P. C. Mahalanobis

PAPERS ON PLANNING

P. C. MAHALANOBIS

PAPERS ON PLANNING

Edited by

P. K. BOSE

M. MUKHERJEE

INDIAN STATISTICAL INSTITUTE LIBRARY
106584
No.
16 SEP 1985
Date
CALCUTTA

STATISTICAL PUBLISHING SOCIETY
CALCUTTA

© STATISTICAL PUBLISHING SOCIETY

First Published : June 1985

338.91 (54)
M214 P

Published by Statistical Publishing Society, 204/1 Barrackpore Trunk Road, Calcutta 700 035
and printed at Eka Press, 204/1 Barrackpore Trunk Road, Calcutta 700 035, India.

PRASANTA CHANDRA MAHALANOBIS
(1893—1972)

FOREWORD

This volume containing 'Papers on Planning' by Prof. P. C. Mahalanobis is being published jointly by the Committee of Management, Mahalanobis Trust and the Statistical Publishing Society.

Mahalanobis Trust Fund was created in June, 1961 by Prof. P. C. Mahalanobis. The first meeting of the Committee of Management which was established under Clause (8.1) of the Trust Deed dated 22nd June, 1961 (Registration No. 6117) was held in October, 1962. It was agreed in the first meeting that the Trustee (Sadharan Brahmo Samaj) would be accountable for all income and management from the date of execution of the management and the Committee of Management would be responsible in respect of its share of the management with effect from the date of formation of the Committee. The Committee of Management was given the responsibility to promote the objects of the Trust. Among other objects, the two main objects were stated as follows :

a) To promote the study and diffusion of the ideals and cultural ideas associated with the life and works of Rammohun Roy and Rabindranath Tagore and to foster the growth of the cultural unity of India and of the whole world,

b) To promote the advancement and dissemination of knowledge of Statistics and other branches of Natural and Social Sciences and Technology for the development of agriculture, industry, arts and crafts, commerce and all other things pertaining to planning for national development of India and welfare of the people of India.

The second meeting of the Committee. i.e. the first meeting of the present Committee of Management was held on May 7, 1982. At its first meeting the Committee of Management decided to print the two publications on Rammohun Roy namely Rammohun Roy and Progressive Movement in India by Dr. J. K. Majumdar and Rammohun O Bharatiya Madhyayuger Sadhana by Pandit Kshiti Mohan Sen Sastri. The two books were duly published in 1982 and 1983. At the meeting of the Committee of Management held on 25th February, 1983, it was decided to reprint 'Shradhyay Smarane—Rabindra Bani' compiled by Prof. P. C. Mahalanobis from

Rabindranath's writings. It was also published in 1983. On the 31st August, 1984 the Committee of Management proposed to publish a Volume Containing 'Papers on Planning' by Prof. P. C. Mahalanobis. The task of editing was entrusted to Prof. P. K. Bose and Prof. M. Mukherjee. The Statistical Publising Society agreed to print the Volume.

Prof. P. C. Mahalanobis took active interest in planning long before independence. The Indian National Congress in the late thirties set up a Planning Board under the Chairmanship of Pandit Jawaharlal Nehru to plan for increasing the pace of economic growth as also to bring about a reduction in inequalities of income and wealth and to raise consumption standard of the people. Netaji Subhas Chandra Bose was then the President of the Congress. This body had produced a plan-document suggesting concrete steps to be taken to save the country from the Vicious Circle of poverty. Prof. Mahalanobis in the early forties created a small cell in the Indian Statistical Institute, Calcutta to study this document at depth and a report was prepared on this document.

From the beginning of the 'Planning Era' in India Prof. Mahalanobis was involved in the process. He delivered a thought provoking address on 'National Income, Investment and National Development' at the National Institute of Sciences, India in October, 1952. In this address he stressed that it would be probably desirable to give immediate attention to increase production to full capacity in both large and small industries and also to increase productivity by all other means such as working 2 or 3 shifts. Even after more than three decades we have not been able to utilise fully the installed capacities of our public sector industries. Prime Minister Jawaharlal Nehru inaugurated the studies relating to planning for national deveopment in the Indian Statistical Institute on 3rd November 1954. The work on economic planning was then organised and carried on with the active collaboration of the Central Statistical Organisation, the Economic Division of the Planning Commission and the Department of the Economic Affairs of the Ministry of Finance. On the basis of four agency Cooperative Studies the 'Draft Plan Frame of the Second Five Year Plan' was prepared. Prof. Mahalanobis was the principal architect.

In the paper on 'The Approach of Operational Research to Planning in India' he stated "It is comparatively easy to prepare plans on paper, the real difficulty lies in implementing them. Suitable instruments and techniques of implementation must be devised to realise the targets. It will be necessary to formulate and give effect to a vast programme of training of personnel at all levels. There will be urgent and continuing need of scientific and technological research oriented towards solving problems of national planning. This is essentially a long range task and it would be necessary to think in terms of 15 or 20 years or more". No attention has been paid to these prophetic words and the net result has been that we have failed to realise the plan targets. Even for implementing 20 point programme initiated by Prime Minister, Indira Gandhi we do not have sufficient trained manpower in the country to work on this scheme.

In this Volume 16 important papers on 'Planning' by Prof. Mahalanobis have been included. The Committee of Management, Mahalanobis Trust feel that these papers are relevant even today and they will help in formulating, implementing and assessing the future five year plans.

We acknowledge with thanks the untiring services rendered by Sri Chitta Bhattacharya and Sri J. Verghese both Deputy Librarians of the Indian Statistical Institute for making photo copies of the original papers; and Sri Asis Kr. Chattopadhyay, Research Scholar, Department of Statistics, Calcutta University for preparing the manuscript and the press copy. We thank most sincerely Sri K. B. Goswami, Adviser and Sri Haradhan Chakraborty, Secretary, Statistical Publishing Society for taking keen interest to publish this volume in time. Finally we record our deep sense of gratitude to Prof. A. Maitra, Director, Indian Statistical Institute and to Sri Abhijit Sen, President, Board of Life Trustees, Statistical Publishing Society for their advice and able guidance in publishing this volume.

P. K. Bose
Chairman
Committee of Management
Mahalanobis Trust

PREFACE*

1.1. The present monograph is a collection of Professor Mahalanobis's principal writings on planning. While Talks on Planning (Asia and SPS, 1961) gives many of these, it misses the most important paper, The Approach of Operational Research to Planning in India. Also, one has to refer original journals for some of the papers included here. The main idea of publishing the compendium is to put in the hands of the reader all his important papers on economic planning. What Prof. Mahalanobis said about planning and economics can largely be gleaned from a perusal of this compendium. We have also sought to make the publication cheap, hoping thereby that many students of statistics and economics could easily procure a copy for his shelf. The paragraphs in the Preface that follow introduce and briefly explain the papers in a logical sequence. The attached list of references tallies with the contents of the volume and forms the major basis of this preface. Some other papers by Professor Mahalanobis and others are, however, briefly covered here; these are mentioned in footnotes at appropriate places.

1.2. Thinking on national planning at a somewhat concrete level started quite early in India, and even in nineteen-twenties, that is, immediately after the Russian revolution, some intellectuals in India came upon the idea of national planning. Notably, M. Visvesvaraya saw quite early that conscious national economic planning was needed for rapid industrial development in India. Subsequently, he proceeded to elaborate a ten year plan, which was not unrealistic, except perhaps on the question of finance of the plan. The leadership of Jawaharlal Nehru as the Chairman of the National Planning Committee (NPC) set up in 1938 gave a great impetus to thinking on planning in the country, and some of the panel reports of the NPC bear close study even today. Though the NPC did not succeed in producing a blue-print of a national plan, it served two very important purposes : the intellectuals in the country got intimately acquainted with notions of planning and the most important political party in the country, to some extent, got committed to a programme of planning. Political upheavals and repressions cut short the

* Based on the papers 'Scientific approach in planning' in Essays on Econometrics and Planning (Mahalanobis 70th Birthday volume), Pergamon and SPS 1964 and 'Professor Mahalanobis' contributions to economics : A condensed survey of research', *Sankhyā*, vol. **35**, Suppt., Dec. 1973 both by the author.

work of the NPC. Public thinking and discussion on planning reached a new tempo in the post-war period because of the release of three important private investigations on the topic : the Gandhian Plan, the Peoples' Plan and the Bombay Plan. In so far as facts and figures presented are concerned, the Bombay Plan prepared by eight leading industrialists of India, was the most realistic. For example, the anticipated rate of growth of national income was 7 per cent in this plan ; the other two plans anticipated double this rate. However, the Gandhian Plan based on the ideas of Mahatma Gandhi and the Peoples' Plan prepared under the auspices of the Indian Federation of Labour, put forward numerous illuminating ideas relating to several aspects of national planning. There were unhappy events in the country immediately before and after the independence and it took some time before Free-India could settle down and launch on planning. Even then, the Planning Commission was set up as early as in 1949 and was preceded by the Industrial Policy Resolution of 1948 which indicated certain ideas on planning. This brief sketch shows that the public opinion in the country was educated so as to be able to receive the idea of national planning with appreciation. The traditional *laissez faire* policy of the Government of India during the British rule did not contribute towards rapid economic development of the country, and it was more or less clear to all sections of the educated public that India's chronic problem of poverty could not be solved unless we have recourse to national economic planning.[1]

1.3. But while the idea of planning was generally accepted, the word 'planning' connoted different notions to different groups of people in the early post-independence period. Even today we are still not very clear on this point though the understanding is getting better day by day. To some extent, this is unavoidable. Economic planning is closely linked with the national policy which is expected to set down our goals in economic, social and political fields and to indicate proximate descriptions of the paths we should follow to attain our goals. The policies should distinguish betweeu our immediate

---

[1] Mahalanobis has summarised Nehru's contributions towards planning as follows: "Under the leadership of Nehru, India has made big advances. He initiated the thinking on planning in India. Through his speeches and through planning committees and the Planning Commission, he has exercised a profound educative influence and made India conscious of the need for national planning. Through the Congress Party and the Government, he has made planning an instrument of national policy on the biggest scale outside the communist countries, and has persuaded India to accept socialism as her goal. He has brought to Indian planning a a full appreciation of the scientific revolution which is transforming the world, a sensitive awareness of human values and cultural traditions, an inherent sense of democracy and an international outlook". (Heralding a new epoch ; A study of Nehru in Talks on Planning, 1961.)

goals from our ultimate goals, and cover not only our short period desiderata but also our more distant perspective. Likewise, spatial dimensions of development should be comprehended along with the temporal dimensions. It will be clearly seen why it is difficult to have unequivocal policy statements in this general field. Firstly, there must be clearly defined agreed goals and then there must be agreement about the path to be followed and measures to be taken for attaining the goals. The system has to cover all our important aspirations in economic, social and political fields. While we have succeeded in setting our tentative targets in so far as our goals are concerned, we are still partly divided about our notions in respect of the efficient paths and measures. It will be appreciated, on the other hand, that clear-cut and accepted policy pronouncements on both goals and paths would have helped us materially in attaining whatever objectives we have collectively set.

1.4. Our difficulties stem partly from our political traditions as well as from the basis of our political power and partly from the vestiges of traditional economic thinking which guided capitalist societies in the past. The basis of our political power as well as our political traditions allow us to be radical but not unduly so. We have accepted the procedure of discussion and persuasion even when we are sure of inherent justice of particular lines of action, knowing fully well that we are eschewing quicker methods and adopting slower ones. In the field of economics, while probably we have steered clear of the *laissez faire* doctrine, we are still very much wedded to Keynesian economics, which does not apply to Indian situation because the type of economy for which the system was developed was quite different from the Indian economy today.

1.5. In this atmosphere of somewhat vague thinking, inadequate formulation of basic issues, and relatively amorphous political alignments, Professor Mahalanobis' advent has been a welcome event. As a scientist, he succeeded quickly in separating essentials from the non-essentials, and developing an interrelated programme of planning which is logically satisfying and unequivocally stated. In this process, he had to sacrifice many details, some of which may be of importance in the context of development planning. It is not possible, however, to comprehend all the complexities of a real economy in a logical system. The process of simplification, which is detrimental to richness of the content, is a necessary step. He was also handicapped by lack of data on several important factors and some of the simplifications were necessary because of this. This was unavoidable in an underdeveloped economy attempting to plan for the first time. In spite of serious difficulties, he succeeded in his pioneering effort towards a concrete formulation of a plan for economic development of India.

1.6. This preface is concerned with a brief descriptive account of his contributions in planning and allied subjects. A summarisation involves a selection of some elements or aspects of the totality of contributions. Since, such selection is essentially subjective, it is quite possible that, in the present write up, I have overplayed some less important aspects of his contribution and underplayed some more important aspects. This contingency, however, is unavoidable.

2. Statistics and planning

2.1. Mahalanobis had an uncanny knack of absorbing a mass of statistical material quickly and locating mistakes in calculations and errors of judgement in the logical scheme of analysis. He had, no doubt, acquired this faculty by not only having had experience of careful scrutiny of thousands of figures in diverse branches of statistics but also from an intimate grasp of the methods used for computation of the figures. Thus apart from a mastery over the science, he had an acute diagnostic ability enabling him to spot the defects, as if intuitively. Perhaps it is this faculty which made him a foremost statistician not only in India but also in the world.

2.2. It is this diagnostic ability which came to his aid when he was drawn into a small group of thinkers on planning selected by Jawaharlal Nehru for shaping India's future development. He was able, within a very short time, to lay his finger on many of the defects from which planning in our country was suffering. But apart from this, he contributed materially to planning in his capacity as a statistician, by ensuring that the planners got the facts and figures needed for planning. He had the foresight in realising that adequate and accurate statistics formed the basis of planning. Since decisions should be based on valid inferences, he thought deeply on the relation between statistical errors and decisions based on estimates subject to errors. In his view, the notion of sampling error is often too narrow from this angle, and large errors may be permissible for certain kinds of decisions. Mahalanobis thus contributed to planning in two distinct fields. Firstly, as the leading statistician of the country, he helped in getting together the bricks out of which plans are made of. And, secondly an accomplished diagnostician, he went beyond the facts and figures to recognise and isolate some of the graver defects in our planning and suggest measures for their remedy.

2.3. To some extent, of course, these two roles were mutually interacting, and one has to be conscious about this in trying to understand Mahalanobis's effective contribution to planning. How is it that a man who has not studied principles of economics in a systematic way could make a material contribution towards formulating the plan for economic development of the country ? This baffling question can be answered only when we remember that as a statistician Mahalanobis was aware of the economic facts of the country better than many economists even before he started thinking on planning. He was, of course, not in favour of the refinements and niceties of deductively arrived economic theories developed in western countries to explain a situation different from ours. He would rather accept the facts about India than adopt or use theories obtained in this manner.[2]

2.4 While Mahalanobis was acquainted with Jawaharlal Nehru for a very long time, he first had long and intimate discussions on planning only in 1940 when Nehru wanted him to prepare a statistical commentary on the NPC reports. Subsequently Nehru maintained an active interest in the development of the Indian Statistical Institute (ISI).

2.5. After the Independence, the Prime Minister depended mostly on Mahalanobis's initiative to develop the organisation of statistics in the country. Mahalanobis started working as the Honorary Statistical Adviser to the Cabinet from February 1949, when a Central Statistical Unit was started in Delhi at his initiative. This unit was converted into the Central Statistical Organisation (CSO) two years later and was entrusted with the task of co-ordination of official statistics and laying down statistical standards. As Honorary Statistical Adviser to the Cabinet, Mahalanobis guided the activities of the CSO in all technical matters from its very inception and even today, this institution, which has grown rapidly, owes much to his technical guidance received in the past. It may also be noted that even earlier, Mahalanobis was instrumental in developing the State Statistical Bureau of West Bengal. The rapid development of official statistics in the country during the post-independence period is very much connected with the history of the CSO and

[2] Some remarks by Mahalanobis on this topic are given below from his, Statistics for economic development, *Journal of Operations Research Society of Japan*, **3**, 3, 1961 : 97-112.

"I may start by saying the sophisticated economic theories, which may be appropriate for advanced countries, had acted for a long time as a formidable thought barrier to economic progress in India". Also "The economic theory of highly developed countries appears to be basically static in character and they are concerned, above all, with the most efficient distribution of the stock of capital and other resources and not with the problems of economic development through an increase in capital accumulation. A theory of the same brand did not help the economic development of India or any other underdeveloped country: it hindered such developments on the other hand," (Mahalanobis, 1959b).

the State Statistical Bureaus, and it may be noted that Mahalanobis was intimately connected with the CSO and also helped to set up as a model, the West Bengal State Statistical Bureau. While the development of official statistics in general is not directly linked with needs of planning, a sound general purpose statistical system is necessary for planning and Mahalanobis materially contributed in this direction.

2.6. Mahalanobis was appointed the Chairman of the National Income Committee in 1949, and this event may be regarded as a corner-stone in the present context. Assimilation of diverse official statistics may not necessarily give a central or national view point to the practitioner. But thinking about national income, in a way, is thinking about the performance of the nation as a whole. While working as the Chairman of the Committee, Mahalanobis became acutely aware of the national problems, national resources and allied matters. It should be pointed out, however, that localised socio-economic surveys conducted by him earlier, including family budget surveys of industrial and rural workers and in particular, a survey of after-effects of the great famine in Bengal in 1943 made him acutely aware of our poverty long before he started thinking on national income. Also, even before this, Mahalanobis undertook some fundamental work in the fields of regional and partial planning. For example, his quantitative work on rainfall and floods have later flowered into the D.V. Project and Hirakud Project on Mahanadi.

2.7. The National Sample Survey (NSS) started at this initiative in 1950 was his answer to the problem of gaps in statistics. The survey is continuing even now and here we have an organisation which can furnish sample estimates of any character quickly depending on our need. In this sampling organisation, the CSO and the State Statistical Bureaus collaborate with one another, and the whole scheme was conceived with vision and foresight. The whole system is conceived in such a way that investigation and processing errors and biases are controlled at all stages, and any data coming out of the system has a built-in guarantee of objectivity.

2.8. Mahalanobis maintained his interest in the NSS throughout its existence. He did not, however, maintain close contact with the routine operations of the survey. On the other hand, he made substantial use of NSS data for his scientific studies on planning and other problems.[3] While

[3] As this preface is concerned with Mahalanobis's contribution to planning, we have not indicated his methodological contributions in the field of use of statistical data. The most important of these in the recent past is his novel idea of fractile graphical analysis. This gives a method of drawing valid inference from survey data of diverse types. In particular, changes in size distribution over time or over regions of some data given in terms of value could be tackled effectively by this method.

making such studies he frequently became conscious about some of the deficiencies of the survey and tried to apply corrective steps to the extent possible. The general idea of the NSS came from him, but in the actual conduct of the survey, his contributions were partial and spasmodic.

2.9. The preceding paragraphs are intended to convey that Mahalanobis was closely connected with the development of operational statistics in the country during the post-independence period. The rapid development in the field owes more to his initiative than to that of any other single person. Secondly, even in this capacity, his work drew him to problems of national development. That is, the types of statistics he had to deal with required his being aware of the needs of planning in the country. Also, his awareness of the planning problems which he got from his association with the Planning Commission enabled him to develop the statistical system in the country keeping the planning needs as the principal objectives.

3. Use of methods of operational research to solve problems of the Indian Second Five Year Plan

3.1. Mahalanobis has made use of some simple mathematical models for studying some aspects of the problems connected with planning. The models enabled him to isolate important sectors of the economy and study their mutual interdependence.[4] This part of the work can best be described as operational research in the field of planning, as he has himself done. The models developed do not follow the tenets of accepted economic theory and hence could not be included in traditional mathematical economics. On the other hand, as the models were developed in an atmosphere of pressing policy needs, much attention could not be paid to develop any refined methods for statistical estimation of the parameters involved. Also, available data in the country were inadequate for application of rigorous procedures of estimation. Consequently, this work should not probably fall under the scope of econometrics.

3.2. While developing the models, Mahalanobis's long experience as a professor of physics came handy. We have stressed so far his background in statistics and his attainments as an applied scientist and diagnostician and ventured to suggest that the concomitance of the two is a major reason for his success as a practical planner; his ability as a physicist, in addition, helped

[4] Mahalanobis' opinion about the use of models in this context is of considerable interest. "I do not think that the models have any permanent value of their own. I have used them as scaffolding to be dismantled as soon as their purpose has been served," (Mahalanobis, 1955b).

him to abstract and concretise his problems and ultimately arrive at reasonable solutions.

3.3. The simple concept of capital output ratio and the fact that the ability of a nation to step up its investment depends on the level of income was given by him in his presidential address to the 37th session of the Indian Science Congress. It will be recalled that in his capacity as the Statistical Adviser to the Central Cabinet, he was brought into contact with the activities of the Planning Commission early in 1949, and in less than one year, he was able to identify and start thinking in terms of some of the basic variables. At the time, he was not in touch with the writings of economists on the topic, and obtained the notions independently. The concept of capital output ratio used by him was conceived as the ratio of investment to the aggregate output resulting directly from the investment activity. He also used an idea of development in all other activities as a consequence of investment in a particular activity and thus tacitly adopted ideas of inter-industrial economics. It is interesting that he turned to capital output ratios again late in his life (Mahalanobis, 1965).

3.4. What is described in India as the single sector model of Mahalanobis is a forward-looking Harrod-Domar type of model. Mahalanobis presented these ideas first in a lecture delivered at the National Institute of Sciences of India in October 1952 (Mahalanobis, 1952). The variables involved in the model are national income (Y_t) and net investment (I_t)[5], where the subscript t stands for time. The two variables are connected by the relations

$$\frac{I_t}{Y_t} = \alpha \qquad \dots \quad (1)$$

$$\frac{Y_{t+1} - Y_t}{I_t} = \beta \qquad \dots \quad (2)$$

where α and β, parameters to be estimated, are described respectively by him as the rate of investment and the income coefficient of investment. The two equations taken together gives the growth path of national income as

$$Y_t = Y_0(1+\alpha\beta)^t \qquad \dots \quad (3)$$

and that of per capita income approximately as

$$y_t = y_0(1+\alpha\beta-\rho)^t \qquad \dots \quad (4)$$

[5] In Mahalanobis's models, the usually accepted definitions of national income, investment and consumer expenditure were systematically used. He always took both national income and investment as 'net', i.e., exclusive of allowances for consumption of fixed capital. He was however, not fully satisfied about this. There could be a more satisfactory concept which would both allow more accurate measurement and be better suited in the context of plan formulation.

where y is per capita income, and ρ the constant rate of growth of population. He used time series data for many countries to work out the α and β coefficients and thus tried to concretise his ideas on the rate of investment and rate of growth of national income in India.

3.5. Simultaneously, by this time as Chairman of the National Income Committee, he was trying to build up estimates of national income and investment for the country. The problem at this stage was just to get a dimensional picture of the levels of national income and investment. But even this dimensional picture was invaluable because this enabled him to have an idea of the base from which we have to start.

3.6. In the two-sector model[6] (Mahalanobis, 1953b) the entire net output of the economy is supposed to be produced in two sectors, one producing all investment goods and the other all consumer goods. Unlike in Marx's scheme, all intermediate goods industries, according to this scheme, are split up between the two sectors such that one could obtain the net output separately for both the sectors, which add up to net national output or national income. It may be recalled that Kalecki also followed this approach. The economy, further, is conceived as closed. The new variable introduced is C_t, such that $Y_t = C_t+I_t$, C_t standing for consumer expenditure in the t-th year. It is then assumed that in the t-th year, the net investment is split up between the two sectors in the ratio $\lambda_c : \lambda_i$, $\lambda_c+\lambda_i = 1$. We then have the following two relations of the type given in equation (2) :

$$\left.\begin{aligned} C_{t+1}-C_t &= \lambda_t\beta_c I_t \\ I_{t+1}-I_t &= \lambda_i\beta_i I_t \end{aligned}\right\} \qquad \ldots \quad (5)$$

where β_c, β_i are reciprocals of sectoral marginal capital output ratios. The above equations lead to

$$Y_t = Y_0\left[\ 1+\alpha_0\ \frac{\lambda_c\beta_c+\lambda_i\beta_i}{\lambda_i\beta_i}\ \{(1+\lambda_i\beta_i)^t-1\}\right] \qquad \ldots \quad (6)$$

where α_0 is I_0/Y_0, giving the pattern of growth of national income over time.

3.7. From actual observations, it has been found that β_i is always smaller than β_c, and as such the above equation shows a higher rate of growth of national income for smaller λ_i for the first few years. But when one takes

[6] A model of exactly this type was developed by Feld'man in the USSR in 1928. A summary of the paper is available in English in Domar's *Essays in the Theory of Economic Growth*. Mahalanobis' work, however, was done independently. "It is interesting to note that the impetus of planning initiated almost identical lines of thinking in the two countries, the USSR and India," (Mahalanobis, 1960b).

a longer time horizon, a larger λ_i systematically gives a higher rate of growth of national income. This model was used as an argument in favour of increasing the allocation of investment in investment goods industries for the Second Five Year Plan. The ratio was of the order of 10 per cent before the plan; and the decision was to raise the ratio to about 33 per cent. Of course, a larger rise would have been desirable for long period ends, but this was not considered to be feasible at the time. The claims of consumer goods industries have to be met and the technological set-up of industries producing capital goods may be such that it is better suited for production of capital goods for the use in consumer goods industries rather than capital goods for capital goods industries. It may take quite some time to introduce drastic change in this set-up. Foreign trade, may, however, come to the aid marginally because one type of capital goods can be exchanged for another type.

3.8. It can be shown from equation (6) that

$$\left|\underset{t\to\infty}{\mathrm{Lt}}\right|\frac{I_t}{Y_t} = \frac{\lambda_i\beta_i}{\lambda_c\beta_c+\lambda_i\beta_i}. \qquad \ldots \quad (7)$$

Some limiting values are given below by way of illustration when $\alpha_0 = 6$ per cent, $\beta_i = 0{\cdot}25$, and $\beta_c = 0{\cdot}50$:

λ_i	$\frac{\lambda_i\beta_i}{\lambda_c\beta_c+\lambda_i\beta_i}$ per cent
0·1	5·3
0·3	17·7
0·5	33·3

Thus when α_0 is higher than the limiting value, the α_t's $\left(\alpha_t = \frac{I_t}{Y_t}\right)$ will gradually decrease until we reach the limiting value. When, however, it is less than the limiting value, an increasing sequence will emerge. One reason of selecting a figure like one-third for λ_i for the Second Plan is that higher values of λ_i would lead to unusually high rates of investment in the limit. In a planned economy, the effort should be to increase α_t deliberately up to a certain level, and the way to do this is to increase λ_i to the extent possible. "It should be also possible to increase the ratios (β_c, β_i) through deliberate planning. Suppose that in the earlier stage of development, a product of an industry has got practically no market, and therefore is of negligible value. At a later stage of development it may, however, be possible to use this waste product as raw material in some other industry which is established by planning. In an economy which is developing harmoniously, a number of such by-products may gradually become useful. Hence the ratio of the value of net output to the value of raw materials would increase because by-products of the type considered above would continue to be sold at negligible prices. An increase in the ability of the machines or of labour to convert the same amount of raw materials into a larger quantity of final product will produce the same effect, price situation remaining the same. A steady increase in β may be, therefore, a characteristic of harmonious development."[7] (Mahalanobis, 1953b).

3.9. J. B. S. Haldane[8] has made some investigations on the maxima of the function given in equation (6). This work, however, is not of practical interest because of one peculiarity of the function. Generally, with realistic values of parameters ($\beta_c > \beta_i$) Y_t at a point of time decreases with increase in λ_i for the first few years, say from year 0 to year T. Then there is a period $T+1$ to $T+\tau$, in which a true maximum exists for each year and can be obtained by following the method given by Haldane. But beyond $T+\tau$ years the function uniformly increases with increase in λ_i. As T and τ are both not very large, and in particular T is small for realistic parameters, the quest of maxima of the function is not very interesting.

3.10. Mahalanobis's single sector and two sector models are to be distinguished from the models developed by Harrod and Domar, which are frequently given by the same expressions. For example, Domar's simplest model (with our notations) is given by

$$\frac{I}{Y} = \alpha \qquad \dots \quad (8)$$

$$\frac{\frac{dY}{dt}}{I} = \beta \qquad \dots \quad (9)$$

which gives

$$Y_t = Y_0 . e^{\alpha\beta t} \qquad \dots \quad (10)$$

[7] Some increase in β has been noticed in manufacturing industries in the USA in the recent past. This may be a result of high and diversified industrialisation. What is possible to achieve by deliberate planning, may also come more automatically when a country reaches an advanced level of industrialisation. Deliberate planning, however, should help in arriving at the position more quickly.

[8] See Haldane, J. B. S. (1955) : The maximization of national income, *Sankhyā*, **16**, 1—2,

This is identical with Mahalanobis's $Y_t = Y_0(1+\alpha\beta)^t$ except for some higher order terms in the expansion $e^{\alpha\beta}$ contributing very little when α and β are small. While Harrod-Domar models seek to describe how an economy moved in the past, and thus explain a phenomenon, Mahalanobis models are essentially forward-looking planning models. Mahalanobis' α thus is not to be likened with propensity to save but with the desire of a democratically formed Government to invest. Similarly, his income coefficient of investment does not seek to explain investment in terms of growth in income and consumption in the past as is done in accelerator theory but is a proximate estimate of the likely increase in income in future for a certain volume of investment, based frequently on analysis of project data of diverse kinds.[9]

3.11. Mahalanobis (1955a, 1955b) next developed what is popularly known as the four sector model for working out the basic dimensions of the Second Five Year Plan of India. This model is to be regarded as an allocation model and not a growth model in the sense the other two are. This model also is the simplest and is an attempt at using scientific principles in solving a very concrete problem of planning placed before him. It was more or less known that the maximum funds available for net investment during the Second Plan period would be of the order of Rs. 5,500 crores. It was also agreed that it would be necessary to provide for 10 to 12 million new people in the labour force during the period. What Mahalanobis did was to accept these two propositions and added a third, a reasonable rate of increase in national income during the period of about 5 per cent per year. He knew also from the two sector model that a reasonable target for investment in investment goods industries would be roughly one-third of the total investment. He, then, put all these in a simple simultaneous equation system and obtained his solution.

3.12. The sectors distinguished by him and the variables and parameters used in summarised below.

	sectors	symbol	new employment	capital needed per worker	total capital needed (3) × (4)	income coefficient of capital	income generated (5) × (6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	investment goods industries	i	n_i	θ_i	$n_i\theta_i$	β_i	$n_i\theta_i\beta_i$
2.	consumer goods industries						
2.1	factory type	1	n_1	θ_1	$n_1\theta_1$	β_1	$n_1\theta_1\beta_1$
2.2	hand type including agriculture	2	n_2	θ_2	$n_2\theta_2$	β_2	$n_2\theta_2\beta_2$
3.	services of all types	3	n_3	θ_3	$n_3\theta_3$	β_3	$n_3\theta_3\beta_3$

[9] See Ott, A. E. (1958): The relation between the accelerator and capital output ratio, Review of Economic Studies, 25(3), No. 68, for a consideration of this topic. It may be added that late in his life, Mahalanobis (1963b) tried to demonstrate that his two sector model could describe the past performance as well.

If N is the total new employment, A is the aggregate net capital formation and E is the aggregate national income generated over the five year plan period, then it is possible to write

$$\left.\begin{aligned} N &= n_i+n_1+n_2+n_3 \\ A &= n_i\theta_i+n_1\theta_1+n_2\theta_2+n_3\theta_3 \\ E &= n_i\theta_i\beta_i+n_1\theta_1\beta_1+n_2\theta_2\beta_2+n_3\theta_3\beta_3 \end{aligned}\right\}. \qquad \ldots \quad (11)$$

Since, N, A and E are taken to be known, and as it is agreed upon that one-third of the total investment will be in the (i) sector, it is possible to solve this simultaneous equation system. Thus, realistic estimates were worked out of the parameters β and θ on the basis of all available evidence, and the equation system was solved giving the broad sectoral allocation of employment, capital investment and increment in national income. The values of parameters and the solution are given below.

sector symbols	values of parameters used		solution		
	β	θ(Rs.)	employment (N) 10^6	investment (A) 10^9 Rs.	income (E) 10^9 Rs.
(1)	(2)	(3)	(4)	(5)	(6)
i	0.20	20,000	0.9	18.5	3.7
1	0.35	8,750	1.1	9.8	3.4
2	1.25	2,500	4.7	11.8	14.7
3	0.45	2,750	4.3	16.0	7.2
total (given)			11.0	56.1	29.0

After getting the solution, the small scale industries (including agriculture) was split up between two sub-sectors, small scale and village industries proper and agriculture on the basis of certain fresh data.[10]

[10] The coefficients adopted for agriculture and household industries were as follows : $\beta_h = 2$, θ_a = Rs. 6250 and θ_h = Rs. 620 when the subscripts h and a respectively stand for the sub-sectors household industries and agriculture. It may be noted that it is not necessary to make an assumption about β_a. The resulting allocation is given below :

sector symbol	investment 10^9 Rs.	increment in	
		income 10^9 Rs.	employment 10^6
a	946	1083	1.58
h	194	387	2.12

3.13. The broad sectoral aggregates were then split up into detailed targets as given in the Draft Plan Frame. For this naturally various supplementary and ancillary considerations were necessary. A trial set of targets for a sector was chosen at first and details about employment, investment and income were aggregated. Then the set was altered on a trial and error basis until it was consistent with the solutions in respect of the sector. This procedure, however, was not followed rigorously. But basically care was taken to ensure that the individual targets within a sector as a whole did not need a higher outlay than was given by the solution and also the aggregate income and employment generated tallied with those given in the solution. Since, not all details were available in respect of all the targets, the procedure sketched here really gave the logical basis of working out detailed targets rather than the actual procedure followed.

3.14. Detailed targets for several industries and services were derived from considerations other than those which were used to obtain the basic solution given in the above table. A rapid expansion of steel industry, for example, was considered necessary because of potential advantages of the country in the field in view of the existence of extensive and rich deposits in the country, the intimate link between the general level of productivity and ability to use machines built out of steel, and shortages of steel felt earlier and consequential drain in the foreign exchange. Similarly for the development of aluminium industry, the need of electricity industry and extreme shortage of copper deposits in the country were the basic considerations. In general, the considerations used for a target, whether relating to a physical product or relating to a service, were given by the experts in the field by way of physical possibilities of increasing output in the case of goods and some assessment of needs of the country in the case of services.[11]

3.15. It may be pointed out that the usefulness of models of this type would depend very much on the accuracy with which the parameters of the model could be estimated. The entire work on the Draft Plan Frame had to

[11] Mahalanobis (1955a) gave particular emphasis to health services. He states (Mahalanobis, 1955b), "Under existing conditions it may take 60 or 70 years to provide one doctor for every two thousand persons in the rural areas on an average..I have thought it desirable, therefore, to include in the Draft Plan Frame a proposal to bring some health service to every home in the country within a reasonable time, possibly in 10 or 15 years (instead of providing an exclusively high quality service to a very small fraction of the population), by establishing two new caders of 2-year and 4-year trained health assistants as a first step to national health service throughout the country. One 6-year trained physician would be in charge of a group of 5 or 6 health assistants...." This scheme would enable placement of one health assistant for every 5 villages in 10 or 15 years at a reasonable cost.

be completed in about four months, and due to this shortage of time the estimates of the parameters used had to be tentative, in spite of the fact that large technical resources were put on the task. But the estimates were undoubtedly the best possible ones under the circumstances. Considerably better estimates, however, could have been worked out, had there been more time.

3.16. Many criticisms[12] of the use of these models spring from a failure to grasp one of their essential features. The models were not devised as a contribution to theoretical economics. They are entirely operational models with a very limited object in view, described earlier. Mahalanobis has taken care to point out this repeatedly. But in spite of this, some of the critics have taken pains to point out the theoretical inadequacies of the models, which admittedly exist. The set up of the four sector model, it may, however, be noted, is similar to the general set up of the linear programming problems, and Mahalanobis's problem with some modifications can be tackled in more generality by means of linear programming.[13] Some of these points are considered in Mahalanobis (1960b).

3.17. According to Mahalanobis, working out a consistent and feasible plan-frame is necessary to planning in a real sense in any country. But this is only a part of the entire complex of social activities which go under the name of planning. There are several conditions and limiting factors which are to be satisfied before it is possible to give effect to a plan of this type. Production of commodities needed to satisfy demand for consumer goods has to be undertaken in the diffused and unorganised sectors of the economy and achieving targets would call for vast organisational effort. Since a rapid rate of development without inflationary effects would depend on this, the ability to produce required amount of consumer goods would constitute a limiting factor. Capacity to invest in any given year will depend, by and large, on the ability of domestic industries to produce capital goods and basic raw materials of various types. Thus the rate of expansion of basic indusies sets down the second limiting factor. Though it is relatively easier to

[12] See Mitra, A. (1957): A note on the Mahalanobis model, *Economic Weekly*; Tsuru, S. (1957): Some theoretical doubts on the plan-frame, *Economic Weekly*, Annual Number, 1957; Chakrabarty, S. (1957): The Mahalanobis model of development planning, *Arthaniti* **1**, No. 1,; Mathur, P. N. (1957): A note on planning in India, *The Indian Economic Journal*, **4**, No. 4; and Sen, A. (1958): A note on the Mahalanobis model of sectoral planning, *Arthaniti*, **1**, No. 2, for some topical critical observations on the Draft Plan Frame.

[13] See Komiya, R. (1959): A note on Professor Mahalanobis' model of Indian economic planning, *Review of Economics and Statistics*, **41**, No. 1, for an attempt at reducing Mahalanobis's problem as one in linear programming.

solve the problem of large-scale production, this limiting factor should be kept in mind. One possible reason why it might be difficult to achieve the desired rate of development is the inability to turn out required number of trained technical and scientific personnel. The problem of trained personnel is also connected with the development of consumer goods production and various services. Thus while labour shortages are unlikely to create any trouble in India in the near future, trained manpower would be a very serious limiting factor. It is possible to work out the financial counterpart of a plan which is feasible in terms of available physical and manpower resources because appropriate fiscal and financial measures needed for its implementation always exist. But the ability to raise resources in financial terms would involve financial and fiscal technicalities and socially and politically feasible measures, and measures which exist theoretically cannot always be implemented in practice. This may be regarded as the fourth limiting factor. Rigidities of the existing administrative system furnish the next important bottleneck. Actual implementation of a plan of this type would call for decentralisation of administrative and financial powers in public enterprises and institutions. Also it will be necessary to have active cooperation between public and private agencies. In general, the entire tone of public administration has to be improved and oriented towards planning for economic development, and until this is done, any satisfactory and logically consistent plan would remain, at best, a theoretical exercise.[14] Finally, in the initial phases of development when large volumes of capital goods and raw materials are to be imported from abroad, foreign exchange difficulties would furnish a

[14] Mahalanobis (1955a) has given considerable thoughts to the problem of improvement of the quality of public services. He has also written quite categorically on this topic :

"Planning on bold lines with a steady expansion of the public sector and advance to a socialistic pattern of economy would require the building up of appropriate admisistrative machinery of a new type at all levels.

"There must be decentralization, on business-like lines, of the day to day management of public enterprises with large delegation of financial, administrative and executive control to develop initiative and responsibility at the periphery so necessary for efficient conduct of business enterprises.

"Attention must be focussed on the implementation of the Plan—on getting things done at the right time—and rules and procedures must, if necessary, be revised to ensure effective action. Secretariat control of the present type must be replaced to a large extent by control by truly autonomous public corporations set up by Government or through the supply of credit by State Banks working under the general guidance of Government in matters of policy.

"Administrative difficulties inherent in the existing Government machinery are likely to prove the greatest obstacle to efficient planning. To overcome such difficulties, large organisational and even constitutional changes may become necessary. The problem is urgent and requires immediate and serious attention."

serious limiting factor and import substitution and export promotion will deserve continued attention.

3.18. In Mahalanobis's words, (1955b) "The logical consistency of the Plan Frame is not a sufficient guarantee of its feasibility in practice. Any one (or two or more in combination) of the ... limiting factors ... can retard progress. However, so far as plan-making is concerned (as distinguished from plan-implementation) all that can be demanded is internal consistency, valid technical reasoning and a correct appreciation of social needs. If the present plan has these merits, then there is only one single issue, namely, whether there is any alternative plan which would eliminate unemployment and poverty more quickly and more effectively; and at the same time, lay foundations for a continuing increase in the level of living in future. If there is no alternative plan which is more satisfactory then the proper policy would be to try to implement the present plan."

4. THE POST PLAN-FRAME PERIOD

4.1. Mahalanobis continued his deliberations on planning even after the Draft Plan Frame and various associated papers were written. His post Draft Plan Fame writings fell generally into four categories : (1) He worked on refining some of his arguments given in the Draft Plan Frame and associated papers. For example, his argument for priority to basic industries were refined, and the question of saving of foreign exchange was explicitly brought out in some of his recent writings. (2) He thought about the importance of technical manpower and educational problems even when he was writing the Draft Plan Frame. But subsequently, he probed more deeply into the subject. As a result of this, he was inclined to think that science had a basic role to play in economic development. He classified types of activities by time taken to start production after the social decision had been taken and tried to explain economic development in a novel way. Development of science, which takes longest time, remains the corner-stone of his explanation. His analysis contained germs of a forward-looking planning theory, and he made some historical analysis to support his observations. (3) Thirdly, Mahalanobis wrote, on the world perspective of the economic development of the pre-industrial countries, and had taken pains to show that rapid development of under-developed areas of the world would help in promoting world peace. He made some analysis of international situation for this, but the theoretical outline considered above also came to his aid.[15] (4) Finally,

[15] Mahalanobis covered these topics in 1958 ; 1959a ; 1959b ; and 1960a. The same topic had sometimes been considered in more than one paper, and as such we refrain from giving detailed references here.

he wrote on the specific problem of industrial labour in India and suggested an interesting solution to our eternal labour troubles and unemployment problem.

4.2. *Priority of basic industries : a re-examination.* Let us consider the case of a country which has to import a given amount of foodgrains every year. The quantity to be imported is obtained in relation to the proximate rate of increase of population and projected estimates of domestic production of foodgrains available for consumption. The requisite quantity of foodgrains has to be purchased at the prevailing world price and hence the cost involved will be the product of the quantity, the world price and the number of years for which the purchases have to be made. Provided the commodity concerned is available in the world market in sufficient quantities, the decision about importing may be taken immediately before the period of consumption. In case it is possible to take decisions earlier, at least by one year, the import of foodgrains may be substituted by import of fertilizers. In India, application of one ton of fertilizer can be expected to produce two extra tons of foodgrains. Since world price of a ton of fertilizer is less than that of a ton of foodgrains, there is considerable saving in foreign exchange in the second variant. The arrangement about distribution will entail administrative measures both in the case of importing foodgrains and in the case of importing fertilizers and the costs involved in the two variants may be of the same order.

4.3. If it is possible to take decision, say, five years before the year of consumption, it is possible to build up fertilizer plants to produce the requisite amount of fertilizer every year by importing necessary machinery from abroad. The foreign exchange requirement of this variant will be considerably less than that in the second variant for any sufficiently long period of years. The distributional problems will remain more or less the same in this case. It should, however, be possible to build up the plant, i.e., raw materials etc., should permit economic exploitation, funds for investment should be available, and there should be no shortages of labour including technical manpower. In India, all these conditions are fulfilled for fertilizer production, and hence construction of fertilizer plants with imported machinery is more economical to the country from the foreign exchange point of view than importing fertilizer from abroad. The overall cost also will be smaller in this variant provided we take a sufficiently long time period into consideration. As labour is relatively cheap, raw materials are available in the country and trade margins and transport costs are likely to be lower, the price of domestically produced fertilizers should be lower than the price of imported fertilizer.

4.4. The last alternative is to build up the capacity to produce machines in the country and then produce fertilizer plants of requisite capacity with domestically produced machines. This will require decisions to be taken at least some ten or fifteen years before the year from which additional consumption is needed because machine building industry has to be developed first and then the fertilizer plant has to be set up. Also since, an integrated plant for building fertilizer plants may not be economical, it may be necessary to build up a complex of machine building industries producing not only fertilizer plants but also other plants. If this is done, the foreign exchange cost (apportioned) will be the minimum for any reasonable period of time. The procedure, however, will require large aggregate investment outlay, and a training programme for engineers and technicians. Also, raw materials etc., should be available for developing a machine building industry, a condition which is satisfied in India. The allocated aggregate cost in India for building up a fertilizer plant is likely to be smaller than when the plant is built with imported machine for reasons outlined in the last paragraph.

4.5. This is the central theme of Mahalanobis's (1958) arguments in "Science and national planning." To sum up, earlier a decision is taken, it is possible to choose a variant which is more economical to the country in the long run, both from saving of foreign exchange and also for other reasons. Of course, choice of each variant is associated with a particular complex of associated tasks not all of which are easy. But supposing decisions are taken and the tasks are squarely faced and fulfilled reasonably well, then it is always better to take decisions as early as possible and in general, choose a variant in which the basic capital goods are produced in the country. In fact, this is a quintessence of the philosophy of planning, and is probably profoundly true, provided there is planning in a real sense. Planning in this context means that democratic decisions on plan targets and plan measures are taken and adhered to strictly. Decisions, however, are not to be taken about a period which is so remote that it is impossible to think concretely about the period. Some risks are involved in taking early decisions; but such risks should be calculated ones. No country in the world is planning to do without electrical energy with a hope that controlled thermo-nuclear power would provide all the energy we need one day.

4.6. *Scientific research, technical manpower and education.* Setting up complexes of heavy industries, as we have already noted, require decisions, among others, on the training programme for engineers and other technical workers to man the industries. For this, it is necessary to set up technical colleges and institutions and train up teachers for such institutions. While setting up basic industrial complexes could be accomplished in ten or fifteen years when a firm decision is taken and there is no dearth of technical man-power, it is necessary to take decisions fifteen or twenty years in advance, if the desire is to man the complexes by domestic personnel. Since, there is little chance of finding foreign personnel for large industrial complexes, the only practical way is to think of the personnel also in the very beginning, that is, to take decisions fifteen or twenty years in advance rather than ten or fifteen years in advance. However, it is not possible to develop such teaching programmes in a country in which scientific research has not developed, and as such it is necessary to think of development of scientific research in the country for economic development.

4.7. A consideration of this type led Mahalanobis to formulate what he aptly described as the four-fold or five-fold logic of economic development. The following paragraphs taken from "The Need of Scientific and Technical Manpower for Economic Development" (Mahalanobis, 1959c) give a concise exposition of the principle.

4.8. "We ... have to think of four levels. First, to increase the supply of consumer goods which, so to say, is at the top or the first level. To do this, we must expand the production of capital goods; this is the second level. Both of these will require a larger and larger supply of engineers, technologists and technical personnel; this is the third level. Engineering and technological development would call for an increasing volume of applied research. But applied research requires a sound foundation of basic research. We must have an increasing supply of research scientists of ability. Unfortunately, their number is small in every country. We must try to make the best use of all whom we can discover. This is the fourth level.

4:9. "Now consider the factor of time. We can set up factories for consumer goods very quickly; in a year or two, if we use imported machinery. To develop the production of capital goods would take more time, from 5 to 10 years at least. To secure an adequate supply of engineering personnel would require still more time. And finally, we must have enough scientists of ability for both applied and basic research which would take at least a generation. This is the four-fold logic of economic development.

4.10. "How to attract and hold a sufficient number of able persons in science and technology is then the crucial problem of national development. This can be done only through a proper social appreciation of science and scientists, which is the fifth and deepest level of the problem."[16]

4.11. It will be seen that Mahalanobis considers scientific advance as the primary pre-requisite of a sustained economic development and hence it will be useful to dilate further on this point. Economic progress entails a steady growth of national product, and this is achieved by transforming various material given by nature into capital goods and consumer goods. This process is technological in nature and engineers and technologists have a vital role to play in the process. Also natural resources vary widely from country to country and proper and efficient utilisation of national resources given in a country involves sustained technological research. Such research could only prosper in an atmosphere in which science in general is flourishing and the stock of scientific knowledge is advancing. Thus promotion of pure research automatically creates a condition in which more utilitarian research could prosper; it is for this reason that one should think of a close link between the economic development and pure research. Organisation and promotion of scientific research in its most comprehensive sense is thus an essential requirement for rapid economic development.

4.12. As research is closely linked with economic development, Mahalanobis made a pioneering attempt to quantify the extent of research in a country and its relation with economic development. He studied (Mahalanobis, 1958) the indicators of economic development and the aggregate research outlay of five countries, USA, USSR, UK, China and India. He noticed that for rich countries with high per capita national income and large per capita consumption of energy, the aggregate expenditure on research was of the order of two per cent of the national income. In poor countries like China and India, the share was extremely low being about 0·4 per cent in China and less than 0·1 per cent in India. Thus, according to him, for underdeveloped countries, it was essential to raise this ratio substantially in order that sustained economic growth was possible. This line of research initiated by him had subsequently been taken up by others and an imporant field of study has been opened.

---

[16] It had also been pointed out elsewhere that higher priority should be given to tiers or levels which are more slowly maturing. (Role of science in economic and national development ; *Indian Journal of Public Administration*, **8**, 2, 1962.)

4.13. Promotion of scientific research, however, is not an easy task in a country like India because this involves social acceptance of newer values. According to him, the value of science to society lies in its unorthodoxy and ability to challenge accepted concepts and theories" In most human activities other than scientific pursuit, best exemplified by administration, a subordinate has to obey his superior. This is also true in judicial and religious matters. Decision of a higher court overrides that of a lower court. Higher the level of a priest, the more is his authority and prestige. In fact, prior to the scientific revolution brought about during last four centuries, most human activities were organised in a hierarchical system in which the view of a person in a higher position in the hierarchy had to be accepted against that of a person in a lower position, merely by virtue of the position. There could be no appeal outside the hierarchy; the only appeal lay with persons still higher up in the hierarchy. It will be seen that for many human activities, this principle remains essential even today. For example, it is not possible to have an efficient army without accepting these tenets. The scientific revolution brought about a new concept of objective validity which has its foundation in nature itself and which cannot be changed or altered by persons having a higher status. The modern age is essentially based on this notion of validity. A linear order of ranking and of levels of authority is indispensible in administration. The opinion or decision of a superior officer must prevail. This is in complete contrast to decision making in science in which the ideal must be complete equality of status of all scientific workers, as all decisions must be based on reason and not on authority. The objective nature of science requires promotion of democratic principles for its progress.

4.14. Even when there is social acceptance of this principle, there is another important obstacle in the way. For sound organisation of science, it is necessary to have an objective method of assessment of scientific workers and their work. A necessary condition for this is the existence of a basic scientific outlook and a free atmosphere of criticism. Appropriate traditions of assessment and criticism developed in many western countries during last four hundred years. Many important scientific institutions in these countries were completely outside government influence; this enabled them to build up a standard of their own and also to help government by offering independent criticism of government scientific policies. In the Soviet Union and other socialist countries, the Academy of Sciences and their associated institutes were deliberately developed as independent institutions outside the sphere of government control. This enabled them to develop adequate standards quickly. The position in India is still unsatisfactory in this respect; but this remains a very important problem which has to be solved before we can hope to be able to progress rapidly towards our economic goals.

4.15. We have observed earlier that the training of technical manpower is intimately linked with long range planning of a country. But the basic problems enumerated above has to be solved before a real headway could be made towards training of technical manpower including research personnel. Certain educational reforms are needed in India in order to help in the process. It was suggested by Mahalanobis that no deserving student should be deprived of educational opportunities because of poverty. This will require free education at all levels. Since it will be difficult to do this at the present stage of our development, the higher education should at least be made free during the Third Five Year Plan period. This will entail abolition of all fees at the university level and devising a system of scholarship which will sustain all deserving students during the period of their training. This will also involve selection of students for higher education entirely on merit.

4.16. "Inequalities in medical care result in a larger number of deaths among the poorer people. Inequalities in educational opportunities have a deeper and more pervasive effect. It is true that some extremely able students succeed in securing scholarships upto the highest level but their number is very small. By and large, it is the rich people who have the opportunity of giving their children the type of education required for posts of influence and responsibility in the country. By and large, those having such training are selected for posts of responsibility on the strength of their higher educational qualifications. In this way the power and privileges of a small group of people at the top tend to be not only preserved but strengthened. In both public services and organised private enterprises practically all posts of influence and power are held by persons belonging to the same small privileged class. This has created an influential group of people who naturally desire to maintain their privileged position and power. During the British period many of the influential people were not enthusiastic about the political change because they were afraid of losing their own privileges. In the same way, it is not surprising that there are people in India today who are not enthusiastic about a rapid economic progress out of a similar fear of losing their privileges and power. It is necessary to remove barriers to educational opportunities to overcome such difficulties. This is the only way in which a sound foundation can be laid for democracy and socialism in India" (Mahalanobis, 1960a). I have quoted this in full because apart from indicating the reasons for the educational reforms suggested by him, the paragraph underlines his deeply human and democratic approach towards all problems of planning.

4.17. As I have pointed out earlier, what Mahalanobis did was to give an indication of a theory, and not any worked-out theory of economic development. In his mind, scientific advancement had a very important and basic role to play in the technological innovations which led to rapid growth of output and productivity of UK and some other nations of the world. This led to a large increase in the level of living of the Western countries; thousands of years of stagnation in the per capita income was replaced by new trends of rapid economic growth over the last century and a half in the Western countries. This gave the Western countries undisputed military supremacy which enabled them to dominate the rest of the world into either direct colonial rule or into conditions of economic and political subjugation.

4.18. Mahalanobis did not directly bring in the question of cause and effect into the picture. He stressed more on simultaneity. In the beginning of the industrial revolution in the 18th century, revolutions in the technologies of spinning and weaving first, then in iron and steel and then in electricity in the 19th century made possible the phenomenal growth in output and productivity. Simultaneously there was emergence of the bourgeoisie and the capitalist class with their aspiration towards social and political power. He, however, ventured to suggest that probably the former stimulated the latter. Also, the spread of scientific outlook probably prepared the ground for the age of reason and the French revolution towards the end of the 18th century; this led to the growth of nationalism, in its modern sense, in Europe in the 19th century. The industrial revolution led to the use of machinery and thus replacement of animal and human power by steam and electrical power. The link between technological development and scientific advance became very close in the 19th century. Mahalanobis specifically admitted of the interacting nature of the industrial and technological advances, without pointing out which was prior. He thought, for example, that industrial development was sometimes stimulated by a new scientific discovery, or scientific discovery was stimulated by industrial needs.

3.19. To sum up, while the role of innovations in economic development has been stressed by eminent theorists like Schumpeter, Mahalanobis pointed out the interrelations between scientific advances and technological innovations. He also brought out clearly the role of decision making at appropriate time. However, one should point out once again that Mahalanobis's analysis was not primarily intended to explain what happened in the past. It was entirely forward looking like his planning models and gave a theoretical frame work to the Indian planners, in order to help them in their work. It also follows that these considerations apply only in a planned economy.

4.20. *Industrialization of underdeveloped countries and world peace.* Subsequent to the October revolution in 1917, USSR adopted a policy of planned economic development and by and large achieved phenomenal success. Other socialist countries followed the suit after the Second World War. In general, the socialist countries succeeded in achieving a larger rate of development in the recent past than the capitalist countries in the post industrial revolution period, thus showing the advantages of planning as a method of economic development. In order to have planned progress, USSR and other socialist countries deliberately adopted a policy of encouraging science and technology by creating a condition in which these pursuits give great prestige. They also adopted long range programmes for the development of technical manpower. These measures support Mahalanobis's analysis of the situation as given earlier. As a result of this, the monopoly of Western countries as the only world power has gone, and socialist countries, as a block, has emerged as a second power to reckon with. This has led to world tension and a state of cold war. Mahalanobis, while thinking about the question of economic development in the context of the world as a whole, was naturally confronted with this situation. He had, however, introduced a fresh point. One basic, and perhaps the most potent reason of the world tension, is the existence of underdeveloped countries of the world. Both Western and Eastern powers are interested in increasing their spheres of influence among these countries, and various diplomatic methods and aids of diverse types are being utilised for this purpose. This is leading to clashes between the Western and Eastern powers, and hence helping to prolong the world tension. In many of the underdeveloped countries, the ruling group is not very stable and is liable to change at a slight provocation. Pressures and counter pressures from Western and Eastern powers, therefore, naturally develop explosives situations in these countries, and many incidents in the underdeveloped countries in the last decade may partly be explained in this way.

4.21. Mahalanobis emphasized that the surest way to avoid tension on this count would be to ensure rapid economic development in the underdeveloped countries of the world. This will lead to stable leadership in these countries. Also if the democratic opinion is satisfied about the progress, the condition within the countries, as a whole, will be stable. This will enable them to react more rationally to political and other pressures from outside.[17] Some of the developed countries in either block may be interested in a reduction in world tension, and they may help in securing economic development of underdeveloped countries. But it has to be realised that rapid growth will entail planning of the type which he has in his mind, i.e., with emphasis on scientific research, technical manpower and basic industries, and the advanced countries has to realise this in order to be able to help effectively. This is the best possible way to secure lasting peace in the world.

4.22. It has been shown by Mahalanobis and some others that if a moderate percentage of world defence outlay is spent on uplifting the conditions of the poorer countries of the world, the results will be spectacular. This is easy to see when it is noticed that the world defence outlay per year in seventies was of the order of three or four times the entire national income of India or more than double that of China. Thus, if there is agreement between Eastern and Western powers, then one way of securing lasting world peace would be to reduce outlay on arms and ammunitions and increase the outlay on development of poorer regions of the world. Mahalanobis attempted not only to elaborate this view but also to propagate this view before a wide forum.

4.23. *Labour problems and unemployment.* Mahalanobis (1959d) explicitly considered labour problems with particular reference to unemployment. The notion of unemployment is admitted to be different in India in comparison with advanced countries mainly because of the existence of a large body of self employed population. "As they do not have any jobs, they cannot lose jobs, and cannot therefore be unemployed in the sense of the industrialised countries" (Mahalanobis, 1959d). On the other hand, it is well known that manpower is grossly under-utilised in the country, and both employees and self employed workers put in much less work than they could. An urgent problem posed in the Second Five Year Plan was, therefore, to make fuller utilization of the available manpower to the tune of equivalent

[17]See also (Mahalanobis, 1959a), "A very small group of families or persons have the largest share of wealth, income and political and economic influence. In fact, the greater the lack of economic development the fewer would be the number of persons who have the effective power of making political and economic decisions. This makes it possible for a foreign power to exert pressure on a small group of powerful persons to give concessions in favour of the foreign power. Such arrangements, because they depend on the will of only a small group of persons, are necessarily subject to violent changes from time to time. Relations between foreign powers and underdeveloped countries are, therefore, basically unstable". The social structure of developing countries was considred briefly in (Mahalanobis, 1963a).

of 11 million regular jobs. This target was not realized, and the problem of fuller utilization of manpower still looms large before the county.

4.24. The condition of living of the working class has not probably improved materially in comparison with the pre-war period and labour productivity has probably remained stagnant, thus introducing a vicious circle. There is a general disinclination for hard work, and overstaffing is rampant in enterprises, which is sometimes justified on grounds of unemployment and underemployment. Mahalanobis was conscious of this stage of affiars, and he pleaded for improvement in efficiency, productivity and remunerations simultaneously.

4.25. Mahalanobis put forward an interesting idea of labour reserve service as a solution of labour problems in industry and other organised enterprises.[18] The service is to be maintained by the government out of funds provided by enterprises and workers themselves supplemented by general revenue. The reserve will be utilized for productive work and hence it will be able to finance a part of its cost out of sale proceeds of goods produced. When a particular worker is thrown out of job by an enterprise for reasons of efficiency or other allied reasons, the enterprise will have to make a payment to the labour reserve service which is considerably lower than his actual remuneration when he was in the pay-roll. The enterprise, however, would think of dismissing a person only when it would consider the benefits accruing is more than the direct contribution to be made. The workers joining the service would draw a pay from the service which is lower than their original pay but is reasonably sufficient for sustenance. They would also receive training while working with the service. Eventually, with industrial expansion, persons in the reserve will continually be absorbed in other enterprises, and the training will be oriented towards this. The labour reserve service will thus be a buffer against unemployment and would serve as an unemployment insurance scheme for the workers concerned. Since, enterprises will be able to dismiss a worker on grounds of ecnomy and efficiency for a small contribution, the chronic labour relations problem will be avoided and the enterprises will be able to work for highest attainable efficiency and productivity. The scheme thus will help both the workers and the entrepreneurs. Since industrial efficiency remains a serious problem with us, and improvement in productivity is essential for our industrial progress, particularly for

[18] To be comprehensive in this topic, one should also study Mahalanobis's Labour problems in a mixed economy, *Indian Journal of Labour Economics*, **3**, 1, 1960, which is not included in this volume.

increasing our foreign earnings, it is necessary to adopt a policy in the field of labour relations in which these goals can be attained without affecting the level of the workers. Mahalanobis's scheme attempted just to do this and deserves serious attention.

5. Concluding remarks

5.1. Mahalanobis's contributions in the field of planning and allied subjects was wide and varied. He helped in setting up a sound statistical system in the country; he prepared a concrete framework for the Second Five Year Plan and he was actively associated with the preparation of a long period perspective of economic development of the country. His role in lying down a sound foundation for statistical reporting was of importance because realistic planning is not possible in the absence of reasonably accurate data. Some of his ideas incorporated in the Draft Plan Frame for the Second Five Year Plan have been accepted by the country and have become a part and parcel of our general thinking on planning. Even his mathematical scaffoldings, which he did not consider as very important, contained ideas which might prove useful in future. The various limiting factors enumerated by him in his Plan Frame narrowed down the field of our future struggle for planned development. His ideas on long range planning with emphasis on scientific research, training of technical manpower and basic industries are gradually gaining acceptance and are likely to help us in achieving sustained economic development.

5.2. I think it will be true to say that Mahalanobis has helped materially in giving a concrete shape to Jawaharlal Nehru's general ideas on socialistic planning. Planning in India would have been more conservative but for his influence and this is all that is claimed as social influence of his work. His influence in theoretical and methodological fields is wide. But we can possibly sum up his contributions by pointing out that he stands for a rational and scientific approach towards planning in India in an atmosphere in which intuitive approach and rule of thumb still play a large role. In planning as well as in his multifarious other activities, he remained true to science.

5.3. I may perhaps conclude this preface by pointing out one aspect of Mahalanobis' scientific approach. Though he was capable of reaching theoretical heights, he was essentially an applied scientist and he would always like to see that his scientific ideas and theoretical formulations were tried in practice. While working in the field of planning, he was not satisfied with preparing a logically consistent and theoretically valid Draft Plan Frame. He was also interested in having the Draft Plan Frame tried in practice. An applied scientist, his theories had to be experimented upon and supported by empirical observations. But when the field of study happened to be planning for national development, this meant a tremendous amount of effort involving meeting of hundreds of people, engineers and technicians, administrators and politicians. And it was because of this that he had to take upon himself a role in the official planning hierarchy of the country.

M. MUKHERJEE
Chairman
Centre for Studies in Social Scinces
Calcutta

REFERENCES

1. (1952) : National income, investment and national development. Lecture at the National Institute of Sciences of India. *Talks on Planning*, Indian Statistical Institute, 1961.

2. (1953a) : Studies relating to planning for national development. *Talks on Planning*, Indian Statistical Institute, 1961.

3. (1953b) : Some observations on the process of growth of national income. *Sankhyā*, 12, 307–312.

4. (1955a) : Recommendations for the formulation of the Second Five Year Plan. *Talks on Planning*, Indian Statistical Institute, 1961.

5. (1955b) : The approach of operational research to planning in India. *Sankhyā*, 16, Parts 1 and 2, 3–62.

6. (1955c) : Approach to planning in India. Radio talk, *Talks on Planning*. Indian Statistical Institute, 1961.

7. (1958) : Science and national planning. Address at the National Institute of Science of India. *Sankhyā*, 20, 69–194. *Talks on Planning*, Indian Statistical Institute, 1961.

8. (1959a) : Industrialization of underdeveloped countries—a means to peace. Third Pugwash Conference, Kitzbuhel, Vienna, *Bulletin of the Atomic Scientists*, 15, No. 1, and *Sankhyā*, 22, Parts 1 and 2, 1960, *Talks on Planning*, Indian Statistical Institute, 1961.

9. (1959b) : Study of the problem of industrialization in the underdeveloped countries. Contemporary East, Moscow, *Talks on Planning*, Indian Statistical Institute, 1961.

10. (1959c) : The need of scientific and technical manpower for economic development. Radio talk, *Talks on Planning*, Indian Statistical Institute, 1961.

11. (1959d) : Unemployment. Chairman's address, All Indian Labour Economic Conference. *Indian Journal of Labour Economics*, 2, No. 1, *Talks on Planning*, Indian Statistical Institute, 1961.

12. (1960a) : Next steps in Planning. Address at the National Institute of Sciences of India. *Sankhyā*, 22, Parts 1 and 2, 143–172, *Talks on Planning*, Indian Statistical Institute, 1961.

13. (1960b) : Operational research models used for planning in India (with M. Mukherjee). *Second International Conference on Operational Research*, 1960.

14. (1963a) : The social transformation for national development. *Sankhyā*, Series B, 25, 49–66.

15. (1963b) : Statistical tools and techniques in perspective planning in India. *Bull. Int. Stat. Inst.*, 40(1), 152–169.

16. (1965) : Use of capital output ratio in planning in developing countries. *Proc. 35th Session, International Statistical Institute*, 47(1), 87–95.

PRASANTA CHANDRA MAHALANOBIS AS I KNEW HIM

The friends and well-wishers of the Indian Statistical Institute have laid those connected with the Institute under a load of gratitude by conceiving of and executing this plan of bringing out a volume of essays to be presented to Professor P. C. Mahalanobis on his Seventieth birthday in June, 1963. To one like me who can claim to have been a close friend of Professor Mahalanobis for over 40 years and who has had the privilege of working with him in guiding the growth and development of the Institute for the last 18 years, this gesture of regard and good-will is especially gratifying, as well as appropriate, for the attainment of the three-score years and ten span by Professor Mahalanobis happens to mark the consummation of a most remarkable period of achievement in the life of this eminent scholar and scientist, restless visionary and planner.

Mahalanobis had left Cambridge, with a brilliant degree in Mathematics and Physics, by the time I was admitted there in 1915. But a close friend of his who continued his studies became a close friend of mine also, and through him I came to know Mahalanobis sufficiently well to stay as his guest in Calcutta in October, 1920, when I visited that city to appear in some Oriental Languages examination.

It was during that visit that I learnt of the high standing of the Mahalanobis family in Bengalee society, as well as getting a glimpse of Mahalanobis's interest in statistics—connected at that time with meteorology, purely as a powerful side interest of a professional teacher of physics. Mahalanobis introduced me to his aunt, a daughter of Keshab Chandra Sen and in his company I called on Dr. Brajendra Nath Seal and Dr. Nilratan Sircar. A year later, I visited Calcutta again and got to know Srimati Nirmalkumari Maitra, then Mahalanobis's fiancé and soon after Mahalanobis's wife. Dr. Heramba Chandra Maitra, her father, was a strict Brahmo and there was much ado over the proposed mode of marriage ceremony but love triumphed in the end.

I learnt of the difficulties that had been overcome only years later, as between 1921 and 1939 I had very little contact with the Mahalanobises. The threads of friendship, not any the worse for desuetude were resumed in Simla where I came to be posted as Joint Secretary to the Government of India in the Department of Education, Health and Lands whither Mahalanobis had come to persuade the Government of India to give him a small grant—not of more than four digits—for developing his statistical laboratory and Institute. For, in the meanwhile this was the stable but unsubstantial from his interest in statistics had taken, an interest which had grown into a passion as the years went by and the time for his retirement from his official post of Professor of Physics at the Presidency College, Calcutta drew nearer. Some space, sparing which was becoming increasingly difficult to an expanding department, had been permitted to be used for the purposes of the Statistical Institute and Laboratory.

My joining the Reserve Bank of India in 1939 as Secretary, to rise to be Deputy Governor (1941) and Governor (1943) marked a turning point in my own relations with Mahalanobis and my interest in his extra-professional work. The Reserve Bank top-level staff, with Headquarters in Bombay, spends about three months of the year (from mid-November to mid-February) in Calcutta, in order to maintain contact with that of other great industrial and commercial capital of the country. My duties therefore involved a three-month sojourn in Calcutta and far more extended opportunities of keeping up contacts with the Mahalanobises. I had taken the opportunity of this sojourn to learn a little Bengali, in order to know better my many friends in Bengal—from Cambridge days, principally. And this forged another link in my friendship with the Mahalanobises as I discovered how closely they had been associated with Rabindranath Tagore and Santiniketan in its early days. Mahalanobis had been Secretary of Visva-Bharati and Rani (the name by which Tagore called Srimati Nirmalkumari Mahalanobis) a deeply devoted ministering angle to the Poet.

Many a Sunday I spent with the Mahalanobises, upto 1942, in a house beyond Baranagar Railway Station and after 1942 in 204, Barrackpore Trunk Road, the present somewhat bewildering Panch Mahal like house. Indeed, I was one of those who strongly advised the purchase of that property—during the war—as I felt attracted by its two tanks and gardenland, mangoes predominating (Amrapali was the apposite name given to it by Rabindranath Tagore). The war led to many profound changes in the location and organization of work of the Institute. Some staff had to be located in far away Giridih in the Santhal country. The Presidency College became less and less of an asylum and the precincts of Amrapali took up the strain.

It was soon after my joining the Reserve Bank that I became a member of the Indian Statistical Institute, to become its President in 1944. Although I have studied lower mathematics it is not a subject I am at ease in or have a talent for, and my only connection with statistics had been carrying out random agricultural crop sample surveys, after Hubback, as a Settlement officer in Raipur in Madhya Pradesh (then Central Provinces and Berar) between 1926 and 1931, as a cross check on soil classification, correlated to soil analysis, and rent-rates fixed by me. However, increasingly I felt a sense of involvement in Mahalanobis's work in statistics and a growing desire to help him in obtaining financial support from the Government of India. As Deputy Governor and later Governor of the Reserve Bank of India, I had some influence with the Finance Ministry and felt I should use it in what appeared to me to be a decidedly deserving cause.

But statistics was not the only bond between the Mahalanobises and myself. Apart from their special relations with the Poet, I discovered Mahalanobis's deep interest in the social and intellectual movements in Bengal, especially in the life and work of Raja Ram Mohun Roy, and I learnt of his great competence as a speaker and writer of Bengali. Tagore became more and more a powerful theme of talk with us—the room reserved for him in Amrapali, from which the Poet could greet the morning sun if ever he stayed with them, the numerous tours in different parts of the world in which the Mahalanobises had accompanied the poet, incidents of these travels that it was a pleasure to recall, particularly the triumphs; the poet's sense of humour; his amazing speed in composing poetry, often a flow like that of the great river in a sailing boat on which he had loved to write; and the Poet's many letters to Rani.

It was inevitable that the Mahalanobises and I should make plans for me to pay my respects to the Poet, and this was hastened by his illness at Santiniketan. The Mahalanobises and I went to the Abode of Peace in February 1941, just for a day or two. I ventured to take a small offering, in the shape of a poem in Sanskrit, which the Poet received graciously and in return for which at my request he read out one of his own (*Abirbhavo*), selected by Rani Mahalanobis. Alas that was the first and the last time that I was to see the Poet. I returned to Bombay, to my duties in the Reserve Bank, and in August 1941 the sad tidings reached me that the Poet had passed away.

I became the Governor of the Reserve Bank in February, 1943 with a more perceptible capacity to interest the Government of India in helping the Indian Statistical Institute, and in 1945 the Education Ministry agreed to make its first large and regular grant of Rupees Five Lakhs to the Institute for its Research and Training School. For Mahalanobis the period after the end of the war was one of more frequent professional trips abroad—he had in the meanwhile been made a Fellow of the Royal Society of U.K. for his work on large-scale agricultural sample surveys—and had also been elected a member of the International Statistical Institute. It was about this period that he resolved in his mind and discussed with me his idea of initiating a National Sample Survey as well as his growing interest in Statistical Quality Control.

This latter interest matured in the shape of a plan to invite Dr. Walter Shewhart, Director of the Research Laboratory of the Bell Telephone Co., the Father of Statistical Quality Control to India, in an effort to arouse interest in the movement in the business world of India. This effort had the welcome support of Dr. Lal Verman of the Indian Standards Institution and took shape in 1948. Dr. Walter Shewhart, accompanied by his wife Edna Shewhart, came to India, stayed in Calcutta with the Mahalanobises at Amrapali and in Bombay with me at the Reserve Bank House. Whilst the visit sowed the seed of statistical quality control in India, which after a late germination is at last showing signs of growing into a tree of considerable size, it laid the foundation of a deep and abiding friendship between the Shewharts and the Mahalanobises on one hand, and the Shewharts and myself on the other, a charmed circle to which my wife, Srimati Durgabai Deshmukh, was admitted on our marriage in January, 1953. Edna is *didi* to both Rani and Durgabai, and the Shewhart home in New Jersey is our American home.

Soon after relinquishing the Governorship of the Reserve Bank in 1949, I was appointed, on the suggestion of the late Dr. John Mathai, then Union Finance Minister, Financial Ambassador in U. S. A. and Europe to the Government of India, and in that capacity accompanied Prime Minister Jawaharlal Nehru in part of his travels on his first visit to the U. S. A. in October-November 1949. Soon after that I was called to Delhi for consultations, but stayed to organize the Planning Commission for the Prime Minister and to become the Union Minister of Finance in May 1952 as a result of a concatenation of events which this is not the place or occasion to elaborate.

It is necessary to state at this stage that Mahalanobis had known Shri Jawaharlal Nehru and had occasion to inform him of what he had been doing to promote statistics in India. Once, I remember, Shri Nehru had come to Bombay to speak on South and South East Asia and International Relations before the Bombay branch of the Indian Council of World Affairs. That evening I was invited to dine with Shri Nehru by his sister Srimati

Huthee Singh, and I had occasion to refer to Mahalanobis's work for statistics and to discover that Shri Nehru was appreciative of it and conscious of the need to encourage it. This friendly interest was to bear fruit later in the appointment of Mahalanobis as Statistical Adviser to the Government of India by Prime Minister Nehru.

My coming on the scene as Minister of Finance led to many important developments of significance to the growth of the country's statistical apparatus, developments which would not have been possible but for Prime Minister Nehru's awareness of the role of statistics in planned economic development. The institution of a Central Statistical Office, the establishment of the National Sample Survey, the regular annual compilation of the National Income Report, with intensive statistical investigations within these fields, whenever and wherever required, the formation of a Statistical Quality Control Policy Advisory Committee—all these were the product of the conjunction of the favourable circumstances which provided for the Indian Statistical Institute and Mahalanobis's ever-burgeoning ideas about the range of its potential services the strongest possible support in the Union Government, in the shape of the understanding by the Prime Minister of the importance of statistics, organized by a non-official, academically oriented and professionally competent body like the Indian Statistical Institute. Apart from the proliferation of its activities as indicated above, this period (1950–1956) saw the strengthening of the Research and Training School and its diversification, including an International Statistical Training Centre, thanks to the support extended by the Government of India.

The recognition of the Indian Statistical Institute into an Institution of National Importance by means of a piece of legislation, most understandingly piloted by the Prime Minister himself, about a couple of years ago, put the coping stone on this imposing edifice the rising of which owes so much to the enthusiasm, energy, initiative and professional competence of Mahalanobis.

The last eight years have seen Mahalanobis grow into a figure of national importance. His name leapt into prominence with his putting out a draft outline of the Second Five Year Plan in the beginning of 1956. Much preliminary work, including the labours of well-known foreign specialists, had gone into this venture. That the Second Plan as finally formulated contained much of the philosophy underlying the Draft Outline testifies to the deep thinking that informed it. Since then Mahalanobis has had an assured place as a *de facto* member of India's Planning Commission, and today he is in charge both of Science and Perspective Planning as a member of the Commission—still *de facto*, because of the impossibility of divorcing him from his major interest : the Indian Statistical Institute.

As President of the National Institute of Sciences of India, Mahalanobis had recently an opportunity to contribute to the stabilization of the resources of that eminent body, including the completion of its new home on Tilak Marg, New Delhi.

It is inevitable that with his assured status in the world of science, statistics and planned economic development Mahalanobis should be frequently called upon to participate in international conferences or to advise Governments of developing countries. With no political predilections he has friends all over the globe and easy access to scientific circles in the countries of both the Western and the Eastern Blocks. Scientists and academicians from both blocks respond to his invitation to spend some time at the Institute as visiting professors or experts. Ronald Fisher, Simon Kuznets, Richard Stone, Frank Yates, Norbert Wiener, John Strachey, J. K. Galbraith, Nicholas Kaldor, A. N. Kolmogorov, J. B. S. Haldane and numerous others have at one time or another helped in the work of the Institute and added new ranges or dimensions to it. Today the Indian Statistical Institute, with its journal Sankhyā, its Ural Computer and its plans for the manufacture of calculating machines can claim to be in the forefront of scientific institutions of international importance, and its School of Research and Training, under its highly competent Director, C. R. Rao, confers graduate and post-graduate degrees of B.Stat. and M.Stat., and research degree of Ph.D. which are recognized as the hall-mark of advanced training in statistical science and practice.

With all his remarkable achievements, Mahalanobis remains a modest man. His absorption in his work and his catholicity of interest make him a man not too easy to get on with. He has no small talk and little capacity to compromise with unreason. But he has no malice and no guile—indeed the intricacies of bureaucratic administration non-plus him—it is here that I have been able to help him a little and to make his path a little easier.

Mahalanobis's eternal preoccupation with work suppresses a genuine capacity for affection—which in any case he would think it his duty to conceal—except towards canine pets. His absent-mindedness is often the butt of Rani's affectionate badinage. It is probably true to say that without Rani's unremitting help and attention, Mahalanobis would make a mess of his foreign travel, leave things behind and catch the wrong planes.

But all these are superficial shortcomings. Functionally, he is extremely efficient and the volume and despatch of his work are amazing. The proudest thing that a friend like me, of over 42 years of standing, can say is that Mahalanobis and I have never had the slightest misunderstanding, not to speak of a quarrel. May he be spared for many more years to enrich the intellectual, academic and scientific life of the country and raise ever higher the stature of her statisticians.

C. D. Deshmukh

Professor P. C. Mahalanobis died on 28 June 1972.

CONTENTS

NATIONAL INCOME, INVESTMENT, AND NATIONAL DEVELOPMENT

Summary of a lecture delivered at the National Institute of Sciences of India, at New Delhi, on 4 October 1952.

1. The gross national product of any country is the total value of all final goods and services produced in any given year together with provision for the consumption of capital assets. The provision for consumption of capital must be used for the repair and replacement of all real physical assets (lands, factories, machinery, buildings, transport and communications, etc.) in order to keep intact the total wealth or means of production. Unless this is done the national product would inevitably fall off. Subtracting the amount required for making good the wear and tear of the real physical assets (usually called the depreciation) from the gross national product one gets the net national product or income and the average share of each person is the per capita net national income. The value of the net national income in India is at present something like 9,000 crores of rupees or Rs. 90 *abja* (one *abja* $= 100$ crores $=$ one milliard $=$ one billion $= 10^9$). Dividing by the total population of 36 crores ($= 360$ millions), the per capita national income is about Rs. 250 per year. These are not exact estimates but will be used as convenient dimensional figures in round numbers for purposes of numerical illustrations.

2. The net national product or income is thus the total value of goods and services which are available for consumption or for the creation of new physical assets. Economic development means increasing the total net production of goods and services. The increase must also not only keep pace with the growth of population but must be at an appreciably faster rate in order that the average share of each individual, that is, the per capita net national income (η) may increase from year to year.

3. The national income may, of course, be increased to some extent by an increase in the average productivity per person. But the only long range way of increasing the national income is to create new physical assets, i.e. new means of production in the form of factories, machines, buildings, transport, etc. The rate of economic development would, therefore, ultimately depend on the amount of new physical assets or means of production which is

created every year, that is, on the proportion of the net national income which is not consumed but is set apart for investment or capital formation in real physical assets for future production.

4. The rate of such net new investment (which may be called α) in highly industrialised countries like the U.S.A., the U.K., Sweden and Switzerland during the last generation or two, appears to have been something between one-tenth and one-eighth (that is, between, say, 10 per cent and 13 per cent) of the net national product. The rate of net investment or new capital formation, of course, fluctuates from year to year but the average rate over a large number of years is fairly steady. In the U.K. during the period 1870–1913 the rate of net investment was 10·8 per cent per year; and its value exceeded 15 per cent and was 15·2 per cent only once in 44 years. In the U.S.A. the average rate of new capital formation was 12 or 13 per cent over several decades and exceeded 16 per cent over a decennial period only on two occasions during the period 1879–1948. In Sweden the rate over a long period before the war was about 11 per cent; and during the post-war period about 13 per cent. In Switzerland in recent years it has been probably something like 10 or 11 per cent. The rate of net investment in India is not known accurately, but one may, perhaps, adopt somthing like 5 per cent or so of the net national product, or roughly about Rs. 450 or Rs. 500 crores in round figures per year for purposes of numerical illustration. This is roughly half or less than half the rate of investment in the industrially advanced countries mentioned above.

5. There is a second important factor, namely, the addition to the national product which is generated, on an average, per unit of the net new investment. This may be called (β) the national income coefficient of net investment. From rough calculations it seems that the numerical value of this coefficient was roughly between one-fifth and one-third (that is, between, say, 20 and 33 per cent) in the above 4 countries during the period under review.

6. It must be emphasized that the income coefficient of investment (β) is not something like the financial return or profit on investments in individual enterprises. For example, an iron and steel plant may give a dividend of 5 or 6 per cent to the owners or share-holders. The value generated or added to the national income at the plant would be much greater, possibly 12 or 14 per cent. In light engineering or in agriculture, the value generated by one unit of investment would be still higher and the income coefficient of investment may be 50 per cent or even 100 per cent in particular sectors, so that

the average coefficient of investment for the whole national economy may have a value of the order of 20 or 30 per cent. A second point is also of great importance, namely, that the total increase in the national income due to new investment is scattered over the whole of the national economy and cannot, therefore, be segregated in any way except in so far as the additional income (at the level of business profits) accrues to the socialized sector of the national economy.

7. The rate of investment (α) and the national income coefficient of investment (β) would naturally fluctuate from time to time depending on the pattern of investment, but it is not improbable that over a number of years their average values would remain fairly stable. Thus, both the rate of investment (α) and the income coefficient of investment (β) may perhaps be treated, over a number of years, as characteristic parameters of a particular economic system.

8. The numerical values of the rate of investment (α) and the income coefficient of investment (β) given above are admittedly rough but can be used to make illustrative calculations of the rate of increase of national income (γ) which is given simply by multiplying together these two figures (that is, $\alpha\beta$). For example, in the U.S.A. the average rate of net investment (α) during the period 1861–1938 was about 12 or 13 per cent; and the average income coefficient of investment (β) was about 30 or 33 per cent. Multiplying the two (α and β) together one gets from 3·6 per cent to 4 per cent or, say, 3·8 per cent as the average rate of increase of net national income (γ) in the U.S.A.

9. It is also necessary to make allowances for the rate of increase of population (which may be called ρ). Population in the U.S.A. was growing at an average rate of roughly 2 per cent during the period 1861–1938. Subtracting 2 per cent ($= \rho$) from 3·8 per cent ($= \gamma =$ rate of increase of net national income) one gets the rate of increase of the per capita net national income per year (that is, $\eta = \alpha\beta - \rho$). This agrees reasonably well with an observed rate of 1·9 per cent per year over the same period. It will be noticed that if the three coefficients (α, β and ρ) remain reasonably constant, then the per capita net national income would increase in accordance with the rule of compound interest, that is, $\eta_t = \eta_0(1+\alpha\beta-\rho)^t$, after t years.

10. Some fairly reliable material is also available for the United Kingdom for the period 1870–1913. The rate of net investment (α) was about 10·8 per cent and the coefficient of net investment (β) about 22 per cent. Multiplying together the two figures, one gets 2·38 per cent as the average rate of increase of net national income per year (γ) and subtracting the rate of

increase of population (ρ) of 0·95 per cent per year (arithmetic average of the decennial increases) one gets 1·43 per cent per year against an observed value of 1·34 per cent per year, over the period under review. The agreement is, again, not unsatisfactory. In the case of Sweden and Switzerland also the numerical values show broadly similar features.

11. The value of the national income coefficient of net investment (β) in India is not known. But assuming that it is as high as 30 or 33 per cent (as in the U.S.A.), and also assuming that the rate of net investment (α) is about 5 per cent, the growth in total national income would be something of the order of one-and-a-quarter (1·25) or one-and-a-half (1·5) of one per cent per year. Population is growing at present roughly at the rate of one-and-a-quarter per cent (1·25%). Subtracting 1·25 per cent from the rate of increase of total net national income (1·25 or 1·5 per cent), the rate of increase of per capita net national income comes out as practically nil or about one-fourth of one per cent ($\frac{1}{4}$%) per year. This would seem to indicate that there has not been any deterioration in the national economy but the per capita net national income in India has probably remained more or less stationary or is growing at a very slow rate. This is in keeping with general impressions.

12. If it is desired to double the per capita income in India in, say, 35 years (with population continuing to grow at the present rate) then the per capita net national income must increase at the rate of 2 per cent per year, and the total net national income must increase at the rate of at least three-and-a-quarter per cent ($3\frac{1}{4}$%) per year. To attain this rate of growth it would be necessary to make new investments at the rate of something like 10 or 11 per cent of the net income per year, that is, the rate of investment must be roughly of the order of Rs. 900 or Rs. 1,000 crores per year. This means that there must be additional investment to the extent of something like Rs. 400 or Rs. 500 crores per year over and above what is being invested at present. The figures given above are, of course, extremely rough and are only dimensional in nature. In fact, the approach in the present discussion has been definitely of the type of operation research, and numerical values have been given primarily with a view to indicating the magnitude of the quantities involved in national development in India.

Discussion

[*Note*—The lecture was followed by a discussion during which the speaker was asked whether he had made any study of the position in socialized economies. He replied that he had collected some fragmentary information about

Poland Czechoslovakia, Hungary, East Germany and U.S.S.R. which, as time was short, he thought might be discussed more conveniently on another occasion. As he received subsequent enquiries on this point he sent a brief note on 6th October, 1952, which is given below.]

In socialized economics the rate of net investment (α) is stated to be definitely higher and possibly of the order of something like 15 or 16 per cent or more. The income coefficient of investment (β) also appears to have a much higher value, namely, of the order of 50 or 60 per cent or even more so that the rate of economic development (as measured by the increase in the per capita net national income) would be much faster under socialized production. If the claims made by the socialized countries are substantially correct then there would seem to be three distinct bands of economic development. One with a rate of new investment of 5 or 6 per cent as in pre-industrial countries like India; another with a rate of investment of 10 to 12 per cent (or nearly double that of the first level) as in West Europe and the U.S.A.; and the third with a rate of investment of roughly from 15 to 18 per cent (or three times that of the first level) as in socialized countries. The income coefficient of investment (β) also may have two broad levels of value, namely, something between 15 or 20 and 33 per cent in capitalistic or mixed economies and roughly twice as high or more under socialized production. It is also possible that there is a still lower level of development in purely agricultural countries in which economic conditions remain stationary, and net national income can increase only by bringing new lands under cultivation. There is no doubt that the above account gives an extremely oversimplified picture. It is being presented here merely to indicate possible trends of economic development and to draw attention to the need of a careful study of these problems in connexion with national planning in India.

STUDIES RELATING TO PLANNING FOR NATIONAL DEVELOPMENT

In 1953-54 an Operational Research Unit (ORU) was established in the Institute to undertake, on a small scale, technical work relating to planning. In September 1954 the Institute was asked by the Planning Commission to undertake jointly with the Central Statistical Organization (Cabinet Secretariat) to study the possibility of solving the problem of unemployment in 10 years and at the same time to increase national income at a reasonably rapid rate. This address was delivered on 3 November 1954 when Prime Minister Jawaharlal Nehru inaugurated studies relating to planning for national development in the Indian Statistical Institute.

1. At the desire of the Planning Commission the Indian Statistical Institute in collaboration with the Central Statistical Organization has set up study groups to examine the problems relating to planning for national development. The Planning Commission is interested, for example, to know whether it is possible to eliminate unemployment, say, in 10 years with an annual rate of investment of the order of 10 per cent of the net national product. In a fully planned economy it is sufficient to state the target in the form of maximizing national income with the assigned rate of investment because it is always possible to use a part of the planned profits to create enough jobs to eliminate unemployment. In a mixed economy there is some advantage in emphasizing the need of attaining full employment with the understanding that it would be desirable, of course, to increase national income at the same time as much as possible. The emphasis on employment is essentially a short range consideration; the long term, objective must be such maximization of income as in capable of being realized under any given socio-political conditions.

2. Different models of economic growth are being constructed and studied on the basis of different sets of relations (sometimes expressed in a mathematical form) between relevant varieties. The object of making different models is to explore a wide range of possibilities which would give some guidance in the choice of the basic approaches. A brief explanation is given in this note of one type of approach. It is convenient to use numerical examples to explain the general procedure. But the figures given here are used purely for purposes of illustration and no special significance should be attached to them. In fact, the aim of the group studies relating to planning is to make realistic estimates of these figures.

3. We assume that the net output of the economy is 100 of which 94 is consumer goods and services and 6 is capital goods. We desire to increase the share of capital goods to an average of 10 per cent. This would have to be done gradually. In the beginning, we may have to import much capital goods from abroad. But it would be clearly more economical to manufacture capital goods within the country. (For example, we are at present importing machinery from abroad to build factories for the production of steel. It is obviously desirable to construct a sufficiently large workshop to build factories for steel production). This means developing the capital goods industries, that is, increasing the production of investment in capital goods enterprises as much as possible. At present only a small portion, possibly less than 10 per cent, of all investments goes to capital goods industries. From preliminary studies it seems that this proportion would have to be increased to, say, 30 per cent to double the national income in 20 years. From the long range view point, it would be still better to push up the share of heavy industries to 40 or even 50 per cent but this may be too difficult to accomplish and too great a sacrifice of the present for the benefit of the future. We may, therefore, adopt 30 per cent as the share of capital goods industries for purposes of illustration—this means an allocation of 3 per cent of net national income or about Rs. 300 crores for investment in capital goods industries every year.

4. Having allocated 30 per cent of the investment to capital goods industries, we may proceed to give, say, 20 per cent to investments in large factories to manufacture consumer goods, 25 per cent to agriculture and small industries, and 25 per cent to services. On the basis of an initial investment rate to Rs. 600 crores per yeaı allocated in the way mentioned above it is possible to study the changes in the national economy in 10 years. We shall assume that the ratio of new income generated to capital investment is one-fourth in the case of large scale enterprises to produce both capital and consumer goods, half in the case of agriculture and small industries, and one in planned services. We also assume for purposes of illustration that the average amount of investment required per engaged person is Rs. 10,000 for capital goods industries, Rs. 7,500 for consumer goods factories, and Rs. 1,000 for agriculture, small industries and services. On certain plausible assumptions (and using a particular form of a model of economic growth) it seems that at the end of 5 years the rate of investment would increase to about Rs. 860 crores per year; national income would increase by 17 per cent, and new jobs created every year would be so large as nearly 48 lakhs. The rate of development would, however, become more rapid as time progresses.

5. At the end of 10 years, the rate of investment would rise to over Rs. 1200 crores, national income would increase by 42 per cent, and employment by nearly 70 lakhs of jobs. (In fact such an increase of employment may not be even necessary in which case the investment in small industries may be fixed at a lower level.)

6. In addition to the planned or directed investments (through, for example, the existing control over capital issues) it is assumed that there would be an unplanned sector; and also that it is possible to work out the relation and interaction between the planned and the unplanned sectors. On the basis of such interaction it would be possible to make a rough estimate of the total increase in national income and the portion available for consumption.

7. At this stage it is necessary to consider the distribution of the increase in income among the population. In principle, the distribution of income can be controlled to some extent through taxation and other financial measures. It is, therefore, possible, in principle, to lay down certain targets in the distribution of income. (This in fact is one of the important responsibilities of Planning Authorities).

8. Once the desired distribution of income is settled, it would be possible to consider the change in the demand of consumer goods and services. Purchasing power would increase with rising income; and the demand for goods and services would increase in a definite way depending on the nature of the commodities or services. Intensive studies have been started on the basis of the data collected by the National Sample Survey to find out how the consumption of particular commodities or services actually changes with increasing levels of per capita expenditure. For example, it seems that if the income increases by 30 per cent, the consumption of salt may increase by only 8 per cent, of cereals by 12 per cent and of cotton textiles by 25 per cent. (These are illustrative figures and should not be taken as actual estimates).

9. The above change in consumption with increasing income refers, of course, to different households or individuals at the same point of time. It is not unreasonable to assume that, as a first approximation, a similar change would take place when the income of the same households or individual increases over time. On this assumption and with any given (desired) distribution of income it is possible, in principle, to make a rough estimate of the total increases in demand of different consumer goods and services. This gives a basis to settle the supply of goods required to meet the increased demand. But it is not necessary to accept the figures exactly as estimated.

It is possible, within certain limits, to make suitable adjustments from social or administrative considerations. For example, the supply of certain luxury items may be deliberately kept low or the supply of certain items like, say, education or health services may be increased. (Such adjustments would be naturally the responsibility of the Planning Authorities.) After such adjustments, the requirements of consumer goods would become available.

10. At the same time it would be necessary to decide the requirements of capital goods which would naturally depend on the programme of investment. Consideration would be also given to imports and exports. It may be decided, for example, to meet certain portions of the requirements (of both capital and consumer goods) through imports. It would be necessary at the same time to settle what additional quantities of which commodities would have to be produced and exported to meet the cost of imports. In this way the final planned bill of goods (to meet estimated requirements of consumption, investment, and export) which would have to be produced in the country, would become known.

11. Next comes the crucial step of examining whether the required additional bill of goods and services can be in fact produced and supplied with the help of the investments of different types for which allocation had been actually made. It would be necessary at this stage to consider the detailed breakdowns of production of commodities and the supply of services. The economic and technological relations between investment, income, and employment in different industries would have to be used at this stage for which intensive studies would be indispensable. (Work on a small scale has been already started.) If the desired requirements of goods and services can be supplied through appropriate investments in different industries within the limits of the allocated resources, then a solution would have been reached. It would be then possible to proceed with the detailed planning within the broad frame of the solution adopted by the Planning Authorities.

12. Further problems would arise as the programme of investment and production becomes more and more concrete. One industry would sell its products to various other industries. Also it would get its needs form other industries. For example, to produce one additional million ton of steel it is necessary to produce (or import) two additional million tons of coal, two additional million tons of iron ore, and additional quantities of many other materials such as manganese ore, dolomite, magnesite, fluxes, refractories, etc. Moreover, fixed and working capital requirements of one industry would be supplied by many other industries, and its own product would be used as

fixed and working capital in other industries. Thus the whole industrial structure is closely interlocked, and in other to conceive of a change in the level of production of one commodity it is necessary to give consideration to the change in output of many other industries. When an approximate allocation of investments is ready, the anticipated consumer expenditure is known, and the requirements of final flows of consumer goods have been settled, it would be necessary to work out the total output of the different industries (inclusive of all intermediate products and consistent with the bill of final goods). This can be done with the help of inter-industry relations (some time called input-output tables). Work is already in progress in 12 sectors (that is, a 12×12 table); and arrangements are being made to prepare a 90×90 table. Later on, it is proposed to consider the inter-relation and two-way distribution of fixed and working capital.

13. In the present approach the essential aim is to adopt a pattern of investments which by developing the capital goods industries would make available a larger and larger supply of capital goods produced within the country and thus make it possible to increase progressively the rate of investment and hence the rate of economic development in the desired way. A larger rate of investments would mean an increase in employment and in salary and wage payments leading to an increase in purchasing power which in its turn would create a larger demand for goods and services. One aim of planning must be to meet the increase in demand by a commensurate increase in the production of the required goods and in the supply of the required services. If this is feasible, a possible solution at the technological level would be available (which may or may not be acceptable depending on other considerations). If the expected requirements cannot be met by the anticipated production, then changes would have to be made in the investment plan until this condition is broadly satisfied. The acceptable solution must also satisfy, as far as possible, the condition of attaining full employment in, say, 10 years. If there is more than one solution satisfying the two basic conditions mentioned above, it would be possible to introduce supplementary conditions relating to the increase of income or the distribution of income.

14. One condition in the aggregate is, of course, that the total production of consumer goods should equal the total personal income after tax deductions together with current payments by public administration other than transfers and factor incomes. It is desirable that this balance should be maintained year by year, and not merely reached at the end of the plan period. It would be difficult to attain this balance during periods of large scale capital construction because the new capital stock realised is not consumable. Gaps between

demand and supply would no doubt sometimes emerge and short range correctives (in the way of price controls, rationing, etc.) may be necessary from time to time.

15. It is necessary but not sufficient to work out a plan in physical terms; the financial counterpart must also be worked out. The most important question here is to find financial means to increase investment from, say, 5 or 6 to 10 per cent of national income. It is possible to use the investment plan itself to help in this matter. For example, new investments can be made entirely or mostly in the public sector so that "profits" or the surplus can be utilised for further investments. (Ploughing back of profits in existing private enterprises can be permitted to the desired extent to enable production being increased at marginal outlay.) Excise duties can be levied at the point of production in large scale industries in the private sector and the proceeds used for national development. Further expansion of large scale manufacture of such consumer goods as can be produced through handicrafts or small industries can be discouraged or prohibited for some time which would make available more resources for capital goods industries and other sectors. Factory production of consumer goods may however, be arranged, preferably in the public sector, in the case of essential commodities, or goods for export, or finally, "luxury" goods on which it is possible to earn very high profit.

16. The model described here, however, definitely contemplates a large increase in small industries to supply as much as possible the increasing demand in the short run. After full employment has been attained, and the capital goods industries have been developed fairly well, it would be possible and desirable to increase the rate of industrialization by drawing away labour from agriculture and small industries. At this stage there would be no danger of creating unemployment through the expansion of large scale factory industries.

17. It would be probably desirable to give immediate attention to increase production to full capacity in both large and small industries, and also to increase productivity by all other means such as working 2 or 3 shifts, because all this can be done with a very small outlay of capacity and also because this would create a good deal of employment. The question of surplus production would emerge which may require government purchases on a large scale to build up inventories which would be used to meet the increase in demand later on. Government trading may be of help in this connexion and may also be useful in earning profits to be utilised for economic development. Suitable excise duties at the point of production and planned

STATISTICAL INSTITUTE LIBRARY No. 106584

profits at the stage of distribution can serve the dual purpose of securing resources for investment and of promoting an egalitarian level of living by imposing higher differential duties or profits on luxury goods.

18. In dealing with the programme of industrial production one most important question would be an adequate supply of trained personnel at all levels. This may indeed prove to be a serious bottleneck. Attention would, therefore, have to be given to estimate the requirements of trained personnel and to make necessary provision to give training to the required number in each field. Input-output tables in respect of man-power would be of help in this connexion. Studies are also being started in this field. In addition, suitable provision will have to be made to ensure an adequate supply of services personnel (including health, education, research, etc.).

SOME OBSERVATIONS ON THE PROCESS OF GROWTH OF NATIONAL INCOME

[*Sankhyā* **12,** 4, 1953]

1.1. In recent years I have had occasion to come into contact with the work on national income and also with some of the problems of economic planning in India. I am not an economist; I have been mostly concerned with analytical statistics and my thoughts naturally turned to the possibility of using simple models on the lines of the physical sciences to study some of these problems.

1.2. In the industrially developed countries in West Europe a high standard of living has been already attained, and the aim is to maintain it at its high level without too violent fluctuations. The position is similar in the U.S.A. and Canada with this difference that in these countries there has also been a large increase in economic activities in recent years. It is natural that West European and North American countries should be greatly concerned with problems of business cycles and economic oscillations (with some increasing interest in recent years in problems of growth in the U.S.A.).

1.3. In India, on the other hand, the present scale of living is extremely low and the most urgent problem is to attain a much higher level which is socially desirable. It may be useful, therefore, to examine how the national income may increase rapidly, in fact, so rapidly that business cycles may be neglected in the first approximation or treated as secondary oscillations superposed on a steeply rising trend. Secondly, in order to make the task manageable, questions of distribution and patterns of consumption expenditure, although of great social significance, may be left out of consideration at first. In the present approach it is assumed that the economic development would take place under central planning.

1.4. It is under the above assumptions that I am studying some very simple models (and am deliberately refraining from considering the detailed mechanism on lines somewhat analogous to a thermodynamic study, as distinguished from a dynamic theory, of the behaviour of gases in physics). Some over-all economic quantities such as the total national income or some of its components are considered as 'variables' and an attempt is made to study the variables in terms of certain 'parameters' which can be treated as constants in comparison with the variables. The variables must be measurable and the parameters estimable from available data, and the relevant concepts must be operational in the sense Bridgeman used this word. Also, both variables and parameters are, of course, subject to errors of observation and estimation but such errors are considered to be dimensionally smaller for parameters in comparison to variables; furthermore such errors are neglected in the present note. I shall conclude this long introduction by stating that I took up those studies primarily as an aid to clear thinking on my own part; and I am publishing the present note in the hope that it may be of some help to others who like me may desire to approach the subjects from the statistical side.

2.1. In a lecture delivered at the National Institute of Sciences of India on 4 October 1952, I used a model to represent economic growth as a first approximation. According to this model, the ratio of net investment to net national income at factor cost in any period of time is taken to be a constant α. Secondly, in any time period the increment of income divided by the investment is also supposed to be a constant depicted by β. On these assumptions, the rate of growth of the economy is given by $\alpha\beta$. If we suppose that the population of the country increases at the constant rate ρ then the rate of growth of the per capita income is given by $\alpha\beta-\rho$.

2.2. When I was studying about this model, I did not know that considerable work had been previously done on models of the same type by Harrod, Domar and others because I was not familiar with economic literature. Now that I have come to know about the previous work I wish to acknowledge their priority.

2.3. The model presented earlier gives a very simplified picture of the economic process; and yet, when data are available over a long time, I noticed that the observed rates of growth in several countries corresponded fairly satisfactorily to the expected rates calculated from this model, the parameters having been estimated from the available data. I have discussed these points in my lecture already mentioned.

3.1. One elaboration of this model is separating the investment in investment goods industries from the investment in consumer goods industries. We assume that the increment of consumption is a constant proportion β_c of the investment in consumer goods industries, and the increment in investment is a constant proportion β_i of the investment in investment goods industries. I have not considered the industry producing intermediate products separately. Conceptually, industries producing raw materials for consumer goods industries are included in the consumer goods industries. Similarly, industries producing raw materials for investment goods industries are included in investment goods industries. It may be mentioned that the division of industries between investment goods industries and consumer goods industries adopted here is somewhat different from Marx's division between Department 1 and Department 2; according to Marx, Department 1 includes *all* raw material producing industries. Secondly, we suppose that a constant percentage λ_c of investment goes to consumer goods industries, and the complementary percentage λ_i going to the investment goods industries ($\lambda_c+\lambda_i = 1$). Under this hypothesis the national income (at constant prices) in year t is given by :

$$Y_t = Y_0\left[\ 1+\alpha_0\left(\frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i\beta_i}\right)\left\{(1+\lambda_i\beta_i)^t-1\right\}\right] \quad \ldots \quad (1)$$

where α_0 is the initial investment rate, and Y_0 the initial national income.

3.2. This model has got several interesting features. As is to be expected, with β_c greater than β_i, in the initial stage of development, the larger the percentage, investment on consumer goods industries, the larger will be the income generated. But there is a critical range of time and as soon as this is passed, the larger the investment in investment goods industries the larger will be the income generated. Hence, it would be desirable to invest relatively more on the consumer goods industries provided we are interested in the immediate future. If, on the other hand, we are interested in the more distant future, relatively larger investment on investment goods industries would give distinctly better results. The following table, which gives the income (at constant price) at different points of time, illustrates the point for some arbitrary values of the parameters :

$Y_0 = 1000$, $\alpha_0 = 5$ p.c. $\beta_c = 30$ p.c. $\beta_i = 10$ p.c.

	value of λ_c		
year	90 p.c.	80 p.c.	70 p.c.
0	1000	1000	1000
5	1071	1068	1064
10	1148	1142	1138
15	1226	1225	1223
20	1308	1316	1322
25	1397	1416	1438
30	1487	1527	1571
35	1583	1650	1726
40	1684	1785	1905
45	1791	1935	2113
50	1904	2100	2354

It will be seen that up to 15 years the highest income is obtained when 90 p.c. of investment goes to consumer goods industries but after this a smaller percentage of investment on consumer goods industries begins to give a better result.

4.1. It may be noted that in the above model the over-all ratio β of increment of income to investment is given by :

$$\beta = \lambda_c\beta_c+\lambda_i\beta_i. \qquad \ldots \quad (2.1)$$

The rate of investment

$$\alpha_t = \frac{I_t}{Y_t} \qquad \ldots \quad (2.2)$$

depends on how the capital stock was originally distributed between the two departments. If the ratio of investment in the investment goods industries (λ_i) is larger than the corresponding ratio of the original capital stocks, then the rate of investment will gradually rise until it reaches a limiting value given by $\lambda_i\beta_i/\beta$. If on the other hand λ_i is smaller than the corresponding ratio of the original capital stocks, then the ratio will gradually fall until it reaches the same limiting value. If the two ratios are identical, then the rate of investment is a constant and the rate of growth of national income also is a constant. In an under-developed country the current rates of investment in investment goods is likely to be small, and, therefore, if we increase this ratio then the value of α would also gradually increase.

4.2. If we consider a case in which investment rate is rising, the initial rise of consumption will be more rapid in a variant of a plan in which λ_c is larger. If, however, we consider the position attained after the lapse of a critical period of time, a smaller value of λ_c will lead to a large rise in consumption. For example, if we have two alternative variants of the investment plan with $\lambda_c = 70$ p.c. and $\lambda_c = 60$ p.c. (other constants having the same values as in the table) the consumption according to the second variant will surpass that according to the first variant in the 29th year.

4.3. Another numerical example with $\alpha_0 = 10$ p.c., $\beta_c = 36$ p.c., $\beta_i = 24$ p.c. may be given. The national income becomes higher in the 5th year and the production of consumer goods greater in the 11th year for the variant $\lambda_c = 80$ p.c. compared with the results produced by a variant with $\lambda_c = 90$ p.c. A lower value of λ_c thus gives distinctly better results when the ratio of β_c to β_i is lower. (The value of λ_c cannot, however, be fixed entirely arbitrarily, and can be changed only within certain technical limits).

4.4. We made some attempt to apply this model to empirical data but so far results have not been satisfactory.

5.1. In the above model β is assumed to be a constant. Certain recent studies have indicated that this is not always true. In the U.S.A., for example, during the period 1897–1950, β exhibited a kind of a parabolic trend. On the other hand, in a pre-industrial economy, I believe it may be possible to secure a steadily increasing β by deliberate planning. We have considered below a model in which β is supposed to be a function of time. Thus, we may assume that

$$\frac{dY}{dt} = \alpha\beta_t Y \qquad \ldots \quad (3)$$

where β_t is equal to $k+lt$, or $k+lt+mt^2$; $k, l, m,$ being constants.

5.2. The solution of the differential equation in the first case is :

$$Y_t = Y_0 e^{a\left(kt+\frac{lt^2}{2}\right)} \qquad \ldots \quad (3.1)$$

where Y_t is the national income in the year t, and Y_0 the original income. However, this model also did not give a good fit to data in respect of the U.S.A. probably because the assumption that α is constant was not valid over the period considered.

5.3. The constants for the equation for β_t in the second case were estimated from the material given by Goldsmith in his recent paper in Income and Wealth, Series II; and the equation is

$$\beta_t = 0{\cdot}33729 - 0{\cdot}00661t + 0{\cdot}00016t^2. \qquad \ldots \quad (3.2)$$

Also, α was calculated from data given by S. Kuznets. The solution for U.S.A. is then given by the following equation :

$$Y_t = Y_0 e^{\frac{11}{100}\left\{0.33729t - 0.00661\frac{t^2}{2} + 0.00016\frac{t^3}{3}\right\}} \qquad \ldots \quad (3.3)$$

6.1. In a planned economy, it may be possible to go on increasing α up to a certain level deliberately. The earlier model considered in this note may, therefore, be realistic under certain conditions of planning with the restriction that the ratios of increment of net outputs to investment are taken as constants. It should be also possible to increase the ratios (β_c, β_i) through deliberate planning. Suppose that in the earlier stage of development, a product of an industry has got practically no market, and therefore is of negligible value. At a later stage of development it may, however, be possible to use this waste product as raw material in some other industry which is established by planning. In an economy which is developing harmoniously, a number of such by-products may gradually become useful. Hence the ratio of the value of net output to the value of raw materials would increase because by-products of the type considered above would continue to be sold at negligible prices. An increase in the ability of machines or of labour to convert the same amount of raw materials into a larger quantity of final product will produce the same effect, price situation remaining the same. A steady increase of β may be, therefore, a characteristic of harmonious development. (Similar effects may also arise at a stage of very high and diversified industrialization and may therefore explain the increase in β in recent years in U.S.A., as observed by Goldsmith.)

6.2. For rapid development it would be desirable to aim at increasing both α and β. The first model is concerned only with an increment of α while the second model is concerned with an increment of β. It will be of interest to consider a model which allows simultaneous variations of α and β. It will be also noticed that in the second model β has been assumed to vary simply with time; it would be more satisfactory if a model can be constructed in which the variation of β would depend on some economic factors. I and some of my young colleagues are engaged in studying problems of this type, and we hope something of practical interest would emerge in time.

RECOMMENDATION FOR THE FORMULATION OF THE SECOND FIVE YEAR PLAN

Prime Minister Jawaharlal Nehru inaugurated the studies relating to planning for national development in the Indian Statistical Institute on 3 November 1954. The work on economic planning was then organized and carried on with the active collaboration of the Central Statistical Organization, the Economic Division of the Planning Commission and the Department of the Economic Affairs of the Ministry of Finance. On the basis of four agency co-operative studies the 'Draft Plan-Frame' was prepared and submitted to the Prime Minister on 17 March 1955. The Panel of Economists, Planning Commission examined the 'Draft' in April 1955 which was then accepted by the National Development Council in May 1955 as the basis for the formulation of the Second Five Year Plan of India.

INTRODUCTION

1.1. The Second Five Year Plan is due to begin on April 1, 1956. The approach in the Second Five Year Plan is to take a perspective view of development over a long period of years, and at the same time to solve immediate problems like unemployment as quickly as possible. Planning would be, therefore, flexible and would always keep a wide time horizon in view; and at the same time detailed annual plans would be prepared and necessary adjustments made at shorter intervals in the light of experience.

1.2. Proper attention must be given to the physical aspects of the Second Five Year Plan. The requirements of each project must be estimated in real terms at the stage of planning and must be forthcoming in right quantities at the right time at the stage of implementation of the project. Also, the products and services resulting from the completion of a project must be fully and promptly utilized to further the execution of other projects and the progress of the plan as a whole.

1.3. A plan in a mixed economy must be comprehensive and cover both the public and the private sectors. To achieve a balanced growth, the activities of the private sector must conform in a general way to the programme of production of the plan as a whole. In an expanding economy the private sector would have an assured market which would facilitate decisions by reducing risks and uncertainties. Also, the over-all programme would be laid down in broad aggregates so that there would be wide scope for adjustments in details at the discretion of the private sector.

1.4. The physical targets of production must also be balanced in terms of money. Incomes are generated in the very process of production; and supplies are utilized through market operations. Planning requires that aggregate incomes should be balanced with expenditure, savings should match investments, and the supply and demand of individual goods and services should be balanced in terms of money so as to avoid any inflationary rise of prices or undesirable shifts in prices. Physical and financial planning are different aspects of the same reality.

2.1. The paper contains chapters on main aims and objectives; provisional targets of production; investment and development expenditure; expected changes in employment and income; finance and foreign trade; and planning organization and administration to supply a tentative frame-work for the formulation of the Second Five Year Plan.

2.2. It is requested that the Central Ministries, State Governments, and other project-making authorities should use the provisional figures given in the paper as a general Plan-frame for the formulation of schemes and projects taking care to make estimates in both physical and financial terms, and to forward them to the Planning Commission as they become ready.

2.3. When the individual schemes and projects have been received in the Planning Commission, the aggregate balances would be examined and adjusted as necessary until an integrated plan is evolved which will be internally consistent and balanced in both physical and financial terms. Estimates of demand and supply are bound to be approximate to begin with; and would have to be worked and reworked to secure a proper balance.

2.4. It is recognized that while projects are being prepared there would be need of a two-way flow of information as well as of consultations between project-making bodies and the Planning Commission. The present recommendations would supply the initial base for such consultations and discussions.

3.1. The programme for the first year (April 1956–March 1957) of the Second Five Year Plan must be completed by October 1955. This first year's programme would contain much carry-over from First Five Year Plan and some new items for which projects are ready or are in an advanced state of preparation. It is requested that projects for 1956-57 (including the carry-over from the First Five Year Plan) should be sent to the Planning Commission.

3.2. The Second Five Year Plan must be ready (in outline form) by March 1956. Projects for the remaining period of Second Five Year Plan should therefore be sent to the Planning Commission.

4.1. Some of the projects would have to be submitted necessarily in a general form at the present stage; and working details would be prepared after it is decided that they would be included in the plan. Nevertheless, it is essential that preliminary information should be given in the prescribed form even if the estimates are of an approximate nature because a technical examination of the projects would not be possible in the absence of such information.

4.2. The Planning Commission would be glad to supply further information in this connection and help in the preparation of schemes and projects.

Chapter One

GENERAL AIMS AND OBJECTIVES

1.1. *The First Five Year Plan* : At the beginning of the Five Year Plan the country was still dislocated by war and partition. There was shortage of food and raw materials. There were signs of inflationary pressures after hostilities had started in Korea. In this situation it is understandable that the targets of the First Five Year Plan were kept modest. Judged in this context, the progress achieved so far may be regarded as satisfactory.

1.2. There are, however, disquieting features. Agricultural prices are declining. Unemployment, especially in urban areas, is increasing. Even the modest expenditure targets in the First Five Year Plan have not been fully achieved on account of delays in preparing projects, inadequate administrative organization, and lack of sufficient facilities to give training to technical personnel.

2.1. *The need for a bold plan* : The population of India is increasing roughly at the rate of 4·5 million per year. With a proportion of about 40 per cent in the labour force, about 1·8 million persons enter the labour force every year. In addition, a large number of persons are without employment in urban areas and a great deal of under-employment exists in villages. Planning must be bold enough to provide new work for about 1·8 million new entrants into the working force every year; and also to offer more work to the large number of persons who are without jobs or who are under-employed at present.

2.2. The level of living is extremely low. Expenditure on consumer goods per person is about Rs. 22 per month of which about Rs. 13 is spent in cash and about Rs. 9 is the value of consumption of home-grown food and home-made articles. Housing is primitive in villages and extremely short in urban areas. The supply of nutritive foods is meagre although nearly two-thirds of the total expenditure is spent on food items. The expenditure on education is only about four annas per person per month and on health less than seven annas.

2.3. The above estimates are for all classes taken together. The position of the poorer section is much worse. Half the population of India or 185 million persons spend less than Rs. 13 per month on consumer goods and possibly half of this amount is consumed in kind or in the form of home-grown food and home-made articles. Of children in the school-going age, less than half attend at the primary stage, and less than one-fifth at the secondary stage. There is probably less than one qualified physician per 30,000 inhabitants in the villages.

3.1. *General objectives of the Second Five Year Plan*: There is a large pool of idle man-power, and many are without jobs; also about 1·8 million persons would be added to the working force every year. The country has large resources of water for hydro-electric and irrigation projects; coal, iron ore and other important minerals; forests, fertile land and cattle. The aim of planning must be to utilize these resources to increase rapidly the level of production and thus of national income.

3.2. Conditions are favourable in many ways. There is economic stability and confidence in Government. Unemployed man-power and unexploited resources can be brought together to increase both consumption and investment simultaneously. India's prestige is high at the international level. Finally the Congress Party and Government have decided that the time has come for economic development on a socialistic pattern.

3.3. The Second Five Year Plan is therefore being formulated with the following objectives in view :

(1) to attain a rapid growth of the national economy by increasing the scope and importance of the public sector and in this way to advance to a socialistic pattern of society;

(2) to develop basic heavy industries for the manufacture of producer goods to strengthen the foundations of economic independence;

(3) to increase the production of consumer goods as much as possible through the household or hand industries; and to provide an adequate market for the products;

(4) to develop factory production of consumer goods in a way not competitive with hand industries;

(5) to increase productivity in agriculture; and to speed up agrarian reforms with an equitable distribution of land to peasant cultivators so as to stimulate the increase of agricultural production and of purchasing power in rural areas ;

(6) to provide better housing, more health services, and greater opportunities for education especially for the poorer sections of the population;

(7) to liquidate unemployment as quickly as possible and within a period not exceeding ten years;

(8) and as the result of such measures to increase national income by about 25 per cent over the plan period and achieve a more equitable distribution of income.

3.4. The basic strategy would be to increase purchasing power through investments in heavy industries in the public sector and through expenditure on health, education, and social services; and to meet the increasing demand for consumer goods by a planned supply of such goods so that there would be no undesirable inflationary pressures. Planning would be thus essentially a feed-back process of matching a continuously increasing (planned) demand by a continuously increasing (planned) production giving rise to a steadily expanding economy.

4.1. *Heavy industries* : In the long run, the rate of industrialization and the growth of national economy would depend on the increasing production of coal, electricity, iron and steel, heavy machinery, heavy chemicals, and the heavy industries generally which would increase the capacity for capital formation. One important aim is to make India independent, as quickly as possible, of foreign imports of producer goods so that the accumulation of capital would not be hampered by difficulties in securing supplies of essential producer goods from other countries. The heavy industries must, therefore, be expanded with all possible speed.

4.2. The new producer goods industries would be developed mainly in the public sector. The private sector would continue to play an important part in the development of basic industries like cement, chemicals, etc.

4.3. The heavy industries being capital-intensive would, however, give relatively little scope for employment; and would also generate a large demand for consumer goods which they themselves would not be able to supply.

5.1. *Household and hand industries* : The increasing purchasing power and consequential demand for consumer goods must be met by increasing the supply of such goods as much as possible through the expansion of household or hand production. This would also quickly generate a large volume of work all over the country.

5.2. Construction work (roads, houses, irrigation and flood control projects, etc.) by hand would also be increased which would create a good deal of employment and generate demand for consumer goods.

5.3. The greater the marketable surplus of consumer goods in the household or hand industries the greater will be the possibilities of investments in heavy industries without any fear of inflation.

5.4. By expanding the household and hand industries and construction work, the aggregate national consumption would increase continually. Also, relatively more employment would be created among the poorer sections of the people so that a greater portion of the increase in income would go to them.

6.1. *Factory production of consumer goods* : The production of consumer goods in factories requires heavy investment of capital per engaged person and in many cases competes with the household or hand industries. Until unemployment is liquidated or brought under control, it is necessary to prevent competition between factories and household or hand industries by not permitting investments to be made in such consumer goods factories as would prevent expansion or lead to a shrinkage of employment in the hand industries.

6.2. In the immediate future the factory production of consumer goods would be expanded (where it is not competitive with hand industries) to increase the supply of essential goods (like antibiotics, fine drugs, etc.) or of goods for export to earn foreign exchange.

6.3. It is recognised that the price of hand-made goods would often be higher than the price of factory-made goods of comparable quality. Appropriate excise duties (which would be selective) would be imposed on factory products to maintain desired price parities with hand-made goods in such cases.

6.4. Once mass unemployment has gone, the aim would be to provide cheap power and small machines to the household sector and hand industries to increase productivity per worker and hence the total national product. At this stage the factory production of consumer goods would also be increased.

7.1. *Agriculture and allied pursuits*: The fixation of ceilings and procedural arrangements for the redistribution of land to peasant cultivators must be decided at an early date in each State in accordance with general principles and standards settled on an all-India basis, and the redistribution must be completed by 1958. This would make visible important structural changes in the economy resulting in stimulation of agricultural production and provision of a large market for the growing output of industry and handicrafts; and would also transfer a part of the national income from recipients who use it largely for luxurious consumption to recipients who will use it for productive purposes and for raising their low standard of life.

7.2. The National Extension Service Blocks (and Community Projects where possible) would be extended all over the country to help and speed up the improvement of living conditions in rural areas.

7.3. Because of the urgent need of increasing the production of food-stuffs and raw materials, the highest priority would be given to the setting up of a State Bank, as recommended in the Report of the Rural Credit Survey Committee, for the supply of agricultural credit.

7.4. The same or an associated system would be used for the supply of credit, raw materials, and marketing facilities to the household and hand industries through an organization of co-operatives with the support (or the direct participation or partnership) of Government.

7.5. As an increase in the caloric value is not enough for a balanced diet, concerted efforts must be made to increase the supply of food of higher nutritive and protective value such as fruits and vegetables, milk and milk products, eggs, fish, meat etc.

7.6. Continuing efforts must be made to increase the production of milk products by imporving the quality of cattle through the introduction of better breeds, by increasing the production of fodder crops and cattle feed, and by providing better veterinary services by increasing the number of trained veterinary surgeons and veterinary assistants.

8. *Health* : There must be a rapid increase in the care of health. A national health service would be established in the rural areas with paid health assistants in charge of a group of villages who would work in contact with fully trained physicians. The number of dispensaries and hospitals, and facilities for medical training would be increased in urban areas.

9.1. *Education* : There must be a rapid increase in literacy, improvement in the pay of teachers, and better organization of education at all levels.

9.2. On the basis of merit, able students, at all levels and in increasing numbers, must be provided with adequate living and educational expenses to enable them to receive education up to the highest standard according to capacity without regard to sex, creed, caste, or social status of the parents. Special educational scholarships and facilities must also be provided for women and backward groups and communities.

10.1. *Social security and welfare* : Existing social security schemes such as Employees State Insurance and Provident Fund schemes would be expanded. A scheme for unemployment benefit in the form of paid attendance at training centres with placement facilities would be introduced in urban areas.

10.2. There must be increasing provision for the social welfare of children (foundling homes, creches, nursery schools, health and recreation centres, etc.), of women (houses for widows, destitute and deserted women; maternity, health, and family planning centres), of juvenile delinquents (remand homes, schools, after-care hostels, etc.), of the handicapped (homes, schools and workshops for the blind, the deaf and the dumb, the crippled, and the mentally deficient or ill, and homes for the aged and the infirm).

11. *Sports and cultural pursuits* : Increasing facilities must be provided for sports and health activities, educational and cultural broadcast and cinema; and the promotion of literature, music, drama art and other cultural pursuits.

12. *Housing* : Better housing must be provided especially for factory workers and proorer sections of the people in urban areas.

13. *Social overheads*: Expenditure on housing, health, education, social security and welfare, sports and cultural pursuits would necessarily increase purchasing power and create additional demand for consumer goods which must be met by increasing the production of additional consumer goods through household and hand industries in the first instance.

14.1. *Balanced development and controls*: With the stepping up of production of both producer and consumer goods, it would be necessary to provide for adequate increases in the supply of electricity and fuels, irrigation, transport, and communication. Proper balances must be maintained between sectors so that production is not hampered by bottleneck.

14.2. The aim of planning would be to avoid shortages giving rise to inflationary pressures on the one hand and over-production with falling prices on the other. In the case of falling prices, especially of consumer goods, the demand would be stimulated promptly by increasing purchasing power through investments in the public sector and through expenditure on social services and by open market operations by Government.

14.3. Government would acquire and keep adequate reserves of foodgrains and important raw materials produced by agriculture to provide against emergencies of short crops in bad years and to maintainpr ices profitable to peasants in years of exceptionally plentiful crops. This would maintain a minimum level of peasant incomes, stimulate production, and promote the welfare of both peasants and the working class in urban areas.

14.4. Shortages may, however, develop in the short run which would be dealt with as they arise by appropriate methods such as Government intervention in the market, Government trading, physical controls, rationing and similar measures. Also, the production programme would be adjusted as necessary to restore equilibrium between supply and demand as quickly as possible.

14.5. Rationing of foodgrains, clothing, and similar essential commodities would be avoided. Control over consumption when necessary, would be related to the shortages of specific physical resources.

15. *Regional development* : Special attention must be given to regional development to reduce disparities in economic opportunities and the level of life between different States.

16.1. *Technical training and scientific research* : A bold plan will require a rapidly increasing technical staff to prepare the various projects as well as to implement them. Training facilities must be expanded sufficiently quickly to turn out technical and scientific personnel in adequate numbers at all levels.

16.2. Scientific and technological research would be expanded and oriented to serve the needs of national development in an effective manner. The National Laboratories, Universities and other scientific institutions and organizations must undertake coordinated researches in accordance with national needs.

16.3. Fundamental research as well as training in research must also be encouraged at the same time to foster the accumulation of basic knowledge and skill for the expansion of applied and technological research.

16.4. The survey of natural resources, especially prospecting for oil and minerals, must be greatly and rapidly increased through State organizations.

17.1. *Expansion of the public sector* : Key industries would be established and developed in the public sector generally in accordance with the Industrial Policy Declaration of 1948 as interpreted in December 1954. Government would also take up the factory production of certain consumer goods which are of strategic importance for the growth of the national economy.

17.2. The public sector must be expanded rapidly and relatively faster than the private sector for steady advance to a socialistic pattern of economy. In order to make available large capital resources for investment and national development and to facilitate the implementation of the Plan, Government will be prepared to enter into such activities as banking, insurance, foreign trade or internal trade in selected commodities.

17.3. Government would also promote enterprises in partnership with the private sector so that, although Government would hold a controlling share, initiative can be left to private management subject to policy decisions by Government.

18.1. *The private sector* : A large majority of the population would be engaged in household production in agriculture in hand industries and in various services which would continue to remain private.

18.2. As the planned demand would have to be matched by the planned production, it would be necessary for the private sector to conform in a general way to the overall programme of production as provided in the Plan. The private sector would be helped by Government by the supply of credit, raw materials and marketing facilities to undertake production in accordance with the Plan.

18.3. Inducements (such as tax exemption or preferential permission for capital issue) would be given to channel the profits of the private sector into desirable forms of investments in both private and public sectors or in Government bonds and securities.

18.4. The private sector would enjoy the advantages of an assured and growing market in an expanding economy, and thus of reduced risks and uncertainties.

19.1. *Finance and foreign exchange* : Large financial resources would be required for the Second Plan. A small portion would come from sterling balances or foreign loans and aid; and the bulk of the resources must be found from within the domestic economy.

19.2. The tax system would be directed to collect an increasing part of the growing national income in order to permit greater capital formation in the public sector and to finance an expansion of social services.

19.3. The public sector would be extended to industrial and commercial activities where necessary for raising resources for public purposes.

19.4. Deficit financing would be undertaken on the scale necessary to bring about the greatest possible expansion of production without introducing permanent and all-embracing rationing of essential commodities.

19.5. Conspicuous consumption would be discouraged by graduated excise duties; and a more equitable distribution of income would be assured by taxes on property and unearned income.

19.6. Excise duties would be levied to raise additional resources and also to maintain desired price parities between different sectors.

19.7. Steps would be taken to promote exports; and the import of non-essential and luxury goods would be discouraged by heavy duties in order to release foreign exchange resources for more urgent needs.

CHAPTER TWO

TARGETS OF PRODUCTION

1.1. The targets of production (mostly in physical quantities) of some important items are shown in Table (1). The physical unit is given in col. (2) and actual production for 1950-51 and 1953-54 in cols. (3) and (4) respectively. Estimates for 1955-56 and planned target for 1960-61 together with the estimated increase (in percentage) during the plan period are shown in cols. (5), (6) and (7) respectively.

1.2. The above targets are provisional. Estimates of requirements and likely supplies have been examined in a general way on available information. The next task is to carry out a detailed check and make necessary adjustments on the basis of projects to achieve internal consistency in the form of a balanced supply and demand of material and labour resources. Such balancing must also have a proper phasing over time so that neither serious bottlenecks nor excessive supplies emerge at any stage of the Plan.

1.3. Explanatory notes are given on some (but not all) of the items mentioned in Table (1). The number shown within brackets after each item gives the serial number of the same item in Table (1).

2.1. *Electricity* (1): Planned electrification must be a main link in economic development in India. The hydro-electric projects started in the First Plan must be continued on an increasing scale in the Second Plan.

2.2. Regional grid-systems combining both thermal and hydel power stations must be planned to secure the best of local fuels (low grade coal, lignite, etc.) and of installed capacity by large consumers (electric-intensive industries like aluminium, alloy-steels, etc.) keeping in view the development of a future super-grid for India as a whole.

2.3. Small power stations (hydel and diesel) would also be developed for urgent requirements in small towns and rural areas.

2.4. The use of electricity for small-scale and household industries, irrigation by tube-wells, etc., must be steadily increased.

2.5. The production of electricity must forestall the growth of industrial production; and the installed capacity must increase from 2·8 million kilowatts in 1953-54 to 6 million kilowatts in 1960-61, that is, must be more than doubled. Also, the utilization of capacity must be increased.

TABLE (1): TARGETS OF PRODUCTION FOR THE SECOND FIVE YEAR PLAN: 1956-57 TO 1960-61

name of item	unit	actuals		provisional estimates		
		1950 –51	1953 –54	1955 –56	1960 –61	percentage increase
(1)	(2)	(3)	(4)	(5)	(6)	(7)
factory producer goods						
1. electricity ..	m. kw.	2.3	2.8	3.5	6.0	71
2. coal ..	m. tons	32	36	37	60	62
3. synthetic petrol ..	th. tons	nil	nil	nil	300	—
4. steel ..	m. tons	1.1	1.1	1.3	5.0	285
5. pig iron (for foundries) ..	m. tons	—	—	0.4	1.8	350
6. iron ore ..	m. tons	3	4	4	13	225
7. aluminium ..	th. tons	3.7	3.8	5	40	700
8. manganese ore ..	m. tons	1	2	2	3.5	75
9. cement ..	m. tons	2.7	4.0	4.6	10.0	108
10. fertilizers						
(a) nitrogenous ..	th. tons nitrogen	9.2	61.4	90	360	300
(b) superphosphates ..	th. tons	55	66	100	200	100
11. heavy chemicals						
(a) sulphuric acid ..	th. tons	99	120	150	450	200
(b) soda ash ..	th. tons	45	56	75	200	167
(c) caustic soda ..	th. tons	11	25	33	100	203
12. heavy machinery to fabricate plants (investment)						
(a) steel and producer goods	Rs. crores	nil	nil	nil	150	—
(b) electrical equipment ..	Rs. crores	nil	nil	nil	40	—
(c) consumer goods ..	index	—	—	100	200	100
13. railway rolling stock						
(a) locomotives ..	no.	nil	86	100	400	300
(b) wagons ..	no.	1095	6892	7000	20000	186
(c) passenger coaches ..	no.	479	786	800	2000	150
14. jute textiles ..	th. tons	892	864	1000	1200	20
factory consumer goods						
15. cotton textiles ..	m. yds.	3718	4906	5000	5500	10
16. woollen textiles ..	m. lbs.	18	20	20	25	25
17. sugar ..	m. tons	1.1	1.1	1.4	2.1	50
18. vegetable oil ..	m. tons	1.2	1.4	1.5	2.0	33
19. paper ..	th. tons	114	137	140	200	43
20. bicycles ..	thousand	101	290	500	1000	100
21. sewing machines ..	thousand	33	68	90	150	67
22. electrical goods ..	index	—	—	100	166	66
hand-made consumer goods						
23. khadi and hand-loom ..	m. yds.	742	1200	1600	3200	100
24. soap ..	th. tons	—	—	28	40	43
25. footwear ..	m. pairs	—	—	80	100	25
26. food industries ..	index	—	—	100	120	20
27. metalwares ..	index	—	—	100	133	33

TABLE (1): TARGETS OF PRODUCTION FOR THE SECOND FIVE YEAR PLAN: 1956-57 TO 1960-61—(*Continued*).

name of item	unit	actuals		provisional estimates		
		1950 –51	1953 –54	1955 –56	1960 –61	percentage increase
(1)	(2)	(3)	(4)	(5)	(6)	(7)
agricultural and associated pursuits						
28. cereals ..	m. tons	41.7	56.1	56	63	13
29. pulses and grains ..	m. tons	8.3	9.6	10	13	30
30. total food grains ..	m. tons	50.0	65.0	66	76	15
31. oilseeds ..	m. tons	5.1	5.6	5.6	7.0	25
32. cotton ..	m. bales	2.9	3.9	4.2	5.8	38
33. jute ..	m. bales	3.3	3.1	5.0	5.4	8
34. sugarcane (raw sugar) ..	m. tons	5.6	4.6	5.0	7.5	50
35. tobacco ..	th. tons	257	256	250	300	20
36. tea ..	m. tons	607	675	675	750	11
37. milk ..	index	—	—	100	125	25
38. wool ..	m. lbs.	—	—	40	50	25
39. timber ..	index	—	—	100	130	30
40. fish ..	index	—	—	100	125	25
rural development						
41. irrigation ..	m. acres	50	58	70	100	43
42. NES and community projects	no. of blocks	—	479	1200	5600	367
transport : railways						
43. mileage ..	miles	—	—	34,500	37,500	9
44. passenger miles ..	index	—	—	100	130	30
45. freight ton-miles ..	index	—	—	100	140	40
roads						
46. national highways ..	th. miles	11.9	—	12.5	17.5	40
47. state roads ..	th. miles	17.6	—	20.0	35.0	75
shipping						
48. tonnage ..	thousand	391	525	610	1.500	146
social service : education						
49. pupils : age 6-11 ..	lakh	187	—	236	380	161
50. pupils : age 11-14 ..	lakh	34	—	51	80	157
51. percentage of students in age groups : 6-11 ..	per cent	42	—	50	75	50
52. ,, ,, 11-14 ..	per cent	14	—	20	30	50
53. technical training, higher education and research ..	index of expenditure	—	—	100	175	75
health						
54. hospital beds ..	thousand	107	112	125	250	100
55. doctors(registered) ..	thousand	—	65	70	90	29
56. health assistants ..	index	—	—	100	300	200
housing						
57. urban houses ..	lakh	101	—	120	150	25
communication						
58. post offices ..	thousand	37	47	53	78	47
59. telegraph offices ..	thousand	36	39	48	70	46
60. telephones ..	thousand	168	220	300	600	100

3.1. *Coal* (2) : The production of coal must be increased from 37 million tons in 1955-56 to 60 million tons in 1960-61 (an increase of about 62 per cent) which would be difficult to achieve but should not be impossible.

3.2. There is great wastage at present of high grade coking coal of which supply is short. Necessary Government action must be taken without any delay to prevent such wastage and to promote better conservation.

4.1. *Synthetic petrol and products* (3) : India is short of petrol and meets most of its requirements by imports. In addition to increasing oil-prospecting as quickly as possible, a State plant to produce about 300,000 tons of synthetic petrol must be installed during the Second Plan, and future production must be increased as necessary.

4.2. The above plant must also be used to establish a base for the development of associated chemical industries.

5.1. *Steel* (4) : India has vast resources of iron ore; and increasing production of steel must be made an important link in economic development. The installed capacity would be increased to 6 million tons and production to 5 million tons by 1960-61.

5.2. Necessary action (in the way of establishing a heavy machinery industry and promotion of metallurgical research) must be taken in the Second Five Year Plan to build up the base for the future expansion of the installed capacity of steel by at least one million ton per year from 1961.

5.3. Increasing production of steel would supply a secure foundation for the fabrication of plants and machinery of all kinds, expansion of construction work and of railways and transport generally. If necessary, steel can also be exported to neighbouring countries which are in urgent need of it.

6.1. *Aluminium* (7) : India has large reserves of bauxite and the production of aluminium must be rapidly increased to take the place of copper which is in short supply and mostly imported. Increasing production of aluminium would, in its turn, facilitate electrification; and the production of both electricity and aluminium must be continuously increased at the same time.

6.2. The production of aluminium should be increased from about 5 to 40 thousand tons during the plan period. One or more aluminium plants must be established in the public sector for this purpose.

7. *Manganese ore* (8) : The extraction of manganese ore must be increased and some of the ore must be converted into ferromanganese before export so as to retain a part of the value created by semi-manufacture.

8. *Cement* (9) : The production of cement must be increased from 4·6 to 10 million tons or more than doubled during the second plan period. The production of other building materials must be increased proportionately to avoid shortages and bottlenecks in construction work.

9.1. *Fertilizers* (10) : The production of nitrogenous fertilizer must be increased by about three times by establishing at least three more factories of roughly the same capacity as Sindri.

9.2. Fertilizer production must also be steadily and continuously expanded along with irrigation to secure a rapid increase in the outturn of agricultural crops in future.

10. *Heavy chemicals* (11) : The production of sulphuric acid, soda ash and caustic soda must be increased by 1960-61 to roughly four times the actual production in 1953-54.

11.1. *Heavy machinery* (12) : For rapid industrialization it is essential to fabricate plants and machinery at home. To instal a plant for the production of one million tons of steel per year it is necessary at present to import machinery worth about Rs. 40 or Rs. 45 crores from outside. Provision has been made for investment of Rs. 150 crores to establish large engineering workshops to fabricate machinery needed for producer goods plants. An immediate aim would be to manufacture every year most of the machinery required for installing a one million ton capacity steel plant.

11.2. Investment of Rs. 40 crores is contemplated for establishing plants for the manufacture of heavy electrical equipment.

11.3. The production of machinery for the manufacture of consumer goods (textiles, etc.) must be roughly doubled during the plan period, and an investment provision of Rs. 50 crores has been made for the purpose.

12. *Railway rolling stock* (13) : The annual production of locomotives must be increased from 100 to 400; of wagons from 7,000 to 20,000; and of coaches from 800 to 2,000 so as to attain self-sufficiency in rolling stock by the end of the plan period.

13. *Jute textiles* (14) : Immediate steps should be taken to ensure a fuller use of the existing capacity and to see that by 1960-61 the full rated capacity is utilized.

14.1. *Factory-made consumer goods* : The factory production of essential consumer goods would be increased in such a way as to prevent competition with the household and hand-industries.

14.2. *Cotton textiles* (15) : Production would be increased to 5,500 million yards per year by 1960-61, the additional production being used mainly for exports. (The remaining part of the internal demand would be met by hand-made cloth.)

14.3. *Woolen textiles* (16) : Manufacture of woollen textiles should increase by about 25 per cent during the second plan period.

14.4. *Sugar* (17) and *vegetable oil* (18) : The production of sugar must be increased (preferably through co-operatives) by about 50 per cent and reach 2·1 million tons. A rise by about 33 per cent of the production of vegetable oil will be necessary.

14.5. *Paper* (19), *bicycles* (20), *sewing machines* (21), and *electrical goods* (22) : Production must increase by roughly between 40 per cent and 100 per cent to meet anticipated increase in demand and also partly for export.

15.1. *Hand-made consumer goods* : Every effort must be made to expand the hand production of consumer goods to provide a marketable surplus to meet the increase in demand.

15.2. *Khadi and handloom* (23) : Production would be increased to 3,200 million yards (from the level of about 1,200 million yards in 1953-54).

15.3. Production of other hand-made articles must be increased by 20 to 40 per cent.

16.1. *Agriculture and allied pursuits* : The production of *cereals* (28) must be increased from 56 million tons in 1953-54 to 63 million tons in 1960-61, and of *pulses and grams* (29) from 10 to 13 million tons. This would make the country self-sufficient in foodgrains at a somewhat higher standard of consumption that at present.

16.2. *Cotton* (32) : Output must increase by 38 per cent to 5·8 million bales so that the net import of cotton can be considerably reduced by 1960-61.

16.3. *Sugarcane* (34) : Output must increase to 7·5 million tons of raw sugar (50 per cent increase).

16.4. *Milk* (37) : Production of milk and other edible animal husbandry products should go up by about 25 per cent.

17.1. *Irrigation* (41) : In order to achieve the agricultural targets mentioned above, the total irrigated area must increase from 70 to 100 million acres.

17.2. Special attention must be given to devising suitable measures for flood control.

18. *National Extension Service and Community Projects* (42) : Vigorous organization and persistent efforts would be required for the expansion of production in agriculture and in household and hand industries. NES blocks, which can supply a convenient machinery for this purpose, must cover the entire country by the end of the Second Plan.

19. *Transport* : *Railway tracks* (43) would be increased by 3,000 miles (9 per cent increase); *passenger miles* (44) and *freight ton-miles* (45) by 30 per cent and 40 per cent respectively. *National highways* (46) would be increased from 12,500 to 17,500 miles (40 per cent increase) and *State roads* (47) from 20,000 to 35,000 miles (75 per cent increase). *Shipping tonnage* (48) would increase from 525,000 (in 1953-54) to about 1,500,000, an increase of 185 per cent.

20.1. *Education* : The number of pupils in schools between the ages of 6 and 14 would increase from about 29 million in 1955-56 to about 46 million in 1960-61.

20.2. The expenditure on *technical training, higher education and research* (53) must increase by 75 per cent.

21.1. *Health* : The number of *hospital beds* (54) must increase from 112,000 in 1953-54 to 250,000 in 1960-61; and the number of *registered doctors* (55) from 65,000 in 1953-54 to 90,000 in 1960-61.

21.2. Two new cadres of junior and senior *health assistants* (56) would be created with two levels of training of two years and four years respectively. Each junior health assistant would be placed in charge of a group of 10 villages or one NES block and one senior health assistant would be in charge of 5 such groups or 5 NES block together with one registered doctor in charge of two such units or 10 NES blocks in such a way that the whole of the rural area is covered by the end of the Second Plan.

22. *Urban Housing* (57) : The number of urban houses must increase sufficiently to provide additional accommodation for 3 million families during the Second Plan.

APPENDIX TO CHAPTER TWO

COMMODITY BALANCES IN 1960–61 (*Provisional*)

1. Attempts have been made to see, in a rough way, that the targets given in Table (1) are consistent. This appendix gives relevant information for five major commodities : electricity, coal, steel, cement and heavy chemicals.

2. *Electricity* : The consumption of electricity in 1960-61 is expected to be 20,000 million kilowatt hours (kwh) which should be possible to secure from an installed capacity of 6 million kilowatts (mkw) with a slightly higher rate of utilization than the present rate. The following allocation of power in million kwh is envisaged in 1960-61 : iron and steel (2500), aluminium (1300), cement (1100), cotton textiles (1500), fertilizers (1000), all other industries (5600) and light, small power, traction and all other uses (7000)—total (20,000).

3. *Coal* : The industrial development envisaged would require at least 60 million tons of coal. The allocation in million tons in 1960-61 is expected to be as follows : railways (14·0), electricity (5·0), iron and steel (15·0), cement and bricks (5·0), cotton textiles (1·5), jute mills (0·5), paper (1·0), fertilizers (1·0), other industries (4·0), bunker and steamer service (2·0), domestic (7·5), synthetic petrol (1·5), and all other uses (2·0)—total (60·0).

4. *Steel* : The rough pattern of utilization in million tons in 1960-61 is given below : steel processing industries (1·5), railways (0·8), industrial development schemes both public and private (0·8), other Government development schemes including multipurpose and State irrigation projects (0·2), construction (0·5), industrial maintenance and packing (0·3), defence and roads (0·1), and all other uses including export (0·7)—total (5·0).

5. *Cement* : The allocation envisaged in million tons in 1960-61 is as follows : all construction (6·4), cement products (0·4), railways (0·5), roads (0·3), multipurpose and State irrigation projects (1·8), and all other uses including export (0·6)—total (10·0).

6.1. *Heavy chemicals* : Balances have been worked out for sulphuric acid, caustic soda and soda ash.

6.2. *Sulphuric acid* : The allocation in 1960-61 in thousand tons will be as follows : ammonium sulphate (60), superphosphate (110), iron and steel (90) and all other uses (190)—total (450).

6.3. *Caustic soda* : The allocation in 1960-61 in thousand tons will be as follows : soap (30), textiles (20), paper (15), aluminium (5) and all other uses (30)—total (100).

6.4. *Soda ash* : The allocation in 1960-61 in thousand tons will be as follows : glass (100), textiles (10), silicate of soda (10), paper (10), other chemicals (25) and all other uses (45)—Total (200).

Chapter Three

INVESTMENT AND DEVELOPMENT

1.1. *Allocation of investment* : The allocation of investment (or net capital formation) by broad sectors is shown in Table (2).

TABLE (2): ALLOCATION OF INVESTMENT

(Rs. crores)

sector	public	private	total	percentage
(1)	(2)	(3)	(4)	(5)
1. electricity	450	50	500	8.9
2. industry	1,000	400	1,400	25.0
3. transport & communication	850	50	900	16.1
4. agriculture & irrigation	750	200	950	17.1
5. construction	250	1,100	1,350	24.0
6. stocks	100	400	500	8.9
total	3,400	2,200	5,600	100.0

1.2. Electricity includes both hydro-electric and thermal power stations. Industry includes the household and hand industries. Construction includes residential houses, schools, hospitals, and public buildings.

1.3. Strictly comparable figures are not available for the First Five Year Plan, but the total investment in the public sector as planned was roughly Rs. 1600 to Rs. 1700 crores and the same amount was estimated for the private sector. Thus, investment or net capital formation through the public sector in the Second Plan would be about double of the planned estimates in the First Plan; and the estimated investment in the private sector would be about 40 per cent higher.

2.1. *Allocation by industries* : The breakdown of investment by important industries is shown in Table (3).

2.2. The provision for iron and steel includes expension of capacity of existing plants; three new plants (Rourkela, Madhya Pradesh and one more); factories for the production of pig iron for foundries, and miscellaneous items.

2.3. Along with the installation of one synthetic petrol plant, necessary action must be taken to train personnel and build up experience through pilot plants for the establishment of associated chemical industries.

TABLE (3): ALLOCATION OF INVESTMENT BY INDUSTRIES

industry	investment (Rs. crores)	percentage
(1)	(2)	(3)
1. iron and steel	425	30.4
2. synthetic petrol	80	5.7
3. heavy machinery to fabricate plants for		
(a) steel and producer goods	150	10.7
(b) electrical equipment	40	2.9
(c) consumer goods	50	3.6
4. cement, chemicals, etc.	100	7.1
5. existing state enterprises	50	3.6
6. aluminium	30	2.1
7. minerals and prospecting	75	5.4
8. fertilizers	100	7.1
9. factory consumer goods	100	7.1
10. household and hand industries	200	14.3
total	1,400	100.0

2.4. The production of electrical appliances would include electrical machinery (such as turbines, generators, transformers, transmission equipment etc.) required for hydro-electric and thermal projects.

2.5. The heavy machinery industry to be established in the public sector must be able by 1960-61 to fabricate machinery required to instal every year a steel plant of a million ton capacity or plants to manufacture producer goods of roughly equivalent value.

2.6. The aluminium industry must be developed to make the country independent of imports of copper by 1960-61; and must continue to be further expanded in future.

2.7. Geological surveys and especially prospecting for oil and minerals by Government organization must be rapidly expanded. Mining operations must also be greatly expanded. A provision of Rs. 75 crores has been made for this purpose.

2.8. Rs. 100 crores have been provided for the installation of fertilizer plants with capacity equivalent to roughly four times the current production at the Sindri factory.

2.9. The greatest importance is attached to the expansion of the household and hand industries as this would be the principal method of liquidating unemployment and also of creating a marketable surplus of consumer goods to meet the increase in demand arising from investments in heavy industries, construction work, and expenditure on social services. Rs. 200 crores or Rs. 40 crores per year have been provided for this purpose.

3.1. *Public development expenditure*: In the First as well as in the Second Plan certain items of current expenditure have been included in addition to provision for investment. This is shown in Table (4).

TABLE (4): PUBLIC DEVELOPMENT EXPENDITURE

sector	second plan				first plan	
	investment (Rs. crores)	current (Rs. crores)	total (Rs. crores)	percent	percent	total (Rs. crores)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. electricity	450	—	450	10.5		
2. agriculture, irrigation and rural development	750	200	950	22.5		
sub-total			(1,400)	(33)	44	990
3. industry and minerals	1,000	100	1,100	26	8	178
4. transport and communication	850	100	950	22	24	536
5. construction and social services	250	500	750	17	24	544
6. stocks	100	—	100	2	—	—
total	3,400	900	4,300	100	100	2,248

3.2. Comparable figures for the First Five Year Plan are given in cols. (6) and (7). The total development expenditure of Rs. 4,300 crores in the Second Plan is just short of double the planned development expenditure of Rs. 2,248 crores in the First Plan.

3.3. In the Second Plan there is a much larger actual expenditure for industrial and mineral development (Rs. 1,100 crores against Rs. 178 crores in the First Plan); and the relative proportion is also much higher (26 per cent of total development expenditure in the Second Plan against 8 per cent in the First Plan). The actual expenditure in the Second Plan is greater but the relative expenditure (as a proportion of the total) is less in all the other sectors.

4.1. *Total development expenditure*: In addition to the current development expenditure included in Table (4), there are current expenditures for purposes of development not included in the Plan. The position is shown in Table (5).

TABLE (5): TOTAL GOVERNMENT EXPENDITURE

(Rs. crores)

item	1955-56 (estimated)	1960-61 (estimated)	total second plan
(1)	(2)	(3)	(4)
1. non-development (defence and civil administration)	625	725	3,400
2. development			
(a) not in the plan	200	225	1,100
(b) in the plan	600	1,100	4,300
3. sub-total	800	1,325	5,400
total	1,425	2,050	8,800

4.2. The total Government expenditure is expected to increase from Rs. 1,425 crores in 1955-56 to about Rs. 2,050 crores in 1960-61; the total development expenditure would increase at the same time from Rs. 800 crores to Rs. 1,325 crores; and the development expenditure included in the Second Five Year Plan would increase from Rs. 600 crores to Rs. 1,100 crores.

4.3. The total Government expenditure during the Second Five Year Plan is expected to be Rs. 8,800 crores out of which Rs. 3,400 crores would be non-development (defence and civil administration), Rs. 1,100 crores development expenditure not included in the Plan, and Rs. 4,300 crores development expenditure included in the Plan.

CHAPTER FOUR

EMPLOYMENT AND INCOME

1.1. *Employment* : In India a very large number of families (comprising a majority of the population) are self-employed, many of which use their labour power only partially and thus suffer from chronic under-employment. They must be provided with opportunities of doing more work and thus increasing their income.

1.2. In the urban areas there is a large number of persons without jobs and seeking work for whom new employment must be created. New work must also be found for roughly 1·8 million persons who, on an average, would enter the working force every year (calculated on the basis of a labour force composition of 40 per cent of a net average increase in population of 4·5 million per year).

2.1. The programme of production, investment, and development (discussed in Chapters Two and Three) is expected to generate a volume of employment shown in Table (6).

TABLE (6): ESTIMATED VOLUME OF EMPLOYMENT IN 1960-61

sector	employment (in millions)		increase	
	1955-56	1960-61	actual (in millions)	percent
(1)	(2)	(3)	(4)	(5)
1. agriculture & allied pursuits	109.5	111.0	1.5	1.4
2. mining & factory establishments	4.0	5.7	1.7	42
3. household enterprises & construction	12.0	15.0	3.0	25
4. communication, railways, banks, insurance	1.6	2.0	0.4	25
5. wholesale and retail trade, transport (other than railways), etc.	10.0	12.0	2.0	20
6. professions, services (including govt. administration) and the rest	14.9	17.3	2.4	16
total	152.0	163.0	11.0	7

2.2. If the targets of production are realized then the problem of unemployment should be brought under control by the end of the Second Five Year Plan. Because of the rapid rate of industrialization proportionately the biggest increase of employment about 45 per cent, would occur in mining and factory enterprises. The household and hand industries, communication, transport, trade, etc., would have an increase of about 20 per cent or 25 per cent and the professions and services of about 16 per cent. Even in the Second Plan labour would not begin to be drawn away from agriculture and allied pursuits, but would increase at a low rate of the order of only 1·5 per cent, which would still mean in increase of 1·5 million persons in the labour force in this sector.

3.1. *Income* : The net domestic output at 1952-53 prices had increased from Rs. 91·9 abja in 1950-51 (the base year of the First Five Year Plan) to about Rs. 103·1 abja (provisional estimate) in 1953-54. This represents an increase of Rs. 11·2 abja or 12·2 per cent in 4 years or just over 3 per cent per year. A part of this increase was probably due to exceptionally good agricultural crops in 1953-54 and another part possibly to a partial correction of the previous under-estimation of crops. If allowance is made for these factors the real increase would be probably about 10 per cent in 4 years.

3.2. In the Second Five Year Plan the rate of investment and development would be roughly double that of the First Plan. The rate of increase of income is also expected to be roughly double or about 5 per cent per year. The same estimate has been generally corroborated from more detailed calculations by sectors on the basis of the investment and development programme.

3.3. The expected increase in national income is shown in Table (7).

TABLE (7) : DOMESTIC PRODUCT OF THE INDIAN UNION AT 1952-53 PRICES

Rs. abja (= 100 crores)

sector	(actual) 1950-51	(estimated) 1955-56	1960-61	increase percent
(1)	(2)	(3)	(4)	(5)
1. agriculture and allied pursuits	45.2	52.8	63.4	20
2. mining and factory enterprises	6.6	9.0	15.0	67
3. household enterprises & construction	9.3	10.2	14.3	40
4. communication, railways, banks, etc.	3.1	3.6	4.7	30
5. wholesale & retail trade, other transport	13.4	15.1	18.8	25
6. professions, services including govt. administration and the rest	14.3	17.3	20.8	20
7. total	91.9	108.0	137.0	27
8. population (millions)	359.3	383.7	409.7	7
9. per capita income (Rs.)	256	282	334	19

Chapter Five

FINANCE AND FOREIGN EXCHANGE

1. *Rate of investment* : The planned net investment covering both public and private sectors is Rs. 5,600 crores over the period of the Second Plan. The current rate of investment is about 7 per cent; this will have to be raised to about 11 per cent of national income by 1960-61.

2.1. *Resources for the public sector* : The total expenditure of the Centre and State Governments combined is estimated at Rs. 8,800 crores for the Second Plan as a whole (Table 5). Expenditure outside the plan would increase from Rs. 825 crores in 1955-56 (estimated) to Rs. 900 crores on an average in the Second Plan. Expenditure on the Plan is expected to increase from Rs. 600 crores in 1955-56 (estimated) to an average of Rs. 860 crores in Second Plan.

2.2. The total receipts from taxes and non tax revenue, at the current rate of intake of 8.5 per cent of national income, would bring in about Rs. 5,200 crores. Borrowings (net) from the public should yield Rs. 1,000 crores (about Rs. 600 crores from loans and Rs. 400 crores from small savings). Allowing for Rs. 200 crores for receipts from railways and miscellaneous items on capital account, the total receipts from domestic sources, at current rates, would be Rs. 6,400 crores.

2.3. This leaves a gap of Rs. 2,400 crores in the public sector. As against this, external assistance may provide Rs. 400 crores. The balance of Rs. 2,000 crores will have to be found at least in part by fresh taxation and profits of such commercial or industrial undertakings as can be started in the public sector. The aim should be to limit deficit financing to a total of Rs. 1,000 to 1,200 crores. A taxation target of 9 to 10 per cent of national income as against the present level of about 7 per cent must be attained.

3.1. The budgetary position on the above basis is shown in Table (8).

3.2. A good part of the additional income in the Second Plan would be created at lower income levels. The heavy industries would take time to become profitable. Also, foreign assistance may not be realised to the fullest extent. It would be essential, therefore, to keep a stringent watch on expenditure outside the Plan; to make necessary adjustments in the price and subsidy policy of Government; to reach new strata for tapping savings; and finally, to make changes in the tax structure to raise additional resources required to finance the Second Plan.

TABLE (8): GOVERNMENT BUDGET: 1956-57 TO 1960-61

(Rs. crores)

(1)	(2)		(3)	(4)
1. on the plan	4,300	1.	on the revenue account	5,200
2. outside the plan	4,500	2.	loans from the public	1,000
		3.	railways and miscellaneous funds	200
		4.	foreign assistance	400
			sub-total	6,800
		5.	additional taxes and loans and profits from state enterprises	800–1,000
		6.	deficit financing	1,000–1,200
total	8,800		total	8,800

4.1. *Finance of the private sector* : Investment in the private sector is estimated at Rs. 2,200 crores out of which Rs. 1,110 crores or about a half is for housing and Rs. 400 crores for industries.

4.2. With deficit financing of Rs. 1,000 to Rs. 1,200 crores by Government, the banking system should be able to provide the credit required for working capital. In fact, conditions of easy credit are likely to emerge.

4.3. The newly set-up financial institutions (such as the Industrial Investment and Credit Corporation) will assist the private sector. The pattern of investment in the private sector will have to be watched continuously and influenced in the desired direction through tax incentives, selective credit controls, capital issue control and similar devices.

5.1. *Foreign trade and payments* : Much larger imports will have to be made of capital goods in the Second Plan. The total needs would come to about Rs. 1,200 crores; adding Rs. 400 crores for imports of equipment for replacements, the total requirement would be about Rs. 1,600 crores for imports of capital goods.

5.2. This must be met partly by increased production of food-grains, sugar, cotton, and petrol; partly through foreign assistance and withdrawal from sterling balances; and by curtailment of non-essential imports and promotion of exports in every possible way.

Chapter Six

PLANNING ORGANIZATION AND ADMINISTRATION

1.1. *Planning Organization* : Planning must be continuous and flexible. In addition to the Five Year Plan, detailed annual plans must be prepared every year. Targets, projects and policies must be continually re-assessed and reformulated to suit changing needs and conditions.

1.2. At the same time it is imperative to keep in perspective the potential growth of the economy over a long period so that decisions can be made to secure a balance between short-term and long-term objectives.

1.3. For planning on lines explained above, it is necessary to build up an appropriate planning organization. A technical organization (consisting of economists, statisticians, scientists, engineers, technologists, and administrators) must be established within the Planning Commission for the preparation and continuing examination of the national plan and for working out the various balances relating to it. Technical units must also be established in the Central Ministries, State Governments, and other agencies to prepare detailed projects and estimates and to revise them as necessary.

1.4. There must be a continual two-way flow of information. Plan targets from the top must be continually checked against possibilities of realization at the level of projects. Possibilities of development envisaged at the bottom must continuously shape the targets formulated at the top.

1.5. Information of many kinds would be continually required for the formulation and revision of the plan and of detailed projects as well as for the assessment of the progress and implementation of the Plan.

1.6. The information service and planning and project activities must be closely related. The Central Statistical Organization in association with the Indian Statistical Institute must function as an integral part of the planning machinery at the Centre. Following the same pattern, the State Statistical Bureaus must serve as focal points for statistical services in connection with planning activities at the State level.

2.1. *Administrative machinery* : Planning on bold lines with a steady expansion of the public sector and advance to a socialistic pattern of economy would require the building up of appropriate administrative machinery of a new type at all levels.

2.2. There must be decentralization, on business-like lines of the day to day management of public enterprises with large delegation of financial, administrative, and executive control to develop initiative and responsibility at the periphery so necessary for efficient conduct of business enterprises.

2.3. Attention must be focussed on the implementation of the Plan—on getting things done at the right time—and rules of procedure must, if necessary, be revised to ensure effective action. Secretariat control of the present type must be replaced to a large extent by control by truly autonomous public corporations set up by Government or through the supply of credit by State Banks working under the general guidance of Government in matters of policy.

2.4. Administrative difficulties inherent in the existing Government machinery are likely to prove the greatest obstacle to efficient planning. To overcome such difficulties, large organizational and even constitutional changes may become necessary. The problem is urgent and required immediate and serious attention.

2.5. Government must rally public support in favour of the Plan and encourage and help non-official organizations to promote its fulfilment.

Appendix

1. The paper dated March 17, 1955 was prepared as a *draft of a "draft Plan-frame*" and has been circulated as such and is subject to revision by the Planning Commission.

2. The general objectives and policy and administrative questions (which are discussed in Chapters One and Six) can be considered on their own merits.

3.1. The quantitative estimates were worked out with two chief aims in view, namely,

(a) an increase in national income of 5 per cent per year; and

(b) creation of new employment by way of gainful occupation or jobs for 11 million persons over the plan period.

3.2. Certain basic allocations of investments were made between investment goods and consumer goods industries. It is necessary to maintain this general pattern of investments but there is scope for adjustments in details.

3.3. The draft Plan-frame is, therefore, not rigid and can be modified; but there are inter-relations between its different parts so that a change of the target in one item may require consequential changes in other items.

4.1. Background information relating to the physical targets and financial estimates (Chapters Two, Three, Four and Five) will be found in a paper prepared jointly by the Economic Division of the Planning Commission, the Economic Division of the Ministry of Finance, the Central Statistical Organization, and the Indian Statistical Institute.

4.2. The draft of the draft Plan-frame and the above-mentioned joint paper are consistent with each other but are not identical.

4.3. The Report of the Panel of Economists dated 10 April 1955 has reference to both the papers.

5.1. Within the general pattern of investments (explained in para 3) an attempt was made to fit in the physical targets on the basis of information that was readily available in the Planning Commission and in the Ministries concerned.

5.2. The draft Plan-frame does not attempt to go into details. In some cases, information was not available; and time was short. Also, it was not necessary to make the list of targets exhaustive or complete in every respect because, as explained in para 3, there is scope for adjustments in details without disturbing the main structure of the Plan-frame.

6.1. The targets are sometimes given as equivalent aggregates within which there can be substitution of components.

6.2. Estimates of financial outlay are to be taken as *net.*

6.3. Construction costs are to be taken as the direct costs of materials, of labour, and of essential technical supervision. It is assumed that excessive margins for intermediaries and other forms of waste will be eliminated.

6.4. It is assumed that promotional and field agencies and services would be integrated and coordinated to prevent unnecessary duplication.

6.5. It is assumed that non-official public organizations would be used wherever possible to decrease overhead expenses and stimuate public interest and participation in the fulfilment of the Plan.

7.1. If the basic approach of the present draft is approved, it is suggested that the paper should be revised as necessary and then issued in the revised form as the *draft* Plan-frame for the formulation of projects.

7.2. After the individual projects are received, further changes and adjustments should be made as necessary to get ready, as quickly as possible, a definitive plan which would be internally consistent and would be capable of attaining the desired objectives.

THE APPROACH OF OPERATIONAL RESEARCH TO PLANNING IN INDIA

CHAPTER 1

RECENT DEVELOPMENTS IN PLANNING

1. The Draft Plan-frame of 17 March 1955 giving Recommendations for the Formulation of the Second Five Year Plan of India (to be referred to subsequently as the Plan-frame) is reproduced in this volume as the previous essay. It was published earlier as an appendix of the present paper by the courtesy of the Planning Commission.

2. The Plan-frame was addressed to plan-making organisations of the country, and contains only such information as was likely to be useful for preparing plan projects. For readers who are not in direct touch with planning in India the mode of presentation of the Plan-frame is not adequate. Any approach to planning which involves social action has to be judged in its historical context. I shall therefore try to explain briefly my own approach to the problem; the circumstances in which the Plan-frame was drafted; and its logical and statistical basis. I shall discuss in a separate paper what would be the implications of the present approach on the future course of planning in India. I have used a personal form of narration because the views expressed in this paper are my own and are not necessarily shared by other persons or agencies with which I am connected.

STATISTICAL DEVELOPMENTS

3. During the greater part of my working life I have been a teacher of physics; but in the early twenties I started using statistical methods to solve problems mostly of practical importance but also sometimes of theoretical interest. My statistical work increased considerably since the establishment of the Indian Statistical Institute in 1931-32. At the desire of Prime Minister Jawaharlal Nehru, I started working as the Honorary Statistical Adviser to the Cabinet, Government of India, from February 1949. In the same year I agreed somewhat reluctantly to become the Chairman of the National

Income Committee with Professor D. R. Gadgil and Dr. V. K. R. V. Rao as members. My colleagues did a great service in laying sound foundations for national income statistics and making a thorough review of the gaps in statistical information in India. In this country many of these gaps can be filled only through the method of sampling, and it was a significant advance when the Government of India decided to initiate the National Sample Survey (NSS) which is operating continually since 1950 in the form of about two complete "rounds" per year covering both rural and urban areas of the whole country. The field staff works under the direct control of the Ministry of Finance; and the statistical work (sample design, processing and analysis of data) is done in the Indian Statistical Institute. The NSS can supply much information required for planning.

4. A Central Statistical Unit had been started in February 1949 and was converted into the Central Statistical Organization (CSO) two years later. It is now a pivotal agency for general coordination and the development of comparable concepts, definitions, and standards on a country-wide basis. The CSO works in close touch with the statistical offices in the Central Ministries as well as with the Statistical Bureaus in the various States of India. Rapid developments have also taken place in the Indian Statistical Institute (ISI), a non-profit scientific institution, which works in close association with Government. The CSO, the NSS, and the Institute provide a good statistical base for technical work relating to planning.

The Planning Commission

5. The Prime Minister had been keenly interested in planning for a very long time. It was because of this personal interest that he was appointed Chairman of the National Planning Committee which was set up by the Indian National Congress Party in 1938. This Planning Committee published a number of valuable reports most of which, however, became out of date after the war. The Planning Commission, with the Prime Minister as Chairman, was established in 1950. It prepared the First Five Year Plan of India for the period 1951-52 to 1955-56; and is now actively engaged in preparing the Second Five Year Plan.

6. As Statistical Adviser I have been connected with the Planning Commission from the beginning. My contact with Government made me increasingly aware of the poverty of the great masses of people, and the

inadequacy of the techniques of production. It has been always my view that statistics is an applied science and its chief object is to help in solving practical problems. Poverty is the most basic problem of the country; and statistics must help in solving this problem.

Some Earlier Work

7. I expressed my views of this period in my presidential address entitled "Why Statistics ?" to the Indian Science Congress held in Poona in 1950. In this paper I used a ratio of the value of product to the capital invested to make preliminary calculations about industrial development; this ratio was subsequently found useful in studies on planning. When the First Five Year Plan was being finalised in 1951 I stressed that a progressive and integrated economic policy, rather than a reliance on a number of useful but unconnected projects or on some parametric marginal rate of saving, would be necessary to achieve a high rate of growth. In 1952, in a lecture delibered at the National Institute of Sciences of India, I put forward certain views on planning; and pointed out that it was necessary to increase the rate of investment from 5 or 6 per cent to 10 or 11 per cent. In a second paper published in *Sankhyā* in 1953, I elaborated these views, and used a model of growth for a planned economy to which reference is made in a later section.

8. Two young colleagues had started working with me from the very beginning. Pitambar Pant, who like me started life as a teacher of physics, has been generally helping me since 1946. He was appointed Private Secretary to the Chairman, Planning Commission, in 1952, and has been actively assisting me in the planning work since then; he is now Deputy Secretary in the Planning Commission. Moni Mukherjee, originally a statistician in the Indian Statistical Institute, who had worked as Secretary, National Income Committee from 1949 to 1954 and is now in charge of the National Income Unit in the CSO, has been closely associated with my work. We went on thinking on our own lines, and I took advantage of my visits abroad to have discussions with distinguished economists and statisticians. Gradually other workers have joined our group among whom I should like particularly to mention I. G. Patel (of the Economic Division, Ministry of Finance), a young economist, who made significant contributions to our thinking especially on the financial side.

The Approach of Operational Research to Planning

9. I have been all the time using the approach of operational research with a view to getting some broad idea of the strategy of planning. In

December 1953 I told Shri Chintaman D. Deshmukh (Minister of Finance and Member of the Planning Commission in charge of its Economic Division) that a small organized group would be useful. He immediately agreed and sanctioned funds to enable an Operational Research Unit (ORU) being established in the Indian Statistical Institute which made it possible to start some preliminary studies on planning. The ORU also gave us the opportunity to invite distinguished foreign economists and specialists to come to India for short visits to participate in our work. The visit of Professor Charles Bettelheim of Paris (Editor of *Planification*) in the winter season of 1953-54 was particularly stimulating and helpful.

10. I may explain why I have been using the phrase 'operational research' in relation to planning in India. Our aim is to solve the problem of poverty, that is, to find a feasible method of bringing about a continuing economic development of the country. It would be necessary to use much scientific and technical knowledge and also to organize continuing research at various levels for this purpose. But research is not our primary objective; the aim is to solve our particular problem. When a practising physician gives medical treatment to a patient he uses much scientific knowledge and may even do some research, but his chief aim is to cure the patient. His observations or experiments on the patient may add to medical knowledge but the treatment given is not primarily for purposes of research. The distinction is important. In my view our studies also have the primary aim of solving a particular problem (and not of doing any theoretical research for its own sake). This is why I have used the phrase operational research in the present connexion. We are speaking of India and suggesting methods which we think are practicable under Indian conditions. I shall be naturally glad if our work is of help to any other country. But it has not been our intention to formulate any general theory which would be universally applicable to other countries.

11. I have tried to set up a conceptual frame-work which would be of help for practical purposes; and I have used certain statistical methods to solve our problem. I do not think that the models have any permanent value of their own. I have used them as scaffolding to be dismantled as soon as their purpose has been served. There is, of course, much need of theoretical thinking and researches; but so far we have been primarily concerned with practical issues, that is, with operational (as distinguished from theoretical) research.

FORMULATION OF THE PROBLEM BY THE PLANNING COMMISSION : SEPTEMBER 1954

12. On 14 September 1954 there was a full discussion in the Planning Commission, under the Chairmanship of the Prime Minister, on the basic approach to the formulation of the Second Five Year Plan which was due to begin in 1956-57. At the end of the discussion the Finance Minister asked : "Is it possible to prepare a Plan which would enable unemployment being liquidated in 10 years and which would also provide for a satisfactory increase in national income at the same time ?" This was the problem set to us.

13. One important decision was taken by the Planning Commission at the same meeting, namely, that the Central Statistical Organization (CSO) should be responsible for the statistical work of the Planning Commission; and that the CSO in collaboration with the Indian Statistical Institute (ISI) should immediately take up studies relating to planning. I had another discussion with the Prime Minister on 17 September 1954 about the basic approach to the Second Plan; and, at his desire, gave him next day a brief note on this subject. He asked me to prepare working papers on the lines of our discussions.

INAUGURATION OF STUDIES ON PLANNING : NOVEMBER 1954

14. Prime Minister Jawaharlal Nehru inaugurated studies relating to planning for national development in the Indian Statistical Institute in Calcutta on 3 November 1954. On 8 November 1954 I submitted to the Prime Minister a general note on planning (which was later circulated as Working Paper No. 1 of the Institute series on planning); and at his desire I explained my views at a meeting of the National Development Council (which consists of the Central Cabinet, the Planning Commission and the Chief Ministers of all the States of India) held in New Delhi on 10 November 1954. From about this time, the Finance Minister made arrangements by which Shri J. J. Anjaria (Chief, Economic Division, Planning Commission) and Shri I. G. Patel (Economic Division of the Ministry of Finance) became closely associated with our work. A number of study groups were quickly organized in the Indian Statistical Institute and a large number of Working Papers were prepared and were circulated in mimeographed form; some of them are being printed.

15. On 20 and 21 December 1954, the Lok Sabha (the Indian Parliament) discussed the economic situation in India and at the end of a long debate adopted a motion that the "objective of our economic policy should be a

socialistic pattern of society and towards this end the tempo of economic activity in general and industrial development in particular should be stepped up to the maximum possible extent." One month later, the Prime Minister raised the question of the basic approach to planning in India at the annual session of the Indian National Congress Party at Avadi where a resolution was passed on 21 January 1955 accepting a socialistic pattern of society suited to Indian conditions as the aim of national planning in India. These decisions settled, in principle, the type of economic development of India in future.

16. The Standing Committee of the National Development Council which had met on 7 January 1955 and had agreed that a unified programme should be prepared for the formulation of the Second Five Year Plan, met again on 27 January and decided that a Draft Plan-frame containing recommendations for the formulation of the Second Five Year Plan should be got ready by April 1955. This was followed by several weeks of work at very high pressure by a small group of economists and statisticians in the Economic Division of the Ministry of Finance, the Economic Division of the Planning Commission, the Central Statistical Organization and the Indian Statistical Institute.

17. I should like to mention that in the winter season of 1954-55 a number of distinguished statisticians and economists came to the Institute from different countries of the world. Among those who came in connexion with economic planning may be mentioned Professor Ragnar Frisch of Norway, Professor Oskar Lange of Poland, Professor Charles Bettelheim of France, Dr. Richard Goodwin from the University of Cambridge, and Academician D. D. Degtyar of the Soviet Gosplan at the head of a Soviet team of economists and statisticians (Professor I. Y. Pisarev, Dr. M. I. Rubinstein and Professor P. M. Moskvin) from the USSR Academy of Sciences. We profited much from our discussions with these distinguished experts. They helped us to think clearly; they made constructive criticisms about the logical basis of our thinking; and they placed at our disposal their own rich experience; but, naturally, they refrained from giving any specific advice on questions of policy. The greatest benefit was that through contacts with such eminent exprts from many different countries we gained confidence in our way of thinking. The basic decisions naturally had to be taken by the small group of Indian statisticians and economists who were working on the Plan-frame.

18. I should also mention that a Panel of Economists had been set up in January 1955 by the Planning Commission with Shri C. D. Deshmukh as Chairman, Professor D. R. Gadgil as Vice-Chairman and twenty leading

economists of India, as members. This Panel met for the first time on 27 and 28 January 1955; and started preparing working papers on a number of subjects relating to planning.

THE DRAFT PLAN-FRAME OF 17 MARCH 1955 AND ASSOCIATED PAPERS

19. I submitted the Draft Plan-frame on 17 March 1955. There was much joint thinking and joint work behind it, and the Draft Plan-frame was truly a cooperative effort although it was issued in my name. The associated working paper giving detailed technical information was submitted on 21 March 1955 and the two papers were sent to the Panel of Economists and were considered by the Panel on 8, 9 and 10 April 1955. The Panel prepared a memorandum on "Basic considerations relating to the Plan-frame" in which they (with the exception of one member) agreed with the basic approach of the Plan-frame and approved generally its proposals and underlying principles. The strong support of the Panel of Economists at this stage was of decisive importance.

20. The Draft Plan-frame, the Joint Working Paper and the Memorandum by the Panel of Economists were considered on 5 May 1955 by the Standing Committee of the National Development Council and on 6 May by the Council itself which gave general approval to the approach adopted in these papers and desired that the Draft Plan-frame should be used as the basis for discussions between the Planning Commission and the Central Ministries and State Governments for the formulation of the Second Plan. It was decided to release all the papers for public information. The approach of the Plan-frame and associated papers was subsequently approved at the meeting of the All-India Congress Committee held at Berhampore on 10 May 1955.

21. On the publication of the Draft Plan-frame there was much discussion in the newspapers and at public and group meetings. There was opposition from certain quarters but public opinion appeared to be generally in favour. The subject was again considered by the National Development Council on 24 July 1955 and it was decided that the physical targets of the Plan-frame should be maintained even if this involved an increase in the financial outlay. After further public discussions the Draft Plan-frame and associated papers were examined by the All-India Congress Committee on 3 and 4 September 1955, and the basic approach and targets were again generally approved. The proposals were approved generally for the third time by the National Development Council on 5 September 1955.

22. I should like to point out, at this stage, that I had called the document of 17 March 1955 a "draft of a draft". My intention was that it would be revised and issued as a draft in the form of a document of the Planning Commission. This, however, was not done; and the Plan-frame was issued in my name in its original form. Its only aim was to supply a convenient starting point for planning within a flexible but connected frame-work.

Chapter 2

PRESENT CONDITIONS IN INDIA

1. India is a vast subcontinent with 12 major language groups[1] and 9 major religious faiths.[2] The country lies between latitudes 8° and 37° north and longitudes 66°20′ to 97° east, measuring about 2000 miles from north to south and 1700 miles from east to west with a land area of abour 1·27 million square miles or 811 million acres. The Tropic of Cancer roughly divides the country into two halves. India has a land frontier of about 8200 miles and a cost-line of about 3500 miles. Measured by the extent of territory, India is the seventh largest country in the world; and is approximately thirteen times as large as the United Kingdom and eight times as large as Japan. The Union of India comprises 14 States (including the State of Jammu and Kashmir) and centrally administered territories.

2. The average annual rainfall in India is about 42 inches. But the distribution is very unequal, some areas getting abundant rainfall while some other getting not more than two or three inches per annum. West Bengal, Assam and the coastal strip towards the west of the western ghats get more than 80 inches of rainfall per year and the rest of the area of the country with the exception of desert regions of Rajasthan and Punjab gets varying rainfall ranging between 20 and 80 inches. Indian climate is markedly affected by monsoons, the South West monsoon being instrumental for 85 per cent of rainfall in the country. The temperature has little extremes except in the north where it ranges from 4°.4C to 46°.1C. The rest of the country is generally hot. Calcutta has a mean annual temperature of 26°.1C with a range from 10°C to 29°.4C. The mean temperature for Madras and Bombay are respectively 26°.7C but the annual ranges are of the order of ten degrees. The country has two important crop seasons, *kharif* or summer and *rabi* or winter; as much as 80 per cent of cereal crops are produced in the *kharif* season and the rest in the *rabi* season.

---

[1] Figures in millions (1951 census) of persons speaking: Hindi (105.64), Urdu (35.57), Hindustani (8.16), Telegu (33.00), Marathi (27.05), Tamil (26.55), Bengali (25.12), Gujrati (16.31), Kannada (14.47), Malayalam (13.38), Oriya (13.15), and Assamese (4.99). Three other languages have special recognition: Punjabi (0.27), Kashmiri (0.05) and Sanskrit.

[2] Figures in millions (1951 census) of religious denominations: Hindus (303.19), Sikhs (6.22), Jains (1.62), Buddhists (0.18), Zoroastrians (0.11), Muslims (35.40), Christians (8.16), Jews (0.03), Tribals (1.66) and Others (0.05).

3. India has the second biggest population in the world, 360 million in 1951 out of which roughly five-sixths belong to the rural areas. Roughly 48 per cent of the population is below 14 years while only about 8 per cent of the population is above 54. The crude birth rate is reported to be 4 per cent and the crude death rate is 2·7 per cent. Also there are 95 females to every hundred male in the country. Population has been increasing at a rate of over 1 per cent per year, i.e., with an annual net addition of about 4 or 4·5 million.[1] Compared to population the land area is small, and the share of land is only about 2 acres per head[2] against nearly 6 times this area in the USA and more than 12 times in the USSR. The average density of population in India is 312 per square mile; it varies considerably from region to region and is as high as 832 per square mile in lower Gangetic plains. Per capita agricultural and arable land is roughly the same in India while the per capita agricultural land is more than twice the arable land in the USA.

4. Agriculture is the chief industry engaging about 70 per cent of working population. Out of every 100 employed Indians, 48 are mainly peasant proprietors including rentiers, 9 mainly tenants, 13 landless labourers, 10 engaged in industries or other non-agricultural production, 6 in commerce, 2 in transport and 12 in services and miscellaneous professions. There are certain difficulties associated with definition of labour force, particularly for the rural population, but roughly the labour force is likely to be between 40 to 45 per cent of the population of the country.

5. Agricultural products from nearly half of the net national output. Besides supplying raw materials to industries like sugar and textiles, it provides the bulk of the country's export. In the total geographical area of 811 million acres, about 300 million acres of net area are cultivated annually in India, the gross cultivated area being of the order of 350 million acres. Besides this, there exists about 60 to 70 million acres of fallow land. Roughly 220 million acres of land are reported to be not available for cultivation while about 130 million acres of land are under forests. The main feature of agricultural

[1] The recent rate of growth of population in India is not known accurately, but there are reasons to believe that it may be as high as 2 per cent. The rate observed over the period 1941 to 1951 was of the order of 1.2 per cent per year. It is worth noting that the growth of population in the UK between 1881-1951 was somewhat higher than this (i.e., 1.2 per cent). The rate of increase in population (by birth and migration) during the same period was still greater in the USA.

[2] Figures quoted without date indicate the general order of values in recent years.

production in India is the excess of food crops (which occupy 85 per cent of the area sown) over non-food crops. Cereals (rice, wheat, barley, *jowar*, *ragi*, *bajra* and maize) from the staple food. India grows tea, coffee, sugarcane, oilseeds, jute and cotton, and other tropical crops including fruits and vegetables; tea and jute are important for export. India is the largest sugarcane producing country of the world and with Pakistan holds virtual monopoly in the production of jute. India follows the USA in cotton and compares favourably with China as a leading producer of rice, millets and tea. The most important oilseed is groundnut. According to official estimates of production, the output of food grains is of the order of 65 million tons of which rice contributes an amount of the order of 25 million tons. The other important grains are wheat and *jowar*, between 8 and 10 million tons and gram and *bajra*, between 3 and 5 million tons. It is not possible to be absolutely sure of these figures, and there is likelihood of some amount of underestimation. The cattle population is very large being about 20 crores[1] in 1956. That is, it is about half the size of the human population. The quality, however, is poor and the supply of milk meagre. The average yield of milk per cow per annum is only a little over 400 lbs., which compares unfavourably with other countries in which the average ranges between 2000 and 7000 lbs. Milk is consumed fluid or converted into products such as *ghee* (clarified butter), *dahi* (curd), *khoa* (dried milk), etc. Bulk of the milk is from buffaloes which comprise a little more than one-fourth of the total population. Dung is the most important manure used in the country and this is one reason why the economic value of the cattle population is more than what is appears on the surface. India's forests cover 280,000 square miles which is nearly 22 per cent of the total geographical area of the country yielding a government revenue worth a little more than Rs. 20 crores annually[2]. Apart from timber and bamboo, forests supply fuel wood, an essential item of domestic use. Fish provides an occasional item of diet for numerous people in India and supplies useful protein. But the output is not large, the total value being of the order of Rs. 50–60 crores. The supply of food in India is adequate when the seasonal rainfall is normal. There was, however, shortage of food for about ten years since 1942 which made it necessary to import foodgrains to the extent of 2 to 3 million tons per year for a number of years with the largest import of 4·7 million tons in 1951. The food position became easier from 1952, partly due to two or three years of exceptionally good crop seasons. However, there is still a somewhat precarious balance between the production

---

[1] 1 crore = 100 lakhs = 10 million ; [2] Rs. 100 = 7,5 sterling = 21 US dollars.

of food and the requirements of the growing population unless one reckons on import of foodgrains.*

6. Agricultural land in India is basically fertile, though naturally suffering from different degrees of exhaustion from continuous use. This is particularly true of alluvial soil of north India. The black soil of Deccan as well as red and laterite soils found in other parts of India are also fertile and suitable for cultivation. About 45 per cent of the total area is under some kind of cultivation. As has been already mentioned, distribution of rainfall in the country is uneven and even a partial failure of monsoon results in famine conditions in some parts of the country. Irrigation, therefore, is very important for Indian agriculture. Of the total area under cultivation, about 17 per cent is under major and minor irrigation and the rest is dependent on rainfall. Out of the total irrigated area of about 55 million acres in 1954, canals accounted for about 22 million acres, wells 16 million acres, tanks 10 million acres and the rest 6 million acres. There is a large difference between the yield per acre on irrigated and on unirrigated lands; and irrigation normally raises production from two to four times the original yield. India has a large number of big and small rivers and the quantity of water that annually flows along India's rivers is estimated at nearly 1400 million acre-feet. Of this volume of water only 5·6 per cent is used for irrigation works and power generation and the rest runs to waste. Irrigation schemes are being developed for a long time and recently a few big river valley schemes (irrigation and electricity) have been started and on completion, these are

* According to the 1951 census the population in the rural areas was roughly 300 million. There is a general impression that there is much surplus population in villages, but this is still an open question. It is possible that although the agricultural population is very large, it is needed to supply labour essential at the period of peak load (at the stage of transplantation of the rice crop, or at the stage of harvesting of rice and other crops). Some direct information on this point has been recently collected which suggests that there is sometimes shortage of agricultural labour at peak loads. This is also indicated by the seasonal movement of factory labour in some cities : a large number of labourers leave their factories to go back to their villages at certain periods of the year (peak load points of agriculture), and come back after finishing agrcultural work. If one portion of the agricultural population is drawn away from the villages, there would be some decrease in the outturn of crops. If the decrease in the outturn of food-grains due to such labour shortage is greater than the net contribution (i.e., total contribution minus consumption of food) of the transferred workers to the national income then obviously it would be economical, in a broad sense, to keep these labour households within the village to supply the peak load of labour required for full agriculture production, even if they do not have other gainful work during the rest of the year. On this view, there would be a biological balance between the size of the agricultural population and the volume of crop production, and it is conceivable that a decrease in agricultural population (without introducing labour saving devices) might diminish the real income per person. This question requires careful study.

expected to irrigate 17 million acres of new land; at this stage India will begin to use 13·6 per cent of her total river flow. There are still large possibilities of developing irrigation schemes. Moreover, there is much scope and need of developing minor irrigation works and water lifting devices for areas unsuitable for flow irrigation. In 1955 India produced 11,000 million kwh of electrical energy, giving a per capita figure of the order of 30 kwh. The corresponding figure in the USA is of the order of 2800, UK 1300 and Japan 650. Hydro-electricity accounts for roughly a little more than one-third of the energy generated in 1954, the rest being produced by the thermal stations.

7. India has the largest reserve of high quality iron ore in the world; there are also fair reserves of coal, bauxite (for aluminium), monazite sand (for thorium), mica, chromite and refractories, some gold and copper and minor minerals. The iron reserves in the country are mostly haematites and magnetites with iron content ranging between 60 and 70 per cent; India's total reserves have been estimated as 21,000 million metric tons and almost inexhaustible at the current rate of production. India ranks seventh among the coal-producing countries in the world and has an average annual production of about 36 million tons. The country has fairly abundant reserves of manganese ore and the present production is third largest in the world; the country has 15 to 20 million tons of good ore containing 50 per cent of the metal; moreover the India ore is non-friable and hence easily transportable. So far as bauxite is concerned, many of the laterites contain 50 to 80 per cent of aluminium; the total reserve of bauxite in the country is estimated at 250 million tons. India has virtual monopoly of mica mining and produces 70 to 80 per cent of world's supply of mica. Small reserves of petrol have been found, but certain areas likely to bear oil have not yet been properly prospected. Geological surveys have made good progress but there has not been enough prospecting for minerals. In recent years, India has been producing minerals worth about Rs. 100 crores, coal contributing roughly half of the total value. The other important minerals are manganese ore, mica, gold, salt, building materials and iron ore, the values in descending order ranging between Rs. 20 to 30 crores.

8. The net output of organized factories is comparatively small and accounts for less than 10 per cent of net material production. The net value added by factories (employing 10 or more persons with power, or, 20 or more persons without power) is only about 6 or 7 per cent of the national income. The number of factory workers is about 2·7 million which is only about two

per cent of the total working force and about three-quarters of one per cent of the total population. The number of factories (in round figures) is about 30,000, of which about 25,000 are small and employ less than 100 persons; 2500 factories employ more than 200 persons; and only about a thousand factories are really big. The geographical distribution of factories and factory employment is very uneven. Most of these industries produce consumer goods and the largest single industry, cotton textiles roughly provides one-fourth of the employment in the factory industry sector. The production of basic investment goods (steel, cement, machinery), or of power (coal, electricity) is extremely low compared to the population. Output of producer goods, including coal and other minerals, is of the order of one-sixth of the total fabricated output. During the First Five Year Plan, the factory output increased by about 40 per cent; of these capital goods exhibited a rise of 70 per cent while both consumer goods and intermediate goods rose by about 35 per cent. Though capital goods production increased more rapidly, the position is yet unsatisfactory because of the very low share of such goods in the base period. Excess capacity is still reported to exist in several of the consumer goods industries. The production of some important commodities in 1953-54 is given in Table 1 of the Plan-frame.

9. India is a country of small scale industries; and only recently attention has been given to the development of large-scale industries. Indian economy is basically one of small household units of production; and most of the enterprises are run by self-employed persons. Cottage industries offer alternative employment to the agricultural labourers. Very little accurate information is available on small-scale industries, but roughly it can be stated that the value of output in the sector is unlikely to be less than that in the organized factories while the labour force engaged in the sector is somewhat more than four times that engaged in the organized sector. Handloom weaving is by far the most important small-scale industry supplying a sizable part of the need of textiles in the country and providing employment for a large number of artisans. The industries are of varied types, ranging from units specializing in goods of artistic value to units carrying on operations using modern technique to some extent.

10. There is a nationalized system of railways (with about 34,000 miles of tracks) which is the principal means of transport in the country. There is roughly 250,000 miles of extra-municipal roads in India of which the share of surfaced roads is not even 4 per cent. The length of all weather roads is only 9·7 miles per hundred square miles of the area of the country, and is very

low compared to the population. The number of registered motor vehicles in 1950-51 was only 308,002. India has a 3500 miles long coast line with five major ports. Indian coastal shipping is at present nearly 300,000 gross rated tons; and practically the whole of the coastal trade is now carried by Indian ships. Air services have been established to link important cities; and a nationalized air transport system is in existence. India possesses 800 registered aircrafts of which about 200 hold current certificates of air-worthiness. The country has 78 aerodromes of which three are international. There is an old and well-established system of posts and telegraphs. The total number of post offices is 6000 in urban and nearly 30,000 in rural areas. The expansion of postal network has kept pace with the growth of population in recent years. The telegraph network is inadequate with about 8000 telegraph offices only. India is very backward in the field of telephones; it is even more backward than China. The total number of telephone lines within the country is even less than that in one city of Australia, viz., Sidney. Thus, transport and communication have a good base but are extremely inadequate.

11. Commerce plays an important part in the Indian economy and the labour force engaged in commercial activities is roughly three times the labour force in organized factories; the total industrial labour force, however, is about 50 per cent above the labour force in commercial activities, and the net output of commerce is somewhat below the net output of the industries. Bulk of the trading in India is handled by small retailers including hawkers, and small wholesalers; but organized trading plays an important role in the Indian economy. Organized traders pay much more income tax than organized industries. Banking also has two sectors: the organized banking with Reserve Bank of India and the State Bank at the apex and the unorganized banking including rural money lenders who play a very important role in production and distribution. There are cooperative banks also, but on the whole the development of cooperation has been inadequate in India; the most important type of primary institution is the credit society which numbers only about 1·4 lakhs and has a membership of 6·6 million. Insurance in India generally does not cater to the poorest of the classes. Recently, insurance has been nationalized and it may have a wider spread in the future.

12. Educational facilities are meagre compared to the population; there is provision of schools for only 50 per cent of the children of the age group 6–11; 17 per cent of the children of the age group 11–14; 8 per cent in the age group 14–17; and less than one (0·9) per cent of those of the age group 17–23. Only about 17 per cent of the population is literate, about 12 per cent

in rural areas and about 35 per cent in urban areas. Moreover, there are great differences in educational facilities in different States or in urban and rural areas. Though nearly 82 per cent of the population live in the rural areas the percentages of total number of students in primary, middle and high schools studying in rural areas are roughly about 60, 67 and 26 respectively in 1949-50. Also, nearly 40 per cent of total number of teachers in primary and middle schools are untrained. Some 380,000 students pass matriculation or an equivalent examination each year, and there has been remarkable growth in this number in recent times. Number of students in some 30 universities and 680 colleges is less than 3 lakhs. There is very little facility for technical and vocational education in the country. There are some 2750 vocational schools, 42 engineering schools and about an equal number of engineering colleges. There are about 20,000 pupils in engineering schools and 16,000 pupils in engineering colleges. Annual outturn is about 2500 engineers from colleges.

13. The average expectation of life is only about 35 years compared to 75 years in the USA and a little over 70 in the UK while infantile mortality per 1000 live births is as high as 130 in India against 30 in the USA and in the UK. Deaths caused by epidemic diseases form nearly 50 per cent of the total mortality. The prevalence of diseases, like malaria and tuberculosis is very high and cause deaths to more than one million persons every year. The number of medical personnel is extremely low. There are only about 65,000 fully qualified (six-year trained) doctors with an overall share of one doctor for about 6000 persons (against about one per 1000 persons in the UK). But the distribution is extremely uneven, only about one-fourth, that is, 15 or 16 thousand doctors live in rural areas with a share of only one doctor for about 20,000 villagers. In some States the proportion is much less. Nurses, health visitors and other auxiliary health and medical personnel are proportionately even fewer in number. Medical institutions are very few; one for about 25,000 persons in the urban areas and one for 50,000 persons in rural areas. The availability of beds is only one per 3000 persons, but again mostly in urban areas. There are about 40 medical colleges now with an annual admission of about 3500 pupils.

14. Not much statistical data are available on the various other social and public services. The most important of these in the recent past was perhaps the problem of rehabilitation of refugees from Pakistan. The problem is now considered to be under control, though there is still influx of refugees from East Pakistan and this is a case of continual worry of the Central and

West Bengal governments. The position of housing in the country, particularly in the urban areas is far from satisfactory and requires regular attention of the government. Other important services which requires attention are welfare of the backward classes and welfare of labourers. Prohibition has been accepted as a policy of the Congress Party, and some of the States have given effect to the policy in spite of its adverse effect on government revenue. Recently, attention is being paid towards reform of government administrative services so as to make the services more suitable for purposes of planning. The press with 330 newspapers and a circulation of dailies totalling only 25 lakhs reaches a small fraction of the population. More than 300 feature films and documentaries are produced each year and there are about 1 million radio receiving sets.

15. The problem of land reform has received considerable attention in recent years; and measures of land reform have practically eliminated or will soon eliminate intermediate rights on land in most of the States. Except in Jammu and Kashmir, compensation on a sliding scale is being paid to intermediaries who are losing their rights on land. In many cases the maximum rent to be charged as well as the maximum size of holding have been prescribed; most of the States have fixed 30 standard acres as the ceiling of holdings. Some attention is being paid to prevent further fragmentation of holding due to operation of laws of inheritance and also to consolidate the holdings on a voluntary and cooperative basis. Most of the States are putting restriction on partition or transfer below specified limits and are adopting legislation for consolidation of holdings. The average size of ownership holdings is very small and less than 5 acres in rural areas. The distribution of rural land is, however, very uneven. About a fifth of rural households have no land. About half either have no land or own less than one or one and a half acre, and their total share is only about two per cent of the total area owned by rural households. At the upper end about 10 per cent of households have more than 10 or 12 acres, and own about 60 per cent of the land.

16. The consideration of various sectors of the economy may be followed by some observations on the aggregates. A rough idea about the general pattern of the total value produced is provided by the following : investment about 5 per cent; public consumption 4 per cent; and private consumption 64 per cent; the rest of the product enters intermediate uses. Investment at the present moment is estimated at a little below 7 per cent of the net national product, but roughly one-fifth of this is in non-monetized activities such as land improvement and construction of huts in rural areas. Public investment

(net) in recent times has moved roughly from one third to half of the total investment. In the organized private sector, most of the fixed investment is in industry and mining, the second most important sector being transport. But investment in industry and transport put together is less than the investment in urban construction. Very little is known about investments in inventories in the private sector. There is not much barter but a large part of the economy (may be something like 30 or 35 per cent of the whole) is non-monetory, with a large volume of home consumption of home produced food and other goods. The national income was about Rs. 28 per month per person; and an expenditure in cash, on an average, probably of only about Rs. 17 or Rs. 18 per month per person. A small number of households are very rich. Only about 5 lakh (half a million) pay income tax with an exemption limit of Rs. 2,500 per year. There is a large number of very poor people; about one eighth of the population (or about 50 million) probably have less than 10 rupees (i.e., 15 shillings or about 2 US dollars) per month per person.

17. While agriculture and allied pursuits (animal husbandry, forestry and fishery) roughly contributes a little less than half of the national income, the remaining half is shared more or less equally by mining and industries, commerce and transport, and various services. There has been some rise in national income in recent times; in particular rises in agriculture, organized industries and in some of the service sectors have been quite pronounced, but a part of the apparent rise may probably be due to statistical adjustments. It is not clearly known how far the estimates of national income from year to year truly reflect the underlying change. But accepting the figures as they are, a large rise in per capita national income is noticed between 1950-51 and 1953-54; subsequently the evidence is indicative of just a maintenance of the per capita level reached in 1953-54.

18. Consumption pattern in the country is different in different regions also there is marked difference between urban and rural areas. Roughly two-thirds of the consumer expenditure in rural areas are on food; in urban areas, the percentage is of the order of 55. Again some 40 per cent of rural expenditure is on foodgrains, while the corresponding figure for urban area is a little above 20 per cent. In so far as meat, fish and eggs are concerned, the rural families spend 2 per cent on these items while the urban families spend 3 per cent. Regarding clothing and milk and milk products, the relative share in urban areas is only slightly above that in rural areas and in respect of fuel and light the percentage is more or less the same. The residual group, of course, is considerably higher in urban areas than in the rural areas. The

pattern of expenditure also naturally varies with the per capita expenditure level of the household. Thus, both in urban and rural areas, the share of expenditure on food is about 70 per cent in the per capita expenditure class below Rs. 8 per month and of the order of 40 per cent in the per capita expenditure class above Rs. 55 per month.

19. There is a good deal of unemployment. Many persons are without jobs and many self employed persons do not have enough gainful work in hand. During the last two or three years unemployment in the urban areas has been increasing. The visible unemployment in urban areas may have reached two or three million in 1954. The corresponding figure in the rural areas may be of the same order, that is, the pool of visible unemployment may be something of the order of 4 or 5 million. There are also fresh additions to the labour force every year. The age structure of the population is fairly stable and as the proportion of the working force is between 40 per cent and 45 per cent, and as the population is growing by something like 4 or 4·5 million every year it follows that about 1·8 million persons would enter the working force every year. Unless sufficient new work is created to absorb these new entrants into the labour force the number of unemployed persons would go on increasing continually. Besides visible unemployment in respect of paid jobs there is a great deal of underemployment or disguised unemployment. Many agricultural labourers or artisans and craftsmen do not have enough work and remain idle for a considerable part of the year. There are conceptual difficulties in giving definite figures. Various estimates have been made ranging from 10 or 12 million to over 30 million in terms of equivalent man years. It is beyond dispute that a very large number of people are often obliged to remain idle for lack of work. For both social and political reasons unemployment is the most pressing problem in India today.

20. On the credit side India has a stable Government with wise leadership, a stable currency credit-worthy at the international level; a fairly stable foreign trade, fairly good Government machinery for law and order and for routine administration; a number of universities sceitnfic institutions and societies; and a nucleus of experienced scientists and technologists.

21. There has been some notable progress during the First Five Year Plan. Some large river valley schemes for irrigation and power have started coming into operation; the area irrigated have gone up by about 6 per cent and power generated has gone up by two thirds. Some completely modern factories in the public sector have started working and mention may be made of Hindustan Shipyards, Hindustan Machine Tools, Sindri Fertilizer Factory,

Hindustan Antibiotics, Hindustan Cables, Hindustan Insecticides, Chittaranjan Locomotives, Indian Telephone Industries and Integral Coach Factory in this connection. All the above enterprises are central; some of the State Governments also started new factories. Further, three steel plants are under construction under the auspices of the Central Government. The progress in the private sector has already noted to be satisfactory, the overall index number of industrial production moving up by about 40 per cent over the plan period. A big scheme of Community Projects and National Extension Service Blocks has been initiated in the rural areas which may develop into an important movement to revolutionize rural economy. Upto 1955-56, work has started in almost a thousand Community Project and National Extension Service Blocks covering a population of a little less than 9 crores. The services are expected to encompass the whole of the rural population during the Second Plan. The area sown has gone up by more than 7 per cent while the index number of agricultural production is roughly 20 per cent above the pre-plan periods. The level of foreign trade has not changed materially over the plan period, but the volume of internal trade has increased. Prices exhibited a declining trend after the post Korean war boom in 1951-52 in spite of some deficit spending by the government towards the end of the plan period; the rate of decline has not been so large as to cause worry. Inland passenger transport remained steady, but the railway goods transport increased by as much as 35 per cent. Education flourished in so far as quantitative aspect is concerned, about 70 per cent more students graduated or passed higher examinations in 1954-55 in comparison with 1950-51, while the corresponding percentage is about 60 for matriculation and equivalent examinations. Further, 14 National Laboratories for scientific and technological research have been established. The progress in health services has not been so large. Also, employment flagged behind and created difficult situations in urban areas. Industrial employment went up by only 5 per cent, employment in railway by 10 per cent while the Central Government services expanded by 12 per cent over a period in which the national product reportedly increased by 18 per cent. But quite apart from the question of material progress, the greatest achievement of the First Five Year Plan has been that it made the whole country Plan-conscious. Increased interest is being taken by the general public in economic conditions and problems; and great expectations have been roused about the Second Five Year Plan.

Chapter 3

THE GENERAL APPROACH TO THE PLAN-FRAME

The Problem of Unemployment

1. The chief aim of planning in India, in the first instance, must be to solve the problem of unemployment as quickly as possible. In India we have vast resources of iron ore, coal, and other minerals; large possibilities of developing river valley (hydro-electric and irrigation) projects; raw materials of many kinds; and yet there are millions of people either without jobs, or sitting partly idle. The obvious reason is the great shortage of capital goods. In highly industrialized countries there is full employment (with potential shortage of labour) when the economy is working at full capacity. Unemployment can occur only when means of production remain idle. The situation in India is different. Unemployment is chronic because of lack of capital goods. The only way of eliminating unemployment in India is to build up a sufficiently large stock of capital which will enable all unemployed persons being absorbed into productive activity. Increasing the rate of investment is, therefore, the only fundamental remedy for unemployment in India.

Small scale and Household Industries

2. In the highly industrialized countries, under conditions of full employment, the rate of investment can be increased only by curtailing consumption. In India the general level of consumption is extremely low. Some savings no doubt can be created by reducing consumption in certain sectors but the scope is small. We have, however, idle man-power and raw materials. It is logical, therefore, to think of expanding the production in the small scale and household industries. This sector is capital-light and labour-intensive. We have a long tradition of handicrafts in India. We know how to manufacture the tools and means of production for the small scale and household industries. A comparatively small amount of capital could generate a large volume of employment and could also supply much additional consumer goods for sale. During the war (1940–45) we witnessed a large expansion of small scale and household production in response to the increasing demand for goods. If we can increase the demand, it should be again possible to increase the production in the small and household industries.

3. How can this be done ? In two different ways. Any increase of investment in the heavy industries producing investment goods (which do not compete with the small and household industries) must create new purchasing power and hence generate new demand. The effect will be the same if we increase expenditure on health, education, and other social services (which also do not compete with the small and household industries). It is clear, therefore, that the basic strategy of planning in India should be, on one hand, to increase investments in the heavy industries and also expenditure on services to increase purchasing power and create fresh demand; and, on the other hand, to increase the supply of consumer goods by increasing investment and production as much as possible in the small and household industries to meet the new demand. In India the correct policy is to increase both consumption and investment at the same time.

4. Until unemployment is brought under control there should not be, therefore, any fresh investments to expand factories which compete with the small and household units of production. In addition, in special cases, it may be also necessary to impose a temporary ban on further expansion of factory production which is competitive with small scale or hand production. This may result in some surplus factory capacity remaining idle temporarily. It may be better to allow machines to remain idle rather than to keep human beings unemployed.

5. The price of hand-made goods would be sometimes higher than the price of factory-made goods of comparable quality. A simple remedy is to levy suitable excise duties on factory-made goods to preserve price parity with hand-made goods at any desired level. This would, no doubt, raise prices to some extent but would at the same time supply additional resources for investment and hence for additional employment, increase of income, and national development.

6. Under planning, the whole economy would be continually expanding. Income and consumption would increase. The unemployed would get more and more absorbed in productive activity. The self-employed, the household sector, and the poorer sections would gain relatively more than the richer sections of the population. The poorer people would not mind paying somewhat higher prices (which would flow back into the hands of Govenrment as additional resources for development), once they realize that this is the inescapable condition for their own prosperity. Any person who has no employment or whose earning is low at present would prefer to have work or to increase his earning even if this means that a part of the increase in income

would go back to Government in the form of additional tax or higher prices. It cannot satisfy a person without employment to know that prices will remain low but he would not be able to make any purchases for lack of money. He would prefer the opportunity to earn something with which to purchase what he wants even if this means that he would have to pay somewhat higher prices.

7. It would be wise to give the highest priority to the elimination of unemployment; and to try to decide the basic approach for the Second Five Year Plan with the object of reaching full employment in 10 years or less.* The above formulation of the problem implies, of course, that after getting rid of unemployment it would be necessary to maintain full employment in future. As population in India is growing steadily it is necessary to create enough new work and employment every year to absorb the new entrants into the labour force. That is, in India employment must expand at least as fast as the population which requires that the national economy must also expand, at least, equally fast.

8. We must thus look beyond 5 or 10 years; and have a "perspective" of 20 or 30 years of even more (although the programme or plan would necessarily have to be worked out in the concrete for 5 or 10 years and even year by year in the light of experience). The aim would be to increase the national income as much as possible while progressing towards full employment, and to continue to increase national income after reaching full employment. This is the logical basis of the two objectives of (a) increasing employment and (b) attaining a satisfactory rate of increase of income which have been adopted in the Plan-frame.

9. In the present approach great emphasis has been given to building up quickly the basic heavy industries. This would lay a sound foundation for the manufacture of machinery which would improve the efficiency of industrial production in future. As the problem of unemployment comes under control and as the basic industries are gradually developed, modern

---

* In a "fully socialized" economy, maximizing national income would be a sufficient condition as this would enable maximizing employment at the same time because a part of the increase in income can be distributed in a suitable way to create a large volume of employment or provide appropriate benefits to the unemployed. (For example, both children and adults can even be paid for attending schools or clinics). In an "unplanned" economy, maximizing profits or income might lead to an increase in unemployment. In highly industrialized countries such temporary unemployment can be taken care of through unemployment insurance and social services. This is not possible in an under-developed country like India where, under mixed economy, it seems preferable to state the aim of (partial) planning as the attainment of full employment (and not simply the maximization of the rate of growth of income).

machinery would be supplied in increasing quantities to the small and household industries; and factory production of consumer goods would also be expanded as necessary to lead to a continually increasing level of living. In India, the wise policy would be to disperse production as much as possible, physically, in the sense of preference being given to the smallest units of production which are economical from a national point of view, and also geographically.

Basic Heavy Industries

10. I may now consider the question of economic development over a long period of time. Although production can be increased to some extent by utilizing idle capacity, by working double or triple shifts, or by increasing the skill of the worker, the long-term growth of the economy will depend on the rate of increase of the means of production, that is, on the rate of increase of investment.

11. Econometric "models" are particularly useful for the study of long period growth. The art of model building lies in selecting a small number of significant factors (out of the innumerable factors affecting the economy) and putting these simple factors in a definite relationship to constitute a "model" which would serve as a representative substitute for reality. A study of the changes in the model would then supply some idea of the real process of growth. The usefulness of the "model" would, of course, depend on the extent to which the model succeeds in representing reality in the essential features under study.

12. Since 1950 we have been studying simple models of the relation between increase in the national income and amount of new investments over a long period of time in the USA, UK and some other countries. On the basis of these studies (Mahalanobis, 1952) I had reached the conclusion that the rate of investment in India must be increased to 10 or 11 per cent, in order to attain a satisfactory rate of expansion of the national economy. Since then further studies were made (to which more detailed reference is made in a later chapter) on the basis of which we found that, under planning, the ratio of the increase of the national income to new investments may be reasonably expected to be about 0·5 in India. If we aim at an increase of income of about 5 per cent per year (which would double the national income in about 14 years and the per capita income in about 18 years) then it would be necessary to increase the average rate of investment to about 10 or 11 per cent per year. As the national income of India is of the order of ten or eleven thousand crores of

rupees, in order to increase the national income by 5 per cent per year or by something like 27 per cent in 5 years, the total capital requirement would be something between, say, five and six thousand crores of rupees spread over 5 years. Besides investments, there would also be some developmental expenditure on training and social programmes. Allowing about one thousand crore for such purposes the "size" of the plan, as measured by the financial outlay, should be something between six and seven thousand crores in 5 years. This is a convenient starting point.

13. The rate of development over a long period is, however, intimately connected with the pattern of investment. For example, if all investments are made in industries producing consumer goods (by importing capital goods from abroad) then there would be, no doubt, a good deal of increase in the immediate supply of consumer goods but there would be no increase in the capacity to manufacture capital goods in India so that we shall have to continue to depend on the import of foreign machinery in future for further expansion of industries. There may also be a glut of consumer goods (as has happened in India from time to time) followed by unemployment.

14. India has plenty of iron ore, coal and other natural resources. The long-term aim should, therefore, be to manufacture capital goods within the country rather than to import them. The proper strategy would be to bring about a rapid development of the industries producing investment goods in the beginning by increasing appreciably the proportion of investment in the basic heavy industries. As the capacity to manufacture both heavy and light machinery and other capital goods increases, the capacity to invest (by using home-produced capital goods) would also increase steadily and India would become more and more independent of the import of foreign machinery and capital goods.

15. Some illustrative figures may be useful. Indian reserves of iron ore have been estimated at about 21,000 million metric tons which is just one-fourth of the total reserves of the whole world and more than three times bigger than the estimated reserves of the USA (less than 7,000 million metric tons), or more than five times that of the UK (4,000 million metric tons, UN Report, 1955). Indian ore has a high iron content. India also has coal. The production of steel in India is 1954 was about 1·2 million tons for a population of possibly 375 or 380 million persons against about 110 million tons for a population of 165 million in the USA and about 20 million tons for a population of 50 million in the UK. Compared to India, the production of

steel per person is more than two hundred times higher in the USA and more than hundred times greater in the UK.

16. More steel per person means more machinery per person; and more machinery means more production per person. The difference in the level of living in these three countries can be easily explained by the differences in the rate of production of steel. For a single factor, the production of steel probably has the highest correlation with national income in different countries.[1]

17. The production of steel must be progressively increased in India. It has been decided that three new million-ton steel plants would be installed during the Second Five Year Plan or as soon as possible. Each new million-ton steel plant involves an investment of about Rs. 100 crores (£75 million sterling or 200 million US dollars) in round numbers. Out of this amount about Rs. 45 crores (£34 million sterling or 90 million US dollars) would have to be spent in foreign currency to import machinery made mostly of steel. It has been proposed in the Plan-frame that a heavy machine building industry should be established in India so that as soon as possible India is able to fabricate machinery for the production of steel (or cement or capital goods) to the value of say Rs. 40 or Rs. 50 crores per year. Once this is done it would be possible to develop steel and other basic industries with the help of our own resources.[2] The ratio of capital to gross value of product is roughly 3 to 1 or somewhat less for the production of steel. On the same basis, the capital required to manufacture heavy machinery worth, say, Rs. 50 crores per year would be about Rs. 150 crores. Even if the heavy machine building industry is more capital-intensive than steel, the total capital required is not likely to exceed Rs. 200 crores; and the value of imported machinery required for this purpose cannot be higher than, say, Rs. 100 crores or Rs. 120 crores. The saving in foreign currency (in imports) for a single million ton steel factory would be about Rs. 40 or Rs. 45 crores. The foreign currency required to

---

[1] From some preliminary studies it appears that the coefficient of correlation between per capita production of steel and per capita national income is so high as +0.75 for a group of 19 countries in 1953 for which data were available.

[2] It is not necessary that India should manufacture everything required for the installation of a steel plant. In the case of machinery for the production of steel there has been much specialization and even industrially advanced countries (like the USA, the UK, or Germany) make considerable purchases from other countries. But they also sell some of their own specialized products so that they do not have to depend on foeign currency or loans. Furthermore, if there is any difficulty in securing capital goods from abroad, they can start manufacturing such goods to meet their own essential needs. It is most desirable that India should attain a similar position as quickly as possible.

established a heavy machine building industry would be recovered by the time three new million ton steel plants are installed with the help of home-produced machinery. If it is known that at least three new million ton steel plants would be installed *after* the establishment of the heavy machine building industry then there would be no risk in the decision to establish such an industry. Under planning there cannot be any doubt that India should produce 10 or 20 or 50 million tons or more of steel as soon as possible. Under planning it is, therefore, a safe and wise decision to establish a heavy machine building industry at the earliest opportunity.

18. I may give another example. India is believed to be short of copper but has large reserves of bauxite from which aluminium can be produced. The present consumption of aluminium is only 7 or 8 thousand tons per year, about half of which is produced in India and about half is imported. India is rapidly developing electricity for which large quantities of copper would have to be imported. The Plan-frame has recommended that the production of aluminium should be progressively increased with a view to replacing copper by aluminium to the largest extent possible. This would be a wise decision because it would increase production through the utilization of Indian resources; and would also make India progressively independent of imports of copper in future. This is the kind of thinking which made us give so much emphasis to the rapid development of the basic industries.*

19. At the same time we also examined the question from a more aggregative (or macroscopic) point of view. Studies based on a statistical model (discussed later) showed that the larger the share of capital goods industries in the total investment the larger would be the increase in the national income over a long period of time (of the order of 15 or 20 or 30 years) and the smaller will be the immediate rise. From the point of view of long range development it will be desirable to increase, as much as possible, the proportion of

---

* A rapid development of basic heavy industries which requires a great deal of capital can be brought about in India only through planning at a national level. A heavy machine building industry at a capital cost of Rs. 150 or Rs. 200 crores can be started only if their are reasonable prospects that new factories for the production of steel or other capital goods would continue to be established in sufficient numbers in future. It is Government alone which can make decisions about the rate and pattern of industrialization in future and hence can make the decision to establish the heavy machine building industry on a sufficiently large scale to make it possible to instal, say, one new million ton steel plant every year in future. Inspite of the unrivalled natural resources for the production of steel in this country, in the absence of planning, India was producing only about one million ton per year up to 1953 and no action has been taken so far to manufacture heavy machinery. This clearly demonstrates how development was retarded for lack of planning in India.

investment in the basic industries producing capital goods. There is, however, a physical and/or socially acceptable limit beyond which it is not possible to push up investments in the capital goods industries because of the shortage of capital goods and technical personnel or because it would involve too great a sacrifice of immediate benefits.

Balance of Demand and Supply

20. There is a second point. We think it would be desirable to avoid inflationary pressures as much as possible so that it would not be necessary to continue indefinitely the rationing of essential goods. The only way to achieve this is by balancing the supply and demand of essential goods. Investments in basic industries must not be pushed above a point beyond which the increase in demand caused by the increase in purchasing power cannot be absorbed by the additional production of consumer goods. This condition has been emphasized in the Plan-frame.

Allocation of Resources

21. What should be the proportion of total investment to be allocated to the industries producing capital goods is the most crucial decision in perspective or long range planning. Once the choice is made of the share of investment in capital goods industries, the availability of capital goods in future years would become more or less determined. The only change which could be made would be through import (or export) of capital goods. From certain studies based on the model of 1953 we reached the conclusion that something between 30 per cent and 35 per cent of the total investment should go to the industries producing capital goods. In India the present proportion is probably less than 10 per cent. In our view this proportion should be increased by three or four times.

22. Having settled the share of investment for the capital goods industries, broadly from considerations of long period development, the next step would be to decide the detailed allocation of investments to individual industries and services. At this stage attention must be given to the need of creating as much employment as possible. We have found it useful to use three sets of contingent parameters in considering different possibilities. We are interested firstly, in the ratio of the increase in output (in physical terms or in money value) to new investment, that is, the output per unit of new investment or the output coefficient of capital; secondly, in the ratio of the increase in net value added to new investment, that is, increase in income per unit of new investment, or the income coefficient of capital (which we

have called β); and, thirdly, in the ratio of investment to the number of persons employed, that is, the amount of capital required per worker or the capital coefficient of labour (which we have called θ). Detailed studies are being made about these technological parameters for individual industries and groups of industries.

23. The technical methods used in the Plan-frame can be now briefly explained. The total amount of investment available having been provisionally settled, we may proceed (provisionally, of course) to distribute the investment to groups of industries or to individual industries and services. In each industry (or group of industries) the amount of investment having been (provisionally) settled, it would be possible (with the help of the technological coefficients mentioned above) to estimate the expected output in physical terms and in money value, the expected contribution to national income, and the expected volume of employment generated. Adding these up we can get the total income and employment which may be reasonably expected to be generated by any particular way of allocation of investments.

24. The physical targets of production, investment, income, and employment are thus completely interlocked. Not only this, there are also physical relations between quantities of material and labour required for the production of different commodities. The targets of production are, therefore, directly connected and interlocked among themselves through physical and technological relations.

25. There is also the question of meeting the expected increase in demand for consumer goods. A great deal of material on family budgets has been (and is being continually) collected since 1950 through the National Sample Survey. It is possible, therefore, to study the differences in the pattern of consumption among households at different levels of per capita (or per household) expenditure. Engel coefficients of elasticity are being studied for this purpose; and provisional values have been calculated for food grains, cloth, sugar and some other commodities. If we assume that households, when their income is increased, would incur expenditure (on an average) in the same way as households who at present have higher incomes are actually doing, that is, if we assume that tastes and preferences would remain (on an average) fairly stable, then it is possible to use the Engel coefficients of elasticity to estimate the increase in demand for individual commodities which is likely to occur as income increases. It is, of course, possible to make such estimates separately for different geographical regions, or for different

occupational groups. In principle, it is thus possible to take into consideration the effect on demand not only of changes in income but also of changes in the rural and urban or occupational or regional distribution of population, or changes in the distribution by size of income.

26. For any particular allocation of investments to individual (or groups of industries and services, it is, therefore, possible in principle to estimate the expected output of commodities, the expected increase in income, the expected increase in employment, and also the expected increase in demand. It is then possible to check whether there is a balance between requirements and supply of raw materials and labour at each stage of production; or whether there is a balance of supply and demand of consumer goods and services. If there is any lack of balance, then the targets must be suitably changed remembering that, in principle, a change in any single item may affect the other items. The balances must be then again checked. The whole process will have to be repeated until a set of physical targets with associated investments, income, and employment is reached which is internally consistent and in which the supply and demand is balanced at every stage of production and consumption.*

27. It is possible to use some mathematical short cuts in making the above calculations. For example, in principle, it is possible to use advanced methods of linear and convex programming. A number of Working Papers on this subject were prepared under the leadership of Professor Ragnar Frisch of Oslo who worked in the Indian Statistical Institute in the winter season of 1954-55. Some of these papers have been printed. These refined methods are extremely powerful but, unfortunately, it is not possible to use them in the immediate future in India for lack of detailed data which would be required for this purpose. In the meantime the simpler methods described in Chapter 4 have been used for the preparation of the Draft Plan-frame.

Five Limiting Factors

28. The aim of planning in India must be to obtain the maximum possible rate of increase of employment and national income over a given time period. Planning must, therefore, maintain a wide perspective of the

---

* It would not be possible to meet the demand for luxury goods and services as large resources cannot be permitted to be diverted to the production of luxury goods. A balance must be brought about through an appropriate price policy (through the imposition, for example, of excise duties) or suitable fiscal measures. There is no danger of inflation if the supply and demand can be balanced in the case of essential commodities used by all sections of the people (such as cereals, cloth, sugar).

growth of the national economy over 10, 20 or 30 years or more; and, at the same time, give adequate attention to the urgent need of eliminating unemployment as quickly as possible.

29. In the present approach, the strategy is to balance the increase in demand created by investments in the heavy capital-intensive industries and expenditure on services by adequate production of consumer goods at first through small and household industries. The rate of development, if inflation is to be avoided, would be determined by the amount of surplus consumer goods which can be actually produced. The production of enough consumer goods in the small and household industries is, therefore, of strategic importance and may constitute a limiting factor.

30. The capacity to invest (without import of capital goods) in any given year is determined by the pattern and volume of production of capital goods in the previous year. The rate of expansion of the basic industries, therefore, sets a limit to the rate of growth of the economy as a whole and may constitute a second limiting factor.

31. The capacity to increase both production and the flow of services would depend on the rate at which technical personnel of the required type can be trained. Lack of trained personnel may be a serious bottleneck. The rate at which training can be provided would thus constitute a third limiting factor.

32. The possibility of planning on the proposed scale would depend on raising adequate financial resources which may constitute a fourth limiting factor. This, no doubt, involves technical questions of monetary and financial policy; but ultimately the basic decisions must be made on broad social and political considerations.

33. Finally, as pointed out in the Plan-frame, even if adequate financial resources can be raised, implementation may become difficult or impossible owing to rigidities in the existing system of administration. There must be thorough decentralization of administrative and financial powers in the case of public enterprises and institutions; and also active cooperation between official and non-official agencies. Inadequate administrative machinery may form a fifth limiting factor.

34. We are aware of these difficulties. The logical consistency of the Plan-frame is not a sufficient guarantee of its feasibility in practice. Any one (or two or more in combination) of the five limiting factors mentioned above

can retard progress. However, so far as plan-making is concerned (as distinguished from plan-implementation) all that can be demanded is internal consistency, valid technical reasoning and a correct appreciation of social needs. If the present plan has these merits then there is only one single issue, namely, whether there is any alternative plan which would eliminate unemployment and poverty more quickly and more effectively; and at the same time, lay the foundations for a continuing increase in the level of living in future. If there is no alternative plan which is more satisfactory, then the proper policy would be to try to implement the present plan.

CHAPTER 4

THE STATISTICAL BASIS OF THE PLAN-FRAME

1. I shall now explain the statistical basis of the Draft Plan-frame. It will be useful to start with a brief recapitulation of some previous work. In 1949-50, I worked with a simple model covering the whole economy, that is, using one single sector for the national economy.[1] I used the ratio of the gross value of the additional product to the new investment required to generate this product; and adopting a value of unity for this ratio gave some estimates of the investment required per person to increase the level of living under Indian conditions.

SINGLE SECTOR MODEL

2. In 1951 and 1952, I worked with another model[2] for the whole economy in which I used the ratio of the increase in net national income per unit of time to the net investment associated with this additional income. I called this ratio β (which is the inverse of the marginal capital coefficient). If α is the rate of *net* investment, that is, the fraction of net national income used for investment, then the rate of growth of the economy is $\alpha\beta$. If ρ is the rate of increase of population (usually less than 2 per cent per annum), then the rate of increase of income per person is $(\alpha\beta-\rho)$ approximately.

3. From direct calculations I had found from the national income data for USA given by S. Kuznets (1946) that the value of β for USA was about one-third. I also found by direct calculations from data of national income and investment for UK given respectively by A. R. Prest (1948) and by J. H. Lenfant (1951) that the value of β for UK was something like one-fourth or a little smaller. I had also made some tentative calculations for Switzerland, Norway and some other countries from which I inferred that the value of β for the USA and some of the West European countries would probably fall between one-fifth and one-third (that is, the over-all marginal capital coefficient would be something between 5 and 3). Using similar values of β for India I reached the conclusion that it would be necessary to increase

---

[1] P. C. Mahalanobis : "Why Statistics ?" Presidential Address to the Indian Science Congress Association, Poona, 1950.

[2] P. C. Mahalanobis : "National income, investment, and national development" (Lecture, National Institute of Sciences, 1952), The model I used is similar to the models used a little earlier by Harrod and by Domar but I did not know of their work at the time of writing.

the rate of investment in India from about 5 per cent at the time to all least 10 or 11 per cent to attain a reasonably satisfactory rate of increase of national income.

Two Sector Model

4. I used a two-sector model in 1953 which I shall now briefly describe.[1] The total net investment is divided into two portions. One part (a fraction, say, λ_k) is used to increase the production of basic capital or investment goods (which may be called the K-sector), and the other part (a fraction, say λ_c) is used to increase the production of consumer goods (to be called the C-sector). It should be noted that λ_k and λ_c are fractions of the total investment, so that $\lambda_k+\lambda_c = 1$. I should also explain that appropriate fractions of investments in industries manufacturing intermediate (producer) goods should be allocated to λ_k and to λ_c in proportion to the value of such intermediate goods used in the capital goods (K-sector) and the consumer goods (C-sector) industries respectively. The two fractions λ_k and λ_c can be settled at the choice of the planners. However, once the value of λ_k is settled, the supply of investment goods produced within the country would become fixed. A change can be brought about only through imports or exports of investment goods. In India I have assumed that, with the progress of planning, the domestic supply of investment goods would become more and more important. That is, although in the beginning India will, no doubt, have to depend on imports of capital goods, the policy would be to make India *independent* of such imports as soon as possible.[2] In the present model I have, therefore, assumed that there would be no imports or exports of investment goods.

5. Let Y_t = national income, C_t = consumption, and K_t = investment at time t; with Y_0, C_0, K_0 as the corresponding values at the initial period. As already mentioned, λ_c and λ_k (with $\lambda_k+\lambda_c = 1$) are fractions of investment allocated to industries producing capital goods (K-sector) and consumer goods (C-sector) respectively. We shall write β_k = ratio of increment of income to investment in industries producing investment goods; β_c = ratio of increment of income to investment in industries producing consumer goods; and define

---

[1] P. C. Mahalanobis: "Some observations on the process of growth of national income". *Sankhyā*, 12(4), 1953.

[2] This does not mean that India would not purchase capital goods from other countries. India would make such purchases but India would also manufacture and export capital goods. Secondly, if for any reason (such as lack of foreign currency, shortage of supply or high prices in the world market, state of blockade or war, etc.) there is difficulty in securing essential investmen tgoods from abroad, India should be able to manufacture such goods within the country.

β as the ratio of increment of income generated to total net investment in the economy as a whole, with

$$\beta = \lambda_k \beta_k + \lambda_c \beta_c, \quad \text{necessarily.}$$

We also have
$$K_{t+1} - K_t = \lambda_k \beta_k K_t, \qquad \dots \quad (4.1)$$

$$C_{t+1} - C_t = \lambda_c \beta_c K_t. \qquad \dots \quad (4.2)$$

We then get
$$K_t = (1+\lambda_k \beta_k)^t K_0, \qquad \dots \quad (4.3)$$

$$Y_t = Y_0 \left[1 + \alpha_0 \frac{\lambda_k \beta_k + \lambda_c \beta_c}{\lambda_k \beta_k} \left\{ (1+\lambda_k \beta_k)^t - 1. \right\} \right] \qquad \dots \quad (4.4)$$

giving national income in terms of the initial income Y_0, the initial rate of investment α_0, and the allocation parameters λ_k and λ_c (which are at our choice), and the contingent coefficients β_k and β_c (which, however, are determined by the pattern of investment and conditions of production).

A Four-Sector Model

6. More recently I found it of great help to use a four-sector model. The two-sector model described above is first used to decide the allocation λ_k to the industries producing capital or investment goods. The industries producing consumer goods and services are divided into three different sectors, namely, factory production of consumer goods (sector $C.1$); the production of consumer goods (including agricultural products) in small and household industries (sector $C.2$); and services such as health, education etc., (sector $C.3$).

7. As creating new employment is an important aim of planning in India, we introduce another set of parameters, θ's, the net investment required per engaged person. The number of jobs created in any sector, which we may call n, is then simply λ/θ per unit investment where λ is the fraction of investment allocated to the sector under consideration. We shall use the subscript k for industries producing investments goods (K-sector); subscripts 1, 2, and 3 respectively for the industries producing consumer goods and services in the three sectors $C.1$, $C.2$ and $C.3$ respectively. We shall then have λ_k, λ_1, λ_2 and λ_3 as fractions of investment allocated to the K-sector, sector $C.1$, sector $C.2$ and sector $C.3$ respectively; with, of course,

$$\lambda_k + \lambda_1 + \lambda_2 + \lambda_3 = 1. \qquad \dots \quad (4.5)$$

We also have β_k, β_1, β_2 and β_3 as the ratio of increment of income to investment; and θ_k, θ_1, θ_2 and θ_3 as the net investment required per engaged person respectively in the four sectors. We now consider a total plan-period of, say, 5 years, and regard the above parameters as average values appropriate to the plan-period as a whole. Also, if n_k, n_1, n_2 and n_3 are the number of additional persons engaged respectively in the four sectors over the plan-period, and A is the total investment over the whole plan-period, then

$$n_k = \lambda_k A/\theta_k,\ n_1 = \lambda_1 A/\theta_1,\ n_2 = \lambda_2 A/\theta_2, \text{ and } n_3 = \lambda_3 A/\theta_3. \qquad \ldots \quad (4.6)$$

If N is the total number of additional persons engaged over the plan-period, and E is the total increase in income over the whole plan-period, then we have

$$N = n_k + n_1 + n_2 + n_3, \qquad \ldots \quad (4.7)$$

$$\begin{aligned} A &= n_k\theta_k + n_1\theta_1 + n_2\theta_2 + n_3\theta_3 \\ &= \lambda_k A + n_1\theta_1 + n_2\theta_2 + n_3\theta_3, \text{ since } n_k\theta_k = \lambda_k A \text{ from (4.6)} \qquad \ldots \quad (4.8) \end{aligned}$$

$$\begin{aligned} \text{Also, } E &= \beta_k\theta_k n_k + \beta_1\theta_1 n_1 + \beta_2\theta_2 n_2 + \beta_3\theta_3 n_3 \\ &\equiv Y_0[(1+\eta)^5 - 1], \text{ say.} \qquad \ldots \quad (4.9) \end{aligned}$$

If we assume a constant annual rate of growth of income of, say, η per cent per year, then E can be derived from the initial income per year Y_0 by applying the η rate to Y_0. For our calculations we have taken η as given and equal to 5 per cent per year.

8. In order to use the above model we must substitute statistical estimates for the different algebraic symbols in the equations. It is possible to treat as 'variables' the increase in national income E, the investment A, and the employment N. But the ratio of net income generated to capital investment β_k, β_1, β_2 and β_3, and the net investment required per engaged person θ_k, θ_1, θ_2, θ_3 respectively for each of the four sectors behave as parameters; and are given in the sense that their respective values are assumed to remain more or less constant and are not sought to be influenced by planning during the period under consideration. Besides these, we have the allocation ratios λ_k, λ_1, λ_2, λ_3 which also are parametric in the sense that they do not change during the period of time under consideration. There is however an important distinction. The income-investment ratios β's are determined by the conditions of production (and the pattern of investments within each of the four sectors) and are not influenced by planning,[1] during the period under consideration. The allocation ratios λ's, on the other hand, are at the choice of the planner within certain limits. The proportion of total investment allocated

[1] The pattern of investment itself is, of course, determined by the programme of investments which results from planning. In this sense, the β-coefficients are also indirectly amenable to planning but only in an implicit or indirect way. In contrast, the λ-coefficients are subject to direct planning.

to investment goods industries λ_k must be decided from considerations of long period changes; and the allocation ratios for the other sectors λ_1, λ_2, λ_3 must then be obtained as solutions of the set of simultaneous equations given above. For example, the rate of increase of income or the employment generated may be treated as 'variables' to which desired values may be assigned. The model would then enable us, with the help of numerical estimates of the various parameters, to study how the allocation ratios λ's, that is, the proportions of total investment going into the different sectors should be chosen so that the desired aims can be realized.

Concepts and Definitions

9. We have been using so far terms like 'national income', 'investment' etc., without giving any definitions. In order to make valid statistical estimates of the magnitudes of the different variables or parameters it is necessary to have operational definitions which can be used for statistical purposes in practice without ambiguity. There are different concepts of *national income*. We have used here the definition adopted in the United Nations publication 'A System of National Accounts and Supporting Tables' [23].[2] It is possible to use other concepts, for example, the USSR definition of national income as the total net material product. Another possibility is to define national income as the sum of the net material product and the value of the directly consumed services; this concept may be particularly useful under planning in a country with a mixed economy like India. What is needed is a concept which would be most suitable for the purpose in view. Some tentative work has been started but no definite conclusions have been yet reached. In this situation I shall use United Nations definition which has wide acceptance. The latest available estimates of domestic product of India (according to UN definition) is for 1953-54 which has been used in our Calculations [2]. Provisional estimates for 1954-55 and 1955-56 have been also prepared for our work by the Central Statistical Organization.

10. *Investment* is the net addition to capital stock within the country in the form of plant, machinery, buildings and other capital goods. There are considerable conceptual and estimational difficulties in calculating the net investment. Standards also vary from one country to another in the proportion of maintenance and repair expenses charged to the operating account. In highly industrialized countries like the USA, the UK, Sweden and Switzerland, during the last decade or two, the rate of investment appears

---

[2] Figures in square brackets indicate serial number of references on p. 129.

to have been between 10 per cent and 13 per cent of the national product. In the UK, during the period 1870–1913, the average rate of net investment was about 11 per cent per year. In the USA the average rate was 12 per cent or 13 per cent over several decades and exceeded 16 per cent over a decennial period only on two occasions during 1879–1948. In Sweden the rate was about 11 per cent over a long period before the war and about 13 per cent after the war; and in Switzerland it was of the order of 10 or 11 per cent in recent years. In socialized countries the rate of net investment is higher and is roughly of the order of 15 or 16 per cent or 20 per cent or even more as seen from the available information about Poland, Czechoslovakia, Hungary, East Germany and USSR. The current rate of investment in India is estimated as being of the order of 7 per cent of the net national product. For rapid industrial development the rate of investment must be increased appreciably.* We have suggested that it should be increased from about 7 per cent to about 10 or 11 per cent by the end of the Second Five Year Plan or should be about 9 per cent on an average during the plan-period.

11. *Employment*, as considered in the present model, is the equivalent number of new jobs that would be created as a result of planned investment and production. In a country like India there are a very large number of persons working on their own account. They do not hold paid posts, and cannot lose their jobs. Many of them, however, do not have enough work and remain idle a part of the time. In their case if the volume of gainful work increases it may not lead to the creation of new jobs but usually some additional members of the household (who used to be partly or wholly idle) would be absorbed (partly or wholly) in the household enterprises. The concept of employment in the present context is, therefore, much wider than that used in the highly industrialized countries. We shall include under employment the increase in the gainful work in the household sector and also part time employment so that the total new employment would represent the increase in terms of something like equivalent man-years.

---

* Simon Kuznets (1952) has shown that the rate of savings out of disposable personal income was remarkably steady and did not rise with the increase of national income in the USA over a long period (1869–1938). This is likely to be true in India also. Investments apparently can be increased in India in any appreciable manner either (a) by ploughing back undistributed profits in private enterprises or (b) through Government planning. To encourage large-scale ploughing back of undistributed profits (which would be practicable only in the case of the big private enterprises) would lead to progressive concentration of capital and financial power. This would be inconsistent with a socialistic pattern of economy. In India investments must be increased in the public sector through national planning.

ALLOCATION TO CAPITAL GOODS INDUSTRIES

12. I shall now consider the proportion of investment that should be allocated to industries producing investment goods (λ_k) through planning. We found from available data that β_k is usually much smaller than β_c (that is, the marginal increase of income per unit of investment is much less in basic industries producing capital goods than in industries producing consumer goods). This being so, the larger the value of λ_k, the smaller is the increase of income in the short run; but after a critical period of several years, income begins to rise very steeply. Using the initial rate of investment, $\alpha_0 = 7$ per cent, $\beta_k = 0{\cdot}2$ and different plausible values of β_c we found that to attain a fairly rapid increase of income over, say, about 30 years, it would be desirable that λ_k should have a value between 0·3 and 0·5. We adopted the value $\lambda_k = 1/3$, as we felt it would not be possible to go beyond this value under present conditions. (See Technical Note at the end of this chapter.)

STATISTICAL ESTIMATES OF THE PARAMETERS

13. The next step is to obtain reasonable estimates of the parameters which occur in the model under study. In principle, it is possible to use time-series data provided prices and the pattern of production had remained fairly steady, and also provided production was up to full capacity. This method, however, cannot be used in India for lack of suitable time-series data. We shall have to rely a great deal, therefore, on short period of technological data.[1]

CURRENT OR REPLACEMENT VALUE OF CAPITAL

14. Investment is a basic item in the present model. It is desirable to express the value of investment at current (rather than historic) prices. For this purpose it is necessary to know the relation between the book value and the replacement value of capital. Consider a steady state in which the stock of capital goods is being maintained without any increase or decrease. Every type of capital goods has a certain life after which it must be replaced. Consider any particular type of capital goods, and let its average life be T years. Also consider any particular item of the given type; it must already have been in use for a certain period, say, t years; it then has $(T-t)$ years of useful life still left. If the stock of capital goods includes a large number

[1] Estimates of β based on data for annual increment of income and investment are not strictly appropriate. I have not entered into refinements because subsequent calculations are of a very rough nature. (It is worth noting, however, that β-coefficients appear to be fairly stable over long periods.)

of items of the given type then there would be one item which still has a useful life of t years left. We may pair these two items (of the same given type), one with useful life of $(T-t)$ years still left and the other with a balance of useful life of t years; then the combined useful life of the two items taken together is $(T-t)+t$ or equal to T years for two items. The average life is thus $\frac{1}{2}(T)$ for each item. This argument would be valid for all items (under the simplifying conditions mentioned above). Hence, the average useful life still left at any time is half of the total life, so that as a first approximation, the current book-value should be half of the replacement value. The replacement value of capital can be, therefore, taken as double the book value.[2] A rough check was made in the following way. If we assume that the paid-up capital is numerically equivalent to net block assets, and inflate the annual increase in the paid-up capital by an index of cost of capital construction (compiled from an index of construction cost and an index of import prices of machinery) for the last few years, for India, then on aggregation the estimate of replacement value is actually found to be about double the present value of the total paid-up capital (which is assumed to be the same as the present book value of net block capital).

15. In a recent survey of 8 small-scale industries in the Calcutta area (1952-53) the replacement value of plant and machinery was found to vary from 2 to 6 times the book value. Also, data on the relation between the output and investment are available for a number of projects. If these relations are used to estimate (on the basis of current output) the capital stock in existing enterprises, it is found in most cases that the estimates of replacement value are 2 to 4 times the corresponding book values of capital. It is necessary to remember that in these cases much of the plant and machinery was purchased many years ago when prices were very low compared to current prices. In addition to adjustments for depreciation, it is, therefore, also necessary to make reasonable allowances for changes in the level of prices. These adjustments are particularly important in the case of plant and machinery but are not necessary in the case of stocks which are usually valued roughly at current prices. Depreciation in the case of buildings would be comparatively small, but adjustments for cost of construction would be necessary. On the basis of studies on the lines explained above it was decided generally to use double the book value as a reasonable estimate of the current replacement value.

---

[2] This question has been discussed in detail under more general conditions by D. G. Champernowne and R. F. Kahn in *Review of Economic Studies*, vol. XXI (2), 1953-54.

INCOME-COEFFICIENT OF CAPITAL (β)

16. One most useful parameter is the general (over-all average) ratio of increment in income to investment defined by

$$\beta = \lambda_k\beta_k+\lambda_1\beta_1+\lambda_2\beta_2+\lambda_3\beta_3. \qquad \dots \quad (4.10)$$

I may first consider briefly the value of this parameter in foreign countries. In the USA, during the period 1861–1938, the average income coefficient of investment (β) was of the order of 30 per cent. In the UK on the basis of data given by A. R. Prest (1948) and by J. H. Lenfant (1951) over the period 1870–1913, I found by direct calculation that it was about 25 per cent. However, much larger values of β are obtained over short periods. Thus, if all available statistics on increment of income and net investment recently released in various United Nations publications are utilised, we get an average estimate of the ratio of the order of 40 per cent for 19 countries. For Japan over the periods 1930-36 and 1947–52, the ratio is as high as 50 per cent. In the latest 'Economic Survey of Asia and the Far East for 1954' by ECAFE [25], the value of this ratio for a number of countries in South-East Asia is quoted (on page xiii) as varying between 40 per cent and 50 per cent.

17. I should also note in the present connexion that in a capitalistic country, when the study covers a fairly long period of time, usually there would be periods of both rising and falling national income. The income coefficient of investment (β) over the whole period would be an average of values of the coefficient during periods of both booms and depressions. The observed ratio would be high when income and investment are both increasing. On the other hand, whenever a part of the capital remains idle (during periods of depression) the observed value of β must necessarily fall.[1] This is fully corroborated, for example, for the USA, for the period 1929–52; the general average is of the order of 0·28 while the average of the positive values only is as high as 0·76 [10].

18. Under planning, the aim is to maintain a continually expanding economy with production at full capacity. In a socialized economy, production is deliberately planned to make the fullest use of all resources and

[1] If the trade cycle in capitalist economies is considered as a sum of harmonic fluctuations, then the average value (caclulated with reference to the trend line) would be about half of the value of β taken over periods of production *above* the trend-line. If production to full or nearly full capacity can be maintained through planning then the value of β would seem to be doubled to a first approximation. That is, the capital coefficient would be roughly halved under planning.

by-products.[2] That is, attempt is made to attain the maximum external economies through planning with the result that values of β are large. In socialized countries the addition to the national product per unit of net new investment appears to be generally much higher than in private enterprise economy and is of the order of 0·6 or 0·7 or even higher.[3]

19. In India, for the First Five Year Plan, this β-coefficient was assumed to be of the order of 0·33 but the actual growth of income seems to have been higher than that envisaged in the plan. Over the six year period 1948-49 to 1953-54, the ratio of increment of income to investment was only slightly lower than 0·5 as revealed by the recent national income statistics. Under conditions of planning the overall income coefficient of investment β in India may therefore be taken to be of the order of 0·5.

Sectoral Values of Income-Coefficients

20. We may now consider the sectoral ratios β_k, β_1, β_2, β_3 bearing in mind that the overall ratio for the economy should be of the order of 0·5. In the sector of capital goods industry, the observed average value of the income-coefficient, based on the Sample Survey of Manufacturing Industries (SSMI) relating to five successive years 1949–1953, comes out as 0·43, which when adjusted for replacement value gives a value of $\beta_k = 0{\cdot}21$.

21. The Census of Manufacturers [3] gives an overall average of $\beta = 0{\cdot}6$ for the five years 1946 to 1950. This includes some investment goods industries, excluding which the income-coefficient for factory production of consumer goods would be somewhat higher and of the order of 0·7. This figure, however, refers to the book value of capital; adjusting by the factor of $\frac{1}{2}$ for replacement value, we get a corresponding income-coefficient for replacement value of $\beta_1 = 0{\cdot}35$.

22. For agriculture, very little direct data are available for estimation of the parameter. We have to use, therefore, the national income data on income and investment which yield a figure of about 1·5 for both agriculture

[2] In a highly industrialized country like the USA, external economies become progressively more important and there is greater utilization of all by-products with the consequence that, during periods of increasing production, the value of β would tend to increase and approximate to the value attained in a planned economy. This may be at least a partial explanation of the observed increase in the value of β in the USA, in recent years.

[3] In discussions with Soviet economists I gathered the impression that the value of β can be as high as one hundred per cent or even more in certain transitional phases of planned economy, that is, the new net income generated may be equal to or even higher than the new investment which is associated with this income.

and household enterprises combined. There was, however, a large and somewhat sudden increase in agricultural production which has pushed up the national income figures since 1951-52; a part of this increase is usually ascribed to exceptionally good monsoons, and a part may be due to a statistical correction of previous under-estimation in official figures of crop production. We have thought it advisable to scale down the figure slightly and have adopted $\beta_2 = 1{\cdot}25$ as a reasonable value.

23. Some fragmentary data are available on the income-coefficient in the small and household industries which we may call β_h. The National Sample Survey, fourth round (April-September, 1952) gave a value of $\beta_h = 2{\cdot}1$. From an earlier survey at Aligarh-Harduaganj in 1948, the income-coefficient was found to be about 2 in rural areas and 1·7 in urban areas. The material supplied by the All-India Khadi and Village Industries Board leads to a value of 2·8. A Survey of Small Scale Industries in Calcutta in 1952-53* had given a much smaller value of 0·94. It had been, however, noted in the report that the small enterprises were passing through a depression and that there was much idle capacity. The value at full capacity would be, therefore, much higher. On the basis of the above material, we have adopted a value of $\beta_h = 2$ (for use in paragraph 28, below).

24. The estimate of income-coefficient of investment for services was obtained as a straight average of figures obtained from balance sheet data released by the Reserve Bank of India [20]. It was found that $\beta_3 = 0{\cdot}45$ approximately.

NUMERICAL VALUES OF CAPITAL REQUIRED PER ENGAGED PERSON (θ)

25. We must next consider estimates of θ, the capital needed per employed person in the individual sectors under study. In the industries producing investment goods (K-sector) the average capital needed per person in the five successive rounds of SSMI (1949–1953) was about Rs. 6,200 only while the figure relating to 1953 alone was about Rs. 8,500 (both figures at book value). Adjusting for replacement value, the average value of θ_k would come to something between Rs. 12,000 and Rs. 17,000 per engaged person.

26. It must be remembered, however, that India is greatly lacking in the basic heavy industries (metals, machinery, heavy chemicals, etc.), on which emphasis will have to be given in the near future. We therefore, made some calculations on the basis of new projects which are being prepared for the Second Five Year Plan. We find that the capital needed per worker

* Bureau of Industrial Statistics, Calcutta, 1953.

ranges from Rs. 35,000 to Rs. 60,000 for industries like iron and steel or machine tools while it is about Rs. 12,000 or somewhat less for industries like cement, aluminium, coal and electricity. The appropriate average for the sector has to be chosen in accordance with the pattern of development of the capital goods industry in the Second Plan. As our intention is to expand rapidly the basic heavy investment goods industries, we have adopted Rs. 20,000 per person as a reasonable figure for the capital coefficient of employment θ_k in this sector.

27. Large scale industries for the production of consumer goods which are included in the Programmes of Industrial Development published by the Planning Commission [7] yield an average value of θ_1 of about Rs. 10,000 per person. The adjusted figure from the Census of Manufactures for the year 1950 is Rs. 7,528. We have adopted Rs. 8,750 as a reasonable estimate of the capital needed per engaged person in the large scale factory production of consumer goods.

28. For small scale and household industries the following material is available on the capital requirement per person, θ_2. The National Sample Survey, third round and fourth round figures are Rs. 430 and Rs. 360 respectively. A survey of small scale industries at Aligarh-Harduaganj, conducted by the Ministry of Industry in 1948, gave Rs. 114 for rural areas and Rs. 465 for urban areas. These figures all refer to what are usually called cottage or household industries of a traditional type. According to the Survey of Small Scale Industries of Calcutta in 1952-53 [9], which covered mostly the production of components for large engineering enterprises, the amount of capital needed per worker was much higher and about Rs. 1,200 per person. The unweighted average of the above estimates is Rs. 620. For agriculture, some data on the cultivation of reclaimed lands and of lands brought under major irrigation schemes give the capital per person as about Rs. 6,250. Using approximate weights for the small scale industries and agriculture, we got Rs. 2,500 per engaged person as a reasonable estimate for the sector of agriculture and small scale and household industries combined (θ_2).

29. For the services sector, the capital coefficient of employment (θ_3) was calculated on the basis of outlay and employment in education and health schemes, transport services, etc., yielding a figure of about Rs. 3,750.

A Numerical Solution of the Four-Sector Model

30. We can now get a solution for our four-sector model. On the basis of an average rate of investment of 9 per cent (as indicated in paragraph 10

above) and from considerations of financial resources we adopted, in consultation with the Economic Divisions of the Planning Commission and of the Ministry of Finance, Rs. 5,600 crores as the target of total asset formation during the plan-period of 5 years. We accept $\eta = 5$ per cent as the assigned rate of increase of national income per year; and $N = 110$ lakhs or 11 million as the number of jobs to be created during the plan period of 5 years. We thus start with :

Y_0 = initial national income = Rs. 10,800 crores.

A = total asset formation = Rs. 5,600 crores.

η = rate of increase of national income = 5 per cent per year.

N = total new employment to be created = 110 lakhs (= 11 million).

λ = proportion of investment in industries producing investment goods = 0·33 (settled from considerations of growth over a long period).

We can also write down the sectoral coefficient :

sector	description	parameters	
K	basic investment goods	$\beta_k = 0.20$,	θ_k = Rs. 20,000
$C.1$	factory consumer goods	$\beta_1 = 0.35$,	θ_1 = Rs. 8,750
$C.2$	household industries (including agriculture)	$\beta_2 = 1.25$,	θ_2 = Rs. 2,500
$C.3$	services	$\beta_3 = 0.45$,	θ_3 = Rs. 3,750

For a plan-period of 5 years, we then get the following results in rounded figures :

sectors	investment (A) (Rs. crores)	increase in income (E) (Rs. crores)	increase in employment (N) (million)
K	1850	370	0.9
$C.1$	980	340	1.1
$C.2$	1180	1470	4.7
$C.3$	1600	720	4.3
	5610	2900	11.0

We have, therefore, obtained the allocation of the total investment and the total man-power between the four broad sectors of the economy.

31. We shall next split up the estimates relating to the combined sector of agriculture and small and household industries into two sub-sectors: (1) agriculture, and (2) small and household enterprises. For this, we can use a subsidiary system of simultaneous equations similar to the one cited earlier. Using the subscript a for the sector of agriculture and h for the sector of household enterprises we may write the employment created in the two sectors respectively as n_a and n_h and the corresponding parameters as β_a, θ_a and β_h, θ_h. Using the numerical values for the combined sector given in the previous paragraph, we then have the following equations

$$n_a + n_h = n_2 = \text{combined employment} = 4{\cdot}7 \text{ million},$$

$$n_a\theta_a + n_h\theta_h = \text{combined investment} = \text{Rs. } 1{,}180 \text{ crores},$$

$$\beta_a n_a \theta_a + \beta_h n_h \theta_h = \text{combined increase in income} = \text{Rs. } 1{,}470 \text{ crores}.$$

We can now substitute the value of β_h from paragraph 23, and of θ_a and θ_h from paragraph 28.

$$\beta_h = 2, \quad \theta_a = \text{Rs. } 6{,}250, \quad \text{and} \quad \theta_h = \text{Rs. } 620.$$

On solution, we get the ratio of increment of income to investment for agriculture β_a as 1·10; and the allocation of increase in income, employment generated, and investment as shown below.

	sector	investment (Rs. crores)	increment in income (Rs. crores)	increment in employment (million)
a	agriculture	986	1083	1.58
h	household enterprises	194	387	3.12
		1180	1470	4.70

Comparison with Figures Given in the Plan-Frame

32. In the Draft Plan-frame, we have retained the above broad sector allocations and have adjusted allocations within sectors to some extent from considerations which are explained later. The figures given in the Draft Plan-frame are compared in the following table with the figures obtained from the numerical solution given above. The allocation of investment and employment in the Plan-frame is found to be in line with the solution.

sector	investment (Rs. crores)		increment in income (Rs. crores)		increment in employment (million)	
	planframe	this paper	planframe	this paper	planframe	this paper
$K+C.1$	2800	2830	710	710	2.1	2.0
$C.2$	1150	1180	1470	1470	4.5	4.7
agriculture	950	986	1060	1083	1.5	1.6
household enterprises	200	194	410	387	3.0	3.1
$C.3$	1650	1600	720	720	4.4	4.3
total	5600	5610	2900	2900	11.0	11.0

33. I shall now consider certain definitional questions which arise in splitting up the figures of investment relating to the sector of large scale enterprises, that is, between sector K (industries producing investment goods) and the sector $C.1$ (factories producing consumer goods). It has been already pointed out that the intermediate products should be allocated to the two sectors in such a way as to obtain the net outputs of both the sectors as final products. Since by choice, 33 per cent of Rs. 5,600 crores, that is, Rs. 1,850 crores of the total investment is allocated to investment goods industries, it follows that the remaining Rs. 950 crores must go to large scale industries producing consumer goods ($C.1$). The two above amounts of investment in the two sectors (Rs. 1,850 crores and Rs. 950 crores respectively) should conceptually include the investments on intermediate goods which are used in respective sectors. Further, it is necessary to allocate the investment on stocks. For this, we have taken three-fifths of the stocks as trading stocks (Rs. 300 crores) and the rest (Rs. 200 crores) as inventories of large scale industries. Thus, the investment pattern presented in the Plan-frame now works out as follows.

sector	industry		investment (Rs. crores)
K	basic investment goods		1850
$C.1$	factory consumer goods		950
$C.2 = (a)+(h)$	household industries		1150
(a)	agriculture	950	
(h)	household enterprises	200	
$C.3$	services		1650
			5600

34. In the next table the above figures are reconciled with the investment figures actually given in Chapter Three, Table (2) of the Draft Plan-frame.* The allocation of investments was shown there as Rs. 500 crores for electricity (including hydro-electric projects combined with irrigation schemes); Rs. 1,400 crores for large scale industries; and Rs. 900 crores for transport (railways, roads, etc.). The total of these three heads comes to Rs. 2,800 crores which may be identified with the total of Rs. 2,830 crores for the K-sector and the sector $C.1$ taken together (as shown in lines 1, 2 and 3 of the following Table). This total can be also broken down into an investment of Rs. 1,850 crores in industries producing investment goods (line 4) and an investment of Rs. 980 crores in this paper or Rs. 950 crores in the Plan-frame (line 5). Agriculture and irrigation (line 6) have been alloted Rs. 950 crores in the Plan-frame corresponding to Rs. 985 crores in this paper; and household enterprises Rs. 200 crores (line 7 of the following Table). The services sector with an allocation of investment of Rs. 1,600 crores has been treated as covering all construction work (buildings for schools, hospitals, residences, roads, etc.) and also trading stocks of Rs. 300 crores.

35. This is as far as our simple model can take us. Further details must be settled from supplementary considerations. For example, the four-

sector	plan-frame			this paper (Rs. crores)
	public	private (Rs. crores)	total	
1. electricity	450	50	500	
2. industry (large-scale)	1000	400	1400	
3. transport (railways, etc.)	850	50	900	
			2800	2830
4. of which investment goods			1850	1850
5. ,, consumer goods			950	980
6. agriculture & irrigation	950	—	950	986
7. household enterprises	—	200	200	194
			1150	1180
8. construction, etc.	250	1100	1350	
9. stocks	—	300	300	
			1650	1600
10. grand total			5600	5610

* Out of total stocks of Rs. 500 crores given in Chapter Three, Table (2) of the Plan-frame, Rs. 200 crores have been transferred to industry (large scale) in the present table; at the same time Rs. 200 crores included under the head industry in the Plan-frame have been separated under household enterprises (Rs. 200 corres) in the present table.

sector model cannot give any guidance to decide the share of investments in the public and the private sectors respectively. The allocation shown above is based partly on historical trends and partly on social policy. Large scale expansion of power plants (often in combination with irrigation schemes in river valley projects) in recent years has occurred mostly in the public sector and railways in India have been mainly State concerns for a long time. In the case of electricity and transport most of the investments would, therefore, take place in the public sector and has been shown in this way. On the other hand, there was very little of large scale industries in the public sector during the First Five Year Plan. The bigger share has been, however, reserved for the public sector in the Plan-frame because it is considered desirable to develop the basic industries (minerals, steel, heavy machines, heavy chemicals etc.) as quickly as possible which would be facilitated if such basic industries are State enterprises.

APPENDIX TO CHAPTER 4

TECHNICAL NOTE ON THE PATTERN OF THE GROWTH OF THE ECONOMY

TWO-SECTOR MODEL

1. In the two-sector model the pattern of the growth of the economy depends on the initial rate of investment (which is given), the values of β_k and β_c, the income-coefficients respectively in the industries producing capital goods (K-sector) and in the industries producing consumer goods (C-sector) which are determined by technological factors and conditions of production and are not at the choice of the planner, and on λ_k, the fraction of the total investment allocated to industries producing capital goods (K-sector) with the remaining share of investments $\lambda_c(\equiv 1-\lambda_k)$ going to industries producing consumer goods.

2. The value $\lambda_k = 1/3$ was adopted on the basis of the pattern of growth emerging from certain values of β_k and β_c which were considered to be reasonable estimates of these parameters under Indian conditions. If the real values of β_k and β_c happen to be different from the values used in the model then the actual pattern of growth would be different from the pattern assumed to be true in the Plan-frame. The effect of a change in β_k or β_c can be studied numerically without any difficulty. I am giving four specimen tables to indicate the differences in the pattern of growth of the economy. Tables (A-1), (A-2) and (A-3) are appropriate to values of $\beta_k = 0{\cdot}15$, $0{\cdot}20$, $0{\cdot}25$ respectively; and Table (A-4) gives some extreme values to illustrate boundary conditions.

3. It is seen from Table (A-1) and (A-2) that for any value of β_c (with given β_k) the growth of the economy is slower for larger values of λ_k upto a *critical period*. Once the critical period is passed the higher the value of λ_k or β_k (or of both) the quicker is the growth of the income over a long period of 20 or 30 years.

4. It is not necessary to go into the details of the present tables but I may illustrate their use in one particular case. Columns (2) and (3) of Table (A-2) may be taken to represent what is likely to happen if the Indian economy continues without planning. Using $\beta_c = 0{\cdot}25$, income will increase by about 42 per cent in 20 years. On the other hand, columns (7) and (8) may represent growth under planning. Firstly, the value of λ_k can be

TABLE (A-1): VALUES OF Y_t (= INCOME AT TIME t) FOR TWO-SECTOR MODEL

$Y_0 = 1{,}000$, $\alpha_0 = 7$ per cent, $\beta_k = 0.15$, $\beta_c = 0.25$, 0.50, 0.75 and 1.00 (for each value of $\lambda_k = 0.1, 0.3, 0.5, 0.7$)

	$\lambda_k = 0.1$				$\lambda_k = 0.3$				$\lambda_k = 0.5$				$\lambda_k = 0.7$			
β_c	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00
year (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1	1071	1023	1048	1064	1015	1028	1040	1052	1014	1023	1032	1040	1013	1018	1023	1028
2	1034	10066	1097	1129	1031	1057	1082	1107	1029	1047	1065	1084	1027	1038	1049	1060
3	1051	1099	1147	1195	1048	1087	1125	1164	1045	1073	1102	1130	1042	1059	1077	1094
4	1069	1133	1198	1262	1066	1118	1171	1223	1063	1102	1141	1180	1059	1083	1108	1133
5	1087	1168	1249	1330	1084	1151	1218	1285	1081	1132	1183	1234	1078	1110	1142	1175
6	1105	1203	1301	1399	1103	1186	1268	1350	1101	1165	1228	1292	1098	1139	1180	1222
7	1123	1238	1354	1469	1123	1222	1320	1418	1123	1200	1277	1354	1121	1172	1223	1273
8	1142	1274	1407	1540	1144	1259	1374	1489	1146	1238	1329	1420	1147	1208	1269	1330
9	1161	1311	1462	1612	1166	1299	1431	1563	1171	1278	1385	1492	1175	1248	1320	1393
10	1180	1348	1517	1686	1189	1340	1490	1641	1198	1322	1446	1569	1206	1291	1377	1463
20	1388	1753	2117	2481	1483	1867	2252	2636	1606	1985	2364	2743	1764	2082	2401	2719
30	1630	2222	2813	3404	1939	2687	3434	4182	2448	3352	4257	5162	3399	4399	5398	6398

TABLE (A-2): VALUES OF Y_t (= INCOME AT TIME t) FOR TWO-SECTOR MODEL

$Y_0 = 1{,}000$, $\alpha_0 = 7$ per cent, $\beta_k = 0.20$, $\beta_c = 0.25, 0.50, 0.75, 1.00$ (for each value of $\lambda_k = 0.1, 0.3, 0.5$ and 0.7)

	$\lambda_k = 0.1$				$\lambda_k = 0.3$				$\lambda_k = 0.5$				$\lambda_k = 0.7$			
β_c / year	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1	1017	1033	1049	1064	1016	1029	1041	1053	1016	1024	1033	1042	1015	1020	1026	1031
2	1035	1066	1098	1130	1034	1059	1084	1110	1033	1051	1070	1088	1032	1043	1055	1066
3	0152	1101	1149	1197	1052	1091	1130	1169	1052	1081	1110	1139	1052	1070	1088	1106
4	1071	1136	1201	1265	1072	1126	1179	1233	1073	1114	1154	1195	1074	1100	1126	1152
5	1089	1171	1253	1335	1093	1162	1231	1300	1096	1150	1203	1256	1099	1134	1169	1204
6	1108	1208	1307	1406	1115	1200	1286	1371	1122	1189	1257	1324	1128	1173	1218	1263
7	1127	1245	1362	1479	1138	1241	1344	1477	1149	1232	1351	1398	1161	1218	1274	1330
8	1147	1282	1418	1553	1163	1284	1405	1527	1180	1280	1380	1480	1199	1269	1338	1408
9	1167	1321	1475	1628	1189	1330	1471	1611	1214	1333	1452	1570	1242	1327	1411	1495
10	1188	1360	1533	1705	1217	1378	1540	1701	1251	1390	1530	1669	1291	1393	1494	1596
20	1417	1799	2182	2565	1605	2056	2506	2957	1902	2403	2904	3406	2370	2848	3326	3804
30	1696	2335	2974	3613	2301	3269	4237	5206	3591	5030	6469	7909	6370	8243	10116	11989

TABLE (A-3). VALUES OF Y_t (= INCOME AT TIME t) FOR TWO-SECTOR MODEL

$Y_0 = 1{,}000$ $\alpha_0 = 7$ per cent, $\beta_k = 0.25$ $\beta_c = 0.25, 0.50, 0.75, 1.00$ (for each value of $\lambda_k = 0.1, 0.3, 0.5$ and 07).

	$\lambda_k = 0.1$				$\lambda_k = 0.3$				$\lambda_k = 0.5$				$\lambda_k = 0.7$			
β_c	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00	0.25	0.50	0.75	1.00
year (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
1	1018	1033	1049	1065	1017	1030	1042	1054	1018	1026	1035	1044	1018	1023	1028	1033
2	1035	1067	1099	1131	1036	1062	1087	1113	1037	1056	1074	1093	1038	1049	1061	1072
3	1054	1102	1151	1199	1057	1096	1136	1175	1059	1089	1119	1148	1062	1081	1100	1118
4	1073	1138	1203	1269	1078	1133	1188	1243	1084	1126	1169	1211	1091	1118	1145	1172
5	1092	1175	1258	1340	1102	1173	1244	1315	1112	1168	1225	1281	1124	1161	1198	1236
6	1112	1212	1313	1414	1127	1216	1304	1393	1144	1216	1288	1360	1163	1212	1261	1310
7	1132	1251	1370	1489	1154	1261	1369	1477	1179	1269	1359	1448	1209	1272	1335	1398
8	1153	1290	1428	1566	1183	1311	1439	1567	1219	1329	1438	1548	1263	1342	1421	1500
9	1174	1331	1488	1645	1214	1364	1514	1663	1264	1396	1528	1660	1327	1425	1523	1621
10	1196	1373	1549	1725	1248	1421	1594	1767	1315	1472	1629	1787	1402	1522	1643	1763
20	1447	1849	2252	2654	1758	2288	2829	3349	2336	3004	3673	4341	3416	4141	4866	5591
30	1768	2460	3151	3843	2809	4076	5343	6609	5654	7981	10308	12635	13522	17279	21036	24792

TABLE (A-4): VALUE OF Y_t (= INCOME AT t) FOR TWO-SECTOR MODEL

$Y_0 = 1{,}000$, $\alpha_0 = 7$, per cent, $\beta_k = 0.1, 0.2, 0.4$, $\beta_c = 0.25, 0.75, 1.25$, $\lambda_k = 0.1, 0.3, 0.7$,

		$\lambda_k = 0.1$			$\lambda_k = 0.3$			$\lambda_k = 0.7$		
year \ β_c		0.25	0.75	1.25	0.25	0.75	1.25	0.25	0.75	1.25
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\beta_k = 0.1$	5	1084	1245	1405	1076	1206	1336	1058	1119	1179
	10	1172	1502	1831	1165	1445	1726	1140	1285	1430
	20	1362	2056	2749	1386	2044	2702	1416	1847	2277
	30	1572	2668	3764	1683	2848	4014	1959	2951	3942
	50	2060	4091	6122	2618	5382	8146	5126	9395	13663
$\beta_k = 0.2$	5	1089	1253	1417	1093	1231	1369	1099	1169	1238
	10	1188	1533	1878	1217	1540	1863	1291	1494	1697
	20	1417	2182	2947	1605	2506	3408	2370	3326	4281
	30	1696	2974	4252	2301	4237	6174	6370	10116	13862
	50	2451	5115	7779	5776	12889	20003	76168	128611	181053
$\beta_k = 0.4$	5	1100	1271	1442	1131	1287	1442	1216	1308	1399
	10	1223	1601	1979	1362	1792	2222	1959	2364	2769
	20	1552	2490	3428	2488	4253	6018	13281	18470	23660
	30	2040	3807	5574	5983	11896	17809	146949	208619	270289
	50	3832	8641	13450	50560	109361	168161	20355669	28956374	37557079

deliberately increased from 0·1 to 0·3. Secondly, the value of β_c is bound to be higher and may be safely taken as 0·5 in which case the income will easily double in 20 years. If β_c increases under planning to 0·75, income would increase two and a half times in 20 years.

5. Professor J. B. S. Haldane considered the question of maximization of national income in the above model in a paper received in March 1954 which was printed in *Sankhyā*, Vol. 16, Parts 1 & 2.

Four-Sector Model

6. In the Plan-frame it is estimated that the volume of new employment would be about 11 million consisting of about 2·1 million in the large-scale (capital-intensive) industries, 4·5 million in agriculture and small and household (capital-light) industries and 4·4 million in the services. These estimates are based on the following values of the income-coefficients of investment (β's) and the capital required per engaged person (θ's) for the different sectors.

sector of the economy		sectoral income-coefficient of investment (β)	sectoral value of capital per engaged Person (θ)
symbol	description		
(1)	(2)	(3)	(4)
K	large-scale industries producing investment goods	0.20	Rs. 20,000
$C.1$	large-scale industries producing consumer goods	0.35	„ 8,750
$C.2$	agriculture and small and household industries	1.25	„ 2,500
$C.3$	services (health, education etc.)	0.45	„ 3,750

7. If the targets of employment are changed from those given in the Plan-frame then the estimates of investment and income would also have to be changed in an appropriate manner. However, the accuracy of all such calculations depends on the accuracy of the adopted values of β's and θ's. If the actual values of β's and θ's (which are contingent parameters determined by technological factors and conditions of production and cannot be settled at the choice of the planners) happen to be different from those used in the Plan-frame then the derived estimates of employment, investment, and income would all have to be changed in an appropriate way. It is possible to study the effect of using different sets of values of β's and θ's. Numerical solutions to the model used in the Plan-frame have been obtained; and calculated values of employment, investment, and income are given in columns

(5), (6) and (7) respectively of Table (A-5) based on the respective values of β's and θ's given in columns (3) and (4) of the same table.

TABLE (A-5): EXPECTED VALUES OF EMPLOYMENT AND INCOME: FOUR–SECTOR MODEL

serial no.	sector of economy (i)	sectoral income coefficient (β_i)	capital per engaged person (in Rs.) (θ_i)	employment (in million)	investment (in Rs. crores)	income (in Rs. crores)	remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	*K*	0.20	40,000	0.46	1,848	370	
2	*C*.1	0.35	17,500	0.68	1,193	418	34 p.c. increase in income
3	*C*.2	1.25	5,000	4.34	2,167	2,708	
4	*C*.3	0.45	7,500	0.52	392	176	
5	*total*	....	....	6.00	5,600	3,672	
6	*K*	0.20	30,000	0.62	1,848	370	
7	*C*.1	0.35	13,125	0.91	1,193	418	34 p.c. increase in income
8	*C*.2	1.25	3,750	5.77	2,167	2,708	
9	*C*.3	0.45	5,625	0.70	392	176	
10	*total*	....	....	8.00	5,600	3,672	
11	*K*	0.20	30,000	0.62	1,848	370	
12	*C*.1	0.35	13,125	0.07	88	31	34 p.c. increase in
13	C_2	1.25	3750	5.40	2,028	2,535	
14	*C*.3	0.45	5,625	2.91	1,636	736	
15	*total*	....	....	9.00	5,600	3,672	
16	*K*	0.20	26,600	0.69	1,848	370	
17	*C*.1	0.35	11,638	0.20	235	82	34 p.c. increase in income
18	*C*.2	1.25	3,325	6.16	2,047	2,558	
19	*C*.3	0.45	4,988	2.95	1,470	662	
20	*total*	....	....	10.00	5,600	3,672	
21	*K*	0.15	40,000	0.46	1,848	277	
22	*C*.1	0.25	20,000	0.12	249	62	25 p.c. increase in income
23	*C*.2	0.75	5,000	5.83	2,910	2,183	
24	*C*.3	0.30	10,000	0.59	593	178	
25	*total*	....	....	7.00	5,600	2,700	
26	*K*	0.15	40,000	0.46	1,848	277	
27	*C*.1	0.25	10,000	0.97	966	242	20 p.c. increase in income
28	*C*.2	0.75	5,000	3.58	1,790	1,342	
29	*C*.3	0.30	5,000	1.99	996	299	
30	*total*	....	....	7.00	5,600	2,160	
31	*K*	0.15	30,000	0.62	1,848	277	
32	*C*.1	0.25	10,000	0.19	192	48	20 p.c. increase in income
33	*C*.2	0.75	5,000	4.33	2,168	1,626	
34	*C*.3	0.15	7,500	1.86	1,392	209	
35	*total*	....	....	7.00	5,600	2,160	

TABLE (A-5): EXPECTED VALUES OF EMPLOYMENT AND INCOME: FOUR-SECTOR MODEL (*contd.*)

serial no.	sector of economy (i)	sector income coefficient (β_i)	capital per engaged person (in Rs.) (θ_i)	employment (in million)	investment (in Rs. crores)	income (in Rs. crores)	remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
36	*K*	0.25	20,000	0.92	1,848	462	
37	*C*.1	0.40	7,500	1.41	1,055	422	30 p.c. increase in
38	*C*.2	1.50	2,000	5.04	1,008	1,511	income
39	*C*.3	0.50	3,000	5.63	1,689	845	
40	*total*	....	....	13.00	5,600	3,240	
41	*K*	0.20	20,000	0.92	1,848	370	
42	*C*.1	0.35	7,500	2.06	1,545	541	25 p.c. increase in
43	*C*.2	1.25	2,000	4.98	996	1,244	income
44	*C*.3	0.45	3,000	4.04	1,211	545	
45	*total*	....	....	12.00	5,600	2,700	
46	*K*	0.25	20,000	0.92	1,848	462	
47	*C*.1	0.40	7,500	1.72	1,288	515	30 p.c. increase in
48	*C*.2	2.00	2,000	3.44	687	1,375	income
49	*C*.3	0.50	3,000	5.92	1,777	888	
50	*total*	....	....	12.00	5,600	3,240	
51	*K*	0.20	25,000	0.74	1,848	370	investment and in-
52	*C*.1	0.35	11,000	0.85	935	327	come as in plan-
53	*C*.2	1.25	3,125	3.74	1,169	1,462	frame; 20 p.c. *less*
54	*C*.3	0.45	4,750	3.47	1,648	741	employment.
55	*total*	....	....	8.80	5,600	2,900	
56	*K*	0.20	16,667	1.11	1,848	370	investment and in-
57	*C*.1	0.35	7,300	1.31	955	334	come as in plan-
58	*C*.2	1.25	2,090	5.60	1,172	1,465	frame; 20 p.c. *more*
59	*C*.3	0.45	3,140	5.18	1,625	731	employment.
60	*total*	....	....	13.20	5,600	2,900	
61	*K*	0.20	20,000	0.74	1,479	296	β's and θ's as in plan-
62	*C*.1	0.35	8,750	0.90	785	275	frame; 20 p.c. *less*
63	*C*.2	1.25	2,500	3.76	940	1,175	employment, investment
63	*C*.3	0.45	3,750	3.40	1,276	574	and income.
65	*total*	....	....	8.80	4,480	2,320	
66	*K*	0.20	20,000	1.11	2,218	444	β's and θ's as in plan-
67	*C*.1	0.35	8,750	1.35	1,178	412	frame; 20 p.c. *more*
68	*C*.2	1.25	2,500	5.64	1,411	1,763	of employment, invest-
69	*C*.3	0.45	3,750	5.10	1,913	861	ment and income.
70	*total*			13.20	6,720	3,480	

8. Let us suppose that the values of all θ's are doubled but β's remain the same, and the total fund to be invested also remains the same, namely, Rs. 5,600 crores. From lines 1–5 of Table (A-5), it is seen that the rise in national income can be large, about 6 per cent per year if we are satisfied with a low target of employment of 6 million (with a very high figure of 4·3 million in agriculture and small and household industries and a very low one of about half a million in the services).

9. Keeping the β's the same, if the θ's are changed to Rs. 30,000, Rs. 13,125, Rs. 3,750 and Rs. 5,625 for the 4 sectors respectively (lines 6–10), it is still possible to have an increase of income of 6 per cent per year together with new, employment of 8 million out of which 1·5 million would be in large scale factories, 5·8 million in agriculture and household production and 0·7 in services. With the above values of β's and θ's it is also possible to achieve 6 per cent rise in income per year and new employment of 9 million over 5 years with, however, only 0·67 million in large scale factories together with 5·4 million in agriculture and household enterprises, and 2·9 million in services (lines 11–15). Employment can be increased to 10 million only if θ's can be lowered to Rs. 26,600, Rs. 11,638, Rs. 3,325 and Rs. 4,988 as shown in lines 16–20 of Table (A-5).

10. Let us next consider a case in which β's have lower values, namely, 0·15, 0·25, 0·75, 0·30 respectively, and θ's have higher values, namely, Rs. 40,000, Rs. 20,000, Rs. 5,000 and Rs. 10,000 respectively (lines 21–25) but the total investment is the same, Rs. 5,600 crores as in the Plan-frame. This represents a more unfavourable situation than that assumed in the Plan-frame. It is possible to attain a rate of increase of income of 5 per cent per year with, however, a low target of employment of 7 million with heavy concentration of 5·7 million in agriculture and household industries, only 0·54 million in large scale factories, and 0·72 million in services. Using the same values of β's and θ's as above, the same total employment of 7 million can be reached with, however, a much better distribution (1·4 million in factories and 2 million in services) if the increase in income can be lowered to about 4 per cent per year (lines 26–30). Using the same values of β's but with another set of values of θ's (lines 31–35) it is still possible to have new employment of 7 million.

11. In more favourable cases with higher values of β's and lower values of θ's (lines 36–40) it is possible to have an increase of income of about 6 per cent per year with new employment of 13 million out of which 2·3 million would be in large scale factories. If the total employment is reduced to

12 million then a much larger number, 3 million, can be absorbed in factory industries (lines 41–45). With somewhat higher values of β's but the same values of θ's and the same investment of Rs. 5,600 (lines 46–50) it is possible to attain a 6 per cent increase in income per year and new employment of 12 million out of which 2·6 million would be in large factories.

12. If the income and investment figures are the same as in the Plan-frame and β's also have the same values but 20 per cent *less* employment needs to be created then it is possible to work with higher values of θ's (lines 51–55). On the other hand, in the same situation if 20 per cent *more* employment has to be created, then the values of θ's must be much lower than those assumed in the Plan-frame (lines 56–60).

13. If β's and θ's retain the same values as in the Plan-frame but 20 per cent *less* employment has to be created then a much lower investment of Rs. 4,500 would be sufficient with, however, a smaller rate of rise of income of 4 per cent per year (lines 61–65). If in the same situation 20 per cent *more* men require to be employed then the investment would have to be increased to Rs. 6,700 crores with an increase of income at the rate of a little over 6 per cent per year (lines 66–70). It is possible in the same way to work out appropriate numerical solutions to study the effect of other values of the parameters or of the variables.

Change in the Value of β-Coefficients

14. It has been already pointed out (Chapter 4, para 18, p. 92) that the average value of β is likely to be appreciably higher in a planned economy as production would continue, in principle, at full capacity. One aim of planning would be to chose λ_i's in such a way as to make β as large as possible over a long period. Although the λ_i's are not independent, (being connected through inter-industry relations), some improvement in the overall pattern of production would be usually possible by an optimum utilization of resources at the given level of investment. For example, appreciable savings in transport may accrue through a properly planned location of units of production.

15. The value of β would also depend on the rate of investment and on the stock of capital already accumulated. With a low rate of investment and a small stock of capital it would not be possible to utilize the resources in a complementary way to the fullest extent owing to indivisibilities in the scale of production. The higher the rate of investment and the greater the stock of available capital the greater is the possibility of making the fullest use of the resources mobilized in the plan. As already pointed out (Chapter 4,

footnote 2, p. 92) in a country (like U S A) with a very high stock of capital it may become progressively easier to secure external economics and hence to have higher values of β. In India an important object of planning must be to increase the rate of investment and to build up quickly a large stock of capital which may, in its turn, lead to an increase in the value of β. Technological improvements in methods of production would also increase the value of β. When any technological improvement occurs either in a research institution or in a particular enterprise it would be possible to introduce the improved method quickly on an extensive scale in a planned economy. At any given rate of investment and with a given stock of capital, for reasons explained above, the value of β is likely to be higher under planning.

16. The value of the β-coefficients may, therefore, be expected to rise in India with the progress of planning in future. With any given amount of total assets formation (for example, Rs. 5,600 crores) and with any given set of values of the β-coefficients (for example, those used in this paper) there would be, in principle, an optimum allocation of resources in relation to the basic objectives (such as an increase of employment of 11 million and a long range rate of increase of income of 5 per cent per year). If the values of the β-coefficients turn out in practice to be somewhat different then the solution used in the plan would not be a true optimum but may still serve as quite an efficient solution. The illustrative tables given above show that the broad type of allocation used in the Draft Plan-frame is likely to be fairly efficient. That is, the general approach of the Plan-frame is likely to be suitable for the purpose in view, and would have a good deal of scope for adjustments in details.

Chapter 5

SUPPLEMENTARY CONSIDERATIONS

1. The estimates of production, employment, income, and investment are given in the Draft Plan-frame by much finer categories than we have considered so far. Certain supplementary considerations have been used to derive these figures (which cannot be obtained from my theoretical model but are consistent with it). One basic step was to calculate the increase in demand of important consumer goods (cereals, cloth, sugar, etc.), which would be generated as a result of the (assigned) increase of 27 per cent in the national income in 5 years. This was done with the help of appropriate Engel elasticities* calculated on the basis of the National Sample Survey data. With the knowledge of the figures obtained from the solution described above, the targets of production were then fixed for the investment goods on partly *a priori* grounds, and for consumer goods on considerations of the anticipated additional demand. For some services, like transport, the targets were derived on the basis of targets of other sectors.

2. On the basis of this trial set of targets, the required investment and the employment generated were computed for individual targets by making use of appropriate technological coefficients. Also, the national income in 1952-53 was carried forward to 1955-56 and 1960-61 by making use of the physical production targets (the income arising from individual targets having been computed separately). For certain major commodities like cement, steel, coal, electricity, and heavy chemicals, the consistency of the trial set was then checked; for example, it was examined whether the production target for cement was equal to the demand for cement implicit in the levels of other targets. Then the trial targets were aggregated by sectors; and the calculated values of employment, income, and investment were checked against the solution. Naturally, a number of discrepancies were found in the beginning which necessitated changes in the targets. But gradually, by the method of repeated trial and error, a set of targets was obtained which was consistent with the solution. Speaking broadly, this set of targets has been reproduced in the Plan-frame. Also, the figures of national income, employment, and investment as given in the Plan-frame were computed on the basis of the given set of targets in the manner described earlier.

* Some tentative values of Engel elasticities have been given in a Working Paper No. 8 of the Institute series on Planning which was circulated in a mimeographed form in December 1954 and is now in the press.

3. To get the initial set of trial targets, a good deal of consideration was given to the physical resources and scarcities, existing economic conditions, and the opinion of various authorities on the desirable or possible increase of production during the plan period. For example, I have already mentioned that to instal a million ton steel plant at a cost of about Rs. 100 crores (Rs. 1000 million) it is necessary to import at present machinery to the value of about Rs. 45 or Rs. 50 crores. I have proposed in the Plan-frame that high priority should be given to establishing a heavy machine building industry to fabricate machinery required to produce steel and other investment goods. Once the heavy machine building industry is established it would be possible to increase investments progressively without depending on imports. Again, the supply of copper is short but India has large reserves of bauxite. It is logical to increase the production of aluminium to a sufficient extent to enable copper being replaced by aluminium in the electricity industry. I have suggested that production of aluminium should be increased from 4,000 tons to 40,000 tons per year in the Second Plan to supply a base for the development of electricity and for other purposes. In the field of agriculture and animal husbandry it was considered more important to improve the nutritional quality of the diet than to increase the total intake of calories. Similar considerations prevailed in deciding many other targets. It is neither possible nor necessary to describe them in detail.

4. There were also supplementary considerations of a much broader type. I am using the phrase "supplementary considerations" as a concise term for all those different arguments or reasons which we recognize to have some bearing on the methods or targets of planning which should be adopted to attain our objectives. That is, we are working within a general frame work of social, political, economic, and cultural values with some (clearly or vaguely) recognized aims and objectives. Once we accept this frame work as given, it becomes necessary to incorporate in the plan all considerations which are likely to help in attaining the desired objectives.

5. The theoretical model which I have used does not, and cannot obviously, incorporate all these supplementary considerations. In our view, the proper function of the theoretical model is to supply some broad general guidance leaving the details to be settled from supplementary considerations.*

* I find simple models useful in planning (just as the thermo-dynamical approach is useful in physics) in revealing the broad characteristics of the system under consideration without getting lost in the details. It is clearly out of question to use any complicated model in India in the near future. Statistical data and other factual material are much too meagre. However,

This gives flexibility to the approach, and the scope to adjust the details in accordance with priorities to be reached by agreement through discussions. It is also clear that the theoretical model (being purely technological in character) is necessarily neutral to questions of social or administrative policy. Here also we must give proper attention to methods which are likely to be of help in attaining the desired objectives. That is, it is necessary continually to refer to what I have called the "supplementary considerations" in making decisions about the Plan-frame.

6. Some of these wider considerations have been indicated in the Plan-frame and some others are given in the Joint Secretariat paper or the memorandum prepared by the Panel of Economists. It is not necessary to repeat them here. In view of the importance of industries, I have made certain observations on the future programme of industrial development in the next chapter. Here I may give some other examples.

7. Consider health services. There are at present about 65,000 fully qualified (six-year trained) doctors in India. Most of the doctors reside in urban areas; and it is believed that in the rural areas there is, on an average, only one qualified doctor for twenty thousand persons. Even this distribution is not uniform. In some States the proportion is probably much smaller. About two thousand six-year trained doctors are turned out in India every year, and the cost of training each doctor is about forty or fifty thousand rupees. Under existing conditions it may take 60 or 70 years to provide one doctor for every two thousand persons in the rural areas on an average (a modest target compared to one doctor for 700 or 800 or 1000 persons in USSR, or UK, or USA). I have thought it desirable, therefore, to include in the Draft Plan-frame a proposal to bring some health service to every home in the country within a reasonable time, possibly in 10 or 15 years (instead of providing an exclusively high quality service to a very small fraction of the population), by establishing two new cadres of 2- year and 4-year trained health assistants as a first step to a national health service throughout the country. In addition to public health duties these health assistants would be given training to provide routine treatment in minor ailments. One

---

when reliable information in great detail becomes available for a very large number of industries or sectors, and also when a great deal of experience has been gathered about the effect of various actions taken in a planned economy, it may become possible to reach quite good solutions to practical problems of planning without any recourse to mathematical models. This is what seems to have happened in the USSR where planning problems are solved with the help of a vast amount of detailed and up-to-date statistics and the use of "balances" (basically something like input-output analysis), but without any mathematical models.

6-year trained physician would be in charge of a group of 5 or 6 health assistants; the latter would be provided with bicycles and would be instructed to contact the physician in difficult cases. The cost of training the health assistants would be much less. Also, it would be possible to turn out twelve or fifteen thousand health assistants per year so that one health assistant could be placed in charge of, say, every five villages in the course of about 10 or 12 or 15 years. At the same time, the number of 6-year trained should, of course, continue to be increased as fast as possible.

8. Let us consider another example: improvement in the efficiency of Goverment machinery. Our theoretical model is neutral because it does not include any variable or parameter corresponding to the type or the efficiency of the administrative machinery. It is our knowledge of the defects and delays of the existing system, and our general appreciation of the level of efficiency which would have to be attained in the management of large Government enterprises that make us think that proper implementation of the plan would be practically impossible without a thorough decentralization of administrative and financial powers. In future the efficiency of public enterprises must be judged on results; and suitable incentives must be offered to increase efficiency. Our appreciation of future possibilities is based partly on the experience of other countries; but obviously, a good deal of experimentation will have to be done to evolve a system suited to Indian conditions and requirements.

9. The recommendations in the Plan-frame on the training programme is very general. There is urgent need of much detailed work being done, on the basis of technical coefficients, to formulate the requirements of technicians at various levels and to formulate appropriate training programmes to meet the demand.

10. Also consider the important question of the respective shares of the public and the private sectors in the new enterprises which would be started during the Second Plan. Our theoretical model does not and cannot say that a particular industry should be included in the public sector, while some other industry should be included in the private sector. Our basic recommendations in this matter are guided by the need of general Government control over the entire economy of the country. This is also in keeping with the Industrial Policy Resolution of the Government of India of 1948, reaffirmed in December 1954, and is in keeping with the resolution of the Lok Sabha of December 1954 and the Avadi resolution on socialistic pattern adopted by the Congress Party in January 1955.

11. Again, consider the question of raising adequate financial resources for investment. Our theoretical model cannot give any specific guidance. Our recommendations are based on preliminary studies made by experts in public finance; but it is only proper to admit that much detailed studies would have to be undertaken in this field in the immediate future.* At this stage, our main task has been to work out a tentative solution in real terms, leaving it to the financial experts to work out the details of the monetary counterpart. We have taken our stand on the obviously true proposition that if something can be shown to be feasible in physical terms, then the financial and fiscal machinery can always be adjusted to supply a satisfactory monetary counterpart (provided there is no difficulty in making necessary institutional changes). I agree that models should be elaborated to include the monetary counterpart. This would enable us to set targets not only of production but also of the price level. Until this is done other *ad hoc* methods have to be used.

12. I would like to recapitulate the basic features of the Plan-frame. We start with a given total investment over the plan period (Rs. 5,600 crores), a given rise of national income (5 per cent per year), and an assigned large volume of new employment to be created (110 lakhs) during the plan period together with a steady improvement of income in future. Our solution indicates a large increase in investment in industries producing investment goods, a small rise in investment in factory industries producing consumer goods, considerable activation of all capital-light small and household enterprises, and a fairly large increase in various services. This solution is not intuitively obvious, and depends both on the validity of the analytical methods used as well as on the approximate accuracy of the values of the parameters adopted. The advantage of putting the whole thing in this form is that the reader can check the validity of the solution.

* It is necessary, in my view, to broaden the base of taxation by introducing taxes on capital gains, wealth, and expenditure and by extending and increasing customs and excise duties. The two objectives should be first, to raise adequate financial resources ; and, secondly, to remove disparities of opportunities and of level of living.

Chapter 6

INDUSTRIAL DEVELOPMENT

Basic Heavy Industries

1. India has very little of heavy industries for the production of investment goods; this sector contributes something like perhaps one per cent to national income. The Plan-frame has stressed the need of establishing and expanding the basic industries to manufacture heavy machinery with all possible speed. This would enable India to instal new plants for the production of steel, cement, and other investment goods with the help of machinery manufactured in India out of domestic resources and to produce in increasing quantities machinery required for mineral prospecting and mining, hydro-electric projects, electrical appliances, railways and other forms of transport, and for the production of consumer goods generally. India has bigger reserves of high quality iron ore than any other country of the world (three times more than either the USA or the USSR) and also coal and large possibilities of increasing the production of electricity. The object of expanding the basic heavy industries would be the continuing expansion in future of the production of both investment and consumer goods with the help of modern machinery driven by power.

2. This would require a large amount of capital goods much of which will have to be imported in the beginning. India's present dependence on imports of capital goods in a fundamental structural weakness which must be corrected as quickly as possible. It would be obviously more economical from the national point of view to produce in India as much heavy machinery as possible because this would ensure a supply of capital goods which would make India increasingly independent of imports and would strengthen India's position in the world market. In my opinion, the development of the heavy machine building industry is so important that, if necessary, targets of even steel, coal, or transport should be reduced to give higher priority to heavy machines because this would facilitate a much quicker rate of industrialization after four or five years.

3. The heavy machinery industry should be in the public sector. For rapid industrialization of an under-developed country it would be desirable to keep the cost of capital goods as low as possible. The further removed the type of capital goods under consideration is from the production of final consumer goods, the greater is the need of keeping the price low. Heavy

machinery which would manufacture machinery to produce investment goods is the furthest removed from the consumption end. It is essential, therefore, that Government should have complete control over the heavy machinery industry so as to be able to fix prices to suit national needs. Such control would enable Government to shape the future pattern of industrialization through a properly planned programme of production of heavy machinery. If imports are properly regulated, it would be also possible to influence the pattern of investment in the private sector through Government policy in respect of the production and price of heavy machinery for that sector.

4. It is neither necessary nor desirable that India should try to become completely self-sufficient in the production of machinery. India should, however, acquire both the means of production and technical knowledge to be able, if and when necessary, to manufacture essential investment goods within the country. This is necessary for economic independence. But under normal conditions India should continue to purchase abroad such machinery and capital goods as it would not be economic from a national point of view to manufacture in India. On the other hand, India should also develop in the course of time the production of specialized machinery for which there would be an external market. The policy should be to encourage both imports and exports of machinery and capital goods which would be of mutual benefit to India and other countries.

5. In the field of mechanized production India should encourage automation, that is, the use of automatic and electronically controlled machines, to the fullest extent possible. There would be many advantages. The requirements of highly trained and experienced technical personnel would be appreciably reduced which would save much expense on training and, what is more important, would also save a good deal of time. The high quality of the product would be automatically maintained and would reduce rejections and waste. Production would proceed at a uniform rate which would facilitate working out integrated programmes. The capital cost of automation would be, of course, much higher which may, however, be partly or wholly offset by savings on account of training and elimination of wastage. One serious disadvantage would be the greater rigidity of an automatized system of production in which it would be difficult to introduce improvements of technique in a piecemeal fashion. The automatized system, even if only obsolete in parts, would have to be either scrapped or continued without any change. In spite of such difficulties India may benefit much by the use of automation from an early date, and possibilities in this direction should be continually explored.

Small Scale and Household Production

6. The long-term aim would be to use as quickly as possible the most technologically advanced machinery for the production of both investment and consumer goods. This is not immediately possible because of the lack of a sufficiently broad base of heavy industries. It is, therefore, necessary to plan for a transition phase, in which preference would be given to capital-light and labour-intensive small scale and household industries to create as much employment as possible in the immediate future and, at the same time, to release capital resources for the heavy industries. However, as the economy expands and employment increases the need of giving preference to labour-intensive but low-efficiency production would decrease. As the supply of power, machinery and other capital goods increases, a gradual and steady change-over would be made to more efficient forms of production by the increasing use of machinery driven by power.

Policy of Greatest Dispersal of Production

7. It is, however, neither necessary nor desirable to copy the developments in the more advanced countries of America and Europe and concentrate production in large factories. On the contrary, the wise policy in India, in my opinion, would be to adopt a policy, of the greatest dispersal of industrial production.

8. This would, of course, include geographical dispersal, that is, locating units of production in such a way that the different regions of India can share equitably in the programme of production. Specialized regional resources and economy of transport must receive proper consideration; but planning should be deliberately aimed at achieving a broad parity in the level of production and of living in the different regions of India and preventing the formation of depressed areas.

9. But this is not all. It would be desirable to try to classify all industries into two broad groups. One, in which the physical scale of production would have to be large; for example, steel, cement, railway rolling stock, fertilizers, heavy machinery, motor cars, antibiotics, etc. In such cases large factories must be established. It would be desirable to do this in well-planned new industrial towns with adequate housing, schools, medical clinics, hospitals, and facilities for sports and cultural activities not only for the workers employed directly in the planned factories but also for other people who would come to live in the new town for subsidiary occupations. The capital cost of large and medium factories established in this way would be high but the additional expenditure would be a social obligation.

10. The second type of industries would be that in which production is technologically possible in small units. In the case of these industries preference should be given to the smallest units which are economical from the point of view of the nation as a whole. Consider, for example, the traditional highly skilled artistic handicrafts of India such as, Banaras or Patola textiles, Kashmir shawls, silver and gold work, metal work of Moradabad or Bidri, irovy and wood carving, Midnapore and Masalipatam mats, artistic leather work, etc.; every one would agree that India should try to preserve and encourage these handicrafts. There is a good deal of scope and need of improving efficiency of production by developing specialized small tools driven by power which would lighten the manual labour. There is no reason, for example, why a metal box should not be pressed out by machinery and the artistic part of the work done by hand. Efforts should be made to improve the design from a functional point of view and to introduce standards of quality.

11. I have much more in view. I believe it would be possible to produce economically in small units many articles which are now manufactured in large factories. The large factories at present enjoy certain facilities which are not available to small scale and household enterprises. The most important advantage is the use of machinery driven by power. If a policy of dispersal is deliberately adopted then arrangements would be made to supply modern machinery driven by power to the small scale and household enterprises. There is no inherent reason why all efficient machines should be large. With the growth of capitalism, as big factories began to be established in large numbers, the mind of the inventor was more and more directed to large units of production which would suit the big factories because such factories (and not small producers) were in a position to offer large financial incentives for new inventions which would increase their efficiency of production. Under capitalism the trend of inventions was, therefore, towards large units. The increasing use of electronic technology has, however, already changed the direction of invention towards smaller machines in many fields. Also, in large factories in many cases, machines are comparatively small in size and are looked after by one or two persons. In such cases it is even now possible to set up small independent units of production. Under planning incentives can be offered for the invention of small but efficient machines.

12. Secondly, large factories are usually able to raise capital or borrow money at low rates of interest, purchase raw materials at competitive prices, and enjoy good facilities for marketing which are often under their direct

control. The small scale and household enterprises are greatly handicapped in this respect. They have difficulty in securing credit and even when they are able to borrow money, they are obliged to pay high rates of interest. Their supply of raw materials and tools is uncertain; also they are sometimes obliged to pay unreasonably high prices. They have very little marketing facilities; and are usually exploited by middlemen. If Government can arrange to supply credit, raw materials, and marketing facilities to the small scale and household industries then their efficiency of production would be much improved, and they would be able to compete with large factories in many cases.

13. The large factories also enjoy many external economies the cost of which is borne by the tax-payer. Most of the large factories are located in or near large towns and cities; and the factory owners usually do not offer housing, education, medical care and other amenities for their workers. There are, of course, exceptions; but by and large most of the privately owned factories depend on the public authorities for such facilities. The cost of roads, water electricity, drainage, transport are not charged to the factories. If the large investments required for such purposes as well as maintenance expenses are taken into consideration then it may be found in many cases that the social cost of factory production is much higher than the cost as it appears in the factory accounts. In addition, there are intangible costs which cannot be expressed in terms of money such as the misery of slum life, evils arising from the workers having to live away from their families, and other adverse social repercussions. If all economic, social and human costs of large factories are properly taken into account, in many cases it would be preferable, from the point of view of the nation as a whole, to substitute production in small scale and household enterprises.

14. As electricity begins to reach the villages (or with the help of small steam or diesel engines) it would be also possible gradually to convert the small and household enterprises in the villages into high efficiency and low cost mechanized units of production. This would avoid the heavy expenses which would be incurred for urbanization if the same production had to be arranged in the large factories. There would be also large savings in transport and other overheads.

15. In small cooperatives or in self-employed household enterprises the workers would be able to work much longer hours than in factories; also, some of the members of the household would do part-time work so that there would be practically double shift operation. Working at home or very near

home in the villages would be less fatiguing than in factories because the workers would be able to take some rest as and when necessary. Household activities and family life would not be disrupted.

16. Dispersal of production in small units in villages or small towns would be particularly suited to social and economic conditions in this country. India has many geographical, linguistic and ethnic regions with large differences in climate, food habits and social customs. It is difficult to transfer surplus labour from one part of the country to another. There is practically no migration from villages in one region to villages in other regions. Labourers come from villages to work in towns and cities; but a good number is seasonal who go back to their villages at the time of peak loads of agriculture. If mechanized industrial occupations can be established in the country, many of the labourers would stay in or near villages which would ensure an adequate supply of agricultural labour at peak-loads. This would be of great help in the transition phase. The policy of dispersal would tend to raise the level of living in villages and remove the present large disparities between rural and urban areas. For all these reasons it is desirable to adopt a deliberate policy of "back to the village" in, however, a new form in which electricity (or small steam or diesel engines) and modern machinery would be supplied to the village for industrial production.

17. The future policy, in my opinion, should be to establish and bring all large units of production under direct Government control; to develop enterprises of a medium size on a cooperative basis; and leave small units of production to household enterprises. Such a policy of dispersal would have political advantages. It would tend to create a large number of household or small scale enterprises which would be organized more and more in the form of cooperatives and would supply a sound foundation for a democratic society. It would avoid, on one hand, the disadvantages of heavy concentration of financial power in the hands of a small number of monopoly capitalists; and, on the other hand, would also avoid the rigidities of a highly centralized, bureaucratic administration. Through a policy of industrial dispersal it would be possible to combine the advantages of both economic and political democracy in an effective manner. This would be a solution entirely in keeping with Indian social and cultural traditions.

Chapter 7

CONCLUDING REMARKS

The first draft of this paper was written in June 1955 and was revised in short intervals between frequent journeys both in India and abroad. Originally it was my intention to give a much fuller account of the implications of the approach to planning adopted in the Plan-frame. I prepared drafts of a number of other chapters but I have not had time to complete them. In the meantime I am making some brief observations on different aspects of planning in India.

2. In the Plan-frame we started with the allocation of investments with a view to realizing the given targets of production. A programme of production which is consistent internally in respect of requirements of men, machinery and materials and is also capable of realizing the desired targets of income and employment is, however, not enough. The raising of financial resources required for this purpose is equally important. If is, therefore, necessary to work out a programme of public finance. The present system of taxes and public finance is based on the model of industrially advanced capitalist societies. Much fresh thinking would be needed to develop a scheme of taxation and monetary measures which would be suitable for an underdeveloped country like India, from the point of view of both economic growth and social justice. In India less than half a million (five lakhs) persons pay income-tax. Assuming an average size of a family of seven for each person paying income-tax, the total number of persons directly affected would be about three and a half million (35 lakhs) or less than one per cent of the total population. This one per cent owns a disproportionately large share of the wealth of the whole country. It would be desirable, from the point of view of social justice, to raise financial resources for the plan by taxation rather than by borrowings or deficit financing which, under existing conditions in India, are likely to increase the profits of those who are already rich. The direct tax can be appreciably increased by suitable changes in the structure of the income tax, and by imposing taxes on capital gains and wealth. It is also possible to introduce a progressive direct tax on personal expenditure at low rates and with a high exemption limit.* Even this is not likely to be enough to supply the large resources needed for a rapid growth of the economy. Additional resources can be secured through indirect taxes by raising customs

* N. Kaldor: *An Expenditure Tax* (Allen and Unwin, London, 1955).

and excise duties in a selective manner. The tax on luxuries can be increased very considerably so as to reduce disparities in the level of living. Essential commodities may also have to be taxed to raise adequate resources; but this should not be a hardship as the income of the majority of the population, who are poor, would increase rapidly with the increase of employment and work. All this would require a good deal of careful study.

3. It is comparatively easy to prepare plans on paper; the real difficulty lies in implementing them. Suitable instruments and techniques of implementation must be devised to realize the targets. It will be necessary to formulate and give effect to a vast programme of training of personnel at all levels. There will be urgent and continuing need of scientific and technological research oriented towards solving problems of national planning. This is essentially a long range task and it would be necessary to think in terms of 15 or 20 years and more.

4. The present system of education aims at providing very detailed teaching and instructions spread over a long period for a very small number of persons who are rich enough to pay for such education or who have the ability to win scholarships. The need for this type of education would continue) and educational facilities of the conventional type will have to be increased as rapidly as possible. But this would not be enough. A new approach will be necessary. Here the aim would be to give very quick training to a very large number of persons to enable them to start functioning as junior or auxiliary technicians in engineering and technology, agriculture, survey of natural resources, education, and health services. Suitable packaged and highly specialized courses would have to be developed for this purpose; and the training would have to be given not only in training schools and institutions but also, in an increasing measure, in factories, mines, irrigation and power projects, farms, and in hospitals and clinics all over the country. The selection of students for different types of training would require careful planning. Appropriate tests and examinations would have to be developed for this purpose. Much study and experimentation would be required to prepare the highly specialized short courses. It would be also useful to provide facilities for training through correspondence courses which can be made available to remote villages.

5. Much thought will have to be given to improve the efficiency of public enterprises. Government administration has been so far concerned primarily with work of a quasi-judicial type in which decisions may affect a large number of people. It is important to avoid wrong decisions. It is

also important to reconcile conflicting views among different Government agencies. There is no special hurry as there is no productive activity in the economic sense. All these call for much consultation and it is safe to have checks and cross-checks at different levels. The emphasis is on "control" in the sense of preventing mistakes or wilful deviations from prescribed rules and "coordination" in the sense of eliminating duplications or adjudicating between conflicting points of view of different agencies. The basic assumption is that the purpose in view would be fulfilled if there is no deviation from the rules.

6. In Government enterprises, on the other hand, the sole purpose is to manufacture specified products or to provide specified services (as in trading). In this case the real test of efficiency is an objective appraisal of output of the final product or services. Mere adherence to rules cannot guarantee the fulfilment of the targets of production. The public enterprises must be given sufficient autonomy to realize their production targets on businesslike lines. Much study and experimentation would be needed to evolve a suitable system of decentralization of the administrative and financial powers of public enterprises within the general frame work of a planned economy. This would naturally involve important questions of recruitment, control and promotion of personnel; incentives to promote efficiency; relationships between Government, management, labour, and consumer, etc. Competence of government officials must be judged on results, literally, on the ability to deliver the goods, and must be suitably recognized.

7. The Government of India had carried on trading in grains on a large scale for about ten years (1943–1952). It is likely that Government would have to take up trading again and gradually to increase the scale of operations. The State Bank is being expanded with a view to providing credit to rural areas on a large scale. Suitable institutions will have to be organized for the further expansion of Government trading and banking. Thought will have to be given to the expansion of foreign trade and the earning of foreign exchange for which a good deal of planning will be needed.

8. Attention will have to be given to land policy. Most of the States have acquired from the landlords the large holdings of land through legislation but very little has been done for the redistribution of the acquired land. One view is that a maximum size of the holding (depending on local conditions) should be fixed and land in excess of the ceiling should be distributed among villagers who do not own or have very little land. Such redistribution would

not necessarily lead to an increase in productivity but it may still be worthwhile because of the social and political benefits which would accrue from it. However, if such a redistribution be not immediately feasible then attempts should be made for a gradual consolidation of holdings with some kind of joint ownership. The success of the *Bhoodan* movement of Acharya Vinoba Bhave, who is advocating joint cultivation of the village as a whole, may be of great help in this connexion. The introduction of mechanized production in agriculture would probably have to come at a later stage when an adequate supply of power and of agricultural machinery manufactured within the country becomes available. With an increase in income the demand for food of better quality (vegetables, eggs, fish, meat, milk and milk products, fruits, etc.) would steadily increase. The pattern of agricultural production would have to be changed for this purpose which would require planning over a period of 20 or 30 years and more.

9. Other aspects of implementation would require attention. However well thought out a plan-programme may be, it is inevitable that shortfalls and deviations would occur in practice. The original programme itself would be based, in many respects, on inadequate or even incorrect information. Changes would also continually occur through the impact of the private sector (which is very large in India) and economic conditions outside India. There would be delays in the process of production which would lead to shortages of machinery, raw materials and labour or of consumer goods from time to time. A most important task of planning must be to introduce controls and take corrective measures at the earliest opportunity. A great deal of advance thinking and preparation is necessary for this purpose. For example, it would be wise to have a fully worked out scheme (and also, preferably, a nucleus organization) for the rationing of commodities like grains, cloth, sugar etc., so that, if any emergency arises, there would be no delay in introducing physical controls. Similar preparatory work would have to be done in other fields like finance, foreign trade, supply of machinery, raw materials and labour, training programmes, and administrative arrangements.

10. A good system of statistical services is essential for the preparation of plan-programmes as well as for an objective appraisal of the results achieved. There must be a continuing flow of statistical information from all sectors of the economy and from all over the country to enable a proper assessment being made of the progress of the plant not only in terms of expenditure but in terms of fulfilment of physical targets and of increase in the volume of employment and of the rise in the level of living. On the basis of such assessment it would be possible to introduce controls and corrective

measures at appropriate points and to make necessary adjustments in the future programme.

11. The type of planning visualized above would be necessarily a continuing process and would have two broad aspects. One would be the current planning directed to projects included in the annual plans within the frame work for a five year plan. The successive five-year plans themselves would have to be fitted into a larger frame work of perspective planning with a wide time horizon of 10 or 20 or 30 years of even more. Perspective planning would be primarily concerned with the technical and scientific aspects of the long-term growth of the economy. Studies and researches would be directed to solve practical problems and would be broadly of the type of "operational research" (although some problems of basic research would no doubt arise from time to time). This would call for the active cooperation of a large number of engineers, technologists, economists, statisticians, and workers in practically all fields of both natural and social sciences.

ACKNOWLEDGEMENTS

12. I have already mentioned that the "Draft Plan-frame" was prepared for issue, after revision, as a document of the Planning Commission but it was actually published in my name. The Draft Plan-frame is, in fact, a cooperative effort and is based on studies on planning conducted in the Indian Statistical Institute in collaboration with the Economic Division of the Planning Commission, the Economic Division of the Finance Ministry, and the Central Statistical Organization. A large number of persons participated in these studies and a number of working papers were produced. A part of this material has been used in the Plan-frame and this paper; other studies have no direct relation with the Plan-frame. All these working papers are going to be printed in the near future. A very brief account of the work done is given below.

13. Professor Charles Bettelheim of France developed a particular method of planning in his papers. His approach may be regarded as a synthesis of the methods of planning followed in socialized countries. He, of course, tried to adapt the methods to Indian conditions. His approach has a good deal in common with the approach of the Plan-frame in regard to the setting up of the targets and the working out of the physical balances. The allocation of investments in the Plan-frame, however, has an entirely different basis. About finances, also, the Plan-frame approach is different. Apart from his, Professor Bettelheim initiated some studies on capacity of production with a view to estimating the additional raw materials and other things

which would be required, if the capacity is to be fully utilized; co-efficients calculated for this purpose were found useful for working out the requirements of raw materials for some of the targets given in the Plan-frame. The following workers were actively associated with the studies initiated by Professor Bettelheim; Asoke Rudra, E. Lobel, A. Qayum, Uma Dutta, Probir Das, P. K. Upadhyay, R. L. Rawat, Nikhilesh Bhattacharya, Pranbandhu Das, G. R. Vernwal, G. V. L. Narasinham and Sashi Chakravarty.

14. Professor Ragnar Frisch of Norway pursued studies based on fairly elaborate transactions matrices. Given such a matrix he would maximize a suitable preference function subject to the constraints given by the relations in the matrix and some boundary conditions. Once a reliable matrix of this kind is available and a suitable preference function can be constructed, his method would give, in principle, a solution of the problem of development. The statistical material available in India is, however, not adequate to enable this method being used with success at present; and his work, at this stage, remains primarily of methodological interest. It may be noted that he obtained his linear programming solutions by his double gradient method and demonstrated its superiority over the simplex method in so far as time requirement is concerned. The following workers were associated with Professor Frisch : Tarapada Chaudhuri, Dev Kumar Bose, Amal Ray and Ajit Halder.

15. Dr. Richard M. Goodwin of Cambridge, England and Dr. Tarapada Chaudhuri prepared an input-output table relating to 1950-51. Material for this purpose was extracted by a quick tabulation of a sub-sample of the National Sample Survey and was used to estimate the overall activity and the sector break-down of costs. The Central Statistical Organization collaborated by supplying detailed information relating to estimates of national income. Work is continuing in this field in the Indian Statistical Institute and recently a larger input-output table for 1951-52 has been completed. Prominent workers in this group were : Tarapada Chaudhuri, Indra Chakravarti, Amiya Dasgupta, Kalpana Joshi, Ashish Chakravarti, Samar Mitra, H. P. Biswas, Prasanta Chowdhury, D. V. R. Murti, B. P. Panesar and Sunil Sinha. Subsequently, Satya Sengupta and his associates worked on studies of a similar type.

16. Jogabrata Roy, Indra Chakravarti, Radha Govinda Laha, A. Ganguly, Shyam Bose and Sukomal Das worked on the problem of projection of consumption and obtained some estimates of elasticities. Their results have been used in the Plan-frame.

17. Ajit Dasgupta worked on the problem of population projection and obtained estimates of projected population under different hypotheses. His group included among others : Murari Majumdar, Ranjan Som, B. N. Sarkar, Dhiren Sarkar and Prosun Sen.

18. Sitanghsu Bhattacharya and Ram Lingam Iyer made some studies on manufacturing industries. Certain field studies on unemployment, and interactions between planned and unplanned sectors were taken up by N. C. Ghosh, H. K. Chaturvedi, Keshav Dutt, Prosun Sen and Sudhir Bhattacharya.

19. Nihar Chakravarti wrote a paper on a plan of land reform. Raja Rao, R. P. Saha, Haribhajan Chowdhury and subsequently G. Kallianpur worked on certain aspects of the problem of land reform.

20. D. B. Lahiri aided by Saibal Banerjee, S. J. Poti, Samar Mitra, Des Raj and Sambhu Halder worked on the general question of the validity of data. D. B. Lahiri subsequently helped in administrative matters relating to planning. C. R. Rao helped in our work by placing the facilities of the Research and Training School at our diposal for these studies. B. Ramamurti (Jt. Director, CSO) assisted by M. P. Srivastava (Asst. Director, CSO) supplied necessary statistical data from the Central Statistical Organization and made its facilities generally available for these studies.

21. J. J. Anjaria (Chief, Economic Division, Planning Commission and Economic Adviser, Ministry of Finance) and I. G. Patel (Deputy Economic Adviser, Ministry of Finance) worked out the financial and monetary side; and generally helped in the preparation of the Plan-frame. Moni Mukherjee (Deputy Director, CSO) and Uma Dutta (of the CSO) worked on my two-sector model and helped me in following up some of my ideas which culminated in the preparation of the Plan-frame. Pitambar Pant (Deputy Secretary, and Private Secretary to the Chairman, Planning Commission) helped at all stages of the work.

22. Academician D. D. Degtyar, Professors I. Y. Pisarev, M. I. Rubinstein and P. A. Moskvin of U.S.S.R. and Dr. Oskar Lange of Poland gave a critical appraisal of the general approach and the final form of the Draft Plan-frame on the basis of their own experience of socialized economies. Their comments and observations were of great help to us although our own approach is different from theirs in certain important respects. The aim of the Plan-frame has been to seek an approach which would be suited to Indian needs and would be in accordance with the social and cultural traditions of India.

REFERENCES

(1) CHAMPERNOWNE, D. G. and KAHN, R. F. (1953-54): The Value of Invested Capital. *The Review of Economic Studies*, XXI (2), No. 55.

(2) GOVERNMENT OF INDIA: Estimates of National Income, 1948-49 to 1953-54 (Central Statistical Organization, 1951).

(3) ———— : Fifth Census of Indian Manufactures: 1950. (Directorate of Industrial Statistics, Ministry of Commerce & Industry).

(4) ———— : The National Sample Survey, Report No. 1. (Department of Economic Affairs, Ministry of Finance).

(5) ———— : India, A Reference Annual 1955. (Ministry of Information & Broadcasting).

(6) ———— : First Five Year Plan, 1951-56 (Planning Commission).

(7) ———— : Programmes of Industrial Development, 1951-56 (Planning Commission, 1953).

(8) ———— : Five Year Plan, Progress Report for 1953-54 (Planning Commission, 1954).

(9) GOVERNMENT OF WEST BENGAL: Economic Survey of Small-Scale Industries of Calcutta, 1952-53. (State Statistical Bureau, 1954).

(10) GOVERNMENT OF USA: Survey of Current Business, July 1953. (Department of Commerce, Washington, D.C.).

(11) HALDANE, J. B. S.: The Maximization of National Income. *Sankhyā*, Vol. 16, Parts I and II.

(12) KUZNETS, SIMON: National Income and its Composition, 1919-1938. (National Bureau of Economic Research, New York, 1946).

(13) ———— : National Product since 1869. (National Bureau of Economic Research, New York, 1946).

(14) ———— (1952): Economic Growth in the United States. *American Economic Review*, XLII, No. 2, May.

(15): LENFANT, J. H.: Great Britain's Capital Formation, 1865-1914. (*Economica*, May, 1951).

(16) MAHALANOBIS, P. C.: "Why Statistics " (Presidential Address to the Indian Science Congress Session, Poona, 1950).

(17) ———— : National Income, Investment, and National Development. Lecture at the National Institute of Sciences, 4 October 1952.

(18) ———— (1953): Some Observations on the Process of Growth of National Income. *Sankhyā*, **12**, Part 4.

(19) PREST, A. R. (1948): National Income of the United Kingdom, 1870-1946. *The Economic Journal.*

(20) RESERVE BANK OF INDIA: Company Finances in India, 1950 and 1951. (*Bulletin*, August, 1954).

(21) SURVEY OF SMALL SCALE INDUSTRIES: Bureau of Industrial Statistics, Calcutta, 1954.

(22) UNITED NATIONS: Report on World Survey of Iron Ore Deposits (1955).

(23) ———— : A System of National Accounts and Supporting Tables (1953).

(24) ———— : Statistics of National Income and Expenditure, Statistical. Papers, Series H, No. 7.

(25) ———— : Economic Survey of Asia and the Far East, 1954 (1955).

APPROACH TO PLANNING IN INDIA

Based on a talk broadcast from All-India Radio on 11 September, 1955. This article explains in a general way the approach to planning recommended in the Draft Plan-frame of 17 March, 1955 which was accepted by Government as the basis for the formulation of the Second Five Year Plan.

1. Two most important problems are facing us at present—poverty and unemployment. We must get rid of unemployment and prevent unemployment in future[1]. We must also continually improve the standard of living, not merely of any particular section of the people but of all sections, and especially the poorer sections[2]. These two aims are, of course, closely related.

2. Increasing the standard of living means a bigger and better supply of food, clothing, housing, medical, care, education and other amenities of life. This bigger supply can be secured only by increasing production of food, cloth and other goods for consumption; and by giving training to more teachers, doctors, and social service workers.

3. Production requires the use of tools, implements and machinery. We can no doubt increase the present production to some extent by working harder and using the present stock of tools and implements to better effect. There is, however, a limit to what we can do in this way.

4. The only permanent way of ensuring a progressively increasing production is to continuously increase our stock of tools and implements and machinery, that is, to increase what is called the capital investment. For a single factor, the production of steel probably has the highest correlation with national income in different countries.

5. Capital investments are of two types and there is an important distinction between the two. One type is used to manufacture goods for direct consumption such as the cloth mills or sugar factories. The other type is utilised for producing steel, cement, heavy chemicals, heavy machinery,

---

[1] According to the National Sample Survey there are about 5 million unemployed and seriously under-employed persons in urban areas. The corresponding figure for rural India may be another 5 millions with, however, a much bigger number of persons who remain partly idle during the year estimated at between 10 or 15 and 30 millions. In addition nearly 2 million persons are entering the working force every year.

[2] Expenditure on food and consumer goods in about Rs. 24 per person per month, of which only about Rs. 16 is spent in cash, rest being the value of home grown food and home produced goods which are cosumed in the home. About a sixth of the population or more than 50 millions have an expenditure of less than ten rupees per person per month out of which probably only five or six rupees are spent in cash.

coal, electricity, railways and such other things which are not directly consumed and are called "producer goods". We may call industries of the first type "consumer goods industries", and those of the second type "basic industries".

6. Steel plays a key role. The larger the supply of steel, the bigger is the production of tools, implements, and machinery; and the bigger the supply of both producer and consumer goods.

7. India has three times more of reserves of iron ore of equal or better quality than the United States of America, but the Americans have 200 times more steel per person than we in India have; and therefore they have more tools, implements, and machinery; and consequently they also have a bigger supply of consumer goods and enjoy a very much higher level of living.

8. We are producing a little over one million tons of steel at present. Three new factories are proposed to be started, with the help of the Germans, the Russians and the British, each to produce roughly one million tons per year. To establish one such steel factory, the cost would be about one hundred crores of rupees. Out of this about 45 crores of rupees or nearly half the expenditure must be incurred for the import of foreign machinery made mostly of steel. If we manufacture this machinery in India all this money would remain within our own country.

9. Why do we then import such machinery ? Because we have not started factories to fabricate heavy machinery needed for the production of steel, cement, etc. The capital cost required to start an integrated machine industry would be large, may be 200 crores of rupees out of which machinery worth 100 or 150 crores of rupees may have to be imported. But once we do this, and establish a heavy machine building industry we shall be able to use our own iron ore and with our own hands produce steel; and then use the steel to produce more machinery to produce more steel and tools; and also to produce machinery to make more consumer goods.

10. We will then not have to worry about foreign exchange every time we wish to start a new factory as we do now. Our dependence on foreign supplies will be greatly reduced. The main obstacle to rapid industrialization being thus removed, we shall be able to increase production and employment quickly and raise the level of living.

11. I may give another example. India is believed to be short of copper but has large reserves of bauxite from which aluminium can be produced. To develop electricity rapidly we should increase the production of aluminium progressively to replace copper as far as possible.

12. We should do our best to establish and expand, basic heavy industries as fast as possible; increase the production of steel, cement, heavy chemicals, coal, electricity; expand railways and transport facilities; and, above everything else, develop a machine building industry to build machines without which there can be no rapid industrialization.

13. We must at the same time expand, as fast as possible, health and medical care, education, scientific and industrial research, social services and opportunity for sports and cultural pursuits.

14. I may consider health services. It is believed that out of 65,000 fully qualified physicians, (basically with 6-year training) only about one-fourth, that is, fifteen or sixteen thousand live in rural areas which have a population of over 300 millions. That is, in rural areas, there is probably one fully-qualified physician for 20,000 persons on an average. Our medical colleges are training out only about 2,000 physicians per year; even if all of them go to rural areas (which is not possible), allowing for casualties it will take two centuries before there is one 6-year trained physician for 1,000 persons, the proportion already reached in some of the advanced countries of the world. It would be possible, however, to turn out every year ten or twelve or fifteen thousand health assistants who would be given training to provide elementary medical aid and to send them to the villages, which would enable every village having the services of such health assistants within 20 or 25 years. I have suggested that such cadres should be established without delay.

15. Large new investments in the basic sector of heavy industries, power and transport, and also new expenditure incurred for the expansion of the social sector would generate fresh purchasing power and give rise to fresh demand for consumer goods.

16. The resources must be allocated in such a way that the additional supply of food and consumer goods is just sufficient to meet this additional demand. This is important. If there is a shortage of essential goods like food or cloth, prices would rise. We must avoid this. The additional demand likely to be created by a given increase in income can be estimated from the observed consumption in households at different levels of income (based on the results of the National Sample Survey).

17. We must now consider the question of increasing the supply of consumer goods.

18. In the industrially advanced countries, agriculture is highly mechanised; in India it still remains essentially a household and small-scale occupation. In the advanced countries, consumer goods are also mostly manufactured in factories. In India we use both factories and small-scale or household industries for this purpose.

19. In fact, even if we exclude food (which is mostly household and small-scale production), the household or cottage or small-scale industries in India still supply more consumer goods than the organised factories do.

20. To increase the production of consumer goods in our country we have thus the choice of using either the household and small-scale industries or the organised factories.

21. In the Draft Plan-frame of 17 March 1955 we suggested that in the immediate future we should encourage the household and small-scale industries to supply as much consumer goods as possible. We also suggested that arrangements should be made for the supply of capital, raw materials, and marketing facilities through branches of a Government agency or through co-operatives supported by Government.

22. In order to provide an assured market for the small-scale and household industries we suggested that destructive competition from factories would be prevented by giving each sector a suitable quota so that competitive factories would not be able to expand production at the cost of the small-scale and household industries.

23. Objection has been raised on the ground that this proposal would tend to retard progress by going back to obsolete and inefficient methods of production so that cost of production would be high, prices would rise, consumers would lose the benefits of cheap mill-made goods, and there may also be inflation through a shortage of supply of consumer goods. These objections have much weight. I am convinced, however, that under Indian conditions it would be wise to encourage the small-scale and household industries. I shall now give my reasons.

24. Capital investment per person employed in basic industries is very high. It is of the order of a lakh of rupees in the case of a steel factory and is something like 20 or 25 thousand rupees in other heavy industities. The consumer goods factories, on the whole, require somewhat less capital; but even then an investment of ten or twelve thousand rupees would be usually required for one new person engaged. In view of meagreness of capital resources there is no possibility, in the short run, of creating much employment through the factory industries. The heavy industries would no doubt

lead to much subsidiary industries in future but this would take 10 or 15 years or even more. The factory production of consumer goods would increase economic activity; but this also would take time.

25. Now consider the household or cottage industries. These require very little capital. About six or seven hundred rupees would get an artisan family started. With any given investment, employment possibilities would be ten or fifteen or even twenty times greater in comparison with corresponding factory industries. Production and turnover are much more rapid in small industries and, therefore, the beneficial effects would quickly accrue.

26. Another advantage of the small industries is that these are scattered widely all over the country, as a result of which the increase in production and in purchasing power would also be widely scattered and would greatly stimulate local economic activities, specially benefiting the rural areas and small towns. It will avoid the cost and difficulties of providing housing, transport, and proper social amenities to the workers, which would be needed if production were to be organised in big factories in urban areas.

27. These advantages, coupled with the need of removing unemployment as quickly as possible, provide the justification for our emphasis that as much work as possible should be created in the small industries; and at the same time, as much of the investment resources as possible should be utilised for laying down firm foundations of industrialization by building up the heavy industries.

28. I am, of course, aware that the price of hand-made articles in some cases would be higher than mill-made articles of comparable quality. I have suggested that in such cases, suitable parity between prices should be maintained by imposing excise duties on mill-made goods.

29. It is true that the policy of encouraging the small and household industries arises partly from the urgency of solving the problem of unemployment and partly from the meagreness of our capital resources. But, I believe, in India the small-scale and household industries can and should continue to enjoy an important and enduring position.

30. As unemployment is brought under control and as the supply of electricity increases, as our machine-building industry develops and as we have a bigger supply of steel, we should manufacture motors and small machines in large numbers; and give these to the artisans working in the small and household industries so that production per person would steadily increase. Our aim should be to increase the productivity in the small and

household industries as much as possible through the use of cheap electricity and machines of the most modern type made in India.

31. The enduring place of small industries in the future economy of the country will become clear if we view industries as being of two types. In one type, production must be concentrated. For example, steel, cement, fertilizers, penicillin, locomotives, and heavy machineries must be produced in large factories, requiring very heavy capital. The direct employment would be negligibly small; and here we should prefer the most modern machinery. We should also encourage the use of as much automatic machines as possible which incidentally would reduce the requirements of highly skilled technical personnel.

32. In the second type, production in small units would be possible with the help of modern machinery and would be also economical from the national point of view, because it would avoid many economic overheads and social costs and evils of congestion in cities and slums. Such industries should continue to be developed in small and household enterprises.

33. The highly skilled artistic handicrafts must, of course, be maintained and developed in small units of production with the help of power, suitable tools, and marketing facilities. Finally, small scale production should be encouraged and should continue whenever articles can be made by local labour mainly from locally available materials for local consumption.

34. In this way, in India, we should be able to maintain a great deal of small-scale and household production which would use cheap power and modern tools and implements, and would be, therefore, basically as efficient and as low cost (at a national level) as factory production.

35. We also envisage, of course, a steady and large expansion of factory production of consumer goods. In the Draft Plan-frame provision has been made for a large increase in the production of many factory-made consumer goods such as sugar, vegetable oil, bicycles, sewing machines, electrical goods antibiotics and fine drugs, etc. Factory production of goods for export should also be encouraged.

36. The question of imposing production quota, that is, production ceiling arises only in the case of factories which are competitive with small-scale and household industries.

37. The basic strategy is now clear. We create demand by a planned expansion of the basic industries and of the social sector, that is, health,

education, etc. We meet the demand by a planned increase in the production of consumer goods as much as possible in the small and household industries, and the rest in factories. As both production and income increase, we divert a portion of the increase in income for new investments again in a planned manner to balance new demand by new production, and the process continues. At each stage, we must be careful that the right quantity of raw materials is available at the right time for production; and the right quantity of consumer goods is available at the right time to meet the demand.

38. For example, when fixing any target for the production of steel we must remember to provide the necessary supply of iron ore, coal power or fuel, and other raw materials, besides a sufficient number of labourers and technical personnel; we must also plan for a corresponding increase in transport facilities to carry the raw materials to the steel factories. Similar arrangements have to be made for other targets of material production as well as for different services. We must take into account the fact that different sectors of the economy are interlocked through inter-industry relations. We must see that the set of targets is internally consistent in the sense that no single target of production is in disagreement with the others.

39. The system of balances, both physical and financial, has to be examined for the plan as a whole. This is of crucial importance. If there is any lack of balance there will be bottlenecks and delays which would continually hamper production.

40. I have been so far discussing the economic and technical aspects of planning. I shall now consider very briefly the social aspects. In the Draft Plan-frame we adopted a target of growth of national income by 5 per cent per year and provision of work in volume, equivalent to 11 million jobs. The new investments in construction, expansion of small-scale and household production, and of health, education, etc. would mean more employment for the poorer sections of the people. This should reduce disparities in the distribution of income.

41. We have also suggested that excise duties, at different rates on different commodities, should be levied partly to maintain price parities and to collect financial resources and partly to increase the price of luxury goods and services which also would reduce disparities in the level of living. Personally, I am in favour of taxes on expenditure, capital gains, and wealth as such; taxes can be effectively used to collect increasing resources for national development and also to reduce disparities.

42. In keeping with the goal of 'socialistic pattern of society' the basic industries would be started and developed mainly in the public sector, that is, as Government enterprises. As the pace of development increases, Government would need larger and larger resources which can be secured only through borrowings, taxes, or profits of State enterprises. In order to secure larger profits, it would be necessary for Government to extend public enterprises so that the public sector would increase faster than private factory enterprises. In time most of the large-scale factories would be in the public sector; units of medium size would be run by co-operatives; and small-scale production would be in household enterprises. This would be in accordance with the decision of Parliament and in conformity with the policy announed by the Prime Minister.

43. It is necessary that in a planned economy organised private factories should conform in a general way to the over-all plan of production and investment. Within this frame-work they would have the fullest scope for production, an assured market arising from an expanding economy, and all possible help and encouragement from Government.

44. I may now consider briefly the question of land reform. Most of the States have acquired from the landlords the large holdings of land through legislation but no definite scheme for redistribution of such land has been yet formulated. One view is that a ceiling (depending on local conditions) should be fixed on the size of holdings; and land in excess of the ceiling should be distributed among other villagers. It is not clear that such redistribution would necessarily lead to an increase in productivity; the poorer sections may not also derive much benefit. In spite of this I should like to get the land redistribution completed by 1958 because of the social and political benefits which would accrue.

45. If, however, such a redistribution is not immediately feasible, then attempts should be made to prepare the country both psychologically and technologically for consolidation of operational holdings with some form of joint ownership of the village as a whole. Much depends on the success of the *bhoodan* movement of Acharya Bhave who is advocating joint cultivation of the village as a whole. This movement should be encouraged as much as possible.

46. When industrialization has made some progress and unemployment has decreased appreciably, attempts should be made for the consolidation of operational holdings. The important aim is joint cultivation and operation. The distribution of profits can be arranged in suitable ways.

47. The introduction of mechanized production on a large scale in agriculture must wait until we can ourselves manufacture agricultural machinery on the required scale. For some time, may be 10 or 15 years to come, we shall have to depend on irrigation projects, better seeds, more fertilisers, etc. to give a higher outturn in agriculture.

48. Planning must be flexible and continuous. There should be a general frame-work for five years; and detailed annual plans should be prepared every year. Targets, projects and policies must be continually re-assessed and reformulated in the light of new experience. Also, we must always keep in view the growth of the economy over a long period of 10 or 15 or 20 years, so that a balance can be secured between short-term and long-term objectives.

49. I have very briefly touched on some aspects of the approach for the Second Five Year Plan. This type of planning calls for a great deal of analysis and thinking at the physical, scientific and technical level. A very large number of technical personnel, of engineers, technologists, scientists, doctors, teachers and professional workers, would be needed both for preparing the plan and for implementing it. There will be also urgent and continuing need of scientific and technological research oriented towards solving the needs of national planning which will be a challenge to all scientists.

50. In formulating the above approach to planning in India we have tried to make recommendations which would be practicable under Indian conditions. We have always kept in view our cultural traditions and the present social and political conditions in India; and have not tried to imitate blindly the methods adopted in other countries, although, naturally, we have learned much from their experience. We believe the present approach is basically Indian and is suited to Indian needs.

51. The success of the present approach depends entirely on the efficiency of the public enterprises which would be established in increasing numbers in future. In the present system of government administration there is a great deal of delay and inefficiency due to excessive centralization, especially in financial matters. The present system depends on adherence to rigid rules which hamper initiative. This must be changed.

52. Every government official must be given more responsibility to make decisions at his discretion; and his competence must be judged on results, that is, in the case of public enterprises literally on his ability to deliver the goods. Administrative and financial procedure must be revised accordingly.

53. And finally, people's co-operation has to be enlisted at all levels and in increasing measure. We have been lagging far behind in the race of material progress; we have now to run. Let us not slacken our steps and falter on the way !

SCIENCE AND NATIONAL PLANNING

Anniversary address delivered as President of the National Institute of Science of India on 8 January, 1958 at Madras. Published in *Sankhyā*, Vol. 20, Parts 1 & 2 (1958), pp. 69–106.

INTRODUCTION

1. Since the Anniversary Meeting is being held separately from the Annual Meeting the tradition has been for the President to select a subject for the Anniversary Address from some branch of science of which he is a student and give a general review acceptable to other scientists. As I can not claim to have specialized knowledge of any particular subject, I looked at the Presidential Addresses of some of my distinguished predecessors for guidance. Since the inaugural address in 1935 I found a continuing concern with problems of organization of scientific research in India. The functions and responsibilities of the National Institute of Sciences have also been reviewed a number of times. Looking back I had the feeling that many of the problems are still with us in one form or another.

2. In 1938, exactly 20 years ago, Dr. Meghnad Saha selected for the Presidential Address the "Problem of Indian Rivers", and pleaded for the initiation of systematic studies to lay a scientific foundation for flood control, irrigation, and navigation. He also gave a full discussion of benefits which would accrue by generation of cheap electrical power out of the energy of running water. He had mentioned at that time; "This is a subject which is just beginning in India but its importance has not been properly realized". He referred to poverty and unemployment; and asserted that "industrialization [was] the only solution of the poverty problem". He also referred to planning in Russia, and pointed out that "when the Supreme Council of the Soviet adopted Lenin's resolution for the electrification of the country, it was the USSR Academy of Sciences, and not a committee of bureaucrats which was requested to give a plan". He concluded his address with the following words :

> "If we desire to fight successfully the scourage of poverty and want from which 90 per cent of our countrymen are suffering, and lay the foundation of a strong and progressive national life, we must make the fullest use of the power which a knowledge of Nature has given us. We must rebuild our economic system by utilizing the resources of our land, harnessing the energy of our rivers, prospecting for the riches hidden under the bowels of the earth, reclaiming deserts and swamps, conquering the barriers of distance and above all, we must mould anew the nature of man in both individual and social aspects, so that a richer, more harmonious and happier race may live in this great and ancient land of ours."

3. The picture in the mind of the scientist twenty years ago has already become real in the great river valley schemes of India. This is the task of the scientist, to see the shape of things to come, not as wishful thinking but based on the knowledge of Nature and worked out in accordance with the methods of science. The two basic problems, poverty and unemployment, mentioned by Saha still remain as acute as ever. The only way out is through rapid industrial development based on science and planning. I feel this is an appropriate subject for my address.

"SPUTNIK"

4. On the 4th of October, 1957, an artificial satellite "Sputnik" was launched by USSR followed in a month's time by a second and bigger one carrying a live dog. We received this news when our Council was in session; and on the 6th October, at the desire of the Fellows of the Institute assembled at the Annual Meeting, we sent a message of congratulation to the USSR Academy of Sciences.

5. The way to outer space beyond the earth's atmosphere was thus opened for the first time. It is a great triumph of science. Epochs of history can no longer be demarcated in terms of dynasties or war between nations but must be thought of in terms of the progress of sciences and technology.

6. The upsurge of science in what we call the West (that is, in the countries of Europe and North America) led to the industrial revolution characterized by the use of machinery driven by steam and later by electricity for the production of goods, and brought about a rapidly increasing level of living in the industrially advanced countries during the last 100 or 150 years. This increase in industrial production gave the West its superiority in armaments and brought practically the whole world under its domination. Striking developments occurred during the last fifteen years. Atomic power for bombs and for electricity, high-speed rockets, guided missiles and satellites have been developed and have great dangers; and also have much of promise for the future, if we do not get involved in a suicidal nuclear war.

7. As scientists, it is also very much our concern to understand the significance of recent events. Russia was practically an underdeveloped country at the time of the Revolution forty years ago. The lauching of the Sputnik from this country became possible only because of the revolutionary progress of science and technology in Russia in the course of one single generation. In Russia, as in all other industrialized countries of the world, scientific research and industrial production have been closely coupled;

progress of one has been both cause and effect of an advance of the other. It is this integrated advance of science and industry which has made it possible for USSR to attain its present leading position in the whole world.

SCIENTIFIC RESEARCH AND ECONOMIC DEVELOPMENT

8. In all industrialized countries, we find a close association between the attention given to scientific education and research, the rate of increase of industrial production and, hence, of the improvement in the standard of living. Consider the three nuclear Powers, UK, USA and USSR, and also two underdeveloped countries, China and India, which have the two biggest populations in the world and much natural resources. Table (1) shows the relation between economic development and expenditure on research in these five countries. The population in each country is adopted as the basis for comparison and is given in million in col. (2). The national income, electricity (in kilowatt-hours), coal (metric tons), total energy (in terms of kwh), and production of steel ingots (metric tons) are shown, in the form of "per person per year", in cols. (3) to (7). Actual expenditure on research per year is given in rupees in col. (8), and is expressed as a fraction of the national income in col. (9); and the expenditure in rupees "per person per year" is shown in col. (10).

9. The estimates are admittedly appropximate and there are well-known difficulties in international comparisons of income and expenditure. Prices and the structure of prices vary widely from one country to another. Concepts and definitions used in different countries are often different. For example, the American figure for expenditure on research includes industries. It is possible that research carried out in industrial concerns is not included in the Russian figure. Nevertheless some striking contrasts come out clearly in Table (1).

10. The three great powers have the highest per capita income, energy, steel and expenditure on research. China is way behind but has already outstripped India in all items, although only a few years ago China was less developed than India. Expenditure on research is Rs. 65 crores in China compared to Rs. 6 crores in India, or more than ten times higher. As a fraction of national income, China spends 0·4 per cent which is seven times higher than the Indian figure of 0·06 per cent. The "per person" expenditure in China is Re. 1·1 per year which is again seven times higher than the Indian expenditure of Re. 0·15 per year. In 1943 Dr. J. C. Ghosh in his Presidential Address to the National Institute had raised the slogan of "one per cent of the national income per year for scientific research". The three advanced countries are spending nearly twice as much at present; and China has almost achieved half the target while, after 15 years, India has gone only one-sixteenth of the way.

TABLE (1): ECONOMIC DEVELOPMENT AND EXPENDITURE ON RESEARCH: 1955

country	population[1] (10)	national income[2]	extimates per person per year[3]				approximate expenditure on research[4]		
			energy			steel ingots (metric tons)			
			electricity (kwh)	coal (metric tons)	total in terms of kwh		actual (rupees crores)	p.c. of national income	per person (rupees)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
USA	165	$ 2000	3812	2.71	8334	0.64	2550	1.8	154
USSR	220	Rubles 5000	850	1.38	3152	0.26	2200	1.8	110
UK	51	£ 300	1845	4.41	9204	0.39	430	2.1	85
China	608	Yuan 135	20	0.15	275	0.005	65	0.4	1.1
India	382	Rs. 250	22	0.10	192	0.004	6	0.06	0.15

[1] Population figures for USA, UK and India taken from *UN Statistical Year Book*, 1956; the figure for USSR taken from the *National Economy of the USSR : Statistical Returns*; the figure for China is based on statistics prepared by the State Statistical Bureau of the People's Republic of China.

[2] The figures of national income for USA and UK are taken from the *Statistics of National Income and Expenditure, UN Statistical Paper, Series H.* No. 10. The figure for India is taken from the *Estimates of National Income* 1948-49—1955-56 (Central Statistical Organisation, Government of India). The figure for China is taken from the source given in the previous note. The figure for USSR is calculated from an estimate given in the *Economic Bulletin for Europe*, May 1957 on the assumption that one-third of the gross savings comprise depreciation. All figures have been drastically rounded off. It is interesting to note the rupee equivalent of the Russian per capita income comes considerably above the rupee equivalent of British per capita income, if the current official excahange rates are used for purposes of conversion. Conversion factors are 1 $ = 4.75 Rs.; 1 £ = 13.3 Rs.; 1 ruble = 1.2 Rs; and 1 yuan = 2 Rs.

[3] All output figures are taken from the *UN Statistical Year Book*, 1956. The USSR steel output figure of 51.3 million metric tons relating to 1957 has been obtained from Russian sources. The figures for coal in metric tons has been converted into kwh by using the factor 1000 kwh = 0.6 ton of coal or 1 ton of coal = 1667 kwh. It may be noted that lignite production in USSR is 114.9 million metric tons as against 2.7 million metric tons in USA; this has not been considered while getting figures in col. (6). Electricity production in China and India excludes generation for own use.

[4] Expenditure on scientific research in USA is taken as $ 5.4 billion in 1953 on the basis of a report on "Funds for Basic Research in the United States 1953" published by National Science Foundation, USA, and briefly reproduced in *Business Week*, 23 November, 1957. It may be noted that only about 8% of the amount was devoted to fundamental research. The percentage in col. (10) for USA is computed on the basis of 1953 figures for national income.

USSR: the expenditure on scientific research is taken as 18.2 billion rubles (as reported in the *Times of India*, in a message dated Moscow, 20 December 1947). It is possible that applied research in industries has not been fully included in this amount.

UK: the expenditure on scientific research is taken as £ 325 million (*Economic Bulletin for Europe*,, May 1957): Highly qualified technical manpower in Western Europe. This source gives a figure of $ 5.2 billion for USA.

China: the figure used is 32,7141 thousand yuan on the basis of the Finance Minister's speech on the budget for 1957 July (1957).

The Indian figure of Rs. 5.79 crores in 1956-57 is estimated from budget accounts and other sources.

11. Table (2) shows the available number and the outturn of engineers and doctors in the five countries. Col. (2) gives the population in million to

TABLE (2) NUMBER AND ANNUAL OUTTURN OF ENGINEERS AND DOCTORS

country	1955 population (10)	engineers				doctors			
		total available		annual outturn		total available		annual outturn	
		year	number (000)	year	number (000)	year	number (000)	year	number (000)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
USA	165	1950	518.8	1956	26.0	1955	218.1	1955	7.1
USSR	200	1956	721.0	1956	71.0	1955	299.0	1956	20.0
UK	51	1956	78.5	1954–5	2.8	1956	85.0	1952–3	1.9
China	608	1955	80.2	1955	18.8	1955	70.5	1955	6.8
India	382	1956	71.9	1955	3.6	1955–6	70.0	1954	3.1
		per million of population							
USA		1950	3144	1956	158.0	1955	1322	1955	42.5
USSR		1956	3605	1956	355.0	1955	1495	1956	100.0
UK		1956	1539	1954–5	55.0	1956	1674	1952–3	37.3
China		1955	132	1955	30.9	1955	116	1955	11.2
India		1956	188	1955	9.4	1955–6	183	1954	8.1

Note :

USA : Data on available number of engineers and doctors as well as the figure of annual outturn of doctors are taken from the *Statistical Abstract of USA*. 1957. The figure for annual outturn of engineers is quoted from "Trained Man-power, USA *vs.* USSR" *Monthly Review*, New York, April 1957.

USSR : Regarding engineers, both the figures are based on Soviet official statistics (in Russian). The figure of numbers of doctors available is taken from the English language publication, *National Economy of USSR : Statistical Returns* while the outturn figure is from the *USSR Reference Book*, November 1957.

UK : Both the figures for engineers are taken from "Highly trained technical man-power in Western Europe", *Economic Bulletin for Europe*, May 1957. The Annual Report of the British Medical Association, 1955-56 (Supplement to the *British Medical Journal*, April 7, 1956) gives the total membership of the Association as 68.306 on March 1956 and states that this number represents 80% of the work in profession. The available number of doctors is estimated on this basis. The figure of annual output as obtained from G.D.H. Cole : *Post War Condition in Britain*, 1956.

China : All the figures are based on the statistical returns for the People's Republic of China prepared by the State Statistical Bureau (in Chinese). However, a based figure of the available number of engineers in 1952 has been taken from Solomon Adler : *Chinese Economy*.

India : The outturn figures are based on the *Educational Statistics* of India. The available number of engineers is taken from *Manpower Studies No.* 5 *: Engineers in India ; Number and Distribution* 1955, (Planning Commission, October 1957). The number of doctors is based on information given by the Planning Commission.

serve as a basis for comparison; cols. (3), (5), (7) and (9) give the years of reference. Col. (4) shows the estimated number of engineers available (in thousands), and col. (6) the annual outturn (in thousands). In the three advanced countries the outturn figures refer to training at university level; in China and India the figures include both graduates and diploma-holders. Col. (8) gives the available number of doctors (in thousands), and col. (10) the annual outturn (in thousands); the outturn figures refer to graduates in all countries. The corresponding numbers per million of the population are given in the lower half of the table.

12. The three advanced countries have much higher numbers of both "available" and "outturn" of personnel. USSR has established a definite lead over both USA and UK. The actual number and proportionate outturn of both engineers and doctors are more than double those of USA. This indicates a striking superiority in technical man-power, the effect of which is bound to be felt in an increasing measure in future. Scientific and technical man-power requires a longer period of maturing than basic heavy industres. In this respect USSR now occupies, beyond dispute, the leading position in the world. It is reasonable to infer that the lead has some connexion with the launching of the "Sputnik".

13. China and India are much behind the more advanced countries. The available number of engineers and doctors are roughly of the same order in both China and India but China still has appreciably fewer than India on a population basis, namely, 132 engineers per million of the Chinese population against 188 engineers per million of the Indian population with 116 and 183 per million as the corresponding figures for doctors. It must be remembered that engineering and medical education of the modern type had started several decades earlier in India. China, however, has left India behind in the outturn of both engineers and doctors. The number of engineers coming out every year is 30·9 per million in China or three times greater than the Indian outturn of 9·4 per million in 1955. As regards doctors, the outturn of China is 11·2 per million against 8·1 per million of India.

14. From Tables (1) and (2) it is clear, that scientific research and availability of scientific and technical personnel are important factors in the economic development and "greatness" of nations however it may be measured. It is also clear that India is lagging very much behind, in these respects.

ECONOMIC AND SOCIAL CONDITIONS IN INDIA

Consumer expenditure

15. The two great problems of India are poverty and unemployment which are but two aspects of economic stagnation and under-development. Since 1950 the National Sample Survey (NSS) has been collecting a good deal of information on social and economic conditions in both rural and urban areas of India. Some of this material has been given in the Statistical Appendix from which much interesting and significant information can be obtained. I shall refer to a few selected examples.

16. The following Table (3) gives in cols. (1) to (4) information on the total consumer expenditure for the whole of India (rural and urban, excluding Jammu & Kashmir) during the period December 1955 to May 1956. Cols. (1) and (3) give the percentage of the population, and cols. (2) and (4) the limiting expenditure in rupees per person per 30 days (which may be spoken of as a month approximately). An example would make the position clear.

TABLE (3): DISTRIBUTION BY SIZE OF (*a*) CONSUMER EXPENDITURE: 1955-56 AND (*b*) LANDHOLDINGS (1953-54): ALL-INDIA

	by total consumer expenditure in rupees per person per 30 days[1]				by size of land-holdings in acres[2]			
	per cent of population	limit of expenditure in rupees	per cent of population	limit of expenditure in rupees	per cent of households	limit of size of land-holdings	per cent of house holds	limit of size of land-holdings
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	upto	less than	upto	less than	upto	less than	upto	less than
1.	5 p.c.	Rs. 3.2	55 p.c.	Rs. 15.7	5 p.c.	0.2 acre	55 p.c.	4.0 acre
2.	10 ,,	,, 6.2	60 ,,	,, 16.9	10 ,,	0.5 ,,	60 ,,	4.7 ,,
3.	15 ,,	,, 8.4	65 ,,	,, 18.4	15 ,,	0.7 ,,	65 ,,	5.7 ,,
4.	20 ,,	,, 9.8	70 ,,	,, 20.0	20 ,,	1.0 ,,	70 ,,	6.6 ,,
5.	25 ,,	,, 10.4	75 ,,	,, 22.2	25 ,,	1.3 ,,	75 ,,	7.9 ,,
6.	30 ,,	,, 10.9	80 ,,	,, 24.0	30 ,,	1.7 ,,	80 ,,	9.7 ,,
7.	35 ,,	,, 11.6	85 ,,	,, 28.6	35 ,,	2.0 ,,	85 ,,	12.6 ,,
8.	40 ,,	,, 12.4	90 ,,	,, 35.8	40 ,,	2.4 ,,	90 ,,	16.2 ,,
9.	45 ,,	,, 13.4	95 ,,	,, 44.2	45 ,,	2.8 ,,	95 ,,	26.0 ,,
10.	50 ,,	,, 14.6			50 ,,	3.3 ,,		

[1] Based on National Sample Survey (NSS): 10th Round, December 1955—May 1956. All-India (rural and urban) excluding Jammu & Kashmir.

[2] Based on National Sample Survey (NSS): 8th Round, July 1954—March 1955. All-India rural area only.

17. It will be seen from the first line, that 5 per cent of the population spends less than Rs. 3·2 per person per month; and from the second line, that 10 per cent or more than 38 million people spend Rs. 8·4 per head per month. From the bottom line of col. (2), we find that 50 per cent or *half of our countrymen, nearly 200 million in number, live on Rs. 14·6 per month or less than half a rupee per day per person.* It would be also seen that 85 per cent of the population can spend less than Rs. 28·6 per month or less than a rupee per head per day; even 95 *per cent of the population spend* less than Rs. 35·8 *per month* or *just above a rupee a day.* The above distribution gives some idea of the poverty in which 95 per cent of our countrymen have to live.

18. Many other facts regarding conditions of living can be found from the Appendix Tables (A.1.0), (A.1.1), and (A.1.2). The rich actually spends more on foodgrains by proportionally less in relation to their total expenditure as can be seen from Table (A.1.1). However, both actual and proportional expenditures on sugar, milk and milk-products, and clothing are relatively much higher among the rich showing that these are essentially luxury items. It is interesting to observe that medical care is apparently the greatest luxury; the poor can have very little of it, and medical expenses go up very steeply as the level of expenditure increases.

Land owned by Household

19. Similar estimates are given in cols. (5) to (8) of the same Table (3) in respect of the size of the holding of lands in acres owned by any assigned percentage of households who own 0·1 acre or more of land. (Households owning less than 0·1 acre were omitted to exclude landless labour and non-agricultural households). It is seen from this table that 20 per cent, or one-fifth of the households, have 1 acre or less; fifty per cent have less than 3·3 acre; 75 per cent have less than 7·9 acre; and 95 per cent less than 16·2 acre. Most of the households in the rural area own very little land.

20. The disparity between the rich and the poor can be seen more clearly from the concentration curves shown in the accompanying chart and also from Table (4) below. The percentage of the population or, alternatively, of households is shown in col. (1). In each line, col. (2) shows what percentage of total expenditure (of the whole population) is shared by the percentage of population from the *bottom* as given in col. (1) of the same line; col. (3) gives the share of the same percentage of persons but from the *top*. Thus, the lower 5 per cent of the population of India share only 1·5 per cent of the total consumer expenditure, while the top 5 per cent of the population share

TABLE (4): CONCENTRATION CURVES OF (*a*) CONSUMER EXPENDITURE : 1955-56 : AND (*b*) LAND OWNED BY HOUSEHOLDS 1953-54 : ALL-INDIA

	(1) persons or (b) households	consumer expenditure on all items by persons		total land owned by households	
		lower	upper	lower	upper
	(1)	(2)	(3)	(4)	(5)
		cumulative percentages			
1	upto 5 p.c.	1.5	18.2	0.2	34.2
2	10 „	3.2	28.8	0.4	48.8
3	15 „	5.2	36.6	0.9	58.6
4	20 „	7.6	44.0	1.5	66.5
5	25 „	10.1	49.9	2.3	72.5
6	30 „	12.8	55.3	3.1	77.5
7	35 „	15.5	60.5	4.6	81.0
8	40 „	18.8	65.6	6.2	84.6
9	45 „	22.3	70.0	8.1	87.5
10	50 „	26.1	73.9	10.5	89.5

18·2 per cent of the total expenditure. We also find that while the lower 25 per cent of the population spend 10 per cent of the total expenditure the top 25 per cent shared 50 per cent; and that the lower half has 26 per cent while the upper half of the population spend 74 per cent of the total expenditure.

21. Similar estimates are given in cols. (4) and (5) of Table (4) in respect of the proportion of land owned by different percentages of households. The bottom 5 per cent owns very little land, only about 0·2 per cent or less, while the top 5 per cent own 34 per cent of all lands owned by households. In the same way, it can be seen that the bottom 20 per cent have 1·5 per cent against 66 per cent of all lands owned by the top 20 per cent. The lower half of households have 10 per cent against 90 per cent owned by the upper half. Disparities are much higher at the top. For example, the top one per cent of households owns approximately 13 per cent of the total land; the top two per cent nearly 21 per cent; and the top five per cent of households owns 30 per cent or almost one-third of all lands owned by households. The concentration of landholdings is clearly much greater than that of household expenditure.

Employment and Unemployment

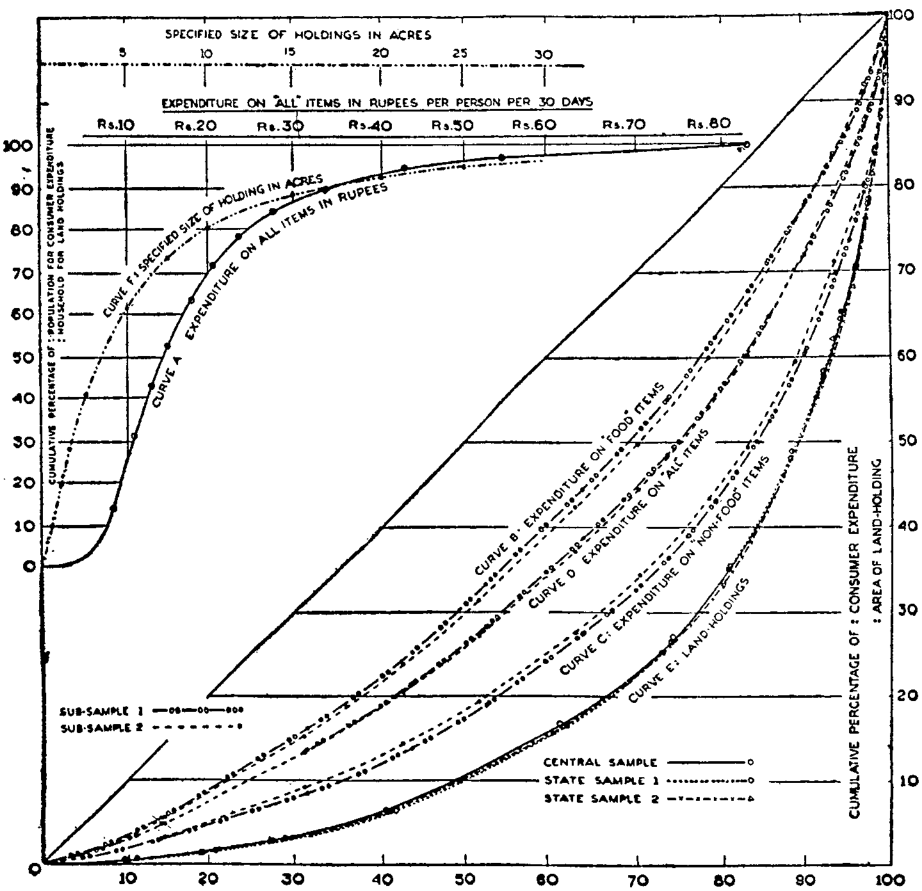
22. Some information on employment and unemployment is given in the Statistical Appendix, Tables (A.3.1), (A.3.2), and (A.3.3). I should explain that there are great difficulties in adopting in India the concept of 'unemployment' used in the advanced countries of the world, where practically all gainfully employed persons receive wages and salaries or have earnings in money (except for time spent by members of a family on their own household work). It is, therefore, possible to specify in an objective manner whether a person is gainfully occupied or is out of work. There are, of course, technical a person is gainfully occupied or is out of work. There are, of difficulties of standardizing the definition of unemployment even in the advanced countries but these are comparatively small. In an under-developed country like India, on the other hand, there is inevitably, a great deal of ambiguity in defining unemployment in an objective manner. Much of the work in household enterprises, in both agriculture and cottage industries, is done by members of the household and is not paid for in maney. Also, a large number of persons work on their own account, such as weavers, tailors, carpenters, smithy, barbers, small store-keepers etc. These people may have enough work to keep them busy the whole day; or they may have to sit idle for a part or most of the time; or many have practically no work in hand; and yet they can never be called technically "unemployed" in accordance with the concept used in the more advanced countries. The above considerations must be kept in mind in interpreting the information given in the Statistical Appendix based on the National Sample Survey covering about 24,700 households in the 9th Round : May–August 1955, and covering about 17,600 households in the 5th and 6th Round, December 1952–August 1953. It must also be remembered that all estimates, being based on sample surveys, have margins of errors of sampling.

23. Subject to these warnings, we may say broadly that about 160 million persons (or roughly 42 per cent out of an estimated population of 382 million in 1955) were in the labour force, that is, were either engaged in work or were seeking work. Among them 2·2 million, were "unemployed" in the technical sense of the advanced countries [Table (A.3.1)], which, however, has no clear meaning in India. In fact, only about 13 million persons who work under Government and public authorities or in pvirate organized large scale enterprises, have employment of the type usual in the advanced countries [Table (A.3.2)]. The technical concept of "unemployment" can be strictly used only in the case of these 13 million persons (out of a total

labour force of 160 million), but is not applicable to the remaining 147 million who work in household or small-scale enterprises.

24. In an under-developed country it is, therefore, necessary to consider how many persons have to sit idle a part or most of the time for lack of work and other economic reasons. From the information collected by the NSS

CONCENTRATION CURVES FOR CONSUMER EXPENDITURE AND LAND HOLDINGS



CUMULATIVE PERCENTAGE OF : POPULATION FOR CONSUMER EXPENDITURE
: HOUSEHOLDS FOR LAND HOLDINGS

BASED ON NATIONAL SAMPLE SURVEY : ALL INDIA

CURVE A : Distribution by expenditure on 'all' item in rupees CURVE B : Concentration curve for expenditure on 'food' items CURVE C : Concentration curve for expenditure on 'non-food' items CURVE D : Concentration curve for expenditure on 'all' items	10th ROUND (Decmeber 1955-May 1956)
CURVE E : Concentration curve for land holdings CURVE F : Distribution by size of land holdings	8th ROUND (July 1954-March 1955)

it would seem that nearly 20 million persons normally work one hour or less per day, 27 million work two hours or less per day, and nearly 45 million persons are engaged in gainful work for 4 hours a day or less [Table (A.3.1), portion B.(2)]. In NSS 5th and 6th Rounds, December 1952–March 1953, it was found that nearly 30 million persons have gainful work for less than 5 days in the month, 30 million less than 10 days, and 53 million lessthan 15 days in the month [Table A.(3.1), portion B(3)]. In another enquiry, NSS : 7th Round October 1953–March 1954, it was found that about 45 million persons were working part-time. They were asked supplementary questions; and from the replies received, it seems that among them about 10 million persons were not able to work full time partly on account of their own ill-health or on account of the illness of other members of the family; over 23 million (or about half) gave reasons of an economic nature such as lack of demand for their labour, lack of tools and raw materials, slack and offseason, etc.; and 13 million gave other reasons. Finally, in NSS : 9th Round, in reply to a specific question, nearly 12 million persons stated that they were seeking additional work and would be available for 4 hours of work or more per day. [Table (A.3.1), portion B.(1)].

25. From the above account it would be seen that it is difficult to give a precise figure for unemployment or under-employment in India. The estimate would depend on which particular concept and definition is used to measure unemployment or under-employment. However, it may, perhaps, be broadly stated that there can be scarcely any doubt that 10 or 12 million persons are either unemployed in the technical sense of the more advanced countries or are severely underemployed. If consideration is extended to those who are sitting idle for more than half or two-thirds of their working time, the number would probably rise to 25 or 30 million persons.

26. Some more specific information is available regarding unemployment among the educated defined as matriculates and persons having higher qualifications. It is estimated that their total number in 1955 was about 50 lakhs out of which 4·7 lakhs (or 9·4 per cent) were unemployed, most probably in the technical sense of the term as being out of a job or seeking a job as in the more advanced countries. It must be remembered in this connexion that in 1955 just over 4 lakhs of candidates passed the matriculation examination, and the number is rising from year to year. It can be easily appreciated that the problem of unemployment among the educated class is likely to become increasingly serious and would have grave social and political implications.

General and Professional Education

27. I shall now briefly consider the question of trained personnel. Some information regarding the number of persons passing the matriculation examination and acquiring other general or professional qualifications every year from 1950 to 1955 is given in appendix Table (A.3.4). Much interesting information can be obtained from this Table. I shall make only a few brief observations.

28. There has been fairly rapid all round progress in numbers. The number of matriculates increased rouhgly from 1·89 lakhs in 1950 to just over 4 lakhs in 1955 or has doubled in 5 years. The rate of increase is about the same at other levels. It is also seen that the number of candidates passing the intermediate examination is roughly 40 per cent of the number who passed the matriculation examination two years earlier; the number taking the first degree is roughly 60 per cent of the number who passed the intermediate examination two years earlier; and the number taking the master's degree is roughly one-fourth of the number who took the first degree, two years earlier. These are approximate statistical proportions which would vary considerably from year to year but can give some idea of the structure of general education. As a very rough rule, out of 100 matriculates in any given year about 40 would pass the intermediate two years later; 24 would take the first degree after two more years; 6 would take the master's degree two years later.

29. It is of interest to make some comparisons on the basis of the number of literates in India which was about 63 million in 1955. The number of matriculates was thus about 5300 per million literates; and the number of first graduates about 900 per million literates in India. In contrast, the number of first graduates in UK is 450 per million literates or proportionately only half that of India.

30. One gets a general impression that the number of students in the university stage is increasing quite fast and is roughly doubling every five years. The rate of increase in the number of science students is, however, much smaller at all stages and the rate of increase of science students is also appreciably smaller than arts students at the intermediate and degree levels and is roughly the same at the stage of the master's degree. The position is not quite satisfactory from the point of view of technical man-power.

31. The fact that the "proportion of graduates to literates" in India seems to be roughly double that of the UK makes it possible that education at the university level in India is expanding in quantity at the cost of quality.

This, I believe, is also the general impression among my scientific colleagues. It raises some serious questions. It is true that when there is a large increase in the number of students, the average quality would usually decrease (as a statistical fact provided the method of selection remains roughly the same.) It is doubtful, however, whether this has been the important reason. We are aware that a very large number of natural and social scientists were, during World War II, and are still being appointed in Government agencies at salaries much higher than those that can be offered by universities and scientific institutions. In consequence there is a great shortage of competent and experienced teachers. The expenditure on laboratories and scientific equipment has not kept pace with the expansion in the number of students and is extremely small in comparison with needs or with standards in other countries. The syllabus and courses of instruction are in many cases out of date. All this requires to be changed.

32. It is clear there cannot be any broadbased advance of science and scientific research in India without making university teacher more efficient and more oriented to present needs than at present. With this problem is linked the question of efficiency of science education in the top classes of secondary schools to which I shall merely draw your attention but which I have no time to consider. It is necessary indeed to formulate a comprehensive scheme of science teaching, from the upper classes of secondary schools upto post-graduate teaching in the universities, and implement the same, in order to lay a sound foundation for science in India. The scientists have a very special responsibility in this matter. It is true, of course, that it would be necessary for Government to make important decisions of policy and to provide adequate funds. But, on the technical side, improvements in science teaching and research can be brought about only through vigorous and untiring efforts of scientists themselves. They have a triple task. They must take the initiative in formulating, at a concrete level and step by step, programmes for the improvement of science teaching and research; and, secondly, persuade Government to take appropriate action in financial and policy matters. Thirdly, scientists should start doing whatever they can on their own; and, then, as and to the extent Government support begins to be available, make the best use of such support for the promotion of science in India.

Scientific and Technical Man-Power

33. The first problem is to attract young men of ability to take up science as a career. The only way is to offer adequate economic and social incentives. First, consider the position in the advanced countries of the world. USSR

has established a definite lead over all other countries including USA in scientific and technical personnel. Professors and research scientists, as a group, get the highest salary and have the highest status in USSR. The Academicians (members of the Academy of Science) have a life pension (half of which would accrue to a surviving widow) in addition to the salary of the post and are held in the highest popular esteem. In USSR science offers the most attractive career to youngmen of intellectual ability. It is being increasingly realized all over the world that it is this high social appreciation of scientists which is the real secret of the rapid advancement of science in USSR. In USA, UK and other countries of Europe also, professors and scientists have had a high status for a long time but the position has deteriorated recently which is a matter of serious concern of these countries.

34. The position of science professors and research scientists in India is however, much worse than that in advanced countries of the West and still more so than USSR. Scientists working in universities and in scientific institutions receive much less salary than scientists working under Government. Scientists in Government employment also are in an unsatisfactory position. As a group (with a few exceptions) they receive less pay and have lower status than administrative officers; and have very little say in the making of decisions in Government. An urgent requirement for the advancement of science in India, is to remove such disparities.

Scientific Societies and Planning

35. I should now like to draw attention to another problem which is likely to become increasingly serious in future. In the Western countries scientific research and science teaching had developed at first in the universities, and later, in connexion with research in industry and independently of Government control. From the 17th century many scientific societies and institutions were established in the countries of the West for the promotion of science and scientific research. More recently Government began to sanction large grants for scientific research. In most countries the largest share of research funds now comes from Government.* This has raised

* In USSR, China, and other socialized economies, all expenses for research are provided by Government. In other countries also, socientific research is being increasingly financed by Government. Even in the USA, out of the total expenditure of \$ 5.4 dollars (= Rs. 2550 crore) in 1953, the share of Government was highest and 52 per cent. Industry came next with a contribution of 44 per cent. The share of universities was only 3 per cent and that of institutes only one per cent. Of the total expenditure, the biggest portion (72 per cent) was spent by industrial concerns, 18 per cent by Government agencies, and only 9 per cent by univesities. It is interesting to note that of the money spent on research by industry, 60 per cent came form industry itself and 40 per cent from Government. (*Scientific American*, November 1957, p. 47).

important questions of policy in regard to Government control over scientific research.

36. It is interesting to observe that in the USSR, an Academy of Sciences was established by the communist Government at a very early date as an autonomous institution independent of the executive control of Government. The Academy has been given great responsibilities and supplied with adequate funds for a wide range of functional activities in scientific research and the promotion of science. It maintains over one hundred scientific institutes spread over the country, and in 1957, had a total staff of 50,000 (fifty thousand) of whom 12,000 (twelve thousand) were professional scientists and 4,000 (four thousand) professors. The point to be emphasized is that in all advanced countries of the world, in the West as well as in USSR, there are well established scientific societies with a great tradition of scientific thinking and criticism which are outside Government and which can be relied upon to supply Government with independent advice in scientific matters.

37. It seems to me that there is need in India of a functional scientific institution which would be outside Government but which would take up, by agreement with Government, such scientific work or research or promotion of science, or the coordination of scientific activities as can be done conveniently and efficiently by a non-official agency with the help of a wholetime staff of competent and high level scientists. Scientists engaged on such "decentralized" research or scientific activities, on a salary basis would be independent of Government and would be able to take an unbiased view of Government policy and activities in scientific fields. In this way it would be possible to build up an organization or system of scientific thinking and criticisms which would be able to render great service to Government by offering unbiased and independent views in scientific matters. There is great need of such advice in connexion with planning and in the appraisal of the progress of various projects.

38. To speak quite frankly, some of these ideas have come to mind because I am not satisfied with the present activities of the National Institute of Sciences. I feel scientists must shoulder greater responsibilities in connexion with national planning. Coming together for occasional meetings is not enough. I should, therefore, like to see the National Institute of Sciences undertake assignments relating to planning for national development which would be done in a systematic and painstaking way by a whole-time or part-time staff. I have a feeling that it is only through work at a concrete level that we shall be able to develop seriousness of purpose and a sense of responsibility in scientific matters of importance for national development.

STRATEGY OF PLANNING IN INDIA

39. The task of planning must be to improve continually the level of living, especially, of the 95 per cent of the population who are poor, and to create enough new employment to get rid of the fear of unemployment. It has been recognized for a long time that this can be done only through rapid industrial developments. As India has plenty of iron ore, coal, bauxite etc. the key to industrialization lies in establishing the manufacture of heavy machinery, heavy electrical equipment (turbines, generators, switch and transmission gear), and machine tools. Once this is done, everything else can be gradually manufactured in India mostly out of domestic resources. As more and more machinery becomes available it would be possible to create more and more employment, and also continually to construct more machinery and expand the production of coal and electricity; steel and aluminium; fertilizers, cement and heavy chemicals; equipment for transport and communications; scientific instruments etc.; and, later on produce more and more consumer goods.

40. It is accepted, in principle, that until sufficient machinery and tool becomes available, it is essential to utilize idle hands for the production of cloth, household utensils and other consumer goods. This is for two reasons. Our greatest shortage is of machinery while we have millions of unemployed persons sitting idle. Whatever machinery we can afford to import or manufacture within the country should be used to build up the basic industries which would produce more machinery, more steel, cement, fertilizers, electricity etc. That is, we must not waste our meagre resources of foreign exchange to import non-essential consumer goods, or machinery for the manufacture of consumer goods which can be produced within the country by putting idle hands to work. Expansion of small scale and village industries would create employment all over the country, increase the supply of cloth and other consumer goods made by hand labour, and improve the level of living without hampering the expansion of basic industries.

41. A third point is also fully recognized. Agriculture and industry are closely interlocked in India. Industrial development is not possible without an increasing supply of cheap food and raw materials. On the other hand, in India, owing to scarcity of land, basic improvements in agriculture can be brought about only through the use of more fertilizers, more irrigation, and better methods of cultivation, all of which would have to depend on large scale industrial development. In the short run, a good deal can and must be achieved by intensive cultivation of land by hand and by improving conditions

of living in rural areas through community projects, land reform, consolidation of holdings, village cooperative etc.

42. This brings us to the fourth point, namely, that planning in India must proceed at two different and clearly distinguishable levels or spheres. One is concerned with questions of large scale industrial development which can be and are decided in every country by a small group of persons at the top. For example, the decision in 1949 to instal a million ton steel plant, its reversal in 1950, and fresh decisions in 1953 and 1954 to expand steel production by 3 or 4 million tons were all taken by the Government of India without any consultations with the general public. It is proper for Government to make such decisions. It is also possible to implement the decisions without any difficulty as it would involve only a small number of persons.

43. The position is entirely different in agriculture or small scale and hand production which involve millions of households scattered over a very big country. Consider consolidation of holdings or village cooperatives. It is necessary, of course, for Government to make policy decisions; but this by itself would not be sufficient because the implementation would depend on securing the willing cooperation or at least the concurrence of millions of persons in the villages. In the beginning, the organization of agriculture and small scale production, which may be called the "diffuse" sector, would be far more difficult than establishing large scale industries. The approach must be through institutional changes, spread of education, improvement of communication etc., and, above everything else, by carrying conviction to the masses that Government is doing its best for national development. Success in establishing the basic industries would give Government increasing control over the national economy, and thus place Government in a strong position to make steady improvements in the diffuse sector and to secure the active support of the masses for national development.

44. Basic industries are thus of crucial importance in two different ways. Firstly, these alone can give us economic independence. Secondly, these alone can place Government in a position to make steady advance in the diffuse sector. The strategy of planning, therefore, requires the highest priority being given to the basic industries, namely heavy machine building, heavy electrical equipment, machine tools, fertilizers, steel, cement etc.

The Question of Foreign Exchange

45. We are aware that grave difficulties have been created by the shortage of foreign exchange. A new approach was adopted in the Second Five Year Plan, and the size of the Second Plan was intentionally made much

bigger than that of the First. It is not surprising that mistakes have been made at the stage of transition from a small to a much bigger scale of planned economy. Techniques and tools of planning are not yet adequate and would have to be improved; and these questions are receiving the attention of Government and the Planning Commission. It would be appropriate, however, for us to examine the question of foreign exchange from the point of view of long term planning.

46. I shall give a numerical example. Consider the questions of foodgrains about which India is in a precarious position. From 1948 to 1953 we imported 19·3 million tons of cereals at a cost of about Rs. 867 crores in 6 years, that is, at the average rate of about 3·2 million tons at a cost of Rs. 145 crores per year. The average price paid was about Rs. 450 per ton.

47. The population of India is growing at the rate of possibly, 5 million persons per year. It takes roughly one ton of cereals to feed 7 persons. At this rate, an additional supply of 700,000 tons of foodgrains *every year* would be required to keep pace with the growth of population. If we decide to purchase this quantity from abroad, we would require *every year* an additional Rs. 30 crores of foreign exchange which would amount to Rs. 450 crore in the course of one five-year plan (and this, also only at the present rate of growth of population).

48. Consider the alternative method of using imported fertilizers to increase the production of cereals. One ton of ammonium sulphate, at a cost of about Rs. 250 per ton, should normally given an additional yield of 2 or 2·2 tons of foodgrains. To give 700,000 tons more of foodgrains, the quantity of ammonium sulphate required would be 350,000 tons of which the price would be Rs. 8·75 crores or say Rs. 9 crores. This would be the additional amount required *every year*; in the course of 5 years the total amount required would be Rs. 135 crore.

49. A still better way would be to instal *every year* a new fertilizer factory to produce 350,000 tons of ammonium sulphate (roughly, like the factory at Sindri). The fixed investment would be about Rs. 20 crore of which the foreign exchange component would be only Rs. 12 crore. After the period of construction is over, each such factory would supply enough fertilizer to take care of the increase of population of one year. The total

[1] Imports fell below one million ton in 1954 and 1955 but we have again started importing foodgrains heavily from 1956.

expenditure in five years would be Rs. 100 crore with, however, a total foreign exchange component of only Rs. 60 crore.[2]

50. It is possible to go one step further, and establish immediately a heavy machine building factory in India, and when this plant is constructed, to manufacture in India the machinery required to set up a fertilizer factory. Of course, it is neither possible nor necessary to set up a machine building plant exclusively for the manufacture of machinery for fertilizer factories; the work can be done in big plants which would manufacture machinery for other industries as well. It is, however, possible to make rough calculations of cost because, in the case of heavy machine building plants, the value of output is roughly equal to the value of the fixed investment. To produce machinery worth Rs. 12 crore (the value of imports required to set up a Sindri-type plant) would thus call for an investment of about Rs. 12 or, say, 15 crore with a foreign exchange component of possibly Rs. 8 or 10 crore. This would be the (apportioned) cost in the first instance. The actual cost of setting up a fertilizer factory would be Rs. 20 crore per year or Rs. 100 crore in 5 years, but this would not involve any expenditure of foreign exchange. of setting up a fertilizer factory would be Rs. 20 crore per year or Rs. 100 crore in 5 years, but this would not involve any expenditure of foreign exchange. In practice, a large machine building plant unit would be established, a point I shall consider a little later.

51. To sum up, in order to feed the fresh additions to the population at the rate of 5 million of persons per year, it would be necessary to provide an additional quantity of 700,000 tons of foodgrains *every year* which would require Rs. 450 crore of foreign exchange over a period of five years. The cost can be reduced to Rs. 135 crore of foreign exchange in a 5-year period if an additional quantity of 350,000 tons of ammonium sulphate is ordered from abroad *every year*, at least two years in advance of the crop season. The cost can be further reduced to Rs. 100 crore (out of which the foreign exchange component would be Rs. 60 crore) over a five-year period if a new fertilizer factory of 350,000 ton capacity is started *every year*; this would call for decision 4 or 5 years ahead of the crop season concerned. The apportioned cost of a heavy machine building factory which would manufacture

[2] Besides this, there will, of course, be current costs of intermediate products used up and wages paid. But when the intermediate products are available within the country, and the output of wages goods industries is sufficient to meet the demand, such costs could be met entirely out of domestic resources. This would, no doubt, call for an expansion of the economy and would require organizational efforts ; but similar and even greater organizational efforts would be needed to produce the goods to be exported to meet the larger requirements of foreign exchange in the other cases. Also, great organizational effort is, in any case, essential for economic development.

machinery in India to instal *every year* a new fertilizer factory of 350,000 ton capacity[1] would be, however, so small as Rs. 12 or 15 crore with a foreign exchange component of perhaps Rs. 8 or 10 crore. Such a decision would have to be made only once but 8 or 10 years in advance of the season in which the fertilizer would be used.

52. The above account is, no doubt, over-simplified but it brings out clearly one important point. In India it is of the greatest importance to take a long view of planning. Additional requirements of foodgrains to cope with the growth of population can be met with an (apportioned) investment of only Rs. 15 or 20 crore and of foreign exchange of Rs. 8 or 10 crore provided a decision can be made 8 or 10 years in advance of the year in which the food would be consumed. If the decision is made 4 or 5 years in advance, the cost would increase to Rs. 100 crore with a foreign exchange component of Rs. 60 crore. If the decision is made a couple of years ahead, the cost would increase to Rs. 135 crore in foreign exchange to import fertilizers; and if the decision to import foodgrains is made only from year to year the cost would go up to Rs. 450 crore in foreign exchange.

53. Similar considerations hold good in other crucial sectors. An investment of Rs. 150 crore, including Rs. 80 crore of imported machinery, would be required to instal a million ton steel plant with a product value of Rs. 40 or 45 crore. A heavy machine building factory with an investment of Rs. 80 crore, with foreign imports worth about Rs. 50 crore, would produce every year machinery worth roughly Rs. 80 crore or the equivalent of imported machinery needed to set up a million ton steel plant. Once such a heavy machinery factory gets into production, it would be possible to start a new million ton steel plant *every year* out of our own resources. An investment of Rs. 30 crore in a plant to manufacture mining machinery would produce goods worth about Rs. 30 crore per year. An investment of Rs. 70 crore in heavy electrical equipment (generators, switchgear, heavy motors, rectifiers, transformers etc.) would give products of the value of about Rs. 45 crore per year; and so on.

Need of long term Planning

54. From the point of view of industrial development over a period of 15 or 20 years there cannot be any doubt that the correct policy would be to establish the heavy machinery industries. Consider, purely for purposes of

[1] It is worth mentioning that there is great scope for the use of fertilizers in India. The rate of utilization (national average over all agricultural land) of nitrogen fertilizer is about 5 kilogrammes per hectare in India compared to USA: 55 kilo, Ceylon: 70 kilo, UK: 208 kilo and Japan: 555 kilo, all per hectare (*FAO Yearbook* 1956, Tables 1 and 93).

illustration, the following programme of investments with a rough value of the product within brackets in each case :—heavy machinery Rs. 150 crore (150 crore), heavy electrical equipment Rs. 100 crore (60 crore), turbines Rs. 20 crore (12 crore), mining machinery and drilling equipment Rs, 30 crore (30 crore), machinery for chemical engineering Rs. 25 crore (25 crore), machine tools[1] Rs. 30 crore (20 crore), aluminium Rs. 25 crore (5 crore), and, say, another Rs. 70 crore for other basic industries giving a total investment of about Rs. 450 crore with foreign exchange requirements of the order of Rs. 300 crore over a period of five years. I am aware that foreign exchange would also be needed to expand transport and other facilities but provision has been made for this and for steel and other investments in the Second Plan.

55. The point I am emphasizing is that Rs. 300 crore of foreign exchange invested in suitable basic industries over a period of 5 years would establish a sound foundation for future industrial development and would enable us to manufacture essential capital goods within the country. (I am not suggesting that we should reduce our imports. On the contrary, we should try, continually to expand our foreign trade. But we must attain as soon as possible a position in which, if necessary, we shall be able to manage on our own in an emergency). We have made some real advance during the First Five Year Plan. It has been a very wise and far-sighted decision to develop atomic energy for which we have much natural resources. Dr. H. Bhabha has shown in a recent article[2] how great would be the benefit of atomic power electricity to Indian economy. Good progress is being made with steel. It is now necessary to make similar far-sighted decisions to establish the basic heavy industries.

56. I should like to refer in this connexion to some recent trade statistics. Indian exports f.o.b. amounted to Rs. 597 crore in 1954-55; Rs. 641 crore in 1955-56; and Rs. 637 crore in 1956-57. Imports c.i.f. in these three years were respectively Rs. 684 crore, Rs. 757 crore, and Rs. 1077 crore. It would be noticed that the increase in imports in 1956-57 over 1955-56, that is, in one year was Rs. 326 crore; and in 1956-57 over 1955-56, that is, in two years was Rs. 393 crore out of which the increase on private account was Rs. 272

---

[1] To give one example, it is worth mentioning that machine tools formed roughly 3 per cent of industrial equipment (in value) over a long period in the USA. On this basis Rs. 20 crore worth of machine tools would suffice for the manufacture in India of about Rs. 600 crore worth of industrial equipment which, in its turn, would enable industrial investments being made to the extent of *at least*, Rs. 1000 crore per year basically out of our own resources. (*The Machine Tool Industry*, New York, Clark, Dodge & Co., May 1948).

[2] *Science and Culture*, October and November, 1957.

crore. I may also mention that the Government outlay on the First Five Year Plan was nearly Rs. 2400 crore; and the outlay on the Second FYP is expected to be roughly double. It is in the context of the above figures that one must view the proposal to invest Rs. 450 crore and utilize Rs. 300 crore of foreign exchange to build up the basic industries. After the factories come into operation, there would be a saving of Rs. 300 or Rs. 350 crore of foreign exchange in the import of capital goods. This is the crucial issue of planning in India.

57. Finance and balance of payments are important aspects of planning; and there is no conflict between financial planning and physical planning. But it must be kept in mind that, in an under-developed country, the physical view is of basic importance. In one single year, 1956-57, our imports suddenly exceeded exports by Rs. 440 crore. If by some happy chance, Rs. 300 crore out of this amount had been utilized to purchase capital goods, required for basic industries, then in five year's time, we would have won our economic independence and would have overcome difficulties of foreign exchange permanently. Although the accounting position would have been the same, the real position would have been entirely different and ever so much better. This is the essential logic of planning in India which we must follow in future.

Planning in China

58. It is instructive to consider what happened in China. Mr. Li Hsiennien, Vice-Premier and Minister of Finance of China, in his speech to the First National People's Congress in Peking on 29 June 1957 (supplement to *Hsinhua News Agency Release, Peking*) stated that China has received foreign loans amounting to 2,174 million yuan (= Rs. 435 crore) before 1953, and 3,120 yuan (= Rs. 624 crore) for China's First Five Year Plan from 1953 to 1957. The total amount of the loan was thus Rs. 1059 crore. A good part of this was used for rehabilitation after the present Government came into power (as stated by the Finance Minister) and a part, no doubt, was used for military expenses during the war in Korea. However, with the whole of the second loan of Rs. 624 crore and a part of the first loan China rapidly developed the basic industries (heavy machinery, heavy electricals, machine tools, steel, fertilizers, trucks etc.). The Finance Minister of China appreciated the help received from USSR, but stated "we may say that we are now in a better position to rely on our own accumulation [i.e., investment] to carry on national constitution." (p. 5, col. 1).

59. It is important to note that foreign credit had tapered off rapidly. In the same speech the Finance Minister stated that foreign loans constituted 117 million yuan or Rs. 23·4 crore in 1956 and 23·3 million yuan or only Rs. 4·7 crore in 1957. China has a foreign trade which is roughly of the same size as India on a per capita basis. Although foreign loans would be of help, it seems that China will not have to worry about foreign exchange for essential requirements in future, and would be able to manage, if necessary, on the trading surplus. It may be mentioned that India received about Rs. 200 crore of foreign assistance, roughly half in grants and half in loans, during the First Five Year Plan; and has fairly firm authorization of receiving at least Rs. 600 crore of foreign assistance during the Second Five Year Plan. India also had foreign assets (held by the Reserve Bank) to the extent of Rs. 723 crore in 1951-52 and Rs. 746 crore in 1955-56 at the end of the First Five Year Plan which China had lacked.

60. In Chinese planning the highest priority was given to develop those basic industries which would enable China to manufacture within the country essential capital goods required for rapid industrial development in future. Remembering that the Chinese economy is bigger than ours, it is of interest to note that China has "set off" on the way to industrialization out of its own resources with comparatively less foreign exchange than India. In contrast, India is likely to continue to have foreign exchange difficulties for some considerable time to come.

61. The Chinese example merely corroborates what an objective scientific analysis had brought out, namely, that India could have built up, and can build up, with the help of only a few hundred crores of foreign exchange those basic industries which would give her economic independence.

62. It is our responsibility, as scientists, to work out the logic and techniques of planning suited to India. It is our responsibility, as scientists, to educate and convince our countrymen that India is a great country and has vast resources, natural and human. We have the responsibility to use these resources to improve the level of living of our countrymen and to promote science and culture. We should welcome, foreign help and cooperation, especially, in science and technology and cultural matters. Also, we must realize that it is not necessary continually to depend upon help from abroad. We must overcome the defeatist attitude which would make us continually

ask for foreign loans[1]. We have the ability and the responsibility to make rapid economic advance with our own resources, and with hard labour, scientific thinking, wise decisions, and unity of purpose. We must have faith in ourselves.

STATISTICAL APPENDIX

HOUSEHOLD CONSUMER EXPENDITURE

1. Since 1950 the National Sample Survey (NSS) has been collecting a wide variety of social and economic statistics from all over the country. A great deal of information has thus become available on household expenditure on items of consumer goods such as foodgrains, sugar, milk and milk products, or all food items taken together, clothing, medical expenses etc., as well as the total expenditure on all items for a period of 30 days. Data collected in the NSS : 10th Round (December 1955–May 1956) for 2754 sample households have been used to show some interesting facts in Tables (A.1.0), (A.1.1), (A.1.2) and (A.1.3). For each household it is possible to calculate the "expenditure per person" by dividing the total expenditure on all consumer goods by the number of persons in the household. In this way each person in the sample would be labelled by the "expenditure per person" of the household to which he belongs. It is then possible to classify all the individuals included in the sample into a number of groups or classes of expenditure level. For example, in Table (A.1.0), the individual persons were classified into groups having 'expenditure per person up to Rs. 8', 'between Rs. 8 and Rs. 11', 'between Rs. 11 and Rs. 13' etc., and finally 'Rs. 55 and above'. These class-ranges are shown in the top line of Table (A.1.0) at the head of cols (1) to (13). Information on different items is given in different lines separately for each class-range in the corresponding cols. (1) to (13).

2. In the first portion of the table the average expenditure per person in rupees per 30 days is shown for 4 'food' items in lines 1 to 4; the total

[1] The Indian Industrial Delegation which visited USA, Canada, UK, West Germany and other countries in Europe in September-November 1957, referring to foreign investments in Canada in its Report to the Federation of Indian Chambers of Commerce and Industry, states :—

> "Eight hundred dollars per capita foreign investment means nearly Rs. 4,000 in Indian currency and at that rate and for such high development India should require Rs. 1,60,000 crore (Rupees one lakh sixty thousand crore) of investment of India of which at least one-third, viz. nearly Rs. 50,000 crore would have to be in foreign currency ! This can only be a dream. The conclusion to draw is, that India cannot be developed without foreign capital which we shall continue to need for at least the next 25 years and in substantially large amounts" (p. 27).

China with a fifty per cent bigger population than India, succeeded in getting a head start, with the help of foreign loans of only Rs. 1059 crore spread over 7 or 8 years.

TABLE (A.1.0): CONSUMER EXPENDITURE IN RUPEES PER PERSON FOR A PERIOD OF 30 DAYS WITH PERCENTAGE OF TOTAL EXPENDITURE: ALL INDIA (RURAL AND URBAN): 1955-56

	items	expenditure classes in rupees per person per month												
		Rs. 0–8	8–11	11–13	13–15	15–18	18–21	21–24	24–28	28–34	34–43	43–55	55 & above	all classes
	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
		average expenditure in rupees per month												
1.	food grains	3.49	4.69	5.89	6.35	6.93	7.58	8.26	8.25	8.71	9.33	10.08	13.98	6.61
2.	sugar	0.09	0.20	0.25	0.36	0.42	0.52	0.65	0.77	1.05	1.13	1.46	2.41	0.51
3.	milk & products	0.15	0.43	0.66	0.92	1.11	1.78	2.15	2.69	3.69	4.71	9.98	8.56	1.75
4.	other food	1.22	1.85	2.34	2.73	3.28	3.54	4.31	4.81	5.67	6.01	7.43	12.34	3.39
5.	food total	4.95	7.17	9.14	10.36	11.74	13.42	15.37	16.79	19.12	21.18	28.95	37.29	12.26
6.	clothing	0.21	0.53	0.79	1.03	1.43	1.92	2.19	2.60	3.86	4.93	4.33	10.24	1.77
7.	medical	0.01	0.09	0.11	0.19	0.27	0.37	0.46	0.51	0.84	1.21	1.73	3.90	0.43
8.	others	1.09	1.62	1.94	2.38	3.05	3.83	4.49	5.89	6.86	10.40	12.23	31.86	4.28
9.	non-food total	1.31	2.24	2.84	3.50	4.75	6.12	7.14	9.00	11.56	16.54	18.29	46.60	6.48
10.	total (all items)	6.26	9.41	11.98	13.96	16.49	19.54	22.51	25.79	30.68	37.72	47.24	83.29	18.74
		percentage of total expenditure												
11.	food grains	55.75	49.84	49.17	45.49	42.30	38.79	36.69	33.04	28.39	24.73	21.34	16.78	35.27
12.	sugar	1.44	2.13	2.09	2.58	2.55	2.66	2.89	2.99	3.42	3.00	3.09	2.89	2.72
13.	milk & products	2.40	4.57	5.51	6.59	6.73	9.11	9.55	10.43	12.03	12.49	21.13	10.28	9.34
14.	other food	19.48	19.66	19.52	19.55	19.88	18.12	19.15	18.64	18.48	15.93	15.72	14.82	18.09
15.	food total	79.07	76.20	76.29	74.21	71.19	68.68	68.28	65.10	62.32	56.15	61.28	44.77	65.42
16.	clothing	3.35	5.63	6.59	7.38	8.67	9.83	9.73	10.08	12.58	13.07	9.17	12.29	9.45
17.	medical	0.16	0.96	0.92	1.36	1.64	1.89	2.04	1.98	2.74	3.21	3.66	4.68	2.29
18.	others	17.42	17.21	16.20	17.05	18.50	19.60	19.95	22.84	22.36	27.57	25.89	38.26	22.84
19.	non-food total	20.93	23.80	23.71	25.79	28.81	31.32	31.72	34.90	37.68	43.85	38.72	55.23	34.58
20.	total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
21.	percentage of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
22.	cumulative percentage	14.01	31.32	43.06	52.20	63.75	71.96	79.00	84.53	89.70	94.55	97.14	100.00	
23.	size of households (persons)	5.40	5.36	5.72	5.00	4.85	4.57	4.48	4.39	4.05	4.49	3.30	3.38	4.83
24.	number of households (million)	9.99	12.44	7.91	7.04	9.18	6.92	6.05	4.85	4.91	4.16	3.02	3.27	79.74
25.	number of persons (million)	53.96	66.67	45.21	35.21	44.50	31.62	27.12	21.32	19.91	18.68	9.99	11.03	385.22
		total expenditure in Rs. crores per 30 days												
26.	on 'food' items	26.69	47.83	41.83	36.48	52.23	42.43	41.68	35.79	38.08	39.58	28.92	41.14	472.18
27.	on 'non-food' items	7.22	14.96	12.86	12.66	21.15	19.35	19.37	19.19	23.01	30.90	18.27	50.75	249.69
28.	on 'all' items	33.91	62.79	54.19	49.14	73.38	61.78	61.05	54.98	61.09	70.48	47.19	91.89	721.87
29.	number of sample households	260	369	240	217	305	244	197	207	193	187	138	197	2754

number of sample villages = 1544. number of sample urban blocks = 1220.

Based on the National Sample Survey (NSS): 10th Round, December 1955-May 1956. All-India (rural and urban) excluding Jammu & Kashmir.

TABLE (A.1.1): INDEX NUMBER OF CONSUMER EXPENDITURE PER PERSON FOR A PERIOD OF 30 DAYS BY ITEMS OF CONSUMPTION : ALL INDIA (RURAL AND URBAN): 1955-56

items	expenditure classes in rupees per person per month												
	0–8	8–11	11–13	13–15	15–18	18–21	21–24	24–28	28–34	34–43	43–55	55 & above	all classes
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	average expenditure per month												
1. food grains	53	71	89	96	105	115	125	129	132	141	152	211	100
2. sugar	18	39	49	71	82	102	127	151	206	222	286	473	100
3. milk & products	9	25	38	53	63	102	123	154	211	269	570	489	100
4. other food	36	55	69	81	97	104	127	142	167	177	219	364	100
5. total food	40	58	75	85	96	109	125	137	156	173	236	304	100
6. clothing	12	30	45	58	81	108	124	147	218	279	245	579	100
7. medical	2	21	26	44	63	86	107	119	195	281	402	907	100
8. others	25	38	45	56	71	89	105	138	160	243	286	744	100
9. non-food total	20	35	44	56	73	94	110	139	178	255	282	710	100
10. total (all items)	33	50	64	74	88	104	120	138	164	201	252	444	100
	percentage of total expenditure												
11. food grains	158	141	139	129	120	110	104	94	80	70	61	48	100
12. sugar	53	78	77	95	94	98	106	110	126	110	114	106	100
13. milk & products	26	49	59	71	72	98	102	112	129	134	226	110	100
14. other food	108	109	108	108	110	100	106	103	102	88	87	82	100
15. food total	121	116	117	113	109	105	104	110	95	86	94	68	100
16. clothing	35	60	70	78	92	104	103	107	133	138	97	130	100
17. medical	7	42	40	59	72	83	89	86	120	140	160	204	100
18. others	76	75	71	75	81	86	87	100	98	121	113	168	100
19. non-food total	61	69	69	75	83	91	92	101	109	127	112	160	100
20. total	100	100	100	100	100	100	100	100	100	100	100	100	100
21. percentage of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
22. cumulative percentage	14.01	31.32	43.06	52.20	63.75	71.96	79.00	84.53	89.70	94.55	71.14	100.00	—
23. size of households (persons)	112	111	118	104	100	95	93	91	84	93	68	70	100
24. number of households	12.53	15.59	9.92	8.83	11.51	8.68	7.59	6.08	6.16	5.22	3.79	4.10	100.00
25. number of persons	14.01	17.31	11.74	9.14	11.55	8.21	7.04	5.53	5.17	4.85	2.59	2.86	100.00
	total expenditure												
26. on 'food' items	5.65	10.13	8.75	7.73	11.07	8.99	8.83	7.58	8.06	8.38	6.12	8.71	100.00
27. on 'non-food' items	2.89	5.99	5.15	5.07	8.47	7.75	7.76	7.69	9.22	12.37	7.32	20.32	100.00
28. on 'all' items	4.70	8.70	7.51	6.81	10.16	8.56	8.46	7.62	8.46	9.76	6.54	12.72	100.00
29. number of sample households	260	369	240	217	305	244	197	207	193	187	138	197	2754

number of sample villages = 1544, number of sample urban blocks = 1220.

Based on the National Sample Survey (NSS): 10th Round, December 1955-May 1956, All-India (rural and urban) excluding Jammu & Kashmir.

(TABLE A.1.2) : CUMULATIVE PERCENTAGE OF EXPENDITURE ON 'FOOD', 'NON-FOOD', AND 'ALL' ITEMS : ALL-INDIA (RURAL AND URBAN) : 1955-56.

per capita expenditure classes in Rs.	actual number of sample households		cumulative percentage of total number of persons		cumulative percentage of expenditure on: 'food' items		'non-food' items		'all' items	
	S.S.I	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2	S.S.1	S.S.2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
			......	......	......	......	cumulative percentage	......	......	......
0—8	135	125	13.84	14.18	5.64	5.66	2.82	2.96	4.67	4.73
8—11	181	188	31.52	31.21	16.15	15.43	8.60	9.15	13.55	13.26
11—13	122	118	43.62	42.50	25.37	23.74	13.80	14.25	21.38	20.45
13—15	115	102	52.65	51.74	33.16	31.41	18.89	19.31	28.23	27.21
15—18	153	152	64.17	63.33	44.38	42.30	27.56	27.59	38.57	37.20
18—21	131	113	73.61	70.32	55.06	49.66	36.32	34.37	48.59	44.36
21—24	89	108	79.36	78.63	62.29	60.03	42.97	43.19	55.62	54.19
24—28	104	103	85.93	83.14	71.32	66.22	52.37	49.24	64.78	60.33
28—34	91	102	90.28	89.12	77.81	75.80	60.63	59.37	71.88	70.10
34—43	98	89	95.31	93.79	86.66	83.73	73.64	71.14	82.17	79.36
43—55	60	78	97.08	97.19	90.83	91.73	79.27	80.07	86.85	87.69
55 & above	98	99	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
all classes	1377	1377								

number of sample villages : S.S.1 = 772, S.S.2 = 772. number of sample blocks : S.S.1 = 610, S.S.2 = 610.

Based on National Sample Survey (NSS) : 10th Round, December 1955–May 1956, All-India (rural and urban) excluding Jammu & Kashmir.

TABLE (A.2.0) : PERCENTAGE OF HOUSEHOLDS (EXCLUDING THOSE OF SIZE LESS THAN 0.10 ACRE) BELOW SPECIFIED SIZE OF OWNERSHIP HOLDING AND THE CORRESPONDING PERCENTAGE OF AREA OWNED : ALL INDIA (RURAL) : 1953-54

	specified size of ownership holdings	number of sample households			cumulative percentage of					
					total number of households			area owned		
		Central	State I	State II	Central	State I	State II	Central	State I	State II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	0.10–0.50 acre	1107	1210	1043	9.49	10.94	9.47	0.37	0.40	0.33
2.	upto 1.00 ,,	1099	1095	1075	18.95	20.58	18.82	1.29	1.37	1.23
3.	,, 1.50 ,,	1060	996	1012	27.38	28.90	27.34	2.70	2.80	2.61
4.	,, 2.50 ,,	1656	1578	1596	40.21	41.33	40.75	6.17	6.20	6.10
5.	,, 5.00 ,,	2856	2805	2622	61.24	61.97	60.68	16.53	16.65	15.54
6.	,, 7.50 ,,	1825	1848	1722	73.73	73.51	72.60	26.99	26.55	25.20
7.	,, 10.00 ,,	1164	1265	1241	80.77	80.60	80.05	35.34	35.17	33.73
8.	,, 15.00 ,,	2311	2495	2486	88.25	88.69	87.71	47.93	48.93	46.06
9.	,, 20.00 ,,	1368	1337	1337	92.42	92.56	91.78	57.83	58.28	55.36
10.	,, 25.00 ,,	1083	964	1021	94.56	94.80	94.11	64.38	65.23	62.18
11.	,, 30.00 ,,	675	629	740	96.13	96.15	95.76	70.29	70.38	68.18
12.	,, 40.00 ,,	757	693	847	97.77	97.77	97.56	77.98	78.19	76.32
13.	,, 50.00 ,,	396	392	414	98.61	98.64	98.48	83.10	83.58	81.39
14.	,, 75.00 ,,	413	395	464	99.48	99.44	99.44	90.16	90.37	89.48
15.	,, 100.00 ,,	127	134	136	99.73	99.71	99.70	92.98	93.64	92.40
16.	,, 250.00 ,,	131	134	128	99.97	99.99	99.97	97.60	99.10	97.69
17.	,, 500.00 ,,	14	6	18	99.99	100.00	100.00	98.62	99.68	99.01
18.	above 500.00 ,,	6	1	4	100.00	100.00	100.00	100.00	100.00	100.00
19.	total	18,003	17,977	17,906						
20.	sample villages	1,410	1,422	1,383						

Based on the National Sample Survey : 8th Round, July 1954–March 1955. Information for the Central sample was collected by an agency of the Government of India and for the State samples by the respective State governments. The Central, State-I and State-II samples are each based on four interpenetrating samples ; and all 12 samples also form, of course, an interpenetrating net word of samples covering the rural area.

expenditure on food items in line 5; on clothing, medical expenses and 'others' in lines 6–8; non-food total in line 9; and finally the expenditure on all items of consumption in line 10.

3. The expenditure on each item can be expressed as a percentage of the total expenditure given in line 20. These percentages are shown in lines 11 to 20 and show many interesting features. The percentage expenditure on foodgrains (line 11) is over 55 per cent in the poorest group in col. (1) and decreases to about 17 per cent in the highest group in col. (12). The total expenditure on food (line 15) falls from 79 per cent at the bottom in col. (11) to 44·8 per cent at the top in col. (12) with an overall average of 65·4 per cent for all families. This shows that for India as a whole, food items make up about two-thirds of the household expenditure ; in the poorest section it can be as high as four-fifths. Many other comparisons can be made on the basis of the results given in this table.

4. The average size of households, that is, the number of persons in the household is given in line 23; the estimated number of households (in million) in line 24; the estimated number of persons (in million) in line 25. It appears that, according to the NSS, there were nearly 80 million household and 385 million persons in India at the time of the survey. The expenditure in Rs. crore per 30 days is also given in lines 26 to 28. The household budget of India came to about Rs. 723 crore per 30 days out of which about Rs. 472 crore were spent on food and Rs. 250 crores on non-food items.

5. Line 21 gives the percentage of persons in each expenditure class. From this line it can be seen that 14·01 per cent of the population spend less than Rs. 8 per person in 30 days. The next line 22 gives the accumulated percentage which is obtained by adding the figures in successive columns. This is very convenient because it makes it possible to see directly the percentage of the population spending less than a specified amount. For example, from col. (2) it would be seen that 31·32 per cent or almost a third of the population spend less than Rs. 11 per person per 30 days; from col. (4), that 52·2 per cent or more than half the population spend less than Rs. 15[1]; from col. (9), that nearly 90 per cent of the population spend less than Rs. 34[2]. This brings out the actual level of living of 90 per cent of our countrymen.

---

[1] Approximately $3 (three US dollars) and British 22s. 6d. or US 10 cents and British 9 pence per head per day.

[2] Approximately $7 (seven US dollars) and British 51 shillings or less than US 25 cents and British 1s. 6d. per head per day.

6. The above information has been shown in a graphical form in the chart on page 150 in "Curve A : Expenditure on all items in rupees" (per person per 30 days) in a solid line in the upper left hand corner of the chart. The vertical scale on the left gives the cumulative percentage of the population and the horizontal scale at the top (in solid line) gives the scale of expenditure in rupees per person per 30 days. It is easy to read off from this graph the percentage of persons having an expenditure below any assigned value. From this it is also possible to obtain (by subtraction from 100) the percentage of persons having an expenditure greater than any assigned value. It is, of course, also possible to obtain for any assigned percentage the limiting value of the expenditure. These values are given in Table (3) in the main text.

Percentage Expenditure on Consumption

7. The information given in Table (A.1.0) is shown in a different form in Table (A.1.1). In each line the average expenditure for all classes, given in col. (13) of Table (A.1.0), is adopted as the basis for comparison and is put = 100. Each figure in the same line is then expressed in the form of a percentage of the figure in col. (13). These are given in the form of index-numbers in Table (A.1.1) and show how the expenditure on each item and the value of other quantities increase with an increase in the level of expenditure.

8. For example, in line 1 for foodgrains, it is seen that in col. (1) the expenditure on food is 53 per cent of the average expenditure for all classes taken together. In contrast, in col. (12), the highest group, the index-number is 211 showing that the relative expenditure on foodgrains is double that of the general average. Also, comparing the index-number 211 with the index-number 53, it is seen that the expenditure is four times greater in the top group compared to the bottom group. For sugar (line 2), the bottom and top index-numbers are 18 and 473 respectively showing an increase of 26 times. Similar comparisons can be made for other items; but, because of errors of sampling, the comparisons should not become too refined. A glance at col. (12) would also show that expenditure in the top group is relatively much greater on non-food items (710) compared to food items (394), and very high (907) in the case of medical expenses. In fact, medical care would seem to be the highest luxury in India which only the richer people can afford.

9. The index-numbers given in Table (A.1.1) lines 11 to 19, show the change in percentages of expenditures (as distinguished from actual expenditure) on different items. It is seen that the percentage expenditure on food-

grains and other items of food decrease with rising expenditure level. The percentage expenditure on sugar, milk and milk-products, and clothing, however, continue to increase as expenditure increases; and the relative increase is highest in the case of medical expense.

Concentration Curves for Consumer Expenditure

10. The question of equality or otherwise of the consumer expenditure can be studied in a different way in the form of what is called "concentration curves". Relevant data are given in Table (A.1.2) and are also shown in a graphical form in curves B, C, and D in the chart mentioned before. Consider the right hand side of the chart. The horizontal scale at the bottom represents percentage of the population (beginning at the bottom with those having the lowest expenditure per person and finishing with those having the highest expenditure at the top). The vertical scale, on the right hand side represents percentages of the total consumer expenditure, rising from zero, to 100 per cent at the top.

11. Consider the total expenditure, say, on all items and call this 100. If each person has an exactly equal share then 5 per cent of the population would have 5 per cent of the total expenditure; 10 per cent of the population would have 10 per cent of the total expenditure and so on. It is possible to draw this as a graph. Corresponding to a point 5 per cent on the horizontal scale the value of the ordinate would be 5 per cent; for 10 per cent on the horizontal scale the corresponding value on the vertical scale would be 10 per cent. The graph is obviously given by the straight line joining the "zero" point on both scales with the "100" point on the both scales which is the straight line inclined at 45° to the axis. This line represents a completely egalitarian distribution without any concentration.

12. The actual distribution or appointment of expenditure is, however, not equal; and it would be of interest to plot the graph of the observed expenditure. Relevant data are given in Table (A.1.2), in which col. (1) shows the expenditure groups as in Tables (A.1.0) and (A.1.1). In this particular case the information is given separately for two sub-samples 1 and 2 based on different sets of sample villages and sample households. It may be mentioned here that the estimates given in Tables (A.1.0) and (A.1.1) were obtained by combining the two sub-samples 1 and 2.

13. The sample villages and the sample households in each sub-sample were selected in accordance with a design of sampling based on the theory of probability. Each sub-sample covers the whole of India (rural and urban),

and each sub-sample would supply valid estimates for every item under study. The two sub-samples are completely interpenetrating; and the results based on the two samples have equal validity and are comparable. The object of using two (or more) interpenetrating sub-samples can be briefly explained. As each sub-sample gives a valid estimate, a direct comparison of the results based on two (or more) sub-samples immediately supplies information on the consistency of the estimates. If two (or more) sub-sample estimates are in good agreement then it is possible to have confidence in the results. If the results diverge widely then the results must be suspect. How this method works in practice would become clear as soon as the procedure for drawing the graphs is explained.

14. The number of sample households in the two sub-samples are given in cols. (2) and (3) to show the size of samples but are not used in drawing the concentration curves. Col. (4) gives the accumulated percentages of persons in sub-sample 1, similar to the figures given in line 22 of Table (A.1.0). Percentages for sub-sample 2 are given in col. (5). The expenditure on, say, food items (or non-food items, or all items) is known for each expenditure group shown in col. (1); and the total expenditure on food items for all expenditure groups taken together is also known. It is, therefore, possible to express the expenditure incurred in any particular group as a percentage of the expenditure incurred by all the groups. In this way, each expenditure group, in each line of Table (A.1.2) would have a figure giving its percentage share of the total expenditure on food (or non-food, or all) items. These percentages can then be added successively from the bottom up, and would supply the 'cumulative percentage of expenditure', say, on food items shown in col. (6). For example, the expenditure group 0–Rs. 8' accounts for 5·64 per cent of the total expenditure on food items. The two groups '0–Rs. 8' and 'Rs. 8–11' together account for 16·15 per cent of the total expenditure on food items; and so on.

15. The cumulative percentages of persons in col. (4) can be represented on the horizontal scale (at the bottom of the chart); and the corresponding cumulative percentage of expenditure can be represented on the vertical scale (on the right of the chart). The values given in the same line in cols. (4) and (6) are plotted on the chart and is shown by the graph for sub-sample 1 of concentration curve B for expenditure on food items. A similar graph can be drawn for sub-sample 2 on the basis of each pair of figures given in the same line of cols. (5) and (7). The two graphs for concentration curve B were drawn in this way. The same procedure was followed in the case of

expenditure on non-food items by plotting the figures given in cols. (4) and (8) for sub-sample 1, and the figures in cols. (5) and (9) for sub-sample 2; these are shown in the two graphs of concentration curve C. For expenditure on all items, the figures in cols. (4) and (10) for sub-sample 1, and figures in cols. (5) and (11) for sub-sample 2, are plotted to give the two graphs of concentration curve D.

16. It is of interest to examine the three sets of double graphs of B, C, and D. Consider the two graphs of curve B, each of which gives an equally valid sample, representing the concentration curve for expenditure on food. They diverge to some extent but not too much. We may, therefore, infer that the 'true' concentration curve B for expenditure on food items lies somewhere in the neighbourhood of the pair of graphs for sub-samples 1 and 2. Also, the divergence between this pair of graphs supplies some idea of the margin of errors of sampling. In the same way, we can locate approximately (and always subject to some margin of errors of sampling) the position of concentration curve C for expenditure on non-food items; and the position of concentration curve D for expenditure on all items of consumption.

17. The divergence between the concentration curve B, on one hand, and the concentration curve D, on the other hand, can be directly seen on the chart to be much greater than the divergence between the pair of graphs for the two sub-samples of curve B or of curve D. From this we may infer that the two concentration curves B and D are significantly different in the statistical sense. Looking at all three pairs of graphs it can be inferred that the three concentration curves B, C and D are all different. It has been possible to make this inference in this very simple manner because we have been able to use a pair of graphs (based respectively on sub-samples 1 and 2) for each of the three concentration curves B, C and D.[1]

18. We may now examine the concentration curve or the figures given in Table (A.1.2) to a understand the implications. For sub-samples 1, the lowest group '0 to Rs. 8' has a percentage share of population of 13·84 per cent, in col. (4); but its share of expenditure on food items of only 5·64 per

[1] When a particular number or quantity (as distinguished from a curve, as in the present case) is estimated, the margin of error can be calculated with considerable accuracy on results based on two or more interpenetrating samples. The rule is extremely simple: for a set of 2, 3, 4, 5, 6,. . . . k interpenetrating samples, the probability would be respectively

$$1/2,\quad 3/4,\quad 7/8,\quad 15/16,\quad 31/32 \ldots (2^{k-1}-1)/2^{k}$$

that the 'true' value of the parameter lies between the two extreme estimates based on the interpenetrating samples. This method is being used in the Indian Statistical Institute since 1937.

cent, in col. (6); and the share of non-food expenditure is still less and only 2·82 per cent, in col. (8); the share of expenditure on all items is 4·67 per cent, in col. (10), and naturally falls between the other two. The position can be ascertained for other groups or for any percentage of the population directly from the graph. It would be seen, the lower the concentration curve at the beginning, the lower will be the share of the poorer households.

19. It will be noticed that expenditure on food is more egalitarian than the expenditure on all items while expenditure on non-food items deviates most from equality. This can be seen clearly from the curves B, C and D on the chart. The further a concentration curve lies towards the lower right-hand corner of the chart, the greater is its deviation from the egalitarian distribution shown by the straight line inclined at 45° to the axis. The more intense the concentration, the greater would be the advantage enjoyed by a few rich men over a very large number of poor people. Concentration curves thus give a simple visual picture of the non-equality of the distribution.

Concentrations Curve for Land-Holdings

20. It is, of course, possible to draw concentration curves for distributions other than that of expenditure. The case of holdings of land by households is of great interest. Some relevant data are given in Table (A.2.0) based on a special survey of land-holdings carried out in the NSS : 8th round : July 1954–March 1955 covering the whole rural area of India. In this survey 12 interpenetrating sub-samples were used; information for 4 of which were collected by the NSS (which is a Central agency) and information for the remaining 8 sub-samples was collected by respective State Governments in the form of two groups of samples called State-I and State-II, each consisting of 4 sub-samples. The information is given in Table (A.2.0) separately for 3 groups of samples : Central, State-I and State-II.

21. Information was obtained about the size in acres of the total holdings of land owned by each household. The households were then classified in groups by size of holding, such as, owning '0·10 to 0·50 acre'; owning '0·50 to 1·00 acre'; and so on. The number of households in each group and also the total area of land held by each group were then calculated; and these were expressed as percentage of the total number of households and of the total area of land owned by all households. The next step was adding up the percentages by successive groups to give the 'cumulative percentage of household' and the 'cumulative percentage of total area of land owned by households'. These figures are given for the Central sample in cols. (5) and

(8) respectively of Table (A.2.0); for State-I samples in cols. (6) and (9) respectively; and for State-II sample in cols. (7) and (10) respectively. These three sets of values were then drawn on the chart in the form of the three graphs of concentration curve E, at the extreme lower right hand corner of the chart.

22. The number of sample households is given in cols. (2), (3) and (4) which show that the size of the sample was much larger in the case of the survey of landholdings compared to the survey of household expenditure. Each of the Central, State-I and State-II samples had about 18,000 sample households compared to only 1377 sample households in sub-samples 1 and 2 in the case of household expenditure. It is of interest to note that the three graphs of curve E lie very close to one another (and are almost indistinguishable), no doubt, due to the large size of the samples. Comparing the graphs of curve E with the graphs of B, C and D, it is seen that the margin of errors of sampling is much smaller in the case of curve E. The size of samples in the case of hand-holdings would seem to be quite adequate.

23. It should be mentioned that in the present case only those households have been included which own more than 0·10 acre of land in order to exclude landless labour and households who practically do not own any land. The most important point to be noted is that the concentration of land-holdings is far greater than the concentration of expenditure on non-food items of consumption. The distribution of land-holdings is thus far more unequal than the distribution of consumer expenditure. The curves B, C, D and E give a clear idea of the inequality in the level of living and in the ownership of land in India at the present time.

EMPLOYMENT AND UNEMPLOYMENT

24. Table (A.3.1) shows the position regarding the labour force, employment, and unemployment based on the 9th Round of the National Sample Survey (NSS) : May–August 1955. Estimated numbers in million are given for each category in cols. (2), (3) and (4) for rural and urban areas, and all-India respectively. The corresponding percentage of the total are shown in cols. (5), (6) and (7). The first portion A gives the basic information. Consider the all-India figures given in col. (4) and corresponding percentages in col. (7). It is seen from line 1, that the total estimated population (on the basis of the National Sample Survey) was 382·4 million in 1955, and from line 3 that the labour force consisted of 162·6 million persons [or 42·5 per cent of the population, as shown in col. (7), line 3] who were at work or seeking work at the time of the survey. Within the labour-force itself 160·4 million were

gainfully occupied (line 5), and 2·24 million were "unemployed" (line 4) in accordance with the concept of "unemployment" used in industrially advanced countries.

25. For various reasons, it is known that the concept of unemployment used in the advanced countries is not suitable in the case of underdeveloped countries in which most of the people work in household enterprises and agriculture. They are never "unemployed" in the technical sense, but may often have to sit idle for lack of gainful work. The figures for "unemployed" given in line 4, are not, therefore, adequate. A better picture can be obtained if consideration is given to the amount of time a person is available for work, or, is actually engaged in gainful work. This has been sought to be done in part B of the table. Three different approaches were used.

26. Information was collected on how many more hours a person was available for work per week and the replies were classified in groups of "available from 1 to 8 hours per week", "from 8 to 14 hours per week", etc., (that is, by units of 1 hour per day per week), shown in lines 6 to 13. Those who are available for work for more than 29 hours per week (that is, who can accept work for more than 4 hours per day for 7 days) are either practically unemployed or are sitting idle for half the week or more. Their number would come to 11·7 million [col. (4), line 9]. This perhaps is a lower limit of effective unemployment.

27. Information about hours of work per week is given (in an accumulated form) in lines 14 to 20. It would be seen that the number of persons working less than 8 hours per week was 20·9 million, and their position was practically the same as that of the unemployed. The number of persons working less than 29 hours per week or 4 hours per day was as large as 44·8 million [col. (4), line 16].

28. A third approach was to enquire how many days a person was engaged in gainful work during 30 days preceding the day of interview. The information is given in the form of accumulated totals in lines 21 to 26. The number of persons working less than 10 days out of 30 days, or less than one-third of the month, was 39·2 million [col. (4), line 22]. This is broadly consistent with the figure 44·8 million given in the previous paragraph.

29. There is, however, a big gap between estimates of the number of unemployed persons based on B.(1) the hours per week available for additional work and B.(2) the hours of work per week. A special enquiry carried out in the NSS: 7th Round, October 1953–March 1954, had given some

TABLE (A.3.1) : STATUS OF ECONOMIC ACTIVITY AND GAINFUL EMPLOYMENT RURAL URBAN & ALL-INDIA

	estimated number of persons in million			percentage of total		
	rural	urban	all-India	rural	urban	all-India
(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Distribution of population by status of economic activity[1]						
1. total population	316.1	66.3	382.4	100.0	100.0	100.0
2. outside labour force	176.4	43.4	219.8	55.8	65.6	57.5
3. in labour force	139.7	22.9	162.6	44.2	34.5	42.5
4. unemployed	0.92	1.32	2.24	0.29	1.99	0.59
5. gainfully employed	138.8	21.6	160.4	43.9	32.6	41.9
B. Distribution of gainfully employed persons by period of work						
(1) *hours available for additional work per weeks*[2]						
6. above 70 hours	0.38	0.04	0.42	0.28	0.20	0.26
7. ,, 56 ,,	1.2	0.11	1.3	0.85	0.51	0.81
8. ,, 42 ,,	6.1	0.7	6.8	4.4	3.3	4.2
9. ,, 28 ,,	10.4	1.3	11.7	7.5	6.2	7.3
10. ,, 14 ,,	17.6	2.5	20.1	12.7	11.6	12.5
11. ,, 7 ,,	22.1	3.2	25.3	15.9	15.0	15.8
12. ,, 1 hour	24.3	3.4	27.7	17.5	15.7	17.3
13. nil	138.8	21.6	160.4	100.0	100.0	100.0
(2) *hours of work per week*[2]						
14. 7 hours & less	18.9	2.0	20.9	13.6	9.2	13.0
15. 14 ,,	24.3	2.6	26.9	17.5	12.1	16.8
16. 28 ,,	40.2	4.6	44.8	29.0	21.5	27.9
17. 42 ,,	64.3	8.5	72.8	46.3	39.5	45.4
18. 56 ,,	109.7	17.2	126.2	79.0	79.4	79.1
19. 70 ,,	133.4	20.3	153.7	69.1	93.9	95.8
20. all	138.8	21.6	160.4	100.0	100.0	100.0
(3) *days of work per 30 days*[3]						
21. less than 5 days	28.2	1.6	29.8	30.2	7.2	18.6
22. ,, ,, 10 ,,	37.2	2.1	39.2	26.7	9.6	24.4
23. ,, ,, 15 ,,	50.1	3.2	53.3	36.1	14.6	33.2
24. ,, ,, 20 ,,	62.5	4.6	67.1	45.0	21.1	41.8
25. ,, ,, 25 ,,	78.3	8.2	86.5	56.4	38.0	53.9
26. ,, ,, 30 ,,	138.8	21.6	160.4	100.0	100.0	100.0

[1] Based on the National Sample Survey (NSS): 9th Round: May–August 1955; growth of population calculated on the Census 1941-1951 rate of 1.32 per cent per annum.

[2] Percentages in cols. (5) to (7) and lines (1) to (20) based on NSS 9th Round, May–August 1955, sub-samples 1 and 2 only, consisting of 8,037 rural and 16,703 urban sample households.

[3] Percentages in cols. (5) to (7) and lines (21) to (26) based on NSS 5th and 6th Rounds, December 1952-August 1953, consisting of 12,976 rural and 5,670 urban sample households.

interesting information on this point. The number of persons working part-time was obtained as 47·2 million corresponding roughly to 44·8 million persons who worked 28 hours or less per week as given in col. (4), line 16 of Table (A.3.1). The enquiry in the 7th Round brought out that among them 10·4 million (22 per cent of the total) were working part-time partly on account of ill-health of the worker and partly because of illness in his household. Also, 23·4 million persons (or roughly half) were working a part of the time for reasons of an economic nature such as lack of demand for their labour, lack of tools and raw materials, slack and off season etc.; and 13·4 million persons gave other reasons. It would seem from the above discussion that at least 23 million persons, who were working part-time for reasons of an economic nature, can be considered as severely "unemployed".

30. It is clear that the volume of under-employment is very great indeed in India. It is, however, difficult to set up precise definitions and standards for unemployment and under-employment especially in rural areas and in household and small scale enterprises and in the case of self-employed persons. The actual number would depend entirely on where the line is to be drawn between employment and under-employment.

31. Table (A.3.2) gives information on the distribution of gainfully employed persons by industries and by economic sectors (public, large scale, private household etc.). From col. (9) it is seen that out of a total number of gainfully employed persons of 160·38 million, 119·76 or nearly 120 million work in agriculture, forestry, livestock, etc. The total number engaged in manufacturing industries is only 17·54 million out of which also only 3·47 million are engaged in modern large scale industries. Trade and commerce with 6·84 million, and service with 5·13 million come next in order of importance.

32. From col. (2), bottom line, it is seen that 7·26 million persons are employed in the public sector, that is, under the Central and State Governments, Municipalities, and other public authorities; and from the total of col. (3) that 5·65 million are employed in private large scale enterprises. These two taken together, namely, 12·91 million persons have employment of the type familiar in industrially advanced countries; and in their case it is probably possible to specify fairly well whether a person is employed or unemployed in the sense in which "unemployment" is defined in advanced countries.

33. The private small scale sector has 146·61 million [col. (7), bottom line] out of which 115·23 million are household labour (col. 4). They may

TABLE (A.3.2): GAINFULLY EMPLOYED PERSONS BY INDUSTRIES: ALL-INDIA 1955

	industry	public	private large scale	private small-scale: household labour	private small-scale: hired labour	private small-scale: domestic service	private small-scale: sub-total (4)+(5)+(6)	not recorded	total
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				million persons					
1.	agriculture, forestry, livestock, fishing and hunting	0.41	0.93	93.23	24.76	0.00	117.99	0.51	199.84
2.	mining and quarrying	0.04	0.39	0.01	0.08	—	0.09	0.00	0.52
3.	manufacturing	0.44	3.47	11.38	2.10	0.00	13.48	0.16	17.55
4.	construction	0.26	0.22	0.66	0.85	0.00	1.51	0.01	2.00
5.	electricity, gas, water, sanitation	0.16	0.01	0.09	0.00	—	0.09	0.01	0.27
6.	trade and commerce	0.10	0.22	4.78	0.72	0.00	5.50	0.02	5.84
7.	service	2.65	0.14	1.07	0.49	0.77	2.33	0.01	5.13
8.	transport and communication	1.47	0.14	1.03	0.24	0.00	1.27	0.03	2.91
9.	not specified above and not recorded	1.73	0.13	2.98	0.67	0.70	4.35	0.11	6.32
10.	total	7.26	5.65	115.23	29.91	1.47	146.61	0.86	160.38

Based on the National Sample Survey (NSS): 9th Round May-August 1955, sub-samples 1 and 2 only consisting of 8,027 rural and 16,703 urban households.

be fully or only partly engaged in work but can almost never be "unemployed" in the technical sense. The structure of employment clearly shows the backwardness of the Indian economy.

34. Table (A.3.3) shows the incidence of "unemployment" among educated persons defined as matriculates or having higher educational qualifications. The concept of "unemployment" used is the same as that used in the advanced countries and is known to be much too restricted and hence unsuitable for underdeveloped countries. However, using this strict definition of unemployment, it is of interest to observe [from col. (7), line 5] that there were about 0·47 million or 4·7 lakhs unemployed in 1955 out of a total of 5 million or 50 lakhs of educated persons altogether. Taking into consideration the fact that about 4 lakhs of candidates matriculated in 1955, and that the number is steadily increasing, it can be easily imagined how very

TABLE (A.3.3): DISTRIBUTION OF TOTAL POPULATION AND UNEMPLOYED PERSONS BY EDUCATION CLASS: RURAL, URBAN & ALL-INDIA: 1955

education class	rural		urban		all-India		percentage of unemployed		
	total	unemployed	total	unemployed	total	unemployed	rural	urban	all-India
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	.....	million persons	.....				.....	percentage	.....
1. below matriculate	314.70	0.76	62.70	1.01	377.40	1.77	0.24	1.60	0.47
2. matriculate	1.10		2.40		3.50				
3. intermediate	0.19		0.65		0.84				
4. graduate and above	0.13		0.57		0.70				
5. sub-total (2–4)	1.42	0.16	3.62	0.31	5.04	0.47	11.42	8.59	9.40
6. total	316.12	0.92	66.32	1.32	382.44	2.24	0.29	1.99	0.59

Based on the National Sample Survey: 9th Round, May–August 1955, sub-samples 1 and 2 only, consisting of 8,037 rural and 16,703 urban sample households. Growth of population calculated on the Census 1941–51 rate of 1.32 per cent per annum.

difficult the problem of unemployment among educated persons would become in future, unless there is rapid economic development.

General and Professional Education

35. Table (A.3.4) shows the number of persons passing different examinations in India each year from 1950 to 1955 based on information collected by the Planning Commission. There is no doubt that general education is increasing quite fast. In most cases numbers have more than doubled in five years since 1950. The number of matriculates was over 4 lakhs in 1955 which represented about 1050 matriculates per million of the population. The number of first graduates was about 57,000 or about 150 per million which is comparable with an outturn of about 20,000 graduates in the UK with a population of 51 million or 392 per million. A comparison can also be made on the basis of literate persons. The number of literates in India in 1955 was about 63·2 million (all ages below 5 are omitted in calculations relating to literacy). The number of matriculates in 1955 was thus about 5300 per million literates; and the number of first graduates was about 900 per million literates. In the UK the number of persons of age 5 years or more was about 44 million and this would be also the number of literates (because of universal literacy) and is comparable to 63 million literates in India. On the basis of

TABLE (A.3.4): GENERAL AND PROFESSIONAL EDUCATION: ALL-INDIA 1950-1955

qualification	number of persons qualifying in 1950	1951	1952	1953	1954	1955	index-number: 1951 = 100
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General education							
1. Matriculation	1,89,184	2,41,143	2,61,059	3,34,760	3,97,005	4,00,014	166
2. Intermediate	59,283	72,685	77,836	89,021	1,04,851	1,26,476	174
.1 Arts	41,652	47,013	52,373	59,703	71,640	86,741	185
.2 Science	17,631	25,672	25,463	29,318	33,211	39,735	155
3. First degree	28,745	32,238	36,136	40,033	50,178	57,051	177
.1 Arts	19,212	21,251	24,965	27,491	35,773	40,444	190
.2 Science	9,533	10,987	11,171	12,542	14,405	16,607	151
4. Master's degree	5,581	7,138	7,734	7,855	9,777	11,013	154
.1 Arts	4,503	5,729	6,054	6,161	7,700	8,802	154
.2 Science	1,078	1,409	1,680	1,694	2,068	2,211	157
5. Doctorate	115	146	164	123	280	324	222
.1 D.Phil. (junior)	56	136	159	115	269	n.a.	(198)
.2 D.Sc. (senior)	59	10	5	8	11	n.a.	(110)
6. total	2,82,908	3,53,350	3,82,929	4,71,792	5,62,091	5,94,878	168
Engineering and technology							
7. Certificate	566	14,189	13,604	17,418	15,718	18,588	131
8. Diploma	784	1,547	2,871	2,575	3,148	3,774	244
9. First degree	1,923	2,189	2,150	3,046	3,520	3,583	164
10. Master's degree	50	66	82	69	211	144	218
11. total	3,323	17,991	19,067	23,108	22,597	26,089	145
Medical science							
12. Diploma	50	117	120	267	—	—	—
13. First degree	2,017	1,624	1,985	2,146	3,131	—	(193)
14. Master's degree	19	256	261	350	693	—	(271)
15. Doctorate	52	54	55	63	48	—	(89)
16. total	2,138	2,051	2,421	2,826	3,872	—	(200)

Contd.

TABLE (A.3.4) (*Contd.*) : GENERAL AND PROFESSIONAL EDUCATION : ALL-INDIA 1950–1955

qualification	number of persons qualifying in						index number : 1951 = 100
	1950	1951	1952	1953	1954	1955	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			AGRICULTURE				
17. Certificates	459	783	1,120	982	999	1,510	193
18. Diploma	585	661	352	691	563	778	118
19. First degree	1,067	1,118	984	914	1,004	971	87
20. Master's degree	146	151	209	190	198	193	128
21. total	2,257	2,713	2,665	2,777	2,764	3,452	127
			VETERINARY SCIENCE				
22. Diploma	62	34	37	—	—	—	—
23. First degree	112	242	237	252	298	330	124
24. Master's degree	—	—	—	—	135	147	—
25. total	174	276	274	252	433	447	124

Notes : (1) Index-numbers within brackets are for year 1954.

(2) Source of information : Division of Perspective Planning, Planning Commission.

an outturn of about 20,000 graduates per year in the UK, the number would work out as about 450 graduates per million literates. The proportion of graduates in India in relation to literates (900) would thus seem to be double that of the UK (450). This supplies some interesting information on social differentials in education.

INDUSTRIALIZATION OF UNDERDEVELOPED COUNTRIES—A MEANS TO PEACE

Paper presented at the Third Pugwash Conference at Kitzbühel—Vienna in September 1958 and then published in the *Bulletin of the Atomic Scientists*, Vol. 15, No. 1 (1959), pp. 12-17 and 46 and in *Sankhyā*, Vol. 22, Parts 1 & 2 (1960), pp. 173-182.

1. The world population was estimated at about 2,600 or 2,700 million in 1956. About 400 million in the highly industrialized countries like the USA, Canada, Western Europe, and Australia—that is, roughly the NATO powers together with some of the advanced neutral countries of Europe like Sweden, Switzerland, Finland, and Austria—have a high level of living with, of course, a great deal of variation among themselves. These 400 million have a total national income of about $ 550 (U.S.) billion out of, possibly, a world income of a little over $ 1,000 billion. The USSR and other socialized countries of Europe with about 300 million people have adopted a planned economy with rapid industrialization. China with 600 million has also started a policy of vigorous economic development. These 900 million in the socialized countries have a total national income, at official rates of exchange, of somewhat less than $ 300 billion with an average income of about $ 330 per person per year[1]. The level of living is still low but is rising rapidly and steadily; and there are wide differences from one country to another.

2. The remaining half of the world's population or over 1,300 million, are in countries which are generally underdeveloped with a few exceptions, like Japan or Argentina, which have more advanced economies. Their total national income would be about $ 190 billion, which would give something less than $ 150 per person per year. Nearly 1,550 million in Africa and Asia (excluding Japan and Turkey and a few small places, but including China) have to live on something like $ 110 billion or on less than $ 75 per person per year[2].

---

[1] Figures given in this paper are based on various adjustements and should be used as very rough approximations. Population estimates are subject to many adjustements. National income figures are difficult to compare ; and the use of official rates of exchange for conversion into U.S. dollars can be often misleading. The results given here should be, therefore, interpreted as broadly indicative of the general position and should not be used for refined comparisons.

[2] The distribution of national income among countries is extremely uneven. Roughly half of the population (or over 1,300 million) have $85 billion, that is, just over 8 per cent or one-twelfth of the national income of the whole world. About two-thirds of the population have $160 billion, or one-sixth of the total income. On the other side, the top 5 per cent (about 130 million) have $325 billion, or almost one-third of the world income ; and the top 10 per cent have nearly $450 milliards, or about 43 per cent of the total income.

3. The underdeveloped countries often have large resources in the form of minerals and land, which is being or can be used to produce agricultural crops of various kinds, and which offer great possibilities of economic development. The highly industrialized countries in the West already have (and naturally desire to continue to have or to increase) opportunities of exploiting these resources to their own advantage. The "East" (as the socialized countries are called) have large resources of their own and are less dependent on the supply of minerals and raw materials from the underdeveloped countries. However, for both strategic and economic reasons, the Eastern powers would continually try to reduce the influence of the Western powers on the underdeveloped countries, which, so long as they continue to remain underdeveloped, must constitute areas of conflicting interests between East and West.

II

4. The scientific and industrial revolution of the last two centuries was brought about almost entirely by the Western countries, and led to a position of indisputable and undisputed military supremacy of the Western powers. The earlier form of exploitation of the resources of the underdeveloped countries was military and political occupation, that is, by the building up of large colonial empires. In some countries, for example, in China, there was no direct political occupation, but the foreign powers established advantageous economic controls. This indirect form of economic influence, backed invariably by military sanctions, became increasingly more important during the present century so that many underdeveloped countries are politically independent but are economically dominated by an industrialized country.

5. In this connection I may also refer briefly to the impact of the characteristically Western doctrine of laissez-faire and division of labour at the international level. To put it crudely, there has been a tendency for at least one school of Western economists to assert that it is proper and wise for the underdeveloped countries to specialize in the production of agricultural crops; and to continue to export agricultural products and minerals to be processed by industrially advanced countries which are in a position to utilize these resources with greater efficiency. Experience, however, has shown that it is not possible to improve the level of living beyond a certain limit on the basis of agricultural production alone. The USA supplies a very instructive example. Agriculture is very highly developed, but has to be supported by perpetual subsidies. This being the position in the USA, it would seem practically impossible for any underdeveloped country to attain a high level

of living through the export of agricultural products alone. In recent years there has been some recognition of the need of economic development through industrialization of the underdeveloped countries. It has been generally assumed, however, that such economic development would broadly follow the pattern of industrialization in the West, essentially a slow process.

6. Since the Second World War attempts have also been made through the United Nations Technical Assistant Program, USA "Point Four," Colombo Plan, etc., to help the underdeveloped countries in economic affairs. The experience of the last twelve years, however, has shown that there has been very little general improvement in the level of living in the underdeveloped countries. It is also being gradually conceded that disparities in the level of living, both *relative* and *absolute*, between the highly industrialized and the pre-industrial countries have been steadily increasing.

III

7. The level of living in underdeveloped countries is extremely low, and the distribution of income is extremely concentrated. For example, in India (which is relatively an advanced country in the underdeveloped group), half the population live on less than 10 cents (USA) a day, and only 10 per cent of the population have more than 20 cents (USA) per day.

8. Most of the people depend on agriculture or on indirect income derived from the export of minerals. There are very few modern manufacturing industries. Unemployment, or rather underemployment, is widespread and universal, for lack of capital and modern tools of production. Facilities for education and medical care are extremely meagre. Naturally, there is also a great scarcity of scientific and technical personnel.

9. A very small group of families or persons have the largest share of wealth, income, and political and economic influence. In fact, the greater the lack of economic development the fewer would be the number of persons who have the effective power of making political and economic decisions. This makes it possible for a foreign power to exert pressure on a small group of powerful persons to give concessions in favour of the foreign power. Such arrangements, because they depend on the will of only a small group of persons, are necessarily subject to violent changes from time to time. Relations between foreign powers and underdeveloped countries are, therefore, basically unstable.

IV

10. The world situation has changed in a most significant way with the emergence of the USSR and other socialized economies. It is now accepted that economic planning in the USSR (and more recently in other socialized countries) has led to a far more rapid rate of industrialization than had been achieved in West Europe and North America in the past. The Western powers do not any longer have monopoly of ability to supply capital goods and technical know-how. There is also a growing belief among underdeveloped countries that the only way of achieving a rapid rate of industrialization would be through economic planning.

11. Very recently, the monopolistic superiority of the West in atomic and nuclear weapons and ballistic missiles has also gone. In this situation, it is inevitable that the conflict of interests between East and West in regard to spheres of influence in the underdeveloped countries would become more and more sharp. This, in brief, is the present position. Recent events in the Middle East, for example, corroborate the above analysis.

V

12. With the progress of industrialization of a country it would automatically follow that its own natural resources would be increasingly exploited by itself. With increasing industrialization it is also inescapable that commercial and economic relations with other countries would increasingly tend to become as between equals.

13. It is agreed that the very process of economic development would generally broaden the base of social and political decisions. That is, with the progress of economic development a larger and larger number of persons would become involved in making economic and political decisions. External economic and political relations would, therefore, tend to become more stable.

14. A quick transformation of the underdeveloped countries into industrialized economies would, therefore, reduce the sphere of conflicting interests; and hence decrease the tension between East and West.

VI

15. The General Assembly of the United Nations passed a Resolution on November 20, 1950 "recognizing that a more rapid economic development of underdeveloped countries is essential for raising the level of productive

employment and the living standards of their populations, for the growth of the world economy as a whole and for the maintenance of international peace and security"; and also that there was need of "an increased flow of international public funds" for this purpose. A Committee of Experts was appointed by United Nations in 1951 "to prepare a report...on unemployment and underemployment in underdeveloped countries, and the national and international measure to reduce such unemployment and underemployment."

16. This Committee made a valuable review of the position and reached the conclusion that economic development was the only radical solution of underemployment; and that external assistance, in the form of capital and technical knowledge, was essential for this purpose. The Committee also made a very tentative estimate, on a per capita basis, of capital requirements and came to the conclusion that for about 1,500 million persons in underdeveloped countries (including China) the external capital required would be about $ 14 million U.S. dollars (or $ 9·3 dollars per person) per year and expected that this would lead to a rise of income of 2 per cent per capita allowing for growth of population.

17. The recent years efforts have also been made to give economic and technical aid to the underdeveloped countries through the United Nations Technical Assistance Board, the World Bank, International Monetary Fund, USA "Point Four" (under various names), the Colombo Plan, etc. It is, however, generally agreed that such efforts have not been adequate, and very little improvement has occurred in the level of living of underdeveloped countries. Mention may be made, for example, of Gunnar Myrdal's recent essays and articles in which he has stressed the fact that rich nations are getting richer more and more rapidly, while poor nations are sometimes even getting poorer.

18. It is also being increasingly appreciated that special efforts have to be made in the initial stage of industrialization. P. M. S. Blackett in his presidential address to the British Association for the Advancement of Science in 1957 stressed the importance of giving external assistance, in the form of capital and technical knowledge, during this initial stage which he called "assisted take-off." He also made some rough estimates of requirements, again on a per capita basis, and thought that about £ 1 (one pound sterling) per head per year or about £ 1,000 million or $ 2·8 billion U.S. dollars per year of external aid would be required for 1,000 million inhabitants for 8 or 10 years for effective industrialization. This estimate of requirement of external aid at the rate of $ 2·8 U.S. dollars per head per year is less than

one-third of the earlier estimate of $ 9·3 U.S. dollars per head per year made in 1951 by the U.N. Committee of Experts. This wide divergence shows that these estimates are very tentative; and that much more detailed studies would be required to supply more realistic figures[1].

VII

19. Unfortunately, no economic theory of development is at present available to guide our thinking in this matter. It, therefore, seems urgently necessary to start serious and systematic studies to build up a general conceptual framework to handle questions of economic development, and more particularly, to formulate a program of action (including the supply of external capital and technical aid) to assist the underdeveloped countries.

20. It is not possible to subsidize the underdeveloped countries indefinitely. The aim must be to make each country sufficiently developed to reach some kind of a steady state or a balanced economy in the course of say 10 years (or 15 years at the most) so that the inflow of external aid would gradually decrease and, preferably, cease after 5 or 10 years. That is, it is necessary to make some realistic estimate of the total external aid required for this purpose so that the industrially developed countries can get some idea of the magnitude of the task.

VIII

21. Estimates prepared by the U.N. Committee of Experts in 1951 and by P. M. S. Blackett in 1957 were both on a per capita basis. Some broad general considerations would, however, show that capital requirements per head would differ from one country to another. The bigger a country (as measured by its geographical area, unexploited natural resources, and population) the greater would be the possibility of achieving its industrial development out of its own resources. In a big country it is possible and desirable to push back the manufacturing process to the utmost limit in order to expand

[1] It is worth noting that the expenditure on defence is of the order of $100 billion (of which the share of NATO powers is about $60 billion and of the USSR about $25 billion) per year at present ; if expenditure on associated research is included the total would be higher. It would be seen, therefore, that the requirement of about $3 billion (as estimated by Blackett) or about $10 billion dollars per year for 1,000 million (on the basis of the rate used by the U.N. Committee) would amount to no more than 3 per cent or 10 per cent of the defence budget of the world. A saving of 3 per cent (or 10 per cent, as the case may be) in the cost of defence, if used in a wise manner, would be more than sufficient for the economic development of 1,000 million people in the most backward countries of the world.

continually its capacity to make investments increasingly out of its own domestic resources.

22. We may consider the case of India as an example. In India it would be economical to establish a heavy machine building industry which would manufacture heavy machines and equipment required for the installation of factories for the production of steel, fertilizers, aluminium, etc. or for the production of heavy electrical equipment like big generators, transformers, switchgears, etc. It would be also economical gradually to establish large-scale industries for the manufacture of synthetic raw materials of many kinds (including the production of petrol from coal, in case an adequate supply of oil is not discovered). Once such basic industries are estabilished it would be possible to expand the production of electricity, coal, steel, aluminium, fertilizers, mining and transport equipment, etc.; and then, with the help of such heavy machinery, producer goods, and energy to manufacture machinery for the increasing production of consumer goods. It follows that a big country would require a comparatively small amount of outside capital.

23. It is of interest to note that in the case of China, with a population of roughly 600 million, the Soviet loan of roughly \$ 1·25 billion U.S. dollars, given for economic development during the First Five Year Plan (from 1953 to 1957), represented only about two U.S. dollars per head spread over five years, or forty U.S. cents per head per year. This seems to have been quite enough to make China "take off" on its way to rapid industrialization, but is clearly a lower limit of external capital requirement.

24. For a big country, external economic transactions (of which foreign trade is a most important form) would be comparatively small in relation to the magnitude of its internal economy. In the USA, for example, external trade is only about 5 or 6 per cent and in the USSR only about 2·5 per cent of the national income. It should not be very difficult, therefore, for a big country to attain a fairly stable balance of payment.

25. It is clear that planning must have a fairly long perspective of time. Factories can be established for the production of consumer goods in 2 or 3 years; large-scale production of steel and other metals, electricity, fertilizers etc., would take at least 7 to 10 years; heavy machinery building and heavy electricals would take from 10 to 15 years. The most slowly maturing sector would be that of scientific and technical manpower which would require planning for 25 to 30 years.

IX

26. In the case of a small country (as measured by its area, natural resources, or population) the problem is more difficult. There is a limit beyond which the manufacturing processes cannot be pushed back, because there is a minimum factory size below which production is uneconomic, in the case of many important commodities like heavy machines, steel etc. It may not be economical for a small country to establish a heavy machine manufacturing industry, because it would not be possible for the country itself to utilize the output every year. There is also a limit below which it may be difficult to undertake in small countries the economic production of steel and other metals on a large scale. A small country, therefore, would have to depend, to a larger measure than a big country, on the import of capital goods as well as of many producer or consumer goods. The industrialization of a small country (unless it has large natural resources like oil or other minerals which it can export on profitable terms) would presumably require comparatively more external aid.

27. Also, the smaller a country, the greater is likely to be the magnitude of its foreign trade in relation to its whole economy. In the case of a small country it is, therefore, of great importance to consider the expansion of foreign trade in desirable directions. In a paper prepared for the Bandung Conference of Afro-Asian countries in April 1955, I had given some preliminary consideration to this problem (see Appendix).

28. The pattern of development is likely to be more or less similar for big countries. But it is not possible to reduce the same pattern mechanically to scale to suit the needs of small countries. The developmental plan for a small country must have specific relation to its own natural resources and also the possibilities of expanding its foreign trade in cooperation with other countries of the same region.

X

29. It is suggested that attempts should be made to set up, as soon as possible, small groups of experts to study the problem of industrialization, at a concrete level, for the underdeveloped countries. The aim would be to formulate the broad strategy of planning for economic development over a period of 15 or 20 years. This would imply preparing a rough time program for the development of agriculture and the establishment of modern industries with appropriate priorities. Special attention will have to be given to health, education, and the supply of scientific and technical manpower.

30. Consideration will have to be given to the expansion of foreign trade, not merely as an extrapolation of current trends, but with a changing pattern over time which would be in keeping with and would also promote rapid economic development. Naturally, economic relations with other countries, especially the underdeveloped countries in the same region, will have to be considered; and economic measures will have to be devised which would promote both the expansion of trade and the economic development of the countries concerned in the regional group. Gunnar Myrdal, for example, in a recent lecture in India (1958) has pointed out the advantage of group of underdeveloped countries in a particular region forming, by mutual agreement, a "common market" protected from outside with, however, a free flow of trade and specialization of manufactures within the protected area.

31. Studies will also have to be made of not only the amount but also of the pattern of external aid, in the form of capital and technical knowledge, which would have to be supplied by the more highly industrialized countries to start the process of industrialization and to carry it through until some kind of a balanced economy has been established when no further special subsidies or long-term development loans would be required. Formulation of even rough estimates would be of great value in supplying a starting point for further thinking.

32. It is believed that enough information is available for at least a good number of countries to enable such studies to be initiated immediately. It would be necessary, of course, for experts from the advanced countries to supply the leadership. At the same time, it would be essential to associate with these studies, as early as possible, technical personnel from the underdeveloped countries. In fact, one important aim of such studies would be to provide opportunities to personnel from underdeveloped countries to acquire knowledge and experience of planning for economic development.

33. The task proposed in this section would call for patient study and the collection of much essential information. It may be necessary to carry out special surveys for this purpose. The formulation of a program of surveys with indication of priorities would indeed be a most useful piece of work as a first step for development. The approach will have to be of a "spiral" type. Attempts would be made to make rough estimates on the basis of available data. This very process would indicate gaps in information. As these gaps are filled up, the first estimates would be revised; and the process of revision would disclose the need of further information; and so on. It is, therefore, necessary to begin serious studies as early as possible.

XI

34. It is true that mere formulation of even a sound technical plan for development would not be of any use until social and institutional conditions within a country become favourable to industrialization. But the very formulation of a general conceptual framework of economic development would serve as a powerful stimulus to set social forces in motion for industrialization.

35. A number of countries of Afro-Asia, such as India, Pakistan, Burma, Ceylon, Indonesia, Egypt and Syria (United Arab Republic), etc., have already started planning for economic development and would welcome and greatly profit by the studies of the type discussed in this note. In fact, these countries would probably agree to help and gladly participate in such studies. There are many other countries which would be seriously interested.

36. There are also countries in which there is as yet no definite movement for economic development. But, in such countries also, individuals here and there may have already started thinking or may soon begin to think on this subject. The proposed studies would give them encouragement and guidance and thus help in the creation of favourable conditions for industrialization.

XII

37. With the progress of industrialization, disparities, both absolute and relative, between the highly industrialized countries and those which are at present underdeveloped, would decrease. Also, some of the advantages which the highly industrialized colonial powers (in either the political or the economic sense) now enjoy in having preferential access to sources of cheap raw materials or of markets would, no doubt, decrease; but this does not mean that there would be any worsening of their absolute level of living. On the contrary, with fuller and better exploitation of the resources of all the countries of the world, it should be possible to reconcile conflicting interests in such a way as to safeguard the level of living of all the countries of the world.

38. The Western Powers have so far refrained from promoting industrialization of the underdeveloped countries in any significant way, possibly because they do not wish any competition to grow about securing minerals and raw materials at concession rates or to lose markets for manufactured products. It is true that Western Powers, especially the USA, have been giving aid to the value of billions of dollars every year to some of the under-

developed countries, but such aid has been extremely selective and mostly for military purposes. Although there is much talk of economic aid, the actual amount devoted to industrial development is extremely small and forms an insignificant proportion of the total aid. For example, the total budget for economic and technical assistance through United Nations and the Specialized Agencies like the International Labour Organization (ILO), Food and Agriculture Organization (FAO), World Health Organization (WHO), etc., amounts to only about $ 34 million dollars compared to something like one hundred times that amount spent on bilateral aid mostly for military purposes. The primary object of Western aid being of a political or military nature, stringent conditions are usually attached.

39. The USSR, on the other hand, may be eager to bring about the industrial revolution in the underdeveloped countries as quickly as possible, because this would make them independent of the Western Powers in economic affairs. This would also create a working class which, according to the Marxist view, may promote social revolution from within. As the USSR, and other Eastern Powers do not have any direct military or political objects in view, they can and actually do give economic aid without strings. Although it is only about two or three years since the USSR has started giving economic aid in any large measure, the impact on the underdeveloped countries has been already very great.

40. The basic difference in the outlook of the West and the East has important consequences. Western aid, primarily military in nature, is usually welcomed by being given to small groups of persons who happen to be in power, often against popular will; and thus serves to preserve reactionary social and political conditions and hamper industrialization in countries receiving such aid. The aid from the USSR and China, on the other hand, is being increasingly sought by and given to groups who are more eager for economic progress and, therefore, tend to have greater popular support behind them.

41. However, once it is realized that the industrialization of the underdeveloped countries is inescapable, and also that any country which actively helps in the process of transformation would steadily gain in political and economic influence, it is inevitable that *both* blocks would try to assist in the process. The advantage will lie with that bloc which approaches this task with greater honesty, sincerity, and efficiency.

42. Nuclear weapons and guided missiles have made the cold war obsolete. Stopping of nuclear tests and gradual disarmament would be most

desirable and welcome, but would not by themselves guarantee peace. In the future, peace can be preserved only by active cooperation between the two blocs (and this may be possible, in principle, even without complete or drastic disarmament). Such cooperation would be difficult if rivalries continue to persist in the underdeveloped countries. A quick transformation of the underdeveloped countries into modern industrialized economies would eliminate areas of conflicting interests.

43. In any case, the proposed studies would give guidance to industrialized countries in the efficient utilization of their economic and technical aid to underdeveloped countries. With the progress of industrialization, rolling adjustments would tend to be made in areas of conflicting interests. Gradually, it may be hoped, both blocs would begin to appreciate the advantages of cooperative efforts for the industrialization of underdeveloped countries as an indispensable condition for world stability and peace.

APPENDIX

Economic Development of Afro-Asian Countries

(*Prepared for the Bandung Conference, April* 1955)

1. The enduring basis of Afro-Asian understanding must be ultimately established on mutual cooperation to bring about a steady increase in the level of living through economic, social, and cultural development in the Asian and African countries. Anti-colonial and peace movements must be looked upon essentially as attempts to secure favourable conditions for such developments.

2. The aim must be to promote the exploitation of all available natural and human resources for the national development of each individual country. The Afro-Asian region or even Southern Asia as a whole has such large resources that there is not the slightest difficulty, at the technological and economic level, to attain a rapid rate of growth of all the national economies. Much capital goods and technical aid form the more advanced countries would be required in the beginning. Fortunately, with the improvement of international relations, such aid is likely to become increasingly available from different parts of the world. It would be of advantage if such aid could be channelled through the United Nations or similar international agencies.

3. It is, however, not necessary to wait for U.N. to take action. It is possible and, indeed, desirable to initiate action at the level of the countries concerned. For example, a Standing Technical Committee (with a small permanent secretariat) may be appointed to study possibilities of fostering economic, social, and cultural cooperation among the Bandung countries. The work of the proposed Committee would be mainly concerned with the study of problems of long-range development. This would not duplicate but would be complementary to activities which are directed to solving more urgent problems in the Economic Commission for Asia and the Far East (ECAFE) and the Colombo Plan.

4. The proposed committee might, for example, examine possibilities of long-term industrial developments in the countries concerned, and possibilities of expansion of international trade not on the basis primarily of the current pattern of imports and exports but from the point of view of promoting a changing pattern of international trade deliberately directed to the national development of all the countries concerned. India at present has a good export market for cloth and some other manufactured products. In a static approach, the current pattern of trade would be sought to be maintained which would retard industrial development in the importing countries (as had

happened in India in relation to the United Kingdom). In a dynamic approach, India would actively promote a rapid industrialization of the more backward countries, fully recognizing that the pattern of Indian exports must change thereby but also appreciating the possibilities of a steady expansion of the foreign trade of all the countries concerned at increasing levels of manufactures.

5. The dynamic approach necessarily calls for a wide horizon of time. Trade agreements and understandings have to be visualized as extending over a period of 5 or 10 years or even more. Prices, terms and conditions must have much greater flexibility than short period trade contracts. The aim would be to maintain at an agreed level or expand in a suitable way, over a number of years, the total volume of imports and exports (measured, say, at constant real prices); and, at the same time, to try to change the pattern of trade in such a way as to promote increasing industrialization of the countries concerned. For example, if India can be assured of a steady supply of, say, rice from Burma over a number of years (preferably at constant real price), then India may undertake to supply not only manufactured consumer goods but also to help in the industrial development of Burma through the supply of minerals, raw materials, capital goods, and technical assistance. In this approach, India must give up the idea of earning large profits through the continuating export of particular types of products; and adopt the policy of mutual help and benefit to attain increasing levels of industrial development of both Burma and India.

6. A dynamic policy of mutual development over a number of years can be promoted most effectively at government level with, however, the fullest participation of the private sector which would be entirely in keeping with the economic policy of India.

7. As already mentioned, a first step may be to set up a small working group or technical committee to initiate economic, social, and cultural studies to supply a scientific basis for preparing long-term developmental schemes on a regional scale. A large membership is not essential; and work can be started with a small group of countries or even on a bilateral basis by agreement between two countries.

8. To make a beginning, India may offer certain physical facilities like accommodations, library, and a small professional and office staff to serve as the nucleus of a secretariat. It would be desirable to have a director from outside India; and the professional staff must come chiefly from the participating countries.

STUDY OF THE PROBLEMS OF INDUSTRIALIZATION IN THE UNDERDEVELOPED COUNTRIES

This article is an English translation of Prof. Mahalanobis' second article "Izuchenic problem industrializatsii slaborasvitikh stran" published in Soveremennyi Vostok (Contemporary East) Moscow, September 1959.

1. I am sincerely obliged to Soviet colleagues for their valuable comments on my article "Industrialization—a key to consolidation of independence" published in the Journal 'Contemporary East' (in December 1958). While aggreeing in general with many of these remarks I think it would be useful to submit some additional remarks on a concrete level. I fully share the opinion of the Soviet economists that initiative and constant efforts for economic development must come from each country; I also agree that for such a country as India there is urgent necessity for agrarian reforms through the consolidation of holdings and organization of agricultural cooperatives. These problems are receiving serious consideration on our part.

2. I would like to emphasize that, in general, the conditions in India are quite typical. For the economically less developed countries, though there are essential differences (for instance, in the number and intensity of population), definite differences are also inherent in the socio-political conditions, system of government, education, scientific activities and the like. There is no doubt that while studying the problems of economic development in different countries such differences must be taken into account. Nevertheless I consider that it is possible and even desirable to work out on the basis of planning experience in the USSR technical and economic norms, coefficients and balance-sheets laying down guiding principles and methods for planning and this might, in general, be useful for all the underdeveloped countries.

3. We cannot but note that the classical and Keynesian theory developed in the advanced capitalistic countries might possibly suit these; but they are of little help for tackling the problems of economic development. For instance, the Keynesian theory may be applied for the purposes of eliminating unemployment—a consequence of economic crisis and depression. But this is inapplicable when we have to deal with the chornic under-employment in the underdeveloped countries.

4. The economic theory of the highly developed countries appears to be basically static in character and they are concerned, above all, with the most

efficient distribution of the stock of capital and of other resources and not with the problems of economic development through an increase in capital accumulation. A theory of the same brand did not help the economic development of India or any other underdeveloped country; it hindered such developments on the other hand.

5. The accepted economic theory in the capitalist countries does not help the idea of economic planning. But, as we know, many underdeveloped countries with their differing socio-political conditions (Burma, Ceylon, India, Indonesia, UAR, some countries of Latin America and others) have come to be seriously interested in planning and have set up planning commissions and boards. It is for this reason that new guiding principles on concrete technical and economical levels have become urgently necessary, so that these might help planning the economically underdeveloped countries.

6. After this let me venture to suggest some proposals regarding the utilization of the very rich experience of planning accumulated by the USSR and other socialist countries. I would like to treat separately three different aspects of such experience. (They are, in fact, inter-connected among themselves but even so may be differently viewed for operational purposes).

7. Firstly, we have general theory of social-economic changes which I will call the economic theory aspect or the abstract economic theory of economic growth.

8. Secondly, there are the technical and economic norms, coefficients, balance-sheets and the like. All these, as a rule, are concrete and appear in the form of quantitative indicators. But these must be carefully distinguished from the third aspect which would be called by us the 'technical project aspect' dealing with specific engineering and technical data.

9. My proposal is directly related to the technical and economic aspect of planning. It is clear enough that what we call the abstract economic theory had played the most important role in the historical development of the Soviet economy. It is quite obvious also that technical project work is extremely important for the implementation of economic planning. However, while considerable volume of information and literature are available on the general questions relating to the progress of the socialist economy in the Soviet Union and in other socialist countries, very little is known regarding technical and economic aspects of economic planning. Meanwhile there is, in my opinion, the urgent necessity for studying the above-mentioned aspect of planning. This is the aspect which may render the greatest help in economic planning to the underdeveloped countries.

10. The technical project level would become important only after definite decisions for projects are arrived at in economic planning. We shall cite an example from Indian experience with the purpose of classifying what we understand by the terms technical and economic information and guiding principles and also showing the extent to which these ranges of information are significant for planning for such a country as India.

11. In India the Steel Industry was founded in the year 1908. However, in the year 1951 when the implementation began of the First Five-Year Plan (1951–56), the production of steel in the country did not exceed a million tons (for a population of 360 million).

12. The proposal for constructing a new steel plant with a million ton capacity was rejected from the First Five-Year Plan under the influence of the economic theory of the capitalist countries. This was done on the ground that demand for steel (estimated for the year 1950) was put at a total of 1·6 million tons. But by 1953-54 with the growth of economic activities during the First Five-Year Plan the deficit in steel was found mounting. Much foreign exchange was required for covering this deficit in steel through import. All these happened, because at the time of preparing the First Five-Year Plan the ideas of material balance-sheets and technical-economic information relating to these balances were not existent in India.

13. By 1954 it came to be realised that we needed to build up new steel plants. At this stage we proposed to build up heavy machine building for production of machinery which were to be supplied to the new steel plants. The Government approved this idea very enthusiastically. But, unfortunately, at the time of preparing the draft of the Second Five-Year Plan in 1955 we could not have technical data. As a result of this, a doubt arose in certain circles regarding the possibility of building the heavy machine building plant.

14. Immediately after the launching of the Second Five-Year Plan we received proposals from the Soviet Union for the construction of an integrated heavy machine building plant with a productive capacity of 80,000 tons of heavy machinery (of items individually weighing upto 130 tons) at a cost of 700 to 800 million rupees. For this the foreign exchange, that was required, constituted 450 million rupees for the import of machinery. At the same time, it was decided to increase the production of steel up to 5 million tons by the end of the Second Five-Year Plan period (1961).

15. Now it has come to be acknowledged that if we proceeded more wisely and began building up of a heavy machine building plant with a

capacity of 80,000 tons considerably earlier, then after the plant came into full production we could have annually produced such a volume of machinery as would have been sufficient for the new metallurgical plant with a capacity for a million tons of steel or for other plants of comparable magnitude. It is quite possible that if we possessed the requisite technical and economic information during the years 1954-55, we might have decided even then to construct the heavy machine building factory with a capacity of 80,000 tons. This would have saved us 4 to 5 years of time and much of foreign exchange also.

16. I hope this example will be a sufficiently convincing proof of the necessity for having reliable technical and economic information in the form of numerical indicators as well as the need for using proper methods of technical and economic analysis as well as for comparative study. There are also other important questions arising out of the necessity for having at disposal data on the material balances and the structure of industrial productions including data on norms of technical nature (for instance, consumption of 150 tons of steel for one steam locomotive, 50 thousand kilowatt hours of electrical power for a ton of aluminium, 3 tons of coal for a ton of finished output etc.). Some of this information is also available in India though scattered here and there. But we still lack much. If the Soviet specialists would offer us information of this type, they would render a very valuable service for our planning. There is a two-fold task. It is necessary to lay down on the one hand, a general method for working out the necessary balances and, on the other, special methods which would answer to the specific conditions of different countries (for instance, to conditions of India with her 400 million population and with large stocks of high quality iron ore). As regards lesser countries it appears to me that priority should be fixed, say, for production of steel or for heavy machine building. There are other important problems also, for which guiding principles are absent. In my opinion this work must and should be included in the programme of joint investigations.

17. Let me examine in brief one of the most important problems for the underdeveloped countries, namely, the problem of proper training of technical personnel. If we assume light industry may be built up during a period of 4 to 5 years, then for the building up of power, metallurgy and transport industry we would obviously require 8 to 10 years, and more for heavy machine building, chemical production and production of heavy power equipment. But the most long-drawn-out process of all would be the training of technical personnel. This is the reason why the question of scientific and

technical personnel, which would be required by the country as its economy goes on developing during the next 5 to 10 or 15 to 20 years, has become a matter of deep concern for the economically underdeveloped countries. Future requirements would naturally depend on the changes in the structure of production. It is quite important that we should have a dynamic approach to this sphere (as in other spheres also). Information on the requirements of technical personnel for each seprate industry must be the initial starting point.

18. We spoke of the necessity for a dynamic approach. Such approach has certain technical consequences. Material balance-sheets or balance-sheets of separate industries may be studied through an analysis of the inter-relations between the material expenditures and output (input and output analysis). And this type of information should have valuable application in the underdeveloped countries or for individual industries, in which cases the technological inter-relation is more or less stable.

19. It should be emphasized that the analysis of the inter-relation among the material expenditures and output (input and output analysis) or linear programming has a basically static value. In all probability they do not offer great help for studying the problem of rapid industrialization, when the structural inter-relations themselves among the material expenditures and output come to alter in a radical fashion. However, the study of the ratios among the expenditures of production and output at different levels of development in such a country as the USSR may throw light on the problems of economic growth.

20. I may venture to state that a study of such relations in their historical perspective in the different republics of the USSR in different plan-periods may be of great interest for purposes of economic planning of the underdeveloped countries. The relatively important point is that technical and economic methods be worked out for studying the problems of planning for economic growth—methods based on concrete data in the form of numerical indicators.

21. We can note in this connexion that our efforts towards perspective planning in India have come to provide us with some experience. It has been found by us that it is extremely useful to know a number of economic coefficients not only in respect of every branch of industry but also for industry-groups and even for national economy as a whole. These include the ratio between the total value of product and total capital; the ratio of net output to national income, as well as to the total capital; the ratio between the

circulating and the fixed capital; between capital and the number of workers; between physical volume of production and capital; between physical volume of production and the number of workers, etc.

22. I have tried to show through concrete examples the nature of works (studies) which, I think, might be useful on the basis of planning experience in India. There are many other questions also, about which we would like to receive more information, namely, on norms and variations in production (of labour forces, equipment, labour conditions and the like), on norms of performance (in railways, in communications and the like), on incentives which would raise labour productivity (relative scales of wages for different professions, etc.). These questions, according to us, are of great value to the underdeveloped countries. Undoubtedly there are also other items of information, which the Soviet specialists might themselves offer us, and these also would be of great value to us.

23. It appears to me that the really urgent task is to set up even a small group of workers comprised of three or four economists, three or four specialists having experience in planning work and three or four statisticians. They would begin studying the Soviet experience in planning at a technical-economic level in concrete and quantitative forms. I think that a group of 8 to 10 even working part-time are capable of preparing a programme for useful investigations. And it is only when the foundation has been laid that we can start defining the lines of approach. New ideas and new approaches to scientific research work would spring up in course of work. Moreover, necessity will arise for drawing in this work other specialists also, for instance, geographers, geologists, technologists and scientists. In my first article I have touched on the question of collaboration among the underdeveloped countries. I think it might be useful to carry on this work in two directions or at two different levels. First, such a collaboration would provide the Soviet specialists with concrete cases and set before them definite tasks in connexion with the development of the economically underdeveloped countries. This would lick the scientific research work into a concrete shape. Secondly, the specialists from the underdeveloped countries will be able to make their contributions with actual data and information for studying the special problems of economic development in their respective countries. Work of a similar nature may be started on a bilateral basis and thereafter it may be expanded, as and when opportunities arise.

24. While we were occupied in our work of perspective planning in India, we have been eager for joint work with the Soviet specialists. For the last

5 or 6 years from 1954 onwards we have been inviting them to India for joint work. The organization of a working group in the USSR would create an active nucleus, which would permit us to push ahead in the study of this problem. We would eagerly look forward to collaborate in this work in any directions deemed suitable by our Soviet friends.

25. I shall now examine another most important aspect of economic development, namely, external trade. The smaller the country, the greater is the significance of external trade for her. This raises the question of a specialization according to the nature of resources and skills and other possibilities existing in each country. In their remarks on my article some Soviet economists rightly observed that it was necessary to find out new principles of division of labour on an international scale. This is a most difficult and, at the same time, the most important task for the future peace and prosperity of entire humanity. It is impossible to solve it without international collaboration, which, of course, cannot be achieved to the extent necessary in the near future. But we propose to start even now some joint work regarding this problem—as a start on a bilateral basis between the countries who are ready to take up such work voluntarily. I propose that Soviet and Indian specialists may start joint studies regarding planning in the Soviet perspective. These studies might be completely distinct from and independent of the current agreements between the countries for a period of 1 to 2 years. Joint investigations may deal with the problems of the future development of trade (perspective). A dynamic approach to this problem is extremely necessary. The purpose of joint investigation must be not only an increase in the volume of trade of the existing pattern but also alterations in the structure in relation to the economic development of both the countries. The pattern of trade must be altered or should increase in such a way as would be advantageous for both the countries.

26. Joint investigations would define the future possibilities at a concrete level and as a result of this it would be easier to take action in the appropriate directions. The above-mentioned investigation will be conducted purely for informative and consultation purposes. It is quite conceivable that if tangible progress be achieved in this matter, other countries may be brought to participate on a bilateral or multilateral basis.

27. I have spoken at length on the possibilities of collaboration between the Soviet Union and India on different problems, because I wish that such collaboration might be started right now though on an experimental basis and on a small scale. But I have spoken also of the multilateral basis, which

might be useful not only for tackling the problem of industrialization of the underdeveloped countries but also for the development of international trade. The greater the number of countries which participate in such investigations, the more effective this investigation. Hence it is necessary to direct all efforts to the implementation of such investigation in a spirit of broad international collaboration. This would be greatly helped by permanent committees and international symposia on the study of problems of this kind.

28. We consider that it would be expedient at present to hold an international Economic Conference for the study of economic development of the underdeveloped countries. Such a conference, in my opinion, may be held primarily at a technical and non-governmental level though with the sanction of respective governments. It is quite clear that a great amount of preparatory work would be required to make this conference really effective.

THE NEED OF SCIENTIFIC AND TECHNICAL MAN-POWER FOR ECONOMIC DEVELOPMENT

This article is based on a talk broadcast from the All-India Radio on 23 September 1959.

1. Four years ago the All-India Radio gave me an opportunity of speaking on problems of National Planning. I am glad, again, to have an opportunity of saying a few words regarding one important, perhaps the *most* important, aspect of economic development namely, the need of expanding our scientific and technical man-power.

2. The object of economic development is the improvement of the level of living of forty crores of our countrymen. This means having a bigger and bigger supply of food, clothes, housing, and such other things, and greater facilities for medical care, education, and cultural amenities. That is, having more and more of what economists call consumer goods and services. Our aim then must be to increase continually the production of consumer goods.

3. How can this be done ? To some extent by using traditional methods of production such as weaving and handicrafts and by employing idle hands to the fullest possible extent. This would give employment to millions of our countrymen who are sitting idle for the whole or a good part of the day for lack of gainful work. But this can go only a part of the way.

4. To increase production in a really big way we must use machinery. For more than a hundred years we have been manufacturing cloth in textile factories. Where did we get the machinery for this purpose ? We have been mostly importing them from abroad. Why ? Because we did not have factories to produce machinery. This brings us to the heart of the problem.

5. Machinery is made of steel, metals and raw materials. The cost of such raw materials is small, and often only ten or fifteen per cent of the price we pay to purchase the machinery from abroad. If we use our own steel and materials and make the machinery ourselves, we can have very much more than what we can purchase from abroad. Obviously, then we must set up factories to manufacture heavy machinery and heavy electrical and other equipments.

6. Until the beginning of the Second Five Year Plan in 1956 we had not given enough attention to this aspect of our problem. Fortunately, it is now being appreciated that we must ourselves manufacture as much machinery as possible.

7. We shall require steel for this purpose. But we have large reserves of high quality iron ore in India, and we can make more and more steel, and use this steel to make more machinery and produce more electricity to drive the machinery. That is, we must produce more and more of what we called "capital goods". This is the second level.

8. However, it is only with the help of engineers, technologists, technicians and skilled workers that raw materials can be converted into machinery and electricity and power; and can then be used for the production of consumer goods. We must then have a larger and larger supply of engineers and technical personnel in future, This then is the third level.

9. We have to go a little deeper. Natural resources are not identical everywhere. There are wide variations from one country to another. It is essential that we should make the best use of what we have in our own country. We can find out how this can be done only through scientific and technological research. We must continually expand research of this type, which is called applied research, in which use is made of basic scientific knowledge to solve practical problems.

10. We cannot stop even here. We have to go one step further. Applied research can use only whatever basic scientific knowledge happens to be available. But we can increase such knowledge through, what is called, fundamental or basic research. The more we do this, the greater will be the possibilities of applied research. The most dramatic example is atomic energy. The possibility of utilising the energy of the atom had first emerged from abstract theoretical developments of physics. It has now thrown open a new vista of technological progress for humanity. We must continually expand both applied and basic research. This is the fourth level.

11. We thus have to think of four levels. First, to increase the supply of consumer goods which, so to say, is at the top or the first level. To do this, we must expand the production of capital goods; this is the second level. Both of these will require a larger and larger supply of engineers, technologists, and technical personnel; this is the third level. Engineering and technological developments would call for an increasing volume of applied research. But applied research requires a sound foundation of basic research. We must have an increasing supply of research scientists of ability. Unfortunately, their number is small in every country. We must try to make the best use of *all* whom we can discover. This is the fourth level.

12. Now consider the factor of time. We can set up factories for consumer goods very quickly; in a year or two, if we use imported machinery.

To develop the production of capital goods would take more time, from five to ten years, at least. To secure an adequate supply of engineering and technical personnel would require still more time. And, finally, we must have enough scientists of ability for both applied and basic research which would take at least a generation. This is the *four*-fold logic of economic development.

13. How to attract and hold a sufficient number of able person in science and technology is then the crucial problem of national development. This can be done only through a proper social appreciation of science and scientists, which is the fifth and deepest level of the problem.

14. I have been speaking so far at a somewhat abstract level. Let us consider the historical evidence. The level of living in Europe was probably about the same as in India two or three hundred years ago. There is some evidence to suggest that, for the vast masses of our countrymen, the level of living has not changed very much since the time of Akbar.

15. There has been, however, a revolutionary progress in Europe and America. This was possible only through the use of machinery driven by steam or electricity instead of by human or animal labour, that is, through the progress of science and technology. The British had first developed the modern way of making steel. Germany started later but, through research, developed more efficient methods. America, through more research, increased the efficiency. More recently, Russia has gone further ahead with the help of still more research.

16. It will be instructive to make some comparisons between the two giants, USA and USSR. American has attained the highest level of living and has the largest supply of consumer goods in the whole world. Russia is still very much behind, especially in luxuries like butter, chocolates, nylon and such other things.

17. In capital goods, on the other hand, the gap is smaller. Russia is already producing roughly half the steel which America can produce. In heavy machine building, for example, to manufacture machinery to erect new factories for steel, USSR has probably gone ahead and can expand the production of steel faster than USA. It is only a question of time before Russia can catch up with America.

18. Next consider the third level of engineers and technical personnel. Here USSR has gone indisputably ahead of USA. In 1957 America had approximately six and a half lakhs of engineers while Russia had nearly eight

lakhs[1]. In the same year, 71,000 engineers had graduated in Russia against about 40,000 in America[2]. Russia already has a larger number of engineers, in absolute numbers as well as on a population basis, and yet Russia is increasing the number at a fast rate. In fact, Russia is training, every year, more engineers than all the other countries of the world, including USA, taken together.

19. We can also learn much from the Americans who have quickly noted the Russian developments in science and technology; and are making better arrangements for the teaching of science, providing more funds for scientific research, and improving the conditions of work for scientists. Similar changes are also occurring in the United Kingdom and other European countries.

20. All this, I think, has an important lesson for us. We have a very low level of living. It is not possible to improve it rapidly by increasing the production of consumer goods with the help of imported machinery. We did try to do this for sixty or seventy years or more and failed. We must first increase, very rapidly, the production of steel, electricity, heavy machinery, and other basic industries. The only way to do this is to increase the supply of scientific and technical man-power. This must be given the highest priority. This is the only secret of the spectacular progress of Europe and America, and now of Russia.

21. Europe and America, and now Russia, have become great by their acceptance of science. Social appreciation has given confidence and encouragement to the scientists. In Russia research scientists have the highest pay and enjoy great social prestige. The President of the Soviet Academy of Sciences gets the highest salary in the whole country, higher than that of the Soviet Prime Minister or the President of the USSR. This, of course, is only a gesture but it has a deep social significance.

22. This brings me to the fifth level. In India also we used to have a great tradition of respect for the Brahmin, pre-eminently as a teacher. The old tradition has lost its values and must go. And it is necessary to build up a new tradition of social appreciation of science and scientists.

23. We have made some progress since independence. The number of educational institutions has doubled. The number passing the Matriculation

[1] Number of engineers in 1957 in USA, 6,37,000 and in USSR, 7,93,000.

[2] In India the estimated number of engineers in 1955 was 72,000 out of which 31,000 were university graduates and 41,000 diploma holders.

examination[1] increased four times in eight years between 1947-48 and 1955-56. Enrolment of students, at the intermediate and university levels[2], nearly doubled in six years between 1950-51 and 1956-57. Enrolment of engineering students, at the degree and diploma levels, rose from about 15,000 in 1955-56 to 31,000 in 1958-59 or had doubled in three years. Over 16,000 persons were awarded the master's or equivalent degree in science, after independence, out of a total outturn of 32,000. That is, we produced more scientists after independence than during the whole previous period. Expenditure on scientific research has increased, perhaps, seven or eight times.

24. The advance in education after independence has been greater in many ways than total achievements during the whole of the British period. This is encouraging but not enough. Some of the improvements are still on the surface. Educated persons are not being fully utilized. The educational base still remains narrow and there are great disparities in opportunities The quality and depth of education and scientific research have not been improving satisfactorily.

25. There is urgent need of a deeper understanding of the scientific revolution which has opened new paths for human civilization. The content of science changes every day. The spirit of enquiry and the search for truth give it its enduring values.

26. Scientists cannot possibly take the place of political leaders or administrators. It is not desirable that they should do this. What is necessary is that scientists should have the initiative and freedom of action in matters which have concern with science and technology.

27. The scientific revolution has no conflict with art, literature, music and such other things in which values do not change with time. Knowledge as such, either of classical languages or of science, is not culture. The scientist also must acquire wisdom and appreciation of human values.

28. India is fortunate in having a Prime Minister who has a full appreciation of human values and who takes a keen personal interest in science and technology. But, what he or Government can do ultimately depends on public opinion. The most basic need is for the general public to appreciate the role of science in the modern world. This is the deepest issue before us.

---

[1] Actual numbers were : 1,16,680 (1947-48) ; 1,61,955 (1948-49) ; and 4,29,494 (1955-56).

[2] In 1950-51 about 3,99,500 and in 1956-57 about 7,68,000.

UNEMPLOYMENT

Address delivered as Chairman of the sectional meeting of the Second All-India Labour Economics Conference at Agra on 1 January 1959. Published in the *Indian Journal of Labour Economics*, Vol. 2, No. 1 (April 1959), pp. 39-45.

1. I feel honoured in having been asked to preside over this Section. I am aware that I am not competent to do this as I am not an economist. However, as the invitation came personally from Shri V. V. Giri, I felt I must accept it.

2. I must also offer my apologies for not having been able to prepare a written speech, owing partly to my absence out of India and partly to heavy pressure of other work. I shall have almost to think aloud for which I hope you will kindly forgive me.

3. I should like to say something about the concept, definition and measurement of unemployment and underemployment. It will be appropriate if I also make some observations on problems of unemployment in relation to national planning with which I have been associated for some time. I was a teacher of physics for one-third of a century, and my approach would be necessarily somewhat physical; and I shall not try to deal with economic theory as I am lacking in knowledge.

4. The attainment of full employment, that is, the fullest utilization of human resources for productive purposes, is a characteristic sign of highly industrialised economies. Unemployment in such countries can occur only when there is a slack in economic activity; that is, only when there is a falling off from full employment. The remedy lies in taking steps to restore economic activity to the fullest extent.

5. An essential characteristic of an underdeveloped country like India is the existence of idle labour which never gets the opportunity of becoming fully productive. That is, a very large number of people can never secure enough gainful employment. In India, we, of course, have some unemployment of the type which occurs in the advanced countries. This occurs mostly in urban areas where many people have jobs on daily or monthly wages or salary, and can lose them or seek jobs of the same type.

6. But we also have a vast number of persons who work in their own household enterprises or on their own account. They may not have enough gainful work and may be sitting idle for a good part of their time. However, as they do not have any jobs, they cannot lose jobs, and cannot therefore be

unemployed in the sense of the industrialised countries. Also, the productivity or output per person is often low so that the work which would be done by one person in advanced countries would sometimes be done by two or three persons or even more in a country like India.

7. I should now like to make some observations regarding the measurement of unemployment and underemployment. As regards unemployment it is possible to use basically the same approach as in the industrially advanced countries. Those who have jobs carrying daily or monthly wages or salaries are, of course, employed; and those who had jobs of this type but lost them or are seeking such jobs are unemployed. It is neither possible nor desirable to copy the definitions used in the advanced countries but necessary adaptations to suit Indian conditions can be made without much difficulty.

8. There are however real difficulties in dealing with those who are engaged in household enterprises or work on their own account and do not have jobs and cannot lose them. They can be never unemployed. But they may not have enough work. Here we may have to adopt other approaches. One can use a concept of a hypothetical or normal "full working-time", and enquire whether a person is active for the full normal working time or for only a fraction of it. There would be, however, some arbitrariness or a subjective element in defining the normal full working time. There are also difficulties in interpreting observed facts. For example, a carpenter who has not enough work on hand may prefer to distribute it, at a slower pace, over his normal full working time. This approach would no doubt supply useful information but comparisons between different types of employment may be somewhat ambiguous.

9. Another possibility is to think in terms of a hypothetical normal output per unit of time (hour, day, week, month etc.), and ascertain whether a person is turning out the full or only a part of the normal output. There is again a subjective element in defining the normal output. There are also great difficulties, even in principle, in defining normal output where the product is not homogeneous but consists of many different kinds or output.

10. Thirdly, there is the approach of thinking in terms of "normal earnings" and enquiring whether a person was earning the full amount or only a fraction of it. The subjective element is still there, but comparisons between different types of work would be possible and meaningful. Information on 'normal working time' or 'normal output' can be of great help in defining 'normal earning'; and ultimately one may have to fall back on the earning approach.

11. I have briefly referred to some of the technical problems and the need of both analytic thinking and experimentation. Collection of data on the basis of different approaches and a careful analysis of the observations would be of great value in formulating adequate concepts and tools for the measurement of unemployment. This deserves urgent and serious attention from economists.

12. I may now refer to the use of sampling methods in this field. Information on employment and underemployment was collected for the first time on an all-India basis in the 9th round of the National Sample Survey, May to August 1955. The results were given in the form of percentages which however can be converted into number of persons by using the usual estimate of 382·4 million as the total all-India population consisting of 316·1 in rural and 66·3 in urban areas[1]. The proportion of the population in the labour force was 44·2 per cent in rural and 34·5 in urban areas or 42·5 per cent for India as a whole. The total labour force thus consisted of 162·6 million persons of whom 139·7 million persons were in rural areas and 22·9 million persons in urban areas. The incidence of unemployment in the total population was 0·29 per cent in rural and 1·99 per cent in urban, was 0·59 per cent in India as a whole. Converted into numbers, this means 0·92 million (9·2 lakhs) persons were unemployed in rural areas and 1·32 million (13·2 lakhs) in urban areas or 2·24 million for India as a whole. Within the labour force itself, the volume of unemployment was about 0·66 per cent in rural and 6·1 per cent in urban areas showing that the incidence of unemployment was proportionately almost ten times greater in the urban areas.

13. I should like to stress once more that in India the number of persons having or seeking employment in the sense of the highly industrialised countries is extremely small. Using the results of the 9th Round of the National Sample Survey, it can be estimated that less than 13 million had jobs of this type of public or large scale private enterprises and offices. Private small scale activities are mostly on a household basis. The total number of persons engaged as hired labour in these small scale enterprises (excluding agriculture, livestock, fishery etc.) was about 5 million so that only about 18 million persons may be considered to have jobs, in the sense of the industrially advanced countries out of the total labour force of 160 million. Viewed in this way, a volume of unemployment of over 2 million is quite serious.

---

[1] Growth of population calculated on the inter-census rate based on 1941 and 1951 censuses. Recent surveys (National Sample Survey 14th Round) indicate that the actual rate of growth is probably much higher than the inter-census rate ; and the population in 1955 may be appreciably greater than 382.4 million.

14. Some experimental studies have been made on the measurement of underemployment which supplied information of considerable interest. I shall give some concrete examples. In the 9th Round of the National Sample Survey (May to August 1955) information was collected about hours of work done per week per person. It was found that the number of persons working less than 8 hours per week was nearly 21 million; they may perhaps be considered to be practically unemployed. The number of persons working less than 29 hours per week or less than 4 hours per day was as large as nearly 45 million.

15. Information was also collected on how many days a person was engaged in gainful work during 30 days preceeding the day of interview. The number of persons working less than 10 days out of 30 days or less than one-third of the month was 39 million which is broadly consistent with the figure 45 million given above in terms of hours of work per week.

16. In an earlier enquiry, in the National Sample Survey, 7th Round (October 1953–March 1954) it was found that about 47 million persons were working on a part-time basis. The same enquiry brought out that among these 47 million persons, 10 million were working part-time; partly on account of ill health of the worker or because of illness in his household and similar causes. About 23 million persons however were working part of the time for reasons of economic nature such as lack of demand for their labour, lack of tools and raw materials, slack season etc.; and 13 million persons gave other reasons. From the above discussion it is clear that at least 23 million persons may be considered to be severely unemployed. The figure would be higher if a somewhat less stringent definition is accepted.

17. In India we thus have an appreciable volume of unemployment (in the sense of the industrialised countries) occurring mostly in urban areas, and also a great deal of underemployment in both rural and urban areas. A radical solution of the problem can be found only through a continuing increase in the economic activity which would create increasing opportunities for productive employment. Economic development consists essentially of an increasing utilisation of the idle man-power for productive purposes. Economic development and an increasing volume of employment are but two aspects of the same social process.

18. The National Income is often used as an index of economic activity. Increase in national income is possible only through more fruitful utilisation of idle labour and unexploited material resources. A steadily rising national

income is thus also another aspect of a steadily increasing volume of employment.

19. In September 1954 the Planning Commission considered the aims and targets of the Second Five Year Plan. After a very full discussion it was decided that an important aim must be to get rid of the fear of unemployment, if possible, in ten years together with a continuing improvement in the level of living, and a gradual reduction of great disparities in income and wealth.

20. I had participated in this discussion; and I thought this was a meaningful formulation of the aim of planning for national development in India. Employment, unemployment, and underemployment should be capable of measurement so that it would be possible to observe whether the Indian economy was gradually approaching full employment. It should be also possible to estimate the national income and ascertain what was the realized increase in income and the realized improvement in the level of living. In this way, the progress of the plan can be assessed in an objective manner.

21. Let me state the problem again : to try to get rid of the fear of unemployment in ten years—this is the crucial issue in India. But this must be achieved with a continuing increase in the level of living. It will not do simply to emphasize the employment aspect alone. Obviously a very large volume of employment can be created simply by destroying all or most of the tools and implements of production. We would then go back immediately to the strone age, and every one would be fully occupied in producing the barest necessities of life. But this would not bring economic prosperity; in fact the level of living would be extremely low. Clearly, this is not the solution we seek.

22. The only way to solve the problem of unemployment and underemployment is to create more opportunities for productive work. This requires the use of tools and machinery. The present production may be increased to some extent by working harder and using the present stock of tools and implements to better effect. But there is a limit to this. The only permanent way of increasing the volume of productive employment is to supply tools and machinery for idle hands, that is, to increase the capital investment. Here also a distinction should be made between investment of two types, namely, one for the manufacture of goods for direct consumption and the other for the manufacture of steel, cement, electricity, and heavy machinery which would produce more machinery, more steel, and more electricity etc. which we may call the basic industries.

23. This must then be broad strategy of planning in India. We have to produce more and more machinery and tools and energy per person so as to increase the productivity of each individual worker, and also to supply more and more people with machinery, tools and power. In India, with our abundant supply of iron ore we should obviously install new steel plants every year. Instead of importing machinery to install these new plants it would be obviously desirable to make such machinery within the country. We must therefore have factories for the production of heavy machinery and heavy electrical equipment. Once we succeed in establishing these basic heavy industries it would be possible to produce more and more essential capital goods out of our domestic resources; and using such capital goods, to increase modern industrial investment at a rapid rate. A rapid industrialization of the country is thus the only radical cure of unemployment.

24. We must be clear therefore that no radical cure of unemployment and underemployment would be possible without a rapid growth of modern industries. We must produce an increasing quantity of steel every year. We must produce increasing quantities of heavy machinery and electrical equipment. More and more goods would be then produced by increasing utilization of our domestic resources. To do this we must of course steadily and rapidly increase our domestic savings.

25. In the Second Five Year Plan it was also recognized that any increase in investment would increase the demand for wage or consumer goods. As our capital resources are meagre to start with, it is desirable to utilize such resources as much as possible for a rapid development of the basic industries (heavy machinery, steel and metals, energy etc.). To meet the increasing demand for consumer goods, it would be, therefore, necessary and desirable to expand the production of small-scale and cottage industries which would also create a large volume of gainful employment. Both investment and consumption can and must be increased at the same time by utilizing idle man-power and idle material resources.

26. I have explained the basic logic or strategy of the Second Five Year Plan. Unfortunately, owing to various reasons, this policy could not be fully implemented; and the rate of development has not been adequate to reduce the volume of unemployment and underemployment. We have not been even able to offer employment to more than two million persons, who coming of age, enter the labour force every year and seek work. The only conclusion must be that we must have a much bigger plan next time and still bigger plans in future years. In the Second Five Year Plan it was visualized that the

investment in the Third Five Year Plan should rise to Rs. 9,900 crores. We must accept Rs. 10,000 crores in round figures as the size of the Third Five Year Plan. Nothing less would get us out of the fear of unemployment.

27. There was much criticism that such an approach was lacking in balance; and some people asked "How do you know that there is no better solution ?" I answered, "Certainly there may be a better way. Please show us a better approach and we would accept it." But in all these years no one has come out with a better solution.

NEXT STEPS IN PLANNING

Anniversary address delivered as the President of the National Institute of Sciences of India on 20 January, 1959 at New Delhi. Published in *Sankhyā*, Vol. 22, Parts 1 & 2 (1960), pp. 143–172.

Introduction

1.1. India adopted planning for economic development with the initiation of the First Five Year Plan in 1951. At this stage, the plan was essentially a list of projects without any clear unity of purpose. A sense of strategy began to develop and certain broad aims were formulated in advance in 1954 for the preparation of a draft frame for the Second Five Year Plan. It was agreed that attempts must be made to get India out of the fear of unemployment in ten years or as soon as possible; to lay sound foundations for a continuing improvement in the level of living, that is, of the national income; and also to bring about greater equality of opportunities.

1.2. In 1955 India accepted socialism as the goal of economic policy. The Second Five Year Plan took a long term view to economic development over a period of 10 or 15 years or more, and adopted a basic strategy for this purpose which involved a crucial change in the outlook. Three years have nearly passed after the initiation of the Second Plan in April 1956. There have been many gains and some set-backs; and much experience has been gathered. We must now prepare our mind for the Third Five Year Plan which will have to be started in about two years. It is, therefore, appropriate that we should now consider the next steps in planning.

Review of Industrial Developments

2.1. Before doing this it will be useful to consider previous developments in India in the context of the history of industrialization of the more advanced countries of the world. The industrial revolution started about two hundred years ago in the United Kingdom, the U.S.A. and countries of Western Europe where science and technology were highly developed. At first there was expansion of the manufacture of textiles and other consumer goods. The use of steel for industrial purposes started less than a hundred years ago. The world production[1] of steel was less than one million metric tons in 1870, and reached 4·4m. tons in 1880 and 28m. tons in 1900. In 1870, U.K. and Germany were producing about 200,000 tons per year and U.S.A. and Russia

[1] Data on production of steel are given in Table (3) in the Appendix.

had just started. By 1880 U.K. and U.S.A. reached 1·3m. tons and Germany reached this level in 1885, and France in 1895. These countries were already industrialized and had a high level of living indicated by an income of from 400 to 600 U.S. dollars per person per year (at current dollars for 1955 and 1956) at the time they reached the level of production of one million tons of steel per year. Health and education also were fairly well developed with the number of physicians ranging between 3·6 and 16·3 per ten thousand of people, and with a proportion of school children between 12 and 19 per cent of the population. Developments were fairly rapid from this time and U.S.A reached 4·3m. tons in 1890, Germany 4m. tons in 1895, U.K. 5m. tons in 1900 and France 4·7m. tons in 1913. During this period there was some further expansion of health, education and research which was broadly in accordance with the previous trend[1]. An output of 4 or 5 million tons of steel per year usually makes a turning point in industrial progress. At this level it becomes possible to establish comprehensive manufacturing complexes of steel, heavy machine building and heavy electrical industries, and chemical engineering.

2.2. Japan had started producing steel just before the First World War and reached one million tons in 1923 when Japan's per capita national income was still quite low and only 125 U.S. dollars. Health and education in Japan were, however, as highly developed as in the advanced countries of Europe and America. Japan reached 4·9m. tons in 1935, that is, in 12 years. It is important to note that modernization in Japan had started about 90 years ago with the Meiji Restoration with deliberate emphasis on health, education, scientific research and industrialization. Japan, for example, had made primary education free and compulsory before U.K.

2.3. Russia had reached the production of about one million tons of steel as early as 1895 but was quite backward in education and health with 1·6 physicians per ten thousand of population and with only 3 per cent of the population in primary schools. Owing to war, revolution and civil war, production in U.S.S.R. had decreased to 0·6m. tons in 1923, but recovered to 4·9m. tons in 1929, by which time education and health had also developed in a remarkable manner approaching conditions prevailing in the more advanced countries at corresponding epochs. China started very recently with 0·6m. tons of steel in 1950 and rapidly reached 5m. tons in 1956 and 10m. tons in 1958.

[1] Information on certain characteristics of development is given for selected countries in Table (1) in the Appendix.

2.4. Until recently industrial developments in India were taking place rather slowly and in a somewhat imitative way of the earlier history of industrial growth in Europe and America in which we can distinguish four layers or phases. On the top or the surface comes consumer goods which can be established fairly quickly with the help of imported machinery. The second layer is the production of electricity, steel and other metals; this is highly capital intensive and requires large imports of machinery and also an appreciable amount of time. Next is the manufacture of heavy machines, heavy electrical apparatus and chemical engineering (for the production of industrial raw materials). This usually requires a much longer time but, once established, would enable a large part of the capital and producer goods being manufactured out of domestic resources. Even more basic is the expansion of health, education, science, and of scientific and technical man-power which takes practically a generation to mature.

2.5. Following the above pattern only upto the first phase of consumer goods, India had become the second biggest producer of textile in the world and had also developed the manufacture of other consumer goods without however establishing the basic industries like metals, heavy machine building and heavy electricals. In fact, in India the production of steel had remained basically at a little above the level of one million tons after nearly half a century of the beginning of the industry, although the country has very large resources of iron ore of the best quality. The economy was developing only very slowly on the basis of immediate demands and supplies without any long range view. Also, there was comparatively little development of health, education, and science in relation to the size of the country and its population.

Gains in the Second Five Year Plan

3.1. There were important gains in the Second Five Year Plan which marked a radical break with the old way of thinking. It was realised that unemployment and poverty can be cured only through rapid industrialization. It was not enough to expand the production of textiles and consumer goods. It was necessary to increase the supply of energy and of machinery and tools of production to create more employment. It was realised that the only to do this in a big country like India was to establish, as rapidly as possible, the basic steel, heavy machine building, and heavy electrical industries and chemical engineering. This would make it possible to produce capital and producer goods of all kinds and thus expand industrial investments increasingly out of domestic resources. This is the only way to secure increasing supplies of machinery and energy, with which we can create more employment and also can give the workers more machinery so that the total production in the country can rise rapidly.

3.2. In India the highest priority must be given to the establishment and expansion of the basic industries. Large investments in the basic industries would, of course, give rise to an increasing demand for food, cloth and other consumer goods. In India it is possible and desirable to meet this demand by setting idle hands to work in the traditional way or in small scale industries to produce consumer goods and other necessities as much as possible. This would also create much employment all over the country.

3.3. It was appreciated that, in India, the production of an agricultural surplus is the key to industrialization. It is not only essential to grow enough food and fibres for our own requirements but it is also necessary to produce a surplus in the form of either industrial or food crops. In India agriculture and manufacturing industries are completely interlocked. Economic progress depends on the advance of both. Advance of one step in agriculture would supply food and raw materials for advance of one step in manufacturing industries which again, in its turn, would speed up irrigation and increase the supply of fertilizers and pesticides and help in the promotion of scientific research, which would lead to further advances in agriculture. The importance of the scattered or diffused phase of production, both in agriculture and in traditional and small scale industries, was broadly appreciated. It is also being increasingly realised that land reform and the organization of village co-operatives are urgent and essential needs for increasing agricultural production.

3.4. The Second Five Year Plan accepted the above strategy of economic development in a general way. It was decided to expand steel production to about 5 million tons; to give high priority to atomic energy; to establish a heavy machine building industry and the manufacture of heavy electricals; and also to develop prospecting for oil exploration and to establish oil refineries of our own. India would be now able to start developing large manufacturing complexes.

3.5. There were, however, gaps and set-backs also. An acute shortage of foreign currency occurred in the very first year of the Second Plan, which in my opinion was not inescapable but was largely due to lack of adequate tools and instruments of planning and also partly to lack of proper appreciation of the strategy of the Second Plan. The shortage of foreign currency created great difficulties. I discussed this question in my Anniversary Address last year. The remedy is in our own hands because in India we can manufacture capital and producer goods increasingly out of our own domestic resources, once the basic industries are established and developed. Therefore the only radical cure of the shortage of foreign currency would be by building up the basic industries as rapidly as possible.

3.6. Foreign aid, especially in the form of long term loans for capital goods and technical personnel, would be of critical importance at the stage of what P. M. S. Blackett has called "assisted take off" in industrialization. Indefinite reliance on foreign loans is neither possible nor desirable. A continuing stream of short-term financial loans from abroad would not be of much help in the long run and may make the position worse. The chief source of capital formation must be domestic savings. Fortunately, the need of raising more resources is admitted and gradually action is being taken in this regard. One notable advance was the acceptance of the principle of an expenditure tax together with a tax on wealth.

3.7. In the highly developed countries of the West, taxes on commodities are usually looked upon as "regressive" as being a burden on the poor. Public enterprises are also expected to be run on a no-loss-no-profit basis. Fortunately our outlook is changing and it is being realised that in an underdeveloped country like India excise and customs duties, purchase tax on commodities or a levy on services would be convenient and adaptable methods to raise resources. It is also agreed in principle that public enterprises should earn and contribute increasing returns for purposes of national development.

3.8. It is encouraging that the question of scientific and technical man-power is receiving increasing attention. The subject is being studied at a technical level in the Division of Perspective Planning in the Planning Commission. A Standing Committee of the Cabinet has been set up for man-power; and administrative units have been established in the Central Government and in the States.

Weaknesses in Planning

4.1. The Second Plan, no doubt, has been a great step in advance. It has set productive forces in motion which cannot possibly be reversed without disaster. There are, however, serious gaps and weaknesses.

4.2. Review of industrialization has shown that there is a close connexion between economic development and progress in health and education. (Some relevant data for both developed and underdeveloped countries have been given in Table 2 in the Appendix.) In West Europe and America there was simultaneous progress of industries and health, education and science. In Russia, before the first World War the production of steel had reached 5 million tons but there was little progress in health and education; and there was revolution. In U.S.S.R., China, and other socialized countries and also in Japan great emphasis was and is being given to progress in health, education and science *pari passu* with industrialization. India would soon reach the critical level of steel production of 5 million tons but is still backward in health, education and science.

4.3. Before considering these three points in some detail I shall refer to another disturbing aspect of the present situation, namely, the steady increase in unemployment.

Increase in Unemployment

5.1. We do not yet have in India any regular reporting of unemployment. Some indications are, however, available from trends in the number of applicants in the Labour Exchange Registers in India, for which some data are given in Tables (4) and (5) in the Appendix. It is disturbing to note that the total number of persons registering in these Exchanges had more than doubled in five years between January 1953 and December 1957. It is also worth noting that the Labour Exchanges can find employment for only a very few; and the average number of applicants for each notified vacancy increased steadily from 23·3 in 1953, year by year, to 33 in 1957. Also, as all notified vacancies were not filled by applicants recommended by the Labour Exchanges, the number of applicants, for each effective placement was nearly 40 in 1953 and had steadily increased to nearly 51 in 1957. That is, the Labour Exchanges can find employment for only two persons or less out of every *hundred* applicants, on an average. This is not a criticism of Labour Exchanges but simply an indication of the heavy back-log of unemployment.

5.2. This back-log differs in different occupational categories for which some information is given in Table (4). The ratio of applicants to effective placements increased in practically all categories except in "others". The greatest relative increase occurred among those seeking "educational", "clerical" and "unskilled" jobs. In 1957 there was only one effective placement for 36 applicants seeking educational posts; and one for 75 seeking clerical or unskilled jobs. It is clear that the size of the Second Plan was not big enough to absorb the fresh seekers of employment who joined the labour force through the growth of population. A much bigger plan is essential to get rid of the fear of unemployment.

5.3. In my Anniversary Address last year I gave some information on unemployment and underemployment obtained through the National Sample Survey. I explained the difficulties of measuring underemployment and stated that there was scarcely any doubt that 10 to 12 million persons in India were unemployed or severely underemployed and that this figure might rise to even 25 or 30 million if consideration is extended to those who were sitting idle for more than half of their normal working time. I had drawn attention to the fact that about 10 per cent of educated persons (matriculates and above) were probably unemployed, and that their number was likely to rise. The evidence from Labour Exchanges would seem broadly to corroborate this.

5.4. It is clear that the Second Five Year Plan has not succeeded in absorbing, in sufficiently large numbers, the new seekers of employment. It is also likely that unemployment is continuing to increase among educated persons especially in urban areas. This is a disturbing sign. The only conclusion to be drawn is that the Third Five Year Plan must be much bigger in size than the Second Five Year Plan. It would be remembered that in the Second Five Year Plan it was visualized that net investments should reach Rs. 9900 crores in the Third Plan. Let us round off the figure, and adopt Rs. 10,000 crores as the target for investment in the Third Five Year Plan.

Health

6.1. Health, education and research have indeed, a dual role. These are no doubt significant constituents of the level of living and, in this sense, are fruits of national development. On the other hand, advance of health, education and research are of basic importance in bringing about industrial and social progress. I shall first consider health.

6.2. In India at present there are about 70,000 physicians of whom a little less than a half are trained at the University level and about 37,000 are licentiates with four-year training in junior medical schools. The distributions of doctors by level and qualification and state of residence in 1954 is given in Table (6). The number of doctors in India as a whole is about 176 per million of population or one physician for about 5700 persons on an average. The number however varies widely from one state to another, from over 600 per million (one doctor for 1700 persons) in West Bengal and Delhi to 40 per million (or one for 25,000) in Rajasthan and Manipur. What is, however, much more serious is that most of the doctors reside in urban areas; and the total number of doctors residing in rural areas (with a population of about 330 million) may be below 10,000 that is, only one doctor for 30,000 persons or more on an average. In some rural areas it is known that there is only one qualified doctor for 50,000 or 100,000 persons.

6.3. An important committee on health and medical care (popularly known as the Bhore Committee from the name of its Chairman) stated in the forward to its report submitted in 1946 that *"no individual should fail to secure adequate medical care because of inability to pay for it"*. This Committee had prepared a long-term programme most of which still remains unimplemented.

6.4. There is no difference of opinion regarding the desirability of providing medical care to all who need it. In India, unfortunately, in some respects we are still at the stage of a somewhat superficial imitation of the most advanced countries of Europe and America. Junior medical schools were abolished after independence on the view that our countrymen cannot be allowed to have anything less than the best. And yet to provide a sufficient number of university trained doctors and adequate hospital and medical services upto the standard of the rich countries of the world is absolutely impossible at present.

6.5. Doctors and drugs are both extremely scarce in India. Doctor's fees and the price of drugs are also high which keep these beyond the reach of most people. The extreme inequality in the distribution of expenditure on medicine and medical services can be appreciated from the relative share of expenditure on these items, shown below (and also from the Chart in the Appendix) for the bottom ten per cent, the lower half, and the top ten per cent of all households.

6.6. The following table gives some similar figures for urban areas in U.S.A. in 1950. Looking at the first line of the table it is seen that the bottom ten per cent of American households share five per cent of the total expenditure on medical services incurred by all households; the corresponding share of the bottom ten per cent of rural households in India is negligibly small and only about 0·1 per cent. From the seocond line it is noticed that the lower half of American households share 37 per cent of the total expenditure while the Indian households share only 6 per cent of the total. We may also look at the top. Ten per cent of the households at the top in America take a share of 19 per cent of the total while the corresponding Indian households at the top have 64 per cent or nearly two-thirds of the total expenditure on medical services. The position is almost as bad in the case of medicine. In India the lower half of rural households share only 8 per cent of the total expenditure on drugs[1], the corresponding figure for urban households being 9 per cent.

[1] Similar figures for the distribution of consumer expenditure on other items like food-grains, all food items, cloth sugar, education, and medical services are given in Tables (12), (13) and (14) in the Appendix.

per cent of households		cumulative percentage of expenditure on			
		medical services		medicine	
		USA[1] 1950	India[3] 1955	India[2] 1952	India[3] 1955
(1)		(2)	(3)	(4)	(5)
		per cent share of expenditure*			
bottom	10 per cent	5	0.1	1	1
(lower half)	50 ,,	37	6	9	8
top	10 ,,	19	64	45	56

[1] USA 1950: Studies on Consumer Expenditure, 1950, Vol. VIII (University of Pennsylvania).

[2] India 1952: National Sample Survey: 4th Round; April-September 1952: All-India (Urban).

[3] India 1955: National Sample Survey: 9th Round May-November 1955: All-India (Rural).

* *Note:* The classification is by size of income of households for the USA 1950 data; by size of expenditure of households for the India 1952 data; and by size of expenditure of persons for the India 1955 data. The American and Indian results are therefore not comparable in a completely rigorous way but the broad picture is clear. The expenditure on both medicine and medical services are far more concentrated in India showing that it is only the very few rich who can afford to pay for medicine and medical services. The two series for India, 1955 have been, however, classified in the same way; and show that the distribution of expenditure on medical services is relatively more concentrated, that is, medical services are even more scarce than medicine in rural areas of India.

6.7. It may be pointed out, at this stage, that in countries with free and universal health services like U.K. and U.S.S.R. every person, in principle, receives essential medical services and medicine. In both countries, as private medical practice is permitted and drugs can be purchased in the market, some medical expenditure may be incurred by the rich on their own, but there is no discrimination between the rich and poor so far as the national health services are concerned. In all other advanced countries medical care is available to the poor either free of charge or at a very small cost.

6.8. I should like to make a few suggestions for consideration for the Third Five Year Plan. Firstly, I think it would be wise to reintroduce training extending over, say, 3 years for a junior type of doctor or auxiliary health worker who would be prepared to serve in villages for a modest allowance of say something like Rs. 1,000 per year with permission for private practice within certain limits. The training cost would be possibly one-fourth or one-fifth of that of a fully qualified doctor. The pay or allowance would also be one-fifth or even less of the pay which would have to be given to a university level doctor. The cost of training and maintaining a junior doctor may be thus five times cheaper.

6.9. The organisation of medical teaching at a junior level would also be feasible on a much larger scale than at the university level. There are about 400 district hospitals which, with some additional facilities, can serve as training centres for junior doctors; and which, on an average, may be able to run out 25 trained persons each per year which would supply 10,000 junior doctors per year after the scheme is in full operation. This would make it possible to have, say, one junior doctor for a group of ten villages in roughly half a million villages in eight or ten years. One fully qualified doctor may be placed in charge of about five junior doctors; and should be able to give some attention to the more difficult cases.

6.10. The cost of providing hospital and other health services would also have to be brought down to a level which the country can afford. The cost of construction of buildings can and should be lowered very appreciably firstly by adopting standards and specifications which would be appropriate for a poor country like India; and, secondly, by improving the efficiency of public construction. It is also necessary to develop rapidly the manufacture of drugs and medical goods, and also to establish factories for the manufacture of machinery for this purpose. There is, of course, need of more systematic research for a fuller exploitation of our own natural resources for medical and health purposes.

6.11. Finally, it seems to me it would be very wise to initiate a truly national health service, even if this be in a skeletal form, during the Third Plan period. The emphasis in the first instance should be on establishing a large number of small village units which would provide essential medical and health service to the villages and also serve as family planning centres. This is the only way in which there would be any real chance of promoting birth-control effectively. This is a matter of great importance and urgency.

Education

7.1. India is backward in education generally. Some comparative information is given in Table (7) for selected countries. In most advanced countries there is practically no illiteracy; and in China also the position is improving rapidly. India is still far off from universal and compulsory primary education. In India the number of illiterates (including both males and females) was 83·5 per cent of the population according to the Census of 1951. The National Sample Survey indicated that there was only a slight reduction of illiteracy to 82·5 per cent of the population as a whole in 1955.

The number of students in primary school in India was about 60 per 1000 of population in 1956 against 87 in China in 1955, 144 in Japan in 1956, 125 in U.S.S.R. in 1957-58, and 154 in U.S.A. in 1955.

7.2. The position is quite different at the secondary level. India had 23 students per 1000 of population at the secondary level in 1956 which was three times higher than the corresponding figure 7·4 in China in 1955. Also, the Indian figure does not compare too badly with 38 in U.S.S.R. in 1957-58 or 48 in U.S.A. in 1955. The number of students in the university and equivalent levels in India is remarkably high with a rate of 1·8 per 1000 of population which can compare favourably with 0·5 in China, 1·6 in U.K., or 2·5 in West Germany and 3·5 in France.

7.3. This structural difference in education comes out even more clearly if we adopt the number of primary students as the base for comparison. For every thousand students in the primary stage, India had about 384 at the secondary level in 1956 which was much higher than the corresponding proportion of 84 in China, and also higher than the proportions in France (264), U.S.S.R. (300) and U.S.A. (312). The number of students in the university and equivalent levels per thousand students in the primary level is also very high in India and was about 30 against 5 or 6 in China, 15 in U.K., 26 in West Germany, 31 in France and 47 in Japan. Only U.S.A. and U.S.S.R. have higher proportions.

7.4. The above comparisons bring out several points. India is weakest at the primary level and is far behind China and all advanced countries of the world. India has a much stronger position at the secondary level on a population basis. If, however, the number of primary students is used as the base for comparison then India has proportionately larger numbers in the secondary schools than most advanced countries of the world including U.S.A. and U.S.S.R. At the university and equivalent levels, also, India has a higher proportion of students than U.K., and has a proportion of the same order as Germany or France on the basis broadly of both population and of the number of students at the primary level.

7.5. It is important to note that higher education in India has been expanding quite rapidly in recent years. Some relevant information is given in Table (9) which shows the enrolment of students by level of education, subjects, and sex in 1950-51 and 1956-57. It can be seen from this table that the total enrolment at higher levels (from intermediate to post-graduate and equivalent courses) was about 400,000 in 1951 and increased to about 780,000 in 1956-57, that is, the number had almost doubled in six years. It can be further noted that the largest increase had taken place at the intermediate level. On the whole, there was relatively greater expansion in arts, commerce and law compared to science and technology including medicine and veterinaries.

7.6. The outturn of qualified persons in India, at intermediate and higher levels, also showed a large increase and, more or less, kept pace with the increase in enrolment. Relevant data for the period 1951–1956 are given in Table (9) in the Appendix. There was, however, a good deal of wastage. On the whole, only about half the candidates who appeared at the examinations at the higher (university and equivalent) levels succeeded in passing these examinations. The proportion of successful candidates was the lowest at the intermediate stage (between 42 and 46 per cent). Relevant figures on number and percentage of successful candidates are given in Table (10). Large percentages of failure give rise to much frustration and to much waste of time, money and effort.

7.7. Some interesting information can be obtained by examining the number of students in higher courses in proportion to the number of matriculates for which relevant statistics are given in Table (11). It can be noticed from this table that for every 10,000 students who matriculated in 1952, about 6,750 had enrolled for courses at the intermediate level in 1952-53 out of whom about 4,400 succeeded in passing the appropriate examinations at this level in 1954. The enrolment at the degree level was 3,319 in 1954-55, and the number receiving degrees two years later in 1956 was 2,364. The enrolment in post-graduate courses in 1956-57 was 1,552. It may be noted that for every 10,000 candidates who had matriculated in 1952 only 2,920 or less than 30 per cent took up course in science and technical subjects at the intermediate level; and less than 12 per cent proceeded with courses in science, technology, agriculture, medicine, and veterinary at the degree stage. Finally, only 156 or less than two per cent took post-graduate courses in science and technology. The educational base is poor for a rapid expansion of scientific and technical personnel at higher levels.

7.8. Higher education in India developed to a great extent in a somewhat imitative way on the British pattern. Social and economic conditions are however entirely different in India. Academic ideals which are realisable in the U.K. sometimes necessarily degenerate into superficial imitation and window dressing. Indian colleges often have very large numbers of students who are not adequately prepared for higher education. University and college teachers are poorly paid and are often obliged to do a good deal of part-time outside work. Classes are very big, and library and laboratory facilities are often poor. It is not surprising that conditions of work in the universities are not entirely satisfactory.

7.9. In the advanced countries of the world there are usually good opportunities for productive employment for the students who come out of universities and other higher institutions. In India the position is entirely different. Only a very small proportion receive vocational or professional training. A very large number receive what is called general education which does not make them fit to undertake any particular productive work. As I have already mentioned, unemployment among educated persons in India is increasing. This is creating a great deal of frustration and discontent. The greatest weakness in India is the lack of an organic relation between the system of education and national needs for economic development.

7.10. A radical reform of the educational system is a most urgent next step in planning. It is necessary, to turn out an increasing number of suitably trained personnel to meet the increasing demands of an expanding economy. The first thing in education must therefore be to give appropriate vocational and professional training which would make graduates of higher educational institutions qualified to undertake productive work of one kind or another. This is not in any way incompatible with what is called general culture. In fact, the two can very well go together. Dr. Zakir Hussain in his Patel Memorial Lectures has recently given a most illuminating exposition of this theme.

Planning for Socialism

8.1. At this stage it is desirable to recall that in India socialism has been declared to be the goal of economic policy. It is quite proper not to try to give any rigid definition. And yet it is essential to have some clear understanding in this matter as a guide to action. In U.S.S.R., China and other countries in which socialism of one form or another has been already established, planning is considered to be an essential requirement for economic and social progress; and the aims and objectives of planning are settled in accordance with the principles of socialism in the accepted form. In other words planning in the socialized countries is an instrument of socialism. In India the position is different. Socialism has been accepted as the aim but not yet been established. It is, therefore, important to examine the relation between planning and socialism.

8.2. Many different ideas have been associated with the concept of socialism in different countries and at different times. I shall select three ideas which have special relevance to our problems. The first is rapid economic development through full utilization of the resources of the country. This was the object for which planning was established in India and should continue to receive full attention. The second idea I should like to mention is removing progressively large disparities in wealth, income, and power; and the third is fostering equality of opportunities of all kinds for all the people of India.

8.3. The distribution of wealth, income and privileges is extremely unequal in India. The number of persons who pay income-tax is of the order of five lakhs or half a million[1]. Multiplying by five, (which is the average number of persons per household) the total number of persons in families paying income-tax would be about 2·5 million out of a population of nearly 400 million or appreciably less than one percent. The class which has some money and influence in India is thus extremely small and possibly forms not more than one or two per cent of the whole population. Facilities for education being both scarce and expensive, higher education is probably almost a monopoly of this privileged class at the top. The inequality in the distribution of expenditure on education service can be seen from Table (14) in the Appendix and the accompanying Chart. The bottom 10 per cent of rural households in India have a share of less than one per cent of the total educational expenditure and the lower half (50 per cent) of households shared 11 per cent only; while the top 10 per cent have as much as 36 per cent. Many poor people do not get even the opportunity to learn how to read and write. Many who complete the primary stage cannot join secondary schools; many who complete the secondary stage are unable to go to institutions of higher education on account of poverty. The same process of selection, on the basis of the income of the parents, continues at all levels of higher education. Finally it is only the rich people who can send their children abroad for higher training and education.

8.4. Inequalities in medical care result in a larger number of deaths among the poor people. Inequalities in educational opportunities have a deeper and more pervasive effect. It is true that some extremely able students succeed in securing scholarships upto the highest level but their number is very small. By and large, it is the rich people who have the opportunity of giving their children the type of education required for posts of influence and responsibility in the country. By and large, those having

[1] The actual number depends on the level of income at which income-tax becomes chargeable; this level has fluctuated between Rs. 2500 and Rs. 4200 per year in recent years.

such training are selected for posts of responsibility on the strength of their higher educational qualifications. In this way the power and privileges of a small group of people at the top tend to be not only preserved but strengthened. In both public services and organized private enterprises practically all posts of influence and power are held by persons belonging to the same small privileged class. This has created an influential group of people who naturally desire to maintain their privileged position and power. During the British period many of the influential people were not enthusiastic about the political change because they were afraid of losing their own privileges. In the same way it is not surprising that there are people in India today who are not enthusiastic about a rapid economic progress out of a similar fear of losing their privileges and power. It is necessary to remove barriers to educational opportunities to overcome such difficulties. This is the only way in which a sound foundation can be laid for democracy and socialism in India.

Educational Reform

9.1. The only real remedy is to make education entirely free and also to ensure that no deserving student would be deprived of educational opportunities on account of poverty. It is no doubt necessary and desirable to do this at all levels of education; but it may be too difficult a task to undertake immediately. As a first step, it is suggested, that this reform should be carried through at the university and equivalent levels during the period of the Third Five Year Plan. This would call for several types of action. Firstly, all fees at the university level would have to be abolished by increasing the direct contribution from Government by an equal amount. Secondly, enough financial assistance would have to be provided by Government to enable every deserving student being maintained during the whole period of his study in higher educational institutions. Thirdly, selection for admission to higher education would have to be made entirely on merit. Fourthly, it would be desirable to institute evening classes, correspondence courses, and external examinations on a large scale to provide opportunities for higher education to those who are unable to attend the day-classes and also to maintain a policy of open door as a safeguard against rigidities and defects which may develop within a strictly controlled system of admissions. Finally, it would be desirable to initiate a scheme for constructive work for the nation which would be obligatory for one or two years for all students who are admitted to higher educational institution or who graduate from such institutions. This is not the occasion to give any detailed scheme but it may be useful briefly to consider some of the implications of the above proposals.

9.2. We have seen that total enrolment in higher education had nearly doubled in six years and was about 780,000 in 1956-57. The direct expenditure on higher education was about Rs. 293 million (Rs. 29·3 crores) out of which about 42 per cent or Rs. 120 million (Rs. 12 crores) came from students' fees.[1] The number ot students during the Third Plan period would no doubt be higher. If expansion continued at about the same rate, the number in the middle of the Third Plan period may reach a million and a half. It may not be however necessary or desirable to allow such an increase in future, and we may provisionally accept a target of one million students in higher education in the Third Plan but also keep in mind a million and a half. For one million students, the Government grant in lieu of fees would come to about Rs. 16 crores, and for a million and a half to about Rs. 24 crores per year at current rates and prices.

9.3. As regards financial assistance for maintenance, at the rate of Rs. 300 or Rs. 400 per year per student on an average, the cost would come to Rs. 30 or Rs. 40 crores per year for one million students. I have used average figures because it would be quite reasonable to adopt something like a "means test" so that the amount of the stipend would depend on what assistance the parent would need to maintain the student without any strain. Secondly, stipends of a larger amount may be offered as incentives to attract students to science and technology or other suitable subjects and also to post-graduate courses. The total cost may be of the order of Rs. 50 or Rs. 60 crores per year. If the Third Plan succeeds in raising the national income by five per cent per year (and this is about the lowest safe limit) then the additional income generated would be at least of the order of Rs. 600 crores per year or more out of which there should not be any difficulty in providing the above expenditure.[2]

9.4. Selection for admissions on merit is indeed a formidable task, but I venture to think it is not beyond our capacity if we call science to our aid.

[1] Compared to a fee income of 42 per cent of the total expenditure in India the income from fees at the university level is less than 11 per cent in U.K. and is about 8 per cent in the land-grant institutions many of which are the great State universities of U.S.A.

[2] It is appropriate at this stage to point out that the proposals to abolish all fees in higher education and to award maintenance stipends out of government funds would merely involve a redistribution of the national income; and should not, in principle, cause any additional strain on the economy as a whole, It would be necessary, of course, for Government to raise the required amount through additional taxation or in other ways. But, in principle, the amount which was being spent by the parents of the students would be set free and would be available for either savings or consumption. In other words, there would be no additional call on physical resources.

The objects of the admission test must be clearly defined, and attempts must be made to maintain uniform standards throughout the country. I shall make a few suggestions to serve as a basis for further discussions. It may be desirable to try to assess such aspects of the candidate's qualifications, for example, as (a) his content of knowledge in appropriate subjects, (b) his ability to search and compile relevant information from books and written materials, (c) his capacity to organize his knowledge and convey his ideas in a clear way in a written form, or (d) his skill in manual or technical work or ability to make scientific observations or experiments. These are all amenable to assessment on a more or less objective basis. For example, modern objective tests, in which a candidate has only to indicate his choice between different alternative answers, can be used in testing knowledge in a standardised manner throughout the country. The ability to compile and collect information from given books and materials can also be standardised at different levels of difficulty. The ability to convey in a coherent form his knowledge and ideas can be tested by asking the candidate to prepare written notes on the basis of material given to him or to be collected by him from given books and papers. His power of expression can be tested by the usual type of free essay for which several hours can be allotted. Some kind of practical work or experiments can also be made a part of the examination.

9.5. I should like to mention that, in my opinion, modern statistical methods can be used very effectively to select a required number of questions for any particular paper out of a given "universe of questions" in a random manner and at the same time to maintain assigned levels of difficulty and subject coverage within prescribed limits with objective certainty. This would have two advantages. It would enable uniform standards being maintained throughout the country and from year to year. It would also permit almost infinite variations in the content of individual question papers so that copying from an answer book can be made practically impossible. Furthermore, with the help of modern electronic computers it would be possible to mark the objective type of papers very quickly and accurately.

9.6. I may also explain that the test for admission need not be one single examination but may very well be different examinations for different groups of subjects. For each examination it would be, however, necessary to maintain as uniform standards as possible over the whole country. To maintain parity or equivalence of standards between different examinations would be technically a more difficult task. However in principle, it is not absolutely necessary that the quality of the candidates should be the same in all subjects.

If there is greater competition in certain subjects it is likely that such subjects would attract candidates of a higher quality on an average. This need not be prevented.

9.7. One great advantage of the proposed system would be that it would be possible to regulate admissions to particular subjects in accordance with social needs and opportunities of employment which are likely to be available to the students after graduation. In this way admission to higher education would be geared to future requirements of trained manpower.

9.8. It would be of advantage in many ways to institute evening classes, correspondence courses and external examinations to offer fuller opportunities for higher education. Correspondence courses are being used very extensively in U.S.S.R. apparently with great success; and it would be possible to take advantage of Soviet experience. Arrangements may have to be made for laboratory or other institutional work for prescribed periods or during vacations. All this would, of course, call for much organizational effort and experimentation which would offer scope for much employment of persons with higher education. A standard system of external examinations (including practical work or tests as necessary) would keep the door open for every one and would be a safeguard against abuses developing within a closed system.

National Service

10.1. If the State undertakes to make education available at its own expense to all deserving students then it would be entirely proper to ask the students to undertake productive and constructive work for the country for one or two years. The maintenance stipend would be continued or can be increased in suitable cases during this period. In many countries of the world a period of service in the armed forces is compulsory. In India, instead of conscripted service in the defence forces, we may think of a period of obligatory service in peace camps or in a peace force for constructive work.

10.2. It would be probably convenient to ask the students to put in their prescribed period of service immediately after their graduation. This would supply every year a large number of highly trained persons who would be able to undertake productive work of various kinds. This would be of direct gain to the nation. For example, it would be possible to use a large number of such students to do teaching work at different levels all over the country. The medical graduates can help in bringing medical care to the villages. For the trainee himself it would be a valuable period of apprenticeship training, something like the "internee" work in hospitals by medical graduates, and would be of help in their finding employment suited to their training and aptitudes. The most valuable aspect of the peace camps or peace forces, if I may use this phrase would be the bringing together of young persons from widely differing types of families in a comradeship of active work for the country. This would be an effective way of promoting the spirit of democracy.

10.3. Although I have spoken of students joining the peace camps or the peace force after graduation from higher institutions of education it is also possible to have "work schools", as Dr. Zakir Hussain has called them, for students before they come to the University. In U.S.S.R. a new policy has been adopted of asking all students to work for at least two years from the age of 15 before they are admitted to institutions of higher education. Various possibilities are thus open. The really important point is to accept the principle that a prescribed period of service in a peace force for say two years at some stage or other would be an obligatory requirement for all educated persons.

Science and Research

11.1. The importance of science and technology for national development has been recognised in India, in principle, since independence. It cannot be said, however, that progress has been entirely adequate or satisfactory. There is urgent need of improving the teaching of science at all levels. Much improvement is also needed in the organization of research. There is no time to make a comprehensive review, and I shall make some brief observations on some selected aspects of the problem.

11.2. Science is developing so fast that it is becoming increasingly difficult for teaching to keep pace with the advancement of knowledge. J. D. Bernal has recently pointed out that :

> "With a rapidly growing civilization, the young will year by year have more to know and also, will be required, by the new demands made on them, to know more. ...Something must be done to simplify and reduce the amount of learning at every stage. ...In the past with some reason, teaching was considered to be the passing on of known and established truths from one generation to the next. ...But clearly, in a civilization where the whole basis of knowledge is expected to change several times in a generation, the passing on of established knowledge becomes palpably inadequate and, also, from its ever-increasing bulk, impossible. It is lucky if most of what is taught is true, or supposed to be true, at the time it is taught. It is certain that it will no longer be considered true by the

time those who are taught are half way through their lives. What is needed, therefore, is a different and lightened content of education. The emphasis will be on discovery rather than knowledge. It will be, not so much the passing on the established truths, as showing the way to criticize and discover new truths; in other words, the active part of the scientific method..'[1]

11.3. Some serious thinking has been going on for some time in the Indian Statistical Institute on organizing an integrated course of science teaching in which emphasis would be given to develop the student's skill in observation, counting, measurement, logical analysis and interpretation of the facts, and the design of new experiments to test the working hypotheses. One single set of observations and experiments may cover different branches of science, which, it is hoped, may give an integrated outlook on scientific method. It is no longer possible to have encyclopaedic coverage of knowledge. The only possibility is to try to make an intensive and integrated study which would touch particular aspects of different branches of science. I have no time to elaborate these thoughts but it seems to me that it will be well worth making some experiments in this direction.

11.4. It is essential to spread the teaching of science extensively at the school level without which it will be never possible to secure a sound foundation for advancement of science in India. Sir Alexander Fleck, in his presidential address to the British Association for the Advancement of Science in 1958 mentioned that in U.S.S.R. children from 11 to 17 years devote 46 per cent of their school time to science subjects. I am aware that it is not possible to approach this level immediately in India but we should keep some such target in view. Teaching of science, both in schools and universities, deserves serious attention by senior scientists.

11.3. As regards the organization of science in its wide rsense, I have on other occasions pointed out that our own National Institute of Sciences is not very active. Our Institute is supposed to have the responsibility of advising Government on scientific matters. In practice there is very little activity of this kind. This I think is partly due to lack of clear ideas regarding what should be the proper function of scientific societies in the changing conditions of the present time; and also, I am sorry to say, partly due to lack of a sense of responsibility on our own part. I have made some suggestions in my Annual Review in 1958 and need not say anything more on the present occasion.

[1] J. D. Bernal; World Without War, 1958, pp. 197–198.

11.6. I am a strong advocate of the public sector but this, in my view, does not mean concentrating all activities in government departments. On the contrary, in the scientific field, I think it is essential to build up and maintain truly independent scientific organizations which would be in a position to offer advice and constructive criticism and suggestions to Government. I have already mentioned that we ourselves have not been sufficiently serious regarding our own responsibilities. But I also think that the time has come for Government to give serious attention to the future structure of scientific organization and research in India not only within government but for the country as a whole.

11.7. If I may put it in this way, the solution does not lie in officialising all scientific activities but gradually to make the scientific organizations truly functional by transferring to them real responsibilities and entrusting them with fruitful activities. The advancement of science requires proper recognition of scientists in the structure of society as a whole. In this connexion I may remind you that Sir Alexander Fleck has given a quotation from an administrator which went on record that "the place of the expert is not in the saddle but as the assistant and the adviser. The scientist must be on tap, not on top." I can only say that the future of India depends on reversing the dictum of the administrator and recognising that the scientist must be on top and not merely on tap. I have a deep conviction that scientists must supply the leadership in national development. It is necessary that they should take the initiative.

APPENDIX

TABLE (1): SOME CHARACTERISTICS OF DEVELOPMENT FOR SELECTED COUNTRIES

	country	year	population in million (10^6)	steel production in million metric tons per year	per capita national income US dollars	physicians per ten thousand of population	school children per cent of population
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	level of one million tons of steel per year						
1.	USA	1880	50	1.3	635	16.3	19
2.	UK	1880	31	1.3	385	6.6	12
3.	Germany	1885	48	1.2	340	3.6	15
4.	France	1895	39	0.9	485	3.9	14
5.	Russia	1895	105	0.9	95	1.6	3
6.	Japan	1923	56	1.0	125	7.7	17
7.	India	1955–56	384	1.3	60	1.7	0.8
	level of 4 or 5 million tons of steel per year						
1.	USA	1890	63	4.3	735	15.9	20
2.	UK	1900	38	5.0	560	8.8	16
3.	Germany	1895	54	4.0	430	4.0	17
4.	France	1913	39	4.7	550	5.3	14
5.	USSR	1929	147	4.9	95	4.3	8
6.	Japan	1935	69	4.9	195	8.4	17
7.	China	1956	608	4.5	70	1.2	1.6
8.	India	1960–61	408	4.3	72	2.1	1.0

Compiled by the Planning Division, Indian Statistical Institute.

NOTES ON TABLE (1)

1. Figures of steel output are taken from Woytinsky and Woytinsky : *World Population and Production*, for all countires except China and India. Chinese and Indian figures relate to finished steel and are respectively taken from *China To-day*, 25 August, 1957, and *Second Five Year Plan*, 1956 (India).

2. For USA, UK and Japan, population figures are taken from the Statistical Abstracts of the respective countries relating to different years. Figures for Germany and France are obtained by interpolation from data given by Woytinsky and Woytinksy. Russian data relating to 1895 are obtained in the same manner while the figure for 1926 is from the *National Economy of USSR.* Chinese data are from unpublished official Chinese sources; and Indian data from the *Second Five Year Plan.*

3. Data on number of school children for USA, Germany, UK and Russia are taken from the *Encyclopaedia of Social Reform* and Mulhall, *Dictionary of Statistics*. French data relating to 1895 is from the *Statistical Year Book : National Institute of Statistical and Economic Studies*, France, while data for 1912-13 are from the *International Year Book of Statistics*, 1920. Data for USSR and India are from sources given in (2). The figure for Japan is based on the *Statistical Abstract of Japan*, 1933 and the *UN Statistical Year Book*. The Chinese figure is from the *Report on Fulfilment of the National Economic Plan in* 1955.

4. The US figures for doctors are from the *Historical Statistics of USA* while those for UK are from the *Professions* by Carr-Saunders and Wilson. French data are obtained from Woytinsky and Woytinsky. The German and Russian figures are from Mulhall, *Dictionary of Statistics* and Woytinsky and Woytinsky, *World Population and Production* while the figure for USSR is from 40 *Years of Soviet Power*. The Japanese figures are from the *Statistical Abstract of Japan*, 1933 and the *UN Statistical Year Book*, 1949-50. Indian and Chinese data are from sources indicated in (3).

5. National income figures are roughly dimensional and are obtained from certain estimates at current dollars for 1955 or 1956 carried backward by index numbers of real per capita income. Some of these current estimates were considered in the Science and National Planning, *Sankhyā*, September 1958.

The index numbers used for USA are taken from data given in the *Economic Report of the President*, 1957 ; and the "Long-term Changes in the National Income of the USA since 1870" by Simon Kuznets, (*Income and Wealth*, Series II). The German figure is adjusted by series available in the *Statistics of National Income and Expenditure*, (UN Statistical Paper, Series H), and the "Long-term Growth of the National Income in Germany" by P. Jostock, (*Income and Wealth*, Series V). For the UK estimates, use has been made of data given by Prest, "National Income of the UK" (*Economic Journal*, March 1948) ; Phyllis Dean, "Contemporary Estimates of National Income in the First and Second half of the Nineteenth Century", (*Economic History Review*, vol. 8, no. 3 and vol. 9, no. 3) ; the *Statistics of National Income and Expenditure* (*UN*) and *UN Statistical Year Book*. The French figures are obtained on the basis of UN sources indicated above and a series of real output per working person given in Colin Clark : *Conditions of Economic Progress*. The figure for Japan is adjusted by data given in the *Japanese Statistical Year Book*, 1957 while Chinese and Indian data relating to current period are taken from official sources.

NOTES ON TABLE (2)

List A (*developed countries*) :

(1) Australia, (2) Austria, (3) Belgium, (4) Canada, (5) Denmark, (6) France, (7) Federal Republic of Germany, (8) Finland, (9) Iceland, (10) Italy, (11) Luxembourg, (12) Netherlands, (13) New Zealand, (14) Norway, (15) Sweden, (16) Switzerland, (17) South Africa, (18) UK, (19) USA.

List B (*socialized countries*) :

(1) Albania, (2) Bulgaria, (3) Czechoslovakia, (4) China, (5) German Democratic Republic, (6) Hungary, (7) Poland, (8) Rumania, (9) USSR, (10) Yugoslavia.

List C (*medium developed countries*) :

(1) Argentina, (2) Bolivia, (3) Brazil, (4) Costa Rica, (5) Cuba, (6) Chile, (7) Columbia, (8) Dominican Republic, (9) El-salvador, (10) Ecuador, (11) Greece, (12) Guatemala, (13) Haiti, (14) Honduras, (15) Ireland, (16) Japan, (17) Jamaica, (18) Mexico, (19) Portugal, (20) Paraguay, (21) Peru, (22) Panama, (2) Puerto Rico, (24) Spain, (25) Turkey, (26) Uruguay, (27) Venezuela.

List D (*underdeveloped countries*) :

(1) Afghanistan, (2) Algeria, (3) Angola, (4) Burma, (5) Belgian Congo, (6) China, (7) Ceylon, (8) Cameroon, (9) Egypt, (10) Ethiopia, (11) French West Africa, (12) Ghana, (13) Hongkong, (14) India, (15) Indonesia, (16) Iran, (17) Iraq, (18) Israel (19) Kenya, (20) Lebanon, (21) Liberia, (22) Malay, (23) Morocco, (24) Mauritious, (25) Mozambique, (26) Madagascar, (27) Nigeria, (28) Pakistan, (29) Philippines, (30) Rhodesia and Nyasaland, (31) Saudi Arabia, (32) South Korea, (33) Syria, (34) Thailand, (35) Taiwan, (36) Tunisia, (37) Tanganyika, (38) Uganda, (39) Vietnam, (40) Yemen.

Sources :

Columns (2), (4), (5), (9) and (10) are from the *UN Statistical Year Book*, 1956.

The Chinese population figure is taken from statistics prepared by the State Statistical Bureau of the People's Republic of China (in Chinese). The Chinese figures for physicians and primary school students are from the statistics prepared by the State Statistical Bureau of the People's Republic of China.

The USSR figures for physicians and primary school students are from the data supplied by the Central Board of Statistics of the USSR.

The method of estimation of national income figures is explained generally in *Sankhyā*, vol. 20, parts 1 and 2, "Science and National Planning".

TABLE (2): POPULATION, NATIONAL INCOME, PRODUCTION OF STEEL AND ELECTRICITY, AND NUMBER OF PHYSICIANS AND PRIMARY SCHOOL STUDENTS BY COUNTRIES AND GROUPS OF COUNTRIES ABOUT 1955-56

countries	population in millions (10^6)	national income in US dollar billion (10^9)	production: crude steel in million (10^6) metric tons	production: electricity billion (10^9) kwh	per capita: national income in US dollar	per capita production: crude steel (kg)	per capita production: electricity (kwh)	physicians per ten thousand of population	primary school pulils per thousand of population
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. United States of America	165	341	106	629	2030	642	3812	13.2	158
2. United Kingdom	50	46	20	94	900	394	1846	16.7	108
3. Developed (sub-total)[1]	450	566	191	1107	1292	436	2527	11.5	132
4. USSR	200	200	45	170	1000	226	850	14.9	65
5. China	620	44	3	12	72	4.8	20	1.2	87
6. Socialized (sub-total)[2]	900	278	63	298	317	72	340	5.9	90
7. Japan	90	21	10	65	230	105	724	10.5	144
8. Medium (sub-total)[3]	350	86	13	120	259	38	360	7.3	116
9. India	380	23	2	8	61	4.5	21	1.8	54
10. Underdeveloped (sub-total) excluding China	900	71	2	25	80	2	28	1.4	65
11. Underdeveloped including China[4]	1500	114	5	37	76	3	25	1.3	73
12. World [3+6+8+10] total	2600	1002	269	1550	395	106	611	5.5	92

Compiled by the Planning Division, Indian Statistical Institute. Population and other figures have been rounded off dimensionally.

[1] Includes developed countries in North America, Europe, Australia (as in list A).

[2] Includes all socialized countries (as in list B).

[3] Includes Japan and medium *developed countries in Europe* and Latin America (as in list C).

[4] Includes underdeveloped countries in Asia and Africa (as in list D).

TABLE (3): OUTPUT OF CRUDE STEEL IN MILLION METRIC TONS[1] FOR WORLD AND SELECTED COUNTRIES

year	World[2]	United Kingdom	United States	Germany	USSR	Japan[6]	China	India
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1870	0.7	0.2	f[3]	0.2	f			
1880	4.4	1.3	1.3	0.7	0.3			
1890	12.4	3.6	4.3	2.2	0.4			
1900	28.3	5.0	10.4	6.6	2.2			
1910	60.5	6.5	26.5	13.7	3.5			
1913	76.5	7.8	31.8	18.9	4.8	0.2		f
1918	78.6	9.7	45.2	15.0	0.4	0.8		0.2
1923	78.5	8.6	45.7	6.3	0.6	1.0		0.2
1929	120.5	9.8	57.3	16.2	4.9	2.3		0.6
1932	50.7	5.3	13.9	5.7	5.9	2.4		0.6[10]
1939	135.6	13.4	47.9	22.4	17.6	6.7	0.5	1.1
1940	142.9	13.2	60.8	19.0	18.3	6.9	0.6	1.3
1944	152.1	12.3	81.3	18.0	13.9	5.9	0.9[7]	1.4
1945	113.3	12.0	72.3	0.3	12.3	2.1	n.a.	1.4
1950	188.7	16.6	87.8	12.1[4]	27.3	4.8	0.2[8]	1.5
1955	269.1	20.1	106.2	21.3	45.3	9.4	2.9	1.7
1956	282.6	21.0	104.5	23.2	48.6[5]	11.1	4.5[9]	1.8

[1] One metric ton = 1.1023 short tons.
[2] Excludes China upto 1932 and 1944-50.
[3] f = less than 100,000 tons.
[4] West Germany from 1950.
[5] USSR 1957 and 1958 figures are 51 and 55 million metric tons respectively.
[6] Includes Korea upto 1932.
[7] Relates to 1943.
[8] Relates to 1949.
[9] China 1957 and 1958 figures are 5.3 and 11 million metric tons respectively.
[10] Relates to 1932-33.

Compiled by the Planning Division, Indian Statistical Institute, from:

(a) Woytinsky and Woytinsky: *World Population and Production: Trends and Outlook*, (New York, 1953).
(b) *United Nations Statistical Year Book*, 1957.
(c) D. G. Zhimerin: *Economy of the Soviet Union, Past and Present*, (Moscow, 1958).
(d) *News and Views from the Soviet Union*, (USSR Embassy, New Delhi, 18 December 1958).
(e) *China Today*: 25 September 1958; 10 January 1959.
(f) *Report on Fulfilment of the National Economic Plan of the People's Republic of China in* 1955 (with Statistical Summary).
(g) Sastry: *A Statistical Study of India's Industrial Development.*
(h) *Statistical Abstract*, India: 1927-28 to 1936-37.

TABLE (4): INCREASE IN LIVE NUMBER ON LABOUR EXCHANGE REGISTERS IN INDIA IN 5 YEARS: 1953-1957.

occupational category	number on live-register at end of month		increase in five years		monthly average of effective placements		ratio of applicants to effective placements[1]	
	January 1953 (131)	December 1957 (181)	number	per cent	1953	1957		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. industrial supervisory	4,317	5,929	1,612	37.3	180	171	24.0	34.7
2. skilled and semi-skilled	46,539	71,508	24,969	53.7	2,247	1,910	20.7	37.4
3. educational	6,615	40,246	33,621	507.5	401	1,117	16.5	36.0
4. clerical	113,424	267,757	154,333	136.1	2,006	3,594	56.5	74.5
5. domestic service	13,987	32,018	18,031	128.9	938	1,141	14.0	28.1
6. unskilled	221,761	460,639	238,878	107.7	8,452	6,178	26.2	74.6
7. others	27,775	44,002	16,227	58.4	1,230	1,958	22.6	22.5
8. all categories	434,428	922,099	487,671	112.3	15,454	16,069	28.1	57.4

[1] That is, col. (8) = col. (2)/col. (6); and col. (9) = col. (3)/col. (7).

TABLE (5): NUMBER ON LIVE REGISTER AND NUMBER OF VACANCIES AND REPLACEMENTS: LABOUR EXCHANGES IN INDIA, 1953-1957

all categories	year				
	1953	1954	1955	1956	1957
(1)	(2)	(3)	(4)	(5)	(6)
1. monthly average of effective placements	15,454	13,538	14,145	15,821	16,069
2. monthly average of vacancies	21,392	19,990	23,377	24,718	24,766
3. monthly average on Live Register	477,575	562,319	647,109	749,099	816,280
4. number of applicants per vacancy (row 3÷row 2)	22.3	28.1	27.7	30.3	33.0
5. number of applicants per placement (row 3÷row 1)	30.9	41.5	45.7	47.3	50.8

Compiled in the Indian Statistical Institute from "A Study of Trends in the Number of Employment Seekers in the Year 1953-1957." (Ministry of Labour & Employment, D.G.R. & E. September, 1958).

TABLE (6): DISTRIBUTION OF DOCTORS PER MILLION POPULATION BY LEVEL OF QUALIFICATIONS AND STATE OF RESIDENCE IN 1954

states	population 1954 (million)	number of doctors			doctors per million (10^6) population			index with West Bengal = 100
		graduate and post-graduate	licentiate	all	graduate and post-graduate	licentiate	all	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Andhra	32.65	2,025	1,908	3,933	62	58	120	19.8
2. Assam	9.59	403	2,281	2,684	42	238	280	46.3
3. Bihar	40.07	1,762	3,302	5,064	44	82	126	20.8
4. Bombay	51.15	6,928	6,044	12,972	135	118	253	41.8
5. Jammu & Kashmir	4.54	32	42	74	7	9	16	2.6
6. Kerala	14.51	836	845	1,681	58	58	116	19.2
7. Madhya Pradesh	26.80	731	1,191	1,922	28	44	72	11.9
8. Madras	31.38	2,959	3,083	6,042	95	98	193	31.9
9. Mysore	20.58	1,100	1,846	2,946	53	90	143	23.6
10. Orissa	14.94	448	800	1,248	30	54	84	13.9
11. Punjab	16.63	1,118	1,915	3,033	67	115	182	30.1
12. Rajasthan	16.74	213	454	667	13	27	40	6.6
13. Uttar Pradesh	65.60	3,244	2,989	6,233	49	46	95	15.7
14. West Bengal	27.41	6,157	10,434	16,591	225	381	605	100.0
15. Delhi	1.93	771	468	1,239	399	242	642	106.1
16. Himachal Pradesh	1.13	31	42	73	27	37	65	10.7
17. Manipur	0.60	3	21	24	5	35	40	6.6
18. Tripura	0.68	31	145	176	45	210	255	42.1
all-India	376.94	28,792	37,810	66,602	76	100	176	29.1

Source : Perspective Planning Division, Planning Commission ; based on Medical Registers.

TABLE (6.1): INCOME AND EXPENDITURE OF UNIVERSITIES AND COLLEGES IN INDIA : 1955-56

type of institution	recurring expenditure (Rs. lakhs)	source of income (percentage)				type of expenditure (percentage)		
		govt. grants	fees	endowment	others	salary	scholarship	others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. university teaching	937	49	34	2	15	25	4	71
2. boards of education	132	1	97	—	2	—	—	100
3. professional colleges	700	67	23	3	7	48	14	38
4. general colleges	1040	34	56	3	7	62	14	24
5. intermediate colleges	125	39	39	7	15	68	22	9
6. total higher	2934	45	42	3	10	44	10	46
in Rs. lakhs	—	1320	1232			1291	293	

Source ; Education in India, Vol. 1, 1955-56.

TABLE (7): STRUCTURE OF EDUCATION: SELECTED COUNTRIES

level of education	USA 1955	USSR 1957–58	UK 1954	West Germany 1956	France 1954	Japan 1956	China 1955	India 1955–56
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. population (in millions)	165	200	51	51	43	90	608	384
number of students in thousands (000's)								
2. primary	25,458	25,055	5,484	4,955	4,921	12,956	53,126	22,890
3. secondary	7,961	7,511	2,483	3,688	1,300	8,063	4,473	8,789
4. higher	2,679	2,100	84	127	150	610	292	681
5. total	36,098	34,666	8,051	8,750	6,371	21,629	57,891	32,369
number of students per 1000 of population								
6. primary	154.3	125.3	107.5	97.2	114.0	144.4	87.4	59.9
7. secondary	48.2	37.6	48.7	71.9	30.2	89.6	7.4	22.9
8. higher	16.2	10.5	1.6	2.5	3.5	6.8	0.5	1.8
9. total	218.7	173.4	157.8	171.6	148.1	240.4	95.3	84.3
number of secondary and higher students per 1000 primary students								
10. secondary	312.7	299.8	452.8	740.3	264.3	622.3	84.2	383.8
11. higher	105.2	83.8	15.3	25.6	30.5	47.1	5.5	29.7
12. total	417.9	383.6	468.1	765.9	294.7	669.4	89.7	413.5
number of higher students per 1000 secondary students								
13. higher	336.5	279.6	33.8	34.6	115.4	75.7	65.3	77.5

Compiled by the Planning Division, Indian Statistical Institute.

1. Population figures are taken from *UN Statitical Year Book* 1956 and 1957 except for China for which they are taken from official data (in Chinese).

2. Educational statistics are taken from the following sources:

USA: *Statistical Abstract of USA*, 1956 and 1957.

USSR: *USSR in Figures* (in Russian), 1958. Structural features of Soviet education are not fully revealed in recent data due to the fact that very few children were born during the war.

UK, West Germany, France and Japan: *UN Statistical Year Book*, 1957.

China: From *Report on Fulfilment of the National Economic Plan of the People's Republic of China in* 1955.

India: Basic Statistics relating to Indian Economy (mimeographed; CSO) for primary education; and *Education in India*, Vol. 1, 1955-56.

TABLE (8): ENROLMENT OF STUDENTS BY LEVEL, SUBJECT AND SEX WITH PERCENTAGE: 1950-51 AND 1956-57

	level and subject	1950-51 number (000) boys	1950-51 number (000) girls	1950-51 number (000) total	1950-51 percentage boys	1950-51 percentage girls	1950-51 percentage total	1956-57 number (000) boys	1956-57 number (000) girls	1956-57 number (000) total	1956-57 percentage boys	1956-57 percentage girls	1956-57 percentage total	index 1950-51 = 100
	(1)	(2.1)	(3.1)	(4.1)	(2.2)	(3.2)	(4.2)	(5.1)	(6.1)	(7.1)	(5.2)	(6.2)	(7.2)	(9)
1.	*Intermediate*	198.6	24.4	223.0	89.1	10.9	100.0	381.2	59.5	440.7	86.5	13.5	*100.0*	198
2.	arts	96.3	18.0	114.3	43.2	8.0	51.2	195.1	48.1	243.2	44.3	10.9	55.2	213
3.	commerce	16.1	0.1	16.2	7.3	0.0	7.3	35.0	0.2	35.2	7.9	0.1	8.0	217
4.	science	84.6	6.3	90.9	37.9	2.9	40.8	145.0	11.2	156.2	32.9	2.5	35.4	172
5.	agriculture	1.6	—	1.6	0.7	—	0.7	6.1	—	6.1	1.4	—	1.4	381
6.	*Diploma*	9.5	0.3	9.8	96.6	3.1	100.0	26.1	0.7	26.8	97.4	2.6	*109.0*	275
7.	„ engineering & technology	8.2	—	8.2	83.7	—	83.7	23.7	—	23.7	88.5	—	88.5	289
8.	„ others	1.3	0.3	1.6	13.2	3.1	16.3	2.4	0.7	3.1	8.9	2.6	11.5	194
9.	*Degree*	130.4	15.0	145.4	89.7	10.3	100.0	236.7	38.4	275.1	86.0	14.0	*100.0*	189
10.	arts	44.4	8.9	53.3	30.6	6.1	36.7	88.8	25.0	113.8	32.2	9.2	41.4	214
11.	commerce	15.8	0.1	15.9	10.9	0.0	10.9	31.1	0.2	31.3	11.3	0.1	11.4	197
12.	science	29.1	2.4	31.5	20.0	1.7	21.7	48.6	5.8	54.4	17.7	2.1	19.8	173
13.	engineering & technology[1]	10.1	—	10.1	6.9	—	6.9	17.7		17.7	6.4	—	6.4	175
41.	medicine & veterinary[2]	13.0	2.3	15.3	8.9	1.6	10.5	20.3	3.7	24.0	7.4	1.3	8.7	157
15.	agriculture	2.7	—	2.7	1.9	—	1.9	3.7	—	3.7	1.3	—	1.3	137
16.	*Post graduate*	18.7	2.6	21.3	87.8	12.2	100.0	30.4	5.6	36.0	84.4	15.6	*100.0*	169
17.	arts	11.0	2.1	13.1	51.7	9.8	61.5	17.3	4.2	21.5	48.0	11.7	59.7	164
18.	commerce	2.0	—	2.0	9.3	—	9.3	2.7	—	2.7	7.5	—	7.5	135
19.1	law	13.2	0.3	13.5	9.1	0.2	9.3	18.9	0.4	19.3	6.9	0.1	7.0	143
19.2	law (higher)	0.2	—	0.2	0.9	—	0.9	0.4	—	0.4	1.1	—	1.1	200
20.1	education (B.T.)	2.1	1.0	3.1	1.4	0.7	2.1	7.6	3.3	10.9	2.8	1.2	4.0	352
20.2	education (higher)	0.3	0.1	0.4	1.4	0.5	1.9	0.5	0.3	0.8	1.4	0.8	2.2	200
21.	science	4.3	0.4	4.7	20.3	1.9	22.2	7.3	0.9	8.2	20.2	2.5	22.7	174
22.1	technology & engineering[1]	0.2	—	0.2	0.9	—	0.9	0.6	—	0.6	1.7	—	1.7	300
22.2	medicine & veterinary[2]	0.3	—	0.3	1.4	—	1.4	1.0	0.2	1.2	2.8	0.6	3.4	400
23.	agriculture	0.4	—	0.4	1.9	—	1.9	0.6	—	0.6	1.7	—	1.7	150
	Intermediate												*100*	
24.	arts, law, commerce	112.4	18.1	130.5	50.5	8.0	58.8	230.1	48.3	278.4	52.2	11.0	63.2	213
25.	science & technology[1]	86.2	6.3	92.5	38.6	2.9	41.5	151.1	11.2	162.3	34.3	2.5	36.8	175
	Degree												*100*	
26.	arts, law, commerce	73.4	9.3	82.7	50.6	6.3	56.9	138.8	25.6	164.4	50.4	9.4	59.8	199
27.	science & technology[2]	54.9	4.7	59.6	37.7	3.3	41.0	90.3	9.5	99.8	32.8	3.4	36.2	167
	Post-graduate												*100*	
28.	arts, law & commerce	13.2	2.1	15.3	61.9	9.8	71.7	20.4	4.2	24.6	56.6	11.7	68.3	161
29.	science & technology[2]	5.2	0.4	5.6	24.5	1.9	26.4	9.5	1.1	10.6	26.4	3.1	29.5	180
30.	*All levels*	357.2	42.3	399.5	89.4	10.6	100.0	674.4	104.2	778.6	86.6	13.4	*100.0*	195
31.	arts, law, commerce	199.0	29.5	228.5	49.8	7.4	57.2	389.9	78.1	468.0	50.1	10.0	60.1	205
32.	education	2.8	1.3	4.1	0.7	0.3	1.0	8.8	4.1	12.9	1.1	0.6	1.7	315
33.	science & technology[2]	155.4	11.5	166.9	38.9	2.9	41.8	275.7	22.0	297.7	35.4	2.8	38.2	178

[1] Includes Agriculture. [2] Includes engineering, medicine & veternary, and agriculture.

Source: Perspective Planning Division, Planning Commission.

TABLE (9): OUTTURN OF QUALIFIED PERSONS IN INDIA BY LEVEL AND SUBJECT: 1950-51 AND 1955-56.

	examination	1950-51				1955-56				index 1950-51 = 100
		number passed			percentage of girls	number passed			percentage of girls	
		boys	girls	total		boys	girls	total		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1.	*Intermediate*	71,272	9,815	81,087	12.1	125,939	20,213	146,152	13.8	180
2.	arts	38,748	7,913	46,661	17.0	75,764	16,482	92,246	17.9	198
3.	commerce	6,393	17	6,410	0.3	11,216	104	11,320	0.9	177
4.	science	25,459	1,884	27,343	6.9	37,716	3,625	41,341	8.8	151
5.	agriculture	672	1	673	0.1	1,243	2	1,245	0.2	185
6.	*Diploma*	8,724	5,418	14,142	38.3	10,031	2,535	12,566	20.2	89
7.	,, engineering & technology	2,026	1	2,027	0.1	4,977	—	4,977	—	264
8.	,, others	6,698	5,417	12,115	44.7	5,054	2,535	7,589	33.4	63
9.	*Degree*	44,141	6,332	50,473	12.5	72,697	13,342	86,039	15.5	171
10.1	arts (pass)	16,586	3,738	20,324	18.4	29,117	7,899	37,016	21.3	182
10.2	,, (hons.)	1,814	450	2,264	19.9	1,865	487	2,352	20.7	104
11.	commerce	5,411	22	5,433	0.4	8,203	50	8,253	0.6	152
12.1	science (pass)	9,640	767	10,407	7.4	13,370	1,577	14,947	10.6	144
12.2	,, (hons.)	713	73	786	9.3	1,077	132	1,209	10.9	154
13.	engineering & technology	1,772	1	1,773	0.1	3,810	6	3,816	0.2	215
14.	medicine & veternary	1,598	325	1,923	16.9	2,583	491	3,074	16.0	160
15.	agriculture	1,037	4	1,041	0.4	887	6	893	0.7	86
16.	*Post-graduate*	7,423	1,100	8,523	12.9	11,742	2,344	14,086	16.6	165
17.	arts	5,020	949	5,969	15.9	7,627	1,901	9,528	20.0	160
18.	commerce	575	1	576	0.2	1i27	4	1,031	0.4	179
19.1	law	3,474	71	3,545	2.0	5,733	118	5,851	2.0	165
19.2	law (higher)	15	1	16	6.2	41	2	43	4.7	269
20.1	education (B.T.)	2,096	881	2,977	29.6	6,052	2,576	8,628	29.9	190
20.2	education (higher)	151	65	216	30.1	301	142	443	32.1	205
21.	science	1,326	72	1,398	5.2	2,277	262	2,539	10.3	182
22.1	engineering	87	1	88	1.1	148	—	148	—	168
22.2	medicine & veterinary	106	11	117	9.4	169	33	202	16.3	173
23.	agriculture	143	—	143	—	152	—	152	—	106
	Intermediate									
24.	arts & commerce	45,141	7,930	53,071	14.9	86,980	16,586	103,566	16.0	195
25.	science, agriculture & technology	28,157	1,886	30,043	6.3	43,936	3,627	47,563	7.6	158
	Degree									
26.	arts, law & commerce	27,285	4,281	31,566	13.6	44,918	8,554	53,472	16.0	169
27.	science & technology	14,760	1,170	15,930	7.3	21,727	2,212	23,939	9.2	150
	Post-graduate									
28.	arts, law & commerce	5,610	651	6,561	14.5	8,695	1,907	10,602	18.0	162
29.	science & technology[1]	1,662	84	1,746	4.8	2,746	295	3,041	9.7	174
30.	*All levels*	124,862	17,248	142,110	12.1	215,355	35,899	251,254	14.3	177
31.	arts, law & commerce	78,036	13,162	91,198	14.4	140,593	27,047	167,640	16.1	184
32.	education	2,247	946	3,193	29.6	6,353	2,718	9,071	30.0	284
33.	science & technology	44,579	3,140	47,719	6.6	68,409	6,134	74,543	8.2	156
34.	doctorate	115	13	128	10.2	261	24	285	8.4	223

[1] Includes engineering, medicine & veterinary, and agriculture. *Source:* Perspective Planning Division, Planning Commission.

TABLE (10): NUMBER OF STUDENTS APPEARING IN AND PASSING DIFFERENT EXAMINATIONS, AND THE PERCENTAGE OF SUCCESSFUL STUDENTS

India : 1951-1952 to 1955-56

	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956
(1)	(2)	(3)	(4)	(5)	(6)
Appeared					
1. Intermediate Arts	109,493	139,422	169,287	189,385	207,118
2. Intermediate Science	61,891	67,155	78,973	85,042	93,405
3. Bachelor of Arts	47,841	54,710	74,824	81,421	79,920
4. Bachelor of Science	23,428	27,457	31,107	34,754	32,667
5. Master of Arts	7,780	7,808	10,281	11,729	13,215
6. Master of Science	2,144	2,114	2,667	2,946	3,142
7. Professional	36,402	41,497	48,237	53,005	48,450
8. total	288,979	340,163	415,376	458,282	477,917
Passed					
9. Matriculation	261,059	324,760	397,005	400,014	429,494
10. Intermediate Arts	52,373	59,703	71,640	86,741	90,182
11. Intermediate Science	25,463	29,318	33,211	39,735	41,557
12. Bachelor of Arts	24,965	27,491	35,773	40,445	37,992
13. Bachelor of Science	11,171	12,526	14,405	16,704	15,979
14. Master of Arts	6,063	6,169	7,753	8,892	9,313
15. Master of Science	1,680	1,694	2,068	2,211	2,456
16. Professional	22,684	26,269	30,162	33,181	35,772
16.1 Commerce	6,785	7,759	8,452	8,773	9,597
16.2 Law	4,538	5,562	6,602	5,996	5,628
16.3 Education & Teacher's Training[1]	5,251	6,215	6,749	9,492	11,106
16.4 Technology & Engineering	2,592	3,117	3,638	3,680	4,444
16.5 Medicine & Veterinary	2,324	2i512	3,541	4,089	3,888
16.6 Agriculture and Forestry	1,194	1,104	1,180	1,151	1,109
17. total	429,142	524,199	622,179	661,104	698,535
Percentage passed					
18. Intermediate Arts	47.8	42.8	42.3	45.8	43.5
19. Intermediate Science	41.1	43.7	42.1	46.7	44.5
20. Bachelor of Arts	52.2	50.2	47.8	49.6	47.5
21. Bachelor of Science	47.7	45.6	46.3	48.1	49.0
22. Master of Arts	77.9	79.0	75.4	75.8	70.5
23. Master of Science	78.4	80.1	77.5	75.1	78.2
24. Intermediate (I.A. & I.Sc.)	45.4	43.1	42.2	46.1	43.8
25. Degree (B.A. & B.Sc.)	50.7	48.7	47.4	49.2	48.0
26. M.A. & M.Sc.	78.0	79.2	75.8	75.7	72.0
27. Professional	62.3	63.3	62.5	62.6	73.8
28. total	50.0	48.0	46.9	49.7	48.8

[1] Includes "others"

Source : Education in India 1952-1953, 1954-1955 and 1955-1956.

TABLE (11): NUMBER AND PROPORTION OF STUDIES IN HIGHER COURSES IN RELATION TO NUMBER OF MATRICULATES IN INDIA IN 1952

courses	number on rolls			per cent			number per 10,000 matriculates		
	boys	girls	total	boys	girls	total	boys	girls	total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intermediate	**first year intermediate courses in 1952-53**								
(0.1) number of matriculates in 1952	222,371	35,767	258,138	100	100	100	10,000	10,000	10,000
1. total on rolls (1952-53)	153,941	20,330	174,261	69.2	56.8	67.5	6,920	5,680	6,750
2. arts	63,851	13,621	77,472	28.7	38.1	30.0	2,870	3,810	3,000
3. commerce	19,510	127	19,637	8.8	0.4	7.6	880	40	760
4. science	62,548	5,903	68,451	28.2	16.4	26.5	2,820	1,640	2,650
5. agriculture	1,209	—	1,209	0.5	—	0.5	50	—	50
6. diploma : technology	5,667	1	5,668	2.5	—	2.2	250	—	220
7.1. ,, : education	235	201	436	0.1	0.6	0.2	10	60	20
7.2. ,, : others	921	477	1,298	0.4	1.3	0.5	40	130	50
Degree	**first year degree courses in 1954-55**								
(0.2) number passed intermediate in 1954	98,011	15,612	113,623	100	100	100	4,408	4,365	4,402
8. total on rolls (1954-1955)	74,947	10,727	85,674	76.5	68.7	75.4	3,370	2,999	3,319
9. arts (pass & hons.)	33,262	7,654	40,916	33.9	49.1	36.0	1,496	2,140	1,585
10. commerce	12,515	77	12,592	12.8	0.5	11.1	563	22	488
11. science	19,567	2,146	21,713	20.0	13.7	19.4	880	600	841
12. technology & engineering	4,000	1	4,001	4.1	—	3.5	180	—	155
13. medicine & veterinary	3,056	733	3,789	3.1	4.7	3.3	137	205	147
14. agriculture	1,221	5	1,226	1.2	—	1.8	55	1	47
15. diploma (others)	1,326	111	1,437	1.4	0.7	1.3	59	31	56
Post-graduate	**first year post-graduate courses in 1956-57**								
(0.3) numbers awarded degrees in 1956	51,698	9,332	61,030	100	100	100	2,325	2,609	2,364
16. total on rolls (1956-57)	33,988	6,084	40,072	65.7	65.2	65.7	1,528	1,701	1,552
17. arts	9,015	2,023	11,038	17.4	21.7	18.1	405	566	428
18. commerce	1,422	11	1,433	2.8	0.1	2.3	64	3	55
19. law	11,698	220	11,918	22.6	2.4	19.5	526	61	462
20. education	7,349	3,295	10,644	14.2	35.3	17.5	330	921	412
21. science	3,375	382	3,757	6.5	4.1	6.2	152	107	146
22. agriculture	264	3	267	0.5	—	0.4	12	1	10
23. diploma (others)	865	150	1,105	1.7	1.6	1.7	39	42	93
Science & Technology	**first year science & technology (totals)**								
24. intermediate (1952-1953)	69,424	5,904	75,328	31.2	2.5	16.4	3,120	1,640	2,920
25. degree (1954-55)	27,844	2,885	30,729	12.5	1.2	6.7	1,252	806	1,190
26. post-graduate (1956-57)	10,988	3,680	14,668	4.9	1.6	3.2	494	1,029	568

Source : Perspective Planning Division, Planning Commission.

Note : Percentage figures given in cols. (5), (6) and (7) are on the basis of the number of candidates who passed the appropriate previous examination as given in lines (0.1), (0.2) and (0.3).

TABLE (12): TOTAL CONSUMER EXPENDITURE PER PERSON PER 30 DAYS AND CUMULATIVE PERCENTAGES OF POPULATION AND CONSUMER EXPENDITURE BY SUB-SAMPLES

National Sample Survey : 9th Round : May-November 1955 ; *All-India (Rural)*[1]

percentile	number of sample households			total consumer expenditure in Rs. per person per 30 days: limiting values			average expenditure			cumulative percentage of: total population			total consumer expenditure		
	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
5	39	39	78	4.91	4.79	4.90	4.01	3.82	3.90	6.32	5.58	5.83	1.69	1.39	1.50
10	38	35	71	5.99	5.85	5.92	5.43	5.39	5.39	12.39	10.86	11.56	3.88	3.26	3.54
15	35	37	73	6.74	6.88	6.80	6.39	6.38	6.38	17.17	15.94	16.50	5.91	5.37	5.62
20	36	43	78	7.54	7.90	7.76	7.25	7.35	7.28	22.16	21.47	21.72	8.32	8.03	8.13
25	37	37	76	8.52	8.59	8.56	8.05	8.31	8.20	26.82	27.05	26.98	10.81	11.06	10.97
30	33	42	75	9.36	9.57	9.53	8.96	9.19	9.06	32.78	32.49	32.61	13.36	14.33	14.34
35	38	41	79	10.17	10.39	10.31	9.80	9.95	9.89	37.43	38.06	37.78	17.39	17.95	17.71
40	38	34	72	11.03	11.09	11.07	10.66	10.74	10.69	42.93	43.75	43.13	21.29	21.95	21.48
45	34	36	73	11.80	12.06	11.92	11.42	11.68	11.49	47.56	48.50	47.74	24.80	25.58	24.97
50	41	43	80	12.83	13.02	12.88	12.35	12.59	12.43	53.11	53.41	53.12	29.36	29.62	29.38
55	40	38	78	14.14	14.05	14.14	13.46	13.45	13.44	58.19	58.65	58.37	33.90	34.23	34.03
60	37	43	80	15.13	15.55	15.24	14.57	14.73	14.64	63.77	63.75	63.83	39.30	39.14	39.30
65	42	34	77	16.61	16.97	16.77	15.81	16.12	16.00	68.51	67.87	68.32	44.29	43.48	44.04
70	44	38	82	18.49	18.59	18.56	17.61	17.88	17.78	74.26	72.37	73.38	51.02	48.75	49.97
75	40	39	78	19.85	20.08	20.02	19.14	19.37	19.26	78.60	77.55	77.94	56.55	55.30	55.76
80	37	40	76	22.59	22.01	22.11	21.22	21.27	21.19	82.95	82.65	82.73	62.69	62.40	62.45
85	39	31	72	24.95	23.60	24.35	23.77	22.97	23.36	87.83	86.19	87.07	70.40	67.71	69.12
90	40	40	79	29.57	27.53	28.59	27.40	25.42	26.23	92.60	91.08	91.47	79.09	75.85	76.74
95	40	40	81	38.05	38.38	38.13	32.85	32.06	32.17	96.92	96.07	96.46	88.54	86.29	87.31
100	40	38	78	194.41	128.86	194.41	55.96	53.30	54.31	100	100	100	100	100	100
all	768	768	1536				15.03	15.24	15.15						

Number of sample villages including 4 uninhabited villages in each sub-sample : 772 (s.s.1), 772 (s.s.2), 1544 (combined).
Number of sample households : 768 (s.s.1), 768 (s.s.2), 1536 (combined).

[1] Excludes Jammu & Kashmir.

TABLE (13): EXPENDITURE IN RUPEES PER PERSON PER 30 DAYS BY ITEMS OF CONSUMPTION AND BY SUB-SAMPLES

National Sample Survey 9th Round : May-November 1955 : All-India (Rural)[1]

per-centile	populations[2] in lakh (10^5)	foodgrains			food total			sugar			clothing			education			medicine			medical services		
		s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
5	197	2.34	2.49	2.39	3.12	3.18	3.18	0.04	0.04	0.04	0.10	0.05	0.08	0.00	0.02	0.01	0.01	0.00	0.01	0.00	—	0.00
10	194	3.01	3.14	3.09	4.41	4.22	4.32	0.06	0.06	0.06	0.09	0.23	0.16	—	0.01	0.01	0.06	0.04	0.05	—	—	—
15	167	3.43	3.54	3.48	5.05	4.94	5.02	0.10	0.11	0.11	0.09	0.42	0.22	0.02	0.01	0.02	0.03	0.04	0.04	0.02	0.02	0.02
20	177	3.42	3.88	3.60	5.15	5.63	5.32	0.13	0.11	0.12	0.33	0.59	0.52	0.00	0.01	0.00	0.07	0.01	0.04	0.05	—	0.02
25	178	4.46	4.37	4.50	6.43	6.48	6.47	0.09	0.21	0.14	0.32	0.34	0.31	0.00	0.05	0.03	0.03	0.01	0.02	—	—	—
30	191	4.28	4.50	4.39	6.73	6.86	6.83	0.25	0.16	0.23	0.27	0.61	0.44	0.02	0.01	0.02	0.08	0.03	0.06	0.01	0.06	0.04
35	175	5.11	5.06	5.05	7.43	7.81	7.56	0.28	0.26	0.24	0.72	0.72	0.74	0.03	0.00	0.01	0.03	0.02	0.02	0.04	—	0.02
40	181	5.44	5.43	5.34	8.16	8.11	8.11	0.26	0.25	0.28	0.61	0.66	0.67	0.08	0.02	0.05	0.05	0.01	0.04	—	0.01	—
45	156	5.18	6.02	5.61	8.59	9.00	8.79	0.35	0.28	0.30	0.66	0.63	0.62	0.04	0.02	0.04	0.15	0.23	0.15	0.02	—	0.02
50	182	6.25	5.70	6.00	9.40	9.65	9.52	0.16	0.34	0.28	0.69	0.57	0.62	0.08	0.04	0.06	0.11	0.08	0.12	—	—	0.01
55	177	5.45	6.09	5.80	9.38	9.97	9.70	0.38	0.35	0.34	1.24	0.79	0.99	0.22	0.14	0.17	0.11	0.09	0.10	0.04	0.02	0.03
60	185	7.05	5.99	6.56	11.13	10.22	10.88	0.33	0.44	0.43	1.00	0.97	1.02	0.05	0.21	0.11	0.15	0.33	0.17	0.08	0.00	0.04
65	152	6.29	6.09	6.30	11.01	11.28	11.12	0.64	0.66	0.60	1.85	1.38	1.62	0.04	0.01	0.05	0.21	0.18	0.23	0.08	0.16	0.08
70	171	5.68	7.03	6.18	12.07	12.22	11.98	0.51	0.60	0.53	1.74	1.67	1.69	0.13	0.15	0.13	0.18	0.19	0.24	0.02	0.02	0.06
75	154	7.15	7.23	7.19	13.32	13.44	13.36	0.49	0.66	0.58	2.19	1.88	2.04	0.12	0.07	0.11	0.18	0.32	0.24	0.02	0.05	0.04
80	162	7.41	7.61	7.50	14.22	14.40	14.30	0.87	0.49	0.69	2.12	2.50	2.27	0.21	0.09	0.14	0.18	0.52	0.39	0.08	0.07	0.07
85	147	7.82	8.49	8.05	15.44	16.70	16.25	0.73	0.71	0.76	2.11	0.92	1.50	0.23	0.20	0.22	0.81	0.46	0.49	0.26	0.18	0.14
90	149	8.36	8.09	8.21	16.28	16.52	16.37	0.68	0.98	0.85	3.43	2.53	2.89	0.15	0.29	0.30	0.82	0.44	0.82	0.19	0.19	0.29
95	169	9.66	7.21	8.50	20.13	17.80	18.30	1.14	1.27	1.08	3.86	4.27	4.24	0.71	0.51	0.46	0.43	1.32	0.84	—	0.39	0.21
100	120	10.51	8.97	9.50	22.88	22.65	23.02	0.98	1.24	1.19	5.87	4.90	5.28	0.58	0.29	0.48	8.37	1.12	4.21	3.43	0.42	1.69
all	3384	5.70	5.71	5.70	9.99	10.16	10.08	0.39	0.44	0.41	1.31	1.27	1.29	0.12	0.10	0.11	0.44	0.25	0.34	0.15	0.07	0.11

Columns (3)–(23): expenditure in rupees per person per 30 days.

Number of sample villages including 4 uninhabited villages in each sub-sample : 772(s.s.1), 772 (s.s.2), 1544 (combined).
Number of sample households : 768 (s.s.1), 768 (s.s.2), 1536 (combined).

[1] Excludes Jammu & Kashmir.

[2] Population estimates used elsewhere are based on projection.

TABLE (14): CUMULATIVE PERCENTAGES OF EXPENDITURE PER 30 DAYS BY ITEMS OF CONSUMPTION AND BY SUB-SAMPLES

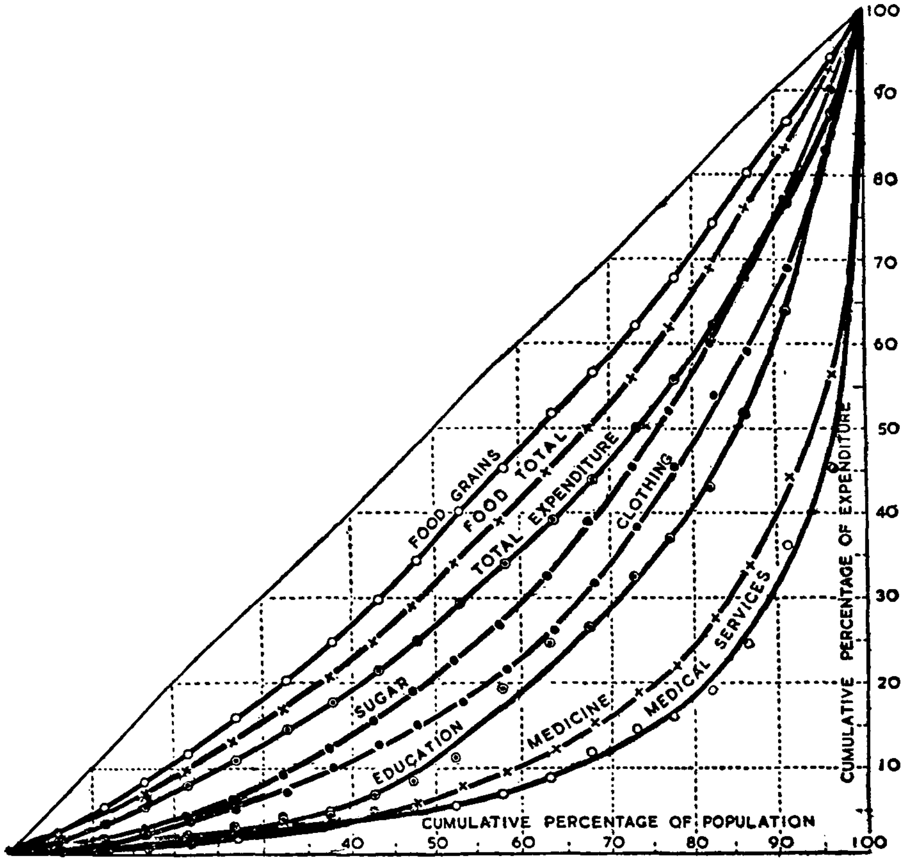
National Sample Survey 9th round : May-November 1955 : All-India (Rural)[1]

per-cen-tile	cumulative percentage of expenditure on																				
	foodgrains			food total			sugar			clothing			education			medicine			medical services		
	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.	s.s.1	s.s.2	comb.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
5	2.59	2.43	2.44	1.98	1.75	1.80	0.61	0.51	0.52	0.48	0.20	0.34	0.20	0.90	0.52	0.15	0.06	0.12	0.07	—	0.05
10	5.80	5.33	5.54	4.65	3.94	4.26	1.56	1.25	1.34	0.88	1.16	1.04	0.20	1.48	0.79	0.99	0.84	0.94	0.07	—	0.05
15	8.68	8.48	8.55	7.07	6.41	6.72	2.76	2.51	2.62	1.22	2.83	1.88	0.98	1.99	1.45	1.35	1.60	1.45	0.66	1.45	0.92
20	11.67	12.24	11.85	9.64	9.47	9.48	4.39	3.86	4.10	2.47	5.42	4.01	1.14	2.25	1.54	2.12	1.76	2.01	2.38	1.45	2.08
25	15.31	16.51	16.00	12.64	13.03	12.85	5.42	6.57	5.90	3.63	6.93	5.27	1.17	4.87	2.88	2.45	1.91	2.26	2.38	1.45	2.08
30	19.79	20.80	20.34	16.65	16.70	16.67	9.19	8.53	9.06	4.88	9.56	7.18	2.41	5.15	3.78	3.54	2.63	3.22	2.74	6.42	3.94
35	23.96	25.73	24.92	20.12	20.98	20.55	12.46	11.91	12.10	7.43	12.73	10.16	3.47	5.21	4.28	3.83	3.04	3.55	3.91	6.42	4.73
40	29.22	31.15	29.92	24.60	25.52	24.85	16.14	15.22	15.66	9.98	15.71	12.94	7.14	6.21	6.71	4.46	3.26	4.09	3.91	6.78	4.74
45	33.42	36.16	34.45	28.58	29.74	28.87	20.25	18.28	19.00	12.31	18.07	15.15	8.87	7.18	8.24	6.05	7.60	6.15	4.65	6.78	5.35
50	39.51	41.07	40.12	33.80	34.39	33.96	22.58	22.15	22.60	15.24	20.28	17.75	12.33	9.29	11.12	7.39	9.12	8.04	4.65	6.78	5.64
55	44.36	46.66	45.45	38.57	39.54	39.01	27.51	26.34	26.86	20.04	23.55	21.79	21.76	16.60	19.39	8.70	10.99	9.57	6.09	8.43	6.86
60	51.26	52.01	51.73	44.78	44.66	44.91	32.24	31.52	32.58	24.29	27.48	26.12	23.96	27.43	24.70	10.62	17.66	12.33	8.89	8.60	8.81
65	56.50	56.40	56.69	50.02	49.24	49.86	39.98	37.80	39.13	31.02	31.97	31.79	25.57	27.71	26.60	13.35	20.65	15.35	11.44	18.13	11.87
70	62.22	61.96	62.17	56.95	54.66	55.88	47.42	44.03	45.59	38.66	37.92	38.44	31.93	34.37	32.49	15.66	24.14	18.94	12.03	19.51	14.48
75	67.67	68.51	67.92	62.75	61.51	61.92	52.81	51.87	51.96	45.93	45.58	45.65	36.46	37.94	37.12	17.49	30.63	22.07	12.63	23.10	16.05
80	73.32	75.32	74.22	68.93	68.73	68.73	62.44	57.59	59.95	52.99	55.67	54.10	44.18	42.45	43.21	19.30	41.28	27.50	14.98	27.90	19.19
85	80.01	80.58	80.33	76.47	74.55	75.71	71.51	63.33	67.86	60.87	58.25	59.15	53.56	49.65	51.72	28.26	47.83	33.70	23.55	36.92	24.71
90	87.00	87.52	86.66	84.24	82.50	82.86	79.77	74.33	76.85	73.39	68.02	69.03	59.38	63.59	63.90	37.17	56.32	44.24	29.72	49.81	36.23
95	94.32	93.82	94.09	92.95	91.23	91.91	92.32	88.84	89.81	86.15	84.79	85.45	85.04	88.75	84.73	41.38	82.47	56.49	29.72	76.93	45.66
100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Number of sample villages including 4 uninhabited villages in each sub-sample : 772 (s.s.1), 772 (s.s.2), 1544 (combined).
Number of sample households : 768 (s.s.1), 768 (s.s.2), 1536 (combined).
[1] Excludes Jammu & Kashmir.

CONCENTRATION CURVES FOR CONSUMER EXPENDITURE

Cumulative percentage of total expenditure per 30 days on selected items based on the National Sample Survey : 9th Round : May-November 1955 : All-India Rural.
Number of sample villages 1544 including 8 uninhabitad villages.
Number of sample households 1536.



limit of per capita expenditure per 30 days	percentage of household	food grains	food total	total expenditure	sugar	clothing	education	medicine	medical services
(0.1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		share in percentage of total expenditure							
Rs. 6	bottom 10 p.c.	5.5	4.3	3.5	1.3	1.0	0.8	0.9	0.05
Rs. 13	lower 50 p.c.	40.1	33.0	29.4	22.6	17.8	11.1	8.0	5.6
Rs. 194	top 10 p.c.	13.3	17.1	23.2	23.2	31.0	36.1	55.8	63.8

OPERATIONAL RESEARCH MODELS USED FOR PLANNING IN INDIA

1. Reproduced from the Proceedings of the Second International Conference on Operational Research, 1960.

2. Based on mimeographed working paper no. PD. WP. 117 (253) dated 3 January 1963 of the Indian Statistical Institute Series of Studies Relating to Planning for National Development started in 1954.

The basic problems of planning in an underdeveloped country like India relate to

(i) a rapid increase in per capita income over a sustained period of time; and

(ii) a rapid reduction of unemployment and under-employment of the country's growing labour force*.

The word rapid in this context should indicate a rate which is considerably larger than the rate at which the magnitudes would have changed in case the economy was left on its own and allowed to proceed unplanned. As these rates are not given, it is necessary to make reasonable estimates about what should be the rate of increase in national income or what should be the rate of absorption of new entrants to the labour force**. The estimates should have an optimal character acceptable to the decision-making authorities (in the present case, the Government of India) which in their opinion would be capable of being realized under the given political-economic conditions (depending on what institutional changes could be possible and what the people of the country could be persuaded to perform) and subject necessarily to the constraints supplied by the technical economic facts (such as natural resources, structure of industrial production, availability of scientific and technical personnel, facilities for training, etc.). To try to obtain a maximum in the mathematical sense is entirely unrealistic. Many of the parameters cannot be precisely defined; and even those which are capable of being clearly defined could be estimated only with large margins of uncertainty for lack

---

* Which is increasing at the rate of 2.5-3 million per year (on the basis of a population of 400 million, a labour force of about 150 million and a rate of growth from 1.5 to 2% per year).

** For example, for social and political stability it would seem necessary to have a rate of growth sufficiently rapid to be able to absorb all new entrants to the labour force after, say, ten years.

of relevant information which itself is a mark of under-development. To give the problem the form of a neat mathematical maximization would amount to an infructuous exercise. We believe, however, it was possible to use the approach of operational research to have a significant impact on economic planning at the national level in India as explained in the present paper. The solution of the basic problem involves four general measures :

(i) to increase the rate of investment in the country;

(ii) to allocate the investment in a way which would make possible increasingly larger investments in future and a continuing rise of the national product, and would at the same time provide progressively large volumes of employment;

(iii) to expand educational and training facilities in such a way as to provide an increasing supply of technical and scientific personnel to enable the desired rate and pattern of investment being realized in succeeding years; and

(iv) to work out the above developmental programme in such a way that there is no fall in the basic consumption standard of the population, preferably with a rise in the level of living of the poorer people.

There are many concomitant measures which would be desirable or even necessary. For example, a retardation of the rate of growth of population would be of help in the general process of growth. Promotion of social justice and progress towards economic democracy would have generally beneficial effects. Positive steps would be necessary to adapt the administrative system to meet the needs of a growing economy. Several other important measures can be mentioned which all belong to the concomitant class according to our notions.

It has not been possible, so far, to arrive at a general solution of the problem stated above. Several aspects of the problem have been studied with the help of simple mathematical models. The object of this paper is to give a descriptive account of some of those adventures, as they may be called, because the methods did not follow the traditional economic analysis, but were of the type which we believe can be called operational research. In January 1950, in his presidential address to the 37th session of the Indian Science Congress entitled, 'Why Statistics ?'(1), P. C. Mahalanobis pointed out that, 'investing one rupee would bring a return of one rupee in future years; but whether one can afford to invest even one rupee depends on this income'. It is of interest to note that the parameter used is the ratio of the value of output to investment, a gross concept. In the absence of national income and investment data relating to the country at the time, no further elaboration (of presentation) was possible.

In a lecture delivered at the National Institute of Sciences in India in October 1952,[2] Mahalanobis used a full forward-looking Harrod-Domar type of model. This may be conveniently called the single-sector model. The variables involved in this model are I_t and Y_t, investment and national income respectively in the t-th year, I_t being reckoned net and Y_t, the unduplicated aggregate (unlike the duplicated aggregate used in the earlier venture). The following two relations are supposed to hold between the variables $I_t/Y_t = \alpha$ and $(Y_{t+1}-Y_t)/I_t = \beta$, the parameter α giving the rate of net investment on net national income and parameter β, the incremental net output-investment ratio. This formulation finally leads to

$$Y_t = Y_0(1+\alpha\beta)^t \qquad \dots \quad (1)$$

giving the growth pattern of income over time with Y_0 as the initial income. In Domar's notation, involving differential rather than difference equations, the above expression can be written as $Y_t = Y_0e^{\alpha\beta t}$. If population in assumed to increase at the rate of $\rho\%$ per year, the per capita income η_t, in the t-th year is given, approximately, by

$$\eta_t = \eta_0(1+\alpha\beta-\rho) \qquad \dots \quad (2)$$

η_0 being the initial per capita income.

The following example taken from the lecture will illustrate the above relations. In the U.S.A. over the period 1861–1938, α was 12%and β was 33%. The rate of increase of national income should therefore be $\alpha\beta = 4\%$. The rate of increase in population over the period, ρ was 2%. Hence per capita income, roughly, ought to increase at the rate $(\alpha\beta-\rho)$ or 2% per year. This rate tallies closely with the actual rate of increase of per capita income in the U.S.A. over the period, which was 1·9%.

In the paper, 'Some Observations on the Process of Growth of National Income',[3] Mahalanobis has given a model of growth in which the net output of the economy is conceived as arising out of two sectors, activities producing consumer goods and activities producing investment goods. Activities producing raw materials are suppose to be allocated between these two sectors, and their outputs get deducted in the appropriate sectors as items of cost, only the final outputs or the net products being considered as variables in the system. The classification adopted is different from the one used by Marx, whose 'department 1' included all capital goods and raw-material producing industries and 'department 2', all consumer-goods producing industries. The variables used in the model are Y_t, C_t, and I_t standing for national income, consumption, and investment respectively in the t-th year. It is assumed that the investment in the t-th year is divided between industries producing investment goods and industries producing consumer goods in the ratio λ_i, λ_c where $\lambda_i+\lambda_c = 1$. Then, as in the case of the single-sector model, incremental output investment ratios β_i and β_c are defined separately for each sector. The basic equations of the model can be written as

$$I_t = I_0(1+\lambda_i\beta_i)^t \quad \ldots \quad (3)$$

$$Y_t = Y_0 \left[1+\alpha_0 \frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i\beta_i} \{(1+\lambda_i\beta_i)^t-1\}\right] \quad \ldots \quad (4)$$

where α_0 is the investment rate in the initial year. In Domar's differential notation equation (4) can be written as

$$Y_t = Y_0\left[1+\alpha_0 \frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i\beta_i} (e^{\lambda_i\beta_i t}-1)\right]. \quad \ldots \quad (5)$$

A model of exactly this type was developed by Feld'man in 1928 in the U.S.S.R.[(4)]. A summary of the paper in English is available in Domar's Essays in the Theory of Economic Growth[(5)]. The Indian work, however, was done completely independently of Feld'man's findings. It is interesting to note that the impetus of planning initiated almost identical lines of thinking in the two countries, the U.S.S.R. and India.

The change in the pattern of growth for income, investment, and investment rate (α_t) with the variation in λ_i can be observed from the figures computed from equations (3) and (4) and presented in Table 1. The following broad conclusions can be drawn from the figures given in Table 1: (a) When $\beta_c > \beta_i$, a lower λ_i will give a larger rise in national income than a higher λ_i in the first few years, but (b) after a few years, the larger the value of λ_i the larger will be the rise in income. Hence it will be desirable to choose as large a value of λ_i as possible if we have a long time horizon in view. But λ_i, which stands for the ratio of investible final resources which are allocated to industries producing investment goods, to the total final investible resources, cannot be pushed up without any limit. In an open economy sector (i) may include those export industries whose proceeds are used for capital imports; this would enable λ_i to be increased to some extent. But in spite of this, the claims of the consumer-goods industries have to be met, and the techno-

TABLE 1. PATTERN OF GROWTH OF INCOME AND INVESTMENT

Initial value : $Y_0 = 100$, $\alpha_0 = 6\%$, $\beta_i = 0.25$, $\beta_c = 0.50$

t	$\lambda_i = 0.1$			$\lambda_i = 0.3$			$\lambda_i = 0.5$		
	I_t	Y_t	α_t	I_t	Y_t	α_t	I_t	Y_t	α_t
0	6.0	100	6.00	6.0	100	6.00	6.0	100	6.00
1	6.2	103	5.97	6.4	103	6.29	6.8	102	6.60
2	6.3	106	5.96	6.9	105	6.59	7.6	105	7.25
3	6.5	109	5.94	7.4	108	6.88	8.5	108	7.93
4	6.6	112	5.92	8.0	111	7.19	9.6	111	8.67
5	6.8	115	5.91	8.6	115	7.51	10.8	114	9.45
6	7.0	118	5.89	9.3	118	7.82	12.2	118	10.21
7	7.1	122	5.87	10.0	122	8.13	13.7	123	11.12
8	7.3	125	5.86	10.7	127	8.45	15.4	128	12.01
9	7.5	129	5.83	11.5	131	8.77	17.3	134	12.93
10	7.7	132	5.82	12.4	136	9.09	19.5	140	13.87
20	9.8	173	5.69	25.5	210	12.12	63.3	272	23.33

logical set-up of industries manufacturing capital goods may be such that it could produce a larger volume of capital goods for consumer-goods industries and not much capital goods for capital-goods industries and it may take time to make this set-up more conducive to the production of capital goods for the manufacture of capital goods. In the table, with $\lambda_i = 0{\cdot}1$, the investment rate is not maintained; clearly an unsatisfactory situation. On the other hand $\lambda_i = 0{\cdot}3$ gives a more desirable picture of development with plausible rise in the rate of investment. With $\lambda_i = 0{\cdot}5$, the investment rate is very high and may not be considered as plausible. In Indian conditions $\lambda_i = 0{\cdot}3$ or 0·4 may be considered to be suitable.

It can be shown that the limiting value of α_t is $\lambda_i\beta_i/(\lambda_i\beta_i+\lambda_c\beta_c)$. If α_0 is smaller than this, then the process of growth will entail progressive increase in α_t until the limiting value is reached. As in the first variant of our example, α_0 can be higher than this limiting value, and the development process here would lead to a gradual decline in the value of α_t until we get the limiting value. If we consider a case in which investment rate is rising, the initial rise in consumption would be more rapid in a variant of a plan in which λ_c is larger. If, however, we consider the position attained after the lapse of a critical period of time, a small value of λ_c would eventually lead to a larger rise in consumption than a larger value of λ_c.

If we plot Y_t's against time and values of λ_i, λ_i going from 0 to 1, we notice that before a critical period Y_t decreases monotonically with λ_i. A true maximum exists within this critical period; and Haldane has indicated the method of computing this maximum[6]. After this range Y_t is monotone increasing with λ_i. The position is indicated in Table 2. It will be seen that the true maximum exists only in the range six to eight years. These discussions are, however, only of theoretical interest. For practical purposes, we are usually interested in t's beyond this critical range.

In the two-sector model the concept of maximization centres round a variable relating to a particular point of time. Thus, we may seek to maximise national income, consumption, or investment at a particular point of time, say after twenty years. This takes no notice of the time path, and it may be desirable to maximize the aggregates of these variables over a certain time horizon. In general, it is possible to conceive of situations in which a lower value at the end point will give a higher aggregate than a higher value at the end point. When we are interested in income we may introduce a variable Z_t given by $Z_t = \int_0^t Y_t dt$. It can be shown that,

$$Z_t = Y_0\left[t\left(1-\alpha_0\frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i\beta_i}\right)+\alpha_0\frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i^2\beta_i^2}(e^{\lambda_i\beta_i t}-1).\right] \quad \ldots \quad (6)$$

We may seek an allocation which maximizes Z_t at a point of time rather than Y_t. It is interesting to note that at the level of the values of parameters we are considering the results given by the two procedures are not widely different.

In the long-range projection given in the First Five Year Plan of India, a somewhat interesting single-sector model was made use of[7]. The variables used in the model are the same as those already considered; also the parameter β was used as defined earlier. But a new parameter, γ was used in the model giving the ratio of increment in investment to increment of income, i.e., the ratio giving the investment made out of increase in income, or $(I_{t+1}-I_t)/(Y_{t+1}-Y_t)$. Ultimately, we arrive at the expression,

$$Y_t = Y_0\left[1+\frac{\alpha_0}{\gamma}\{(1+\gamma\beta)^t-1\}\right]. \quad \ldots \quad (7)$$

As it is very difficult to estimate γ, this model was not found to be operationally very useful. In the plan calculations the model was used with a larger time lag; here the standard lag has been used for elegance of presentation. In the Second Plan projections a simple single-sector model as given in equation (1) was used in preference to this.

TABLE 2. VARIATION OF Y_t WITH t AND λ_t

Initial values : $Y_0 = 10{,}000$, $\alpha = 6\%$, $\beta_t = 0.25$, $\beta_c = 0.50$

t/λ_t	0.00	0.01	0.10	0.20	0.30	0.40	0.50
0	10,000	10,000	10,000	10,000	10,000	10,000	10,000
1	10,300	10,298	10,293	10,270	10,255	10,240	10,225
2	10,600	10,597	10,581	10,550	10,330	10,504	10,479
3	10,900	10,896	10,878	10,853	10,823	10,794	10,763
4	11,200	11,194	11,186	11,166	11,139	11,114	11,081
5	11,500	11,492	11,493	11,490	11,482	11,464	11,444
6	11,800	11,803	11,824	11,836	11,846	11,853	11,849
7	12,100	12,101	12,153	12,198	12,241	12.278	12,306
8	12,400	12,412	12,485	12,576	12,662	12,746	12,819
9	12,700	12,710	12,839	12,975	13,118	13,259	13,397
10	13,000	13,021	13,192	13,397	13,607	13,826	14,045

t/λ_t	0.60	0.70	0.80	0.90	0.99	1.00
0	10,000	10,000	10,000	10,000	10,000	10,000
1	10,210	10,195	10,180	10,165	10,151	10,150
2	10,451	10,425	10,396	10,367	10,341	10,336
3	10,729	10,693	10,655	10,615	10,576	10,570
4	11,049	11,010	10,966	10,918	10,870	10,864
5	11,416	10,381	11,339	11,290	11,237	11,230
6	11,838	11,818	11,787	11,745	11,695	11,686
7	12,324	12,331	12,325	12,302	12,266	12,262
8	12,883	12,934	12,970	12,985	12,978	12,976
9	13,325	13,643	13,744	13,822	13,867	13,870
10	14,264	14,475	14,673	14,847	14,976	14,992

In the models considered so far use has been made of marginal or incremental capital-output ratios. We could, however, use the total or aggregate ratios for preparing similar models. This requires the introduction of a new variable K_t giving the stock of capital in the country. Instead of the usual ratio $\beta = (Y_{t+1} - Y_t)/I_t$, we can use the ratio say $\beta' = Y_t/K_t$. We also have to use the relation $K_{t+1} = K_t + I_t$. Most of the above models then can be translated in terms of β'. As it was not possible to estimate the parameter β' in the absence of an estimate of capital stock in the country, models of this type are not immediately useful*.

The models considered here are essentially forward-looking planning models and are qualitatively different from the Harrod type of model con-

* It is worth noting that in general β and β' are not equal; and it would be of great interest to make an empirical study of these two parameters using statistical data relating to various countries. A long time series of national income and investment expressed at constant prices furnish suitable data for estimating both α and β used in the earlier models. Such time-series data on capital stock are, however, available only for a few countries.

cerned with the accelerator. While an accelerator explains the rise in investment in terms of increase of consumption or income in the past, an incremental output-capital ratio estimates the increase in income and consumption in future arising out of current investment. It has been shown that the two may be numerically equal under special circumstances but are qualitatively different.[8]

Finally, we may consider a different type of model developed by Mahalanobis for working out the basis of the Second Five Year Plan of India.[9] While the earlier models are growth models, this model should properly be called an allocation model. The object of the model is to get a consistent solution to obtain a desired rise in national income as a result of given amount of investment, and at the same time creating a desired volume of employment. It was necessary to use such a model to get the broad sector allocations of investments in the Draft Plan-frame for the Second Plan prepared by Mahalanobis.

The model distinguishes four sectors and can conveniently be referred to as the four-sector model. One of the sectors produces investment goods as before, and three others produce consumer goods consisting of : (a) factory production; (b) agriculture and household industries; and (c) service sectors. The sectors may for convenience by denoted by (i), (1), (2) and (3). With this notation the allocation parameters, as before, may be written as λ_i, λ_1, λ_2 and λ_3; and the incremental net output-investment ratios as β_i, β_1, β_2 and β_3. As employment is to be specifically considered in the model, a set of new parameters θ_i, θ_1, θ_2, θ_3 is introduced giving the investment required per engaged person in the four sectors respectively. The variables, income (E) and investment (A), are depicted by a new notation because these give the respective increments over the plan period of five years; and a new variable N is also introduced giving the increment in employment over the plan period of five years. The sector breakdown of N may be denoted by the corresponding small letter n_i, n_1, n_2, n_3 with the sector suffixes. The basic set-up is ultimately given by,

$$N = n_i+n_1+n_2+n_3 \qquad \dots (8)$$

$$A = n_i\theta_i+n_1\theta_1+n_2\theta_2+n_3\theta_3 \qquad \dots (9)$$

$$E = n_i\theta_i\beta_i+n_1\theta_1\beta_1+n_2\theta_2\beta_2+n_3\theta_3\beta_3. \qquad \dots (10)$$

These, together with the relation $\lambda_i+\lambda_1+\lambda_2+\lambda_3 = 1$, form the set of equations in which we are interested.

The actual situation before the preparation of the Plan-frame was somewhat like this. It was known from the Ministry of Finance that the maximum (permissible) level of investment for the plan period would be Rs. 56,000 million. It was also the general feeling that an attempt should be made to create new employment for about 10–12 million persons. In this situation it was felt that it would be reasonable to have a target of increase of national income at the rate of 5% per annum. Also, with a view to facilitating long-period developments extending beyond the Second Plan, it was considered advisable to choose a value of $\lambda_i = 0{\cdot}33$. Since λ_i is known n_i being equal to $\lambda_i A/\theta_i$, is also known if θ_i can be assumed to be known. The values of the parameters θ_i, θ_1, θ_2, θ_3 and β_i, β_1, β_2, β_3 were estimated on the basis of available statistical information, and values of N, A, and E being known, we can solve the equations (8), (9), and (10) for n_1, n_2 and n_3. From this we can easily work out the investment required and income originating in the different sectors.

The values of the parameters used for calculations are given in Table 3 below :

TABLE 3. PARAMETERS USED IN THE FOUR-SECTOR MODEL.

sectors	parameters	
		Rs.
(i) investment goods	$\beta_i = 0.20$	$\theta_i =$ 20,000
(1) factory consumers goods	$\beta_1 = 0.35$	$\theta_1 =$ 8,750
(2) agriculture and household industries	$\beta_2 = 1.25$	$\theta_2 =$ 2,500
(3) services	$\beta_3 = 0.45$	$\theta_3 =$ 2,750

The solution for the plan period may then be tabulated as :

TABLE 4. SOLUTIONS FOR THE FOUR-SECTOR MODEL

sectors	investment (A), Rs. million	increase in income (E), Rs. million	employment (N), million
(i) investment goods	18,500	3,700	0.9
(1) factory consumers goods	9,800	3,400	1.1
(2) agriculture and household industries	11,800	14,700	4.7
(3) services	16,000	7,200	4.3
	56,100	29,000	11.0

one U.S. dollar = Rs. 4.75.

The household sector was then subdivided into agriculture proper and household industries, and the allocation for these subsectors were worked out as follows :

	investment (A), Rs. million	increase in income (E), Rs. million	employment (N), million
Agriculture	9,800	10,830	1·58
Household industries	1,940	3,870	3·12
	11,800	14,700	4·70

These figures were rounded off and slightly modified before they were incorporated in the Draft Plan-frame.

Two observations on the four-sector model would be pertinent. The usefulness of a model of this type depends very largely on the accuracy of the parameters used. Considerabe work was done to make the estimates of the parameters as realistic as possible. The statistical material was, however, meagre at the time of the preparation of the plan-frame. Moreover, as the plan-frame calculations were urgently required, it was not possible to devote a lot of time to the improvement of the estimates. In fact, the only choice was to make the best possible use of the available data within a very limited time*. A number of criticisms have been levelled against the model subsequently. [(10), (11), (12), (13), (14), (15)]. But most of the critics failed to grasp the essentially operational character of the model. It was never intended to be an addition to theoretical economics. In fact, no other claim can be made in favour of the model except that it provided a rational framework for solving a concrete allocation problem quickly and in time for urgent decisions of national importance. It may be added, however, that models of this type with certain elaborations could be used to give optimal solutions to problems of national planning with the help of linear programming.

In conclusion, we may briefly consider some other models which were also constructed in connection with the Indian plans but were not directly used in national planning. The fact that these models were not used in

* The five-year period of the First Five Year Plan was due to terminate at the end of March 1956. The studies on planning were inaugurated by Prime Minister Nehru in November 1954 ; and it was desired that preliminary allocations should be made by March 1955, in order that the Second Five Year Plan could be got ready in time for the budget session of the Parliament in 1955-56. The work on the Draft Plan-frame (which was submitted to Government on 17 March 1955) had to be completed in about four months.

actual planning was due to reasons which had very little to do with the value of the models for planning purposes. Two of these are due to Bettelheim, the first, an extension of Mahalanobis's two-sector model; and the second a new model for perspective planning. In the first model[16] Bettelheim distinguishes between gross product and net product of sector (i), thus bringing in the question of replacement requirements, and obtains the expression

$$Y_t = Y_0 \left[1+\alpha_0 \frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i\beta_i\frac{\lambda_c}{\mu}} \left\{ \left(1+\lambda_i\beta_i-\frac{\lambda_c}{\mu}\right)^t -1 \right\} \right] \qquad \ldots \quad (11)$$

where μ is the ratio of net investment to increase in requirements of replacement which is assumed to be constant. Thus, here, national income increases only when $\lambda_i > \dfrac{1}{\mu\beta_i+1}$ and not always as in Mahalanobis's two-sector case. Bettelheim's model for perspective planning is developed in a large number of working papers[17], and it is not possible to give a full account in the space at our disposal. Apart from the variables already considered, he has made use of wage-rate and productivity in sectors (i) and (c) as variables, and his expression for the ratio of the increase in investment to the increase in output (δ) is given as

$$\delta = \frac{\rho_i(\rho_c'-1)}{\rho_i(\rho_c'-1)+\rho_c} \qquad \ldots \quad (12)$$

where ρ's are sectoral productivities, and ρ' is defined as p/w, where w is the overall wage-rate. The basic conclusion of his analysis is that one should prefer an investment allocation and choice of technique which would maximise the fund available for future investmemt. But when two variants give approximately the same surplus he would choose one which would give a larger supply of consumer goods after a given period of time.

Finally, it may be mentioned that Ragnar Frisch and J. Sandee used linear programming for solving problems of planning in India, both makimg use of intput-output tables constructed in the Indian Statistical Institute[18] [19]. The work involved maximization of a social-welfare function subject to inter-industry and certain other constraints. While Frisch attempted to maximize a weighted function of income and employment, Sandee attempted only to maximize consumption. This line of work is of considerable theoretical interest and may be of practical value in the not too distinct future when more adequate statistical data become available.

References

1. Mahalanobis, P. C., 'Why Statistics ?' Presidential address to the 37th session of the Indian Science Congress, January 1950 (Proceedings).
2. Mahalanobis, P. C., 'National Income, Investment, and National Development', Lecture at the National Institute of Sciences of India, October, 1952 (Proceedings).
3. Mahalanobis, P. C., 'Some Observations on the Process of Growth of National Income', *Sankhyā*, 1954, **12**, Part 4.
4. Feld'man, G. A., 'On the Theory of National Income Growth', *Planovoe Khoziaistvo*, November 1928, No. 11. pp. 146-170.
5. Domar, E. D., 'Essays in the Theory of Economic Growth', 1957, pp. 223-261.
6. Haldane, J. B. S., 'The Maximization of National Income', *Sankhyā*, December 1955, **16**, Parts 1 and 2.
7. Mukherjee, M., 'The Technique of Social Accounting in a Pre-industrial Economy', *Sankhyā*, 1954, **14**, Parts 1 and 2.
8. Ott, A. E., 'The Relation between the Accelerator and Capital Output Ratio', *Review of Economic Studies*, June 1958, **25**(3), No. 68.
9. Mahalanobis, P. C., 'The Approach of Operational Research to Planning in India', *Sankhyā*, December 1955, **16**, Parts 1 and 2.
10. Chakravarty, S., 'The Mahalanobis Model of Development Planning', *Arthaniti*, 1957, **1**, No. 1.
11. Sen, A., 'A Note on the Mahalanobis Model of Sectoral Planning' *Arthaniti*, 1958, **1**, No. 2.
12. Mathur, P. N., 'A Note on Planning in India', *The Indian Economic Journal*, April 1957, **4**, No. 4.
13. Komiya, R., 'A Note on Professor Mahalanobis' Model of Indian Economic Planning', *Review of Economics and Statistics*, 1959, **41**, No. 1.
14. Tsuru, S., 'Some Theoretical Doubts on the Plan-Frame', *Economic Weekly*, Annual Number, 1957.
15. Mitra, A., 'A Note on the Mahalanobis Model' *Economic Weekly*, 1957.
16. Bettelheim, Ch., 'Investment Allocation and Increase in National Income' (Indian Statistical Institute, Studies Relating to Planning for National Development Working Paper No. 10 (mimeographed), December, 1954).
17. Bettelheim, Ch., 'The Technologiacl Choices and the Aim of Economics Planning' (Indian Statistical Institute, Studies Relating to Planning for National Development (mimeographed), Working Paper No. 62, and six other Working Papers bearing numbers 68, 69, 70, 71, 72 and 73, July 1956).
18. Frisch, R., 'Planning for India : Selected Explorations in Methodology', Asia Publishing House and Statistical Publishing Society, 1960.
19. Sandee, J., 'A Demonstration Planning Model for India', Asia Publishing House and Statistical Publishing Society, 1960.

THE SOCIAL INFORMATION FOR NATIONAL DEVELOPMENT

Published in *Sankhyā*, Vol. **25**, Ser. B (1963), pp. 49-66

1. Introduction

1.1. The problem of improving the material and cultural conditions of the poorer countries of the world has been engaging serious attention during the post-war period. The desire for political independence is rapidly increasing and will continue to grow in the countries still under colonial rule. Also, more and more countries are becoming and will become politically independent. With the gaining of independence, it is being increasingly realized that political freedom is necessary, but is not enough. In most of the under-developed areas, attention is being given increasingly to economic development to improve the level of living, by increasing the flow of goods and services and by expanding facilities for cultural amenities. It is also being increasingly appreciated that rapid economic growth can be brought about only by an increasing accumulation of capital to supply modern tools and machinery for new and expanding productive activities which would, in time, solve problems of unemployment or under-employment, and would also continually improve the level of living. Such accumulation of capital would call for increasing domestic savings, and the utilization of such savings for productive purposes. The choice of productive activities (that is, of investments) must also be such as to secure the best possible rate of economic growth over a time horizon of a generation or more.

1.2. How to bring this about ? This is where the question of social transformation becomes relevant. Some broad general principles may perhaps be stated with confidence.

2. The structural transformation

2.1. It is necessary to give opportunities for participation in productive activities to the largest number of people, and as soon as possible, to all such people as are capable of undertaking such work, and also to utilize available resources in the most effective way for the benefit of the nation as a whole. To create fullest opportunities for rapid growth, it is necessary to remove all barriers to the effective utilization of productive forces, by the people, for the benfit of all the people of the country.

2.2. There are many facets to the problem, some of which are general and some peculiar to particular countries. It is not possible to arrange them in any clear order of priority. In fact the heart of the problem is to make changes in all necessary directions at the same time, in a balanced way, so as to bring about the structural transformation as quickly as possible.

2.3. The transformation of the social structure cannot be an entirely internal process. Outside influences have been and will continue to be at work. Colonial rule and economic exploitation of the underdeveloped countries have themselves given rise to reactions promoting the desire for political independence and for improvement in the level of living in the under-developed areas.

2.4. A new factor, of conscious international cooperation in improving the social, political, and economic conditions of the underdeveloped countries has also emerged during the last ten or fifteen years through a quickening of the world conscience on humanitarian grounds and also in the enlightened self-interest of the more advanced countries. Isolation is no longer possible, physically, psychologically or organizationally. The influence of information, ideas, advice and aid from outside would be an increasingly important factor.

2.5. A structural transformation of the whole society is, however, indispensable to make conditions fit for rapid economic growth. Without such transformation, any amount of help from outside would be ineffective. The experience of many countries during the post-war period would corroborate this.

3. The scientific revolution

3.1. It is also necessary to develop the outlook of science and the experimental attitude of mind in order to acquire knowledge of natural and social forces and to invent new techniques for initiating material and social changes. This is the only way in which decisions can be made increasingly in a rational manner, in accordance with principles of objective or scientific validity based on relevent data and correct reasoning, instead of on the sanction of authority based on status and power or custom and conventional or revealed rules and laws. This may be called the scientific revolution.

3.2. The need of what I have called "the scientific revolution" is recognized, but has not received sufficient attenton. I have considered some aspects of this problem in the next paper on "The Scientific Base of Economic Development,"

4. Modernization of society

4.1. The social transformation and the scientific revolution are both necessary. These are but two aspects of modernization which can be distinguished but not separated. The social transformation and the scientific revolution in combination leads to modernization. The task of international cooperation is to promote and help, in every possible way and in a peaceful manner, the modernization of the underdeveloped countries.

4.2. *Urgency of the task* : The scientific and industrial revolution took place in West Europe and North America roughly over a period of three or four hundred years. It is not possible to wait for such a long time for the underdeveloped countries to attain a reasonable level of living. The historical process of transformation must proceed five or ten times faster. Such speeding up of the process of transformation has always been a characteristic feature of biological evolution, and can be achieved.

4.3. *Different phases of the transformation* : Some of the newly independent countries are large, some are of medium size, and some are extremely small in areas, or in natural resources or in population. They would have widely differing needs. The particular form and contents and components of each step of modernization would depend on the special conditions of each country and the stage of development reached by it, and would therefore, vary from one country to another or from one region to another of the same country and also, over a period of time, in the same country or in the same region.

4.4. *International cooperation* : The most significant fact of the present age is the rapidly expanding contacts between different countries of the world. This tendency is bound to become stronger in future, increasing the scope of international affairs in every direction. At the same time, what George Washington had said about "no country being able to go beyond its own self-interest in international affairs," would continue to remain valid. The real need is, therefore, to discover new areas of mutual self-interest, and to expand spheres of common interest on both bi-lateral and multi-lateral basis to the fullest extent.

4.5. It is also clear that even the most advanced countries still have unlimited scope for both social and scientific progress. For all countries, large or small, advanced or underdeveloped, international cooperation is necessary and beneficial. The smaller and the less-developed a country, the greater however will be the need and importance of such cooperation.

5. Problems of internal reforms

5.1. There is general agreement about some of the most important contents or elements or aspects of the social transformation, such as :—land reform; removal of social, economic and political barriers; mass education and technical training; increasing equality of opportunities; the possibility of a labourer or an initiator securing the fruits of his labour; or the need of medical and health services and cultural amenities etc. There is much in common in respect of such components or aspects of social transformation in the case of all underdeveloped countries, with, however, the need of adaptations to suit the special conditions of each individual country. Some of these components or aspects are briefly considered below.

5.2. *Land reform* : Historically, land reform has been a most important factor in the economic development of all advanced or rapidly developing countries. Agriculture and industry must advance at the same time. It is, however, generally agreed that an agricultural surplus (or, the surplus from extractives) is essential for industrial development. Changes in land tenure and legislation would, therefore, be one of the requirements of the highest priority in most, if not all, underdeveloped regions.

5.3. The aim must be to secure the fruits of his labour to the cultivator so that he has the incentive to improve the land and to introduce more advanced technological methods. Tenancy law should protect the tenant against eviction so long as he is using the land efficiently, and to secure to him the right of fair compensation upon termination of the lease for all unexhausted improvements made by him. It is also necessary to eliminate the unproductive consumption of the surplus from land by intermediaries and landlords, who have no productive functions, by abolishing their rights.

5.4. The question of economy of scale of production may, admittedly, introduce difficulties. The breaking up of large farms may lead to a reduction of the surplus; however, the beneficial effects of greater equality of income and wealth may compensate for the other loss. Also, in countries where there are too many cultivators, often with scattered plots, further breaking up of the holdings may easily have adverse effects on the efficiency of production. In such a situation it may be necessary to promote consolidation of holdings either voluntarily through cooperatives, or by legislation, or both. Redistribution of land has limits and is a complicated question. It is wise to recognize that steps taken at one stage may have to be reversed at a later stage. Appropriate measures must be devised to suit the needs of each country at any particular stage of development. The basic aim would always remain the same, namely, to increase the agricultural surplus, and to use it for productive purposes, as effectively as possible, in speeding up the growth of the economy as a whole.

5.5. *Removal of social, economic, legal and political barriers* : The underdeveloped countries have the very difficult task of achieving a far faster rate of growth than had been achieved by the most advanced countries during and after the industrial revolution. It is indispensable that every one in the working age-group should be fully utilized to increase the national product. It is necessary, therefore, to remove all social, economic, legal and political barriers which prevent individuals, or groups and section of individuals, to become fully productive. Conditions are worst in a country stratified by caste, colour, creed or language, and where whole sections of people are sometimes deprived of opportunities by customs, law, or social and political pressures by ruling groups. Removing all such barriers is an essential condition for rapid growth.

5.6. *Equality of opportunities and vertical mobility* : Removal of social and other barriers, in principle, is necessary but not sufficient. It is essential to help one to make himself fit for the highest type of productive work of which he is capable. Opportunities for education and training and for productive work must be made as widely available as possible. Great inequalities of wealth and income often lead to denial of opportunities to the poorer people, and, unless removed, give rise to a sense of frustration among the underprivileged and hamper the growth of national solidarity. Sufficiently rapid economic progress would be difficult or impossible in societies in which there is lack of vertical mobility and where small sections try to preserve their privileges based on heredity, custom or law without any relation to their productive contributions.

5.7. *Horizontal mobility* : The social system may also hamper the utilization of resources because customs or caste restrictions prevent labour from moving into new occupations, or labour is tied to the soil, or land may be concentrated in the hands of small sections of the people who are unwilling to divert it for more productive use for reasons of social or political prestige. A small number of producers even in underdeveloped countries may sometimes band together to prevent the free entry of others or the introduction of new techniques. All such restrictions must be removed to increase the horizontal mobility of resources.

5.8. *Possibility of securing fruits of labour and enterprise* : The elimination of concentration of social, economic or political privileges in the hands of small sections of the people would promote both vertical and horizontal mobility, and make it possible for every one to secure a fair share of the fruits of his labour and enterprise. This is one of the most important consequences of the social transformation and is particularly helpful in promoting rapid economic growth. Appropriate legal and institutional changes must be made to achieve this.

6. National integration

6.1. *Sectional interests and barriers* : A characteristic feature of under-development is the segmentation of the country into innumerable regions, castes, tribes, languages, religious communities, occupational and other groups which focus attention on the welfare of small sections of the people without any awareness of the best interests of the country as a whole. It has to be recognized that rapid progress is impossible without painful adjustments and damage to sections of the people whose interests are based on special privileges or old techniques; and, that old beliefs, customs, and social institutions have to be discarded, and all barriers of caste, customs, creed, colour, language and sectional interests must be ruthlessly eliminated. The greater the prevalence of such social barriers in the country, the greater are the sectional rigidities within government administration, and the fiercer are the inter-agency jealousies and fights which continually delay decisions and hamper speedy action.

6.2. *Integration* : The removal of social and economic barriers is an indispensable condition for the emergence of the sense of national solidarity without which national development is impossible. It is not possible to isolate the scientific, or the social, or the industrial aspects of the transformation from one another. Advance must be made at the same time on all fronts. This creates difficulties but also has its advantages. Progress in one direction stimulates and promotes progress in another direction. It is the task of leadership to maintain a proper balance between the different aspects and phases of the process of modernization in its full sense. The aim continually must be to create a society from which social, economic and political privileges have been completely eliminated. To bring about such a transformation would call for wise leadership with a clear appreciation of aims and objectives, a rational and experimental attitude of mind with confidence in the outlook of science, and willing to pay the price of much painful adjustments.

7. Danger of superficial imitation of advanced countries

7.1. Because of the sense of urgency for economic growth which is strengthening everywhere, there is a peculiar danger of adopting, in a superficial way or at too early a stage, methods, and forms and institutions, which are working successfully in the advanced countries. It has to be kept in mind that existing social and political institutions, or high levels and standards of quality or performance, were established in the advanced countries only with the gradual growth of the economy. Such institutions may not be useful at an earlier stage of development, and may even hamper progress. For example, in underdeveloped countries, there is sometimes a tendency to adopt too expensive or too sophisticated schemes of education, care of health, public buildings and construction, wages or salaries of government employees or labour legislation.

7.2. *Education and training*: Mass education to spread literacy both among children and adults has special urgency; here all possible help should be utilised, for example, by using the services, for a small part of the day or the week, of those who are already literate. Because the numbers involved are very large, the adoption of too high a standard for teacher qualifications, school buildings etc., at the primary level, would make the cost prohibitive. At the secondary stage, more attention would have to be given to the qualifications of teachers and other educational aids; but scales of pay or cost of buildings should still be kept in balance with the general level of living of the students and the parents themselves. At the tertiary level, still higher standards would have to be adopted for staff qualifications and there would be need of more expensive teaching aids; but the expenditure must be kept within the limits of what the country can afford. It is at the stage of advanced studies and research that standards should be really high and comparable with the advanced countries; however, as the number of advanced and research workers would be very small in the beginning, this would not involve any large total expenditure.

7.3. The educational system should be viewed as a pyramid; the lower the stage the wider should be the base (that is, the number of persons under instruction) and the lower the scales of expenditure compared to advanced countries, while at the highest stage of advanced studies and research the number involved would be extremely small but scales of expenditure may approximate to those of advanced countries. Adoption, at too early a stage, of standards and scales of expenditure of advanced countries at lower levels would lead to severe restrictions in numbers usually coupled with admission of students on the basis of family income; this must have most undesirable social and psychological consequences. When resources in men, materials and money are inadequate, to increase the number of students in accordance with the pressure on admissions, would necessarily lead to window dressing and a dilution of students in practice. This can seriously hamper progress; the only remedy is to adopt a system which would be in keeping with basic aims and yet within the means of the country.

7.4. *Medical care and technical services* : A similar situation can arise even more easily in the field of medical care. Adoption of the high level of university education for physicians in the advanced countries as the only standard at an early stage would necessarily mean that most of the people will be deprived of medical services in underdeveloped countries for a very long time. A two-tier approach with a junior cadre of medical personnel with, say, three or four years' training, together with a much smaller number of physicians with university training, would make it possible to spread medical services much wider and much faster. This would be equally true in many other lines of technical work. A two or even a three-tier approach with a higher, a medium, and even a third level of workers who have had a very quick and specialized training, would be not only within the means of the underdeveloped countries but may be even more effective, because, in the still backward conditions of the country, the lower level workers would be much nearer to the general population and would be able to work in closer touch with them. This would be particularly true in agricultural extension and other services which would bring the technical workers into contact with large sections of the population.

7.5. *Government expenditure* : Government expenditure often tends to become unduly large in underdeveloped countries owing to the adoption of the much higher standards of advanced countries. This leads to unnecessarily high scales of wages and salaries for government employees or costly public buildings; which, in its turn, would increase the feeling of separation between government and the people, and hamper national integration.

7.6. *Labour legislation* : As production becomes modernized and factories and enterprizes grow in numbers and in size, it would be necessary to develop labour legislation and regulations to ensure that labour secures a fair share of the surplus, and also to ensure working conditions being maintained reasonably safe and healthy. Legislation in imitation of the more advanced countries, at too early a stage, may, however, lead to increasing inefficiency of performance, especially, in countries with surplus labour, and may increase costs of production so much as to have serious adverse effects on exports. The most important thing is to establish a definite link between remuneration and output in the case of all types of work of which the volume and quality can be estimated even roughly. It is necessary to recognise that trade union movements can gain in real strength only on the basis of increasing productivity.

8. National leadership

8.1. The transfer of modern technology from the advanced countries also calls for much adaptation to suit the needs and local conditions of underdeveloped regions. To profit by the experience of the advanced countries and yet to introduce modern technology and modern social and political institutions in a way suitable to the particular stage of development of the country is a matter of crucial importance in the process of modernization. Ultimately, success would depend on the growth of a rational outlook and the experimental attitude of mind, first, among the leadership at all levels and then gradually among the general mass of the people.

8.2. It is extremely important that the advanced countries should help and encourage in every way all progressive groups within the country in promoting the process of modernization and refrain from offering technical or economic aid in any way which would hamper the social and scientific transformation.

THE SCIENTIFIC BASE OF ECONOMIC DEVELOPMENT

1. Phases of economic development

1.1. The essential characteristic of an underdeveloped country is an extremely low level of living, that is, inadequate supply of food, clothes, housing, drugs and other consumer goods, and also lack of facilities for education, care of health, social security, cultural amenities, etc., for the nation as a whole. It is possible to make available small quantities of consumer goods by direct imports or by domestic production on a small scale, with the help of imported machinery. In most of the underdeveloped countries it is, however, not possible, for lack of necessary foreign exchange, to import or to produce, with imported machinery, enough consumer goods for the people as a whole. In India, the first textile mill was established in 1817; and India gradually became the second biggest producer of textiles, next only to America. One hundred and fifty years later, India would still remain underdeveloped. The production of textiles or small quantities of other consumer goods for a small part of the nation cannot, by itself, lead to industrialisation and economic development.

1.2. Economic development can occur only by increasing the per capita production of the nation as a whole, through an increasing use of machinery driven by steam or electricity as a substitute for human and animal labour. In countries with appreciable natural resources, it is necessary to establish the basic engineering and power industries to enable the manufacture of both consumer and capital goods within the country. Establishing a minimum complex of such basic industries would take at least ten or fifteen years, for which planning must start ten or fifteen years in advance.

1.3. To increase modern industrial production would call for an increasing supply of engineers, technologists, and technical personnel. The only way to ensure this would be to establish and increase the number of schools, training colleges and universities, and also to train teachers for such institutions. This would take at least fifteen or twenty years; so that planning for this purpose must start fifteen or twenty years in advance.

1.4. The best way of utilising the raw materials and natural resources available within the country, for both domestic consumption and for exports, can be found out only through applied scientific research.[1] Applied research, in its turn, must be based on advances in fundamental research. Also, to establish an adequate base for applied research it is necessary to promote the spirit of pure research and supply the stimulus of scientific criticism. This would be possible only when at least a certain minimum number of scientists are engaged in fundamental research, and opportunities for pure research are becoming increasingly available. It is therefore necessary to promote the advancement of both applied and fundamental research. To establish a minimum base for scientific research would take more than a generation of twenty-five or thirty years; this, being the most slowly maturing sector, must be given the highest priority.

2. The scientific base of the advanced countries

2.1. The scientific base of the modern age can be appreciated by even a brief review of the recent history of the advanced countries. Four hundred years ago the generally accepted view was that the earth was at the centre of the universe; the position of human beings was unique and supreme; and the highest sanction of truth was either divine revelation or abstract logical reasoning in the mind of man. In the sixteenth and the seventeenth centuries, there was a complete revolution in the picture of the physical world; the earth was seen as a small planet moving round the sun; and the method of empirical observations and experimentation was gradually established in both physical and life sciences.

2.2. Progress was at first slow in the sixteenth century. A few selected names may be recalled to indicate the gradual transformation of ideas. In astronomy, Nicholas Copernicus (1473–1543) supported the view that the planets including the earth itself were revolving in orbits round the sun; Tycho Brahe (1546–1601) supplied astronomical observations of unprecedented accuracy to make the next steps possible; Johann Kepler (1571–1630) formulated the descriptive laws of planetary motion; and Galileo (1564–1642) made conscious propaganda in favour of the new philosophy of the universe. In anatomy, Andreas Vesalius (1514–64) published his observations on the human body in 1543; in physics, William Gilbert (1544–1603) gave an account

[1] Even the most advanced countries are obliged to devote large resources to research for the improvement of products already being manufactured and also to develop new products in order to hold their position in the world export market. It is not possible for the underdeveloped countries to start or expand the export of fully or partly manufactured products by simply borrowing the current technology from advanced countries ; it is essential also to develop applied research for a continuing improvement of technologicl methods,

of magnetism based on trustworthy experiments in 1600); in physiology, William Harvey (1578–1657) described the circulation of the blood in 1628; John Napier (1550–1617) supplied a convenient tool for computation by the use of logarithms; and Rene Descartes (1596–1650), a philosopher, contributed the powerful concepts of coordinates for geometrical representation and of mathematical functions. Francis Bacon (1561–1626), firmly stated that the only true method in science was to proceed from particular sense observations to wider generalizations (*Novum Organum*, Book I, xix), and clearly recognised that "the true and lawful goal of the sciences is ... that human life be endowed with new discoveries and power."

2.3. The concept of an objective world of physical reality gradually took firm shape in the seventeenth century in the hands of gifted astronomers, mathematicians and scientists. A few names may be mentioned from among those who were born in the first half of the century: Pierre Fermat (1601–1665), Christian Huygens (1629–95), Blaise Pascal (1623–62), Robert Boyle (1627–91), John Ray (1627–1705), Robert Hooke (1635–1703), Issac Newton (1642–1727), and Gottfried Wilhelm Leibniz (1646–1716). The rate of advancement of science increased progressively in the eighteenth and the nineteenth centuries, and during the last few decades has opened new frontiers with almost unimaginable possibilities.

2.4. The advancement of science prepared the ground for the industrial revolution in Europe in the eighteenth century, first in spinning and weaving, next in the use of iron and steel, and then of electricity in the nineteenth century, which stimulated the growth of the capitalist economies in West Europe and North America. The spread of the scientific outlook also prepared the ground for the age of reason and the French revolution, which occurred at the end of the eighteenth century, and promoted the growth of nationalism in Europe, in its modern sense, in the nineteenth century.

2.5. The industrial revolution increasingly replaced human and animal power by steam or electricity to drive machinery for the increasing production of both consumer and capital goods. The development of engineering techniques led to a close linkage between science and technology; and during the last hundred and fifty years, industrial development is being stimulated by a scientific discovery or a scientific discovery is being stimulated by industrial needs.

2.6. For the last five or six thousand years, or more, the average per capita production remained more or less constant or fluctuated within narrow limits. The industrial revolution changed all this, and led to a spectacular increase in the variety and volume of goods produced. As a consequence of such increasing production, the standard of living of the advanced countries of West Europe and North America reached a level far higher than the rest of the world. Also, the advancement of science, technology and industry, made it possible for the western countries to become strong military powers; and, because of such military supremacy, the west was able to bring a large part of the world either into direct colonial rule or into conditions of economic or political subjugation.

2.7. The last forty years have also seen the rise of U.S.S.R., as another world power, rapidly growing, through the promotion of science and technology, in economic, industrial and military strength together with a continuing increase in the level of living. The monopoly of scientific and technological knowledge and the unchallengeable military supremacy of the western countries have now gone. The increasing parity between the "western" and the "eastern" countries in science, technology, industry, and military power is a most significant fact of the present time. Because of the unprecedented destructive power of atomic and nuclear weapons, it has become absolutely necessary to avoid a nuclear war which would be catastrophic for both sides and the whole world. Coexistence of both the "western" and the "eastern" powers has become indispensable.

2.8. There is no intention on either side to make a direct attack. The advanced countries pose no special problems because it is not possible to hold such countries indefinitely in subjugation. However, so long as there are underdeveloped areas, both power groups are likely to try to extend their influence over the less advanced countries, and this would remain a continuing source of potential conflicts. The very existence of underdeveloped countries should, therefore, be seen as a threat to peace. Rapid transformation of all the underdeveloped countries into modern viable societies is an essential condition for peaceful coexistence. Such a transformation would promote the enlightened self-interest of both power groups, and would also create conditions favourable for the advancement of human and cultural values on a world-wide basis.

3. THE ROLE OF SCIENCE IN THE MODERNISATION OF THE LESS ADVANCED COUNTRIES

3.1. Modernisation of the less advanced countries through rapid industrialisation is thus an urgent need of the whole world. Is such modernisation possible or can a modern society with a variable economy, with expanding social and political freedom, and cultural amenities, be sustained without establishing a sound scientific base ? This is a question of crucial importance for the present age.

3.2. In order to answer this question, it is necessary to appreciate the deeper changes in human thinking which were brought about by the emergence of science. In every sphere of organised activity in human society, authority has always been associated, and must always be associated with a system of hierarchical levels. This applies to primitive societies, matriarchal, patriarchal, or tribal; successive levels of feudal lords; organised churches and religions; military, police and administrative systems; enterprises, business and commerce; and law. A law court of appeal may reverse the decision of a lower court; but the decision of the court of appeal is itself subject to change by a still higher court. The decision of the highest court, to which a case has been actually referred, has to be accepted not because such a decision is necessarily right, but because it is the decision of a superior authority.[2] Society must accept this authority principle for stability and orderly progress, even in organised revolutionary activities.

3.3. This very authority principle must, however, be absolutely and completely rejected in the field of science. Modern science is based on a patient accumulation of facts, on the study of processes and their interrelations or interactions and a stability or uniformity of nature[3] which can be discovered

---

[2] It is possible, indeed, that this decision itself would have been reversed if there had been a still higher court to which the case could be referred. If a decision of a higher court of appeal is considered to be like the turning up of "heads" (in tossing an unbiased coin) when the decision upholds the verdict of the lower court, and is considered to be like the turning up of "tails" when the verdict of the lower court is reversed, then the successive decisions of the higher court would look like the results of the tossing of a coin. This would be the real guarantee that the system of law is functioning properly.

[3] The phrase "uniformity of nature" must be, of course, interpreted to include chance events and random processes. Although games of chance were known and were widely prevalent in ancient times in China, India and other countries, it is important to note that the concept of probability did not arise until the 16th and the 17th centuries, that is, not until the emergence of modern science. This is easy to understand. Before the emergence of the modern scientific view of an objective world of physical reality, all chance events would have to be necessarily ascribed to the whims of gods, demons, or supernatural forces. After the emergence of the scientific view of an objective world of physical reality, it became necessary, both logically- and psycho logically, for the human mind to accommodate the occurrence of chance events as an integral part of the uniformity of nature. This could be accomplished only on the basis of the theory of probability, or rather, as I should prefer to put it only through a statistical view of the world. It seems to me, therefore, that the concept of probability, or the statistical view of the world, did arise at the same time as the emergence of modern science only because it could not possibly have arisen earlier.

by the human mind. The findings of the most eminent scientists are subject to critical check by their professional colleagues and by the youngest scientific workers, and must be rejected if there is no satisfactory corroboration. Science can advance only through free criticism on a completely democratic basis, with every research worker of competence enjoying equal status. The theoretical or conceptual framework of science must be continually revised to find a proper place for all known facts. A single new observation may call for a more comprehensive theory. The older accumulated knowledge continues to remain valid; later discoveries must, however, be integrated with the earlier knowledge. The accumulation of scientific knowledge is increasing through the efforts of all the scientific workers of the world. A new fact may be observed or a new theory formulated by any worker, however young, and in any country where research has been established. International collaboration is, therefore, an indispensable condition for the progress of science.

3.4. Authority derived from status is irrelevant to science. Science has introduced a new concept of "scientific", or "objective validity" which has its foundation in nature itself, and which cannot be upset by any authority based on status or by supernatural powers. The transformation of all the advanced or rapidly advancing countries has been based on accepting, in an increasing measure, a scientific or rational view of life. This is the foundation of the modern age.

3.5. It is essential in every country to establish and strengthen the outlook of science, a way of thinking which becomes more and more powerful as it is more widely adopted, and which replaces dogma, superstition, and outdated customs. This scientific outlook cannot be established by force. It must depend on acceptance through proper understanding. In practical affairs, the important point is that a wise policy and programme of action should be increasingly adopted on the basis of rational argument, supported by relevant factual evidence, and should not be rejected because bias or formal dogmas or conventional rules of procedures. It is, therefore, necessary continually to encourage and promote the advancement of science in every country, large or small. Because science is indivisible, and also because science must be established in every country, it is also necessary, continually, to promote scientific collaboration between all countries of the world, large and small, and advanced or developing.

3.6. It is scarcely necessary to point out that there is no conflict between the scientific and rational view of life, on one hand, and aims and objectives based on moral or cultural values, on the other hand. On the contrary, moral and cultural values which are truly universal, and are not narrowly sectarian or nationalistic in a restricted sense, must have an objective and rational basis.

3.7. The advancement of science and the growth of the scientific outlook must be recognised as an essential condition for the modernisation of the less advanced countries. It is necessary for each country to have, as quickly as possible, a sufficient number of men with a scientific outlook to influence the thinking of the nation. How to attract and hold a sufficient number of able persons to science is thus the crucial problem of national and world development. This can be achieved only through a proper and adequate social appreciation of science and scientists. The actual transformation must be brought about from within each country. Scientific aid from the advanced countries can, however, be of great help in this process.

4. Present programmes of technical aid

4.1. The need of technical aid has been recognised for some considerable time. Bi-lateral or multi-lateral and international technical aid has often taken the form of either offering educational and training facilities to young workers from the less advanced countries or sending technical or scientific experts to such countries. Considerable benefit has no doubt accrued through such aid but it is necessary to recognise that much effort has also been wasted.

4.2. Scholars from the less advanced countries are usually selected on the basis of results of examinations; success in examinations not being a necessarily reliable indicator of scientific or technical ability, the very process of selection is inefficient. Some of the young scholars have difficulty in adjusting themselves to the pattern of living in the advanced countries. Some of them do not do well in their studies. Some pass the examinations successfully but have no aptitude for scientific work. Some of the more able scholars prefer to live and settle down in the advanced countries, especially in the U.S.A., because of the higher level of living or greater opportunities for scientific work. Some scholars of ability, when they return to their own countries, are unable to find suitable openings for a scientific career; and some of them go back to the country where they were trained. In applied science and technology, and especially in social sciences, many young scholars, who had often studied problems or learnt methods which are appropriate for advanced countries but totally irrelevant to their own native countries, are unable to adapt or develop methods to suit local conditions. Out of the large number of scholars who go to advanced countries for training, only a very small number of really able scientific workers ultimately become available for fruitful work in their own country. The cost of giving scientific or technological training in an advanced country is also very high. Giving training to individual scholars in advanced countries (whether the expenses are provided in the form of foreign aid or met by the scholars themselves or by the country of origin) have been, therefore, extremely wasteful in terms of both men and money.

4.3. There has been also continuing difficulties in finding suitable individual experts for the less advanced countries. Competent scientific workers are reluctant to accept such assignments partly because of the lack of facilities for their own work in the less advanced countries and partly because their scientific or academic career is likely to be adversely affected through their absence abroad. In consequence, assignments sometimes have to be given to persons who are not fully qualified for the job, with unsatisfactory results. To create suitable conditions for scientific work in the less advanced countries is an indispensable condition for attracting competent scientists to go out to such countries.

4.4. Programmed technical aid on a group basis has been more effective. A team of young engineers from a less advanced country can receive most valuable training in an advanced country when such training is oriented to specific technological projects. Teams of experts from advanced countries have also been of very great help in establishing factories or in starting new projects in the less advanced countries. Such technical aid, especially in engineering, technology and applied sciences, should be continued and expanded. Special projects for establishing technological and research centres in the less advanced countries have also been taken up by some of the international agencies. This type of aid can be of great value provided a sufficient number of scientific workers in the less advanced countries can be trained to work in such centres, and also provided necessary conditions are established to enable them to do their work properly.

5. Science education and research

5.1. It has been argued in the earlier sections that for modernisation it is necessary to establish a foundation for scientific research and the social appreciation of science in the developing and less advanced countries. Every path-finder in a new field of research must work in the first instance by himself; if he is successful, other persons gradually get interested in the subject. Such path-finders always had, and will always have to overcome much opposition, and even hostility, until the new subject becomes a recognised part of the "established" field of science. But it is only a few scientists of outstanding ability who can work in isolation. Most research workers require the stimulus of free interchange of views and ideas and of appreciation among professional colleagues.

5.2. The community of scientists has a structure of a series of widening circles similar to the structure of scientific subjects or of science as a whole. When a top scientist speaks appreciatively of some work in his special field, other scientists or lay men accept his evaluation and pass on the information to others. The social appreciation of science gradually emerges as a result of the diffusion, in widening circles, of the views of scientists, who are experts in specialised fields of research, to scientists in related and associated fields, then to scientific workers generally, and finally, through persons of position and standing who have contacts with scientists, to the general public. The speed with which such appreciation can spread increases rapidly with the number of scientific workers and improvements in the channels of communication. In the advanced countries, the awareness of the importance of science is increasing rapidly which, in its turn, is raising the social status of scientists and is promoting an increasing flow of resources for research.

5.3. The whole process is extremely slow in underdeveloped countries. The number of research scientists is very small; and channels of scientific communication are non-existent or meagre. Scientific workers usually receive lower pay and have a lower status than the administrative staff in government or in business concerns; and have to work in a rigid system of hierarchical authorities. Promotion may depend, not so much on the high quality of the scientific work done, but on success in pleasing those who are higher up in the official hierarchy. Even permission to apply for posts elsewhere is subject to the discretion of superior officers. There is a continuing tendency to bring scientists and scientific work under stricter control of the administrators, partly, perhaps, from an unconscious fear of rivalry of power. Even if the right of criticism is accepted in principle, it is restricted in practice because scientific workers are often afraid, rightly or wrongly, of giving offence to persons holding higher posts. In consequence, many scientists in underdeveloped countries suffer from a lack of self-confidence, and are afraid to take up original lines of investigation. There is little possibility of a proper evaluation or appreciation of scientific work within the country. This leads to an exaggerated dependence on the opinion of foreign scientists and gives rise to much imitative work. Also, when there is lack of appreciation or criticism from the advanced countries, there is sometimes a tendency to ascribe the unfavourable view to racial or national prejudices, and there is resistance against collaboration with foreign scientists.

5.4. In underdeveloped countries there are very few, sometimes only one or two, individuals of outstanding ability in scientific research or in any other scientific field. As leadership can be supplied only by individuals of high ability, and as such persons are few in number, it is much more difficult in underdeveloped countries to utilise the services of individuals of average ability and qualifications. The advanced and advancing countries have a double advantage. They have a large number of persons with qualities of leadership and can, therefore, utilise in a fruitful way larger numbers of persons of average ability. This is why many scientific workers from underdeveloped countries, who are unable to do much useful work in their own native country, can often do very good work in the enviornment of a higher state of organisation of research in an advanced country.

5.5. The aim of scientific aid must be to create in every underdeveloped country, as quickly as possible, a sufficient number of research scientists to form a community of professional workers which would be sufficiently large to facilitate an independent evaluation of scientific work through free criticism and frank exchange of views. It is, therefore, necessary to focus attention on identifying and giving support to persons who have the ability to undertake research work of high quality, and to try to increase their number as quickly as possible, and at the same time to offer opportunities for training to persons of average ability whose services would be equally essential in supplying a wide base for the pyramid of scientific work.

5.6. There is urgent need of fostering the spirit of objective scientific criticism through free expression and exchange of views and opinions. One effective way of promoting this would be to make it easy for scientific workers to migrate from one post to another and give an absolute guarantee of such freedom to migrate. Any scientific worker who feels, rightly or wrongly, that he has not enough opportunities for fruitful work in one institution would be free to migrate to some other institution. Such migrations or the possibility of such migrations would have an indirect but most important selective effect on scientists at all levels.

5.7. It is necessary to recognise that the social value of an individual scientist of high ability is far greater in a developing country because of the leadership he may be able to supply. It is only scientists engaged in fundamental research who can function as the eyes and ears of the nation in making the nation appreciate and identify urgent needs of applied research. The emergence of even one or two outstanding research scientists can enhance the prestige of the nation in a most significant way at the international level and promote the growth of self respect and self confidence of the nation. This is why it is particularly important in developing countries to identify such individuals, at first very few in number, and give them all possible facilities and encouragement to continue their work in their own country.

5.8. In the highly developed countries science advanced both from progress at the highest levels of research, at the top, and from the wide diffusion of education, at the bottom. The same strategy may be adopted with advantage in the less advanced countries. What is urgently needed is to lay the foundations, with as wide a base as possible, for a country-wide system of school education oriented to science and, at the same time, to develop advanced studies of science and technology and research at the highest level. The school system must fit into the economic life of the general mass of the people and have its grass roots in the villages. It must offer facilities for training technicians and technical personnel for science and technology and also supply candidates of outstanding merit for admission to higher scientific and technological institutions.

6. Need of direct aid for science

6.1. I shall offer, briefly, a few suggestions for giving direct aid for the development of science in the less advanced countries. I have stressed the need for building up a system of school education with a definite orientation to science. It would be, however, a fatal mistake to establish an expensive system of education on the model of the advanced countries which would have little relevance to local needs and would be beyond the means of the national economy. It is necessary to evolve a system, through experimentation and trial and success, which would be within the means of the national economy. The approach must be therefore to use teaching aids which are easily available or can be made available on a large scale and at a low cost. As most of the pupils will be living in villages, it would be of great advantage if agriculture and some of the rural industries can be adopted as a base for the teaching of science. The programme may consist largely of nature studies, observations, and experiments which can be done with the help of simple articles, specimens, etc., likely to be locally available or which can be constructed with local materials.

6.2. There would be still some need of supplying teaching aids and materials from outside which would have to be specially designed to reduce costs. It is essential also to prepare books of instructions and text books to suit a fairly wide range of needs. These are difficult tasks which would call for extended study and research by scientists of high calibre with a serious interest in problems of science education. As basic conditions in underdeveloped countries are likely to be similar to a large extent, it may be possible to evolve broad general methods for science education which would be capable of being adapted without much difficulty to suit different local conditions.

6.3. A great deal of pioneering research would be necessary for this purpose for which the help of advanced countries is indispensable. A good deal of experimental studies will have to be undertaken under conditions actually prevailing in underdeveloped regions. In the beginning, the studies would have to be organised on a small scale with the help and support of the local authorities and of such teachers and scientists as may be available to cooperate in the venture in the underdeveloped country itself. The project can be gradually extended in the light of experience, to cover different subject fields at different educational levels, and also from one underdeveloped country to another. Fortunately, even one or two scientists can start the work in one single country. The important point is to make a beginning at the earliest opportunity.

6.4. I may now mention a second type of programme. Certain facilities for scientific research are already available in India and other developing countries. In most of these countries, scientific work is being hampered for lack of small replacement parts, additional accessories and instruments, and supply of essential consumable stores which have to be imported from the advanced countries. It is often difficult to secure import licences on account of shortage of foreign currency. This difficulty can be overcome through a simple plan of gifts in kind of replacement parts, instruments and equipment, stores, books and journals and reprints or microfilms of scientific papers etc., to be arranged through non-governmental committees of scientists. Such commodities, which can be set up in the advanced countries through or in cooperation with appropriate scientific organizations or societies, would try to secure suitable grants from Government and other sources. In developing countries where scientific research has already started, the counterpart committees of scientists would also be set up, preferably, at a non-governmental level and with a majority of members from universities and non-governmental scientific institutions. All arrangements would be made with the concurrence of the government of the less advanced country concerned, but decisions relating to gifts for scientific work must be made by direct consultations between the scientific committees themselves. A scheme of this type can be usefully started, on an experimental basis, for a few selected countries, at a low cost, with gifts to the total value of perhaps one or two hundred thousand dollars per year. The amount can be increased if the experiment proves successful.

6.5. Another important form of scientific aid would be to arrange for competent research scientists from the advanced countries to work for a year or two in existing research units in the less advanced countries or to help in establishing high level research units in such countries. The less advanced countries can offer challenging problems and opportunities for research in many fields of science, which cannot be duplicated in the advanced countries, for example, in geology, meteorology and geography; biology, botany, and zoology; agriculture; medical science and public health; economics of development; linguistics; archaeology; and historical and cultural studies of various kinds. In some of the developing countries there would be also increasing opportunities for active participation in research in mathematics and statistics, and physico-chemical and technological sciences. In establishing research units in underdeveloped countries it would be desirable to keep one broad aim in view, namely, to encourage joint studies by active collaboration between different research units. This would help in developing a community of research cells or units which, in its turn, would foster the growth of the spirit of scientific criticism and appraisal among wider circles of scientific workers.

6.6. To attract competent visiting scientists it is necessary to offer them facilities to pursue or start fruitful research in the less advanced countries; sometimes special equipment may have to be provided for this purpose. Secondly, the assignment in a less advanced country, would have to be treated as deputation in the same way as participation in scientific expeditions, and which would be recognised as a part of normal duties and also as a possible qualification for promotion. The visiting scientist must receive sufficient compensation in his home currency to meet his continuing home commitments during his absence abroad. Living and other local expenses should be normally met by the institution or by the government of the country in which he would work. Such sharing of costs would promote effective cooperation in the less advanced country, and would also reduce the total cost appreciably.

6.7. An important part of the responsibilities of a visiting scientist would be to give training to the scientific workers of the underdeveloped countries. When necessary, the visiting scientists would be able to select, for further training in an advanced country, the right type of persons who can be depended upon to go back to their own country after the completion of the training abroad. It would be also possible to give aid in the form of equipment and instruments in an effective way on the basis of objective appraisals of needs and possibilities by the visiting scientists.

6.8. A fourth programme could be to send from advanced countries young scholars, who have just finished their education in universities or higher educational institutions or have already done some research, to start or continue suitable lines of research for about two years or so in existing institutions or in research units to be established for this purpose in underdeveloped countries. The common participation in research projects of young scholars from the advanced and the underdeveloped countries would be of great help in establishing scientific traditions and an atmosphere of scientific criticism. It would promote self-confidence among the scientific workers of the underdeveloped country, especially, if the visiting scholars from advanced countries take higher degrees from institutions in the less advanced countries.

6.9. All the above forms of scientific aid can be started, if desired, on a small scale and at low cost, and, if successful, can be expanded in the light of experience. Also, these forms of scientific aid would not in any way overlap or hamper bigger programmes for gifts of expensive equipment or large projects for the setting up of national or regional centres and institutes for scientific research in the less advanced countries. On the contrary, the modest programme described in this note would prepare the ground for bigger projects.

7. Conclusion

7.1. In conclusion I may refer, very briefly, to some recent developments. After the second world war the movement for terminating colonial rule gained rapidly in strength; and, one country after another in Asia and Africa has won political independence. It is being increasingly realised, however, that independence is not enough for economic development. The need of economic and technical aid is also being increasingly appreciated. Both the "western" and the "eastern" powers have started helping in the economic development of the less advanced countries in Asia, Africa and Latin America, but still without an adequate impact. The time has come to recognise that economic aid is essential but is also not sufficient.

7.2. Revolutions to capture political power have been occurring throughout human history and are even now occurring in many of the politically independent countries in Latin America or in most of the newly independent countries in Asia and Africa. Such revolutions do not automatically promote rapid economic development, because purely political revolutions do not lead to any fundamental transformation of the old society based on the principle of authority associated with levels of status. It is becoming increasingly clear that rapid economic development cannot be achieved without developing a structure of society in which decisions would tend to be made more and more on grounds of reason, that is, in accordance with the principle of objective validity instead of authority. It is relevant to note that the French Revolution was preceded by the age of reason; the American War of Independence had the support of influential leaders inspired by the spirit of science; and the socialist government, which was established after the October Revolution in 1917 in Russia, made great efforts to build up a countrywide system of science-oriented education and to promote scientific research and, in this way, succeeded in modernising the whole society leading to rapid economic development.

7.3. One thing is clear. In the absence of rapid economic development, political conditions in the less advanced countries would remain unstable. In many or most countries there would be one revolution after another tending to get the two power groups involved directly or indirectly in the struggle. The world must get out of this vicious circle. There are only two possibilities. One is for a violent type of revolution to occur which would suddenly change the whole structure of society to make it fit for rapid development of science and economic progress. The other alternative is deliberately to build up the foundation of science-oriented education and research to promote the modernisation of society in a peaceful way, and make conditions favourable for economic development.

7.4. Aid for scientific and economic development from either the western or the eastern countries, even when given in a spirit of competition, would be cooperative in effect. In any event, competition in constructive tasks of building up scientific foundations in developing countries is less dangerous and is likely to be far more useful than competition in the methodologies of warfare. Also, collaboration in promoting education and research in pure science can be pursued without any threat to national security or national interests, and would be of great help in promoting a rapid advance of the underdeveloped countries and in fostering better understanding among the nations of the world. The advanced countries have a great opportunity for peaceful cooperation in giving aid for science.

Certain aspects of the problems mentioned in this paper were discussed by me in articles and addresses between 1955 and 1959 which were printed in my book *Talks on Planning* (published in 1961), and in other articles such as *A Note on Problems of Scientific Personnel* (1959), and *Recent Developments in the Organisation of Science in India* (1959), and also presented at the Conference for International Economic Cooperation and Partnership held in Austria (Salzburg-Vienna) in July 1962.

Professor P. M. S. Blackett in his presidential address to the British Association for the Advancement of Science in 1957 and in other articles in *Nature*, (3 February, 1962; May 1962 etc.) has considered various problems from the point of view of the advanced countries. Professor Stevan Dedijer made a penetrating analysis in an article in *Nature* (6 August, 1960) and in another article published in Stockholm, *TVF*, 33 (1962).

STATISTICAL TOOLS AND TECHNIQUES IN PERSPECTIVE PLANNING IN INDIA

Invited paper, 34th Session, International Statistical Institute, Ottawa, Canada, 1963. The paper was originally published in *Bull. Inst. Stat. Int.* **40** (1). 152–169.

Introduction : The phrase 'perspective planning' is being used in India since about 1954 or 1955 in the field of National Planning in which long-range targets have to be set up 10 or 15 or 20 years in advance. The object of the present paper is to explain why perspective planning is essential in the case of underdeveloped countries and give some illustrative examples of the statistical information and methods which have been found useful for this purpose in India. This is not the occasion to attempt a comprehensive discussion of techniques of perspective planning.

It is useful to make a distinction between projections and targets. The word "projection" is used in the same way as in advanced countries to refer to the value of production, consumption or of other variates, at a specified date in future, estimated on the basis of historical records. Projections are essentially estimates obtained on the basis of analysis of time series or some kind of extrapolation in time. It is convenient to use the word "target" as the value of production, of consumption or of other variates of interest which is desired to be attained on a specified date in future, through the process of implementation of an economic plan. The word "target" would be used consistently in this sense.

Objects of planning in India : The ultimate objects of planning are to improve the level of living, and expand facilities for education, care of health, cultural amenities, etc., for *all* the people of the country. A spectacular improvement in the level of living of the advanced countries has been possible in the past, and a similar improvement would be possible in the less advanced areas in future, only through a continuing increase in the per capita production of *all* the people of the country. Such increase in per capita production can be attained only through a continuing substitution of human and animal power by machines, driven by steam or by electricity, for productive purposes of all kinds including industry, agriculture, transport and distribution.

Changes in the level of living : As our chief concern is with the improvement of the level of living, a continuing National Sample Survey was started in India in 1950. The Survey collects comprehensive information on various aspects of the level of living in rural and urban areas with a view to assessing the change over time. The total per capita expenditure per month on all consumer goods and services of each household has been used as a rough indicator of the level of living of the household. The method of fractile graphical analysis[1] has been used to study the distribution by size of total per capita expenditure per month of households. Studies are also being made of the relationship between the total per capita consumer expenditure and the per capita consumption of individual items in terms of money and also in physical quantities where possible.

A study of the distribution of per capita total consumption expenditure by decile groups of households (arranged in ascending order of the total per capita consumer expenditure in each household), shows that for the data collected in the National Sample Survey, Round 8 (covering the period July 1954–March 1955), the percentage share of the lowest decile group was 3·01 in rural areas and 2·65 in urban areas, and of the second lowest decile group (between the tenth and the twentieth percentiles of households ranked by per capita expenditure) was 4·09 and 3·90 for rural and urban areas respectively. For purposes of perspective planning, 4 per cent may be used as the share of the second lowest decile group of households.[2]

Targets of planning : The average per capita expenditure in the second lowest decile group was a little over Rs. 10 per month[3] in 1960-61. For purposes of illustration, it is possible to adopt a target of raising, over a period of fifteen years, the average per capita consumption expenditure in the second lowest decile group of households from Rs. 10 to Rs. 20 per month (or fifty dollars per capita per year). This amount, at 1960-61 prices, would provide only a very modest level of living in terms of food, clothing and other essential good, services, and amenities.

Doubling the per capita expenditure in fifteen years implies a rate of growth of nearly 5 per cent per capita per year. It is of interest to note in the present connection that the per capita income in USA has increased sevenfold in the course of 120 years or at a rate a little over 1·6 per cent per capita

---

[1] See 'A method of fractile graphical analysis,' *Econometrica*, **28**, 325-351, 1960; also 'A preliminary note on the consumption of cereals in India,' *Bull. Int. Stat. Inst.* **39**, 53-76, 1962.

[2] The lowest decile group has not been used because it may be a somewhat heterogeneous category comprising vagrants, persons living in isolation, tribal people, households in a transient income group etc. many of whom would require special ameliorative measures.

[3] One rupee = 1 shilling 6 pence = 21 U. S. cent approximately.

per year. A reasonable target of planning in India would thus call for a rate of increase of income at a rate nearly three times greater than the actual rate of increase attained in the USA during the last 120 years. The above comparison supplies a rough idea of the dimension of the efforts required for economic development in India.

For purposes of planning it is necessary to deal with actual figures and not merely in percentages. The population of India is expected to increase to about 650 million by 1975 compared with about 430 million in 1960. (This, of course, is the population projection for 1975 on plausible assumptions, and not a target; in fact, if it were possible to bring about a reduction in the rate of growth of population, Indian planners would no doubt adopt a much lower figure as a target). The number of second lowest decile group of households in 1975 would be about 12·5 million on the basis of about five persons per household. To attain a target of Rs. 1,200 (or $ 240) per year per household, the aggregate income of the second lowest decile group of households would have to be Rs. 15,000 million. If it is assumed that this group would still continue to have a 4 per cent share of the total expenditure of the households[4] then the aggregate national consumption expenditure of households would be twenty-five times greater or Rs. 375,000 million. The aggregate national income of India in 1975 would have to be somewhat larger to allow for investments and certain other items. The level of national income to be attained in 1975 would have to be somewhat more than double the target of income at the end of Third Five Year Plan in 1966. The rate of growth would have to be about 7 per cent per year.

Need of rapid industrialization : Such a rapid change (at a rate three times greater than that of USA) would call for rapid industrial expansion over a period of fifteen years.

The ultimate aim is continual expansion of consumer goods and services. It is necessary to increase the supply of machinery and energy for this purpose. In India, and in most of the other underdeveloped countries, it is not possible continually to import machinery for production of goods or of fuel on account of the shortage of foreign currency. It is essential to establish and expand

---

[4] In India the distribution of consumption expenditure of households by size of expenditure has been found to be steady (with some small fluctuations probably due to the effect of changes in prices) over the last ten years. The pattern of distribution of income of households by size of income has also been found generally to change only very slowly over time in most countries of the world. The assumption that the share of the second decile group (or of other fractile groups) of households would remain practically the same in India in 1975 is plausible.

industries to manufacture machinery and electrical transport, and construction equipment. To increase the capacity for the production of capital goods and energy would be thus the only sound foundation for the expansion of consumer goods and services in future.

At the same time, in all underdeveloped countries it is possible to increase the production of consumer goods with small tools by using traditional methods. This type of production is labour intensive and would give gainful employment to a large number of people who would otherwise remain idle for a good part of their time.

In India a dual strategy was adopted from 1956 in the Second Plan to expand, on one side, the strategic heavy industries for steel, metals, machinery, electricity and chemicals etc. to build up the foundations of industrial progress, and at the same time also to expand the traditional cottage industries and small scale production.

Targets of capital goods : It is therefore necessary to expand and set up not only targets of income or of consumer goods but also of machinery, steel and other metals, electricity, transport, etc., which would be used for the production of the desired volume of consumer goods and services.

Targets of scientific and technical personnel : To achieve the targets of production, it would be necessary rapidly to increase the technical staff to prepare and implement an increasing number of projects. Training facilities must be expanded sufficiently quickly to turn out technical and scientific personnel in adequate numbers at all levels. Scientific and technological research would have to be expanded and oriented to serve the needs of national development in an effective manner. Fundamental research as well as training in research must also be encouraged and developed at the same time to foster the accumulation of basic knowledge and to supply a sound foundation for national decisions being made increasingly on rational grounds.

Balances at the stage of production and utilization : An essential condition for successful planning is to estimate in real terms the requirements of each project to ensure that the right quantities of materials, machinery and men are available at the right time at every stage of the implementation of the project. Also, products and services resulting from the completion of each project must be promptly and effectively utilized to promote the execution of other projects and for the progress of the plan as a whole.

The physical targets of production must be balanced in terms of physical quantities of raw materials, machinery, energy, transport, etc. and also in terms of manpower and of the flow of money. Incomes are generated in the very process of production; and supplies are utilized through market operations. Planning requires that aggregate incomes should be balanced with expenditure, savings should match investments, and the supply and demand of individual goods and services should be balanced in real terms so as to avoid any inflationary rise of prices or undesirable shifts in prices. Physical and financial planning are different aspects of the same reality.

In India a perspective view of development over a long period of years began to be taken from the end of 1954. It was recognized that the targets and the balances of materials and of man power would be only approximate partly through lack of information and partly for defects in organization and implementation. It was therefore recognised that planning would have to remain flexible to enable necessary adjustments to be made almost continuously. At the same time it was essential to keep in view a wide time horizon of fifteen or twenty years or more.

The use of simple models : In 1954-55, some simple models were used to work out the basic strategy of the Second Five Year Plan. The total investment was divided into two parts, one λ_i as the fraction used for investments for the production of capital goods, and the other λ_c as the fraction used for investments for the production of consumer goods ($\lambda_i+\lambda_c = 1$). If the corresponding net output-investment ratios for the production of investment goods and for the production of consumer goods respectively are β_i and β_c then the total net output-investment ratio is $\beta = \lambda_i\beta_i+\lambda_c\beta_c$. By using the following two-sector model and using numerical values for the total investment and estimated values of β_i and β_c, suitable values of λ_i and λ_c were selected so as to enable the economy to grow at the target rate of 5 per cent per year or so. In order to estimate the volume of employement, the capital investment required per worker, say θ, was also used.

The growth of national income (Y) in the two-sector model is given by the following formula :

$$Y_t = Y_0 \left[1+\alpha_0 \frac{\lambda_i\beta_i+\lambda_c\beta_c}{\lambda_i\beta_i} \{(1+\lambda_i\beta_i)^t-1\} \right]$$

in which Y_0 is the national income in the base year, Y_t the national income in the t-th year, and α_0 the rate of investment in the base year.

On this basis, a draft plan-frame for the Second Plan was prepared in March 1955.[5] Values of the different parameters as used in the draft

[5] The methods used have been described in 'The approach of operational research to planning in India', *Sankhyā*, **16**, 3-130, 1955, printed earlier in this volume.

plan-frame, the Second Plan (1956–61) as actually realized, and the Third Plan (1961–66) as estimated, are shown in the Table 1.

TABLE 1. INVESTMENT ALLOCATION, CAPITAL PER WORKER AND NET OUTPUT-INVESTMENT RATIO

plan	percentage allocation of investment for		capital per worker (Rs.)	net output-investment ratio		
	invest-ment goods	consumer goods		invest-ment goods	consumer goods	total ($\lambda_i\beta_i+\lambda_c\beta_c$)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	λ_i	λ_c	θ	β_i	β_c	β
Second Plan :						
Draft plan-frame (1955)	33	67	5,100	0.20	0.67	0.51
Second plan : actual (1956-61)	36	64	5,400	0.11	0.53	0.38
Third plan : estimate (1961-66)	39	61	6,900	0.21	0.63	0.47

Many changes were made in the targets and allocations of the draft plan-frame at the stage of the preparation of the Second Plan; the values of the parameters of the Second Plan as actually realized and the values given in the draft plan-frame are therefore not strictly comparable. The interesting point to note is that the estimated parameters for the Third Plan are fairly close to the parameters used in the draft plan-frame.

The rate of investment (α_0) in the first year of the Second Five Year Plan was 9·8 per cent, the initial national income (γ_0) was Rs. 108·0 billion and the values of the other parameters were $\lambda_i = 36\%$, $\lambda_c = 64\%$, $\beta_i = 0{\cdot}11$, $\beta_c = 0{\cdot}53$, as given in the second row of the above table. Using these values in the above expression, the estimated national income comes out as Rs. 129·7 billion for 1960–61 against as actual figure of Rs. 130·1 billion, both expressed at 1952-53 prices. In the case of the Third Five Year Plan, using the parameters given in the third row of the table, an initial income of Rs. 145·0 billion (at 1960-61 prices) and an initial rate of investment of 11 per cent, the estimated income for 1965-66 on the basis of the two-sector model is Rs. 188·9 billion against an estimate of Rs. 190·0 billion given in the Third Five Year Plan on the basis of detailed sector-wise calculations.

It may be concluded, therefore, that the two-sector model can supply a fairly reliable method for estimating future income. Values of the parameters used for the base period are no doubt subject to errors of estimation;

but this would be true in the case of other methods also. The two-sector model gives realistic estimates presumably because it has reasonably correct structural relations between relevant variables.

Values of output-investment ratios : Output-investment ratios β_i and β_c determine, together with the chosen values of λ_i and λ_c and the total amount of investment, the rate of increase of income and have an important role in planning. These two coefficients of net output-investment ratios were calculated from technological and statistical information in respect of hundreds of enterprises combined with appropriate weights. The calculated values for manufacturing industries are given in Table (A-1).

Need of perspective planning : *Steel.* The need of looking a long way ahead was learnt in India through experience. I shall give one example. In 1949 when preparatory work had just started for the First Five Year Plan, a decision was practically reached to increase the capacity for the production of steel from a little less than one million ton per year to two million tons per year in the course of five years. However, a careful survey was made of the current demand as in 1949. It was found that the maximum demand would be about 1·5 million ton per year. With marginal expansion of existing steel plants, it was possible to produce about a million ton per year within the country. Owing to the wide prevalence of the views of short-range economic theory, it was therefore decided that it would be inadvisable to include a new million-ton steel plant in the First Five Year Plan of India.

In consequence, great difficulties began to be experienced from the early years of the First Plan. Practically all the estimates for investments had been made in purely financial terms and a sizable increase in investments had been approved purely on a financial basis. As soon as the investment projects began to be implemented, there was a sharp and continuing increase in the requirements of steel and other goods and services. Very soon the demand for cement increased to nearly three times the domestic supply. There was also a continuing and large expenditure of foreign currency for the import of steel, which added up to something like 2,000 million dollars in the next ten years or so. In 1950 it would have been possible to establish a new million ton steel plant with perhaps about 150 million dollars of imported machinery. Had this project been started at that time an additional supply of one million ton of steel (worth more than one hundred million dollars per year) would have been available from the early years of the Second Five Year Plan, and would have resulted in a very large and continuing saving of foreign exchange. The decision to drop the million ton steel project from the First Plan was due to attention being focussed only on the current demand in 1949, that is, due to a complete failure to appreciate the need of looking ahead to get ready to meet the demand for steel which was certain to increase rapidly in future.

Targets of steel in 1970 : At heavy cost we had learnt the lesson of not proceeding with the building up of capacity for steel production twelve or fifteen years ago. Much attention is now being given to advance planning for steel. A detailed analysis of the requirements of steel is made, where possible, by individual items of production. With a given set of production targets for, say, 1970, it is possible in this way to prepare useful estimates of the requirements of steel. Some illustrative figures for the transport equipment industry is given in the Table 2.

TABLE (2) : STEEL REQUIREMENTS FOR TRANSPORT EQUIPMENT INDUSTRY IN 1970

	industries	production target in 1970	tons of rolled steel required per unit of output	steel requirement in 1970 (in thousand tons)
	(1)	(2)	(3)	(4)
1.	steam locomotives	300	150	45.0
2.	electric ,,	150	55	8.3
3.	diesel ,,	200	55	11.0
4.	wagons	40,000	12	480.0
5.	passenger coaches	2,500	30	75.0
6.	automobiles	180,000	2.9	522.0
7.	motor cycles, scooters	150,000	0.1	15.0
8.	bicycles	4,000,000	0.02	80.0
9.	ships (GRT)	160,000	0.65	104.0

Source : Demand for steel, special steel and pig iron, Indian : 1960—1970 : Perspective Planning Division, Planning Commission.

The transport equipment industry would thus require about 1·34 million ton of steel per year. Requirements of other industries were estimated in the same way; the grand total for industries came to about 8 million tons of rolled metal.

In other cases of different approach is necessary. The steel requirement per rupee of net investment has been estimated for different types of activities. For example, the consumption of steel is 40 tons per investment of Rs. 100,000 in railways; the corresponding figure is so low as only 5 tons in large- and medium-scale irrigation. The total steel requirements for a target of investment in the Fourth Plan amounting to Rs. 170,000 million can be estimated at 20 or 21 million tons.

Also, on the basis of the investment outlay for the last year of the Fourth Plan, one can estimate the steel requirement at about 5 million tons at the end of the Fourth Plan. Adding to this the current requirement of 8 million tons for industries, the total demand would be about 13 million tons of steel in 1970-71. In the same way it has been estimated that the requirements of steel would reach 18 or 19 million tons in 1975.

Balance of electricity : It is possible in the same way to estimate the requirements of electricity from the physical targets of production for any given year. For example, the production of ferro-manganese in 1960-61 was 100,000 tons for which the electricity consumed was 500 million kwh. For a target production of 385,000 tons for ferro-manganese in 1970-71, the requirements of electricity would be 1,952 million kwh. A similar method of calculation was used for different types of industries. Table (A-3) in the Appendix gives the details. Steel and electricity are typical illustrations of the material balances which have been prepared in India for important commodities and energy for perspective planning of the economy fifteen or twenty years ahead.

Perspective planning of fertilizers : The population of India is growing roughly at the rate of perhaps 9 million per year. The additional quantity of food grains required for these 9 million people would be about 1·5 million tons a year. This would add up to 22·5 million tons in the first five-year period (not to speak of 60 million tons in the second five-year period). At an average price of 90 dollars per ton, the cost of importing 22·5 million tons in a five year period would come to about 2,000 million dollars.

On the other hand, if imported ammonium sulphate is used, each ton on an average should increase the yield of food grains by about 2·2 tons. On this basis, roughly 10 million tons of imported ammonium sulphate would enable the domestic production of food grains being increased by about 22 million tons in a five-year period. At an average price of 70 dollars per ton of fertilizers, the cost in foreign currency would be only about 700 million dollars or a third of the cost of imported food grains.

Imported foodgrains can be quickly distributed and it is possible to make necessary arrangements for such imports at short notice (a year or so under normal conditions of easy availability of foodgrains in the world market), the lack of foreign currency being the only limitation in a country like India), The import of fertilizers, however, requires placing of orders a year or two or even more in advance because the supply position is not so easy as in the case of foodgrains. Such a plan would, therefore, require taking a view of future needs two or three years ahead.

A third possibility would be to set up a new factory every year for the production of 750,000 tons of ammonium sulphate per year. At the cost of about 90 million dollars for each factory, the total expenditure would come to 450 million dollars of which, however, only 250 million dollars would be the foreign exchange requirement. The setting up of a new fertilizer factory would require at least five or six years; the process of planning must therefore start something like 10 years in advance.

Finally, it is also possible to manufacture in India machinery for the installation every year of a new fertilizer factory with capacity to produce 750,000 tons of ammonium sulphate per year. The foreign exchange requirement for this purpose would be less than 100 million dollars, to be spent once and for all. However, the installation of a plant to manufacture machinery for the production of fertilizers would take at least five or six years. When the first batch of machinery is produced, it would take another five years or so to complete the construction of a fertilizer factory. Such a plan would require a view being taken of future requirements at least 12 or 15 years in advance.

Consumer goods : In the case of consumer goods the increase in demand is estimated on the basis of the increase of income accepted as a target. Standard methods are used to calculate the elasticity of demand from information regarding expenditure on and consumption of (in physical terms, where possible) a large number of commodities and services; which is being collected every year by the National Sample Survey (NSS) of India. In the NSS, the design of interpenetaring net-work of sub-samples (IPNS) is always used providing at least two independent estimates of each variate. It is, therefore, possible to estimate the elasticity of demand on the basis of each sub-sample and also on the basis of the combined sample of the two sub-samples pooled together. Table (A-2) in the Appendix gives estimates of percentage increases in demand over the five-year period of the Third Plan. The two independent sub-sample estimates supply useful information on the margin of uncertainty of the estimates.

In a planned economy it is not possible to allow the supply to increase with the demand without any restriction. It is necessary to increase domestic savings by restricting the consumption of non-essential or luxury goods. It is therefore necessary to impose excise and sales tax or controls on imports or on production to bring about a balance between the planned supply and the estimated demand.

Recently the method of fractile graphical analysis is being used for estimating elasticities of demand for households having different values of total per capita consumer expenditure (which is a rough indicator of the level of living). This approach has the great advantage of showing, in a very simple way, the pattern of change of the elasticity of demand with a change in the level of living. Analysis by fractile groups is particularly useful in studying the effect of excise and sales tax in balancing supply and demand.

Perspective planning of man-power : It is only with the help of skilled workers, technicians, technologists and engineers that raw materials can be converted into machinery, electricity, and power, which can then be used for the production of both capital and consumer goods. A rapidly increasing supply of engineers and technical personnel is essential for economic development. It is necessary to establish and broaden the base of primary and secondary education and to establish technical and scientific institutions and increase their number rapidly. The most serious difficulty is the lack of trained and experienced teachers at all levels. To build up a sound foundation for the outturn of technical personnel would take a great deal of time; it is a much more slowly maturing process than establishing heavy machine building, steel, heavy electrical or heavy chemical industries. Perspective planning is indispensable, and it is necessary to have targets twenty years or more in advance.

Scientific and technical man-power : From about 1955 a great deal of attention is being given in India to the question of technical man-power. The method used for estimating the requirements of technical personnel is simple and straightforward. Information relating to manufacturing industries for the reference period 1956 was collected as a part of the National Sample Surveys and was analysed in detail to ascertain the number of professional and technical workers (including engineers and scientists) employed in manufacturing industries. Estimates for a number of selected industries are given in Table 3 in the form of percentages of total employment (that is, number of engaged persons) in different industries. Separate figures are given in column (2) for the proportion of professional, technical and associated workers taken together, in column (3) for the proportion of engineers, architects and surveyors, and in column (4) for the proportion of scientists including chemists, physicists, geologists and other physical scientists.

There are wide variations in requirements of professional and technical personnel or of engineers or scientists from one industry to another. In chemicals, and aircraft assembling and repair, the proportion of professional and technical staff is about 10 per cent. The chemical industries, naturally, require 5 per cent of scientists (no doubt, mostly chemists) and only 0·6 per cent of engineers. In contrast, aircraft assembling and repair requires a high proportion of about 5·5 per cent of engineers but practically no scientists.

TABLE (3): TECHNICAL PERSONNEL IN SELECTED INDUSTRIES : SAMPLE SURVEY OF MANUFACTURING INDUSTRIES, 1956

industries	percentage of total employment		
	professional	engineers	scientists
(1)	(2)	(3)	(4)
1. rice milling	0.87	0.08	0.00
2. cotton textiles	0.90	0.12	0.51
3. glass and glassware	0.99	0.19	0.18
4. tea manufacturing	2.39	0.31	0.03
5. aluminium, copper, brass : secondary products	2.49	1.58	0.05
6. sugar	2.65	0.51	0.71
7. general engineering and electrical engineering	4.27	2.02	0.01
8. paints and varnishes	5.44	0.31	3.47
9. cement	5.53	0.89	1.12
10. petroleum refining	5.56	1.55	2.40
11. electricity generation and transmission	6.50	4.79	0.04
12. iron and steel : primary products	6.70	2.86	0.58
13. railway wagon manufacturing	8.46	3.02	0.21
14. aircraft assembling and repair	9.93	5.47	0.00
15. chemicals (including drugs)	9.99	0:62	5.06

Source : *Occupational Pattern in Manufacturing Industries, India 1956* by Pitambar Pant and M. Vasudevan with a foreword by P. C. Mahalanobis, Planning Commission, Government of India, 1959. In col. (2) 'professional' stands for all professional, technical and related workers. In col. (3) 'engineers' cover architects and surveyors. In col. (4) 'scientists' stand for chemists, physicists, geologists and other physical scientists.

With any assumed target of production for any particular industry in any given year, it is possible to estimate the total number of engaged persons and hence the number of professional staff, engineers and scientists. Requirements of engineers and technical personnel were estimated in this way for purposes of perspective planning.

Expansion of technical staff: Appropriate action was taken to expand the capacity of existing scientific and technological institutions and to establish new institutions all over the country to ensure a sufficiently rapid expansion of scientific and technical personnel. The following table shows the new admissions into universities and higher educational institutions of the university standard in science and technology.

TABLE (4): ADMISSIONS INTO HIGHER DEGREE LEVEL INSTITUTIONS IN SCIENCE AND TECHNOLOGY

	subject	1950-51	1960-61	1965-66	1975-76	1950-51	1960-61	1965-66	1975-76
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		in thousands				as percentage of 1950-51 figures			
1.	science	51	116	199	264	100	227	390	518
2.	engineering	4	14	25	70	100	350	625	1,750
3.	medicine	2.5	6	8	20	100	240	320	800
4.	agriculture	2.0	5	9	15	100	250	450	750
5.	total	59.5	141	241	369	100	237	405	620

On the whole the planning for scientific and technical manpower, particularly for engineering, has been quite satisfactory in India. For example, the new admissions in engineering increased from 4,000 a year in 1950-51 to 14,000 a year in 1960-61. Also, the target is about 25,000 new admissions in 1965-66, and 70,000 in 1975-76.

Outturn of engineers: The Appendix Table (A-4) gives the outturn of scientists and engineers in India from 1915 to 1960. It would be seen from Table (A-4), line 8 and column (4), that the number of degree level engineers turned out between 1915 and 1947 was 14,984 in thirty three years before independence. This was practically matched by a turnout of 14,385 in five years during the period of the First Plan (1951–56). The outturn increased much further to 24,166 during the five-year period of the Second Plan.

The outturn for individual years between 1951 and 1960 also shows a very rapid increase. The outturn of degree level engineers was 1,700 in 1951 which was nearly doubled in three or four years. Perspective planning of technical personnel was seriously started from 1955; the effect became visible after four years in 1959 when the outturn rose to 6,779 against 3,689 in the previous year, that is, an increase of more than three thousand in one year.

Scientific Research: Although the intake and outturn of scientists also has been increasing fairly rapidly, I am sorry to say that perspective planning of scientific research has not yet started seriously. The emergence into the modern age of any underdeveloped country would be possible only with the building of the base of science education and scientific research. Certain compelling reasons can be appreciated very easily. Natural resources are not identical everywhere; there are wide variations from one country to another. Resources available within any country can be used most effectively only through continuing applied scientific and technological research in which use is made of basic scientific knowledge to solve practical problems. It is also necessary to provide facilities for fundamental research not only for the accumulation of scientific knowledge but also to supply scientists who would be able to diagnose problems properly and identify how such problems should be handled or what kind of help should be obtained from abroad. There is also a deeper need of replacing the traditional pattern of making decisions on the basis of authority by decisions to be made increasingly on objective grounds based on scientific and rational thinking.

Perspective planning is indispensable : The need of perspective planning, especially in underdeveloped countries, may be stated very briefly in conclusion. It is necessary to increase the supply of consumer goods. To do this it is necessary to expand continually the production of capital goods. Both would require an increasing supply of engineers and technicians. Industrial and technological developments would call for a rapid expansion of applied research which, in its turn, would require a sound foundation of basic research.

The factor of time may be next considered. Factories for the production of practically any kind of consumer goods can be established in a year or two with the help of imported machinery or fuel. To develop the production of capital goods and energy would take at least ten or fifteen years. To secure an adequate supply of engineering and technical personnel would require twenty or twenty-five years. To have enough scientists of ability for both applied and basic research would take at least a generation or even more. It is clear that perspective planning, looking fifteen or twenty years ahead, is indispensable for all underdeveloped countries.

Appendix

TABLE (A-1): ESTIMATES OF β AND θ FOR MAJOR GROUPS OF MANUFACTURING INDUSTRIES WITH 1957 AND 1960-61 WEIGHTS

	β		θ (thousand Rs.)	
	1957 weights	1960-61 weights	1957 weights	1960-61 weights
(1)	(2)	(3)	(4)	(5)
1. metallurgical industries	0.19	0.20	178.9	172.3
2. metallurgical : semi-manufacturing	0.47	0.45	17.1	19.0
3. mechanical and general engineering	0.66	0.65	11.4	10.9
4. transport equipment	0.45	0.45	15.4	15.3
5. electrical equipment	0.50	0.49	16.6	18.5
6. industrial machinery (I)	0.62	0.61	24.9	22.7
7. industrial machinery (II)	0.47	0.43	17.4	20.1
8. chemicals	0.35	0.32	29.1	20.3
9. textiles	0.38	0.38	10.6	10.5
10. rubber and leather products	0.62	0.61	14.5	14.8
11. food industries	0.30	0.30	13.0	12.9
12. mining industries	0.33	0.35	17.6	20.5
13. timber and cellulose industries	0.33	0.31	11.2	12.3
14. mining and oil industry	0.43	0.39	9.5	11.1
15. all industries	0.36	0.35	13.2	15.3

Note: The coefficients are obtained from detailed industry-wise information compiled by the Perspective Planning Division of the Planning Commission in collaboration with the Planning Unit of the Indian Statistical Institute.

TABLE (A-2): ESTIMATES OF PERCENTAGE INCREASES IN DEMAND OVER THE THIRD FIVE YEAR PLAN PERIOD 1961–1966

name of item	percentage increase in demand								
	urban India			rural India			all-India		
	ss. 1	ss. 2	combined	ss. 1	ss. 2	combined	ss. 1	ss. 2	combined
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. pulses	22	32	32	19	21	20	21	23	22
2. vegetables	35	38	36	22	23	22	26	27	26
3. spices	30	31	30	18	17	17	19	20	19
4. edible oil	35	35	35	23	20	22	26	24	25
5. sugar	38	39	38	29	28	29	31	31	31
6. milk and milk products	46	43	44	33	40	36	37	40	38
7. meat, fish eggs	38	40	39	21	21	21	26	28	27
8. fruits and nuts	46	45	45	23	25	24	32	33	32
9. beverage and refreshments	42	41	41	28	27	27	34	34	34
10. tobacco	36	35	36	22	19	21	25	23	24
11. kerosene	32	33	32	19	18	19	22	22	22
12. fuel and light	33	33	33	19	17	18	22	21	21
13. cotton clothing (mill-made)	49	43	48	36	33	34	39	35	37
14. washing soap	38	39	39	30	27	30	33	32	33
15. toilets	45	41	41	22	22	22	32	30	30
16. railway	53	49	53	46	33	35	49	40	43
17. conveyance	53	55	53	38	28	35	44	40	43
18. cinema	45	53	49	32	30	31	41	42	44
19. domestic utensils	31	46	37	37	23	36	37	26	36

Note: Based on elasticites calculated in the Indian Statistical Institute, Calcutta from 10th round NSS data relating to December 1955–May 1956.

TABLE (A-3): ELECTRICITY BALANCE

	consuming industry	unit	volume of production			electricity consumption in m.kwh			electricity consumption per unit of production
			1960-61 production	1965-66 capacity	1970-71 capacity	1960-61	1965-66	1970-71	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.	iron and steel								
	1 finished steel	m. ton	2.2	7.5	13.5	1,100	3,750	6,750	500 kwh/ton
	2 pig iron	„	0.9	1.5	3.0	18	30	60	20 „
	3 steel re-rolling					200	550		
2.	ferro-manganese	000 tons	100.0	220.0	385.0	500	1,100	1,925	5,000 „
3.	ferro-silicon	„	6.0	40.0	60.0	48	320	480	8,000 „
4.	alloy steel	„	—	200.0	500.0	—	250	625	1,250 „
5.	aluminium	„	18.5	125.0	240.0	370	2,500	5,000	20,000 „
6.	copper	„	8.9	22.0	50.0	27	66	150	3,000 „
7.	zinc	„	3.2	15.0	30.0	13	63	126	4,200 „
8.	coal								
	1 bituminous	m. ton	53.0	97.0	180.0	106	1,940	3,600	20 „
	2 brown	„	—	6.0	12.0	—	240	240	20 „
9.	petroleum (refining)	„	4.6	17.0	30.0	161	595	1,050	35 „
10.	fertilizers								
	1 nitrogenous, electrolytic process	000 tons	110.0	80.0	80.0	462	1,280	1,280	16,000 „
	2 nitrogenous, rest	„	—	920.0	1,920.0	—	3,864	8,064	4,200 „
	3 phosphatic	„	55.0	500.0	1,250.0	25	225	563	450 „
11.	heavy chemicals								
	1 sulphuric acid	„	363.0	1,750.0	3,700.0	91	438	925	250 „
	2 soda ash	„	145.0	530.0	860.0	22	80	129	150 „
	3 caustic soda, chemical process	„	—	50.0	90.0	—	25	45	500 „
	4 caustic soda, electrolytic process	„	100.0	350.0	610.0	420	1,470	2,562	4,200 „
12.	plastics	„	10.0	85.0	250.0	1	5	16	60 „
13.	soap	„	150.0	500.0	700.0	30	100	140	200 „
14.	synthetic rubber	„	—	50.0	140.0	—	35	98	700 „
15.	paper and paper board	„	350.0	820.0	1,500.0	630	1,476	2,775	1,800 „
16.	newsprint and security paper	„	25.0	151.5	240.0	16	98	156	650 „

Source: Perspective Planning Division paper: Demand for Electricity, India, 1960–1970. The table covers all industrial uses of electricity. The norms of electricity requirement in different industries, given in column (9), have been used to work out the consumption of electricity in 1960–61, 1965–66 and 1970–71 given respectively in columns. (6), (7), and (8).

TABLE (A-3) : ELECTRICITY BALANCE—*Contd.*

consuming industry	unit	volume of production			electricity consumption in m.kwh			electricity consumption per unit of production
		1960-61 production	1965-66 capacity	1970-71 capacity	1960-61	1965-66	1970-71	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
17. cement	m. tons	8.0	15.0	26.0	960	1,800	3,120	120 kwh/tons
18. cotton textiles	m. metres	4,572.0	5,300.0	6,400.0	1,998	2,316	2,797	437 kwh/000 metres
19. jute	000 tons	1,065.0	1,200.0	1,600.0	415	468	624	390 kwh/ton
20. rayon and staple fibre								
1 rayon filament	m.lbs.	47.0	140.0	250.0	147	438	781	3,125 kwh/000 lbs.
2 staple fibre	"	47.8	75.0	120.0	40	62	99	825 "
3 chemical pulp	000 tons	—	120.0	250.0	—	60	125	500 kwh/ton
21. woollen fabrics-yarn	m. lbs.	28.0	67.0	100.0	84	201	300	3,000 kwh/000 lbs.
22. silk	m. yds.	350.0	550.0	800.0	105	165	240	300 kwh/000 yards
23. sugar	m. tons	2.7	3.5	4.5	162	210	270	60 kwh/ton
24. vegetable oil	"	0.8	1.2	2.2	100	140	275	125 "
25. vanaspati ghee	000 tons	330.0	550.0	730.0	73	121	161	220 "
26. bicycles	m. nos.	1.0	2.2	3.5	15	33	53	15 kwh/nos.
27. sewing machines	000 nos.	300.0	700.0	1,200.0	18	42	72	60 kwh/nos.
28. electric fans	m. nos.	0.9	2.8	4.5	18	56	90	20 kwh/nos.
29. electric lamps	"	39.5	83.0	120.0	6	12	18	150 kwh/000 nos.
30. matches	m. gross boxes	33.0	45.0	52.0	20	27	31	600 kwh/000 gross boxes
31. plywood	m. sq. metre	15.5	27.0	45.0	14	25	42	930 kwh/000 sq. metres
32. calcium carbide	000 tons	10.0	67.0	110.0	35	235	385	3,500 kwh/ton
33. automobile tyres	m. nos.	1.4	3.7	7.5	150	396	803	107 kwh/nos.
34. automobiles	000 nos.	53.5	100.0	200.0	54	100	200	1,000 kwh/nos.
35. coke	m. tons	5.0	15.0	25.0	125	375	625	25 kwh/ton
38. Total					8779	26,672	47,870	

Source : Perspective Planning Division paper : Demand for Electricity, India, 1960–1970. The table covers all industrial uses of electricity. The norms of electricity requirement in different industries, given in column (9) have been used to work out the consumption of electricity in 1960-61, 1965-66 and 1970-71 given respectively in columns (6), (7) and (8).

TABLE (A-4): OUTTURN OF SCIENTISTS AND ENGINEERS IN INDIA

	year	number of persons graduating					
		master's degree in natural science		engineering			
		total	average per year	degree	diploma	total	average per year
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	1915–19	832	166	568	1,703	2,271	454
2.	1920–24	917	183	771	1,902	2,673	535
3.	1925–29	1,923	385	1,619	4,322	5,941	1,188
4.	1930–34	2,784	557	2,190	5,397	7,587	1,517
5.	1935–39	2,938	588	2,901	5,331	8,232	1,646
6.	1940–44	3,378	676	3,765	6,208	10,045	2,009
7.	1945–47	2,511	837	3,170	4,538	7,708	2,569
8.	1915–47	15,283	463	14,984	29,473	44,457	1,347
9.	1948–50	2,947	892	4,691	4,623	9,314	3,105
10.	1951–55 (1st Plan)	9,062	1,812	14,385	11,629	26,014	5,203
11.	1956–61 (2nd Plan)	15,799	3,160	24,166	27,037	51,203	10,241
12.	1951	1,409	1,409	2,301	1,700	4,001	4,001
13.	1952	1,680	1,680	2,559	2,049	4,608	4,608
14.	1953	1,694	1,694	2,926	1,693	4,619	4,619
15.	1954	2,068	2,068	3,238	2,833	6,071	6,071
16.	1955	2,211	2,211	3,361	3,354	6,715	6,715
17.	1956	2,456	2,456	3,456	4,131	7,587	7,587
18.	1957	2,832	2,832	3,507	4,413	7,920	7,920
19.	1958	2,982	2,982	3,689	5,944	9,633	9,633
20.	1959	3,558	3,558	6,779	6,182	12,961	12,961
21.	1960	3,971	3,971	6,735	6,367	13,102	13,102

Note : Figures are taken from 'Recent developments in the organization of science in India' by P. C. Mahalanobis ; 'Engineers in India' by Scientific and Technical Manpower Division, Planning Commission ; 'Education in India' by Ministry of Education, and also direct information from the Resources and Scientific Research Division of the Planning Commission.

TABLE (A-5): AVERAGE PER CAPITA CONSUMER EXPENDITURE IN RUPEES PER MONTH (30 DAYS), PERCENTAGE SHARE OF TOTAL CONSUMER EXPENDITURE AND LIMITING VALUES OF CONSUMER EXPENDITURE BY FRACTILE GROUPS FOR THE 8TH ROUND OF THE NATIONAL SAMPLE SURVEY, JULY 1954—MARCH 1955, ALL-INDIA: RURAL AND URBAN

fractile group (percentage)	average per capita consumer expenditure (Rs.)						percentage share						limiting values (Rs.)					
	rural			urban			rural			urban			rural			urban		
	ss. 1	ss. 2	pooled	ss. 1	ss. 2	pooled	ss. 1	ss. 2	pooled	ss. 1	ss. 2	pooled	ss. 1	ss. 2	pooled	ss. 1	ss. 2	pooled
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1. lowest	—	—	—	—	—	—	—	—	—	—	—	—	2.19	2.20	2.19	2.76	2.43	2.43
2. 0— 10	4.21	4.64	4.48	6.20	6.68	6.54	2.75	3.03	3.01	2.96	2.46	2.65	5.48	5.89	5.70	8.14	8.52	8.30
3. 10— 20	6.25	6.56	6.42	9.30	9.96	9.59	4.07	4.41	4.09	4.27	3.48	3.90	7.01	7.39	7.18	10.22	11.24	10.82
4. 10— 30	7.72	8.24	7.99	11.62	12.83	12.06	5.05	5.57	5.33	4.56	4.72	4.86	8.26	8.93	8.67	12.68	14.02	13.29
5. 30— 40	9.26	9.52	9.37	13.75	15.19	14.28	6.11	6.19	6.18	6.73	5.34	5.70	10.15	10.18	10.17	14.65	16.91	15.30
6. 40— 50	10.91	10.89	10.90	16.00	18.56	16.94	7.18	7.43	7.27	7.05	6.86	6.78	11.74	11.75	11.74	17.42	20.17	18.50
7. 50— 60	12.61	12.65	12.63	19.00	21.62	20.11	8.27	8.35	8.35	8.29	7.82	8.01	13.73	13.70	13.73	20.91	23.79	21.73
8. 60— 70	14.82	15.12	14.94	22.68	26.82	23.86	9.51	10.00	9.74	9.98	9.71	9.64	16.23	16.69	16.42	24.45	29.65	26.08
9. 70— 80	17.72	18.54	18.17	27.20	33.52	29.52	11.78	12.23	11.95	11.65	12.16	11.86	19.72	20.83	20.22	30.92	37.20	33.48
10. 80— 90	22.42	23.80	23.04	36.56	43.54	39.00	14.78	16.18	15.53	15.43	15.78	15.61	26.79	28.03	27.55	46.71	53.16	46.65
11. 90—100	46.44	39.00	42.16	65.20	88.22	76.78	30.50	26.61	28.55	29.08	31.67	30.99	239.25	112.96	239.25	525.07	333.92	525.07
12. 0—100	14.93	14.98	14.96	22.44	27.69	25.24	100.00	100.00	100.00	100.00	100.00	100.00	239.25	112.96	239.25	525.07	333.92	525.07
13. number of villages or blocks	353	353	706	238	228	466	353	353	706	238	466	466	353	353	706	238	228	466
14. number of households	931	938	1869	963	892	1855	931	938	1869	963	892	1855	931	938	1869	963	892	1855

Source: Indian Statistical Institute, Calcutta.

USE OF CAPITAL OUTPUT RATIOS IN PLANNING IN DEVELOPING COUNTRIES

This paper was originally published in *Bull Int. Stat. Inst.*, **XLI**, 87-95.

Some general considerations

1. The use of statistical information on capital and output for purposes of planning can be considered under three heads. Firstly, before any project is considered for inclusion in any plan, it is obviously necessary to know the capital cost of the project as well as the flow of annual output expected from it; such information is also required to choose between different projects or programmes. The aggregate investment and output for any draft plan, or exercises in preparing a plan, must be obtained by adding up respectively the capital costs of the projects and also the expected flow of annual outputs. In this very simple sense, capital and output data are being used and have always been used in every country by individual enterprises or at all higher levels of planning. Such use does not, however, involve the capital-output ratio as a parameter in any particular economic model.

2. Secondly, statistical information of a historical type on capital and output derived from administrative or census or survey data can be used in various ways as background knowledge for purposes of planning. Any historical approach would involve many social, institutional and environmental conditions. To transform such conditions into a quantitative form is difficult, even in principle, and usually not possible in practice. In spite of such difficulties statistical information on capital and output, as well as the ratio of the two, have considerable interest and value in a historical analysis of the economy of a country. A critical analysis of the success or otherwise of the implementation of plans in previous periods can be a guide to realistic decisions for the future and may be of help in exercises in estimating growth rates in future. A consideration of the use of such background type of knowledge has also been excluded from this paper.

3. The object of this note is to consider certain aspects, in a very preliminary and superficial way, of the use of a particular function of the two variables, namely, the capital-output ratio in economic planning with special reference to India. This capital-output ratio can be used in principle in many ways. At the most abstract level, multi-sector programming with

sectoral capital-output ratios may be used to obtain sectoral targets on optimisation of a suitable "welfare" or some other "value" function. The approach has been a stimulating tool for clarification of ideas and significant advances in the theory of planning. Some of the results have supplied valuable guidance in a qualitative way somewhat like the background knowledge of the economic-historical experience mentioned above. As far as I know, multisector programming has not been used so far in any country for making actual quantitative decisions.[1]

4. Simpler models using the capital-output ratio for the country as a whole or for some of its major sectors can be used to study the effect of different patterns of investment on the long term growth of the economy. So long, as the sectors chosen are relatively independent, the procedure is valid and useful. This method was of help in the allocation of investments in the draft plan-frame for the Second Five Year Plan of India (1956–1961). Such simple models are likely to be useful in the initial stages of planning in under-developed countries when very little techno-economic or economic-historical information is available. But problems change continually as detailed planning is done more and more on the basis of projects. The simple aggregative models which were useful at the stage of the Second Five Year Plan of India are no longer relevant. It is, however, conceivable that other models, using capital-output ratios based on a small number of sectors which are to a large extent independent, can be of help in solving specific new problems.

5. A very simple way of using capital-output ratios is to make direct comparisons over time or for different conditions of operations, for example, single and double shift, or comparisons at micro-level, between different groups in the same branch of industry or even of different enterprises; such comparisons are sometimes quite useful. Aggregative values of the ratio for the same or similar branches of industry in different States or regions can supply valuable information on variations due to regional differences of an intrinsic kind or to differences in the efficiency of management. Comparisons of the rolling capital-output ratio can also be useful for particular purposes.

Statistical information

6. I shall now try to give some idea of the type of information on capital-output ratios which are now available in India. There is an annual census of industrial establishments above certain limiting size, defined by a

[1] The following two recent papers illustrate this type of work: (1) An optimising planning model, by S. Chakravarty and Louis Lefeber, *Economic Weekly*, Annual Number, February 1965; (2) A consistency model of India's Fourth Plan, by Alan S. Manne and Ashok Rudra, *Sankhyā*, Series B, Vol. 27, Parts 1 & 2, 1965.

minimum of 50 workers on an average if using power and 100 workers on an average if not using power. An annual sample survey is used for establishments of a smaller size, with a cut-off point at a lower limiting size defined by 10 or more workers using power and 20 or more workers not using power. Table 1 presents the ratios based on the 1961 survey of industries for 17 selected industries.[2]

The census data, which are for larger enterprises, have larger capital-output ratios. Data of the above type, however, have well-known limitations, for example, under-estimation of the value of fixed capital for older installations. In principle it is necessary to use the "replacement value" of the fixed capital. As there are great technical difficulties in estimating the replacement value, this method has not been used in India except in some occasional exercises.

TABLE 1. CAPITAL-OUTPUT RATIO BASED ON SURVEY OF INDUSTRIES, 1961

industries	total capital/value of output			total capital/value added		
	census	sample	total	census	sample	total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. electricity, gas	2.40	2.00	2.27	7.33	4.09	5.97
2. basic chemicals, fertilizer	1.46	0.59	1.39	4.74	2.61	4.62
3. cement	0.98	0.42	0.98	4.19	1.25	4.18
4. petroleum refineries	1.45	—	1.45	4.17	—	4.17
5. iron and steel, basic	1.03	0.52	0.99	3.92	2.56	3.84
6. non-ferrous metals, basic	1.09	0.47	0.92	3.99	2.46	3.68
7. paper and paper board	0.98	0.41	0.92	3.60	1.95	3.47
8. sugar	0.60	0.51	0.60	3.02	3.00	3.02
9. motor vehicles	0.48	—	0.48	2.38	—	2.38
10. metal prod, except machinery	0.58	0.54	0.57	2.21	2.03	2.15
11. non-electrical machinery	0.76	0.70	0.75	2.10	2.20	2.13
12. electrical machinery	0.69	0.38	0.66	2.14	1.22	2.07
13. miscellaneous food	0.36	0.24	0.32	2.45	1.16	1.98
14. rail road equipment	0.63	0.60	0.63	1.89	2.36	1 89
15. paints and chemicals	0.54	0.38	0.52	1.70	1.70	1.70
16. printing and publishing	0.65	0.52	0.62	1.58	1.09	1.44
17. cotton textiles	0.43	0.29	0.42	1.40	1.62	1.40
18. all industries	0.64	0.43	0.60	2.40	1.95	2.33

[2] *Source :* Estimate of Total Capital, Employment and Output in Manufacturing Industries, 1961 (mimeo) issued by Central Statistical Organization, India, 1965. Only industries having a total productive capital of Rs. 50 crores or more have been included. The industries in tables are generally arranged in descending order of total capital/value added ratio.

7. Data obtained from projects are more useful for purposes of detailed planning. Some estimates based on project data are given in Table 2 below.[3]

TABLE 2. CAPITAL-OUTPUT RATIO BASED ON PROJECT DATA

industries	shift	fixed capital/ value of output	total capital/ value of output	fixed capital/ value added	total capital/ value added
(1)	(2)	(3)	(4)	(5)	(6)
1. aluminium	3	3.16	3.86	12.64	15.44
2. generators	1	3.00	3.64	7.50	9.10
3. oil refinery equipment	1	2.75	3.08	6.88	7.70
4. turbines	1	2.50	3.00	6.25	7.50
5. heavy forging	1	2.20	2.50	5.50	6.25
6. chem. ind. machinery	1	2.00	2.33	5.00	5.82
7. finished steel	3	2.28	2.68	4.38	5.15
8. nitrogenous fertilizer	3	1.61	2.01	4.02	5.02
9. vegetable oil	1	0.15	0.29	2.50	4.83
10. steel casting	1	1.43	1.73	3.58	4.32
11. paper and paper board	3	1.33	1.69	3.09	3.93
12. sugar	3	0.60	1.00	2.22	3.70
13. artificial silk	1	1.00	1.43	2.56	3.67
14. crude oil refining	3	1.10	1.50	2.44	3.55
15. cement machinery	1	1.00	1.33	2.50	3.33
16. coal mining machinery	1	1.00	1.33	2.50	3.32
17. cotton yarn	2	0.73	1.06	2.28	3.31
18. refrigerators	1	1.00	1.40	2.22	3.11
19. steam locos	2	0.80	1.13	2.16	3.05
20. metal cutting tools	1	0.80	1.13	2.00	2.82
21. iron ore	–	2.27	2.47	2.52	2.74
22. jute textiles	1	0.50	0.78	1.72	2.68
23. coal	–	2.00	2.20	2.35	2.59
24. cement	3	0.92	1.00	2.30	2.50
25. copper	3	0.28	0.61	1.12	2.44
26. sulphuric acid	3	0.64	1.03	1.45	2.34
27. cotton cloth	2	0.50	0.85	1.35	2.30
28. wagons	1	0.50	0.75	1.50	2.25
29. superphosphate	3	0.48	0.88	1.20	2.20
30. rubber footwear	1	0.50	0.82	1.28	2.10
31. jute textile machinery	2	0.50	0.83	1.25	2.09
32. agricultural implements	1	0.50	0.83	1.25	2.08
33. automobiles	1	0.40	0.60	1.33	2.00
34. leather	1	0.33	0.63	1.00	1.89
35. radio sets	1	0.40	0.80	0.89	1.78
36. cotton textile machinery	2	0.50	0.83	0.83	1.38
37. dry batteries	1	0.20	0.60	0.44	1.33

[3] *Source :* A Survey of Economic Coefficients for Organized Industries in India, Perspective Planning Division, Planning Commission, April 1959 (mimeo.).

Comparison between project and survey data is difficult. Projects refer usually to new units of production; survey data to the industry as a whole with production units of varying age. The difficulty in valuation of fixed capital has been already mentioned; another difficulty arises from the fact that project data include a reasonable amount of inventory while the survey data supply the actual inventory holdings, which have been sometimes unnecessarily large in India.

8. That the value of the capital-output ratio would decrease when the number of shifts is increased is an elementary point which does not call for any comments. Some numerical information may, however, be of interest. Table 3 below shows that a total capital/value-added ratio of about 3 was reduced to about 2 when a single shift was changed to a double shift.[4]

TABLE 3. FREQUENCY DISTRIBUTION OF CAPITAL-OUTPUT RATIO FOR SINGLE AND DOUBLE SHIFTS

range	single shift	double shift
(1)	(2)	(3)
0 — 0.90	0	1
1 — 1.99	20	47
2 — 2.99	29	18
3 — 3.99	12	9
4 — 4.99	9	2
5 — 5.99	3	0
9 — 6.99	2	0
7 — 7.99	2	0
total	77	77
average	2.98	2.03

9. Another important factor is the form of the new investment. It is possible either to set up new units or to make substantial extensions of old units. Extensions should normally lead to lower capital-output ratios in comparison with new units. In census and survey data it is not possible to distinguish between substantial extensions and new units. Some information is given in Table 4 below on the reduction of the ratio in the case of substantial extensions based on direct returns.[5]

[4] *Source :* See footnote 3.

[5] *Source :* The Investment-Output-Employment relationships, Phasing of Investment and Time lags in Organized Manufacturing Industries, (mimeo.), Perspective Planning Division, Planning Commission, March 1960.

TABLE 4. CAPITAL-OUTPUT RATIO FOR NEW UNITS AND SUBSTANTIAL EXTENSIONS

industries	shifts	fixed capital/ value added	fixed capital/ value of output	lag between new unit and extension (month)
(1)	(2)	(3)	(4)	(5)
1. *Sugar*				
new unit	3	3.14	1.10	
substantial extension	3	2.23	0.78	11
2. *Cotton yarn*				
new unit	3	2.15	0.75	
substantial extension	3	1.82	0.60	6
3. *Cotton cloth*				
new unit	3	2.50	0.40	
substantial extension	3	0.94	0.15	6
4. *Cement*				
new unit	3	4.12	1.65	
substantial extension	3	2.50	1.00	10

A detailed study of investment and output is necessary to decide between a substantial extension and the setting up of a new unit at any particular stage of planning. A lower capital-output ratio is not, however, necessarily decisive. It is essential to keep in view the need of future expansion. A suitable new unit may be preferable, even if it is more capital intensive, because it would offer more scope for extensions in future.

10. The time lag between the investment and production is an important factor in the relation between capital and output. Table 5 below gives some estimate of time lags between the date of issue of Industries Act license and the date of realization of full production.[6] The data are given separately for

TABLE 5. LAG IN YEARS BETWEEN INVESTMENT AND GENERATION OF OUTPUT

industries	new unit		extension		combined	
	n	lag	*n*	lag	*n*	lag
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. wood, paper, etc.	1	5.42	2	3.37	3	4.05
2. industrial machinery	6	4.12	4	3.92	10	4.03
3. metallurgical industries	8	4.12	1	3.25	9	3.93
4. cement, glass, etc.	2	4.42	4	3.58	6	3.85
5. chemical industries	7	3.83	13	3.67	20	3.70
6. food industries	1	4.50	1	3.58	2	3.62
7. rubber products	1	3.58	1	3.42	2	3.54
8. textiles	4	3.58	2	3.33	6	3.50
9. transport equipment	5	4.08	3	2.42	8	3.46
10. electrical equipment	8	3.17	6	3.58	14	3.42
11. total	43	3.90	37	3.51	80	3.72

[6] *Source :* See footnote 5.

new units and substantial extensions. It is somewhat surprising but true that extensions do not have generally a smaller time lag in India. Their only advantage is in respect of smaller capital-output ratios.

11. Project data have to be used for purposes of the detailed planning of investments. Historical information on capital-output ratios based on census and survey data are not adequate for detailed planning but give some guidance in assessing likely performance in future. Census and survey data on capital-output ratios may therefore be quite useful for models for long range projections. Census and survey estimates may also be of considerable help in making detailed comparisons in individual industries.

Use of sample surveys

12. India is having an annual census of manufacturing industries. I am not sure that in developing countries, the usefulness of an annual census would be always commensurate with the cost. An annual sample survey, on the other hand, is likely to be quite useful from very early stages of industrialisation. In developing countries continuing attention must be given to the validity and margin of error of survey data. On the side of sampling techniques, the use of the design of interpenetrating network of samples (IPNS) supplies a great deal of statistical control. Estimates of the capital-output ratios for fifteen selected industries, based on two inter-penetaring sub-samples as well as the pooled samples, are given in Table 6 in respect of the sample (that is, the small scale) sector of the 1959 survey of industries.[7] The sub-sample estimates are generally closer for the total capital/value-added and fixed capital/value added ratios, as could be expected. Also, differences in sub-sample estimate may, apart from technical errors (sampling or non-sampling), represent real physical differences between different units. The survey estimates may, therefore, be sufficiently reliable for many practical purposes.

Concluding observations

13. The capital/value-added ratio has the advantage that it is independent of industrial classification, and can be aggregated at all levels. The capital/value-of-output ratio for any level of aggregation depends on the composition or "mix" of types of industrial production; comparisons over

[7] *Source:* Tables with notes on the Annual Survey of Industries, 1959 :Sample Sector: Summary Results, National Sample Survey No. 91, Cabinet Secretariat, Government ofIndia, 1964. Units in completely enumerated strata occur in both sub-samples.

TABLE 6. CAPITAL-OUTPUT RATIO BY SUB-SAMPLES BASED ON SURVEY OF INDUSTRIES, 1959: SAMPLE SECTOR

selected industries	*n*			fixed capital/ value of output			total capital/ value of output			fixed capital/ value added			total capital/ value added		
	s.s.1	s.s.2	pooled	s.s.1	s.s.2	pooled	s.s.1	s.s.2	pooled	s.s.1	s.s.2	pooled	s.s.1	s.s.2	pooled
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1. electric light and power	53	50	100	2.47	1.90	2.20	2.57	2.05	2.32	4.88	4.79	4.79	5.08	4.97	5.05
2. water supply station	41	40	52	1.55	1.82	1.69	1.60	1.88	1.74	4.62	4.85	4.85	4.77	5.22	5.00
3. sugar factories	32	23	48	0.29	0.29	0.29	0.38	0.42	0.41	2.37	2.91	2.70	3.08	4.25	3.77
4. ginning and pressing	151	135	238	0.54	0.29	0.36	0.64	0.39	0.45	2.64	2.68	2.66	3.12	3.52	3.36
5. paper and paper board	37	36	63	0.27	0.21	0.24	0.54	0.50	0.52	1.19	0.92	1.06	2.38	2.15	2.27
6. basic chemicals	39	38	68	0.19	0.16	0.17	0.40	0.48	0.45	1.01	0.78	0.87	2.13	2.36	2.27
7. non-electrical machinery	166	155	320	0.25	0.25	0.25	0.42	0.75	0.58	0.80	0.80	0.80	1.31	2.39	1.83
8. non-ferrous metals	46	44	84	0.06	0.08	0.07	0.23	0.23	0.23	0.45	0.65	0.54	1.67	1.98	1.80
9. rubber and rubber products	35	34	64	0.18	0.16	0.17	0.26	0.68	0.43	0.81	0.53	0.67	1.18	2.31	1.71
10. glass and glass products	28	27	49	0.15	0.27	0.23	0.40	0.49	0.45	0.52	1.03	0.83	1.33	1.85	1.65
11. ferrous metals	64	62	113	0.19	0.12	0.14	0.35	0.30	0.32	0.77	0.65	0.70	1.42	1.63	1.54
12. electrical machinery	42	43	78	0.17	0.20	0.18	0.33	0.39	0.35	0.73	0.73	0.73	1.45	1.43	1.44
13. cotton textiles	226	206	412	0.13	0.12	0.13	0.20	0.30	0.31	0.63	0.50	0.56	0.94	1.22	1.36
14. tobacco manufacture	238	223	452	0.04	0.03	0.04	0.19	0.23	0.21	0.20	0.14	0.17	0.87	1.11	1.00
15. boots and shoes	25	22	41	0.04	0.06	0.05	0.14	0.18	0.16	0.16	0.22	0.18	0.49	0.66	0.56

time would be valid to the extent the industrial compositions of each sector remains the same over time. The relation between capital and full-capacity output is, in principle, of a physical or technical nature. However, the difference between the theoretical full-capacity output and the actual output may be large during periods of slack demand, or for lack of raw materials or other inputs or inefficiency of management.

14. Capital/output ratios at the national level can be obtained as the weighted average of ratios for individual units and would supply meaningful information for the capital/value-added ratio at the national, or at any level of aggregation. The capital/capacity-output ratio at the national level could give only a hypothetical asymptotic upper limit which can be never realised in practice due to management inefficiencies, shortages of materials, or of man-power etc., even in a fully planned economy, and, in addition, due to fluctuations of demand in a mixed economy. The capital/value-added ratio appears to be more useful for use in aggregative models.

15. Wherever the national economy is partitioned into more than one sector, the sectoral capital/output ratios would be necessarily inter-dependent; and in general increasingly so as the number of sectors is increased. The sectoral capital/output ratio would be more directly meaningful, the greater is the independence of the sectors under consideration.

16. The capital/value-added or capital/capacity-output ratios for individual establishments or industries may be useful for purposes of planning at the micro-level. The effect of any very small sector of the economy on the overall national economy would be generally negligible and the estimated values may be fairly stable in the absence of strong fluctuations in the rest of the economy. However, since capital accumulation over time would be heterogeneous and there would be changes in techniques and management, the ratios estimated from census of manufactures or similar data would be usually different from incremental ratios calculated from engineering data.

17. There are many pitfalls in the estimation and the use of capital-output ratios. Such ratios are automatically susceptible to change with fluctuations in demand or other factors. The larger the oscillations in any national economy, the larger would be the fluctuations in the numerical value of the capital-output ratios and the less useful would be such ratios for theoretical or practical purposes except perhaps as an indicator for the study of booms and depressions. In a planned economy, one important aim is to smooth out the economic fluctuations as much as possible. The greater the stability, that is, the less the economic fluctuations the greater would be the

stability and hence the greater the usefulness of capital-output ratios. In fact, if fluctuations can be smoothed out to a very large extent, due to such smoothing out itself the capital-output ratio would tend to be reduced by half.

18. I am afraid I have given a very pedestrian and, shall I say, a "deflated" view of the use of the capital-output ratio. The real point I think is, that the capital-output ratio is a good tool for economic models and programming of various kinds which have theoretical value but cannot be directly used in making practical decisions; for useful and suggestive historical analysis of the national economy; and for purposes of direct comparisons in the simplest possible way.

19. I am therefore strongly in favour, firstly, of systematic collection of statistical data on the capital-output ratio through census and surveys and also from project and engineering data. Planning with such data would give a deeper "feel" of statistical realities in underdeveloped countries. Feeding in of such live data into sophisticated mathematical models is the only way in which such models can become increasingly useful for practical purposes. To put the matter in a very blunt way, in the application of practical problems (or even in theoretical physics) the most important point is to decide which variables, parameters or restraints can be neglected. Such decisions can and must be made only on the basis of quantitative empirical data.

INDIAN STATISTICAL INSTITUTE LIBRARY
No. 106584
Date 16 SEP 1985
CALCUTTA