted by g(II),

Table 5.3 : Estimated Values and Qualitative Ranks for the Liability Index of Non-engaged Human Resources (ξ) and Comparable Percentages of Boys Non-enrolled in Phase II and Percentages of Males Unemployed in Phase S by Districts of India, 1970-71

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
INDIA	M	1.000	55.34	27.20
ANDHRA PRADESH	H	1.098	63.93	27.10
1. Srikakulam	H	1.142	67.27	27.44
2. Vishakhapatnam	H	1.116	66.16	26.46
3. East Godavari	M	1.068	61.31	27.12
4. West Godavari	M	1.037	59.25	26.57
5. Krishna	M	1.057	58.39	28.84
6. Guntur	M	0.987	52.36	28.85
7. Ongole	M	1.088	60.33	29.46
8. Nellore	M	1.017	56.78	27.25
9. Chittoor	M	1.011	59.20	24.61
10. Cuddapah	M	1.041	60.10	26.13
11. Anantapur	M	1.082	62.07	27.51
12. Kurnool	H	1.116	62.08	30.07
ANDHRA PRADESH (Contd.)				
13. Mahbubnagar	H	1.097	65.33	25.74
14. Hyderabad	M	0.922	41.74	33.37
15. Medak	H	1.119	68.72	24.41
16. Nizamabad	H	1.138	68.17	26.36
17. Adilabad	H	1.174	70.73	26.81
18. Karimnagar	H	1.129	69.49	24.48
19. Warangal	H	1.120	68.04	25.10
20. Khammam	H	1.146	68.75	26.44
21. Nalgonda	H	1.098	68.80	22.78

N.B. : Ranking Symbols of Liability Index (ξ) of Non-engaged Human Resources

Liability Index Range of Value	Symbol
1.285 and above	VH
1.095 to 1.285	H
0.905 to 1.095	M
0.715 to 0.905	L
0.525 to 0.715	VL
Below 0.525	EL

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
ASSAM	H	1.206	64.32	35.00
1. Goalpara	H	1.238	68.72	33.44
2. Kamrup	H	1.208	63.50	35.86
3. Darrang	H	1.226	68.73	32.59
4. Nowgong	H	1.183	64.34	33.24
5. Sibsagar	H	1.193	59.16	38.51
6. Lakhimpur	H	1.216	63.35	36.52
7. Mikir Hills	H	1.187	70.81	27.78
8. North Cachar Hills	M	1.044	65.36	21.70
9. Cachar	H	1.151	61.96	32.85
10. Mizo	M	0.961	45.73	32.78
BIHAR	H	1.166	63.69	32.45
1. Patna	H	1.112	55.92	35.23
2. Gaya	H	1.191	61.82	36.01
3. Shahabad	H	1.204	62.16	36.71
4. Saran	H	1.270	62.77	41.25
5. Champaran	H	1.145	68.42	26.71
6. Muzaffarpur	H	1.183	65.60	32.07
7. Darbhanga	H	1.184	64.87	32.80
8. Monghyr	H	1.169	63.58	32.77
9. Bhagalpur	H	1.162	63.50	32.32
10. Saharsa	H	1.136	67.04	27.24
11. Purnea	H	1.126	67.24	26.28

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
BIHAR (Contd.)				
12. Santhal Parganas	H	1.158	66.82	29.11
13. Palamau	H	1.202	67.22	32.15
14. Hazaribagh	H	1.227	66.15	34.95
15. Ranchi	H	1.145	62.20	32.17
16. Dhanbad	M	0.959	57.51	22.13
17. Singhbhum	H	1.115	59.88	32.00
GUJARAT	L	0.888	46.86	26.20
1. Jamnagar	M	0.939	49.76	27.52
2. Rajkot	M	0.910	44.85	29.64
3. Surendranagar	M	0.949	50.60	27.50
4. Bhavnagar	M	0.948	48.42	29.38
5. Amreli	M	0.920	48.37	27.28
6. Junagadh	M	0.944	50.02	27.61
7. Kutch	M	0.962	52.12	27.15
8. Banaskantha	M	0.978	59.27	22.03
9. Sabarkantha	M	0.924	48.09	27.82
10. Mahesana	M	0.916	44.46	30.48
11. Gandhinagar	L	0.821	41.66	25.69
12. Ahmedabad	L	0.790	38.28	26.27
13. Kheda	L	0.806	40.73	25.41
14. Panchmahals	M	0.917	54.17	21.92
15. Vadodara	L	0.814	43.93	23.15
16. Bharuch	L	0.869	46.67	24.95
17. Surat	L	0.825	45.64	22.43
18. Valsad	M	0.922	46.65	28.99
19. The Dangs	M	0.961	60.90	19.35

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
HARYANA	L	0.894	46.74	26.75
1. Ambala	L	0.808	43.53	23.10
2. Karnal	L	0.885	48.84	24.22
3. Rohtak	M	0.961	43.82	34.47
4. Gurgaon	L	0.889	45.44	27.54
5. Mahendranagar	M	0.942	44.87	32.09
6. Hisar	L	0.865	49.08	22.46
7. Jind	M	0.939	51.40	26.04
HIMACHAL PRADESH	M	1.051	50.24	35.64
1. Chamba	M	1.038	58.83	26.98
2. Kangra	M	1.046	46.88	38.18
3. Mandi	M	1.052	50.03	35.91
4. Kulu	M	0.971	54.21	26.01
5. Lahul & Spiti	L	0.765	53.32	11.10
6. Bilaspur	M	1.041	49.46	35.53
7. Mahasu	M	0.961	51.99	27.25
8. Simla	L	0.904	47.09	27.20
HIMACHAL PRADESH (Contd.)				
9. Sirmaur	L	0.889	55.70	18.43
10. Kinnaur	L	0.808	50.42	16.94
JAMMU & KASHMIR	H	1.126	59.47	33.22
1. Anantanag	M	1.093	61.18	29.12
2. Srinagar	H	1.109	58.19	33.00
3. Baramula	H	1.100	62.47	28.52
4. Ladakh	H	1.111	61.90	29.90
5. Doda	H	1.105	61.88	29.39
6. Udhampur	H	1.117	61.62	30.60
7. Jammu	H	1.191	52.70	44.12
8. Kathua	H	1.171	57.74	38.12
9. Rajauri	H	1.188	61.88	35.73
10. Punch	H	1.165	61.35	34.46

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
KARNATAKA	M	1.015	58.03	26.00
1. Bangalore	M	0.934	50.92	26.11
2. Belgaum	M	0.985	57.42	24.22
3. Bellary	M	1.046	62.22	24.58
4. Bidar	H	1.126	64.96	28.31
5. Bijapur	M	1.029	58.91	26.26
6. Chikmagalur	M	0.998	56.45	26.05
7. Chitradurga	M	0.985	57.77	23.90
8. Coorg	L	0.903	51.78	22.96
9. Dharwar	L	0.888	50.96	22.55
10. Gulbarga	H	1.117	66.30	26.43
11. Hassan	M	1.030	58.38	26.80
12. Kolar	M	1.027	61.40	23.88
13. Mandya	M	1.065	64.55	24.04
14. Mysore	M	1.041	63.58	23.01
15. North Kanara	M	0.979	52.26	28.30
16. Raichur	M	1.061	64.99	23.35
17. Shimoga	M	1.019	55.20	28.83
KARNATAKA (Contd.)				
18. South Kanara	M	1.065	50.13	36.78
19. Tumkur	M	0.996	59.18	23.52
KERALA	L	0.858	42.57	27.71
1. Cannanore	L	0.844	46.28	23.34
2. Kozikode	L	0.874	43.47	28.12
3. Malappuram	L	0.896	45.35	28.17
4. Palghat	L	0.900	54.54	20.31
5. Trichur	M	0.956	42.88	34.90
6. Ernakulam	L	0.750	38.13	23.43
7. Kottayam	L	0.726	36.28	23.24
8. Alleppey	L	0.726	31.34	27.65
9. Quilon	L	0.816	38.44	28.20
10. Trivandrum	L	0.778	40.22	23.68

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
MADHYA PRADESH	H	1.198	64.32	34.33
1. Morena	H	1.193	65.91	32.57
2. Bhind	H	1.184	62.85	34.55
3. Gwalior	H	1.142	56.39	37.08
4. Datia	H	1.184	64.14	33.45
5. Shivpuri	H	1.171	67.96	29.03
6. Gunna	H	1.214	67.70	32.55
7. Tikamgarh	H	1.228	70.68	31.00
8. Chhatarpur	H	1.191	70.19	28.60
9. Panna	H	1.233	69.77	32.17
10. Satna	H	1.217	64.54	35.61
11. Rewa	H	1.270	65.28	39.02
12. Shahdol	H	1.223	69.85	31.36
13. Sidhi	H	1.279	72.39	33.36
14. Mandsaur	H	1.116	58.63	33.16
15. Ratlam	H	1.199	62.46	36.05
16. Ujjain	H	1.173	59.80	36.51
17. Jhabua	VH	1.373	75.77	37.54
18. Dhar	H	1.177	68.60	28.98
19. Indore	H	1.114	49.54	41.04
20. Dewas	H	1.214	63.80	36.01
21. Khargone	H	1.238	67.09	34.96
22. Khandwa	H	1.198	60.24	37.95
MADHYA PRADESH (Contd.)				
23. Shajapur	H	1.203	65.75	33.47
24. Rajgarh	H	1.218	69.82	31.01
25. Vidisha	H	1.184	67.36	30.61
26. Sehore	H	1.161	60.48	34.94
27. Raisen	H	1.214	67.31	32.93
28. Hoshangabad	H	1.148	58.65	35.56
29. Betul	H	1.192	63.87	34.31
30. Sagar	H	1.147	60.59	33.78
31. Damoh	H	1.203	63.24	35.64
32. Jabalpur	H	1.148	55.82	38.07
33. Narsimhapur	H	1.204	60.18	38.46
34. Mandla	H	1.220	66.62	34.00
35. Chhindwara	H	1.219	64.84	35.44
36. Seoni	H	1.203	64.97	34.11
37. Balaghat	H	1.127	61.13	31.79
38. Surguja	H	1.195	71.28	27.94
39. Bilaspur	H	1.178	62.35	34.57
40. Raigarh	H	1.162	65.22	30.84
41. Durg	H	1.174	61.70	34.83
42. Raipur	H	1.192	61.90	36.08
43. Bastar	H	1.280	74.02	31.97

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ) Rank	Liability Index (ξ) Value	Percent Non-enrolled in Phase II	Percent Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
MAHARASHTRA	L	0.879	47.73	24.75
1. Greater Bombay	EL	0.452	31.74	6.39
2. Thana	L	0.825	48.23	20.17
3. Kolaba	M	1.030	50.37	33.94
4. Ratnagiri	M	1.053	46.66	38.98
5. Nasik	M	0.923	49.55	26.48
6. Dhulia	M	0.974	53.20	27.15
7. Jalgaon	L	0.880	42.11	29.80
8. Ahmadnagar	M	0.934	49.19	27.62
9. Poona	L	0.885	43.80	28.72
10. Satara	M	1.025	46.77	36.70
11. Sangli	M	0.920	47.77	27.83
12. Sholapur	M	0.931	50.94	25.86
13. Kolhapur	M	0.916	48.63	26.71
14. Aurangabad	M	0.957	53.73	25.37
15. Parbhani	M	0.966	56.99	23.13
16. Bhir	M	1.003	57.35	25.69
17. Nanded	M	0.998	58.30	24.44
18. Osmanabad	M	0.983	54.86	26.34
19. Buldhana	L	0.881	47.52	25.04
20. Akola	L	0.878	47.15	25.13
21. Amravati	L	0.875	46.83	25.20

States and Union Territories	Liability Index (ξ) Rank	Liability Index (ξ) Value	Percent Non-enrolled in Phase II	Percent Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
MAHARASHTRA (Contd.)				
22. Yeotmal	M	0.921	53.26	23.02
23. Wardha	L	0.884	46.64	26.02
24. Nagpur	L	0.870	43.97	27.40
25. Bhandara	L	0.863	48.46	22.84
26. Chandrapur	M	0.938	55.91	21.97
MANIPUR	H	1.189	50.68	45.74
1. Manipur North	H	1.171	58.97	37.02
2. Manipur West	H	1.236	59.32	41.06
3. Manipur South	H	1.210	51.61	46.57
4. Manipur Central	H	1.186	48.89	47.17
5. Manipur East	H	1.179	51.03	44.70
MEGHALAYA	H	1.167	66.19	30.33
1. Garo Hills	H	1.227	69.12	32.26
2. United Khasi & Jaintia Hills	H	1.128	64.24	29.05
NAGALAND	M	1.053	57.34	29.47
1. Kohima	M	0.957	54.21	24.94
2. Mokokchung	M	1.094	51.03	38.17
3. Tuensang	H	1.115	66.82	25.85

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
ORISSA	H	1.116	66.61	25.99
1. Sambalpur	M	1.001	65.09	18.63
2. Sundargarh	H	1.107	67.69	24.41
3. Keonjhar	H	1.178	70.50	27.30
4. Mayurbhanj	H	1.201	73.25	26.65
5. Balasore	H	1.117	60.06	31.98
6. Cuttack	M	1.088	58.31	31.29
7. Dhenkanal	M	1.087	64.03	26.11
8. Baudh Khondmals	M	1.088	70.14	20.80
9. Bolangir	M	1.069	70.56	18.93
10. Kalahandi	H	1.153	76.13	20.43
11. Koraput	H	1.184	80.21	19.17
12. Ganjam	H	1.195	66.96	31.78
13. Puri	M	1.039	58.31	27.54
PUNJAB	L	0.759	45.04	17.99
1. Gurdaspur	L	0.844	44.66	24.88
2. Amritsar	L	0.752	44.89	17.55
3. Firozpur	L	0.757	48.32	14.88
4. Ludhiana	VL	0.684	40.52	16.28
5. Jullander	L	0.782	40.78	23.44
6. Kapurthala	L	0.788	44.02	21.06
PUNJAB (Contd.)				
7. Hoshiarpur	L	0.800	39.63	25.88
8. Ropar	L	0.754	42.20	20.16
9. Patiala	L	0.763	46.47	16.93
10. Sangrur	L	0.721	50.28	10.45
11. Bhatinda	L	0.744	50.28	12.22
RAJASTHAN	VH	1.303	66.14	40.76
1. Ganganagar	VH	1.296	65.94	40.40
2. Bikaner	VH	1.302	62.18	44.18
3. Churu	VH	1.359	66.14	45.05
4. Jhunjhunu	VH	1.364	60.70	50.24
5. Alwar	VH	1.336	65.19	44.10
6. Bharatpur	VH	1.289	65.81	39.97
7. Sawai Madhopur	VH	1.295	67.86	38.65
8. Jaipur	H	1.282	62.95	42.04
9. Sikar	VH	1.377	64.01	48.27
10. Ajmer	H	1.216	57.94	41.40
11. Tonk	VH	1.302	60.07	38.05
12. Jaisalmer	VH	1.285	70.68	35.36
13. Jodhpur	VH	1.309	65.06	42.16

Table 5.3 (Continued)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
RAJASTHAN (Contd.)				
14. Nagaur	VH	1.355	69.05	42.12
15. Pali	VH	1.325	67.25	41.49
16. Barmer	VH	1.313	73.00	35.42
17. Jalore	VH	1.357	73.24	38.55
18. Sirohi	VH	1.340	68.34	41.60
19. Bhilwara	H	1.209	69.47	30.66
20. Udaipur	VH	1.292	67.47	38.76
21. Chittaurgarh	H	1.220	66.78	33.85
22. Dungarpur	VH	1.407	69.55	45.72
23. Banswara	VH	1.411	71.53	44.24
24. Bundi	H	1.279	68.70	36.63
25. Kota	H	1.231	61.03	39.79
26. Jhalawar	H	1.284	67.14	38.52
TAMIL NADU	L	0.878	50.38	22.32
1. Madras	L	0.776	33.75	29.29
2. Chingleput	L	0.890	50.39	23.26
3. North Arcot	M	0.915	53.41	22.40
4. South Arcot	M	0.920	55.79	20.71
5. Dharmapuri	M	1.004	63.52	20.21
6. Salem	L	0.877	56.70	16.65
7. Coimbatore	L	0.794	50.71	15.61
8. Nilgiris	L	0.895	45.16	28.22
TAMIL NADU (Contd.)				
9. Madurai	L	0.858	47.89	22.98
10. Tiruchirapalli	L	0.856	50.79	20.22
11. Thanjavur	L	0.884	49.39	23.67
12. Ramanathpuram	M	0.913	48.16	26.96
13. Tirunelveli	L	0.892	46.25	27.04
14. Kanyakumari	L	0.856	40.24	29.61
TRIPURA	H	1.137	54.57	38.34
1. West Tripura	H	1.190	53.88	42.96
2. North Tripura	M	1.091	53.78	35.52
3. South Tripura	H	1.171	56.77	38.95
UTTAR PRADESH	L	0.896	53.48	20.94
1. Uttar Kashi	VL	0.621	50.60	2.42
2. Chamoli	M	0.994	58.57	23.87
3. Tehri Garhwal	M	1.014	50.95	32.20
4. Garhwal	H	1.161	58.38	36.81
5. Pithorgarh	H	1.098	58.31	32.00
6. Almora	H	1.131	58.76	34.15
7. Nainital	L	0.883	59.64	14.43
8. Bijnore	M	0.928	55.06	21.95
9. Moradabad	M	0.913	57.42	18.69
10. Budaun	L	0.850	59.87	11.71
11. Rampur	L	0.890	60.09	14.55
12. Bareilly	L	0.859	57.04	14.90

Table 5.3 (Continued)

States and Union Territories		Liability Index (ξ)		Percent	
		Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)		(2)	(3)	(4)	(5)
UTTAR PRADESH (Contd.)					
13.	Pilbhit	L	0.815	57.10	11.50
14.	Shahjahanpur	L	0.782	57.13	9.02
15.	Dehradun	VL	0.641	41.98	11.60
16.	Saharanpur	L	0.849	53.47	17.35
17.	Muzaffarnagar	L	0.895	53.78	20.56
18.	Meerut	L	0.891	49.96	23.62
19.	Bulandshar	M	0.961	52.82	26.51
20.	Aligarh	M	0.911	51.63	23.65
21.	Mathura	M	0.913	50.83	24.57
22.	Agra	M	0.910	50.37	24.76
23.	Etah	L	0.889	53.95	20.00
24.	Mainpuri	L	0.900	52.34	22.22
25.	Farrukhabad	L	0.840	52.04	17.97
26.	Etawah	L	0.895	49.54	24.32
27.	Kanpur	L	0.795	45.67	20.11
28.	Fatehpur	L	0.887	53.38	20.34
29.	Allahabad	M	0.924	51.33	24.91
30.	Jhansi	L	0.890	51.34	22.39
31.	Jalaun	L	0.878	48.87	23.63
32.	Hamirpur	L	0.896	53.67	20.76
33.	Banda	L	0.880	54.59	18.73
34.	Kheri	L	0.778	58.39	7.54
35.	Siteput	L	0.814	57.04	11.49
36.	Hardoi	L	0.820	55.32	13.55
37.	Unnao	L	0.892	54.74	19.49
38.	Lucknow	L	0.822	47.91	20.22
39.	Rae Bareli	M	0.916	54.92	21.23
40.	Bahraich	L	0.760	59.57	5.12
41.	Gonda	L	0.806	58.02	10.00
42.	Bara Banki	L	0.812	58.28	10.24
43.	Faizabad	M	0.920	54.38	22.00
44.	Sultanpur	M	0.962	54.91	24.68
45.	Pratapgarh	M	1.026	53.65	30.68
46.	Basti	L	0.843	56.68	14.04
47.	Gorakhpur	M	0.919	54.03	22.23
48.	Deoria	M	0.963	54.55	25.05
49.	Azamgarh	M	1.058	54.26	32.63
50.	Jaunpur	M	1.053	51.93	34.33
51.	Ballia	M	1.054	52.59	33.75
52.	Ghazipur	M	1.033	53.87	31.04
53.	Varanasi	M	0.944	48.99	28.59
54.	Mirazapur	M	0.909	54.44	21.05

Table 5.3 (Concluded)

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
WEST BENGAL	L	0.891	45.74	27.45
1. Darjeeling	L	0.892	46.32	26.96
2. Jalpaiguri	M	0.937	51.39	25.93
3. Cooch Behar	M	0.926	51.82	24.71
4. West Dinajpur	M	0.933	51.81	25.24
5. Malda	M	1.008	54.50	28.55
6. Murshidabad	M	1.033	53.91	31.00
7. Nadia	M	0.991	48.00	33.07
8. 24-Parganas	L	0.886	42.50	29.89
9. Howrah	L	0.836	41.25	27.19
10. Calcutta	EL	0.401	31.85	2.33
11. Hooghly	L	0.897	42.57	30.68
12. Burdwan	L	0.902	45.70	28.28
13. Birbhum	M	0.989	49.64	31.39
14. Bankura	M	0.974	48.52	31.28
15. Midnapore	M	0.933	44.17	32.04
16. Purulia	M	0.919	50.24	25.57

States and Union Territories	Liability Index (ξ)		Percent	
	Rank	Value	Non-enrolled in Phase II	Unemployed in Phase S
(1)	(2)	(3)	(4)	(5)
ARUNACHAL PRADESH	M	1.035	67.08	19.48
1. Kameng	M	0.920	68.50	9.41
2. Subansiri	H	1.121	70.22	23.23
3. Siang	M	1.060	65.70	22.61
4. Lohit	M	0.925	63.30	14.41
5. Tirap	H	1.101	67.00	24.55
CHANDIGARH	EL	0.462	27.66	10.72
DELHI	VL	0.654	42.85	11.92
DADRA & NAGAR HAVELI	L	0.836	45.34	23.59
GOA	L	0.901	47.86	26.27
PONDICHERRY	L	0.804	41.88	24.14

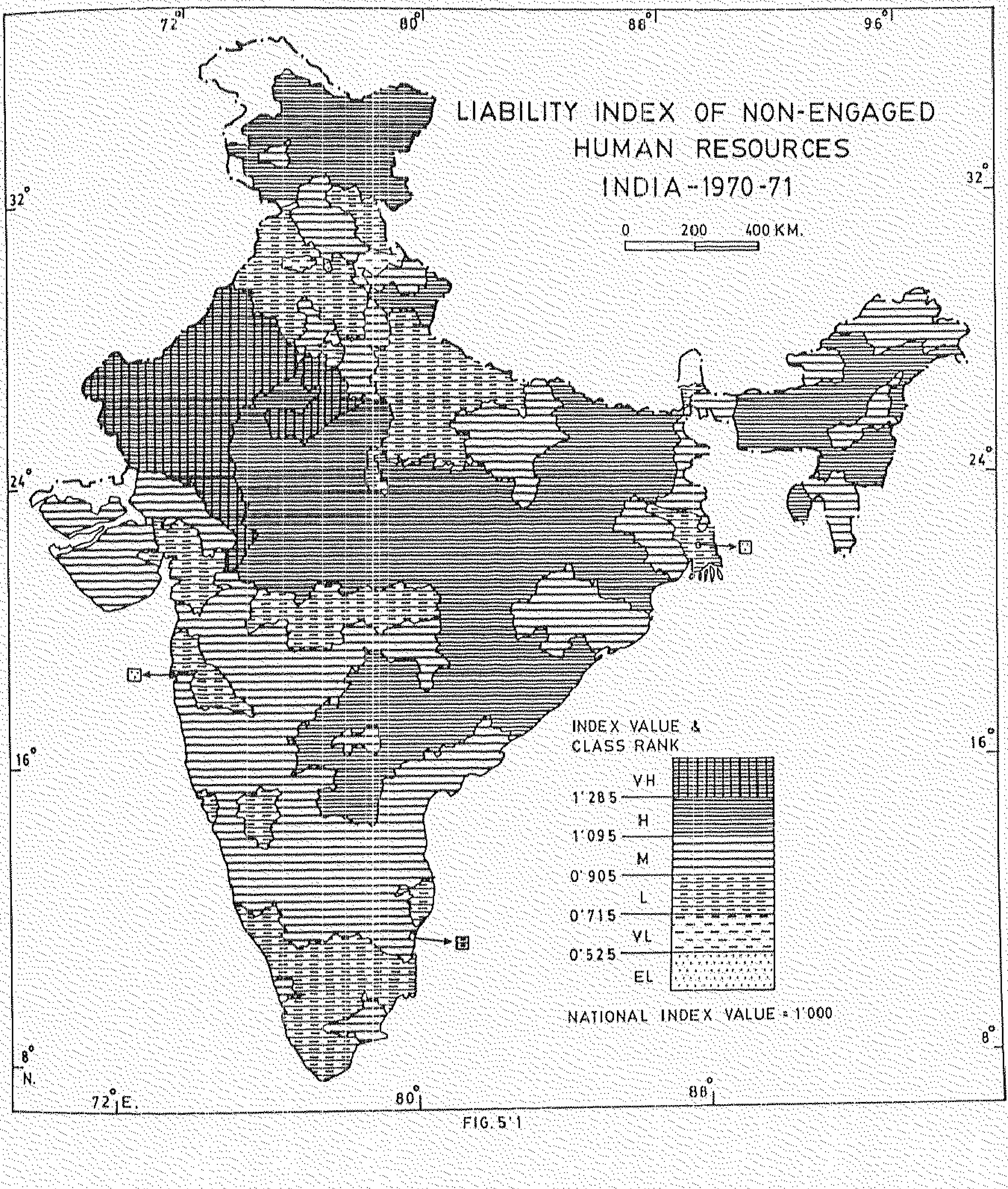

LIABILITY INDEX OF NON-ENGAGED HUMAN RESOURCES
INDIA - 1970-71
0 200 400 KM.
INDEX VALUE & CLASS RANK
VH
1'285
H
1'095
M
0'905
L
0'715
VL
0'525
EL
NATIONAL INDEX VALUE = 1'000
72°
80°
88°
96°
32°
24°
16°
8° N.
72° E.

FIG. 5'1

corresponding to L(II) and the percentage of males unemployed in the over-all activity phase S. is denoted by u(S), corresponding to L(S). The general ranges of g(II) and u(S) have been shown in Table (5.2) corresponding to different qualitative ranks of liability, ξ. We shall note the actual quantitative characterisation in terms of g(II) and u(S) as they occur in different regions identified below :

VH Liability Region (1) of North-Western India

This region of very high non-engaged human resource liability has occurred only in the north-western part of India, extending over most of Rajasthan, barring a few of its eastern districts and including the districts of Jhabua (of Madhya Pradesh) in its southern fringe.

Quantitative characterisation by constituents :-

g(II) : 60% to 76% (i.e. H or VH ranks by L(II)),

u(S) : about 35% to 50% (i.e. more or less VH and EH ranks by L(S)).

H Liability Region (2) of Extensive Spread in Central and Eastern India

This region of high non-engaged human resource liability is spread extensively in contiguous form, extending mainly in the States of Bihar and Madhya Pradesh, north-eastern and south-western parts of Orissa, northern Andhra

Pradesh and also in a few eastern districts of Rajasthan in contiguity with Madhya Pradesh. This extensive region can be divided into three really broad regions, occurring in contiguous form as follows :

H Liability Region (2.1) of Central India

This is spread mainly in Madhya Pradesh, extending in the adjacent districts of Rajasthan.

Quantitative characterisation by constitutents :-

g(II) : 49% to 74% (mainly M and H ranks and also some VH ranks by L(II)).

u(S) : 28% to 42% (mainly VH and H ranks and also M ranks by L(S)).

H Liability Region (2.2) of Eastern India

This is spread mainly in Bihar, extending in the adjacent districts in the north-eastern Orissa (the region is in contiguity with Region (2.1)).

Quantitative characterisation by constituents :-

g(II) : 56% to 73% (mainly above national rank M, rank H and also some with VH ranks by L(II)).

u(S) : 24% to 41% (ranks M, H and VH by L(S)).

H Liability Region (2.3) of South-Central India

This is spread mainly in the northern part of Andhra Pradesh (excluding the capital district of Hyderabad) with adjacent districts around, extending in the northern tip of Karnataka, the southern-most district of Bastar in Madhya Pradesh, connecting the south-western part of Orissa (this region is in contiguity to the south of Region (2.1)).

Quantitative characterisation by constituents :-

g(II) : 60% to 80% (H and VH ranks by L(II)).

u(S) : 19% to 32% (mainly M ranks and some with H and L ranks by L(S)).

H Liability Region (3) of Far-Eastern India

Mainly Assam, Meghalaya, Manipur and some districts in Tripura, Nagaland and Arunachal Pradesh form this region.

Quantitative characterisation by constituents :-

g(II) : 49% to 71% (mainly M and H ranks and also some VH ranks by L(II)).

u(S) : 28% to 47% (mainly H ranks and also some VH and M ranks by L(S)).

H Liability Region (4) of Northern-most India

This is spread mainly in the State of Jammu and Kashmir.

Quantitative characterisation by constituents :-

g(II) : 53% to 62% (mainly H ranks and some M ranks by L(II)).

u(S) : 28% to 44% (mainly H and VH ranks and also some with M and EH ranks by L(S)).

M Liability Region (5) of South India

This is a region mainly spread contiguously in most of Karnataka, in the south-eastern half of Andhra Pradesh and in the adjoining districts of Tamil Nadu.

Quantitative characterisation by constituents :-

g(II) : 42% to 53% (L, M and H ranks by L(II)).

u(S) : 20% to 37% (L, M and H ranks by L(S)).

M Liability Region (6) in Maharashtra State

In contiguity with the above mentioned Region (5) an extensive region of Maharashtra State falls in this category of medium ranked liabilities of non-engaged human resources.

Quantitative characterisation of constituents :-

g(II) : 47% to 58% (mainly M ranks and also some L ranks by L(II)).

u(S) : 22% to 39% (mainly M and H ranks and also some with VH ranks by L(S)).

M Liability Region (7) in Gujarat State

Except the districts along the Gulf of Khambat in the West Coast, from Surat to Ahmedabad, the rest of Gujarat falls in this category of medium level liabilities.

Quantitative characterisation of constituents :-

g(II) : 44% to 61% (mostly L and M ranks by L(II)).

u(S) : 19% to 30% (L and M ranks by L(S)).

M Liability Region (8) in Orissa State

The districts in the central one-third of Orissa State (along the Mahanadi Course) fall into this category of medium level liabilities.

Quantitative characterisation by constituents :-

g(II) : 58% to 71% (M and H ranks mainly and also some VH ranks by L(II)).

u(S) : 19% to 31% (L and M ranks mostly by L(S)).

M Liability Region (9) in West Bengal State

Except the central patch of districts from Twenty-four Parganas to Burdwan, the rest of West Bengal State falls into this category of medium liabilities.

Quantitative characterisation by constituents :-

g(II) : 41% to 54.5% (L and M ranks by L(II)).

u(S) : 22% to 33% (mainly M and H ranks by L(S)).

M Liability Region (10) in Eastern Uttar Pradesh

A contiguous region with medium liability occurs within eastern Uttar Pradesh, bordering the State boundary of Bihar.

Quantitative characterisation by constituents :-

g(II) : 49% to 55% (M ranks by L(II)).

u(S) : 21% to 34% (L, M and H ranks by L(S)).

H + M Liability Areas (11) in Western Uttar Pradesh

The core of this is in the northern part of Uttar Pradesh, bordering Nepal, with H liability rank; this core area extends in the eastern and southern districts (right upto Agra district in the southern border) in a sort of linear belt where the liability rank is M.

Quantitative characterisation by constituents :-

g(II) : 58% to 59% in the core and 50% to 57% in the extended areas (M ranks by L(II)).

u(S) : 32% to 37% in the core (mostly H rank by L(S)) and 18.5% to 26.5% in the extended areas (L and M ranks by L(S)).

M Liability Areas (12) in Himachal Pradesh

Most of Himachal Pradesh is under this M category of liability.

Quantitative characterisation by constituents :-

g(II) : 47% to 58% (M ranks by L(II)).

u(S) : 26% to 38% (M and H ranks by L(S)).

M Liability Patch (13) in Haryana

Three districts of Haryana to the West of Delhi fall in the category of medium liability.

Quantitative characterisation by constituents :-

g(II) : 44% to 51% (generally L ranks and some M ranks by L(II)).

u(S) : 26% to 34.5% (M and H ranks by L(S)).

M Liability Patches (14) in the Far North-Eastern India

It is a combination of three patches with M liability and these patches are :

i) most of Arunachal Pradesh,

ii) western part of Nagaland with the district of North Cachar of Assam,

iii) Mizoram and the adjoining district of Tripura.

Quantitative characterisation by constituents :-

g(II) : 46% to 68% (L, M and H ranks by L(II)).

u(S) : 22% to 38% (L, M and H ranks by L(S)).

L + VL Liability Region (15) in Punjab, Haryana and Western Fringe of Uttar Pradesh Including Delhi

This is one of the major least liability regions in the neighbourhood of the capital of India. Here Delhi itself has VL rank where as Chandigarh, the joint capital of Punjab and Haryana, has EL rank of liability.

Quantitative characterisation by constituents :-

g(II) : 39% to 54% (below national level with rank M, and also with rank L by L(II)).

u(S) : 2% to 26% (EL, VL and L ranks mostly, and also few M ranks by L(S)).

L Liability Region (16) in Central Uttar Pradesh

This is another broad region with least liability of non-engaged human resources.

Quantitative characterisation by constituents :-

g(II) : 46% to 60% (L and M ranks by L(II)).

u(S) : 5% to 24% (EL, VL and L ranks by L(S)).

L Liability Region (17) in Tamil Nadu and Kerala

Most of Tamil Nadu, Kerala and the adjoining Coorg district of Karnataka form this third major region with least liability rank.

contd.../-

Quantitative characterisation by constituents :-

g(II) : 31% to 57% (mainly VL and L ranks and some M ranks by L(II)).

u(S) : 15% to 30% (VL, L and M ranks by L(S)).

L Liability Area (18) in Bombay and its Industrial Hinterland

This area with L liability is spread over three districts, mainly in Bombay, Thana and Pune, having its core at Bombay, where the liability rank drops down to even EL level.

Quantitative characterisation by constituents :-

g(II) : 31.7% (EL rank by L(II)) in the core area, and 44% to 48% (L rank by L(II)) in the hinterland districts.

u(S) : 6.4% (EL rank by L(S)) in the core area, and 20% to 29% (L and M ranks by L(S)) in the hinterland districts.

L Liability Area (19) in North-Eastern Maharashtra

This area with L liability, is spread as a sort of linear belt along the north-eastern border of Maharashtra and also along the rail-way track from Bhandara in the east to Jalgaon in the West of this belt.

Quantitative characterisation by constituents :-

g(II) : 42% to 48.5% (L rank by L(II)).

u(S) : 23% to 30% (mostly M by L(S)).

L Liability Area (20) in Gujarat State

This area of L liability rank is spread over the districts from Surat to Ahmedabad (the coastal districts around the Gulf of Khambat).

Quantitative characterisation by constituents :-

g(II) : 38% to 47% (VL and L ranks by L(II)).

u(S) : 22% to 26% (VL and L ranks by L(S)).

L Liability Area (21) in Calcutta and its Industrial Hinterland

This area of L liability rank is spread over five districts, namely, Calcutta, Twenty-four Parganas, Howrah, Hooghly and Burdwan, having its core at Calcutta, where the liability rank drops down to even EL level.

Quantitative characterisation by constituents :-

g(II) : 31.85% (nearing the boundary between VL and EL ranked classes by L(II)) in the core area, and 41% to 46% (L ranks by L(II)) in the hinterland districts.

u(S) : 2.33% (EL rank by L(S)) in the core area and 27% to 31% (L and M ranks mainly by L(S)) in the hinterland districts.

The details of these regionalisations can be directly visualised from Figure (5.1). The actual positions of a district in terms of the constituents L(II) and L(S) of ξ can also be obtained from the estimates presented in Table (5.3) and also from the Figures (2.4) and (3.6). In this connection it is also worthwhile to look into the relevant Figures (2.6) for L(III) and also the Figures (3.2) and (3.4) for L(IV) and L(V), all relating to the year 1970-71. We are now going for a comprehensive analysis on spatial association, involving not only L(II) and L(S) but also all other fundamental indices L(I), L(II), L(III), L(IV) and L(V) to throw further light on the nature of their association with ξ.

5.3 Comprehensive Analysis of Spatial Association of the Liability Index with Different Phase-specific Indices

From the bi-polarised multicollinear system (ref. to the correlation matrix in Table (5.1)), we have formulated the liability index, ξ, of non-engaged human resources by a special device that could eliminate, to start with, the consideration of strong inter-relations within the two polarised groups of variables. We shall now take into consideration the entire correlation matrix, given in Table (5.1), together with the additional variable ξ, for a comprehensive spatial association analysis on the liability index. This analysis is particularly necessary to expose the implicit linkages of ξ with all fundamental indices, that ought to exist, in some form or other, in our multicollinear system.

The liability index, ξ , is so formulated as to depict liabilities for both the formative and the activity phases. As such ξ is likely to show high inter-relations with the fundamental indices from both the phases, without much alignment bias to either of the two groups of indices. This has been more or less the fact, as gets revealed from the estimates given below :

Correlation coefficient of ξ with			
formative phase indices		activity phase indices	
L(I)	: 0.6246	L(IV)	: 0.7825
L(II)	: 0.8012	L(V)	: 0.7866
L(III)	: 0.6003	L(S)	: 0.8012

These pairwise correlation coefficients alone are not, however, sufficient to expose the complexities of linkages that ξ has in the entire multicollinear system of all the spatial variables or indices involved; we have to take into account the entire correlation matrix of Table (5.1) along with the above mentioned additional values of correlation coefficients, and then search for the complexities of the linkages. In this search, we have to make use of the advantage of the VLS procedure of regression analysis, rather than the usual OLS procedure. In fact, the OLS procedure of regression analysis is incapable of revealing appropriately the complex linkages in a multicollinear system, for its axis-biased least squaring. Moreover, we can achieve certain useful discriminatory power through VLS procedure of regression, which we cannot have through OLS procedure of regression. To state more precisely, out of a set of multicollinear variables, we need to search for that particular variable which is best explained by the most relevant combination among other variables. Now, every additional increase in the number of explanatory variables (regressors) always increases the multiple correlation coefficient in the OLS regression procedure, whereas it may at times decrease the correlation coefficient in the VLS regression, indicating the redundance of the inclusion of an additional regressors in the multicollinear set-up. This advantageous property provides us with the discriminatory power of identifying the most relevant combination of regressors for a particular choice of regressand. With varying choices of the regressand and different combinations of regressors, the best dependent variable and the corresponding combination of most relevant regressors can be well identified by the maximum value of VLS correlation coefficient.

For comprehensive spatial association analysis, we shall now subject the spatial indices to this kind of VLS treatment. We have altogether seven spatial variables, including ξ , for which the correlation matrix has already been presented in Table (5.1) and also here in this section (for additional correlation coefficients for the inclusion of ξ). However, ξ along with its constituent variables L(II) and L(S), make a three variable space (or, 3-space, in short), in which we shall get a perfect VLS regression of ξ on L(II) and L(S). The two important aspects that are to be noted are : (i) all three variables ξ , L(II) and L(S) cannot be included for the VLS regression treatment, limiting thereby the maximum number of variables to six, (ii) the search for the highest VLS correlation coefficient would be limited to a total number of variables above three, as we intend to go for a system which is more enlarged than the formulating one. Thus, our search for the best dependent regressand and the corresponding combination of most relevant regressors would be within the total variable space, constituted of 4 to 6 variables. The VLS correlation coefficients with reference to different variable spaces, for each of the included variables as regressor by turn, are tabulated in the following matrix shown in Table (5.4). From a comparative analysis of these estimates of VLS correlation coefficients, we can make the following critical observations :

1) The golbal maximum value of VLS correlation coefficients is attained in 5-space of all considered variables except L(I) and L(S), and the liability index, ξ , turns out to be the globally best dependent variable in this space. The corresponding maximum value of the VLS correlation

coefficient, $r_{\xi,\hat{\xi}}$, is so extremely high that it attains almost the near-unity value of magnitude 0.99102. The corresponding combination of most relevant spatial variables, explaining almost the entire spatial variation of ξ ($r^2_{\xi,\hat{\xi}}$ = 0.98212), are only the fundamental indices L(II) and L(III), relating to the Middle and High+Higher Secondary levels of education in the formative phase, and the fundamental indices L(IV) and L(V), relating to the job-searching activity phase and the main activity phase respectively. Thus, the spatial variation in the non-engaged human resource liabilities are really contributed by the spatial variations of all these four phase-wise components of non-development and non-utilisation of human resources.

2) With the inclusion of L(I), corresponding to Primary level of education, the value of VLS correlation coefficient $r_{\xi,\hat{\xi}}$ reduces to 0.96541 in the 6-space. On the other hand, with the exclusion of the formative phase variable beyond the Middle education level, namely L(III), the value of $r_{\xi,\hat{\xi}}$ further reduces to 0.94289 in the 4-space. These discriminating facts, obtained through the advanced method of VLS regression, establish the redundancy of only L(I), among the indices of the formative phase, when we are concerned on the question of liability for non-engaged human resources. Also, it establishes the relative importance of L(III) over L(I) in the

Table 5.4 : The VLS Correlation Coefficients in Different Variable-spaces for Spatial Indices Related to Liability, Non-development and Non-utilisation of Human Resources in India, 1971

Spatial variable (L)	VLS correlation coefficients $r_{L, \hat{L}}$									
	6-space		5-space				4-space			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
L(I)	0.40858	0.63038	0.49395	0.47813	0.54040	-	-	0.61217	0.64126	-
L(II)	-	0.77999	-	-	0.62273	0.66554	0.83990	-	0.75907	0.48798
L(III)	0.29466	0.58462	0.39430	0.37794	-	0.48939	0.65309	0.53811	-	-
L(IV)	0.86448	0.56223	0.70818	0.73758	0.69256	0.65605	0.42095	-	0.48444	0.80224
L(V)	0.88392	0.59368	0.74341	-	0.71568	0.67806	-	-	-	0.81052
L(S)	0.90025	-	-	0.76474	-	-	-	0.48072	-	-
ξ	0.91220	0.96541	0.96103	0.96202	0.97682	0.99102	0.90113	0.90414	0.92737	0.94289

N.B : (1) The variables not included in the variable-space are shown by " —" (dash).

(2) $\hat{L}$ is the estimate of L from the linear VLS regression on other variables considered in the variable-space.

context of explaining the spatial variation of the liability index, ξ. Thus, the liability for non-engaged human resources has really started with the incidences of non-enrolment of boys to Middle level of education, which in turn gives rise to the problem of child-labour with its crippling impact on our economy. Its effect, in fact, has continued further over the subsequent formative sub-phase also.

3) At another instance, with the exclusion of the main activity phase variable L(V), the value of $r_{\xi,\hat{\xi}}$ drops down to 0.90113 in the 4-space, showing that the liability of non-engaged human resources does not end just with a required attention to the job-searching phase alone; rather, it goes further beyond to the main activity phase V if the human resources remain unutilised even at that advanced age beyond 35 years. Thus, none of the two separately characterised sub-phase indices of the activity phase could be dispensed with in the context of explaining the spatial variations of our liabilities, measured by ξ.

4) It should be noted in this context that the explanatory role of L(V) to ξ, in association with L(IV), L(III) and particularly L(II), cannot be fully achieved by L(S) without L(II) in the extended multicollinear system, even though ξ rests for its formulation on L(II) and L(S). This is revealed by the falling value of $r_{\xi,\hat{\xi}}$ to 0.96202 (as compared with

the maximal value of 0.99102) in the 5-space itself, with the inclusion of L(S) and thereby forcing the replacement of L(II) by L(I) for technical reasons as clarified earlier. This empirical fact and also that revealed from the comparison of two results shown for $r_{\xi,\hat{\xi}}$ in the 6-space, establish the relative importance on the need for inclusion of L(II) over L(S) in the evaluation of comprehensive spatial association of ξ as regressand with other indices in the extended multicollinear system.

5) Following our convention of denoting the standardised variable u by z_u, the best fit VLS regression in terms of standardised variables may be written as :

$$\hat{z}_{\xi} = 0.34637\, z_{L(II)} + 0.27604\, z_{L(III)} + 0.34301\, z_{L(IV)} + 0.35074\, z_{L(V)} \quad \ldots (5.4)$$

with VLS correlation coefficient, $r_{\xi,\hat{\xi}} = 0.99102$.

By use of the mathematical theorem on total differential (Euler's) and also the relevant central axis as fitted through the scatter of spatial observational points in the corresponding variable space, it has already been proved by Pal and De [1979] what would be the distinct contributions of the regressors in explaining the total variation of the regressand, measured by the squared VLS correlation coefficient. Their findings can be expressed simply as follows. Of the total variation accounted by the VLS regression, and given by $r^2_{\xi,\hat{\xi}}$, the contribution of the j-th regressor, denoted by c_j, is given by the following equation :

$$c_j = a_j^2 / \sum_{i=II}^{V} a_i^2 , \qquad \ldots (5.5)$$

where a_{II}, a_{III}, a_{IV} and a_V represent, in order, the regression coefficients of the VLS regression in standardised form, shown in equation (5.4) above.

Thus, of the total accounted variation of z_ξ of magnitude 0.9825, the contributions of the regressors $z_{L(II)}$, $z_{L(III)}$, $z_{L(IV)}$ and $z_{L(V)}$ have been respectively the following :

$$c_{II} = 0.27464 , \quad c_{III} = 0.17443 , \quad c_{IV} = 0.26933,$$
$$c_V = 0.28160 \qquad \ldots (5.6)$$

Thus the explanatory roles have remained more or less same for L(II), L(IV) and L(V), while it has been somewhat reduced (roughly to two-third magnitude of above) for L(III), in explaining the total spatial variation of ξ .

6) It should be noted here that the feature of relative contributory roles of regressors cannot be brought out distinctly by the OLS procedure. In the present case, although ξ-axis biased least squaring, as implicit in the OLS procedure, improves slightly the OLS correlation coefficient to 0.99981

(from the VLS correlation coefficient 0.99102), the presence of multicollinearity actually distorts the evaluation of OLS regression coefficients, say, a_j^*'s, so much as to give a negative value for a_{III}^*. In fact, the presence of multicollinearity between L(II) and L(III) is responsible for such a meaningless negative value for a_{III}^* together with a much exaggerated value of a_{II}^* against a_{II}. Also the presence of multicollinearity between L(IV) and L(V) has resulted into a considerably lower value for a_V^* against a_V and somewhat enhanced value of a_{IV}^* against a_{IV}. The quantitative OLS estimates as have been worked out and used above for the qualitative observations are not being presented here for the sake of brevity only. However, we report our qualitative observations only to bring home the fact that the above type of discriminations, justifying uniquely and distindtly the contributions of most relevant regressors, in explaining the variations of the best discriminated regressand (or, dependent variable), have been possible, not by the OLS regression procedure, but only by the VLS regression treatment.

7) In the formulating model for ξ, shown in the equation (5.1), the mode of formulation is such that the contributory roles, say, c'_{II} and c'_S of L(II) and L(S) respectively, are equal, i.e. we have $c'_{II} = c'_S = 0.5$ for the formulating model equivalent to (5.1) with standardised variables, namely,

$$z_\xi = \frac{1}{2\rho} \left[z_{L(II)} + z_{L(S)} \right] \qquad \ldots (5.7)$$

(accepting it, as it were, as a perfect VLS regression). From the classificatory boundary values, shown in the last two columns against the class-rank M of ξ , it can be easily worked out that the percentage of boys non-enrolled in Phase II is about 55.34 , and the percentage of adult males unemployed in the over-all activity phase S is about 27.20 . The critical all-India value of all of L(II), L(S) and ξ has been unity. The percentage figures of 55.34% and 27.20% stand for the all-India 1971 benchmark value corresponding to the all-India critical value of L(II) and L(S). An weighted average of these percentages with weights as the relative contributions c'_{II} and c'_{S} respectively, can be taken as to correspond the critical all-India value of ξ and that removes the abstraction of ξ in terms of average percentage of non-attainments in the functions expected to be performed by boys and adult males. Granting this weighting scheme, the average percentage of non-attainments corresponding to all-India critical value of ξ (in 1971) works out to be about 41.27 . This is what we get from our formulating model for ξ .

Now, with the VLS regression interpretation of ξ in the extended multicollinear system of phase indices, we have to interpret the all-India critical value of ξ (in 1971) in terms of all of the most relevant contributory variables namely L(II), L(III), L(IV) and L(V). We have already reported the corresponding values of relative contributions c_{II} ,

c_{III}, c_{IV} and c_V. The 1971 all-India percentages of non-enrolled boys and unemployed males have been as shown below :

Table 5.5 : **Non-enrollment** and Unemployment Percentages of Boys and Males in India, 1971

Percentage of boys non-enrolled in		Percentage of Males Unemployed in	
Phase I :	37.34	Phase IV :	31.32
Phase II :	55.34	Phase V :	21.40
Phase III :	77.66	Phase S :	27.20

Using the percentage figures shown against phases II, III, IV and V, and weighting them by c_{II}, c_{III}, c_{IV} and c_V, the weighted average percentage of non-attainments corresponding to all-India critical value of ξ works out to be 43.21, which is fairly close enough to that, worked out from the formulating model, i.e. 41.27%. Granting that our non-engaged human resource liabilities get better explained by appropriate contributions from all component phases II, III, IV and V in the extended multicollinear (or, interconnected) system, we would take that the percentage figure of 43.21 is more relevant to represent the weighted average percentage of non-attainments corresponding to all-India critical value of ξ (equal to unity). Once this is taken as the benchmark percentage value corresponding to $\xi = 1$, we can get for classifying the ξ-values the interval-length $\Delta\xi$ in terms of percentage non-attainments interpretation as equal to 8.2 ($= \Delta\xi \times 43.21$).

This value is identical to what we get by combining $\Delta L(II)$ (= 9.4%, in terms of the percentage non-enrollment interpretation for phase II) and $\Delta L(S)$ (= 5.98%, in terms of the percentage unemployment interpretation for phase S) with the weights as used for L(II) and L(S) in the formulating model (5.1). Because of all these agreements quoted above, we can remove the abstractions in the classification scheme of ξ, shown in Table (5.2), with the following figures of percentage non-attainments corresponding to the defining class-boundaries of ξ.

Table 5.6 : Extension of Table (5.2) in Terms of Weighted Average Percentage of Non-attainments in Functions of Formative and Activity Phases by Boys and Adult Males, 1971

Class rank	Defining boundaries by the liability index (ξ)	Corresponding boundaries by weighted average percentage of non-attainments
VH	1.285 and above	55.5 and above
H	1.095 to 1.285	47.3 to 55.5
M	0.905 to 1.095	39.1 to 47.3
L	0.715 to 0.905	30.9 to 39.1
VL	0.525 to 0.715	22.7 to 30.9
EL	below 0.525	below 22.7

This percentage interpretations of non-attainments in functions would now add more meaning to regional patterns, identified already in section (5.2).

8) As the indices on non-development and non-utilisation of human resources and also the formulated liability index have different intensities of spatial variation, as reflected in their standard deviation quoted below :

$$\sigma_{II} = 0.16763, \quad \sigma_{III} = 0.10488, \quad \sigma_{IV} = 0.26096,$$

$$\sigma_{V} = 0.39774 \text{ and } \sigma_{\xi} = 0.17287.$$

It is worthwhile to look into the VLS regression in terms of un-standardised indices corresponding to its standardised version shown in (5.4). The empirical estimate of the VLS regression in terms of un-standardised variables can be written as :

$$\xi = -0.19000 + 0.35720\, L(II) + 0.45498\, L(III) + 0.22722\, L(IV) + 0.15244\, L(V), \quad \ldots \quad (5.8)$$

with VLS correlation coefficient = 0.99102.

In the context of comprehensive analysis on spatial association in the extended variable space for explaining the spatial variation of the liability index of non-engaged human resources, it was necessary to have the VLS regression analysis in terms of standardised variables (as in relation (5.4)) (since the change of scale (or, measurement unit) and the shift of origin on the original variables do not ever affect the standardised variables). But the same VLS regression, when gets expressed in terms of un-standardised variables, involves number of non-comparable scales in the sense that different all-India benchmark percentages, shown in Table (5.5) for 1971, are now actually used to define different regressors, L(II), L(III), L(IV) and L(V), and also the deduced benchmark percentage of 43.2% is now used for the regressand ξ. This kind of index formulation had been necessary elsewhere for time-path comparisons of non-development or unemployment patterns for any particular phase. While all percentage figures are comparable over all phases, the different phase indices are, however, not comparable because of different scales implicit in it. For a proper understanding of phenomena, it is necessary to look into the un-standardised form of VLS regression (5.8) in conjunction with their corresponding benchmark percentages. This can be readily comprehended if we convert the relation (5.8) into corresponding relation with all indices changed into their percentage forms. Following the symbols used in Chapters 2 and 3, the indices L(II), L(III), L(IV) and L(V) are now changed to the corresponding variables g(II), g(III), u(IV) and u(V) respectively in percentage forms, and the symbol $\wedge$ is used to denote the variable in percentage form corresponding to the liability index, ξ. Then, with the use of benchmark percentages, we may write the relation (5.8) in the following form.

$$\wedge = -8.21 + 0.27884\, g(II) + 0.25309\, g(III) + 0.31341\, u(IV) + 0.30773\, u(V), \quad \ldots (5.9)$$

with VLS correlation coefficient, $r_{\xi,\hat{\xi}} = 0.99102$.

Now Λ denotes the non-engaged human resource liability in terms of average percentage of non-attainments to functions in the formative phases II and III and the activity phases IV and V by boys and adult males, whereas g(II) and g(III) denote the percentages of boys non-enrolled in the Middle education phase II and the High + Higher Secondary education phase III respectively, and, u(IV) and u(V) stand for the percentages of adult males unemployed in the job-searching phase IV and the main activity phase V.

The variables of relation (5.9) being all in comparable percentage forms, it is now more meaningful than the form (5.8). It is very interesting to note that the form (5.9), involving economically comparable variables, stand very much in line with the original standardised form (5.4), involving statistically comparable variables, at least in respect of relative dimensions of their regression coefficients. This relation (5.9) provides us with some useful interpretations in terms of marginal rate of change of liability percentage Λ with respect to any regressor in the form of percentage non-enrollment or percentage unemployment. Thus, corresponding to 1% reduction in u(IV), u(V), g(II) and g(III) the respective reduction in liability percentage are only the fractional values : 0.3134%, 0.3077%, 0.2788% and 0.2531%, quoting in order of the falling magnitudes. These figures, derived from regression coefficients of the relation (5.9), are more or less same relative to the two component activity phases IV and V and then it reduce slightly and gradually relative to the formative phases II and III, with the least value for the last quoted phase. Although the marginal rates are slightly lower for the two formative phases, the dimensions of the tasks ahead for efforts toward liability-reduction are tremendous in view of the overwhelming all-India percentage values (in 1971) corresponding to these phases shown in Table (5.5). Again, coupling the all-India percentage figures, showing the incidences of male unemployment (ref. again to Table (5.5)) with the bulky sizes of phases IV and V (among all the five phases, the percentages of total males are concentrated in phases IV and V and these are 33.10 and 24.21 as against 15.03% and 10.72% in phases II and III respectively), the dimensions of the tasks ahead for efforts toward liability reduction would be no less tremendous at all.

5.4 Identification of Existing Spatial Interactions Between the Formative and the Activity Phases for Respective Representative Indices

We shall apply similar kind of VLS regression evaluation for the identification of the best explained spatial variable and also the corresponding most relevant combination of variables among all six indices of the formative and the activity phases, the correlation matrix of which has already been shown in Table (5.1). Here, as the three indices in each broad phase are strongly multicollinear, our search for the highest VLS correlation coefficient would be limited to examinations in only 4 to 6 variable-spaces. This restriction on our search (below 4 variable-spaces are not considered) is also necessary in order to identify the existing spatial interactions in an extended system of variables, polarised in two broad phases. Thus, for our present investigation, the VLS correlation coefficients with reference to different variable-spaces, considering always each of the included variables as regressand in turn, are tabulated in the following matrix, shown in Table (5.7). From a systematic analysis on the variable-spaces, quoted in this Table, we make the following critical observations towards depicting the spatial interactions between the indices of the formative and the activity phases as existed in the reference year 1970-71 in India.

1) In the 6-variable space we have only one possible combination out of the six considered variables, and in this global combination of all six variables, both L(S) and L(V) turn out to be almost equally best with the magnitude of the VLS correlation coefficient equal to 0.79 (approximated to two places of decimals). Because of this almost equal status for the similar kind of variables in the activity phase it would be better to search for distinct identification of the best dependent variable in reduced variable-spaces containing

only one of these equally competing variables L(V) and L(S).

2) Thus in the reduced 5-space, out of the two possible alternative combinations of variables, the combination of all distinct phase-indices, L(I) to L(V), has yielded the variable L(II) as the best dependent variable. The corresponding VLS correlation coefficient is about 0.81, and this value is a little reduced to about 0.80, the moment L(V) is replaced by its possible alternative L(S) in the 5-space (still retaining, however, L(II) as the best dependent variable). It should be noted that the inclusion of both L(V) and L(S) in 6-space did not help us in the proper identification of the dependent role of L(II) as gets revealed in 5-space, because of the strong inter-connectedness between L(V) and L(S), placing both of these variables, in a sort of mutually supportive way, in the status of almost equally best dependent variables in the 6-space. However, the VLS correlation coefficients for L(V) or L(S) in 6-space have not been higher than what we have obtained for L(II) in 5-space in both the alternatives, and this justifies our stand on consideration of only one of L(V) and L(S) for the discrimination to be made from the VLS correlation coefficients. For the two alternatives in 5-space, the closeness of the VLS correlation coefficients for L(II) is not unempected as the correlation coefficients of L(II) with each of L(V) and L(S) are noticed to be quite close (ref. to

Table 5.7 : VLS Correlation Coefficients for Different Regressand Spatial Indices Related to Formative and Activity Phases of Human Life-span, 1971

Spatial variable (L)	VLS correlation coefficients ($r_{L,\hat{L}}$)								
	6-space	5-space		4-space					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L(I)	0.47921	0.64658	0.65690	0.34811	0.38023	0.45563	0.47962	–	–
L(II)	0.55423	0.80399	0.80928	–	–	0.49365	0.50798	0.55038	0.57811
L(III)	0.37821	0.60265	0.61733	0.23013	0.26022	–	–	0.39223	0.42648
L(IV)	0.75519	0.43013	0.41751	0.75601	0.68231	0.68069	0.63746	0.62064	0.56791
L(V)	0.78582	–	0.44836	–	0.73932	–	0.67170	–	0.59890
L(S)	0.79360	0.45337	–	0.78854	–	0.70455	–	0.64105	–

N.B. : (1) The variables not included in the variable-space are shown by " — " (dash).

(2) $\hat{L}$ is the estimate of L from the linear VLS regression on the remaining variables, included in the variable-space.

Table (5.1)). Anyway, here we have no confusion in identifying distinctly a single index L(II) as the best dependent variable in the two alternative 5-spaces. And, in view of the fact that the alternative with the most relevant regressors, L(I), L(III), L(IV) and L(V), has not only yielded the maximum VLS correlation coefficient for L(II), but also included only the non-overlapping phase-indices as regressors, we have no hesitation to accept this as the most acceptable alternative in 5-space. Having accepted this result of discrimination from the VLS regression analysis in the extended multicollinear system of altogether six spatial variables, we are now confirmed of the importance of the enrollment situation in the Middle level education phase II which gets spatially interacted or influenced by the situations prevailing in the two other education phases I and III, and also by the employment situations prevailing in the two distinct activity phases IV and V.

3) Now, as the index corresponding to Middle education phase II has turned out to be the best dependent spatial variable in the 5-space of all phasewise indices, we would like now to investigate the situations without this variable for all possible alternatives in 4-space. Incidentally, we have also investigated the other alternatives by replacing L(I) or L(III) by L(II) to complete the exercise of covering all possible alternatives in 4-space. Now, among all six feasible

alternatives shown in 4-space, the best dependent variable turns out to be L(S), explained by the most relevant combination of regressors namely L(I), L(III) and L(IV), after dropping L(II) from 5-space for our consideration. In this case, the globally best VLS correlation coefficient for L(S) is found to be of magnitude equal to about 0.79 and the replacement of L(S) by L(V) reduces the VLS correlation coefficient for L(V) to a distinctly lower magnitude of 0.74 in 4-space. In fact, for any other alternatives in 4-space, including the alternatives obtained through replacements of L(I) or L(III) by L(II), we always get much lower values of VLS correlation coefficients for either L(S) or L(V). However, in the four alternatives with the inclusion of L(II), the respective best dependent variables have always turned out to be either L(S) or L(V) (as the case may be for our choice on inclusion of either of L(S) or L(V)). As for these alternatives we have not been in a position to identify the dependent variable with the globally best VLS correlation coefficient, we have no reason for accepting L(II) as a regressor to explain the spatial variations of either L(S) or L(V). Thus, L(II) actually gets explained by L(V) in 5-space rather than itself explaining L(S) or L(V) in 4-space. So the best dependent variable in 5-space turns out to be L(II) while the best dependent variable in the reduced 4-space without L(II) is L(S). Because of this status of dependence for both L(II) and L(S), we have additional justifications for considering only these two indices in our formulating model for the liability index, ξ .

4) Following our convention of denoting the standardised variable of u by z_u, the best fit VLS regression for L(II) in terms of standardised variables may be written as :

$$\hat{z}_{L(II)} = 0.37269\ z_{L(I)} + 0.35835\ z_{L(III)} + 0.26611\ z_{L(IV)} + 0.28519\ z_{L(V)}, \quad \ldots (5.10)$$

with VLS correlation coefficient = 0.80928 .

On the basis of these regression coefficients, we estimate the contribution of the j-th regressor, denoted by c_j (ref. to the relation (5.5)), for j = I, III, IV and V, and these are

$$c_I = 0.33114, \quad c_{III} = 0.30614, \quad c_{IV} = 0.16882, \quad c_V = 0.19390 \quad \ldots (5.11)$$

This shows the relative proportional importance of the four regressors in explaining the spatial variation of L(II), and these four factors together explain a proportion of about 0.655 (= squared VLS correlation coefficient) of the total spatial variation of L(II); (the rest could be attributed to other factors like available facilities for Middle level education, etc. not considered in our study).

The above VLS regression may be translated into the following three equivalent forms using un-standardised variables and related percentage versions with scale and origin changes on initial indices :

VLS regression (5.10) in terms of un-standardised variables

$$L(II) = -0.08297 + 0.21429\ L(I) + 0.57275\ L(III) + 0.17094\ L(IV) + 0.12020\ L(V) \quad \ldots (5.12)$$

VLS regression (5.12) in terms of corresponding percentage variables

$$g(II) = -4.59165 + 0.31759\ g(I) + 0.40814\ g(III) + 0.30203\ u(IV) + 0.31082\ u(V) \quad \ldots (5.13)$$

VLS regression (5.13) in terms of complementary percentage variables

$$n(II) = -29.26641 + 0.31759\ n(I) + 0.40814\ n(III) + 0.30203\ m(IV) + 0.31082\ m(V) \quad \ldots (5.14)$$

where $n(\varphi)$ $(= 100 - g(\varphi))$, φ = I, II, III, denote the percentage of boys enrolled for education in phase φ, and $m(\varphi)$ $(= 100 - u(\varphi))$, φ = IV, V, denote the percentage of adult males employed in economic activities in phase φ.

For all these alternative forms of VLS regressions (i.e. (5.10) and (5.12) to (5.14)) the same VLS correlation coefficient of magnitude 0.80928 will be obtained because of the analytical reasons stated already. The forms (5.13) and (5.14) being in terms of the variables in comparable percentage forms we use these for easy comprehension of the analysis based on the concept of marginal rates of change of g(II) and n(II) relative to any of the relevant explanatory variables. In view of the complementary nature of the variables involved in the two regressions (5.13) and (5.14) the regression coefficient associated with any phase-specific percentage non-enrolment/unemployment variable is found not to differ from the regression coefficient associated with the corresponding phase-specific percentage enrollment/employment variable of complementary nature; however, the intercept parameters differ for necessary adjustments in the two complementarily specific situations. The empirical estimates of the marginal rates, whether in terms of (5.13) or (5.14), exhibit almost equal role in the percentage change of g(II) (alternatively, n(II)) relative to unit percentage change in g(I), u(IV) and u(V) (alternatively, n(I), m(IV) and m(V) respectively), while the marginal rate of change in percent for g(II) relative to unit percentage change in g(III) (alternatively, n(III)) is considerably higher. Thus the prevailing situation in the High + Higher Secondary education level of phase III is a significant influencing factor for the non-enrollment or complementarily enrollment in the preceding Middle level of education of phase II, besides the almost equal influencing roles of situations prevailing in other phases, I, IV and V. The roles of the activity phases IV and V confirm that the prevailing employment situations are definite influencing factors to the incidences of enrollment or, otherwise, dropping out (or, non-enrollment) in phase II of Middle level education, giving rise to the undesirable generation of the child labour problem.

5) The best fit VLS regression for L(S) in 4-space with standardised variables can be written as :

$$\hat{z}_{L(S)} = 0.40103z_{L(I)} + 0.28418z_{L(III)} + 0.63930z_{L(IV)} \quad \ldots(5.15)$$

with VLS correlation coefficient = 0.78854.

On the basis of these regression coefficients our estimates on the relative contributions of the regressors in explaining the spatial variation of L(S) are the following :

$$c_{I} = 0.24732, \quad c_{III} = 0.12418 \text{ and } c_{IV} = 0.62850 \quad \ldots (5.16)$$

Here the proportionate share of the total variation of L(S), explained by the regressors, is about 0.622 (the rest is obviously due to other factors like existing job-market situations, etc. as operative with productive and related activities of our national economy, which are not considered in our analysis). The striking role played by the prevailing employment situation in the job-searching phase IV in explaining the spatial variation of the over-all employment situation is easily comprehensible. However, it is important to notice that in our existing employment situation, it is the phase I of Primary education which has played a more important role in explaining the variation in the over-all employment situation, rather than the phase III of High + Higher Secondary level of more matured skill-formative education. Thus, it follows from the relative contributions of the two explanatory formative phases I and III that our present situation of over-all human resource utilisation is influenced more by the prevailing situation of our society with more of illiterate and semi-literate labour-contents that have yet incompletely acquired basic-skill, rather than by that with completely acquired basic-skill (with at least upto High + Higher Secondary level of education).

Likewise the preceding case (given in (4)) the best fit VLS regression in 4-space, given in relation (5.15), can be translated into the following three equivalent forms in terms of un-standardised variables and related percentage versions of it with scale and origin changes on initial indices :

VLS regression (5.15) in terms of un-standardised variables

$$L(S) = -0.98831 + 0.41631\ L(I) + 0.82005\ L(III) + 0.74145\ L(IV) \quad \ldots (5.17)$$

VLS regression (5.17) in terms of corresponding percentage variables

$$u(S) = -26.88193 + 0.30326\ g(I) + 0.28722\ g(III) + 0.64391\ u(IV) \quad \ldots (5.18)$$

<u>VLS regression (5.18) in terms of complementary percentage variables</u>

$$m(S) = 3.44298 + 0.30326\, n(I) + 0.28722\, n(III) + 0.64391\, m(IV) \quad \ldots (5.19)$$

where $n(\varphi)$ $(= 100 - g(\varphi))$, φ = I and III, and $m(\varphi)$ $(=100-u(\varphi))$, φ = IV, are as defined already below the relation (5.14). Here $u(S)$, or, complementarily $m(S)$ $(= 100 - u(S))$, denote the percentage of adult male unemployment, or, complementarily the percentage of adult male employment in the over-all activity phase S. As before, we get the same VLS correlation coefficient 0.78854 for all the alternative forms of above mentioned VLS regression (i.e. (5.15) and (5.17) to (5.19)). The last two forms of the regression can again be utilised with its regression parameters interpreted as the marginal rates of change in, say, $m(S)$ relative to change in any specific regressor (the set of regressors now includes $n(I)$, $n(III)$ and $m(IV)$). In terms of assessment by the marginal rates, any improvement in percentage employment in the job-searching phase IV would impart the highest percentage share of improvement in over-all employment level (of about 0.64 percent in $m(S)$, corresponding to 1% improvement in $m(IV)$). Here the two phases I and III of basic-skill formation through education behave closely if our assessment is based on the corresponding marginal rates, of relation (5.19). However, the enrollment percentage is yet quite low for phase III as compared with that of phase I (all-India value of n(I) = 62.66% as against the meagre value of n(III) = 22.34% for boys), indicating that it would not be so easy a task to improve upon the value of n(III) as compared with n(I) in general.

It should be noted that the contribution of n(II) in explaining m(S) appears to be redundant, according to the discrimination made through the VLS regression treatment, valid in a multicollinear situation. We have already noted in Chapter 2, the linked nature of phase II in between phase I and phase III on the progressive path of education. As such the role of the intermediary phase is really taken care of by both phases I and III, and thus, the incorporation of n(II) in explaining m(S) has turned out to be unnecessary. It is because of this reason that our optimal composite index formulation (specific representation divergence minimising and φ-order preserving optimal equispaced formulation), which was intended to represent all three phase-specific indices L(I), L(II) and L(III) in Chapter 2, resulted into a linear combination having maximum positive weight associated with L(I) and also considerable positive weight associated with L(III), but only zero weight associated with the intermediary phase-specific index, L(II). Thus the composite index, formulated therein, turned out to be effectively a linear combination of only L(I) and L(III), and yet its correlation coefficient with L(II) had been as high as of magnitude 0.8878, implying that the role of L(II) had already been taken into account by L(I) and L(III) in the composite index formulation.

5.5 Comparisons Between the Non-engaged Human Resource Liability Pattern and the Labour-Absorptive Behaviour Patterns of Agricultural and Manufacturing Activities

It may be recalled that in Chapters 2 and 3 all the phasewise indices have been meant for assessment of the shortfalls or gaps from the over-all age-distribution of male population in two broad phases, namely, the basic-skill formative phase (specific to age-interval 5 to 18^+ years in the total human life-span) and the over-all activity phase (specific to age-interval 19 to 60^+ years in the same life-span), accounted by the age-distribution of school-attending boys in the formative phase and by the age-distribution of employed male workers in the activity phase. In the synthetic analysis, already made in the present chapter, we have evaluated the spatial variation of over-all male employment as influenced by some relevant indices related to the phases I, III and IV. We have also evaluated how the non-enrollment patterns in the Middle education phase II, largely responsible for the well substantiated child labour problem, get explained by the spatially varying situations as prevalent in all other non-overlapping phases I, III, IV and V, although this phase II itself is not directly involved in explaining the spatial variation in employment situation, whatever be its implicit explanatory role through its transitional interconnections with the preceding and the forward education phases I and III respectively. Besides, we have developed an over-all measure of liability of non-engaged human resources, formulated initially with the variables L(II) and L(S), the two important phase-indices, depicting with proper representations of the issues of child labour problem and the over-all unemployment problem. However, finally it has been substantiated, through an appropriate analytic device, that the liability index, so formulated initially, is really taking into account the non-engaged human resources in all the four phases, starting with the phase II, which is directly associated to the issue of child labour problem. The dependent role played by L(II) in relation to L(I), L(III), L(IV) and L(V), and also that played by L(S) in relation to L(I), L(III) and L(IV), provides justifications for not only the initial formulation, but also the extended accountability of ξ through all the distinct phases from II upward.

It should be noted in this connection that it is only the education phase I where we find a reduction of spatial disparity in enrollments over the decade under our present consideration (ref. to Chapter 2). So the exclusion of L(I) in the final accounting by ξ is quite acceptable on the face of reducing trend in spatial disparity and over-all improvements in the Primary education phase I. Thus in many ways, ξ could be considered as the representative synthetic index of shortfalls from our declared objective of full education upto the stage of High + Higher Secondary education and also the desired objective of full employment situation ultimately, as evaluated from the comparisons of the relevant age-distribution profiles in the corresponding phases, for male population only.

So long our scope of study on the shortfalls has been restricted to the segment of male population only. The complementary female segment of human resources, possessing much different behavioural patterns, has not been taken into account in respect of similar types of shortfalls, together with the male segment of human resources. Similar kind of investigations for female segment, as have been done for males, could be done separately, but not attempted here within the limited scope available to an individual research worker involved in a Ph.D. dissertation. However, in our subsequent investigations made in Chapter 4 , on the empirical evaluations of the labour-absorbtive behaviours of the over-all agricultural activity-base and the detailed manufacturing activity-bases, we have not got all the raw data in such a form as to undertake this analysis separately for the male and the female segments of the total reported level of labour absorption. It is also difficult to attempt any meaningful apportioning of levels of output and capital (as implicit in the over-all activity-base) in terms of segmentation by sex. So our empirical evaluation is done only for the total labour absorption level including both males and females. As such we are not in a position to make a proper comparative study in a strict sense, between the liability pattern of non-engaged male human resources and the over-all labour-absorptive behavioural patterns of agricultural and manufacturing activities. We can only attempt for some kind of tentative comparisons only for the spatial associations in this connection.

In Chapter 4 we have identified two spatial patterns shown in Figures (4.1) and (4.2). In Figure (4.1) we have a double-variable super-imposed mapping of the two variables related to the fitted labour absorption function for the broad over-all agricultural sector. Here the normal growth-path in labour absorption level gets evaluated by the functional estimates of agricultural labour absorption, based on corresponding known levels of agricultural activity-bases in different areas. The deviation D of the actual labour absorption level in excess of the estimated normal level corresponding to the existing activity-base in any area is taken as one of the two variables mapped in Figure (4.1). The other variable, p, is the spatial index of agricultural labour productivity. The ranges of values of these variables are classified into three qualitative ranks each, denoted by H, M and L for the spatial variable, D, and by h, m and l for the other spatial variable, p. In Figure (4.1), the areas with rank combination of (D, p) as (H, 1) have been identified as the excessively high agricultural labour surplus areas and those with rank combination (M, 1), as the high agricultural labour surplus areas.

Again, in Figure (4.2) we have another kind of stratified double-variable mapping on the over-all labour-absorptive efficiency measure for manufacturing activities, shown by the first two important strata out of three total strata of relative manufacturing output levels, designated as 'substantial', 'considerable' and 'negligible', for the districts with non-zero manufacturing activities. In this figure, the districts with no manufacturing activities have also been shown and designated as 'nil'. Within the stratified areas, generating 'substantial' and 'considerable' levels of manufacturing output, the variations in qualitative ranks of labour-absorptive efficiency measure have been shown. However, as the labour-absorptive efficiency for the areas with 'negligible' manufacturing output levels are predominantly of 'low' rank, we have not shown the marginal variations in efficiency ranks for these areas. On the other hand, in the areas, generating 'substantial' and 'considerable' manufacturing output, the qualitative efficiency ranks do not fall below the medium rank, M (which is also the all-India average level). Although efficiency ranks M and above have been shown in these areas, as such we had to ignore them for an ultimate depiction of significant areal groupings with 'substantial' and 'considerable' manufacturing activities that will be used in our present comparative study. Thus, on the basis of comparative analysis using mainly the Figures (5.1), (4.1) and (4.2), and also the varieties of relevant figures and established data, presented in Chapters 2 and 3, we can make very broadly the following qualitative observations :

1) We have already established from our decadal comparisons made in Chapters 2 and 3 that there had been improvements in respect of human resource development through formal education in different phases (particularly in the phase I of Primary education, generally), but significant deterioration has been noted almost everywhere with varying intensities in respect of human resource utilisation (or, employment situations in productive and related economic activities). In fact, this deteriorating trend in employment situation has continued unabatedly in the forward time-path after 1971 also in view of our ever increasing population growth accompanied by comparably limited growth in the scope of labour absorption in productive and related activities in our economy. Our present synthetic analysis thus stresses on the labour-absorptive behaviours of productive sectors, considered in Chapter 4 (for time-points ahead of 1971) against the backdrop of our liabilities in respect of non-engaged male human resources

(as evaluated for the latest reference year 1971 of our study in this connection), depicted in Figure (5.1).

2) . A comparison of the spatial distributions of liability measure ξ and the agricultural labour-surplus areas having (H, l) and (M, l) ranks of (D, p), shown respectively in Figures (5.1) and (4.1) reveals that there is a striking similarity between the spatial distribution of very high and high liability areas and that of 'excessively high' and 'high' agricultural labour surplus areas. Thus, practically all areas with very high or high liabilities of non-engaged male human resources have exhibited the 'excessively high' or 'high' agricultural labour surplus conditions even for workers already engaged in agricultural activities. These so-called 'surplus agricultural labour' are actually under-employed presently in the agricultural activities under compulsions for not being able to find alternative avenues or opportunities of employment in non-agricultural activities and thereby forced to remain captive in the agricultural sector under the prevailing general condition of labour-abundant national economy. This means that our reported agricultural workers are not always fully employed in the agricultural sector with the existing agricultural activity-bases. As a result of this special feature of economic backwardness, the development of human resources in their formative phase must have got affected adversely, culminating into high incidences of non-enrollment

and drop-outs, increasing liabilities of non-engaged human resources.

3) Again a comparison of spatial configurations, shown in Figures (4.2), (4.1), (5.1) and (3.6) (the last quoted figure refers to the over-all employment conditions in 1971), reveals that there have been many coincidences of areas with negligible or no manufacturing activities, with major parts of very high or high liability areas or with 'excessively high' or 'high' agricultural labour surplus areas. In fact, our industrial manufacturing activities are yet (ref. to the year 1976) not that wide-spread geographically compared with our large stock of labour, remaining captive in the wide-spread agricultural activities all over India. At the moment the manufacturing activities are highly localised in nature, concentrated mainly in and around the traditional metropolises and big urban centres of India, which provide the advantages of localisation economy in productive performances. Thus, even if there has been, for example, the growth of manufacturing activities in a narrow southern part of Bihar adjoining West Bengal and Orissa, it has not been adequate enough to reduce very high ranks of liability of non-engaged male human resources as it stand presently in Bihar.

4) On the other hand, our traditional centres of multi-functional manufacturing activities, spread in the hinterland

of the metropolises of Bombay, Calcutta, Madras and Delhi and also of the big urban centres like Ahmedabad, Chandigarh, etc. (ref. to Figure (4.2)), are also the areas with extremely low, very low or low ranks of our liability measures (ref. to Figure (5.1)), with hardly any agricultural labour-surplus problems (ref. to Figure (4.1)). In fact, the areas with 'substantial' and 'considerable' manufacturing activities are much more wide-spread in Tamil Nadu beyond the hinterland of the metropolis of Madras and these areas are largely coincident with the areas of high incidences of employment (ref. to Figure (3.6)) therein. This is also matching with the wide-spread areas with low ranks of liabilities in Tamil Nadu, which extend beyond the State-border to the adjoining State of Kerala.

5) We have a wide-spread region with low rank of liability around the capital of India, extending over-all the neighbouring States of Punjab, Haryana and Uttar Pradesh (ref. to Figure (5.1)). Apart from the 'substantial' and 'considerable' manufacturing activity-bases as have been noted in and around the capital city (ref. to Figure (4.2)), much of these areas, falling in the Indo-Gangetic plains with modernised agricultural activities, are quite advanced in agricultural production. In consequence, the problem of agricultural labour-surplus condition has been practically absent in the wide-spread areas around the capital city (ref. to Figure (4.1)).

As a result of advancement in both agricultural and manufacturing activities in this wide-spread region around Delhi, the allied activities like trade and other tertiary activities have developed in this region, extending over vast areas of Uttar Pradesh in the Western and Central parts. All these flourishing activities together have really been responsible for the occurrence of wide-spread regions with low ranks in non-engaged male human resource liabilities therein.

5.6 Concluding Remarks

(1) The spatial patterns of the labour-absorptive qualities of the present agricultural activity-base and the localised nature of manufacturing activities with yet inadequate manufacturing activity-base have largely been corroborative with the gloomy state of affairs as depicted by the over-all index of non-engaged human resource liability, ξ. Any reduction possibility in our liability level rests on the genuine supports of the productive and related activity-bases of our national economy. The present agricultural activity-base, although flourishing in many areas, particularly in Punjab, Haryana and adjoining areas of Uttar Pradesh, besides some other areas, has largely attained a kind of saturation in respect of labour absorption for the existing situation of its performance in agricultural production over wide-spread geographical areas in India as discussed in the preceding

sections. Definitely, the productive performance of these agriculturally less productive areas could be up-graded, if we are in a position to apply our lessons from the Punjab-Haryana patterns of agricultural productivity in all those less productive areas, where feasible. If that is possible, there would have been some possibilities of improving the labour-absorptive qualities of some of the present agricultural activity-bases. However, with the limitations of agricultural land resources and with the problem of ever increasing population growth we have to think for alternative avenues of labour absorption in other activities besides agriculture, particularly the industrial manufacturing. From the limited concentration of manufacturing activity-bases to a few traditional industrial core areas, as we have noted in Figure (4.2), we can quite confidently say that our manufacturing activity-bases are yet inadequate to be considered as sufficiently supportive for solutions to our labour absorption problems amid abundant non-engaged human resource stock. Even with the limited manufacturing activity-bases we could have expected better labour absorption levels in the core areas of manufacturing activities, had our industrial entrepreneurs acted in tune with the social situation by giving more attention to labour absorption than what they are giving presently; after all for most of the manufacturing activity-bases, the labour-absorptive scales are sufficiently lower than the corresponding productive scales (ref. to the analysis in Chapter 4). In fact, the core areas exhibited more profit motive with increased production and relatively reduced labour absorption. This would be clear from the following summary Table (5.8) for all manufacturing activities together.

Table 5.8 : Relative Labour-Absorptive Performances of Different Areas with Different Intensities of Concentrations of Manufacturing Production : India, 1976

Types of Areas by Concentrations of Manufacturing Output	Percentage Share		Relative Labour Absorption Index
	Value of Output $[(Y/\Sigma Y) \times 100]$	Man-hours of Labour $[(L/\Sigma L) \times 100]$	Col. (3) $\div$ Col. (2)
(1)	(2)	(3)	(4)
Substantial	80	73	0.912
Considerable	15	17	1.133
Negligible	5	10	2.000
Nil	0	0	-

This table shows the core areas of substantial manufacturing activities (concentrated in the limited areas of about 16% of all-India geographical areas) have accounted for 80% of all-India manufacturing output, but a reduced 73% of all-India man-hours of labour, absorbed in manufacturing activities. As a result of this, the value of relative labour absorption index, shown in Col. (4) of the same table, falls considerably below unity (equals 0.91), while that in the areas of negligible manufacturing activities it becomes contrastingly as high as 2.00.

To throw further light on the labour-absorptive behaviours of the four dominant regions around the four traditional metropolises of Bombay, Calcutta, Madras and Delhi, we present below the estimates of the labour absorption index for these regions for the two categories of districts within it with 'substantial' and 'considerable' manufacturing activities (ref. to Chapter 4).

Table 5.9 : Relative Labour-Absorptive Performances for the Categories of Manufacturing Activity-Bases in the Four Dominant Regions of India : 1976

Region of Dominant Manufacturing Activities Around the Core of	Value of Relative Labour Absorption Index in Areas with Concentrations of Manufacturing Output	
	Substantial	Considerable
Bombay	0.699	1.788
Calcutta	1.108	1.262
Madras	0.969	1.522
Delhi	0.864	0.605

The estimates in this table show that the oldest manufacturing core around Calcutta has exhibited the least profit motive of the manufacturing entrepreneurs, with the index value above unity for both types of areas with 'substantial' and 'considerable' manufacturing activities, whereas the relatively recent manufacturing core around Delhi, has exhibited the maximum profit motive, particularly in growing areas with yet not 'substantial' manufacturing activities, with the labour absorption index value below unity for both types of areas. The most important dominant manufacturing region around Bombay had exhibited maximum diversity between areas with 'substantial' and 'considerable' manufacturing activities, showing the values of the labour absorption index as equal to 0.70 and 1.79 respectively. This is certainly a glaring change in entrepreneurial behaviour pattern in respect of labour absorption between the two types of areas even within the same dominant region around Bombay. The divergence in the value of labour absorption index for the two types of areas in the dominant manufacturing region around Madras is not that pronounced as it is in the region around Bombay; it is just below unity (= 0.97) in the areas of 'substantial' manufacturing activities, but considerably above unity (= 1.52) for the other type of areas within the same Madras region. Both the regions around Calcutta and Madras, thus, do not show much of entrepreneurial profit motive, while the two regions around Bombay and Delhi do exhibit it quite significantly. Thus, although there are regional variations, the relative profit motives with enhancement in production, possibly through more of capital-use and reduced labour absorption, as exhibited in the most important and growing core areas of manufacturing activities, are not always conducive to solutions for increasing problems of labour absorption, prevalent in our labour-abundant economy.

2) Now, our manufacturing activity-bases are still at the phase of its infancy with disproportionately small contributions to the national GDP (Gross Value of Domestic Product). The share of national GDP as could be worked out for different sectors of our national economy from the official sources of data are as follows :

Table 5.10 : Shares of National GDP by Different Sectors of National Economy : 1960-61 to 1975-76

(At constant 1960-61 factor cost)

Sectors of National Economy	% Share of National GDP			
	1960-61	1965-66	1970-71	1975-76
Agricultural	50.84	42.55	41.96	41.78
Manufacturing (regd.)	8.45	11.31	11.58	11.19
Other Industrial	5.72	6.13	5.85	5.75
Tertiary	34.99	40.01	40.61	41.28

Source : Government of India, C.S.O. [1977].

In this table, the primary and the secondary activities of production are shown in the first three rows under the headings 'Agricultural' and 'Manufacturing + Other Industrial' in order, while the last row refers to the 'Tertiary' activities, mainly trade and various services, which grow with the growth of the two formerly mentioned productive sectors. From the table it is clear that the primary agricultural production activities are still dominant with about 42% share of the national GDP, while the manufacturing activities contribute only about a little more than 11% to our national economy. The fall in the contribution of agriculture to national GDP from 51% in 1960-61 to 42.5% in 1965-66 is really balanced by corresponding rise in other sectors, but this balancing is due to a higher share of increase in the tertaiary sector. Thus, the increase in the contribution of the manufacturing sector has not been very encouraging, with the percentage changing from 8.5 in 1960-61 to 11.3 in 1965-66 and remaining more or less stagnant there afterwards relative to national GDP. Under this general situation of relative stagnancy, there cannot have been enough scope of relatively substantial employment generation in the manufacturing sector to reduce the more acute liabilities as present in the agricultural sector over quite wide-spread areas. So the deterioration in the employment situation as shown for the decade from 1960-61 to 1970-71 is likely to get more pronounced in the forward time-path. It is now clear that we have no escape-routes for solutions to these ever-increasing labour absorption problems unless we generate more of activities in the manufacturing sector.

3) It is also noted that our traditionally dominant manufacturing regions have exhibited the presence of multi-functional manufacturing activities particularly in their respective cores such as Bombay, Calcutta and Madràs and these are increasing production by taking advantage of the

localisation economy. In fact, our manufacturing activities have grown mostly by taking advantages of localisation economy. In this we do not perceive any distributive perspective for reducing the regional disparities in activity concentration, particularly with the growth of activities in yet less developed areas. Some national planning efforts, such as locating a gigantic steel mill (at Bhilai) in Durg + Rajnandgaon districts in the under-developed area of Madhya Pradesh, or, that at Rourkella in the under-developed area of Orissa, have not created much of impact in the local area as regards labour absorption mainly due to the fact that those industrial centres are devoid of getting advantages of localisation economy as would have been available if these centres were grown as some sort of industrial complexes with allied industries. On the other hand, the example of Faridabad industrial complex in Gurgaon district of Haryana and also the example of Durgapur industrial complex in Burdwan district of West Bengal establish the importance of the need for industrial growth through formation of industrial complexes in under-developed areas with no or negligible manufacturing activities, if it had to produce any effect on the productive as well as on the labour-absorptive patterns of local economies. Thus, granting the lessons of our past national planning efforts and with the objective of finding solutions to our growing labour absorption problems, it becomes imperative that we have to generate enough manufacturing activities, preferably not in the form of unifunctional manufacturing activity-bases (forsaking the advantages of localisation economy), but in the form of industrial complexes (having the advantages of localisation economy of inter-related activities) in many areas showing very high and high ranks in non-engaged human resource liabilities as depicted in Figure (5.1).

In our suggestion made above it is taken for granted that a region with VH or H rank of liability, without much of manufacturing activities and with saturated agricultural activity-bases, has a better chance of generating sustained growth of manufacturing activities, if at least one core industrial complex could be created with simultaneous expansion of multi-functional activities, rather than a manufacturing base with limited functions. The above approach of manufacturing expansion is also supported by the principles of regional growth in activities as followed in functional regionalisation (ref. to Chapter 2), with the development of growth centres and gradual centrifugal spread of inter-related activities around them. Broadly, the pattern of concentration of manufacturing activities in India as depicted in Figure (4.2) has really tallied with this kind of functional regionalisation framework. In fact, many isolated industrialised districts of India, surrounded by large patches of under-industrialised areas, could not show yet the centrifugal spread of industrial activities, simply because of the absence of multifunctional industrial complexes within. The proper course of action to develop adequate labour-absorptive activities in vast areas of acute non-engaged human resource liabilities involves really the choice of appropriate growth centres and building up of multi-functional industrial complexes instead of a limited functional expansion approach to develop under-industrialised areas as followed sometimes in our various national planning efforts in the past.

(4) It is also to be emphasised that, as our need for the solutions to labour absorption problems rests largely on the over-all generation of more and more of manufacturing activities, adequate attention for manufacturing expansions in all the existing activity cores and centres are also required; after all whatever little manufacturing activity-bases we have today, cannot be allowed to deteriorate for the sake of our gigantic non-engaged human resource liability, especially with reference to the activity phase. All these traditional metropolitan cores are generally surrounded by under-industrialised areas lying in the wider hinterland of the metropolises. Any deterioration in the labour-absorptive behaviours of the established manufacturing activity-bases around the traditional metropolises would adversely affect the labour-absorptive possibilities in the wider under-industrialised hinterland, as is evident from our detailed discussions related to " Todaro Paradox" , made earlier in Chapter 3. After all, to off-set

the effect of " Todaro Paradox" within the existing manufacturing activity centres, the expansions of activities at the existing metropolitan and big urban centres seem to be essential, so long as our non-engaged human resource liability remains acute in the surrounding areas.

5) The non-engaged human resource liability situation, in relation to labour-absorptive behaviours of activities, has received prime attention in our discussions above simply because it is in the activity phase where deterioration in human resource utilisation has followed, culminating into enhanced labour absorption problems, while there has been some improvement in respect of human resource development in the basic-skill formative phase. This is quite evident from the average picture as reflected in the all-India estimates presented below by different phases for the two time-points, 1960-61 and 1970-71.

From the estimates shown in the last column of the above table, we can see that the size of the over-all activity phase, comprised of phases IV and V, is bigger than its counter-part, i.e., the broad formative phase, comprised of phases I, II and III (accounting for about 57.31% of total male population in the over-all activity phase as against the residual 42.69% in the broad formative phase in 1970-71). The population content of the over-all activity phase are noted to have suffered from the hazard of employment deterioration in both

Table 5.11 : Comparisons of all-India Estimates by Different Formative and Activity Phases on Non-enrollment and Unemployment, 1960-61 and 1970-71

Formative/Activity Phase	Percentage of Boys/Adult Males Non-enrolled/ Unemployed		Percentage of Total Males in Each Phase in 1970-71
	1960-61	1970-71	
Phase : I of Primary Education	42.81	37.34	16.94
Phase : II of Middle Education	63.32	55.34	15.03
Phase : III of High + Higher Secondary Education	86.46	77.66	10.72
Phase : IV of Job-searching Activity	22.90	31.32	33.10
Phase : V of Main Activity	14.81	21.40	24.21
Phase : S of Over-all Activity	19.53	27.20	57.31

its constituent phases IV and V over the decade under our consideration. On the other hand, all constituent phases I, II and III of the broad formative phase have recorded some positive signs of improvements in the form of increased proportionate enrollments in formal education during the same decade. However, over-all distressing features as revealed in this table is that an overwhelmingly major proportion of boys have still remained non-enrolled (substantial constituents of which are the incidences of dropping out from the formal education system) in the two on-going forward phases II and III, more acutely so in III. Despite the decadal improvements, the position is still distressingly gloomy in the terminal year of the decade, with non-enrollment proportions as very high as 77.66% in the phase III of High + Higher Secondary education and as high as 55.34% in the phase II of Middle school education. This is what stands as the average all-India situation; the situation actually is gloomier in quite wide-spread areas of India as gets revealed in the regional variations shown in Figures (2.4) and (2.6) in Chapter 2. Thus the tasks, necessary for solutions to the problems of non-engaged human resource liabilities in the formative phases, are no less than what we have for the activity phases.

6) In fact in our discriminatory analysis, given in section (5.4), we have been able to identify the spatial inter-connectedness among phases, when examined it in the extended multicollinear system of all phases. The relation (5.13) shows that the spatial variations in shortfalls in terms unemployment in both phases IV and V do influence positively and almost equally the non-enrollment type of shortfalls in the phase II of Middle level school education, and particularly phase II only of the three phases of education. This is indicative of the resulting enhanced non-enrollments including drop-out incidences at the stage of Middle level education, which is connected with the generation of prevailing

child labour problems, if the local productive economy remains crippled by the increasing level of unemployment. However, the employment situation has not been revealed as the only factors influencing the incidences of non-enrollment in phase II. The prevailing situation of spatial variation in the forward education phase III, indicating the varying degrees of absence of local scopes and facilities for forward level of education, has been also quite highly responsible for the enhanced non-enrollments in phase II of Middle level education. Further, the influencing role of education in phase I is readily comprehensible in view of the sequential connectedness of phase I and phase II. Thus, it becomes imperative that for any improvement of the enrollment situation in phase II, our attention for reduction of shortfalls is required in all other inter-connected phases related to human resource development and utilisation.

7) Thus in many ways, the spatial variable, representing the phase II of Middle level education, has played utterly a role dependent on the situations prevailing in all other phases. Besides, phase II by itself has not played much of explanatory role for other phases, except the expected positive sequential role of it in connection with phase III in our education system, and its child labour generating negative role, as exhibited in the explanation of the spatial variation of the non-engaged male human resource liability, ξ or Λ (ref.

to the relations (5.8) and (5.9)). Thus, when the question of explanatory role to over-all employment situation arises through our discriminatory analysis, the absence of phase II representing variable in the group of most relevant spatial variables for explanation of the over-all employment situation is noticeable (ref. to the alternative relations (5.18) or (5.19)). Here it is noted that the over-all employment situation, although influenced predominantly by the employment situation in the job-searching phase IV, is also influenced, almost equally, by the prevailing enrollment situations in both phases I and III, representing Primary and High + Higher Secondary levels of education. Thus, it becomes imperative that for any improvement in the over-all employment situation, our attentions for reductions of shortfalls are required not only in the job-searching activity phase IV alone, but also in the education phase III, covering the High + Higher Secondary level of education, with control of equally necessary dimension over the shortfalls, right at the starting phase I covering Primary education.

8) All the above analytical findings and discussions have been towards unfolding the complexities of inter-connections that exist among varieties of phase-indices and other related measures considered in our investigations on the spatial variations and configurations in respect of human resource development and utilisation. Once the complex nature of this

inter-connectedness has been unfolded, we are now in a position to comprehend through established analytical relations, how any lack of attention to a particular phase would affect the happenings in some other phase of different variety, with an ultimate set-back on the front of achieving our goal towards reduction of non-engaged human resource liabilities, whether in any activity phase or in any basic-skill formative education phase.

Thus it is clear that for any degree of fulfilment of this ultimate goal of liability reduction, we must have multi-pronged attentions for reduction of shortfalls in all the inter-connected phases, with balanced creation or provision of requisite facilities for basic-skill formative education and necessary opportunities in the form of activity generations. It should be clearly understood that the solution to India's labour absorption or human resource utilisation problems lie not only in the creation of more productive activities alone, particularly in the industrial manufacturing sector with sufficiently adequate dimension, but also in the simultaneous creation or provision of facilities for sufficient basic-skill formation compulsorily, as far as these are practicable. Our assessment from Figure (4.2) and relevant statistical findings has revealed that the labour-absorptive efficiency with most of our manufacturing activity-bases are improving with the improvement in the production level by taking advantages of the localisation economy, particularly in our traditional manufacturing regions with 'substantial' and 'considerable' production levels. However, the labour-absorptive behaviours, revealed by our analysis with the efficiency measures, are not sufficient yet, particularly in the core areas of manufacturing activities, so much so that there has been often a lack of parity between measures of the productive scale and the labour-absorptive scale for the same activity-base; there should be no reason why the labour-absorptive scale should be so below the productive scale for practically all the activity-bases, under the general labour-abundant conditions of our economy. Thus, a little sympathetic attention to labour absorption is expected from the entrepreneurs of manufacturing activity centres, particularly in the traditional core areas.

9) For adequate expansion of industrial manufacturing activities, however, the attention is also drawn to certain relevant problems also. Apart from the serious problem of recently developing crisis of energy supply, the other important problem seems to be the lack of injections of sufficient financial resources at proper growth centres under the stated framework of functional regionalisation, both in the yet under-industrialised regions and also in the traditionally industrialised regions. A search for remedies to these problems seems to be the true kind of necessity right now, that could ensure the growth promoting and growth sustaining aspects, both in terms of production and labour absorption, for existing and

required activity-bases to be created newly, keeping regional dimensions within consideration. With the revealed evaluations of spatial configurations and regional variations, on the basis of varieties of formulated phase-indices and related measures as shown in quantitative terms with corresponding qualitative rankings in various tables and presented in various figures for easy comprehension of their spatial configurations, we are now better-equipped with the knowledge and insight into the relevant regional problems as existing today. Equipped with this detailed knowledge on regional variations regarding problems of male human resource development and utilisation, our planning efforts should be oriented towards an intensive kind of creation or provision of facilities for basic-skill formation together with a balanced form of activity generation, more in the secondary manufacturing sector, where practicable, in the lines already suggested. If a right kind of industrial manufacturing growth-path in favour of labour absorption supportive productive activities is not followed, India's ever-increasing human resource-stock is going to face still more serious unemployment hazards. All our regional analyses, made earlier, have been oriented with the emphasis on diagnostic evaluation of our liabilities on the non-engaged human resources in both the formative and the activity phases, in relation with the performances out of the labour-absorptive behaviours of our existing activity-bases, both for primary agricultural and secondary manufacturing productions, so that our vision gets clarified towards finding steps to avert such serious unemployment hazards.

5.7 Summary and Conclusion

The main objective of this study has been estimation of model formulations, empirical evaluations and statistical analyses for identifying the existing regional patterns and structures of human resource development in the formative phase of human life-span through education, and the utilisation, or otherwise non-utilisation, during the activity phase of life-span in existing productive and related activities of our labour-abundant developing economy of India. Despite some awareness to the problems of development and balanced-utilisations of human resources into activities and also despite the various follow-up planning efforts undertaken, or stated to be undertaken, as reported in different " Five-Year Plan" and related documents of Indian national government in post-independent era, no positive results are yet in sight towards some significant reduction at least, if not the complete elimination, of the problems. In fact, the problems are so deep-rooted, with their diverse manifestations in different geographical areas of our large country, that any centralised decision-making towards solution could not visualise proper follow-up action programmes needed at regional levels to sort out micro-level intricacies or complexities present in this connection.

It is to be emphasized also that the relevant data-base has been yet very scanty for any reasonable kind of decentralised regional evaluations of the existing patterns and structures needed in this regard for a proper understanding of micro-level situations. However, in our labour-abundant economy with ever-increasing population growth, the growing human labour stock is becoming more and more liabilities than assets in national economy. Thus it is felt that some sort of exploratory research investigations must start in this connection for at least an evaluation of the existing regional patterns and structures and also a diagnosis of the varying intensities of the problems as they exist in different geographical areas, so that we are in a position to clarify our visions towards the dimensions of tasks ahead for attempting for the much desired solution of the problems related to human resource development and utilisation. With this motivation, the present piece of statistical investigation is undertaken on the analyses of spatial variations by districts of India. This is to be carried out in the following important aspects of shortfalls in human resource development and utilisation.

(i) Identification of spatial patterns and their changes in the decade : 1960-61 to 1970-71, for different intensities of shortfalls (or, gaps) towards reaching the objective of full education for all boys (scope of present study limited to boys only) in the overall formative phase (5 to 18^{+} years of age) of basic skill-development through education, with breakdowns in the three education phases, I : Primary, II : Middle and III : High + Higher Secondary. Here it is proposed to identify the gaps, by the three formative phases, for both time-points 1960-61 and 1970-71, through detailed comparative analyses between the age distribution of total male population for almost entire life-span and the age-distribution of school-attending boys within the period of formative phase for each of the smallest possible areal units of observation proposed in our study, if possible directly, otherwise indirectly through statistically consistent procedures.

(ii) Identification of spatial patterns and their changes in decade : 1960-61 to 1970-71, for different intensities of shortfalls towards reaching the desired objective of full employment of all males (scope of present study is limited to males only) in the overall activity phase (19 to 60^{+} years of age) of gainful absorptions into productive and related activities of our national economy, with breakdowns into initial job-searching activity phase IV (19 to 35^{+} years) and main activity phase V (36 to 60^{+} years). Here also it is proposed to identify the shortfalls in full employment situation, by the two activity phases for both time-points 1960-61 and 1970-71, through the detailed comparative analyses between the age-distribution of male workers in the life-span enveloping the over-all activity phase, and the age-distribution of total male population as referred to already in (i), for each of the smallest possible areal units of observation proposed in our study, if possible directly, otherwise indirectly through statistically consistent procedures.

(iii) Empirical evaluations of the labour-absorptive behaviours of broadly the primary agricultural activities together and the different secondary manufacturing activities (in all, for 20 manufacturing sectors as per two-digited NIC classifications) at a time-point around 1971 (decided by the availability of detailed raw data from official sources). Here we propose to fit statistically the labour absorption functions for the above-mentioned activity-bases with the detailed data on labour-absorption level, output-base, capital-base, etc. by all districts of India. The results of above functional fits would be used finally for identification of agricultural-labour surplus areas and the regional patterns of over-all labour-absorptive efficiency of manufacturing activities.

(iv) Finally attempts will be made, as far as possible, for a synthetic regional analysis based on the preceding aspects of study.

From the aspects of study as covered above, it is clear that the design of our investigation is for making a comprehensive assessment on the existing situations of shortfalls from, or non-attainments of, certain desired goal of accomplishment as expected for our dynamic human labour stock at all different but inter-connected important phases of effective life-span of actions. The regional structure and trend of different phase characters or attributes and their various inter-connections as could be identified or unfolded, under the existing situations of shortfalls, cannot certainly be the ideal one that signifies the desired goal of accomplishment. But unless we are in a position to identify or unfold the complexities of our existing situation, we are not in a position to clarify our vision towards conditioning of our on-going processes of development and activity, needed to bridge up the gap between the existing situation and the desired goal of accomplishment. The present attempt is, however, limited to the comprehensive assessment of the complexities of the existing situation, and not much beyond, except the identification of the present behavioural patterns of human resource-absorptive performances of our existing primary and secondary activity-bases, that could enlighten us only on the dimensions of the tasks ahead in respect of the conditioning of our on-going processes of productive and related activities, but not on the actual details of action-programming for the conditioning processes of development and activity requirement. A full-fledged action-programme formulation for reduction of shortfalls from the desired goal of accomplishment, needed for human resource development and utilisation with necessary regional dimensions, would require further complementary studies on evaluations of much of dynamic as well as spatial linkages and interactions with other sectors as well; this is, however, not within the scope of present study, undertaken by an invividual research worker with his limited available resources. What has been aimed at here is to show a regional approach for understanding the present pattern and short period trend so that a desirable spatial pattern on the question of human resource development and utilisation, and the related basic skill-formative facility and labour-absorptive activity generations, could be easily visualised for future on sound regional principles, with special attentions to more problem-ridden areas. The present regional approach is essentially of interdisciplinary nature in which an integration of the geographic principles of spatial variation analysis and the economic principles of labour-absorptive behaviour analysis in the context of human resource development and utilisation has been attempted through applications of varieties of statistical techniques, mathematical tools and analytic devices.

The statistical and analytical methods that have been applied in this dissertation, ,with necessary modifications, if needed, befitting our complex situations, for different screenings establishing reliable data-base, varieties of relevant spatial index formulation, depictions of many important inter-connections and inter-relations and also certain important trend paths etc., are briefly hinted below :

(a) The statistical investigations, intended in this study for identifications of spatial configurations and variations, are to be based on information and data as could be obtained from official sources and publications, related to age-specific estimates on population, education, employment, details of labour-absorptive production activities, etc. . However, the framework of official data compilation or reporting or presentation and the limitations implicit in the routine collection of basic raw data — often for incompleteness, reporting bias, concept un-standardisation, etc., cannot be expected to be so tailor-made as to suit or serve our purpose directly in our detailed statistical analyses. The official data compilations for broad areal units like States have not, however, suffered so much as that for small areal units like districts, on the question of consistencies, precision and comparability of raw data. Any way, as the design of our study is to make a detailed accounting of district-level variations ultimately, it becomes important to attempt some sort of feasible generation of reliable data-base, making full use of official information and data through appropriate analytic screenings. Thus, quite a considerable portion of this dissertation has necessarily been devoted to make use and evolve appropriate statistical and other analytic methods for establishing reliable data-base at both State and district levels, particularly for the two census years 1961 and 1971 under consideration of our study.

(b) The analytic screenings applied for the generation of data-base have been of different types, depending upon the nature of situations involved at the compilation stage. One such important type of analytic screening used for building up of the age-specific data of male population or of its two particular segments of our interest, namely, 1. school-attending boys in different educational sub-phases covering the broad formative phase from 5 to 18^{+} years of age, and 2. male workers in important phases within the over-all activity-phase from 19 to 60^{+} years of age, has been made (i) through an initial elimination or minimisation, if necessary, of " random fluctuation component" of reporting error, by a standard method of " series analysis" and (ii) for final estimation of reliable data-base, through fitting in two stages appropriate models of continuous type by OLS, restricted OLS or NILeS procedures.

(c) Another important analytic screening has been done for the model age-distribution profile related to activity phase of only 1971 (and not for 1961) as established from officially reported data-base, finally compiled in this connection on a sampling basis over the raw data schedules of 1971 total census counts. Here to eliminate the sampling error, the presence of which could be checked from some relevant aggregate data given on the basis of total counts of the same 1971 census, we shifted the 1971 model age profile on proportionate employment a little downward by a rigourous mathematical procedure so that the final model profile becomes reflective of the exact decadal change in employment as established through comparable census counts with adjustments for comparability in concept of employment-status for 1961 with that of 1971. It is to be noted in this connection that the census definition of workers for 1961 and 1971 differred, and to achieve time-path comparability, the necessary adjustments that are needed for our purpose have been done by granting the rigourous analytic screening as already done in connection with their study for establishing the district level workers of 1961, with definition comparable to that of 1971.

(d) By all above mentioned analytic screenings, together with some algebraic adjustment procedures, we could establish the data-base for the three segments of population, with certain desired level of consistency and reliability, with areal breakdowns upto State level only, and not below the State. Thus, by use of these reliable data-base, we could only establish our various indices of non-enrollment for different education phases and also those of incidences of unemployment in different activity phases, through appropriate algebraic treatment, for States of India and also for India.

(e) In the absence of possibilities of direct estimation of such indices for districts by the same procedure as used for States, we had to go for indirect evaluation of the relative variation in values of a particular phase index for districts as compared with that of the corresponding parent State. This we have done by the " indicator method" of economic index formulation by use of appropriate districtwise surrogate indicators that could be used in cross-ratio form with our actual State estimates of different phase indices to generate the corresponding district estimates. The indicator method is, however, modified for statistical consistency in terms of divergence-matching and high inter-correlation between the estimated and the actual values with known all-India actual data and available State break-downs. If necessary, the surrogate indicator has been used in appropriately power-transformed form to achieve above mentioned statistical consistency.

(f) To identify any 'formal' regional configuration based on any composite characteristic which is reflected in more than one inter-related spatial variables, we have not only used the super-imposing technique of mapping according to geographic principles, but also formulated regional index for the composite characteristic according to multivariate statistical principles so that it could be used more gainfully with added advantage of unified spatial ranking and of using simplified mapping technique for the same purpose, particularly when the number of constituent variables is more than two. Thus, in connection with our composite index formulation for the entire formative phase, we examined the applicability of three important principles of index formulation, namely, 1. Kendall's optimal index formulation [1939], based on the aggregate representation maximising principle, 2. Pal's equity index formulation [1963, 1971], based on the specific representation equalising principle, and 3. Pal's equi-spaced optimal index formulation [1985, 1989], based on the principle of aggregate representation maximisation subject to the restriction of equi-spacing of specific representations in certain desirable order. However, we had to finally modify Pal's equi-spaced optimal index formulation procedure with further restriction on specific representations to achieve certain desirable consistency of interpretation. We have also used Pal's equity formulation /1963/ for formulation of a synthetic liability index of non-engaged human resources, constructed with a certain special device that made the common specific representation of the synthetic index coincident with the maximised aggregate representation.

(g) The composite index of non-enrollment as formulated for the formative phase, has associated the order of its magnitudes with the districts, and as such the marginal rate of spatial change of a constituent phase-index relative to the composite index (as could be measured by the corresponding regression coefficient) could be compared between time-points for a measure of change in spatial disparity in phase-index character between time-points.

(h) Some mathematical and statistical formulations of other important indices like the employment opportunity index and the different labour-absorptive and productive efficiency measures related to different activity-bases borrow the supports of economic principles and phenomena. For identifications of agricultural labour surplus areas we needed an integration of both geographical and economic principles together with the use of certain statistical evaluation procedure establishing normal spatial trend-path for the existing spatial variation in agricultural activity-bases.

(i) It is emphasized that various multivariate regression analyses have been attempted in many instances of this dissertation by judicious choices between OLS (Ordinary Least Squares) and recently developed VLS (Vertical Least Squares) regression procedures [Pal & De, 1979], and, at times, by a combination of both, if necessary, for eliminating the problems involved in any particular situation — in connection with our depiction of many important interconnections and for various inter-relation analyses, apart from the statistical fittings of various age-distribution model profiles, as already referred to in (b), and of different labour absorption functions for agriculture and detailed manufacturing activity-bases.

(j) The question of choice among (1) OLS, (2) VLS and also (3) combined VLS and OLS regressions, rests on the underlying error assumptions as implicit with the two regression procedures. It is implicit in the OLS regression that only the dependent variable in a multivariate regression fit contains error of observation, while for a VLS regression in a multicollinear system of all variables, it is more realistically assumed that all variables involved in the fit contain errors. The corroborative consequence of the OLS error assumption is that the OLS regression is developed by an axis-biased least squaring along the axis of dependent variable, with the result of maximum possible explanation for dependent variable, giving rise to maximised value of OLS correlation coefficient. On the other hand, the corroborative consequence of the VLS error assumption is that the VLS regression is developed through the joint error minimisation, without any bias towards any particular variable-axis, but along the lines vertical to the central axis of closest fit through the scatter of observation points in the Euclidean space of all variables. Thus the maximum possible axis-biased OLS explanation of dependent variable, in the form of maximised value of OLS correlation coefficient, is not attained by the unbiased vertical least squaring procedure implicit in the VLS regression, with the result that the VLS correlation coefficient turns out to be always lower than the corresponding OLS correlation coefficient. However, it should be noted that the OLS regression fit fails to identify the true and distinct roles of explanatory variables by the corresponding regression coefficients because of its axis-biased least squaring even in presence of high degree of multicollinearity among explanatory variables. Thus, when it is more important to identify truly the relative roles of different explanatory variables in a multicollinear system the VLS regression fit becomes relatively more useful because of its realistic assumption, recognising the presence of errors in all inter-connected variables. Thus we have found, the OLS fit is more useful than the other when we are concerned, for example, in estimating age-distribution model profiles as referred to already in (b). On the other hand, the VLS fit is found to be more useful than the other, when we are concerned, for example, in estimating the relative roles of different phase-indices in explaining the spatial variation in liability measure of non-engaged human resources. Yet in another instance, we had to take resort to a combined application of both (referred to as " VLS-δ Constrained OLS" regression in one of the chapters of this dissertation), particularly for our statistical fittings of certain forms of labour absorption functions.

(k) Moreover, we can achieve certain useful discriminatory power through VLS procedure of regression which we cannot have through OLS procedure of regression. The particular discrimination in which we have been interested is : out of a set of multicollinear variables, we have to search for that particular variable which is best explained by the most relevant combination among other variables. Now, every additional increase in the number of explanatory variables (regressors) always increases the multiple correlation coefficient in the OLS regression, whereas it may at times decrease the correlation coefficient in the VLS regression, indicating the redundance of the inclusion of an additional regressor in the multicollinear set-up. This advantageous property provides us with the discriminatory power of identifying the most relevant combination of regressors for a particular choice of regressand. With varying choices of regressand and different combinations of regressors, the best dependent variable and the corresponding combination can be uniquely identified by the maximum value of VLS correlation coefficient. This mode of discrimination by VLS regression has been very successfully utilised in many situations for synthetic analysis in order to unfold the underlying complexities of varieties of interaction present in an extended system of many spatial measures.

Thus, by all these applications of statistical and analytic methods as briefly described above we have completed our detailed investigations according to the design of spatial analyses, as already pointed out, on the important aspects of shortfalls in human resource development and utilisation in India, which have been presented already in different chapters of this dissertation. Some of our main findings and observations as reported already in those chapters are highlighted below :

(1) As proposed already in our design of investigation on the shortfalls of human resource development in the broad formative phase from 5 to 18^+ years of age, the actual identification and evaluation of the different intensities of shortfalls in the three education phases, I, II and III, had been preceded by our statistical fittings of continuous type of

age-distribution model profiles for total male population and also for the school-attending boys by States of India, so that the difference between the two could be used as the measure of non-enrollment proportions at each age. The final form of those model profiles that fitted best with the data-bases are both of modified exponential varieties. While the steady monotonically decreasing age-distribution model profile for the total male population in the life-span of our interest (5 to 60^+ years of age), explained by attrition rates, is well-expected, the steady rise during the Primary education phase (5 to 9^+ yrs.) and subsequent monotonic fall during the Middle education phase II and the High + Higher Secondary education phase III, as revealed in the age-distribution model profile for the school-attending boys is a disturbing and rather undesirable feature. The occurrence of modal value at the age around 9^+ years, practically for all States of India in the empirical estimations for both 1961 and 1971, is indicative of the general feature of heavy drop-outs right at the beginning of the Middle education phase or just before.

(2) Six spatial indices have been constructed, measuring the intensities of non-development of basic-skill related to the three education phases, each at two time-points 1961 and 1971. These phase-indices, varying over all districts of India, are each comparable between time points, but not between two different phases. The percentage figures of

non-enrollment as calculated corresponding to the values of all six phase-indices of non-enrollment are, however, mutually comparable. All these quantiative estimates by districts along with their corresponding qualitative ranks, (designated as EL (extremely low), VL (very low), M (medium national level), H (high), VH (very high), EH (extremely high) are presented in various tables in this dissertation (ref. to Appendix Tables (A.1) and (A.2)). Thus, we have now a good knowledge of so much of qualitative information and quantitative data for the first time in a comprehensive manner. For easy comprehensions of the spatial configurations and related regional patterns of non-development in basic-skill formation by phases and by the two time points, we have also presented our qualitative information cartographically in various figures in this dissertation (Figures (2.1) to (2.6)).

(3) In line with the general falling tendencies in the age-distribution model profiles of school-attending boys, for all States, beginning at the bordering age between the education phases I and II, and and at much faster rates than what shown in the corresponding model profiles of male population during the phases II and III, the expansion in the areas of non-development from phase to phase in forward age-path could also be noticed in both 1961 and 1971. Thus, this progressive increase in the shortfalls from phase I to phase II and further to phase III from the desired level of development in

the skill formative phases of education have been well reflected in the corresponding expansions in the areal coverages of non-development features.

(4) Although there has been some general improvement in the proportional enrollments of boys in all phases over the decade between 1961 and 1971, there has been strong agreements between the two spatial patterns for each phase. These general agreements for all three phases get well reflected in the corresponding correlation coefficients between time-points, with magnitudes as high as 0.93, 0.86 and 0.92 respectively for education phases I, II and III.

(5) Although there has been general agreement in the spatial patterns of any education phase between the two time-points, with probing investigation according to the procedure discussed in (g) above, the differential behaviours in the spatial rate of change between time-points could be detected for the three phases. The 1971 to 1961 ratios of the spatial rates of change are estimated to be as 0.86, 1.01 and 1.29 respectively for education phases I, II and III. This establishes that the spatial disparity in basic-skill formation has marginally decreased in phase I, remained unchanged in phase II and considerably increased in phase III. These critical empirical findings are reflective of the following situations. There has been some sort of attention in the

decade for improvement of facilities in the first phase (like the opening of Primary schools, particularly in places where the Primary school-going boys did not have such facilities available within reasonable distances of their reach) over wide geographical areas. In the second phase, however, the extension of facilities for Middle level education has taken place largely in those areas where some sort of formal base of education in the first phase already existed. On the other hand, extension facilities for High and Higher Secondary education has taken place with a bias towards certain selected developed areas, rather than the non-developed areas. Such areas are mainly concentrated in Delhi, Tamil Nadu, West Bengal, Punjab, Haryana, Maharashtra and Gujarat States with high urban character.

(6) The important findings in respect of spatial disparity in development just discussed could be worked out only through the judicious use of our composite index, as formulated for the broad formative phase by the multivariate statistical method, discussed in (f). The districtwise quantitative estimates and qualitative ranks for this composite index of non-development of basic-skill have been recorded in Table (2.10) for both time points 1961 and 1971, and mapped in Figures (2.7) and (2.8). On the basis of our analysis with these figures depicting composite formative phase characteristic, we notice that although there had been marked

reduction in geographical coverages of areas with incidences of severe non-development of basic-skill (noted from the marked fall in frequency of districts from 1961 to 1971 with class ranks EH and VH of composite index value, as in Table (2.9)), vast areas still remained severely non-developed in the terminal year of the decade under consideration. According to Figure (2.8), the areas of severe non-development (in 1971) are mostly in Orissa, Madhya Pradesh and Rajasthan. Again wide areas with considerable non-development (H and M ranks in 1971 composite index value) are concentrated in the northern, western, central and eastern India with, however, some patches with better conditions mainly in Punjab, Haryana, parts of Uttar Pradesh, Gujarat, Maharashtra, deltaic West Bengal, etc. In contrast, there are large areas of significant and high development (EL and VL ranks in 1971 composite index values) in southern India except mainly the northern Andhra Pradesh and north eastern districts of Karnataka, besides other patches just mentioned above. Taking into consideration the total formative phase as a whole, it is well-established from our comprehensive regional analysis that attentions for improvements in basic-skill formatiion have been in most of the States in the immediate neighbourhood of the capital State of Delhi, in the two traditionally developed southern-most States (Kerala and Tamil Nadu) and also in some States with high urban character.

(7) Turning to the activity phase, the final age-distribution model profiles of male workers that fitted best by our analytic screening procedures (ref. to (b) and (c)) has been found to be of " logit" variety. Although our defined overall activity phase is spanned over the period from 19 to 60^{+} years of age, the model profile fitted with actual empirical data continues with downward trend, in the backward age-path, grazing towards zero level in the proportion of male employment at around 6 years of age, with minor variations, for practically all States of India at both time-points. Thus, incidences of child labour problem have already set in at the beginning of Middle education phase II (beginning from the age of 10 years). The picture of the empirically effective activity phase for all States can be summarised as follows : the male workers' age-distribution model profiles of all States depict an increasing trend in the proportions of employed males of age above 6 years, upto the age of around 47 years generally on the average, with marginal variations between States and the two time-points. At that age of 47 years, certain maximal values of employment proportions occur. Beyond that age of maximal employment proportion, the profile shows a declining trend. The nature of profile that occurs between the age of 47 to 60^{+} years is more or less the mirror image of that between 47 and 34 years in reverse order of age. Beyond 60^{+} years a steeper fall occurs for the model profile,

about which we are not concerned for our present analysis on the over-all activity phase from 19 to 60^+ years. We are also not probing on the incidences of child labour as evidenced from these various model profiles of different States, except deriving the confirmations on the existence of substantial intensities of child labour problems. The mirror image similaraties in the model profile on either side of the age of 47 years in the range of 34 to 60 years, and not beyond, provides an analytical justification for the dividing age-boundary between the two activity phases IV and V at around 35^+ years of age as had been already decided from the prevailing general situation, derived otherwise from economic considerations.

(8) Our finally revised (ref. to (c)) age-distribution model profiles for male workers have been compared with that for total male population, as already referred to in (1), and the difference between the two has been used to form the measure of incidences of unemployment for only phase IV, termed as job-searching phase. The corresponding totals having been derived otherwise for the over-all activity phase S (comprised of phases IV and V), the measure of the incidence of unemployment for phase V have been derived from the residual estimates of phase IV out of the totals of phase S (details available in subsections (3.3.1)). With the use of these various estimates, six spatial indices have been

constructed, measuring the intensities on incidences of unemployment related to the job-searching activity phase IV, the main activity phase V and the over-all activity phase S, each at two time-points 1961 and 1971. These phase-indices, varying over all districts of India, are each comparable between time-points, but not between phases. The percentage figures of unemployment as calculated corresponding to the values of all six phase-indices of incidences of unemployment are again mutually comparable. All these quantitative estimates by districts and along with their corresponding quantitative ranks are presented in various tables in this dissertation (ref. to Table (3.5) and Appendix Table (A.3)). Thus, we have generated successfully a reliable data-base that provides us with detailed knowledge of so much of qualitative information and quantitative data with precision, permitting comparability between the two time-points, for the first time in a comprehensive manner. Again, for easy comprehension of the spatial configurations and related regional patterns on the incidences of unemployment by all three activity phases for both time-points, we have also presented our qualitative information cartographically in various figures in this dissertation (ref. to Figures (3.1) to (3.6)).

(9) The incidences of unemployment is obviously more pronounced in the job-searching phase IV, comprised of relatively younger adult-males, than in the main activity phase V,

comprised of older generations of matured males. However, the spatial disparity or variation in the incidences of unemployment (in any activity phase relative to over-all activity phase) has remained relatively lower in phase IV for relatively younger adult males, as compared with its counterpart in the activity phase, at both time-points, 1961 and 1971. Interestingly, the pattern of spatial disparity (or, spatial variation) has practically remained same at both time-points for each of the activity phase-indices, although between activity phases there has been marked difference in spatial disparity as pointed out already (to be noted that the marginal rate of change in the incidences of unemployment for phase IV relative to the over-all phase S has been of magnitude 0.85 approximately for both time-points, while that for phase V relative to phase S, has been of much higher magnitude, about 1.29, again for both time-points (ref. to subsection (3.5.1)). With this persistency in spatial disparity, the spatial pattern on the incidences of unemployment for the over-all activity phase S , at any time-point, has remained more or less similar to that of any of the constituent phases IV and V , which could also be confirmed otherwise by the high degree of inter-correlations, all very near to unity, as shown in the correlation-matrix (ref. to Table (3.6)).

(10) Although the spatial variation patterns have remained similar for all three phases IV, V and S at any time-point,

it has changed markedly between time-points for any activity phase as effected by the general situation of employment deterioration in the decade, together with the migratory forces as operating with different intensities in different areas. As such the estimate of correlation coefficient for any activity phase index on the incidences of unemployment between the two time-points has remained much below unity (about 0.59, 0.65 and 0.63 for activity phases IV, V and S respectively). The extent of the decadal employment deterioration can be comprehended on the average by the increasing values of all-India proportions of unemployed males as estimated and requoted below in percentage figures.

Year	Phase IV	Phase V	Over-all Phase S
1961	22.90	14.81	19.53
1971	31.32	21.40	27.20

(11) While the details of differential employment deterioration patterns over the decade have been depicted in our various map analyses of Figures (3.1) to (3.6), for the three phase-indices on the incidences of unemployment over the two time-points, our relevant district frequency analysis has brought out the following distressing facts. We observe that a drastic reduction in the frequency of districts over the decade in the distinctly favoured class of ranks (EL + VL),

with a value as high as 78% (approximately), has been recorded uniformly by any index L(S), L(V) or L(IV), showing an alarmingly significant and wide-spread deterioration in employment situation in the short time-span, even in areas considered favourable in 1961. It is to be noted that the relatively favourable areas of employment situation have reduced in the same proportion (in number of districts) over the decade in both phase IV and phase V — implying, as though, the favourable areas are equally affected, in respect of both phases IV and V, under deteriorating employment situation over the decade. But this has not been so with the disfavoured areas (or, relatively unfavourable areas with class ranks EH + VH + H); the relatively unfavourable areas have, in fact, enlarged over the decade much more in the job-searching phase IV than in the main activity phase V (almost in the ratio of 5 : 2 in terms of frequency of such districts) — resulting ultimately into correspondingly wide-spread disfavoured areas in 1971 for both the phases. Thus, the adverse effect of the deteriorating scope of employment in the relatively unfavourable areas, has been much more in the job-searching phase IV, than in the main activity phase V. This is reflective of the fact of greater sensitivity of the job-searching phase IV to changes in employment situation as compared to that of the main activity phase in an under-employed national economy.

(12) Our district frequency analysis on the decadal changes, concerning favoured (EL + VL ranked) transitionally favoured or disfavoured (L + M ranked) and relatively unfavoured (EH + VH + H ranked) districts, further established that the adverse effect of decadal employment deterioration has been much more on the distinctly favourable areas of employment opportunities, resulted from the operating migratory forces under deteriorating employment situation.

(13) With the above mentioned patterns of employment deterioration, the resulting regional patterns of incidences of unemployment as depicted by L(S) in 1971 can be summarised as follows. The favourable areas (with EL and VL ranks) have been found to be concentrated in major region around the capital State of Delhi, extending in the north-west (in Punjab mostly), and also in the north and in the east (mostly in western and central Uttar Pradesh). On the other hand, the most unfavoured areas (with EH, VH and H ranks) are extended in a major central part of India, stretching from the western border to the eastern border (of India) through Rajasthan, Madhya Pradesh, Bihar, southern West Bengal, coastal Orissa mostly, and also through Assam, Manipur, Mizoram and Tripura in the far-eastern India. The major core of this disfavoured region lies in Rajasthan and adjoining areas in Madhya Pradesh with extremely high and very high incidences of unemployment. These disfavoured areas are some times

interspersed with transitionally disfavoured or favoured (L or M ranked) areas, particularly in parts of Bihar, Orissa, West Bengal and Far-Eastern India. In the northern and southern neighbourhood of the main stretch of disfavoured areas, the transitional areas are seen to occur in the extreme northern part of Jammu & Kashmir and also in Gujarat, Maharashtra, Andhra Pradesh, and in much of Karnataka. This changing scene for areas with less intensities of unemployment has continued further to the southward direction till we find the southern part of Karnataka, major northern part of Tamil Nadu and parts of Kerala to be in the relatively favoured group (with VL + EL ranks).

(14) Despite the similarities in spatial disparity between time-points for any of the phases IV or V, relative to that of phase S, the absolute spatial disparity as measured for phase S, are noticed to be markedly different between the two time-points. It is interesting to note that in spite of a strong spatial disparity in employment opportunities in 1961, the spatial disparity in the incidences of unemployment in 1971 has been much lower, possibly under general deterioration of employment situation, by virtue of labour mobility, induced at least locally by attractive forces of areas with high employment opportunities and the repulsive forces of areas with low or no employment opportunities. This particular feature of deteriorating employment scenario, despite

the presence of better employment opportunities, could be explained by what is known as " Todaro Paradox" (details in subsection (3.5.6)).

(15) For a more refined evaluation of " Todaro Paradox" effect in the neighbourhoods of various centres or areas with relatively better employment opportunities, we have actually devised the index of employment opportunity for the two time-points by use of the two phasewise incidences of unemployment in a sort of analytical combination (ref. to (h) above), the details of which is given in subsection (3.5.2). On the basis of this employment opportunity index we observe the following. There has been a high spatial co-association between the initial year (1961) employment situation, as revealed by the employment opportunity index, ε^{61}, and the terminal year (1971) incidences of unemployment as reflected by the index $L^{71}(S)$. Expectedly, the spatial co-association has been negative; the corresponding OLS correlation coefficient has been at the order of -0.62, implying that generally greater the employment opportunities in the initial year, the lower has been the incidences of unemployment in a district in the terminal year and vice versa. However, as the correlation coefficient is much below unity in absolute sense, we have many incidences of local peculiarities not following the above mentioned general type of spatial phenomenon. These local peculiarities could largely be explained by the

phenomenon of " Todaro Paradox" at favourable areas of employment opportunities or its opposite phenomenon at the unfavourable neighbourhood areas.

(16) We have also analysed the employment opportunity index, ε^{61}, in conjunction with actual percentage measure of decadal employment deterioration, denoted by d (ref. to formulation (3.44)) to get a better explanation of the spatial variations on the incidences of unemployment $L^{71}(S)$. It should be noted that as the local peculiarities quoted in (15) above with both types of the phenomenon of " Todaro Paradox" and its opposite phenomenon (anti-Todaro) existed side by side between the two types of neighbouring areas, we did not get much of inter-relation between d and ε^{61} (the OLS correlation coefficient is only 0.19). In the total absence of Todaro and anti-Todaro phenomena, we could have expected a high degree of negative correlation between d and ε^{61}. However, in view of the situation of near-independence between d and ε^{61}, if the additional incorporation of d (in addition to ε^{61}) could explain better the spatial variations of L^{71}, we could then infer the presence of Todaro and anti-Todaro phenomena. Indeed we get a much improved relation as shown in the OLS regression reported in standardised form in equation (3.45) of Chapter 3, for which the degree of fit has been as high as 0.83, (increased from the absolute magnitude of correlation

coefficient, 0.62, without the incorporation of d as referred to earlier in (15)).

(17) The above multiple linear regression of L^{71} on d and ε^{61}, has explained about 69% (squared value of correlation coefficient) of total spatial variation of L^{71}. The relative shares (measured by the squared regression coefficients for the regression equation expressed in standardised form) being respectively 37.4% and 62.6% for the two explanatory variables d and ε^{61}, we can say that these variables have explained about one-third and two-third of the total explained variation of L^{71}. Above inference drawn from the OLS regression has been found to be almost the same if it were drawn from the corresponding VLS regression (simply because of the near-independent behaviours of the two explanatory variables). Thus ε^{61} turns out to be relatively more important than d (about two times as important as d) in explaining the spatial variation of L^{71}.

(18) For an actual identification of areas operating under " Todaro or anti-Todaro" phenomenon, it has been further established (in observation (5) of subsection (3.5.6)) that in an area with " Todaro Paradox" situation, we would expect a paradoxical negative or non-compatible association between ranks of L^{61} and d effected by the migration possibilities leading to " Todaro Paradox". It should be noted that such in-migration into favourable areas would be effected by people's

out-migration from less favourable areas around, and in this process of out-migration, the employment level of less favourable areas might get improved, while the favourable areas themselves get deteriorated, and as a result of these situations we could expect the said non-compatible association between ranks of L^{61} and d. As a corrollary to this, if we notice a compatible association between ranks of L^{61} and d, in an area, we could infer the absence of " Todaro Paradox" situation in that area. Thus for actual identification of areas with the presence or absence of " Todaro Paradox" situation, we considered jointly both d and L^{61} for a bi-variate spatial analysis. The result of this analysis can be highlighted very briefly as follows. Broadly speaking, the major portion of a north India including Uttar Pradesh, northern Madhya Pradesh, Rajasthan and other northern States (except the small north-western patches of both Himachal Pradesh and Jammu & Kashmir) and also the State of Arunachal have exhibited the compatible (i.e. positive) co-association between ranks of d and L^{61}, while the rest of India have followed, more or less generally, the non-compatible (i.e. negative) co-association, establishing the presence of " Todaro Paradox" situation in the latter. Thus, quite wide-spread areas are operating under the " Todaro Paradox" situation signifying the depth of human resource utilisation problems even in the current favourable areas within. On the other hand, the favourable areas within the broad areas, showing compatible co-association between the ranks of L^{61} and d withstood the general pressure of employment deteriorating situation by promotion of greater employment opportunities, offsetting the in-migration pressure. Such areas are mostly in the northern India, in and around the capital State of Delhi. It is to be noted in this connection that Delhi is the only place where the value of d has been negative, implying decadal improvement in employment promotion (in contrast to the general situation of employment deterioration).

(19) In view of the important explanatory role of d and also of ε^{61} (and additionally ε^{71}, for forward decision-making) we have recorded the quantitative estimates, and qualitative ranks of these spatial variables in Table (3.5) and (3.10), and presented them cartographically for easy comprehension of their spatial configuration and patterns of variation in Figures (3.9), (3.7) and (3.8) respectively. The details of classification of areas and the actual compatibility, or otherwise, non-compatibility between ranks of d and L^{61} (which shows strong negative association with ε^{61}) can be directly seen from the relevant comparisons of the maps. However, on the basis of occurrence or non-occurrence of "Todaro Paradox" in two types of areas, with or without much favourable employment characteristics, we finally could classify all areas into four types of areas with combined employment characteristics as summarised below :

Type I : Areas with favourable employment characteristics, not following the " Todaro Paradox" —— implying low or no employment deterioration over the decade.

Type II : Areas with favourable employment characteristics, following the " Todaro Paradox" —— implying significant employment deterioration over the decade.

Type III : Areas with unfavourable employment characteristics, following also the " Todaro Paradox" in complementary form —— implying insignificant employment deterioration over the decade.

Type IV : Areas with unfavourable employment characteristics, also not following the " Todaro Paradox", even in its complementary form —— implying significant employment deterioration over the decade.

Thus, the employment situations of four above mentioned types of areas have been differently influenced by the nature of employment deterioration, together with the migration possibilities, as influenced by the varieties of employment characteristics, following or not following the " Todaro Paradox" . We have, in fact, exposed how the 1960-61 spatial pattern of the incidences of unemployment (i.e., L^{61}) have undergone a sea-change to give rise to broad regional groupings of districts, with less divergences between neighbouring areas in terms of incidences of unemployment in 1970-71 (i.e. L^{71}).

(20) Further it has been possible for us to characterise L^{61} by revealed employment opportunity pattern ε^{61} in explaining the pattern of changes in employment level in the following decade. At the end of the decade under consideration, we have also the knowledge of the pattern of L^{71} and the corresponding opportunity pattern ε^{71}, as emerged. Thus, we have used ε^{71} for further characterisation of L^{71} and formed a measure of composite unemployment characteristic analytically with the recognition, however, of the prevailing economic situations. This measure can be reckoned as a guide to the varying emphasis needed for future policy decisions towards activity generation in the forward time-path in different areas for reducing incidences of unemployment. The estimates of this measure, denoted by $\mathcal{E}$, are computed for States only in our present analysis and recorded in Table (3.12). On the basis of this index measure we could identify three distinct categories of States; the exact details and coverages of these categories are given in subsection (3.5.8). In all our analysis referred to above, we have identified important regional patterns not only by districts but also for States of India and presented in appropriate subsections of Chapters 2 and 3.

(21) So long our scope of study on the shortfalls has been restricted to the segment of male population only. The complementary female segment of human resources, possessing much different behavioural patterns in respect of similar kinds of shortfalls, have not been taken into account, together with the male segment of human resources. Similar kind of investigations for female segment, as we have done here for male segment, could be done, however, separately, but not attempted within the limited scope as available to an individual research worker involved in Ph.D. dissertation. However, we have accounted for about 80 percent of total human labour participation into formal activities by our consideration of only the male segment of population. In our subsequent investigations, made in Chapter 4 , on the empirical evaluations of the labour-absorptive behaviours of the agricultural activity and different manufacturing activities, we have not got all the raw data in such a form as to undertake this analysis separately for male and female segments on the total labour absorption level reported. It is also difficult to attempt for any apportioning of output and capital bases (as implicit in the over-all activity-base) in terms of segmentation by sex. So, our empirical evaluation is done only for the total labour absorption level including both males and females.

(22) Economic analyses have usually focussed attention on the determination of production relations explained by

technological base comprised of usually capital and labour. But in our context of human resource utilisation, we are here interested to analyse spatial variations in the labour-absorptive behaviour by different districts with their existing activity-bases comprised of established capital-structure and current level of production. In view of our problems regarding shortfalls in human resource utilisation, it becomes important for us to examine the labour-absorptive performances of the activity-bases in contrast to their productive performances. In the present study we have done this for the broad primary agricultural activities together (reference year 1981) and the different secondary manufacturing activities (in all for 20 manufacturing sectors as per two-digited NIC classifications) (reference year 1976). Details of the formulation of activity-bases, model structures for labour absorption functions, etc., for the two above mentioned sectors have been presented in the sections of Chapter 4. In connection with the fitting of labour absorption functions for different manufacturing activity-bases, we have also incorporated the effect of localisation economy, as resulted from the prevalent regional specialisation in productive activities, through an additional incorporation of localisation performance factor as an explanatory variable with the activity-base. Here, for analytical reasons and also from economic considerations, the distribution parameter, δ , involved in the formulation of the activity-base as an explanatory variable for the labour absorption level, has been determined by VLS regression technique, and later for the final fit with the additional incorporation of the localisation performance factor, we have used " VLS-δ Constrained OLS" regression procedure as referred to already in (j) above. The analytic model form for different fitted labour absorption functions has been an analogue of the Cobb-Douglas (C-D) variety of production function.

(23) The various multivariate regression techniques, as applied in the different context of our study, with due regards to the fitness of applications in particular situations, have been also critically reviewed in Chapter 4. The relative merits and demerits of the advanced VLS regression procedure [Pal & De, 1979] as against the usual OLS regression procedure have been well brought out through detailed critical appreciations, and to make a full use of the advantageous aspects of both, we have made use of a judicious combination of both, referred to already as " VLS-δ Constrained OLS" procedure (ref. to (22) and (j) above). In this context, we have also critically reviewed Malinvaud's so-called "orthogonal regression" technique [1980] regarding its relative merits and demerits, as contrasted to that of the above-mentioned advanced and usual regression procedures, and established its inappropriateness for any kind of viable regression analysis with certain minimum standard of statistical rigour.

(24) Details regarding the statistical fit for the agricultural labour absorption function are given in section (4.3) of Chapter 4. From the estimated agricultural labour absorption function it gets established that the scale of labour absorption diminishes with improvement in agricultural activity-base. This means that the core areas of agricultural activities with its greater concentration of agricultural land-soil and value of field-crop output absorb generally less of labour. As a result, the areas with advanced agricultural activity-base have higher agricultural productivity per unit labour than the areas with less advanced agricultural activity-base, (this is the situation now prevalent in agriculturally advanced regions of Punjab, Haryana, and western Uttar Pradesh). Further, from the statistical fit on the response of agricultural activity-base to labour absorption level, it gets clearly established that the two components, namely, the quality-corrected land-soil and the agricultural field-crop output of the over-all activity-base have almost equal roles.

(25) Granting that the normal growth path in agricultural labour absorption level is given by the functional estimates of agricultural labour absorption levels from the correspondingly available activity-bases in different areas the deviation, D, in actual labour absorption level (log—transformed) in excess of estimated normal level (log-transformed) corresponding to the existing agricultural activity-base in any area,

is taken as a measure of possible agricultural labour surplus, remaining captive in agricultural activities in the form of under-employed labour. In fact, this measure, D, is examined in conjunction with the agricultural labour productivity measure, p, through a bi-variate mapping shown in Figure (4.1) for the purpose of precise identifications of agricultural labour surplus areas spread in various parts of India. The ranges of values of these two variables are classified into three qualitative ranks each, denoted by H, M and L for the spatial variable, D, and by h, m and l for the other spatial variable, p. In Figure (4.1) the areas with rank combination of (D, p) as (H, l) have been identified as the " excessively high agricultural labour surplus-areas", and also those areas with rank combination (M, l) as the " high agricultural labour surplus areas". The details of areas falling under these two categories as could be easily comprehended from the bi-variate spatial distributions, depicted in Figure (4.1) have been summarised in our various observations made in subsection (4.3.2).

(26) As regards the labour absorption function for different manufacturing activity-bases, our analyses have been done in considerable details both from theoretical standpoint and from applied angle, since we have hardly any prior work in this context of labour absorption function, although we have varieties of studies available in the interconnected

theme of production relations. In connection with the production relations, very important path-setting contributions have been made by Pal et al [1981] in which, for the first time, the incorporation of localisation factor has been made explicitly to permit a kind of unified regional analysis of production relations. In the present analysis much of our concepts are really analogous to similar concepts in production relations, but in view of the fundamental difference that exists between the primary productive performance and the secondary labour-absorptive performance of the same productive activity-base, we have to reformulate our concepts and approach for labour-absorptive performance relation altogether from an independent angle. Because of this independence of approach, we had to establish analytically many of the underlying properties of involved parameters and related measures independently through number of Lemmas, Propositions and Observations as recorded in section (4.8) of Chapter 4.

(27) The labour-absorptive efficiency measures have been developed analogically with Farrel's concept and measure of technical efficiency and its subsequent improvement as done by Pal et al (1981), incorporating the vital concept of localisation economy, not considered in Farrel's measure, with, however, necessary adjustment and interpretations of the measures relevant to our context. In this connection, we have established both theoretically and empirically that the

labour-absorptive efficiency measures as could be developed from the original Farrel's work [1957] is not appropriate to take care of the localisation economy in the labour-absorptive efficiency measure. Thus, this measure could be really called a localisation-free labour-absorptive efficiency measure. Further, by use of the improved analogue of Pal et al [1981], we have formulated our over-all measure of labour-absorptive efficiency and given for both, the independent economic interpretations in terms of concept, termed scaled and modified scaled labour absorptivity, developed by use of some vital parameters estimated from the labour absorption function, both with and without the incorporation of the localisation performance factor denoted by Ω. In this connection, from the fit of production function on the same activity-base (as used for the labour absorption function), we have also formulated another efficiency measure, (falling in line with the Farrel's definition of productive efficiency which has been shown as proportional to " productivity per unit activity-base" by Pal et al) called the internal productivity of activity-base, T_*. In all our study in Chapter 4, the activity-base is empirically estimated by a formulation with due recognition and representation of the relative roles played by its components of " existing capital-structure" and " current output level", through the distribution parameter, δ, emerged in the evaluation of the labour-absorption function.

With re rence to our modified labour absorption function, we have a o developed the vital measure related to activity-base speci c localisation economy in two alternative forms, termed as the degree of localisation economy, α_*, and the localisation power parameter, α, connected by the relation : $\alpha_* = 1 + \alpha$. Further, the parameters of importance that emerged from the fit of modified labour absorption function are

μ = over-all labour-absorptive scale of the activity-base,

μ_* = localisation-accounted labour-absorptive scale of the activity-base,

and these are connected with the localisation economy measures as follows : $\alpha_* = \mu/\mu_*$

and $\alpha = (\mu - \mu_*)/\mu_*$.

In fact, the product measure $\alpha\mu_*$ (or, equivalently $\mu - \mu_* = s$, say) has been used in conjunction with our localisation performance factor, Q, to contruct the final spatial measure termed above as the localisation component of efficiency, denoted by Q_* ($= Q^{\alpha\mu_*}$). Our over-all labour-absorptive efficiency measure, E, and the localisation-free labour-absorptive efficiency measure E_* have been established to be really propertional to the " modified scaled labour-absorptivity" and the " scaled labour-absorptivity" respectively, where these two absorptivity measures are nothing but the usual, labour-absorptivity per unit activity-base with due recognition of the respective labour-absorptive scales μ_* and μ for the activity-base. Farrel's concept of efficiency without the explicit recognition of the presence of localisation economy has led us to construct an alternative measure of " localisation-free labour-absorptive efficiency" , denoted by E_O , which can be also shown to be proportional to the corresponding scaled labour-absorptivity per unit activity-base with due recognition of the over-all scale μ_O as estimated from the labour absorption function without the incorporation of the localisation performance factor. However, in actual exposition, Farrel's fit for the production function accepted apriori the productive scale, $\lambda_O = 1$, for any industry. If we accept this restriction on λ_O the corresponding productive efficiency measure would be just proportional to the usual measure of productivity per unit activity-base. However, in our case for the measure T_* defined already, we have implicitly not accounted the slight variation in the values of λ_O from unity that exist for most of our manufacturing activity-bases. We have already established in our various findings shown in Chapter 4 that μ is comparable to μ_O and E_* is comparable to E_O. Also we have established that the various labour-absorptive efficiency measures related to the modified labour absorption function are connected by the relation : $E = (E_* \cdot \Omega_*)$. Thus, our over-all labour-absorptive efficiency measure is really the product of the localisation-free efficiency measure and the localisation component of the efficiency measure.

(28) The detailed analytic properties of these spatial measures of efficiency and their various characterisations and inter-connections as established theoretically and empirically, are presented in details in Chapter 4. Out of these details, some important results of our interest in the context of human resource utilisations are highlighted below in very brief form :

(28.1) The way we have decided on the statistical estimations, of the original and the modified labour absorption function (without and with the incorporation of Q) for the labour absorption level L (fitted under log-transformation), the log-linear correlation coefficient of L has turned out to be better with E_* than with E_O, for any manufacturing activity-base. Thus, our choice of method of estimation has resulted into a better depiction of interaction between labour absorption level and the localisation-free efficiency measure. Yet, after the incorporation of the localisation factor, the response of the efficiency measure E_* on the spatial variations of L still remains low to moderate. This shows the indequacy of even the localisation-free efficiency measure E_* to capture the said response to a substantial extent. Anyway, the feature of depiction of the said response more sensitively by E_* than E_O has also been established empirically for the variations of activity-bases, through an analysis of relationship between the correlation coefficients $r_{\ln L,\ \ln E_*}$ and $r_{\ln L,\ \ln E_O}$. The OLS correlation coefficient has turned out to be as high as 0.96 and the regression coefficient for the fit of $r_{\ln L,\ \ln E_*}$ on $r_{\ln L,\ \ln E_O}$ has shown a magnitude of 1.46. This means that when the depiction of response by E_O is increased among activity-bases, the depiction of response by E_* is improved more, about 1.46 times the former treatment. Thus, E_* turns out to be empirically more sensitive in capturing the said response, although both are of the same variety of localisation-free efficiency measure.

(28.2) It has been established that the type of formulation of E_* is yet not a satisfactory depictor of localisation economy effect on the activity-base, simply because the very mode of evaluation of the normal expansion path $\hat{L}$ for L makes E_* log-linearly independent of the localisation factor of efficiency Ω_*. Thus, the formulation of the efficiency measure, $E = E_*\Omega_*$, comes into the picture as the final localisation-accounted over-all efficiency measure. We have finally established through various Lemmas, Propositions and empirical evidences that $r_{\ln L,\ \ln E}$ is always of higher magnitude than $r_{\ln L,\ \ln E_*}$ and the empirical magnitudes of $r_{\ln L,\ \ln E}$ have turned out to be of very high to predominantly high magnitude. This establishes that the over-all measure E is most appropriate in capturing the spatial variation in the labour absorption level L for all our manufacturing activity-bases operating under different intensities of presence of localisation economies.

(28.3) As much of the responses of E to the spatial variation of L are induced by the localisation economy that is prevalent with the different activity-bases it is not unexpected to get a predominantly high degree of fit between $r_{\ln L, \ln E}$ and σ, the localisation power parameter depicting the effect of localisation economy. It is almost a near-perfect relationship (correlation coefficient = 0.99975) for its fit which can be expressed conveniently in a rectangular hyperbolic form, the exact details of which are shown in Observation 5 of the subsection (4.9.1). From the particular rectangular hyperbolic form of functional fit, we can note that both σ and $r_{\ln L, \ln E}$ are covarying through increasing positive values of both along the rectangular hyperbolic path. Thus, with the diminishing role of localisation economy (σ-tending from high positive values to zero) the spatial variation in the level of labour absorption gets less and less explained by the over-all labour-absorptive efficiency. As illustrations, we may cite the two extreme cases of manufacturing activity-bases of

(i) " beverage" industry (code no. 22) with maximum $\sigma = 3.18$, maximum $r_{\ln L, \ln E} = 0.99$, and

(ii) " jute textile" industry (code no. 25) with minimum $\sigma = 0.11$, minimum $r_{\ln L,\, \ln E} = 0.66$.

(29) Just noted that for "jute textile" the labour absorption level gets least explained by the labour-absorptive efficiency with its activity-base operating under insignificant presence of localisation economy. Despite this, the activity-base has exhibited the maximum values of both its productive scale and labour-absorptive scale, with magnitudes well above unity. In fact, we have been able to explain the peculiarities of " jute" industry by the internal productive efficiency measure, T_*. For this industry the labour absorption level is almost equally explained by both E and T_* ($r_{\ln L,\, \ln T_*} = 0.65$, $r_{\ln L,\, \ln E} = 0.66$). The next higher value of $r_{\ln L,\, \ln E} = 0.81$ has occurred with the " leather" industry (code no. 29) for which also we have some low positive value of $r_{\ln L,\, \ln T_*} = 0.33$, implying some explanation of the spatial variable of L through T_* alongwith its substantive explanation by E. But in contrast, the productive efficiency measure T_* has played a negative role of moderate magnitude (on the spatial variation of labour absorption level for the distributive type of activity-base of " Electricity, etc." (code no. 40+41), as shown by $r_{\ln L,\, \ln T_*} = -0.48$. This means that with increasing productive efficiency for the activity-base of this industry, the labour absorption

level is moderately falling. This negative role of productive efficiency measure thus erodes considerably the gain effected by the localisation economy towards increasing labour absorption level for the activity-base of this industry. For all other manufacturing industries considered in our analysis, the roles of T_* in explaining the spatial variations in labour absorption level have been insignificantly positive and negative around zero value ($r_{\ln L,\ \ln T_*}$ ranging from -0.14 to 0.19). Denoting the spatial variables of existing capital-structure and current output level respectively by K and Y, it has been established theoretically that the magnitude of $r_{\ln L,\ \ln T_*}$ turns out to be positive or negative according as : $COV(\ln L, \ln Y) >$, or, $< COV(\ln L, \ln K)$. These particular inequality relations indicate the advantageous or disadvantageous substitution between labour and capital-structure together with the resulting productive performance in the form of output level. This explanation corroborates the feature of " electricity etc." industry (code no. 40+41) that despite its high capital-structure its performance has been unsatisfactory in respect of output level, so that the second type of equality holds, resulting into the moderately negative value of $r_{\ln L,\ \ln T_*}$ as quoted already.

(30) As " jute textile" is the only industry showing some parity between the labour-absorptive scale, μ_0 (comparable

with μ), and the productive scale λ_0 of the same activity-base, both above unity at maximal levels, and also with a maximum value of its distribution parameter δ (related to capital) ($\delta = 0.58$ (for " jute") $> 0.50 =$ the general level of distribution parameter which is the characteristic value attained by most of the manufacturing activity-bases with certain insignificant variation in the range $0.39 < \delta < 0.58$), we can derive our lesson from the point of view of our objective of optimising labour absorption, that under the condition of increasing labour-absorptive scale μ_0 (or, μ) with the distribution parameter δ greater than its counterpart $(1 - \delta)$, we should improve upon capital-use, provided the productive scale λ_0 of the same activity-base is comparably increasing. Here is a case for comparison between λ_0 and μ_0. From the point of view of our expected parity between μ_0 and λ_0 as exhibited by the " jute" industry, particularly in view of our existing problems due to shortfalls in human resource utilisation, we examined the difference or gap of λ_0 in excess of μ_0 for different activity-bases with varying levels of the presence of localisation economy (measured by α). Qualitatively we have identified the disparity of scales as 'negligible', 'considerable', 'substantial' and 'very substantial', measured by the corresponding ranges in the values of $(\lambda_0 - \mu_0)$ as _(0, 0.12_7, (0.12, 0.24_7, (0.24, 0.36_7 and (above 0.36). Again it should be noted that the critical value of α is unity (corresponding to $\mu = 2\mu_*$) above which the effect of localisation economy predominates over the localisation-accounted scale of labour absorption. Keeping this in view, α has been classified as to indicate the qualitative differentiation of localisation economy as 'predominantly operative', 'highly operative', 'moderately operative' and 'insignificantly operative' by the corresponding ranges in the values of α as (above 1.00), (0.67, 1.00_7, (0.34, 0.67_7, and (0.34 and below) respectively. The cross-classification of the activity-base by the " disparity of scales, $(\lambda_0 - \mu_0)$ " and " operative localisation economy α " for the different manufacturing activity-bases in Table (4.6) in Chapter 4. In this table, the " jute" industry is at the diagonally bottom position at cell (4, 4) while the " petroleum, etc. (code no. 30) is at the diagonally top position at cell (1, 1). Thus, while " jute" industry shows insignificantly operative localisation economy with negligible disparity of scales, the " petroleum, etc." industry shows the predominantly operative localisation economy with very substantial disparity of scales. As a result, while the " jute" industry exhibits the maximum attention for labour absorption taking minimum advantage of localisation economy, the " petroleum, etc." industry, on the other extreme, has exhibited the minimum attention for labour absorption despite its functioning under predominantly operative localisation economy. The details regarding other activity-bases are presented along with the Table (4.6) in Chapter 4.

However, our general impression from those detailed comprehensive evaluations can be summarised as follows.

It has been adequately established that most of the manufacturing activity-bases exhibited much better performances in terms of their function of " production" than that of " labour-absorption" . The productive efficiency has been practically independent of labour absorption level (except for distinctive " jute textile" industry) with most of the activity-bases. As our measure of productive-efficiency is capital-based, we have all the reasons (particularly evidenced from the performance of " petroleum, etc." industry, " beverage" industry, etc., and also from the negative role of productive efficiency played on labour absorption level by the " Electricity, etc." industry despite its huge capital structure) to suspect that the utilisation of capital-structure implicit in an activity-base, has not been very often conducive of a better labour-absorptive performance of the activity-base, and, at times, has not been conducive of satisfactory productive performance also. However, the localisation factor, depicting the advantages of regional production specialisation, or the localisation economy, particularly in core areas of activities, has not only induced strongly the labour-absorptive efficiency, but also enhanced the production level much more strongly, so that the productive scale has turned out to be always superior to the labour-absorptive scale of the same activity-base.

(31) The spatial variation in the labour absorption level, L, as we have noted already, is strongly depicted practically for all activity-bases by the over-all labour-absorptive efficiency measure, E, as related to the localisation-accounted activity-base. However, as the localisation economy-influenced activity-base often exhibited substantial disparity of scales (productive in excess of labour-absorptive), the same labour-absorptive efficiency measure has different absolute responses to labour absorption level, L, in areas with different intensities of production. With the predominance of agricultural activities in Indian economy, our manufacturing activities are still in their infancies and as these are functioning by taking advantages of localisation economy mostly, the two-digited manufacturing activities have been highly localised in nature (ref. to Table (4.7) for actual empirical details). Thus, the comparability of the labour-absorptive efficiency measure could be done more meaningfully among districts having a kind of comparable intensity of manufacturing production. Thus, for the totality of all manufacturing activities, we have devised an intensity measure of production, $\hat{Y}$, (the details of which is given in section (4.10)) and also devised the over-all manufacturing labour-absorptive efficiency measure, $\bar{\bar{E}}$, which is an output weighted average of efficiency E of different activity-bases (details are also in section (4.10)), and ultimately gone for

a bi-variate mapping for a comprehensive depiction of the over-all manufacturing activity characterisations on space. Qualitatively, we have identified the intensity of manufacturing production as 'substantial i.e. rank : (H + VH + EH)', 'considerable i.e. rank : (M + L)', 'negligible i.e. rank : (VL)' and 'nil (total absence)' measured by the corresponding ranges in values of $\hat{Y}$ as (above 1.20), (0.35, 1.20], (0, 0.35] and [0]. The qualitative ranks of over-all efficiency, $\bar{\bar{E}}$, for the two important strata of 'substantial' and 'considerable' intensity of manufacturing production, are identified respectively by starred and unstarred rank symbols, and denoted by (EH*, EH), (VH*, VH), (H*, H), (M*, M), and (L*, L) corresponding to the ranges of values of $\bar{\bar{E}}$ as (above 3.2), (2.0, 3.2], (1.2, 2.0], (0.8, 1.2] and (0.35, 0.8]. However, in our bi-variate mapping with ($\hat{Y}$, $\bar{\bar{E}}$), above qualitative ranks for $\bar{\bar{E}}$ for the two important strata are explicitly identified while the totality of all areas with $\hat{Y}$ under the two residual strata are identified separately in Figure (4.2). As the labour-absorptive efficiency $\bar{\bar{E}}$ for the areas with 'negligible' intensity in $\hat{Y}$ are predominantly of "low" rank, we have not shown the marginal variations in $\bar{\bar{E}}$ for this strata. On the other hand, the low ranks (L*, L) in $\bar{\bar{E}}$ did not occur at all for the two important strata.

To understand how the over-all efficiency ranks of $\bar{\bar{E}}$ get contributed by the constituent efficiency ranks E of all separate manufacturing activities, we have also classified similarly the values of E by its qualitative ranks and tabulated all the qualitative ranks for the aggregate (or, over-all) and separate manufacturing activities for the two strata of 'substantial' and 'considerable' intensity of over-all manufacturing productions and presented in Table (4.8) and summarised their district frequencies in Table (4.9C). The quantitative estimates of $\bar{\bar{E}}$ have also been shown in Table (4.8). Finally the detailed analysis on the regional patterns of over-all manufacturing labour-absorptive efficiency under our stratification scheme (ref. to Figure (4.2)) has also been made and described in section (4.10). All these detailed qualitative information on the industry-specific over-all efficiency measure E and also both qualitative and quantitative information in terms of $\bar{\bar{E}}$, in addition to the depiction of bi-variate aggregate patterns as in Figure (4.2) help us to getting a comprehensive picture of labour-absorptive performances of existing Indian manufacturing activities as these existed in 1976 (the reference year of our study).

(32) Our synthetic regional analyses, made in this concluding Chapter 5, are mainly aimed at analytic unfolding of the complexities of spatial co-associations and interactions among various important measures of shortfalls in the male human resource development and utilisation at all different but inter-connected important phases of effective life-span of

actions, by taking full advantage of the discriminatory power of the advanced VLS procedure of regression as already highlighted in (k) above. From our stated discriminatory analysis in pursuit of the best dependent variables as explained by most relevant combinations of spatial variables among a total of six phase-indices L(I), to L(V) and L(S) (reference year, 1971) we could identify the following two important relations explaining the spatial variation of the measure for the Middle education phase II in 5-variable space and the spatial variation of the measure for the over-all activity phase S in 4-variable space.

(32.1) The details of analytic contentions and steps involved in the discrimination process identifying the dependent role of the phase II specific measure in 5-variable space, out of altogether six spatial variables considered, is given in section (5.4) of this chapter. From the final result of this analysis we get a firm confirmation on the importance of enrollment situation in Middle level education phase II that gets spatially interacted or influenced by the situations prevailing in the other two education phases I (corresponding to Primary education) and III (corresponding to High + Higher Secondary education) and also by the employment situations prevailing in the two distinct activity phases IV (the job-searching phase) and V (the main activity phase). Denoting the percentage of boys non-enrolled and the percentage of adult males, unemployed in some relevant phase φ by $g(\varphi)$ and $u(\varphi)$ respectively, and the corresponding percentages of enrolled boys and employed adult males by $n(\varphi)$ and $m(\varphi)$ respectively, with φ = I, II, III in the broad formative phase and φ = IV, V, S in the broad activity phase, we have expressed the final VLS regression in four equivalent alternatives shown in equations (5.10) (using standardised phase-indices), (5.12) (using un-standardised phase-indices), (5.13) (using corresponding phasewise percentages of non-enrollment and unemployment) and (5.14) (using complementary phasewise percentages of enrollment and employment). From these we could make the following qualitative inferences. Out of total accounted spatial variation of L(II) (squared VLS correlation coefficient of magnitude 0.66) the shares of 33.1%, 30.6%, 16.9% and 19.4% are explained respectively by L(I), L(III), L(IV) and L(V). The empirical estimates of marginal rates as depicted by the respective regression coefficients, same for both equations (5.13) and (5.14), show almost equal role in the percentage change in phase II (enrollment, or, non-enrollment) relative to unit percentage change in phases I, IV and V, while that relative to unit percentage change in phase III is considerably higher. Thus, the prevailing situation in the forward education level of phase III is a significant influencing factor for the non-enrollment, or, complementarily enrollment in the preceding Middle level education phase II, besides the equal role of other phases I, IV and V. The involvement of activity phases IV and V does tell us that the prevailing employment situations have definite roles in influencing the enrollments, or otherwise, the incidences of dropping out (or, non-enrollments) in the Middle level education phase, giving rise to the undesirable generation of child labour problem.

(32.2) Our search for the best dependent variable in the 4-variable space, comprised of phase-index L(IV), any one of the phase-index L(V) or L(S) and any two of the phase-indices L(I), L(II) and L(III) (these three are sequentially interconnected with the increasing level of education), yielded L(S) as the globally best dependent variable explained by the most relevant combination of explanatory variables, L(I), L(III) and L(IV), revealing the redundancy of L(II) for explaining not only L(S) maximally, but also L(V) substantially (the VLS correlation coefficient for which is globally the second best). The interesting feature that emerges is that L(II) gets explained best by the main activity phase variable L(V) along with others in 5-variable space, rather than itself getting involved directly in explaining L(S) or L(V) in 4-variable space. As in the previous case (32.1) here also we have shown the final VLS regression for the measure of overall activity phase S in four equivalent alternative forms, given in equations (5.15), (5.17), (5.18) and (5.19) in terms of standardised phase-indices, un-standardised indices, phasewise percentage measures of non-enrollment and unemployment, and the phasewise complementary percentage measures of enrollment and unemployment respectively. The qualitative inferences as have emerged from these alternatives of the best OLS regression in 4-variable space are as follows. Out of the total accounted variation of L(S) (squared VLS correlation coefficient of magnitude 0.62), the shares of 62.9%, 27.7% and 12.4% are explained respectively by L(IV), L(I) and L(III). The striking role played by the prevailing employment situation in the job-searching phase IV in explaining the spatial variation of the over-all employment situation is easily comprehensible. However, it is important to notice that it is the Primary education phase I which has played a more important role in explaining the over-all employment situation, rather than the phase III (i.e. High + Migher Secondary education phase of more matured skill-formation). Thus, the relative contributions of the two explanatory formative phases I & III only suggest that our present situation of over-all human resource utilisation has been influenced more by the prevailing situation of our Indian society with more of illiterate and semi-literate labour contents that have yet incompletely acquired basic-skill, rather than that having completely acquired basic-skill (with education level at least upto High + Higher Secondary stage).

In terms of empirical estimates of marginal rates as depicted by the respective regression coefficients, same for both equations (5.18) and (5.19), we infer that any improvement in percentage employment in the job-searching phase IV would impart highest percentage share of improvement in overall employment (of about 0.64% in m(S), corresponding to 1% improvement in m(IV), the two education phases I and III are now coming closer if our assessment is done by the corresponding marginal rates of equation (5.19). However, the enrollment percentage is yet quite low for phase III as compared with that for phase I (all-India value of n(I) = 62.66% as against the measure of n(III) = 22.34% for boys), indicating that it would not be so easy a task to improve upon the value of n(III) as compared with n(I) in general.

(33) In our discriminatory analysis, just summarised, the dependency status has emerged for both L(II) and L(S) out of a total of six fundamental spatial variables considered for the formative and the activity phases. Independent of these supportive results, it could be established analytically also that L(II) is the best representative single variable for depiction of the spatial variations of all three formative phase-indices, and also L(S) is the best representative single variable of all three activity phase indices. For the existence of a bi-polarised sort of correlation matrix for the six spatial variables and also in view of our

interest for maximum composite depiction of the inter-correlations that exist between the two polarised groups (actually the group of formative phase-indices and the residual group of activity-phase-indices), our analytic formulation for a synthetic liability index of non-engaged human resources had to be devised analytically in such a way that the inter-relation between the two polarised groups does not get diluted or overshadowed by the overwhelmingly high magnitudes of within-group correlation coefficients (ref. to (f) above). The analytical details of this device has been discussed in section (5.1) in this chapter. The actual empirical formulation of the liability index of non-engaged human resources, denoted by ξ , has been shown in equation (5.3). The quantitative magnitudes, qualitative ranks for the liability index, ξ , for all districts are recorded in Table (5.3) in which the characteristic values of percentage enrollment in phase II and of percentage unemployment in phase S , characterising ξ , have also been presented. The qualitative ranks of districts by the liability measure, ξ , have also been mapped in Figure (5.1). Analyses based on the patterns of regions as identified on this map and from the use of characteristic values, recorded in Table (5.3), are presented in section (5.2) of the present chapter.

(34) Next, to unfold the implicit linkages of the liability index, ξ , with all the fundamental indices, that ought to

exist in our multicollinear system of all considered variables, we have used again the discriminatory power of the VLS regression technique to search for the best dependent variable and the corresponding most relevant combination of spatial indices in all feasible variable-spaces, constituted by a total of 4 to 7 variables. Some important details of this search are recorded in Table (5.4). The details of analytic judgements and steps involved in the discrimination process have been given in section (5.3) of this chapter. Our final discrimination has gone in favour of the synthetic liability index, ξ, (recognised as the globally best explained dependent variable with the magnitude of the maximal VLS correlation coefficient very near to unity; actually it is 0.991). The corresponding combination of the most relevant spatial variables are only the fundamental indices L(II) and L(III), relating to Middle and High + Higher Secondary levels of education in the formative phase, and the fundamental indices L(IV) and L(V), relating to the job-searching activity phase and the main activity phase. Thus, the spatial variation in the non-engaged human resource liabilities is really contributed by the spatial variations of all these four phasewise components of non-development and non-utilisation of human resources.

(35) The relative contributions of the four phase-indices L(II) to L(V), as evaluated from the corresponding VLS regression in terms of standardised variables shown in equation (5.4),

are as follows : out of the total accounted variation of ξ (squared VLS correlation coefficient of magnitude 0.982), the shares of 27.5%, 17.4%, 26.9% and 28.2% are explained respectively by L(II), L(III), L(IV) and L(V). It has been also shown that this feature of relative contributory roles of the explanatory variables cannot be brought out distinctly by the OLS procedure. In the present context, although ξ -axis biased least squaring as implicit in the OLS procedure, has improved slightly the OLS correlation coefficient to 0.99981 (as against the corresponding VLS correlation coefficient = 0.99102), the presence of multi-collinearity has distorted the distinct evaluation of the OLS regression coefficients so much as to give rise to a negative value for the OLS regression coefficient associated to L(III). In fact, the presence of multi-collinearity between L(II) and L(III) has been responsible for such meaningless negative value for the said regression coefficient for L(III) with much exaggerated value for the OLS regression coefficient, associated to L(II). Also, the presence of multi-collinearity between L(IV) and L(V) has resulted into a considerably lower value of regression coefficient for L(V) and somewhat enhanced value of that for L(IV) in OLS results as compared to the VLS ones.

(36) From the VLS regression in alternative form, with variables expressed as percentages of shortfalls in human resource development and utilisation (i.e. using the variables

$g(\varphi)$ and $u(\varphi)$ for different φ, and percentage non-attainments to functions, in place of ξ), shown in equation (5.9), we have inferred that corresponding to 1% reduction in u(IV), u(V), g(II) and g(III), the respective reductions in non-attainment percentage are only the fractional values 0.313%, 0.308%, 0.279% and 0.253%, quoted in order of falling magnitudes. Although the marginal rates as quoted above are slightly lower for the two formative phases, the dimensions of tasks ahead for efforts towards liability reduction are actually tremendous in view of the overwhelming all-India shortfall percentages in these phases, shown in Table (5.5) for 1970-71. Again, coupling the all-India percentage figures, showing the incidences of male unemployment (ref. again to Table (5.5)) with the bulky sizes in phases IV and V (percentages of total males, concentrated in phases IV and V, are 33.00% and 24.21% as against those in phases II and III are 15.03% and 10.72% respectively), the dimensions of the task ahead in any efforts towards liability reduction would also be no less tremendous here also.

(37) A comparison of the spatial distributions of liability measure, ξ, and the agricultural labour-surplus areas, as depicted in Figure (5.1) and (4.1), reveals that there is striking similarity between the spatial distribution of very high and high liability areas and that of " excessively high" or " high" agricultural labour surplus areas. Thus,

practically all areas with very high or high liabilities of non-engaged male human resources have exhibited the " excessively high" and " high" agricultural labour-surplus conditions even for workers already engaged in agricultural activities. These so-called " surplus agricultural labour" are actually under-employed presently in agricultural activities under compulsions for not being able to find out alternative avenues or opportunities of employment in non-agricultural activities and thereby forced to remain captive in the agricultural sector under the prevailing general condition of labour-abundant national economy. This means that our reported agricultural workers are not always fully employed particularly in the agricultural sector with the existing agricultural activity-bases. As a result of this special feature of economic backwardness, the development of human resources in the formative phase must have got affected adversely, culminating into high incidences of non-enrollment and drop-outs, increasing ultimately our liabilities.

(38) Again, from a comparison of spatial configurations, shown in Figures (4.2), (4.1), (5.1) and (3.6), the facts that emerge can be summarised as follows. There have been many coincidences of areas having negligible or no manufacturing activities, with major parts of very high or high liability areas or with " excessively high" or " high" agricultural labour surplus areas. In fact, our industrial

manufacturing activities are yet (year referred is 1976) not that wide-spread geographically, compared with our large labour stock that remain captive in wide-spread agricultural activities all over India. At the moment, tne manufacturing activities are highly localised in nature, concentrated mainly in and around the traditional metropolises and big urban centres of India, that provided the advantages of localisation economy in productive performances. Thus, even if there has been, for example, the growth of manufacturing activities in a narrow southern part of Bihar, adjoining West Bengal and Orissa, it has not been adequate enough to reduce very high liability ranks of non-engaged male human resources as it stand presently in Bihar.

(39) On the other hand, our traditional centres of multi-functional manufacturing activities, spread in the hinterland of the metropolises of Bombay, Calcutta, Madras and Delhi, and also of the big urban centres like Ahmedabad, Chandigarh, etc. (ref. to Figure (4.2)), are also the areas of extremely low, very low or low ranks according to our classification of liability measures (ref. to Figure (5.1)), with hardly any agricultural labour-surplus problems (ref. to Figure (4.1)). In fact, the areas of 'substantial' and 'considerable' manufacturing activities are much more wide-spread in Tamil Nadu beyond the hinterland of the metropolis of Madras and these areas are largely coincident with the areas of high incidences

of employment (ref. to Figure (3.6)) therein. This is also matching with the wide-spread areas, ranked low according to our liability measure in Tamil Nadu, that extend beyond the State border to the adjoining State of Kerala.

(40) We have an wide-spread region with low liability rank around the capital of India, extending over all the neighbouring States of Punjab, Haryana and Uttar Pradesh (ref. to Figure (5.1)). Apart from the 'substantial' and 'considerable' manufacturing activity-bases as exhibited in and around the capital city (ref. to Figure (4.2)) much of these areas, falling in the Indo-Gangetic plains with modernised agricultural activities, are quite advanced in agricultural production. In consequence, the problem of agricultural labour surplus condition has been practically absent in the wide-spread areas around the capital city (ref. to Figure (4.1)). As a result of advancement in both agricultural and manufacturing activities in this wide-spread region around Delhi, the allied activities like trade and other tertiary activities have developed in this region, extending over vast areas of Uttar Pradesh in the western and central parts. All these flourishing activities together have really been responsible for the occurrence of wide-spread regions having low ranks in non-engaged male human resource liabilities therein.

(41) Any reduction possibility in our liability level rests on the genuine supports of the productive and related

activity-bases of our national economy. The present agricultural activity-base, although flourishing in many areas, particularly in Punjab, Haryana and adjoining areas of Uttar Pradesh, besides some other areas, has largely attained a kind of saturation in labour absorption level for the existing situation of their performance in agricultural production over widespread geographical areas in India. Definitely, the productive performance of these agriculturally less productive areas could be up-graded, if we are in a position to apply our lessons from the Punjab - Haryana patterns of agricultural productivity in all those less productive areas, where feasible. If that is possible, there might be some scope of improving the labour-absorptive qualities of some of the present agricultural activity-bases. However, with the limitations of agricultural land resources and with the problem of ever-increasing population growth, we have to think for alternative avenues of labour absorptions in other activities besides agriculture, particularly the industrial manufacturing. At the moment it has got established that our manufacturing activity-base is yet inadequate to be considered as sufficiently supportive of solutions to our labour absorption problems amid abundant non-engaged human resource stock. Even with the limited manufacturing activity-base we could have expected better labour absorption levels in the core areas of manufacturing activities, had our industrial entrepreneurs -

acted in tune with the social situation by giving more attention to labour absorptions than what they giving presently; after-all for most of the manufacturing activity-bases, the labour-absorptive scales are sufficiently lower than the corresponding productive scales. In fact, the core areas exhibited more profit motive with increased production and relatively reduced labour absorption (ref. to data in Table (5.8) for further details). There are, however, regional variations (ref. to Table (5.9)), even then in many important traditional and growing centres, the relative profit motives with enhanced production, possibly through more of capital-use and reduced labour absorptions, are not always conducive of solutions to increasing problems of labour absorption as present in our labour abundant economy. Anyway our manufacturing activity-bases are still at the phase of infancy, with disproportionately small contributions to national G.D.P. (Gross value of Domestic Product) and continued stagnancy in respect of the share of manufacturing sector in the over-all national economy over the decade centred at 1971 [ref. to Table (5.10) and related analysis). If this situation prevails, we cannot have enough scope of relatively substantial employment generation in the manufacturing sector to reduce the more acute sort of liabilities as present in the agricultural sector in quite wide-spread areas. So the employment deterioration as shown during the decade 1961 to 1971 is likely to have been more pronounced in the forward time-path. However, it is clear that we have no escape-route for solutions to ever-increasing labour absorption problems unless we generate more of activities in the manufacturing sector.

(42) From our present experience of multi-functional manufacturing activity-based traditional growth centres with hinterland spread, as against the limited-function based stagnancy as exhibited in many isolated industrial centres of India, it appears that a proper course of action to develop adequate labour-absorptive activities in vast areas with acute non-engaged human resource liability lies really on the choice of appropriate growth centres and building up of multi-functional industrial complexes, instead of a limited-functional approach to develop under-industrialised areas, as sometimes followed in our various national planning efforts in the past. Again, as our manufacturing activities are yet distressingly inadequate, sufficiently adequate attention for manufacturing expansions in all the existing activity-cores and centres are also required; after all whatever little manufacturing acticity-bases that we have today cannot be allowed to deteriorate for the sake of our gigantic non-engaged human resource liability, especially with reference to the activity phase. All these traditional metropolitan cores are generally surrounded by under-industrialised areas lying in the wider hinterland of the metropolises functioning as core of

manufacturing areas in the immediate neighbourhood. Any deterioration in the labour-absorptive behaviours of the established manufacturing activity-bases around the traditional metropolises, would adversely affect the labour-absorptive possibilities in the wider under-industrialised hinterland, as is evident from our detailed discussion related to " Todaro Paradox" . After all to offset the effect of " Todaro Paradox" within the existing manufacturing activity-bases, the expansions of activities at the existing metropolitan and big urban centres seem to be essential, so long as our non-engaged human resource liability remains acute in the surroundings.

(43) Again, from our discriminatory analysis as referred to in (32.1) and (32.2) above, we have identified a two-way interaction possibility between formative and activity phases. We have noted how any shortfalls in the activity phases IV and V influence the shortfalls in the Middle education phase II in the form of increased incidences of dropping out (or, non-enrollment), giving rise to child labour problems that cripple our national economy. So, to tackle this issue of child labour problems we must reduce shortfalls in the activity phases as well. On the other hand, we have also noticed how shortfalls in the formative phases I and III influence the shortfalls in the over-all activity phases. Thus, it becomes imperative that to improve the over-all employment situation

our attentions are required for reduction of shortfalls not only in the job-searching activity phase IV alone but also in the education phase III, covering the High + Higher Secondary level, with controls of equally necessary dimensions right at the Primary education phase I. Thus, it is clear that for any degree of fulfilment of the ultimate goal of liability reduction, we must have multi-pronged attentions to the reduction of shortfalls in all the relevant inter-connected phases with a balanced creation of requisite facilities for basic education and necessary opportunities in the form of activity generations.

(44) All the above analytic findings and discussions have been towards unfolding the complexities of inter-connections that exist among varieties of phase-indices and other related measures considered in the identification of spatial variations and configurations in respect of human resource development and utilisation. Once unfolded the complex nature of inter-connectedness, we are in a position to comprehend, through established analytical relations, how any lack of attention to a particular phase would affect the results in some other phase of different variety, with our ultimate goal of reduction of liability of non-engaged human resources, whether in the activity phase or in the basic-skill formative phase. It should be clearly understood that the solutions of India's labour absorption or human resource utilisation

problems lie not only in the creation of more of productive activities, particularly in the industrial manufacturing sector with sufficiently adequate attention and efforts, but also in the simultaneous generation of adequate facilities for sufficient basic-skill formation on a compulsory basis, as far as these are practicable. However, we have other problems too on the question of adequate activity generation particularly through enough industrial manufacturing expansions. Apart from the serious problem of recently developing crisis on energy supply, the other important problem seems to be the lack of injections of sufficient financial resources at proper growth centres under the stated functional regionalisation framework (ref. to section (5.6)), both in the yet under-industrialised regions and also in the traditionally industrialised regions. A search for remedies to these problems seems to be the right kind of necessity right now, that could assure the growth-promoting and growth-sustaining aspects, both in terms of production and labour absorption for the existing and the required activity-bases to be created newly, keeping in mind regional dimensions. We are now better equipped with the knowledge and insight into the relevant regional problems as existing today. Equipped with this detailed knowledge on regional variations regarding the problems of human resource development and utilisation, our planning efforts should be oriented towards an intensive kind of generation of facilities for basic-skill formation together with a balanced form of activity generation, more in the secondary manufacturing sector, where practicable, on the lines already suggested. If a right kind of industrial manufacturing growth-path with adequate labour absorption supportive productive activities are not followed, India's ever-increasing human resource stock is going to face still more serious unemployment hazards. All our regional analyses made earlier have been oriented with emphasis on the diagnosis of our liabilities on the non-engaged human resources in both formative and activity phases, in relation with the performances on the labour-absorptive behaviours of our existing activity-bases, both for primary agricultural and secondary manufacturing productions, so that our vision gets clarified towards finding steps to avert such ever-increasingly serious unemployment hazards.

APPENDIX TABLES

TABLE (A.1) : Estimated Percentage of Boys in the Age Group 5 years-19 years Not Enrolled in Schools : 1960-61 and 1970-71

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
INDIA	42.81	37.34	63.32	55.34	86.46	77.66
ANDHRA PRADESH	39.99	36.48	66.95	63.93	90.82	89.04
1. Srikakulam	43.98	40.39	70.21	67.27	93.75	92.12
2. Vishakhapatnam	43.75	39.06	70.02	66.16	93.58	91.10
3. East Godavari	37.65	33.55	64.96	61.31	89.02	86.59
4. West Godavari	34.22	31.32	61.93	59.25	86.23	84.64
5. Krishna	33.72	30.42	61.48	58.39	85.80	83.82
6. Guntur	34.79	24.46	62.44	52.36	86.70	77.94
7. Ongole	38.25	32.48	65.24	60.33	89.26	85.67
8. Nellore	40.08	28.77	67.02	56.78	90.89	82.27
9. Chittoor	38.98	31.27	66.09	59.20	90.05	84.59
10. Cuddapah	37.49	32.23	64.81	60.10	88.88	85.45
11. Anantapur	38.91	34.38	66.03	62.07	89.99	87.31
12. Kurnool	37.99	34.39	65.25	62.08	89.28	87.32
13. Mahbubnagar	46.30	38.09	72.04	65.33	95.37	90.34
14. Hyderabad	28.58	15.55	56.59	41.74	81.20	67.01
15. Medak	44.99	42.14	71.01	68.72	94.46	93.43
16. Nizamabad	45.23	41.47	71.20	68.17	94.63	92.93
17. Adilabad	48.30	44.65	73.58	70.73	96.72	95.25
18. Karimnagar	46.55	43.09	72.23	69.49	95.54	94.13
19. Warangal	44.70	41.30	70.77	68.04	94.25	92.82
20. Khammam	45.92	42.18	71.74	68.75	95.10	93.46
21. Nalgonda	45.94	42.24	71.75	68.80	95.12	93.51
ASSAM	38.46	37.06	69.29	64.32	89.88	86.17
1. Goalpara	44.31	42.32	74.37	68.72	94.23	90.06
2. Kamrup	36.87	36.13	67.84	63.50	88.63	85.44
3. Darrang	43.18	42.32	73.41	68.73	93.42	90.07
4. Nowgong	39.22	37.08	69.97	64.34	90.47	86.19
ASSAM (Contd.)						
5. Sibsagar	32.00	31.35	63.20	59.16	84.54	81.50
6. Lakhimpur	37.17	35.96	68.11	63.35	88.86	85.31
7. Mikir Hills	51.92	44.93	80.56	70.81	99.40	91.88
8. North Cachar Hills	44.22	38.27	74.36	65.36	94.23	87.10
9. Cachar	36.03	34.39	67.06	61.96	87.95	84.05
10. Mizo	25.00	18.74	55.86	45.73	77.86	68.64
BIHAR	46.65	40.16	70.00	63.69	90.99	85.64
1. Patna	35.54	30.95	61.10	55.92	83.11	78.52
2. Gaya	45.30	37.83	68.98	61.82	90.10	83.95
3. Shahabad	41.59	38.25	66.10	62.16	87.58	84.26
4. Saran	44.51	39.02	68.38	62.77	89.58	84.81
5. Champaran	53.37	46.34	74.87	68.42	95.16	89.82
6. Muzaffarpur	47.88	42.60	70.92	65.60	91.78	87.34
7. Darbhanga	47.84	41.66	70.89	64.87	91.76	86.69
8. Monghyr	46.17	40.01	69.64	63.58	90.68	85.53
9. Bhagalpur	45.63	39.91	69.23	63.50	90.32	85.46
10. Saharsa	51.46	44.49	73.51	67.04	94.01	88.61
11. Purnea	50.15	44.76	72.58	67.24	92.21	88.79
12. Santal Parganas	51.33	44.20	73.43	66.82	93.94	88.42
13. Palamau	52.29	44.73	74.11	67.22	94.52	88.77
14. Hazaribagh	51.10	43.32	73.26	66.15	93.79	87.83
15. Ranchi	47.19	38.30	70.40	62.20	91.34	84.30
16. Dhanbad	40.79	32.74	65.45	57.51	87.00	80.00
17. Singhbhum	42.44	35.49	66.76	59.88	88.16	82.18
GUJARAT	40.65	39.34	53.43	46.86	79.47	69.12
1. Jamnagar	45.24	44.36	56.36	49.76	82.36	71.94
2. Rajkot	39.28	36.03	52.51	44.85	78.57	67.12

TABLE (A.1) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		THIRD PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
GUJARAT (Contd.)						
3. Surendranagar	47.71	45.86	57.88	50.60	83.83	72.74
4. Bhavnagar	43.35	42.00	55.17	48.42	81.20	70.64
5. Amreli	42.91	41.92	54.89	48.37	80.92	70.60
6. Janagadh	46.15	44.83	56.92	50.02	82.91	72.19
7. Kutch	48.10	48.66	58.11	52.12	84.06	74.19
8. Banaskantha	60.68	62.93	65.27	59.27	90.83	80.84
9. Sabarkantha	45.41	41.42	56.47	48.09	82.46	70.32
10. Mahesana	36.35	35.41	50.52	44.46	76.57	66.74
11. Gandhinagar	29.71	31.10	45.67	41.66	71.58	63.91
12. Ahmedabad	29.46	26.25	45.48	38.28	71.39	60.40
13. Kheda	33.57	29.72	48.55	40.73	74.57	62.95
14. Panchmahals	52.37	52.57	60.64	54.17	86.48	76.13
15. Vadodara	36.05	34.57	50.31	43.93	76.35	66.20
16. Bharuch	35.56	39.02	49.97	46.67	76.01	68.93
17. Surat	36.85	37.32	50.86	45.64	76.91	67.91
18. Valsad	38.49	38.98	51.99	46.65	78.04	68.91
19. The Dangs	66.63	66.43	68.40	60.90	93.70	82.30
HARYANA	41.24	32.37	54.86	46.74	82.28	70.58
1. Ambala	34.43	27.99	50.17	43.53	77.53	67.33
2. Karnal	44.19	35.24	56.84	48.84	84.26	72.70
3. Rohtak	39.10	28.37	53.47	43.82	80.90	67.64
4. Gurgaon	40.03	30.51	54.09	45.44	81.53	69.29
5. Mahendragar	40.51	29.74	54.42	44.87	81.85	68.71
6. Hisar	43.98	35.59	56.70	49.08	84.12	72.94
7. Jind	45.95	39.03	57.96	51.40	85.36	75.22

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
HIMACHAL PRADESH	41.77	34.28	57.04	50.24	83.03	73.98
1. Chamba	51.43	46.75	65.08	58.83	89.15	82.24
2. Kangra	35.84	29.68	51.18	46.88	78.56	70.69
3. Mandi	42.31	33.80	59.10	50.03	83.56	73.82
4. Kulu	48.58	39.70	59.59	54.21	86.95	77.88
5. Lahul & Spiti	42.30	38.40	55.61	53.32	83.04	77.02
6. Bilaspur	40.92	33.05	58.12	49.46	82.64	73.26
7. Mahasu	41.89	36.51	58.81	51.99	83.29	75.74
8. Simla	36.52	29.95	54.27	47.09	81.64	70.90
9. Sirmaur	47.32	41.90	62.50	55.70	86.74	79.30
10. Kinnaur	44.94	34.34	60.91	50.42	85.26	74.20
JAMMU & KASHMIR	52.26	47.93	65.56	59.47	89.55	82.81
1. Anantanag	54.68	50.56	67.18	61.18	91.02	84.42
2. Srinagar	49.29	45.74	63.79	58.19	87.93	81.65
3. Buramula	54.89	52.72	67.31	62.47	91.14	85.60
4. Ladakh	53.39	51.75	66.39	61.90	90.30	85.08
5. Doda	54.00	51.71	66.76	61.88	90.64	85.06
6. Udhampur	54.56	51.29	67.11	61.62	90.95	84.82
7. Jammu	45.51	37.52	61.29	52.70	85.62	76.43
8. Kathua	51.50	45.03	65.20	57.74	89.22	81.22
9. Rajauri	56.81	51.72	67.95	61.88	91.96	85.06
10. Punch	54.99	50.84	66.24	61.35	90.26	84.58
KARNATAKA	38.95	36.19	60.07	58.03	86.85	80.99
1. Bangalore	32.15	27.87	54.58	50.92	81.48	74.24
2. Belgaum	37.52	35.43	58.96	57.42	85.78	80.42

TABLE (A.1) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
KARNATAKA (Contd.)						
3. Bellary	42.19	41.60	62.52	62.22	89.20	84.84
4. Bidar	48.81	45.35	67.25	64.96	93.64	87.32
5. Bijapur	37.41	37.29	58.87	58.91	85.69	81.80
6. Chikmagalur	37.74	34.25	59.13	56.45	85.95	79.52
7. Chitradurga	38.38	35.86	59.63	57.77	86.43	80.75
8. Coorg	32.98	28.82	55.28	51.78	82.17	75.07
9. Dharwar	29.77	27.91	52.52	50.96	79.41	74.28
o. Gulbarga	48.70	47.25	67.17	66.30	93.57	88.52
1. Hassan	39.45	36.63	60.46	58.38	87.22	81.32
2. Kolar	43.19	40.52	63.26	61.40	89.90	84.10
3. Mandya	46.84	44.79	65.87	64.55	92.36	86.95
4. Mysore	44.36	43.44	64.10	63.58	90.70	86.07
5. North Canara	33.06	29.36	55.34	52.26	82.24	75.53
6. Raichur	47.23	45.40	66.15	64.99	92.62	87.35
.7. Shimoga	37.17	32.74	58.69	55.20	85.51	78.33
.8. South Canara	34.69	27.00	56.69	50.13	83.56	73.46
.9. Tumkur	40.71	37.63	61.41	59.18	88.14	82.05
ERALA	24.73	20.35	48.58	42.57	80.52	72.17
1. Cannanore	27.18	24.06	50.93	46.28	83.10	76.31
2. Kozikode	27.85	21.22	51.55	43.47	83.77	73.18
3. Malappuram	29.22	23.10	52.73	45.35	85.01	75.28
4. Palghat	37.64	33.40	59.93	54.54	92.62	85.13
5. Trichur	24.77	20.64	48.59	42.88	80.52	72.52
6. Ernakulam	22.43	16.33	46.26	38.13	77.94	67.06
7. Kottayam	18.65	14.78	42.18	36.28	73.29	64.87
8. Alleppey	17.52	11.03	40.89	31.34	71.78	58.84
9. Quilon	22.43	16.59	46.26	38.44	77.94	67.42
o. Trivandrum	26.09	18.17	49.90	40.22	81.97	69.49

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
MADHYA PRADESH	53.02	47.98	69.22	64.32	88.04	78.58
1. Morena	55.90	50.38	71.07	65.91	89.60	79.87
2. Bhind	52.34	45.81	68.77	62.85	87.66	77.38
3. Gwalior	42.64	36.87	62.08	56.39	81.87	71.98
4. Datia	55.30	47.72	70.69	64.14	89.28	78.44
5. Shivpuri	59.97	53.56	73.61	67.96	91.73	81.52
6. Gunna	57.37	53.16	72.00	67.70	90.38	81.31
7. Tikamgarh	62.67	57.94	75.25	70.68	93.08	83.68
8. Chhatarpur	60.76	57.14	74.10	70.19	92.13	83.30
9. Panna	60.76	56.46	74.10	69.77	92.15	82.96
10. Satna	53.66	48.31	69.63	64.54	88.39	78.76
11. Rewa	53.92	49.41	69.80	65.28	88.53	79.36
12. Shahdol	61.37	56.58	74.46	69.85	92.43	83.02
13. Sidhi	64.12	60.77	76.12	72.39	93.80	85.02
14. Mandsaur	45.55	39.86	64.15	58.63	83.69	73.87
15. Ratlam	48.84	45.24	66.43	62.46	85.66	77.06
16. Vjjain	46.31	41.48	64.68	59.80	84.15	74.86
17. Jhabua	68.62	66.58	78.74	75.77	95.94	87.65
18. Dhar	57.91	54.57	72.34	68.60	90.67	82.03
19. Indore	32.62	28.46	54.29	49.54	74.88	66.03
20. Dewas	52.00	47.21	68.55	63.80	87.47	78.16
21. Khargone	55.24	52.20	70.65	67.09	89.25	80.82
22. Khandwa	44.73	42.08	63.57	60.24	83.19	75.22
23. Shajapur	56.23	50.13	71.28	65.75	89.78	79.74
24. Rajarh	62.28	56.54	75.02	69.82	92.89	83.00
25. Vidisha	58.08	52.62	72.45	67.36	90.76	81.04
26. Sehore	50.21	42.43	67.36	60.48	86.46	75.42
27. Raisen	57.92	52.55	72.35	67.31	90.67	81.00
28. Hoshangabad	46.26	39.90	64.65	58.65	84.12	73.89
29. Betul	53.09	47.30	69.26	63.87	88.08	78.21

TABLE (A.1) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
MADHYA PRADESH (Contd.)						
30. Sagar	50.00	42.58	67.21	60.59	86.33	75.51
31. Damoh	51.38	46.39	68.13	63.24	87.12	77.70
32. Jabalpur	40.87	36.14	60.77	55.82	80.72	71.50
33. Narsimhapur	48.24	42.00	66.02	60.18	85.31	75.17
34. Mandla	56.16	51.48	71.24	66.62	89.74	80.45
35. Chhindwara	53.99	48.77	69.85	64.84	88.57	79.01
36. Seoni	52.79	48.95	69.06	64.97	87.91	79.11
37. Balaghat	46.76	43.34	65.00	61.13	84.43	75.96
38. Surguja	63.13	58.93	75.52	71.28	93.31	84.15
39. Bilaspur	50.01	45.09	67.22	62.35	86.34	76.97
40. Raigarh	54.90	49.34	70.43	65.22	89.07	79.32
41. Durg	51.02	44.14	67.90	61.70	86.92	76.43
42. Raipur	49.60	44.44	66.95	61.90	86.10	76.60
43. Bastar	66.34	63.55	77.42	74.02	94.87	86.30
MAHARASHTRA	47.61	40.89	53.40	47.73	80.54	70.00
1. Greater Bombay	21.89	18.08	36.21	31.74	62.16	53.33
2. Thana	48.68	41.76	53.99	48.23	81.13	70.49
3. Kolaba	53.94	45.55	56.84	50.37	83.96	72.56
4. Ratnagiri	47.49	39.09	53.33	46.66	80.47	68.96
5. Nasik	50.61	44.07	55.06	49.55	82.20	71.77
6. Dhulia	52.76	50.80	56.21	53.20	83.34	75.25
7. Jalgaon	39.50	31.83	48.64	42.11	75.67	64.39
8. Ahmednagar	50.61	43.44	55.06	49.19	82.20	71.42
9. Poona	43.00	34.45	50.75	43.80	77.85	66.11
10. Satara	41.63	39.26	49.93	46.77	77.01	69.06
11. Sangli	47.79	40.97	53.50	47.77	80.64	70.04
12. Sholapur	53.36	46.59	56.53	50.94	83.66	73.11

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
MAHARASHTRA (Contd.)						
13. Kolhapur	49.79	42.44	54.61	48.63	81.75	70.88
14. Aurangabad	62.56	51.82	61.21	53.73	88.21	75.75
15. Parbhani	66.32	58.30	63.03	56.99	89.95	78.78
16. Bhir	67.08	59.04	63.38	57.35	90.28	79.12
17. Nanded	66.82	61.01	63.26	58.30	90.17	79.99
18. Osmanabad	63.82	54.02	61.82	54.86	88.80	76.81
19. Buldhana	48.61	40.54	53.96	47.52	81.09	69.80
20. Akola	44.53	39.92	51.64	47.15	78.76	69.44
21. Amravati	43.30	39.38	50.92	46.83	78.03	69.12
22. Yeotmal	55.10	50.92	57.44	53.26	84.55	75.31
23. Wardha	46.06	39.05	52.52	46.64	79.65	68.93
24. Nagpur	40.90	34.71	49.50	43.97	76.56	66.28
25. Bhandara	50.01	42.16	54.73	48.46	81.87	70.72
26. Chandrapur	62.64	56.12	61.25	55.91	88.25	77.79
MANIPUR	24.47	25.64	51.35	50.68	75.58	74.14
1. Manipur North	32.97	34.55	59.75	58.97	83.65	82.06
2. Manipur West	33.36	34.96	60.10	59.32	83.98	82.38
3. Manipur South	25.25	26.46	52.29	51.61	76.54	75.08
4. Manipur Central	23.41	24.50	49.54	48.89	73.83	72.42
5. Manipur East	24.69	25.87	51.70	51.03	75.96	74.51
MEGHALAYA	42.65	39.31	72.87	66.19	92.92	87.82
1. Garo Hills	48.04	42.81	77.44	69.12	96.80	90.41
2. United Khasi and Jaintia Hills	39.14	36.98	69.89	64.24	90.40	86.10
NAGALAND	37.10	33.11	62.87	57.34	86.40	80.41
1. Kohima	33.60	29.19	60.17	54.21	84.01	77.58
2. Mokokchung	29.29	25.87	56.17	51.03	80.24	74.52
3. Tuensang	47.31	44.35	71.39	66.82	94.16	89.18

States and (1)	FIRST PHASE Age Group (years) : 5-10 1960-61 (2)	1970-71 (3)	SECOND PHASE Age Group (years) : 10-15 1960-61 (4)	1970-71 (5)	THIRD PHASE Age Group (years) : 15-19 1960-61 (6)	1970-71 (7)
[illegible]	47.59	42.60	78.20	66.61	94.46	89.61
[illegible]	45.22	40.69	76.24	65.09	92.87	88.25
[illegible]	51.63	44.00	81.46	67.69	97.06	90.58
[illegible]	52.72	47.73	82.32	70.50	97.74	93.07
[illegible]	57.93	51.53	86.29	73.25	99.97	95.47
[illegible]	37.09	34.64	69.04	60.06	86.92	83.64
[illegible]	37.22	32.66	69.16	58.31	87.03	82.01
[illegible]	43.63	39.37	74.88	64.03	91.76	87.28
[illegible]	[illegible]	47.24	80.80	70.14	96.54	92.75
[illegible]	56.79	47.80	85.43	70.56	99.96	93.12
[illegible]	61.87	55.66	89.17	76.13	100.00	97.93
[illegible]	67.13	61.78	92.88	80.21	100.00	99.95
[illegible]	46.82	43.06	77.58	66.96	93.95	89.93
[illegible]	38.44	32.65	70.29	58.31	87.97	82.00
[illegible]	37.42	30.18	52.20	45.04	79.58	68.83
[illegible]	38.11	29.47	52.78	44.66	80.20	68.50
[illegible]	35.72	29.78	51.10	44.89	78.49	68.73
[illegible]	40.60	34.50	54.48	48.32	81.92	72.19
[illegible]	30.86	24.26	47.47	40.52	74.71	64.20
[illegible]	31.55	24.56	48.03	40.78	75.31	64.46
[illegible]	35.14	28.64	50.69	44.02	78.07	67.84
[illegible]	33.72	23.20	49.65	39.63	76.99	63.24
[illegible]	34.22	26.30	50.02	42.20	77.36	65.95
[illegible]	39.25	31.91	53.57	46.47	80.99	70.34
[illegible]	45.95	37.34	57.96	50.28	85.36	74.12
[illegible]	43.36	37.35	56.30	50.28	83.73	74.13

Districts by States and Union Territories (1)	FIRST PHASE Age Group (years) : 5-10 1960-61 (2)	1970-71 (3)	SECOND PHASE Age Group (years) : 10-15 1960-61 (4)	1970-71 (5)	THIRD PHASE Age Group (years) : 15-19 1960-61 (6)	1970-71 (7)
RAJASTHAN	57.50	53.73	69.81	66.14	87.40	79.89
1. Ganganagar	55.89	53.40	68.82	65.94	86.58	79.73
2. Bikaner	48.66	47.50	64.22	62.18	82.67	76.67
3. Churu	53.90	53.73	67.59	66.14	85.54	79.89
4. Jhunjhunu	50.36	45.25	65.34	60.70	83.63	75.44
5. Alwar	56.74	52.19	69.46	65.19	87.02	79.12
6. Bharatpur	56.93	53.19	69.46	65.81	87.11	79.62
7. Sawai Madhopur	60.06	56.56	71.34	67.86	88.68	81.27
8. Jaipur	53.89	48.67	67.58	62.95	85.53	77.30
9. Sikar	55.02	50.33	68.29	64.01	86.13	78.17
10. Ajmer	45.78	41.23	62.26	57.94	80.98	73.14
11. Tonk	62.78	58.60	72.95	60.07	90.00	82.23
12. Jaisalmer	67.74	61.36	75.77	70.68	92.31	83.50
13. Jodhpur	54.40	51.99	67.90	65.06	85.80	79.02
14. Nagaur	59.97	58.56	71.29	69.05	88.64	82.21
15. Pali	59.26	55.55	70.87	67.25	88.29	80.78
16. Barmer	68.23	65.46	76.04	73.00	92.53	85.32
17. Jalore	67.23	65.89	75.49	73.24	92.08	85.51
18. Sirohi	59.87	57.37	71.24	68.34	88.59	81.65
19. Bhilwara	62.85	59.28	72.99	69.47	90.04	82.55
20. Udaipur	59.64	55.91	71.10	67.47	88.47	80.96
21. Chittaurgarh	60.22	54.78	71.44	66.78	88.76	80.41
22. Dungarpur	63.65	59.41	73.45	69.55	90.41	82.61
23. Banswara	66.80	62.85	75.24	71.53	91.88	84.17
24. Bundi	62.06	57.97	72.52	68.70	89.65	81.94
25. Kota	52.30	45.75	66.58	61.03	84.69	75.72
26. Jhalawar	59.29	55.38	70.89	67.14	88.30	80.70

TABLE (A.1) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-71	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
TAMILNADU	21.80	20.66	55.70	50.38	82.06	67.05
1. Madras	8.62	9.27	35.03	33.75	60.23	51.33
2. Chingleput	24.08	20.67	58.54	50.39	84.82	67.06
3. North Arcot	25.70	23.22	60.48	53.41	86.68	69.71
4. South Arcot	23.89	25.34	58.32	55.79	84.60	71.77
5. Dharmapuri	32.81	32.85	68.44	63.52	94.17	78.26
6. Salem	26.15	26.18	61.10	56.70	87.30	72.55
7. Coimbatore	22.46	20.93	56.54	50.71	82.88	67.34
8. Nilgiris	19.84	16.60	53.14	45.16	79.52	62.33
9. Madurai	19.92	18.67	53.24	47.89	79.62	64.82
10. Tiruchirapalli	21.72	21.00	55.60	50.79	81.96	67.41
11. Thanjavur	19.63	19.86	52.85	49.39	79.23	66.17
12. Ramanathpuram	19.80	18.88	53.09	48.16	79.47	65.06
13. Tirunelveli	18.94	17.42	51.91	46.25	78.29	63.34
14. Kanyakumari	15.65	13.18	47.19	40.24	73.47	57.72
TRIPURA	33.76	29.60	60.31	54.57	84.14	77.92
1. West Tripura	32.89	28.84	59.55	53.88	83.42	77.26
2. North Tripura	32.77	28.73	59.44	53.78	83.33	77.17
3. South Tripura	36.52	32.02	62.74	56.77	86.40	80.01
UTTAR PRADESH	49.46	36.52	70.54	53.48	89.00	78.61
1. Uttar Kashi	48.23	32.69	69.66	50.70	88.26	75.76
2. Chamoli	59.04	43.79	77.07	58.57	94.42	83.52
3. Tehri Garhwal	44.71	33.14	67.06	50.95	86.06	76.11
4. Garhwal	57.37	43.51	75.97	58.38	93.52	83.34
5. Pithorgarh	58.74	43.41	76.88	58.31	94.26	83.28
6. Almora	59.77	44.07	77.54	58.76	94.80	83.70
7. Nainital	60.23	45.40	77.84	59.64	95.05	84.54

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
UTTAR PRADESH (Contd.)						
8. Bijnore	50.46	38.70	71.25	55.06	89.60	80.15
9. Moradabad	55.94	42.09	75.02	57.42	92.74	82.42
10. Budaun	60.49	45.76	78.16	59.87	95.31	84.75
11. Rampur	57.53	46.10	76.08	60.09	93.60	84.96
12. Bareilly	54.79	41.54	74.24	57.04	92.10	82.06
13. Pilbhit	55.78	41.63	74.91	57.10	92.64	82.12
14. Shahjahanpur	56.29	41.66	75.25	57.13	92.93	82.14
15. Dehradun	31.75	22.50	56.52	41.98	76.78	66.90
16. Saharanpur	48.73	36.50	70.02	53.47	88.56	78.60
17. Muzaffarnagar	51.29	36.92	71.83	53.78	90.09	78.90
18. Meerat	44.61	31.86	67.00	49.96	86.00	75.12
19. Bulandshahr	49.14	35.61	70.31	52.82	88.81	77.96
20. Aligarh	47.28	34.03	68.96	51.63	87.68	76.79
21. Mathura	44.69	32.98	67.05	50.83	86.04	75.99
22. Agra	43.61	32.39	66.23	50.37	85.35	75.53
23. Etah	51.29	37.16	71.84	53.95	90.09	79.07
24. Mainpuri	47.49	34.97	69.12	52.34	87.81	77.48
25. Farrukhabad	46.62	34.57	68.49	52.04	87.27	77.19
26. Etawah	43.81	31.34	66.38	49.54	85.48	74.70
27. Kanpur	37.16	26.62	61.14	45.67	80.91	70.75
28. Fatehpur	49.62	36.38	70.65	53.38	89.10	78.51
29. Allahabad	46.74	33.63	68.58	51.33	87.35	76.49
30. Jhansi	46.71	33.64	68.55	51.34	87.32	76.49
31. Jalaun	42.33	30.49	65.25	48.87	84.50	74.02
32. Hamirpur	50.06	36.76	70.96	53.67	89.36	78.79
33. Bonde	51.24	38.04	71.80	54.59	90.06	79.69
34. Kheri	56.80	43.52	75.59	58.39	93.21	83.35
35. Sitapur	54.93	41.54	74.34	57.04	92.17	82.06

TABLE (A.1) (Concluded)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
UTTAR PRADESH (Contd.)						
36. Hardoi	52.49	39.07	72.67	55.32	90.79	80.40
37. Unnao	52.71	38.26	72.82	54.74	90.92	79.84
38. Lucknow	39.28	29.30	62.86	47.91	82.42	73.05
39. Rae Bareli	53.80	38.51	73.57	54.92	91.54	80.02
40. Bahraich	55.89	45.30	74.98	59.57	92.71	84.47
41. Gonda	56.03	42.98	75.08	58.02	92.79	83.00
42. Bara Banki	56.11	43.35	75.14	58.28	92.83	83.24
43. Faizabad	52.62	37.75	72.76	54.38	90.86	79.49
44. Sultanpur	53.43	38.49	73.32	54.91	91.33	80.00
45. Pratapgarh	51.58	36.74	72.04	53.65	90.26	78.77
46. Basti	55.92	41.01	75.01	56.68	92.73	81.71
47. Gorakhpur	50.45	37.26	71.24	54.03	89.60	79.14
48. Deoria	51.96	37.99	72.30	54.55	90.48	79.66
49. Azamgarh	50.20	37.59	71.07	54.26	89.45	79.37
50. Jaunpur	47.20	34.42	68.91	51.93	87.63	77.08
51. Ballia	45.99	35.31	68.02	52.59	86.88	77.74
52. Ghazipur	48.06	37.04	69.53	53.87	88.16	78.99
53. Varanasi	41.25	30.63	64.42	48.99	83.78	74.14
54. Mirzapur	49.10	37.83	70.28	54.44	88.79	79.55
WEST BENGAL	36.56	35.57	58.21	45.74	85.51	72.78
1. Darjeeling	36.50	36.48	58.16	46.32	85.47	73.39
2. Jalpaiguri	46.25	44.91	65.48	51.39	92.49	78.66
3. Cooch Behar	42.99	45.67	63.13	51.82	90.26	79.10
4. West Dinajpur	47.08	45.66	66.06	51.81	93.04	79.09
5. Malda	50.43	50.52	68.37	54.50	95.19	81.81

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
WEST BENGAL (Contd.)						
6. Murshidabad	48.92	49.42	67.34	53.91	94.23	81.21
7. Nadia	39.76	39.18	60.71	48.00	87.94	75.16
8. 24-Parganas	33.73	30.72	55.92	42.50	83.25	69.31
9. Howrah	30.34	28.94	53.03	41.25	80.36	67.94
10. Calcutta	19.05	17.25	42.02	31.85	68.81	57.18
11. Hooghly	32.06	30.81	54.51	42.57	81.85	69.38
12. Burdwan	37.07	35.52	58.62	45.70	85.91	72.74
13. Birbhum	42.26	41.91	62.59	49.64	89.74	76.87
14. Bankura	39.46	40.02	60.48	48.52	87.72	75.71
15. Midnapore	35.38	33.17	57.27	44.17	84.58	71.10
16. Purulia	43.92	42.93	63.81	50.24	90.90	77.49
ARUNACHAL PRADESH	44.11	44.76	68.94	67.08	91.98	89.41
1. Kameng	45.93	46.61	70.39	68.50	93.29	90.68
2. Subansiri	48.27	48.98	72.17	70.22	94.84	92.19
3. Siang	42.26	42.88	67.52	65.70	90.72	88.19
4. Lohit	39.22	39.80	65.05	63.30	96.92	86.02
5. Tirap	43.95	44.60	68.86	67.00	91.92	89.35
CHANDIGARH	13.90	11.30	31.88	27.66	57.31	49.77
DELHI	34.01	26.53	48.34	42.85	73.70	55.53
DADRA AND NAGAR HAVELI	43.58	40.37	52.99	45.34	79.58	65.72
GOA	32.67	26.40	50.69	47.86	85.42	78.57
PONDICHERRY	23.34	18.35	47.86	41.88	67.42	53.52

TABLE (A.2) : Indices of Non-Development of Basic Skill for Boys by Different Age Groups : *Estimates and Classified Ranks, for Districts of India in 1960-61 and 1970-71*

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
INDIA	1.147 (H)	1.000 (M)	1.144 (H)	1.000 (M)	1.113 (H)	1.000 (M)
ANDHRA PRADESH	1.071 (M)	0.977 (M)	1.210 (H)	1.155 (H)	1.169 (VH)	1.146 (H)
1. Srikakulam	1.178 (H)	1.082 (M)	1.268 (VH)	1.216 (H)	1.207 (VH)	1.186 (VH)
2. Vishakhapatnam	1.172 (H)	1.046 (M)	1.265 (VH)	1.195 (H)	1.205 (VH)	1.173 (VH)
3. East Godavari	1.008 (M)	0.898 (M)	1.174 (H)	1.108 (H)	1.146 (H)	1.115 (H)
4. West Godavari	0.916 (M)	0.839 (L)	1.119 (H)	1.070 (M)	1.110 (H)	1.090 (H)
5. Krishna	0.903 (M)	0.815 (L)	1.111 (H)	1.055 (M)	1.105 (H)	1.079 (H)
6. Guntur	0.932 (M)	0.655 (L)	1.128 (H)	0.946 (M)	1.116 (H)	1.004 (H)
7. Ongole	1.024 (M)	0.870 (L)	1.179 (H)	1.090 (H)	1.149 (H)	1.103 (H)
8. Nellore	1.073 (M)	0.770 (L)	1.211 (H)	1.026 (M)	1.170 (VH)	1.059 (H)
9. Chittoor	1.044 (M)	0.837 (L)	1.194 (H)	1.070 (M)	1.160 (VH)	1.089 (H)
10. Cuddapah	1.004 (M)	0.863 (L)	1.171 (H)	1.086 (H)	1.144 (H)	1.100 (H)
11. Anantapur	1.042 (M)	0.920 (M)	1.193 (H)	1.121 (H)	1.159 (VH)	1.124 (H)
12. Kurnool	1.017 (M)	0.921 (M)	1.179 (H)	1.122 (H)	1.150 (VH)	1.124 (H)
13. Mahbubnagar	1.240 (H)	1.020 (M)	1.302 (VH)	1.180 (H)	1.228 (VH)	1.163 (VH)
14. Hyderabad	0.765 (L)	0.416 (VL)	1.022 (M)	0.754 (L)	1.046 (M)	0.863 (L)
15. Medak	1.205 (H)	1.128 (H)	1.283 (VH)	1.242 (H)	1.216 (VH)	1.203 (VH)
16. Nizamabad	1.211 (H)	1.111 (M)	1.286 (H)	1.232 (H)	1.218 (VH)	1.197 (VH)
17. Adilabad	1.294 (H)	1.196 (H)	1.329 (VH)	1.278 (VH)	1.245 (VH)	1.226 (VH)
18. Karimnagar	1.247 (H)	1.154 (H)	1.305 (VH)	1.256 (VH)	1.230 (VH)	1.212 (VH)
19. Warangal	1.197 (H)	1.106 (M)	1.279 (VH)	1.229 (H)	1.214 (VH)	1.195 (VH)
20. Khammam	1.230 (H)	1.130 (H)	1.296 (VH)	1.242 (H)	1.225 (VH)	1.203 (VH)
21. Nalgonda	1.230 (H)	1.131 (H)	1.296 (VH)	1.243 (H)	1.225 (VH)	1.204 (VH)
ASSAM	1.030 (M)	0.992 (M)	1.252 (H)	1.162 (H)	1.157 (VH)	1.110 (H)
1. Goalpara	1.187 (H)	1.133 (H)	1.344 (VH)	1.242 (H)	1.213 (VH)	1.160 (VH)
2. Kamrup	0.987 (M)	0.968 (M)	1.226 (H)	1.147 (H)	1.141 (H)	1.100 (H)
3. Darrang	1.156 (H)	1.133 (H)	1.326 (VH)	1.242 (H)	1.203 (VH)	1.160 (VH)
4. Nowgong	1.050 (M)	0.943 (M)	1.264 (VH)	1.162 (H)	1.165 (VH)	1.110 (H)
5. Sibsagar	0.857 (L)	0.840 (L)	1.142 (H)	1.069 (M)	1.089 (H)	1.049 (H)
6. Lakhimpur	0.965 (M)	0.963 (M)	1.231 (H)	1.145 (H)	1.144 (H)	1.098 (H)
7. Mikir Hills	1.390 (VH)	1.203 (H)	1.456 (EH)	1.279 (VH)	1.280 (EH)	1.183 (VH)
8. North Cachar Hills	1.184 (H)	1.025 (M)	1.344 (VH)	1.181 (H)	1.213 (VH)	1.122 (H)
9. Cachar	0.965 (M)	0.921 (M)	1.212 (H)	1.119 (H)	1.132 (H)	1.082 (H)
10. Mizo	0.669 (L)	0.502 (VL)	1.009 (M)	0.826 (L)	1.002 (M)	0.884 (L)

NB : Interpretation of Ranking Symbols :-

Index of First Phase: Range of Value	Symbol	Index of Second Phase: Range of Value	Symbol	Index of Third Phase: Range of Value	Symbol
1.[illegible]5 and above	EH	1.425 and above	EH	1.250 and above	EH
1.[illegible]5 - 1.625	VH	1.255 - 1.425	VH	1.150 - 1.250	VH
1.[illegible]5 - [illegible].375	H	1.085 - 1.255	H	1.050 - 1.150	H
[illegible] - [illegible].125	M	0.915 - 1.085	M	1.950 - 1.050	M
[illegible] - [illegible].875	L	0.745 - 0.915	L	0.850 - 0.950	L
[illegible] - [illegible].625	VL	0.575 - 0.745	VL	0.750 - 0.850	VL
Be[illegible] [illegible]375	EL	Below 0.575	EL	Below 0.750	EL

[illegible] high; [illegible] high; H : high; M : medium; L : low;

TABLE (A.2) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
BIHAR	1.249 (H)	1.076 (M)	1.265(VH)	1.151 (H)	1.172(VH)	1.103 (H)
1. Patna	0.952 (M)	0.829 (L)	1.104 (H)	1.010 (M)	1.070 (H)	1.011 (M)
2. Gaya	1.213 (H)	1.013 (M)	1.246 (H)	1.117 (H)	1.160(VH)	1.081 (H)
3. Shahabad	1.114 (M)	1.024 (M)	1.194 (H)	1.123 (H)	1.128 (H)	1.085 (H)
4. Saran	1.192 (H)	1.044 (M)	1.235 (H)	1.134 (H)	1.153(VH)	1.092 (H)
5. Champaran	1.429(VH)	1.241 (H)	1.353(VH)	1.236 (H)	1.225(VH)	1.157(VH)
6. Muzaffarpur	1.282 (H)	1.141 (H)	1.281(VH)	1.185 (H)	1.182(VH)	1.124 (H)
7. Darbhanga	1.281 (H)	1.116 (M)	1.281(VH)	1.172 (H)	1.181(VH)	1.116 (H)
8. Monghyr	1.236 (H)	1.072 (M)	1.258(VH)	1.149 (H)	1.168(VH)	1.101 (H)
9. Bhagalpur	1.222 (H)	1.069 (M)	1.251 (H)	1.147 (H)	1.163(VH)	1.100 (H)
10. Saharsa	1.378(VH)	1.191 (H)	1.328(VH)	1.211 (H)	1.210(VH)	1.141 (H)
11. Purnea	1.343 (H)	1.199 (H)	1.311(VH)	1.215 (H)	1.200(VH)	1.143 (H)
12. Santhal Parganas	1.375(VH)	1.184 (H)	1.327(VH)	1.207 (H)	1.210(VH)	1.138 (H)
13. Palamau	1.400(VH)	1.198 (H)	1.339(VH)	1.214 (H)	1.217(VH)	1.143 (H)
14. Hazaribagh	1.368 (H)	1.160 (H)	1.324(VH)	1.195 (H)	1.208(VH)	1.131 (H)
15. Ranchi	1.264 (H)	1.026 (M)	1.272(VH)	1.124 (H)	1.176(VH)	1.085 (H)
16. Dhanbad	1.092 (M)	0.877 (M)	1.182 (H)	1.039 (M)	1.120 (H)	1.030 (M)
17. Singhbhum	1.136 (H)	0.950 (M)	1.206 (H)	1.081 (M)	1.135 (H)	1.058 (H)
GUJARAT	1.089 (M)	1.054 (M)	0.965 (M)	0.847 (L)	1.023 (M)	0.890 (L)
1. Jamnagar	1.212 (H)	1.188 (H)	1.018 (M)	0.899 (L)	1.060 (H)	0.926 (L)
2. Rajkot	1.052 (M)	0.965 (M)	0.949 (M)	0.810 (L)	1.012 (M)	0.864 (L)
3. Surendranagar	1.278 (H)	1.228 (H)	1.046 (M)	0.914 (L)	1.079 (H)	0.937 (L)
4. Bhavnagar	1.161 (H)	1.125 (H)	0.997 (M)	0.875 (L)	1.045 (M)	0.910 (L)
5. Amreli	1.149 (H)	1.123 (M)	0.992 (M)	0.874 (L)	1.042 (M)	0.909 (L)
6. Junagadh	1.236 (H)	1.200 (H)	1.028 (M)	0.904 (L)	1.068 (H)	0.930 (L)
7. Kutch	1.288 (H)	1.303 (H)	1.050 (M)	0.942 (M)	1.082 (H)	0.955 (M)
8. Banaskantha	1.625(EH)	1.685(EH)	1.179 (H)	1.071 (M)	1.170(VH)	1.041 (M)
9. Sabarkantha	1.216 (H)	1.109 (M)	1.020 (M)	0.869 (L)	1.062 (H)	0.905 (L)
10. Mahesana	0.973 (M)	0.948 (M)	0.913 (L)	0.803 (L)	0.986 (M)	0.859 (L)
11. Gandhinagar	0.796 (L)	0.833 (L)	0.825 (L)	0.753 (L)	0.922 (L)	0.823(VL)
12. Ahmedabad	0.789 (L)	0.703 (L)	0.822 (L)	0.692(VL)	0.919 (L)	0.778(VL)
13. Kheda	0.899 (M)	0.796 (L)	0.877 (L)	0.736(VL)	0.960 (M)	0.810(VL)
14. Panchmahals	1.402(VH)	1.408(VH)	1.096 (H)	0.979 (M)	1.114 (H)	0.980 (M)
15. Vadodara	0.965 (M)	0.926 (M)	0.909 (L)	0.794 (L)	0.983 (M)	0.852 (L)
16. Bharuch	0.952 (M)	1.045 (M)	0.903 (L)	0.843 (L)	0.979 (M)	0.888 (L)
17. Surat	0.987 (M)	0.999 (M)	0.919 (M)	0.825 (L)	0.990 (M)	0.874 (L)
18. Valsad	1.031 (M)	1.044 (M)	0.939 (M)	0.843 (L)	1.005 (M)	0.887 (L)
19. The Dangs	1.784(EH)	1.779(EH)	1.236 (H)	1.100 (H)	1.207(VH)	1.060 (H)
HARYANA	1.104 (M)	0.867 (L)	0.991 (M)	0.844 (L)	1.058 (H)	0.909 (L)
1. Ambala	0.922 (M)	0.750 (L)	0.906 (L)	0.786 (L)	0.998 (M)	0.867 (L)
2. Karnal	1.184 (H)	0.944 (M)	1.027 (M)	0.882 (L)	1.085 (H)	0.936 (L)
3. Rohtak	1.047 (M)	0.760 (L)	0.966 (M)	0.792 (L)	1.042 (M)	0.870 (L)
4. Gurgaon	1.072 (M)	0.817 (L)	0.977 (M)	0.821 (L)	1.050 (H)	0.892 (L)
5. Mahendranagar	1.085 (M)	0.796 (L)	0.983 (M)	0.811 (L)	1.054 (H)	0.885 (L)
6. Hisar	1.178 (H)	0.953 (M)	1.024 (M)	0.887 (L)	1.083 (H)	0.939 (L)
7. Jind	1.230 (H)	1.045 (M)	1.047 (M)	0.929 (M)	1.099 (H)	0.968 (M)

TABLE (A.2) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
HIMACHAL PRADESH	1.119 (M)	0.918 (M)	1.031 (M)	0.908 (L)	1.069 (H)	0.953 (M)
1. Chamba	1.384(VH)	1.252 (H)	1.180 (H)	1.063 (M)	1.150(VH)	1.059 (H)
2. Kangra	0.960 (M)	0.795 (L)	0.925 (M)	0.847 (L)	1.012 (M)	0.910 (L)
3. Mandi	1.133 (H)	0.905 (M)	1.068 (M)	0.904 (L)	1.076 (H)	0.950 (M)
4. Kulu	1.301 (H)	1.063 (M)	1.077 (M)	0.980 (M)	1.120 (H)	1.003 (M)
5. Lahul & Spiti	1.133 (H)	1.028 (M)	1.005 (M)	0.963 (M)	1.069 (H)	0.992 (M)
6. Bilaspur	1.096 (M)	0.885 (M)	1.050 (M)	0.894 (L)	1.064 (H)	0.943 (L)
7. Mahasu	1.122 (M)	0.978 (M)	1.062 (M)	0.939 (M)	1.072 (H)	0.975 (M)
8. Simla	0.978 (M)	0.802 (L)	0.980 (M)	0.851 (L)	1.051 (H)	0.913 (L)
9. Sirmaur	1.267 (H)	1.122 (M)	1.129 (H)	1.006 (M)	1.117 (H)	1.021 (M)
10. Kinnaur	1.204 (H)	0.920 (M)	1.100 (H)	0.911 (L)	1.098 (H)	0.955 (M)
JAMMU & KASHMIR	1.399(VH)	1.284 (H)	1.184 (H)	1.074 (M)	1.153(VH)	1.066 (H)
1. Anantanag	1.464(VH)	1.354 (H)	1.214 (H)	1.105 (H)	1.172(VH)	1.087 (H)
2. Srinagar	1.320 (H)	1.225 (H)	1.152 (H)	1.051 (M)	1.132 (H)	1.051 (H)
3. Baramula	1.470(VH)	1.412(VH)	1.216 (H)	1.129 (H)	1.174(VH)	1.102 (H)
4. Ladakh	1.430(VH)	1.386(VH)	1.199 (H)	1.118 (H)	1.163(VH)	1.096 (H)
5. Doda	1.446(VH)	1.385(VH)	1.206 (H)	1.118 (H)	1.167(VH)	1.095 (H)
6. Udhampur	1.461(VH)	1.374 (H)	1.212 (H)	1.113 (H)	1.171(VH)	1.092 (H)
7. Jammu	1.219 (H)	1.005 (M)	1.107 (H)	0.952 (M)	1.102 (H)	0.984 (M)
8. Kathua	1.379(VH)	1.206 (H)	1.178 (H)	1.043 (M)	1.149 (H)	1.046 (M)
9. Rajauri	1.521(VH)	1.385(VH)	1.228 (H)	1.118 (H)	1.184(VH)	1.095 (H)
10. Punch	1.473(VH)	1.362 (H)	1.197 (H)	1.108 (H)	1.162(VH)	1.089 (H)
KARNATAKA	1.043 (M)	0.969 (M)	1.085 (H)	1.048 (M)	1.118 (H)	1.043 (M)
1. Bangalore	0.861 (L)	0.746 (L)	0.986 (M)	0.920 (M)	1.049 (M)	0.956 (M)
2. Belgaum	1.005 (M)	0.949 (M)	1.065 (M)	1.037 (M)	1.104 (H)	1.036 (M)
3. Bellary	1.130 (H)	1.114 (M)	1.130 (H)	1.124 (H)	1.149 (H)	1.092 (H)
4. Bidur	1.307 (H)	1.215 (H)	1.215 (H)	1.174 (H)	1.206(VH)	1.124 (H)
5. Bijapur	1.002 (M)	0.999 (M)	1.064 (M)	1.064 (M)	1.103 (H)	1.053 (H)
6. Chikmagalur	1.011 (M)	0.917 (M)	1.068 (M)	1.020 (M)	1.107 (H)	1.024 (M)
7. Chitradurga	1.028 (M)	0.960 (M)	1.077 (M)	1.044 (M)	1.113 (H)	1.040 (M)
8. Coorg	0.883 (M)	0.772 (L)	0.999 (M)	0.936 (M)	1.058 (H)	0.967 (M)
9. Dharwar	0.797 (L)	0.748 (L)	0.949 (M)	0.921 (M)	1.023 (M)	0.956 (M)
10. Gulbarga	1.304 (H)	1.265 (H)	1.214 (H)	1.198 (H)	1.205(VH)	1.140 (H)
11. Hassan	1.056 (M)	0.981 (M)	1.092 (H)	1.055 (M)	1.123 (H)	1.047 (H)
12. Kolar	1.157 (H)	1.085 (M)	1.143 (H)	1.109 (H)	1.158(VH)	1.083 (H)
13. Mandya	1.254 (H)	1.199 (H)	1.190 (H)	1.166 (H)	1.189(VH)	1.120 (H)
14. Mysore	1.188 (H)	1.163 (H)	1.158 (H)	1.149 (H)	1.168(VH)	1.108 (H)
15. North Kanara	0.885 (M)	0.786 (L)	1.000 (M)	0.944 (M)	1.059 (H)	0.973 (M)
16. Raichur	1.265 (M)	1.216 (H)	1.195 (H)	1.174 (H)	1.193(VH)	1.125 (H)
17. Shimoga	0.996 (M)	0.877 (M)	1.060 (M)	0.997 (M)	1.101 (H)	1.009 (M)
18. South Kanara	0.929 (M)	0.723 (L)	1.024 (M)	0.906 (L)	1.076 (H)	0.946 (L)
19. Tumkur	1.090 (M)	1.008 (M)	1.110 (H)	1.069 (M)	1.135 (H)	1.056 (H)
KERALA	0.662 (L)	0.545(VL)	0.878 (L)	0.769 (L)	1.037 (M)	0.929 (L)
1. Cannanore	0.728 (L)	0.644 (L)	0.920 (M)	0.836 (L)	1.070 (H)	0.982 (M)
2. Kozikode	0.746 (L)	0.568(VL)	0.931 (M)	0.785 (L)	1.079 (H)	0.942 (L)
3. Malappuram	0.782 (L)	0.618(VL)	0.953 (M)	0.819 (L)	1.095 (H)	0.969 (M)
4. Palghat	1.008 (M)	0.894 (M)	1.083 (M)	0.985 (M)	1.193(VH)	1.096 (H)

TABLE (A.2) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
KERALA (CONTD.)						
5. Trichur	0.663 (L)	0.553(VL)	0.878 (L)	0.775 (L)	1.037 (M)	0.934 (L)
6. Ernakulam	0.601(VL)	0.437(VL)	0.836 (L)	0.689(VL)	1.004 (M)	0.864 (L)
7. Kottayam	0.499(VL)	0.396(VL)	0.762 (L)	0.656(VL)	0.944 (L)	0.835(VL)
8. Alleppey	0.469(VL)	0.295(EL)	0.739(VL)	0.566(EL)	0.924 (L)	0.758(VL)
9. Quilon	0.601(VL)	0.444(VL)	0.836 (L)	0.694(VL)	1.004 (M)	0.868 (L)
10. Trivandrum	0.699 (L)	0.486(VL)	0.902 (L)	0.727(VL)	1.056 (H)	0.895 (L)
MADHYA PRADESH	1.420(VH)	1.285 (H)	1.251 (H)	1.162 (H)	1.134 (H)	1.012 (M)
1. Morena	1.497(VH)	1.349 (H)	1.284(VH)	1.191 (H)	1.154(VH)	1.028 (M)
2. Bhind	1.402(VH)	1.227 (H)	1.242 (H)	1.136 (H)	1.129 (H)	0.996 (M)
3. Gwalior	1.142 (H)	0.988 (M)	1.122 (H)	1.019 (M)	1.054 (H)	0.927 (L)
4. Datia	1.481(VH)	1.278 (H)	1.277(VH)	1.159 (H)	1.150(VH)	1.010 (M)
5. Shivpuri	1.606(VH)	1.434(VH)	1.330(VH)	1.228 (H)	1.181(VH)	1.050 (M)
6. Gunna	1.536(VH)	1.424(VH)	1.301(VH)	1.223 (H)	1.164(VH)	1.047 (M)
7. Tikamgarh	1.678(EH)	1.552(VH)	1.360(VH)	1.277(VH)	1.199(VH)	1.078 (H)
8. Chhatarpur	1.627(EH)	1.530(VH)	1.339(VH)	1.268(VH)	1.186(VH)	1.072 (H)
9. Panna	1.627(EH)	1.512(VH)	1.339(VH)	1.261(VH)	1.186(VH)	1.068 (H)
10. Satna	1.437(VH)	1.294 (H)	1.258(VH)	1.166 (H)	1.138 (H)	1.014 (M)
11. Rewa	1.444(VH)	1.323 (H)	1.261(VH)	1.179 (H)	1.140 (H)	1.022 (M)
12. Shahdol	1.643(EH)	1.515(VH)	1.345(VH)	1.262(VH)	1.190(VH)	1.069 (H)
13. Sidhi	1.717(EH)	1.627(EH)	1.375(VH)	1.308(VH)	1.208(VH)	1.095 (H)
14. Mandsaur	1.220 (H)	1.068 (M)	1.159 (H)	1.059 (M)	1.078 (H)	0.951 (M)
15. Ratlam	1.308 (H)	1.211 (H)	1.200 (H)	1.128 (H)	1.103 (H)	0.992 (M)
16. Ujjain	1.240 (H)	1.111 (M)	1.169 (H)	1.080 (M)	1.084 (H)	0.964 (M)
17. Jhabua	1.838(EH)	1.783(EH)	1.423(VH)	1.369(VH)	1.235(VH)	1.129 (H)
18. Dhar	1.551(VH)	1.462(VH)	1.307(VH)	1.239 (H)	1.167(VH)	1.056 (H)
19. Indore	0.874 (L)	0.762 (L)	0.981 (M)	0.895 (L)	0.964 (M)	0.850 (L)
20. Dewas	1.393(VH)	1.264 (H)	1.238 (H)	1.153 (H)	1.126 (H)	1.006 (M)
21. Khargone	1.479(VH)	1.398(VH)	1.276(VH)	1.212 (H)	1.149 (H)	1.041 (M)
22. Khandwa	1.198 (H)	1.127 (H)	1.149 (H)	1.088 (H)	1.071 (H)	0.968 (M)
23. Shajapur	1.506(VH)	1.343 (H)	1.288(VH)	1.188 (H)	1.156(VH)	1.027 (M)
24. Rajgarh	1.668(EH)	1.514(VH)	1.355(VH)	1.261(VH)	1.196(VH)	1.069 (H)
25. Vidisha	1.556(VH)	1.409(VH)	1.309(VH)	1.217 (H)	1.169(VH)	1.044 (M)
26. Sehore	1.345 (H)	1.136 (H)	1.217 (H)	1.093 (H)	1.113 (H)	0.971 (M)
27. Raisen	1.551(VH)	1.407(VH)	1.307(VH)	1.216 (H)	1.168(VH)	1.043 (M)
28. Hoshangabad	1.239 (H)	1.068 (M)	1.168 (H)	1.060 (M)	1.083 (H)	0.952 (M)
29. Betul	1.422(VH)	1.267 (H)	1.251 (H)	1.154 (H)	1.134 (H)	1.007 (M)
30. Sagar	1.339 (H)	1.140 (H)	1.214 (H)	1.095 (H)	1.112 (H)	0.972 (M)
31. Damoh	1.376(VH)	1.242 (H)	1.231 (H)	1.143 (H)	1.122 (H)	1.000 (M)
32. Jabalpur	1.095 (M)	0.968 (M)	1.098 (H)	1.009 (M)	1.039 (M)	0.921 (L)
33. Narsimhapur	1.292 (H)	1.125 (H)	1.193 (H)	1.087 (H)	1.098 (H)	0.968 (M)
34. Mandla	1.504(VH)	1.379(VH)	1.287(VH)	1.204 (H)	1.156(VH)	1.036 (M)
35. Chhindwara	1.446(VH)	1.306 (H)	1.262(VH)	1.172 (H)	1.140 (H)	1.017 (M)
36. Seoni	1.414(VH)	1.311 (H)	1.248 (H)	1.174 (H)	1.132 (H)	1.019 (M)
37. Balaghat	1.252 (H)	1.161 (H)	1.174 (H)	1.104 (H)	1.087 (H)	0.978 (M)
38. Surguja	1.690(EH)	1.578(VH)	1.365(VH)	1.288(VH)	1.202(VH)	1.084 (H)
39. Bilaspur	1.339 (H)	1.208 (H)	1.214 (H)	1.127 (H)	1.112 (H)	0.991 (M)
40. Raigarh	1.470(VH)	1.321 (H)	1.272(VH)	1.178 (H)	1.147 (H)	1.021 (M)
41. Durg	1.366 (H)	1.182 (H)	1.227 (H)	1.115 (H)	1.119 (H)	0.984 (M)
42. Raipur	1.328 (H)	1.190 (H)	1.210 (H)	1.118 (H)	1.109 (H)	0.986 (M)
43. Bastar	1.776(EH)	1.702(EH)	1.399(VH)	1.337(VH)	1.222(VH)	1.111 (H)

TABLE (A.2) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
MAHARASHTRA	1.275 (H)	1.095 (M)	0.965 (M)	0.862 (L)	1.037 (M)	0.901 (L)
1. Greater Bombay	0.586(VL)	0.484(VL)	0.654(VL)	0.573(EL)	0.800(VL)	0.687(EL)
2. Thana	1.304 (H)	1.118 (M)	0.976 (M)	0.871 (L)	1.045 (M)	0.908 (L)
3. Kolaba	1.445(VH)	1.220 (H)	1.027 (M)	0.910 (L)	1.081 (H)	0.934 (L)
4. Ratnagiri	1.272 (H)	1.047 (M)	0.964 (M)	0.843 (L)	1.036 (M)	0.888 (L)
5. Nasik	1.355 (H)	1.180 (H)	0.995 (M)	0.895 (L)	1.058 (H)	0.924 (L)
6. Dhulia	1.413(VH)	1.360 (H)	1.016 (M)	0.961 (M)	1.073 (H)	0.969 (M)
7. Jalgaon	1.058 (M)	0.852 (L)	0.879 (L)	0.761 (L)	0.974 (M)	0.829(VL)
8. Ahmadnagar	1.355 (H)	1.163 (H)	0.995 (M)	0.889 (L)	1.058 (H)	0.920 (L)
9. Poona	1.151 (H)	0.922 (M)	0.917 (M)	0.791 (L)	1.002 (M)	0.851 (L)
10. Satara	1.115 (M)	1.051 (M)	0.902 (L)	0.845 (L)	0.992 (M)	0.889 (L)
11. Sangli	1.280 (H)	1.097 (M)	0.967 (M)	0.863 (L)	1.038 (M)	0.902 (L)
12. Sholapur	1.429(VH)	1.248 (H)	1.021 (M)	0.920 (M)	1.077 (H)	0.941 (L)
13. Kolhapur	1.334 (H)	1.137 (H)	0.987 (M)	0.879 (L)	1.053 (H)	0.913 (L)
14. Aurangabad	1.675(EH)	1.388(VH)	1.106 (H)	0.971 (M)	1.136 (H)	0.975 (M)
15. Parbhani	1.776(EH)	1.561(VH)	1.139 (H)	1.030 (M)	1.158(VH)	1.014 (M)
16. Bhir	1.796(EH)	1.581(VH)	1.145 (H)	1.036 (M)	1.162(VH)	1.019 (M)
17. Nanded	1.790(EH)	1.634(EH)	1.143 (H)	1.053 (M)	1.161(VH)	1.030 (M)
18. Osmanabad	1.709(EH)	1.447(VH)	1.117 (H)	0.991 (M)	1.143 (H)	0.989 (M)
19. Buldhana	1.302 (H)	1.086 (M)	0.975 (M)	0.859 (L)	1.044 (M)	0.899 (L)
20. Akola	1.192 (H)	1.069 (M)	0.933 (M)	0.852 (L)	1.014 (M)	0.894 (L)
21. Amravati	1.160 (H)	1.054 (M)	0.920 (M)	0.846 (L)	1.005 (M)	0.890 (L)
22. Yeotmal	1.475(VH)	1.364 (H)	1.038 (M)	0.962 (M)	1.089 (H)	0.970 (M)
23. Wardha	1.234 (H)	1.046 (M)	0.949 (M)	0.843 (L)	1.026 (M)	0.888 (L)
24. Nagpur	1.095 (M)	0.930 (M)	0.894 (L)	0.794 (L)	0.986 (M)	0.853 (L)
25. Bhandara	1.339 (H)	1.129 (H)	0.989 (M)	0.876 (L)	1.054 (H)	0.910 (L)
26. Chandrapur	1.678(EH)	1.503(VH)	1.107 (H)	1.010 (M)	1.136 (H)	1.002 (M)
MANIPUR	0.655 (L)	0.687 (L)	0.928 (M)	0.916 (M)	0.973 (M)	0.955 (M)
1. Manipur North	0.883 (M)	0.925 (M)	1.080 (M)	1.066 (M)	1.077 (H)	1.057 (H)
2. Manipur West	0.893 (M)	0.936 (M)	1.086 (H)	1.072 (M)	1.081 (H)	1.061 (H)
3. Manipur South	0.676 (L)	0.709 (L)	0.945 (M)	0.932 (M)	0.986 (M)	0.967 (M)
4. Manipur Central	0.627 (L)	0.656 (L)	0.895 (L)	0.883 (L)	0.951 (M)	0.932 (L)
5. Manipur East	0.661 (L)	0.693 (L)	0.934 (M)	0.922 (M)	0.978 (M)	0.959 (M)
MEGHALAYA	1.142 (H)	1.053 (M)	1.317(VH)	1.196 (H)	1.196(VH)	1.131 (H)
1. Garo Hills	1.287 (H)	1.146 (H)	1.399(VH)	1.249 (H)	1.246(VH)	1.164(VH)
2. United Khasi & Jaintia Hills	1.048 (M)	0.990 (M)	1.263(VH)	1.161 (H)	1.164(VH)	1.109 (H)
NAGALAND	0.994 (M)	0.887 (M)	1.136 (H)	1.036 (M)	1.112 (H)	1.035 (M)
1. Kohima	0.900 (M)	0.782 (L)	1.087 (H)	0.979 (M)	1.082 (M)	0.999 (M)
2. Mokokchung	0.784 (L)	0.693 (L)	1.015 (M)	0.922 (M)	1.033 (M)	0.960 (M)
3. Tuensang	1.267 (H)	1.188 (H)	1.290 (H)	1.207 (H)	1.212 (H)	1.148 (H)
ORISSA	1.274 (H)	1.141 (H)	1.413(VH)	1.204 (H)	1.216(VH)	1.154(VH)
1. Sambalpur	1.211 (H)	1.090 (M)	1.378(VH)	1.176 (H)	1.196(VH)	1.136 (H)
2. Sundargarh	1.383(VH)	1.178 (H)	1.472(EH)	1.223 (H)	1.250(EH)	1.166(VH)
3. Keonjhar	1.412(VH)	1.278 (H)	1.487(EH)	1.274(VH)	1.259(EH)	1.198(VH)
4. Mayurbhanj	1.552(VH)	1.380(VH)	1.559(EH)	1.324(VH)	1.299(EH)	1.229(VH)
5. Balasore	0.993 (M)	0.928 (M)	1.247 (H)	1.085 (M)	1.119 (H)	1.077 (H)
6. Cuttack	0.997 (M)	0.874 (L)	1.250 (H)	1.054 (M)	1.121 (H)	1.056 (H)

TABLE (A.2) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
ORISSA (Contd.)						
7. Dhenkanal	1.168 (H)	1.054 (M)	1.353(VH)	1.157 (H)	1.182(VH)	1.124 (H)
8. Baudh Khondmals	1.360 (H)	1.265 (H)	1.460(EH)	1.267(VH)	1.243(VH)	1.194(VH)
9. Bolangir	1.521(VH)	1.280 (H)	1.544(EH)	1.275(VH)	1.290(EH)	1.199(VH)
10. Kalahandi	1.657(EH)	1.490(VH)	1.611(EH)	1.376(VH)	1.288(EH)	1.261(EH)
11. Koraput	1.798(EH)	1.655(EH)	1.678(EH)	1.449(EH)	1.288(EH)	1.287(EH)
12. Ganjam	1.254 (H)	1.153 (H)	1.402(VH)	1.210 (H)	1.210(VH)	1.158(VH)
13. Puri	1.029 (M)	0.874 (L)	1.270(VH)	1.054 (M)	1.133 (H)	1.056 (H)
PUNJAB	1.002 (M)	0.808 (L)	0.943 (M)	0.814 (L)	1.025 (M)	0.886 (L)
1. Gurdaspur	1.021 (M)	0.789 (L)	0.954 (M)	0.804 (L)	1.033 (M)	0.882 (L)
2. Amritsar	0.957 (M)	0.797 (L)	0.923 (M)	0.811 (L)	1.011 (M)	0.885 (L)
3. Firozpur	1.087 (M)	0.924 (M)	0.984 (M)	0.873 (L)	1.055 (H)	0.930 (L)
4. Ludhiana	0.826 (L)	0.650 (L)	0.858 (L)	0.732(VL)	0.962 (M)	0.827(VL)
5. Jullander	0.845 (L)	0.658 (L)	0.868 (L)	0.737(VL)	0.970 (M)	0.830(VL)
6. Kapurthala	0.941 (M)	0.767 (L)	0.916 (M)	0.795 (L)	1.005 (M)	0.874 (L)
7. Hoshiarpur	0.903 (M)	0.621(VL)	0.897 (L)	0.716(VL)	0.991 (M)	0.814(VL)
8. Ropar	0.916 (M)	0.704 (L)	0.904 (L)	0.762 (L)	0.996 (M)	0.849(VL)
9. Patiala	1.051 (M)	0.855 (L)	0.968 (M)	0.840 (L)	1.043 (M)	0.906 (L)
10. Sangrur	1.230 (H)	1.000 (M)	1.047 (M)	0.908 (L)	1.099 (H)	0.954 (M)
11. Bhatinda	1.161 (H)	1.000 (M)	1.017 (M)	0.908 (L)	1.078 (H)	0.954 (M)
RAJASTHAN	1.540(VH)	1.439(VH)	1.261(VH)	1.195 (H)	1.125 (H)	1.029 (M)
1. Ganganagar	1.497(VH)	1.430(VH)	1.244 (H)	1.191 (H)	1.115 (H)	1.027 (M)
2. Bikaner	1.303 (H)	1.272 (H)	1.160 (H)	1.124 (H)	1.064 (H)	0.987 (M)
3. Churu	1.443(VH)	1.439(VH)	1.221 (H)	1.195 (H)	1.101 (H)	1.029 (M)
4. Jhunjhunu	1.349 (H)	1.212 (H)	1.180 (H)	1.097 (H)	1.077 (H)	0.971 (M)
5. Alwar	1.520(VH)	1.398(VH)	1.255(VH)	1.178 (H)	1.120 (H)	1.019 (M)
6. Bharatpur	1.524(VH)	1.424(VH)	1.255(VH)	1.189 (H)	1.122 (H)	1.025 (M)
7. Sawai Madhopur	1.608(VH)	1.515(VH)	1.289(VH)	1.226 (H)	1.142 (H)	1.046 (M)
8. Jaipur	1.443(VH)	1.303 (H)	1.221 (H)	1.137 (H)	1.101 (H)	0.995 (M)
9. Sikar	1.474(VH)	1.348 (H)	1.234 (H)	1.156 (H)	1.109 (H)	1.006 (M)
10. Ajmer	1.225 (H)	1.104 (M)	1.125 (H)	1.047 (M)	1.043 (M)	0.942 (L)
11. Tonk	1.681(EH)	1.569(VH)	1.318(VH)	1.248 (H)	1.159(VH)	1.059 (H)
12. Jaisalmer	1.814(EH)	1.643(EH)	1.369(VH)	1.277(VH)	1.189(VH)	1.075 (H)
13. Jodhpur	1.457(VH)	1.392(VH)	1.227 (H)	1.176 (H)	1.105 (H)	1.017 (M)
14. Nagaur	1.606(VH)	1.568(VH)	1.288(VH)	1.240 (H)	1.141 (H)	1.059 (H)
15. Pali	1.587(VH)	1.488(VH)	1.280(VH)	1.215 (H)	1.137 (H)	1.040 (M)
16. Barmer	1.827(EH)	1.753(EH)	1.374(VH)	1.319(VH)	1.192(VH)	1.099 (H)
17. Jalore	1.800(EH)	1.765(EH)	1.364(VH)	1.323(VH)	1.186(VH)	1.101 (H)
18. Sirohi	1.603(VH)	1.536(VH)	1.287(VH)	1.235 (H)	1.141 (H)	1.051 (H)
19. Bhilwara	1.683(EH)	1.587(VH)	1.319(VH)	1.255(VH)	1.159(VH)	1.063 (H)
20. Udaipur	1.597(VH)	1.497(VH)	1.285(VH)	1.219 (H)	1.139 (H)	1.042 (M)
21. Chittaurgarh	1.613(VH)	1.467(VH)	1.291(VH)	1.207 (H)	1.143 (H)	1.035 (M)
22. Dungarpur	1.704(EH)	1.591(VH)	1.327(VH)	1.256(VH)	1.164(VH)	1.064 (H)
23. Banswara	1.789(EH)	1.683(EH)	1.360(VH)	1.292(VH)	1.183(VH)	1.084 (H)
24. Bundi	1.662(EH)	1.552(VH)	1.310(VH)	1.241 (H)	1.154(VH)	1.055 (H)
25. Kota	1.401(VH)	1.225 (H)	1.203 (H)	1.103 (H)	1.090 (H)	0.975 (M)
26. Jhalawar	1.588(VH)	1.483(VH)	1.281(VH)	1.213 (H)	1.137 (H)	1.039 (M)
TAMIL NADU	0.584(VL)	0.553(VL)	1.006 (M)	0.910 (L)	1.057 (H)	0.864 (L)
1. Madras	0.231(EL)	0.248(EL)	0.633(VL)	0.610(VL)	0.776(VL)	0.661(EL)
2. Chingleput	0.645 (L)	0.554(VL)	1.058 (M)	0.910 (M)	1.092 (H)	0.864 (L)
3. North Arcot	0.688 (L)	0.622(VL)	1.093 (H)	0.965 (L)	1.116 (H)	0.898 (L)

TABLE (A.2) (Contd.)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
TAMIL NADU (Contd.)						
4. South Arcot	0.640 (L)	0.678 (L)	1.054 (M)	1.008 (M)	1.089 (H)	0.924 (L)
5. Dharmapuri	0.879 (M)	0.880 (M)	1.285(VH)	1.148 (H)	1.213(VH)	1.008 (M)
6. Salem	0.700 (L)	0.701 (L)	1.291(VH)	1.024 (M)	1.124 (H)	0.934 (L)
7. Coimbatore	0.602(VL)	0.561(VL)	1.022 (M)	0.916 (M)	1.067 (H)	0.867 (L)
8. Nilgiris	0.531(VL)	0.444(VL)	0.960 (M)	0.816 (L)	1.024 (M)	0.803(VL)
9. Madurai	0.533(VL)	0.500(VL)	0.962 (M)	0.865 (L)	1.025 (M)	0.835(VL)
10. Tiruchirapalli	0.582(VL)	0.562(VL)	1.005 (M)	0.918 (M)	1.055 (H)	0.868 (L)
11. Thanjavur	0.526(VL)	0.532(VL)	0.955 (M)	0.892 (L)	1.020 (M)	0.852 (L)
12. Ramanathpuram	0.530(VL)	0.506(VL)	0.959 (M)	0.870 (L)	1.023 (M)	0.838(VL)
13. Tirunelveli	0.507(VL)	0.466(VL)	0.938 (M)	0.836 (L)	1.008 (M)	0.816(VL)
14. Kanyakumari	0.419(VL)	0.353(EL)	0.853 (L)	0.727(VL)	0.946 (L)	0.743(EL)
TRIPURA	0.904 (M)	0.793 (L)	1.090 (H)	0.986 (M)	1.083 (H)	1.003 (M)
1. West Tripura	0.881 (M)	0.772 (L)	1.076 (M)	0.974 (M)	1.074 (H)	0.995 (M)
2. North Tripura	0.878 (M)	0.769 (L)	1.074 (M)	0.972 (M)	1.073 (H)	0.994 (M)
3. South Tripura	0.978 (M)	0.858 (L)	1.134 (H)	1.026 (M)	1.112 (H)	1.030 (M)
UTTAR PRADESH	1.324 (H)	0.978 (M)	1.274(VH)	0.966 (M)	1.146 (H)	1.012 (M)
1. Uttar Kashi	1.292 (H)	0.875 (M)	1.258(VH)	0.916 (M)	1.136 (H)	0.976 (M)
2. Chamoli	1.581(VH)	1.173 (H)	1.392(VH)	1.058 (M)	1.216(VH)	1.075 (H)
3. Tehri Garhwal	1.197 (H)	0.887 (M)	1.212 (H)	0.920 (M)	1.108 (H)	0.980 (M)
4. Garhwal	1.536(VH)	1.165 (H)	1.373(VH)	1.055 (M)	1.204(VH)	1.073 (H)
5. Pithorgarh	1.573(VH)	1.162 (H)	1.389(VH)	1.054 (M)	1.214(VH)	1.072 (H)
6. Almora	1.601(VH)	1.180 (H)	1.401(VH)	1.062 (M)	1.221(VH)	1.078 (H)
7. Nainital	1.613(VH)	1.216 (H)	1.406(VH)	1.078 (M)	1.224(VH)	1.088 (H)
8. Bijnore	1.351 (H)	1.036 (M)	1.287(VH)	0.995 (M)	1.154(VH)	1.032 (M)
9. Moradabad	1.498(VH)	1.127 (H)	1.355(VH)	1.038 (M)	1.194(VH)	1.061 (H)
10. Budaun	1.620(VH)	1.225 (H)	1.412(VH)	1.082 (M)	1.227(VH)	1.091 (H)
11. Rampur	1.541(VH)	1.234 (H)	1.374(VH)	1.086 (H)	1.205(VH)	1.094 (H)
12. Bareilly	1.467(VH)	1.112 (M)	1.341(VH)	1.031 (M)	1.186(VH)	1.057 (H)
13. Pilbhit	1.494(VH)	1.115 (M)	1.353(VH)	1.032 (M)	1.193(VH)	1.057 (H)
14. Shahjahanpur	1.507(VH)	1.116 (M)	1.360(VH)	1.032 (M)	1.197(VH)	1.058 (H)
15. Dehradun	0.850 (L)	0.603(VL)	1.021 (M)	0.759 (L)	0.989 (M)	0.861 (L)
16. Saharanpur	1.305 (H)	0.978 (M)	1.265(VH)	0.966 (M)	1.140 (H)	1.012 (M)
17. Muzaffarnagar	1.374 (H)	0.989 (M)	1.298(VH)	0.972 (M)	1.160(VH)	1.016 (M)
18. Meerut	1.195 (H)	0.853 (L)	1.210 (H)	0.903 (L)	1.107 (H)	0.967 (M)
19. Bulandshar	1.316 (H)	0.954 (M)	1.270(VH)	0.954 (M)	1.144 (H)	1.004 (M)
20. Aligarh	1.266 (H)	0.911 (M)	1.246 (H)	0.933 (M)	1.129 (H)	0.989 (M)
21. Mathura	1.197 (H)	0.883 (M)	1.211 (H)	0.918 (M)	1.108 (H)	0.978 (M)
22. Agra	1.168 (H)	0.867 (L)	1.197 (H)	0.910 (L)	1.099 (H)	0.973 (M)
23. Etah	1.374 (H)	0.995 (M)	1.298(VH)	0.975 (M)	1.160(VH)	1.018 (M)
24. Mainpuri	1.272 (H)	0.936 (M)	1.249 (H)	0.946 (M)	1.131 (H)	0.998 (M)
25. Farrukhabad	1.249 (H)	0.926 (M)	1.237 (H)	0.940 (M)	1.124 (H)	0.994 (M)
26. Etawah	1.173 (H)	0.839 (L)	1.199 (H)	0.895 (L)	1.101 (H)	0.962 (M)
27. Kanpur	0.995 (M)	0.713 (L)	1.105 (H)	0.825 (L)	1.042 (M)	0.911 (L)
28. Fatehpur	1.329 (H)	0.974 (M)	1.276(VH)	0.964 (M)	1.147 (H)	1.011 (M)
29. Allahabad	1.252 (H)	0.901 (M)	1.239 (H)	0.928 (M)	1.125 (H)	0.985 (M)
30. Jhansi	1.251 (H)	0.901 (M)	1.238 (H)	0.928 (M)	1.124 (H)	0.985 (M)
31. Jalaun	1.134 (H)	0.816 (L)	1.179 (H)	0.883 (L)	1.088 (H)	0.953 (M)
32. Hamirpur	1.341 (H)	0.985 (M)	1.282(VH)	0.970 (M)	1.151(VH)	1.014 (M)
33. Banda	1.372 (H)	1.019 (M)	1.297(VH)	0.986 (M)	1.160(VH)	1.026 (M)
34. Kheri	1.521(VH)	1.166 (H)	1.366(VH)	1.055 (M)	1.200(VH)	1.073 (H)
35. Sitapur	1.471(VH)	1.112 (M)	1.343(VH)	1.031 (M)	1.187(VH)	1.057 (H)
36. Hardoi	1.406(VH)	1.046 (M)	1.313(VH)	0.999 (M)	1.169(VH)	1.035 (M)

TABLE (A.2) (Concluded)

Districts by States and Union Territories	FIRST PHASE Age Group (years) : 5-10		SECOND PHASE Age Group (years) : 10-15		THIRD PHASE Age Group (years) : 15-19	
	1960-61	1970-71	1960-61	1970-71	1960-61	1970-71
(1)	(2)	(3)	(4)	(5)	(6)	(7)
UTTAR PRADESH (Contd.)						
37. Unnao	1.412(VH)	1.024 (M)	1.316(VH)	0.989 (M)	1.171(VH)	1.028 (M)
38. Lucknow	1.052 (M)	0.785 (L)	1.136 (H)	0.866 (L)	1.061 (H)	0.941 (L)
39. Rae Bareli	1.441(VH)	1.031 (M)	1.329(VH)	0.992 (M)	1.179(VH)	1.030 (M)
40. Bahraich	1.497(VH)	1.213 (H)	1.355(VH)	1.076 (M)	1.194(VH)	1.088 (H)
41. Gonda	1.501(VH)	1.151 (H)	1.357(VH)	1.048 (M)	1.195(VH)	1.069 (H)
42. Bara Banki	1.503(VH)	1.161 (H)	1.358(VH)	1.053 (M)	1.195(VH)	1.072 (H)
43. Faizabad	1.409(VH)	1.011 (M)	1.315(VH)	0.982 (M)	1.170(VH)	1.024 (M)
44. Sultanpur	1.431(VH)	1.031 (M)	1.325(VH)	0.992 (M)	1.176(VH)	1.030 (M)
45. Pratapgarh	1.381(VH)	0.984 (M)	1.302(VH)	0.969 (M)	1.162(VH)	1.014 (M)
46. Basti	1.498(VH)	1.098 (M)	1.355(VH)	1.024 (M)	1.194(VH)	1.052 (H)
47. Gorakhpur	1.351 (H)	0.998 (M)	1.287(VH)	0.976 (M)	1.154(VH)	1.019 (M)
48. Deoria	1.392(VH)	1.017 (M)	1.306(VH)	0.986 (M)	1.165(VH)	1.026 (M)
49. Azamgarh	1.344 (H)	1.007 (M)	1.284(VH)	0.980 (M)	1.152(VH)	1.022 (M)
50. Jaunpur	1.264 (H)	0.922 (M)	1.245 (H)	0.938 (M)	1.128 (H)	0.992 (M)
51. Ballia	1.232 (H)	0.946 (M)	1.229 (H)	0.950 (M)	1.119 (H)	1.001 (M)
52. Ghazipur	1.287 (H)	0.992 (M)	1.256(VH)	0.973 (M)	1.135 (H)	1.017 (M)
53. Varanasi	1.105 (M)	0.820 (L)	1.164 (H)	0.885 (L)	1.079 (H)	0.955 (M)
54. Mirazapur	1.315 (H)	1.013 (M)	1.270(VH)	0.984 (M)	1.143 (H)	1.024 (M)
WEST BENGAL	0.979 (M)	0.952 (M)	1.052 (M)	0.826 (L)	1.101 (H)	0.937 (L)
1. Darjeeling	0.978 (M)	0.977 (M)	1.051 (M)	0.837 (L)	1.100 (H)	0.945 (L)
2. Jalpaiguri	1.239 (H)	1.203 (H)	1.183 (H)	0.928 (M)	1.191(VH)	1.013 (M)
3. Cooch Behar	1.151 (H)	1.223 (H)	1.140 (H)	0.936 (M)	1.162(VH)	1.018 (M)
4. West Dinajpur	1.261 (H)	1.222 (H)	1.194 (H)	0.936 (M)	1.198(VH)	1.018 (M)
5. Malda	1.350 (H)	1.353 (H)	1.235 (H)	0.985 (M)	1.226(VH)	1.053 (H)
6. Murshidabad	1.310 (H)	1.324 (H)	1.217 (H)	0.974 (M)	1.213(VH)	1.046 (M)
7. Nadia	1.065 (M)	1.049 (M)	1.097 (H)	0.867 (L)	1.132 (H)	0.968 (M)
8. 24-Parganas	0.903 (M)	0.823 (L)	1.010 (M)	0.768 (L)	1.072 (H)	0.892 (L)
9. Howrah	0.812 (L)	0.775 (L)	0.958 (M)	0.745 (L)	1.035 (M)	0.875 (L)
10. Calcutta	0.510(VL)	0.462(VL)	0.759 (L)	0.575(VL)	0.886 (L)	0.736(EL)
11. Hooghly	0.858 (L)	0.825 (L)	0.985 (M)	0.769 (L)	1.054 (H)	0.893 (L)
12. Burdwan	0.993 (M)	0.951 (M)	1.059 (M)	0.826 (L)	1.106 (H)	0.937 (L)
13. Birbhum	1.132 (H)	1.122 (M)	1.131 (H)	0.897 (L)	1.156(VH)	0.990 (M)
14. Bankura	1.057 (M)	1.072 (M)	1.093 (H)	0.877 (L)	1.130 (H)	0.975 (M)
15. Midnapore	0.947 (M)	0.888 (M)	1.035 (M)	0.798 (L)	1.089 (H)	0.916 (L)
16. Purulia	1.176 (H)	1.150 (H)	1.153 (H)	0.908 (L)	1.170(VH)	0.998 (M)
ARUNACHAL PRADESH	1.181 (H)	1.199 (H)	1.246 (H)	1.212 (H)	1.184(VH)	1.151(VH)
1. Kamong	1.230 (H)	1.248 (H)	1.272(VH)	1.238 (H)	1.201(VH)	1.168(VH)
2. Subansiri	1.293 (H)	1.312 (H)	1.304(VH)	1.269(VH)	1.221(VH)	1.187(VH)
3. Siang	1.132 (H)	1.148 (H)	1.220 (H)	1.187 (H)	1.168(VH)	1.136 (H)
4. Lohit	1.050 (M)	1.066 (M)	1.175 (H)	1.144 (H)	1.248(VH)	1.108 (H)
5. Tirap	1.177 (H)	1.194 (H)	1.244 (H)	1.211 (H)	1.184(VH)	1.150(VH)
CHANDIGARH	0.372(EL)	0.303(EL)	0.576(VL)	0.500(EL)	0.738(EL)	0.641(EL)
DELHI	0.911 (M)	0.711 (L)	0.874 (L)	0.774 (L)	0.949 (L)	0.716(EL)
DADRA & NAGAR HAVELI	1.167 (H)	1.081 (M)	0.958 (M)	0.819 (L)	1.025 (M)	0.846(VL)
GOA	0.875 (M)	0.707 (L)	0.916 (M)	0.865 (L)	1.100 (H)	1.013 (M)
PONDICHERRY	0.625 (L)	0.491(VL)	0.865 (L)	0.757 (L)	0.868 (L)	0.689(EL)

TABLE (A.3) : Indices of the Incidences of Unemployment of Adult Males and Unemployment Percentages by Different Age Groups : Estimates and Classified Ranks for Districts of India in 1960-61 and 1970-71

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
INDIA	0.731 (L)	22.90	1.000 (M)	31.32	0.692 (L)	14.81	1.000 (M)	21.40
ANDHRA PRADESH	0.648(VL)	20.29	0.995 (M)	31.17	0.718 (L)	15.36	1.026 (M)	21.96
1. Srikakulam	0.514(VL)	16.10	1.009 (M)	31.60	0.497(VL)	10.65	1.049 (M)	22.45
2. Vishakhapatnam	0.518(VL)	16.23	0.972 (M)	30.46	0.504(VL)	10.78	0.989 (M)	21.17
3. East Godavari	0.617(VL)	19.33	0.996 (M)	31.19	0.665 (L)	14.23	1.027 (M)	21.98
4. West Godavari	0.724 (L)	22.69	0.978 (M)	30.65	0.858 (M)	18.36	0.999 (M)	21.39
5. Krishna	0.689(VL)	21.57	1.044 (M)	32.75	0.792 (L)	16.94	1.108 (M)	23.72
6. Guntur	0.647(VL)	20.27	1.049 (M)	32.87	0.717 (L)	15.34	1.117 (M)	23.90
7. Ongole	0.695(VL)	21.77	1.063 (M)	33.30	0.803 (L)	17.18	1.140 (M)	24.39
8. Nellore	0.604(VL)	18.94	0.996 (M)	31.21	0.643 (L)	13.77	1.029 (M)	22.01
9. Chittoor	0.494(EL)	15.49	0.917 (M)	28.72	0.467(VL)	10.00	0.901 (M)	19.28
10. Cuddapah	0.475(EL)	14.87	0.962 (M)	30.14	0.438(VL)	9.38	0.973 (M)	20.82
11. Anantapur	0.758 (L)	23.75	1.008 (M)	31.57	0.922 (M)	19.73	1.048 (M)	22.42
12. Kurnool	0.922 (M)	28.87	1.081 (M)	33.86	1.257 (H)	26.90	1.170 (H)	25.05
13. Mahbubnagar	0.846 (L)	26.50	0.950 (M)	29.77	1.097 (M)	23.48	0.954 (M)	20.42
14. Hyderabad	0.732 (L)	22.93	1.188 (H)	37.20	0.872 (M)	18.66	1.359 (H)	29.09
15. Medak	0.782 (L)	24.49	0.910 (M)	28.52	0.968 (M)	20.72	0.891 (M)	19.07
16. Nizamabad	0.616(VL)	19.32	0.969 (M)	30.36	0.664 (L)	14.21	0.984 (M)	21.06
17. Adilabad	0.766 (L)	24.01	0.983 (M)	30.79	0.938 (M)	20.08	1.007 (M)	21.55
18. Karimnagar	0.569(VL)	17.83	0.912 (M)	28.58	0.585 (L)	12.52	0.894 (M)	19.14
19. Warangal	0.496(EL)	15.54	0.930 (M)	29.14	0.470(VL)	10.07	0.922 (M)	19.74
20. Khammam	0.797 (L)	24.98	0.974 (M)	30.52	0.999 (M)	21.38	0.993 (M)	21.25
21. Nalgonda	0.406(EL)	12.73	0.858 (L)	26.87	0.342(VL)	7.33	0.811 (L)	17.35
ASSAM	0.617(VL)	19.33	1.267 (H)	39.70	0.507(VL)	10.84	1.243 (H)	26.59
1. Goalpara	0.662(VL)	20.74	1.235 (H)	38.68	0.529(VL)	11.31	1.191 (H)	25.50
2. Kamrup	0.540(VL)	16.91	1.306(VH)	40.91	0.382(VL)	8.18	1.302 (H)	27.87
3. Darrang	0.531(VL)	16.63	1.204 (H)	37.72	0.372(VL)	7.97	1.144 (M)	24.49
4. Nowgong	0.874 (L)	27.38	1.228 (H)	38.48	0.822 (L)	17.58	1.182 (H)	25.29
5. Sibsagar	0.446(EL)	13.96	1.388(VH)	43.47	0.282(VL)	6.03	1.434 (H)	30.69
6. Lakhimpur	0.312(EL)	9.79	1.331(VH)	41.69	0.160(EL)	3.43	1.342 (H)	28.72
7. Mikir Hills	0.224(EL)	7.03	1.050 (M)	32.89	0.095(EL)	2.03	0.921 (M)	19.70
8. North Cachar Hills	0.867 (L)	27.17	0.848 (L)	26.56	0.812 (L)	17.37	0.656 (L)	14.03
9. Cachar	1.058 (M)	33.14	1.216 (H)	38.10	1.113 (M)	23.82	1.163 (H)	24.89
10. Mizo	1.117 (H)	35.00	1.214 (H)	38.03	1.214 (H)	25.97	1.160 (H)	24.82

* IIU & Rank : Index of the Incidences of Unemployment and Rank.

** U P : Unemployment Percentage.

N.B : Ranking Symbols for Phasewise Indices :-

Index of Fourth Phase: Range of Value	Symbol	Index of Fifth Phase: Range of Value	Symbol
1.50 and above	EH	1.75 and above	EH
1.30 — 1.50	VH	1.45 — 1.75	VH
1.10 — 1.30	H	1.15 — 1.45	H
0.90 — 1.10	M	0.85 — 1.15	M
0.70 — 0.90	L	0.55 — 0.85	L
0.50 — 0.70	VL	0.25 — 0.55	VL
Below 0.50	EL	Below 0.25	EL

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age-Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	U P**	IIU & Rank*	U P**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
BIHAR	0.907 (M)	28.41	1.140 (H)	35.71	0.973 (M)	20.82	1.297 (H)	27.76
1. Patna	1.012 (M)	31.70	1.217 (H)	38.12	1.158 (H)	24.78	1.439 (H)	30.79
2. Gaya	0.962 (M)	30.14	1.239 (H)	38.83	1.069 (M)	22.87	1.481(VH)	31.69
3. Shahabad	1.072 (M)	33.58	1.266 (H)	39.67	1.269 (H)	27.16	1.533(VH)	32.80
4. Saran	1.193 (H)	37.37	1.398(VH)	43.80	1.504(VH)	32.18	1.794(EH)	38.39
5. Champaran	1.075 (M)	33.67	0.965 (M)	30.23	1.275 (H)	27.28	0.995 (M)	21.30
6. Muzaffarpur	1.313(VH)	41.14	1.129 (H)	35.36	1.752(EH)	37.50	1.277 (H)	27.32
7. Darbhanga	1.068 (M)	33.47	1.147 (H)	35.92	1.263 (H)	27.02	1.309 (H)	28.01
8. Monghyr	0.954 (M)	29.87	1.150 (H)	36.02	1.054 (M)	22.56	1.315 (H)	28.13
9. Bhagalpur	0.871 (L)	27.29	1.132 (H)	35.48	0.913 (M)	19.54	1.284 (H)	27.47
10. Saharsa	0.979 (M)	30.66	0.983 (M)	30.79	1.099 (M)	23.51	1.024 (M)	21.93
11. Purnea	0.893 (L)	27.97	0.952 (M)	29.83	0.949 (M)	20.31	0.974 (M)	20.85
12. Santhal Parganas	0.456(EL)	14.29	1.040 (M)	32.57	0.327(VL)	6.99	1.120 (M)	23.98
13. Palamau	0.825 (L)	25.84	1.128 (H)	35.33	0.837 (L)	17.91	1.275 (H)	27.28
14. Hazaribagh	0.610(VL)	19.13	1.209 (H)	37.88	0.519(VL)	11.11	1.424 (H)	30.47
15. Ranchi	0.663(VL)	20.78	1.132 (H)	35.46	0.592 (L)	12.67	1.282 (H)	27.45
16. Dhanbad	0.425(EL)	13.31	0.824 (L)	25.81	0.292(VL)	6.25	0.774 (L)	16.57
17. Singhbhum	0.695(VL)	21.77	1.123 (H)	35.19	0.637 (L)	13.64	1.267 (H)	27.11
GUJARAT	0.667(VL)	20.89	1.009 (M)	31.61	0.586 (L)	12.54	0.871 (M)	18.64
1. Jamnagar	0.610(VL)	19.11	1.048 (M)	32.84	0.509(VL)	10.89	0.926 (M)	19.81
2. Rajkot	0.594(VL)	18.62	1.120 (H)	35.09	0.488(VL)	10.45	1.028 (M)	22.01
3. Surendranagar	0.895 (L)	28.04	1.048 (M)	32.82	0.936 (M)	20.02	0.925 (M)	19.79
4. Bhavnagar	0.588(VL)	18.44	1.108 (H)	34.72	0.481(VL)	10.29	1.011 (M)	21.64
5. Amreli	0.410(EL)	12.86	1.044 (M)	32.70	0.271(VL)	5.80	0.919 (M)	19.68
6. Junagadh	0.520(VL)	16.28	1.051 (M)	32.93	0.395(VL)	8.45	0.930 (M)	19.90
7. Kutch	0.967 (M)	30.29	1.039 (M)	32.56	1.058 (M)	22.63	0.913 (M)	19.55
8. Banaskantha	0.226(EL)	7.07	0.866 (L)	27.13	0.105(EL)	2.25	0.683 (L)	14.63
9. Sabarkantha	0.555(VL)	17.40	1.058 (M)	33.14	0.439(VL)	9.39	0.939 (M)	20.10
10. Mahesana	0.264(EL)	8.27	1.147 (H)	35.92	0.134(EL)	2.88	1.068 (M)	22.85
11. Gandhinagar	0.343(EL)	10.73	0.992 (M)	31.07	0.204(EL)	4.36	0.848 (L)	18.14
12. Ahmedabad	0.592(VL)	18.55	1.008 (M)	31.56	0.485(VL)	10.39	0.869 (M)	18.60
13. Kheda	0.891 (L)	27.92	0.979 (M)	30.68	0.929 (M)	19.89	0.831 (L)	17.78
14. Panchmahals	0.664(VL)	20.81	0.867 (L)	27.16	0.582 (L)	12.47	0.684 (L)	14.65
15. Vadodara	0.797 (L)	24.96	0.904 (M)	28.32	0.778 (L)	16.64	0.732 (L)	15.66
16. Bharuch	0.939 (M)	29.42	0.967 (M)	30.31	1.010 (M)	21.61	0.815 (L)	17.44
17. Surat	0.642(VL)	20.11	0.880 (L)	27.56	0.552 (L)	11.81	0.701 (L)	15.00
18. Valsad	1.047 (M)	32.81	1.099 (M)	34.44	1.201 (H)	25.70	0.998 (M)	21.36
19. The Dangs	0.912 (M)	28.56	0.774 (L)	24.25	0.963 (M)	20.61	0.572 (L)	12.24
HARYANA	0.541(VL)	16.95	0.920 (M)	28.84	0.359(VL)	7.68	1.136 (M)	24.30
1. Ambala	0.370(EL)	11.58	0.813 (L)	25.46	0.182(EL)	3.90	0.924 (M)	19.77
2. Kurnool	0.806 (L)	25.26	0.845 (L)	26.48	0.629 (L)	13.47	0.983 (M)	21.04
3. Rohtak	0.478(EL)	14.97	1.148 (H)	35.96	0.274(VL)	5.86	1.598(VH)	34.20

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HARYANA (Contd.)								
4. Gurgaon	0.446(EL)	13.97	0.948 (M)	29.71	0.246(EL)	5.26	1.180 (H)	25.26
5. Mahendranagar	0.941 (M)	29.48	1.064 (M)	33.34	0.804 (L)	17.21	1.417 (H)	30.33
6. Hisar	0.291(EL)	9.12	0.794 (L)	24.88	0.125(EL)	2.67	0.890 (M)	19.05
7. Jind	0.811 (L)	25.40	0.904 (M)	28.33	0.635 (L)	13.58	1.094 (M)	23.42
HIMACHAL PRADESH	1.089 (M)	34.12	1.206 (H)	37.79	1.406 (H)	30.10	1.594(VH)	34.11
1. Chamba	0.937 (M)	29.37	0.961 (M)	30.10	1.066 (M)	22.82	1.066 (M)	22.82
2. Kangra	1.266 (H)	39.66	1.285 (H)	40.25	1.719(VH)	36.79	1.692(VH)	36.21
3. Mandi	1.122 (H)	35.16	1.220 (H)	38.20	1.419 (H)	30.38	1.558(VH)	33.33
4. Kulu	0.762 (L)	23.88	0.932 (M)	29.20	0.768 (L)	16.43	1.016 (M)	21.75
5. Lahul and Spiti	0.288(EL)	9.02	0.454(EL)	14.21	0.164(EL)	3.50	0.324(VL)	6.93
6. Bilaspur	1.224 (H)	38.34	1.208 (H)	37.84	1.630(VH)	34.88	1.535(VH)	32.85
7. Mahasu	1.005 (M)	31.47	0.969 (M)	30.34	1.190 (H)	25.47	1.080 (M)	23.12
8. Simla	0.834 (L)	26.14	0.967 (M)	30.30	0.886 (M)	18.96	1.078 (M)	23.07
9. Sirmaur	0.697(VL)	21.85	0.692(VL)	21.67	0.666 (L)	14.26	0.633 (L)	13.54
10. Kinnaur	0.436(EL)	13.66	0.651(VL)	20.40	0.316(VL)	6.77	0.575 (L)	12.31
JAMMU & KASHMIR	0.860 (L)	26.94	1.137 (H)	35.61	0.950 (M)	20.33	1.404 (H)	30.05
1. Anantanag	0.902 (M)	28.27	1.020 (M)	31.97	1.004 (M)	21.48	1.174 (H)	25.12
2. Srinagar	0.614(VL)	19.24	1.135 (H)	35.56	0.545(VL)	11.66	1.390 (H)	29.74
3. Baramula	0.789 (L)	24.72	1.006 (M)	31.50	0.811 (L)	17.38	1.146 (M)	24.54
4. Ladakh	0.663(VL)	20.78	1.045 (M)	32.74	0.615 (L)	13.17	1.219 (H)	26.09
5. Doda	0.833 (L)	26.10	1.028 (M)	32.22	0.884 (M)	18.92	1.188 (H)	25.43
6. Udhampur	0.692(VL)	21.67	1.065 (M)	33.37	0.658 (L)	14.07	1.256 (H)	26.89
7. Jammu	1.004 (M)	31.44	1.433(VH)	44.90	1.188 (H)	25.42	2.013(EH)	43.08
8. Kathua	1.064 (M)	33.32	1.283 (H)	40.19	1.303 (H)	27.89	1.688(VH)	36.13
9. Rajauri	1.259 (H)	39.45	1.209 (H)	37.87	1.703(VH)	36.46	1.536(VH)	32.87
10. Punch	1.237 (H)	38.75	1.177 (H)	36.88	1.656(VH)	35.45	1.473(VH)	31.53
KARNATAKA	0.649(VL)	20.33	0.995 (M)	31.17	0.674 (L)	14.42	0.894 (M)	19.13
1. Bangalore	0.324(EL)	10.13	0.995 (M)	31.16	0.223(EL)	4.78	0.894 (M)	19.14
2. Belgaum	0.743 (L)	23.28	0.936 (M)	29.33	0.837 (L)	17.91	0.813 (L)	17.39
3. Bellary	0.778 (L)	24.38	0.945 (M)	29.61	0.900 (M)	19.27	0.825 (L)	17.65
4. Bidar	0.565(VL)	17.71	1.069 (M)	33.50	0.542(VL)	11.59	1.003 (M)	21.47
5. Bijapur	0.769 (L)	24.08	1.000 (M)	31.31	0.883 (M)	18.89	0.902 (M)	19.30
6. Chikmagalur	0.483(EL)	15.13	0.993 (M)	31.10	0.422(VL)	9.03	0.892 (M)	19.09
7. Chitradurga	0.438(EL)	13.74	0.926 (M)	29.01	0.362(VL)	7.75	0.798 (L)	17.09
8. Coorg	0.723 (L)	22.66	0.892 (L)	27.94	0.802 (L)	17.16	0.752 (L)	16.10
9. Dharwar	0.846 (L)	26.49	0.881 (L)	27.60	1.027 (M)	21.98	0.738 (L)	15.79
10. Gulbarga	0.542(VL)	16.97	1.005 (M)	31.49	0.506(VL)	10.83	0.910 (M)	19.47
11. Hassan	0.582(VL)	18.25	1.020 (M)	31.97	0.568 (L)	12.16	0.932 (M)	19.94
12. Kolar	0.701 (L)	21.97	0.922 (M)	28.89	0.763 (L)	16.33	0.793 (L)	16.98
13. Mandya	0.501 (VL)	15.69	0.928 (M)	29.06	0.447(VL)	9.57	0.800 (L)	17.13

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
KARNATAKA (Contd.)								
14. Mysore	0.536(VL)	16.80	0.896 (L)	28.08	0.498(VL)	10.66	0.758 (L)	16.23
15. North Kanara	0.623(VL)	19.53	1.065 (M)	33.36	0.633 (L)	13.54	0.997 (M)	21.34
16. Raichur	0.862 (L)	26.99	0.908 (M)	28.43	1.058 (M)	22.64	0.773 (L)	16.55
17. Shimoga	0.544(VL)	17.04	1.082 (M)	33.89	0.510(VL)	10.91	1.022 (M)	21.87
18. South Kanara	1.045 (M)	32.73	1.336(VH)	41.84	1.437 (H)	30.76	1.429 (H)	30.58
19. Tumkur	0.454(EL)	14.21	0.910 (M)	28.52	0.382(VL)	8.18	0.777 (L)	16.63
KERALA	0.697(VL)	21.83	0.962 (M)	30.14	0.350(VL)	7.49	0.782 (L)	16.74
1. Cannanore	0.529 (L)	16.57	0.917 (M)	28.74	0.225(EL)	4.82	0.726 (L)	15.53
2. Kozikode	0.719 (L)	22.54	0.974 (M)	30.51	0.367(VL)	7.86	0.798 (L)	17.08
3. Malappuram	0.230(EL)	7.22	1.078 (M)	33.77	0.060(EL)	1.29	0.938 (M)	20.07
4. Palghat	0.998 (M)	31.26	0.813 (L)	25.48	0.618 (L)	13.22	0.599 (L)	12.83
5. Trichur	0.913 (M)	28.61	1.170 (H)	36.65	0.536(VL)	11.48	1.068 (M)	22.86
6. Ernakulam	0.593(VL)	18.59	0.920 (M)	28.83	0.270(VL)	5.79	0.730 (L)	15.61
7. Kottayam	0.702 (L)	22.00	0.828 (L)	25.94	0.354(VL)	7.57	0.617 (L)	13.20
8. Alleppey	0.684(VL)	21.43	1.061 (M)	33.23	0.339(VL)	7.26	0.914 (M)	19.56
9. Quilon	0.709 (L)	22.22	0.976 (M)	30.58	0.359(VL)	7.68	0.801 (L)	17.14
10. Trivandrum	0.794 (L)	24.86	0.929 (M)	29.10	0.429(VL)	9.19	0.740 (L)	15.84
MADHYA PRADESH	0.874 (L)	27.38	1.237 (H)	38.75	1.081 (M)	23.13	1.300 (H)	27.82
1. Morena	0.843 (L)	26.42	1.179 (H)	36.93	1.021 (M)	21.86	1.206 (H)	25.80
2. Bhind	1.064 (M)	33.33	1.243 (H)	38.95	1.478(VH)	31.63	1.312 (H)	28.08
3. Gwalior	0.738 (L)	23.12	1.315(VH)	41.20	0.826 (L)	17.68	1.434 (H)	30.70
4. Datia	0.621(VL)	19.45	1.210 (H)	37.89	0.628 (L)	13.44	1.256 (H)	26.87
5. Shivpuri	0.634(VL)	19.88	1.072 (M)	33.59	0.650 (L)	13.91	1.037 (M)	22.19
6. Gunna	0.959 (M)	30.03	1.178 (H)	36.92	1.252 (H)	26.79	1.205 (H)	25.79
7. Tikamgarh	0.714 (L)	22.36	1.131 (H)	35.42	0.784 (L)	16.78	1.128 (M)	24.14
8. Chhatarpur	0.737 (L)	23.09	1.059 (M)	33.16	0.825 (L)	17.65	1.016 (M)	21.75
9. Panna	0.715 (L)	22.39	1.167 (H)	36.55	0.786 (L)	16.81	1.186 (H)	25.37
10. Satna	1.028 (M)	32.19	1.271 (H)	39.82	1.398 (H)	29.91	1.359 (H)	29.08
11. Rewa	1.142 (H)	35.78	1.379(VH)	43.20	1.654(VH)	35.39	1.546(VH)	33.09
12. Shahdol	0.758 (L)	23.73	1.142 (H)	35.77	0.861 (M)	18.43	1.146 (M)	24.52
13. Sidhi	0.994 (M)	31.15	1.207 (H)	37.81	1.326 (H)	28.39	1.251 (H)	26.78
14. Mandsaur	0.928 (M)	29.07	1.197 (H)	37.50	1.189 (H)	25.44	1.235 (H)	26.43
15. Ratlam	0.815 (L)	25.54	1.289 (H)	40.38	0.968 (M)	20.71	1.389 (H)	29.73
16. Ujjain	0.697(VL)	21.84	1.303(VH)	40.82	0.755 (L)	16.16	1.413 (H)	30.24
17. Jhabua	0.465(EL)	14.57	1.329(VH)	41.63	0.397(VL)	8.49	1.458(VH)	31.21
18. Dhar	1.114 (H)	34.90	1.071 (M)	33.55	1.590(VH)	34.03	1.035 (M)	22.15
19. Indore	0.894 (L)	27.99	1.432(VH)	44.85	1.120 (M)	23.96	1.642(VH)	35.13
20. Dewas	0.906 (M)	28.40	1.283 (H)	40.20	1.145 (M)	24.51	1.379 (H)	29.52
21. Khargone	0.937 (M)	29.36	1.256 (H)	39.34	1.207 (H)	25.84	1.333 (H)	28.52
22. Khandwa	0.974 (M)	30.53	1.341(VH)	42.01	1.285 (H)	27.50	1.479(VH)	31.66
23. Shajapur	0.844 (L)	26.43	1.210 (H)	37.91	1.022 (M)	21.88	1.257 (H)	26.89
24. Rajgarh	0.684(VL)	21.43	1.131 (H)	35.44	0.733 (L)	15.68	1.129 (M)	24.16

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MADHYA PRADESH (Contd.)								
25. Vidisha	0.897 (L)	28.11	1.119 (H)	35.05	1.127 (M)	24.13	1.109 (M)	23.74
26. Sehore	0.513(VL)	16.06	1.255 (H)	39.32	0.463(VL)	9.92	1.332 (H)	28.50
27. Raisen	0.910 (M)	28.52	1.193 (H)	37.39	1.153 (H)	24.68	1.229 (H)	26.31
28. Hoshangabad	0.905 (M)	28.35	1.270 (H)	39.78	1.142 (M)	24.45	1.356 (H)	29.03
29. Betul	1.017 (M)	31.85	1.232 (H)	38.59	1.375 (H)	29.42	1.293 (H)	27.67
30. Sagar	0.747 (L)	23.39	1.220 (H)	38.21	0.842 (L)	18.01	1.273 (H)	27.24
31. Damoh	0.855 (L)	26.78	1.272 (H)	39.85	1.043 (M)	22.33	1.360 (H)	29.12
32. Jabalpur	0.760 (L)	23.81	1.350(VH)	42.29	0.866 (M)	18.54	1.495(VH)	32.00
33. Narsimhapur	1.105 (H)	34.61	1.356(VH)	42.48	1.568(VH)	33.56	1.506(VH)	32.23
34. Mandla	1.115 (H)	34.93	1.226 (H)	38.42	1.591(VH)	34.05	1.284 (H)	27.48
35. Chhindwara	0.924 (M)	28.94	1.266 (H)	39.66	1.180 (H)	25.26	1.350 (H)	28.89
36. Seoni	1.022 (M)	32.02	1.226 (H)	38.41	1.386 (H)	29.66	1.283 (H)	27.45
37. Balaghat	0.908 (M)	28.45	1.158 (H)	36.29	1.149 (M)	24.59	1.172 (H)	25.09
38. Surguja	0.328(EL)	10.26	1.035 (M)	32.43	0.227(EL)	4.87	0.980 (M)	20.99
39. Bilaspur	0.962 (M)	30.12	1.240 (H)	38.84	1.258 (H)	26.92	1.306 (H)	27.95
40. Raigarh	0.668(VL)	20.92	1.129 (H)	35.36	0.705 (L)	15.09	1.125 (M)	24.08
41. Durg	1.115 (H)	34.93	1.248 (H)	39.09	1.591(VH)	34.05	1.319 (H)	28.23
42. Raipur	1.040 (M)	32.59	1.290 (H)	40.41	1.426 (H)	30.51	1.391 (H)	29.77
43. Bastar	0.523(VL)	16.39	1.161 (H)	36.36	0.478(VL)	10.24	1.176 (H)	25.17
MAHARASHTRA	0.730 (L)	22.87	0.907 (M)	28.41	0.702 (L)	15.02	0.936 (M)	20.03
1. Greater Bombay	0.004(EL)	0.12	0.287(EL)	8.99	0.000(EL)	0.00	0.150(EL)	3.22
2. Thane	0.470(EL)	14.73	0.762 (L)	23.86	0.349(VL)	7.47	0.710 (L)	15.19
3. Kolaba	1.159 (H)	36.32	1.173 (H)	36.74	1.464(VH)	31.34	1.408 (H)	30.15
4. Ratnagiri	1.345(VH)	42.13	1.334(VH)	41.79	1.854(EH)	39.68	1.728(VH)	36.98
5. Nasik	0.726 (L)	22.75	0.956 (M)	29.95	0.697 (L)	14.91	1.018 (M)	21.78
6. Dhulia	0.965 (M)	30.22	0.981 (M)	30.73	1.094 (M)	23.41	1.060 (M)	22.70
7. Jalgaon	0.908 (M)	28.44	1.054 (M)	33.02	0.993 (M)	21.25	1.189 (H)	25.44
8. Ahmadnagar	0.780 (L)	24.44	0.990 (M)	31.02	0.781 (L)	16.71	1.076 (M)	23.03
9. Poona	0.685(VL)	21.45	1.029 (M)	32.24	0.634 (L)	13.58	1.145 (M)	24.50
10. Satara	0.886(VL)	27.75	1.250 (H)	39.16	0.955 (M)	20.44	1.559(VH)	33.36
11. Sangli	0.863(VL)	27.05	1.002 (M)	31.39	0.917 (M)	19.63	1.097 (M)	23.48
12. Sholapur	0.687(VL)	21.52	0.938 (M)	29.37	0.638 (L)	13.65	0.987 (M)	21.12
13. Kolhapur	0.691(VL)	21.64	0.967 (M)	30.31	0.643 (L)	13.77	1.037 (M)	22.20
14. Aurangabad	0.709 (L)	22.22	0.922 (M)	28.90	0.671 (L)	14.36	0.962 (M)	20.59
15. Parbhani	0.706 (L)	22.11	0.854 (L)	26.76	0.666 (L)	14.25	0.851 (M)	18.22
16. Bhir	0.549(VL)	17.20	0.936 (M)	29.32	0.447(VL)	9.56	0.984 (M)	21.07
17. Nanded	0.603(VL)	18.88	0.894 (L)	28.02	0.518(VL)	11.09	0.916 (M)	19.60
18. Osmanabad	0.550(VL)	17.24	0.956 (M)	29.95	0.449(VL)	9.60	1.018 (M)	21.79
19. Buldhana	1.091 (M)	34.18	0.916 (M)	28.70	1.330 (H)	28.46	0.951 (M)	20.36
20. Akola	1.051 (M)	32.93	0.916 (M)	28.68	1.253 (H)	26.82	0.950 (M)	20.34
21. Amravati	1.061 (M)	33.23	0.918 (M)	28.74	1.271 (H)	27.21	0.954 (M)	20.41
22. Yeotmal	0.937 (M)	29.35	0.853 (L)	26.71	1.044 (M)	22.35	0.849 (L)	18.17
23. Wardha	1.013 (M)	31.73	0.942 (M)	29.52	1.182 (H)	25.29	0.995 (M)	21.29
24. Nagpur	0.337(EL)	10.56	0.989 (M)	30.97	0.206(EL)	4.41	1.074 (M)	22.98
25. Bhandara	0.710 (L)	22.25	0.845 (L)	26.48	0.673 (L)	14.40	0.837 (L)	17.91
26. Chandrapur	0.597(VL)	18.69	0.820 (L)	25.68	0.510(VL)	10.91	0.797 (L)	17.06

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MANIPUR	1.296 (H)	40.61	1.568(EH)	49.13	1.462(VH)	31.29	1.972(EH)	42.21
1. Manipur North	0.899 (L)	28.16	1.308(VH)	40.98	0.813 (L)	17.39	1.476(VH)	31.60
2. Manipur West	1.358(VH)	42.55	1.451(VH)	45.45	1.565(VH)	33.49	1.740(VH)	37.24
3. Manipur South	1.138 (H)	35.65	1.579(EH)	49.46	1.182 (H)	25.29	1.991(EH)	42.60
4. Manipur Central	1.360(VH)	42.59	1.612(EH)	50.50	1.567(VH)	33.54	2.058(EH)	44.03
5. Manipur East	1.404(VH)	43.97	1.540(EH)	48.25	1.649(VH)	35.29	1.913(EH)	40.95
MEGHALAYA	1.250 (H)	39.16	1.136 (H)	35.60	1.451(VH)	31.05	1.045 (M)	22.36
1. Garo Hills	1.234 (H)	38.66	1.198 (H)	37.52	1.421 (H)	30.42	1.135 (M)	24.29
2. United Khasi & Jaintia Hills	1.260 (H)	39.48	1.096 (M)	34.32	1.470(VH)	31.46	0.985 (M)	21.08
NAGALAND	0.499(EL)	15.62	1.080 (M)	33.84	0.348(VL)	7.45	1.104 (M)	23.62
1. Kohima	0.478(EL)	14.98	0.941 (M)	29.48	0.298(VL)	6.38	0.875 (M)	18.72
2. Mokokchung	0.781 (L)	24.47	1.347(VH)	42.19	0.650 (L)	13.91	1.546(VH)	33.09
3. Tuensang	0.252(EL)	7.89	0.970 (M)	30.38	0.108(EL)	2.31	0.918 (M)	19.64
ORISSA	0.691(VL)	21.63	0.900 (M)	28.18	0.757 (L)	16.20	1.074 (M)	22.98
1. Sambalpur	0.115(EL)	3.60	0.678(VL)	21.23	0.044(EL)	0.94	0.685 (L)	14.66
2. Sundargarh	0.108(EL)	3.37	0.853 (L)	26.72	0.039(EL)	0.85	0.986 (M)	21.11
3. Keonjhar	0.796 (L)	24.94	0.934 (M)	29.26	0.949 (M)	20.31	1.140 (M)	24.39
4. Mayurbhanj	0.623(VL)	19.52	0.919 (M)	28.79	0.643 (L)	13.76	1.110 (M)	23.77
5. Balasore	1.021 (M)	31.98	1.064 (M)	33.32	1.409 (H)	30.15	1.401 (H)	29.98
6. Cuttack	1.015 (M)	31.79	1.045 (M)	32.73	1.395 (H)	29.85	1.362 (H)	29.15
7. Dhenkanal	0.676(VL)	21.19	0.903 (M)	28.29	0.733 (L)	15.68	1.080 (M)	23.12
8. Baudh Khondmals	0.341(EL)	10.68	0.745 (L)	23.34	0.247(EL)	5.28	0.796 (L)	17.03
9. Bolangir	0.535(VL)	16.76	0.687(VL)	21.52	0.504(VL)	10.80	0.700 (L)	14.98
10. Kalahandi	0.695(VL)	21.79	0.734 (L)	22.99	0.766 (L)	16.38	0.777 (L)	16.62
11. Koraput	0.333(EL)	10.43	0.694(VL)	21.76	0.238(EL)	5.09	0.712 (L)	15.23
12. Ganjam	0.559(VL)	17.51	1.058 (M)	33.15	0.541(VL)	11.58	1.390 (H)	29.74
13. Puri	0.983 (M)	30.79	0.941 (M)	29.47	1.326 (H)	28.38	1.153 (H)	24.67
PUNJAB	0.738 (L)	23.13	0.657(VL)	20.57	0.568 (L)	12.15	0.674 (L)	14.42
1. Gurdaspur	0.809 (L)	25.35	0.870 (L)	27.26	0.633 (L)	13.55	1.029 (M)	22.03
2. Amritsar	0.788 (L)	24.69	0.646(VL)	20.25	0.607 (L)	12.99	0.642 (L)	13.74
3. Firozpur	0.578(VL)	18.12	0.562(VL)	17.60	0.371(VL)	7.95	0.514(VL)	11.00
4. Ludhiana	0.814 (L)	25.50	0.607(VL)	19.01	0.639 (L)	13.67	0.581 (L)	12.43
5. Jullunder	0.908 (M)	28.44	0.827 (L)	25.90	0.760 (L)	16.26	0.949 (M)	20.32
6. Kapurthala	0.907 (M)	28.42	0.755 (L)	23.65	0.759 (L)	16.24	0.822 (L)	17.58
7. Hoshiarpur	1.070 (M)	33.54	0.893 (L)	27.97	0.987 (M)	21.12	1.072 (M)	22.95
8. Ropar	0.847 (L)	26.53	0.726 (L)	22.75	0.680 (L)	14.55	0.772 (L)	16.53
9. Patiala	0.788 (L)	24.70	0.627(VL)	19.65	0.607 (L)	13.00	0.612 (L)	13.10
10. Sangrur	0.653(VL)	20.45	0.416(EL)	13.03	0.450(VL)	9.63	0.319(VL)	6.82
11. Bhatinda	0.254(EL)	7.95	0.475(EL)	14.89	0.100(EL)	2.15	0.394(VL)	8.44

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
RAJASTHAN	0.831 (L)	26.03	1.393(VH)	43.65	0.986 (M)	21.09	1.727(VH)	36.95
1. Ganganagar	1.070 (M)	33.52	1.379(VH)	43.20	1.472(VH)	31.51	1.698(VH)	36.34
2. Bikaner	0.980 (M)	30.69	1.492(VH)	46.74	1.279 (H)	27.38	1.925(EH)	41.20
3. Churu	0.974 (M)	30.52	1.517(EH)	47.53	1.268 (H)	27.14	1.976(EH)	42.30
4. Jhunjhunu	0.945 (M)	29.61	1.648(EH)	51.62	1.209 (H)	25.88	2.254(EH)	48.23
5. Alwar	0.867 (L)	27.17	1.482(VH)	46.42	1.054 (M)	22.57	1.904(EH)	40.74
6. Bharatpur	0.946 (M)	29.65	1.370(VH)	42.93	1.211 (H)	25.93	1.682(VH)	35.99
7. Sawai Madhopur	0.643(VL)	20.14	1.329(VH)	41.65	0.656 (L)	14.03	1.602(VH)	34.29
8. Jaipur	0.559(VL)	17.51	1.431(VH)	44.82	0.525(VL)	11.23	1.800(EH)	38.53
9. Sikar	0.852 (L)	26.69	1.595(EH)	49.97	1.025 (M)	21.94	2.140(EH)	45.80
10. Ajmer	0.830 (L)	25.99	1.407(VH)	44.07	0.983 (M)	21.03	1.753(EH)	37.52
11. Tonk	0.727 (L)	22.79	1.314(VH)	41.18	0.797 (L)	17.07	1.574(VH)	33.68
12. Jaisalmer	0.446(EL)	13.96	1.235 (H)	38.69	0.366(VL)	7.84	1.426 (H)	30.51
13. Jodhpur	1.056 (M)	33.10	1.434(VH)	44.93	1.443 (H)	30.88	1.808(EH)	38.69
14. Nagaur	1.048 (M)	32.83	1.427(VH)	44.70	1.424 (H)	30.48	1.793(EH)	38.38
15. Pali	0.877 (L)	27.47	1.415(VH)	44.32	1.073 (M)	22.97	1.769(EH)	37.85
16. Barmer	0.758 (L)	23.76	1.237 (H)	38.75	0.852 (M)	18.24	1.429 (H)	30.58
17. Jalore	0.957 (M)	29.99	1.329(VH)	41.64	1.234 (H)	26.40	1.602(VH)	34.28
18. Sirohi	0.954 (M)	29.89	1.418(VH)	44.42	1.227 (H)	26.26	1.775(EH)	37.99
19. Bhilwara	0.559(VL)	17.50	1.097 (M)	34.37	0.524(VL)	11.22	1.181 (H)	25.28
20. Udaipur	0.737 (L)	23.08	1.332(VH)	41.74	0.814 (L)	17.42	1.608(VH)	34.42
21. Chittaurgarh	0.670(VL)	21.00	1.190 (H)	37.28	0.700 (L)	14.99	1.344 (H)	28.76
22. Dungarpur	0.704 (L)	22.06	1.526(EH)	47.81	0.758 (L)	16.21	1.995(EH)	42.69
23. Banswara	0.721 (L)	22.59	1.486(VH)	46.54	0.786 (L)	16.83	1.911(EH)	40.91
24. Bundi	0.733 (L)	22.96	1.272 (H)	39.86	0.807 (L)	17.27	1.495(VH)	31.99
25. Kota	0.617(VL)	19.34	1.362(VH)	42.65	0.615 (L)	13.15	1.664(VH)	35.62
26. Jhalawar	0.739 (L)	23.16	1.328(VH)	41.61	0.818 (L)	17.52	1.600(VH)	34.25
TAMIL NADU	0.527(VL)	16.50	0.937 (M)	29.35	0.392(VL)	8.40	0.638 (L)	13.66
1. Madras	0.962 (M)	30.14	1.179 (H)	36.93	1.021 (M)	21.86	0.919 (M)	19.68
2. Chingleput	0.529(VL)	16.57	0.968 (M)	30.31	0.395(VL)	8.45	0.672 (L)	14.38
3. North Arcot	0.500(VL)	15.65	0.940 (M)	29.44	0.361(VL)	7.72	0.642 (L)	13.73
4. South Arcot	0.505(VL)	15.83	0.875 (L)	27.42	0.367(VL)	7.86	0.573 (L)	12.26
5. Dharmapuri	0.221(EL)	6.93	0.857 (L)	26.85	0.099(EL)	2.12	0.554 (L)	11.86
6. Salem	0.337(EL)	10.55	0.730 (L)	22.88	0.193(EL)	4.12	0.430(VL)	9.20
7. Coimbatore	0.165(EL)	5.17	0.684(VL)	21.42	0.062(EL)	1.33	0.387(VL)	8.29
8. Nilgiris	0.722 (L)	22.62	1.144 (H)	35.83	0.647 (L)	13.86	0.876 (M)	18.76
9. Madurai	0.893 (L)	27.99	0.958 (M)	29.99	0.908 (M)	19.43	0.661 (L)	14.14
10. Tiruchirapalli	0.388(EL)	12.15	0.857 (L)	26.86	0.241(EL)	5.16	0.554 (L)	11.87
11. Thanjavur	0.681(VL)	21.33	0.985 (M)	30.86	0.590 (L)	12.63	0.691 (L)	14.79
12. Ramanathpuram	0.599(VL)	18.78	1.098 (M)	34.40	0.482(VL)	10.31	0.822 (L)	17.58
13. Tirunelveli	0.495(EL)	15.51	1.103 (H)	34.55	0.356(VL)	7.61	0.827 (L)	17.70
14. Kanyakumari	0.669(VL)	20.95	1.191 (H)	37.32	0.573 (L)	12.27	0.935 (M)	20.01

Table (A.3) (Continued)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TRIPURA	0.971 (M)	30.42	1.348(VH)	42.24	0.932 (M)	19.94	1.553(VH)	33.24
1. West Tripura	1.259 (H)	39.44	1.489(VH)	46.64	1.387 (H)	29.69	1.813(EH)	38.81
2. North Tripura	0.869 (L)	27.22	1.264 (H)	39.60	0.770 (L)	16.48	1.398 (H)	29.93
3. South Tripura	0.870 (L)	27.25	1.364(VH)	42.73	0.771 (L)	16.50	1.578(VH)	33.77
UTTAR PRADESH	0.649(VL)	20.33	0.773 (L)	24.22	0.593 (L)	12.69	0.780 (L)	16.70
1. Uttar Kashi	0.085(EL)	2.66	0.115(EL)	3.61	0.023(EL)	0.50	0.038(EL)	0.81
2. Chamoli	0.630(VL)	19.75	0.859 (L)	26.92	0.566 (L)	12.12	0.923 (M)	19.75
3. Tehri Garhwal	0.662(VL)	20.73	1.115 (H)	34.92	0.611 (L)	13.08	1.395 (H)	29.85
4. Garhwal	0.722 (L)	22.61	1.225 (H)	38.38	0.702 (L)	15.02	1.621(VH)	34.69
5. Pithorgarh	1.022 (M)	32.00	1.109 (H)	34.74	1.219 (H)	26.08	1.383 (H)	29.60
6. Almora	0.925 (M)	28.97	1.153 (H)	36.11	1.040 (M)	22.26	1.471(VH)	31.49
7. Nainital	0.114(EL)	3.56	0.563(VL)	17.65	0.037(EL)	0.80	0.472(VL)	10.10
8. Bijnore	0.628(VL)	19.67	0.801 (L)	25.11	0.563 (L)	12.04	0.826 (L)	17.68
9. Moradabad	0.441(EL)	13.83	0.700 (L)	21.95	0.321(VL)	6.88	0.667 (L)	14.28
10. Budaun	0.267(EL)	8.37	0.472(EL)	14.78	0.145(EL)	3.10	0.356(VL)	7.62
11. Rampur	0.365(EL)	11.43	0.567(VL)	17.77	0.237(EL)	5.08	0.477(VL)	10.21
12. Bareilly	0.366(EL)	11.47	0.579(VL)	18.13	0.239(EL)	5.11	0.492(VL)	10.54
13. Pilbhit	0.285(EL)	8.94	0.464(EL)	14.55	0.161(EL)	3.44	0.347(VL)	7.43
14. Shahjahanpur	0.114(EL)	3.58	0.375(EL)	11.76	0.038(EL)	0.80	0.248(EL)	5.30
15. Dehra Dun	0.099(EL)	3.11	0.467(EL)	14.64	0.030(EL)	0.64	0.350(VL)	7.50
16. Saharanpur	0.381(EL)	11.93	0.659(VL)	20.64	0.254(VL)	5.44	0.605 (L)	12.95
17. Muzaffarnagar	0.386(EL)	12.10	0.759 (L)	23.77	0.260(VL)	5.56	0.757 (L)	16.21
18. Meerut	0.437(EL)	13.70	0.857 (L)	26.84	0.317(VL)	6.78	0.918 (M)	19.65
19. Bulandshahr	0.746 (L)	23.38	0.937 (M)	29.36	0.740 (L)	15.84	1.059 (M)	22.66
20. Aligarh	0.787 (L)	24.66	0.853 (L)	26.71	0.806 (L)	17.24	0.911 (M)	19.51
21. Mathura	0.513(VL)	16.06	0.886 (L)	27.75	0.408(VL)	8.73	0.968 (M)	20.73
22. Agra	0.665(VL)	20.84	0.886 (L)	27.75	0.617 (L)	13.20	0.968 (M)	20.72
23. Etah	0.866 (L)	27.14	0.744 (L)	23.30	0.938 (M)	20.08	0.734 (L)	15.70
24. Mainpuri	0.899 (L)	28.18	0.810 (L)	25.37	0.996 (M)	21.31	0.840 (L)	17.97
25. Farrukhabad	0.834 (L)	26.13	0.679(VL)	21.27	0.883 (M)	18.90	0.635 (L)	13.59
26. Etawah	0.917 (M)	28.73	0.873 (L)	27.34	1.026 (M)	21.97	0.946 (M)	20.24
27. Kanpur	0.432(EL)	13.53	0.747 (L)	23.41	0.310(VL)	6.64	0.739 (L)	15.82
28. Fatehpur	0.569(VL)	17.83	0.752 (L)	23.56	0.481(VL)	10.30	0.747 (L)	15.98
29. Allahabad	0.486(EL)	15.22	0.896 (L)	28.07	0.374(VL)	8.01	0.986 (M)	21.11
30. Jhansi	0.437(EL)	13.69	0.818 (L)	25.62	0.316(VL)	6.77	0.853 (M)	18.25
31. Jalaun	0.668(VL)	20.94	0.852 (L)	26.69	0.621 (L)	13.30	0.910 (M)	19.48
32. Hamirpur	0.300(EL)	9.41	0.765 (L)	23.97	0.174(EL)	3.73	0.767 (L)	16.42
33. Banda	0.674(VL)	21.11	0.703 (L)	22.03	0.630 (L)	13.47	0.671 (L)	14.36
34. Kheri	0.097(EL)	3.05	0.324(EL)	10.16	0.029(EL)	0.62	0.196(EL)	4.20
35. Sitapur	0.091(EL)	2.84	0.464(EL)	14.54	0.026(EL)	0.56	0.347(VL)	7.42
36. Hardoi	0.162(EL)	5.06	0.534(VL)	16.72	0.065(EL)	1.40	0.433(VL)	9.27
37. Unnao	0.784 (L)	24.56	0.726 (L)	22.74	0.800 (L)	17.13	0.706 (L)	15.11
38. Lucknow	0.287(EL)	9.00	0.751 (L)	23.52	0.162(EL)	3.48	0.744 (L)	15.94
39. Rae Bareli	0.655(VL)	20.52	0.779 (L)	24.42	0.602 (L)	12.88	0.790 (L)	16.91
40. Bahraich	0.371(EL)	11.63	0.234(EL)	7.32	0.244(EL)	5.23	0.117(EL)	2.50

Table (A.3) (Concluded)

Districts by States and Union Territories	Non-working Adult Males in the Fourth Phase Age Group (Years) : 19-35				Non-working Adult Males in the Fifth Phase Age Group (Years) : 36-60			
	1960-61		1970-71		1960-61		1970-71	
	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**	IIU & Rank*	UP**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UTTAR PRADESH (Contd.)								
41. Gonda	0.473(EL)	14.81	0.411(EL)	12.87	0.358(VL)	7.67	0.286(VL)	6.11
42. Bara Banki	0.549(VL)	17.19	0.421(EL)	13.18	0.454(VL)	9.72	0.297(VL)	6.36
43. Faizabad	0.580(VL)	18.18	0.803 (L)	25.16	0.496(VL)	10.63	0.829 (L)	17.74
44. Sultanpur	0.895 (L)	28.03	0.883 (L)	27.67	0.987 (M)	21.13	0.964 (M)	20.63
45. Pratapgarh	0.810 (L)	25.38	1.070 (M)	33.51	0.843 (L)	18.05	1.307 (H)	27.96
46. Basti	0.383(EL)	12.00	0.550(VL)	17.23	0.257(VL)	5.50	0.454(VL)	9.72
47. Gorakhpur	0.488(EL)	15.29	0.813 (L)	25.48	0.377(VL)	8.07	0.846 (L)	18.10
48. Deoria	0.883 (L)	27.66	0.894 (L)	28.01	0.967 (M)	20.69	0.983 (M)	21.04
49. Azamgarh	0.839 (L)	26.27	1.111 (H)	34.81	0.891 (M)	19.07	1.388 (H)	29.70
50. Jaunpur	0.911 (M)	28.54	1.177 (H)	36.87	1.016 (M)	21.74	1.521(VH)	32.55
51. Ballia	0.965 (M)	30.22	1.142 (H)	35.77	1.113 (M)	23.82	1.449 (H)	31.02
52. Ghazipur	0.855 (L)	26.79	1.080 (M)	33.85	0.919 (M)	19.66	1.328 (H)	28.41
53. Varanasi	0.444(EL)	13.93	0.997 (M)	31.23	0.325(VL)	6.96	1.168 (H)	25.01
54. Mirazapur	0.643(VL)	20.15	0.777 (L)	24.33	0.584 (L)	12.51	0.786 (L)	16.81
WEST BENGAL	0.824 (L)	25.80	1.039 (M)	32.56	0.633 (L)	13.55	0.968 (M)	20.72
1. Darjeeling	0.568(VL)	17.79	1.024 (M)	32.07	0.351(VL)	7.50	0.945 (M)	20.23
2. Jalpaiguri	0.686(VL)	21.50	0.987 (M)	30.92	0.474(VL)	10.14	0.892 (M)	19.09
3. Cooch Behar	0.547(VL)	17.13	0.950 (M)	29.78	0.330(VL)	7.07	0.840 (L)	17.98
4. West Dinajpur	1.185 (H)	37.13	0.965 (M)	30.23	1.129 (M)	24.15	0.860 (M)	18.41
5. Malda	0.945 (M)	29.60	1.075 (M)	33.67	0.787 (L)	16.85	1.021 (M)	21.86
6. Murshidabad	1.090 (M)	34.15	1.147 (H)	35.94	0.988 (M)	21.14	1.133 (M)	24.25
7. Nadia	1.282 (H)	40.15	1.218 (H)	38.14	1.278 (H)	27.34	1.245 (H)	26.65
8. 24-Parganas	0.790 (L)	24.77	1.113 (H)	34.86	0.593 (L)	12.69	1.079 (M)	23.09
9. Howrah	0.639(VL)	20.01	1.028 (M)	32.19	0.423(VL)	9.05	0.951 (M)	20.35
10. Calcutta	0.071(EL)	2.23	0.128(EL)	4.00	0.013(EL)	0.28	0.035(EL)	0.74
11. Hooghly	0.835 (L)	26.16	1.137 (H)	35.63	0.647 (L)	13.85	1.117 (M)	23.91
12. Burdwan	0.752 (L)	23.56	1.066 (M)	33.39	0.548(VL)	11.73	1.008 (M)	21.57
13. Birbhum	1.146 (H)	35.91	1.159 (H)	36.32	1.070 (M)	22.91	1.152 (H)	24.65
14. Bankura	0.926 (M)	29.02	1.161 (H)	36.38	0.763 (L)	16.33	1.155 (H)	24.72
15. Midnapore	1.215 (H)	38.06	1.180 (H)	36.95	1.174 (H)	25.12	1.184 (H)	25.34
16. Purulia	0.064(EL)	2.00	0.978 (M)	30.65	0.011(EL)	0.23	0.880 (M)	18.83
ARUNACHAL PRADESH	0.709 (L)	22.20	0.756 (L)	23.68	0.580 (L)	12.41	0.638 (L)	13.67
1. Kameng	0.347(EL)	10.88	0.405(EL)	12.70	0.179(EL)	3.84	0.230(EL)	4.91
2. Subansiri	0.839 (L)	26.30	0.883 (L)	27.66	0.729 (L)	15.60	0.791 (L)	16.92
3. Siang	0.822 (L)	25.76	0.866 (L)	27.13	0.706 (L)	15.10	0.767 (L)	16.41
4. Lohit	0.537(VL)	16.81	0.588(VL)	18.43	0.358(VL)	7.66	0.415(VL)	8.88
5. Tirap	0.886 (L)	27.77	0.929 (M)	29.09	0.794 (L)	17.00	0.857 (M)	18.33
CHANDIGARH	0.278(EL)	8.72	0.425(EL)	13.32	0.116(EL)	2.49	0.330(VL)	7.06
DELHI	0.771 (L)	24.16	0.534(VL)	16.71	0.262(VL)	5.60	0.271(VL)	5.79
DADRA & NAGAR HAVELI	0.695(VL)	21.77	0.898 (L)	28.14	0.665 (L)	14.24	0.794 (L)	16.98
GOA	0.683(VL)	21.40	1.001 (M)	31.35	0.735 (L)	15.72	0.905 (M)	19.36
PONDICHERRY	0.688(VL)	21.55	0.996 (M)	31.22	0.629 (L)	13.46	0.711 (L)	15.23

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