Impact of Liberalisation on Performance of Indian Industries

A Firm Level Study

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This paper tries to see the impact of liberalisation on the performance of selected Indian industries with firm level data. The performance indicators chosen for this study are growth of value added, capital intensity, labour productivity (partial productivity indicator) and total factor productivity (TFP). The paper also observes the performance of these industries in terms of inter-temporal changes in efficiency from 1989 to 1994. It concludes that productivity growth and efficiency level have not improved as per expectation during the post-reform period and the distribution of efficiency is skewed. However, the time period is not long enough to reach any final conclusion. But such study is needed to review the impact of liberalisation on Indian industries for better monitoring of reform policies.

I
Introduction

INDIA followed the strategy of planning for her industrialisation during the first four decades since the First Five-Year Plan in 1951. The plans were implemented under the framework of a mixed economy with a substantial role for the public sector and a state regulated private sector. The former was given the charge of heavy and key industries (due to high gestation period, low rate of return and huge investment requirements), and the latter mainly the consumer goods industries. Two basic objectives of each successive Five-Year Plan were 'self-reliance' and 'social justice'. Self-reliance was sought to be created by protecting the home market from foreign competition by high rates of tariff and other forms of restrictions.

The principal instruments of actual policy used to serve the objective of self-reliance were an elaborate industrial licensing scheme under the Industries Development and Regulation Act (IDRA) of 1951 and a protective foreign trade regime. It controlled not only entry into an industry and capacity expansion, but also technology, output mix and import content. Moreover, concentration of economic power was controlled by the Monopolistic and Restrictive Trade Practices (MRTP) Act of 1970. Finally, the Foreign Exchange Regulation Act (FERA) of 1973 was used to regulate foreign investment in India. These acts together created a highly protected industrial regime where there was neither any significant role of even internal competition nor any strict planning for industrial development.

This set of policies has achieved limited success in creating a self-reliant economy (a wide diversification of the industrial base to produce a broad range of industrial products), but it has grossly underemphasised the importance of efficient use of resources, particularly labour and capital.

Since there was overcentralisation of power of decision-making over investment, product-mix and pricing and formal and informal distribution control, public sector enterprises did not have enough autonomy for commercial viability. On the other hand, since the home market was protected, private enterprises were not compelled to improve the efficiency and quality of their products. Policy-makers believed that the slower and inefficient growth experienced by India during the last 40 years was the result of a tight regulatory system over the industrial and foreign trade sector of the economy. This has thus created an economy of subsidy and inefficiency. The new economic policy (NEP), of which the new industrial policy (NIP) of 1991 [Patel 1992; Sandesara 1991; Subrahmanian 1991] is the most important part, was launched against this background [Ghosh and Neogi 1993, 1996]. The NIP of 1991 was a major part of the broad structural adjustment programme in India which was specifically set in motion with a declared objective of transforming the basic nature of functioning of the economy in lieu of planned economic development over the period from 1951 to 1990.

Liberalisation is a process of economic policy changes specifically initiated from 1991 as declared state policy. It had its own economic, political and international compulsions. Indian economic reforms in their current form had been initiated with the help of financial support from the International Monetary Fund (IMF) and the World Bank, and lately also from the Asian Development Bank (ADB). Hence, these reforms have been involved with a set of conditionalities mutually agreed upon between the government of India and the multilateral institutions. When the crisis reached its peak in 1991, the IMF had extended an 18-month balance of payments assistance programme of US $ 2.2 bn to India covering the initial period up to March 1993. This reform package (popularly called 'new economic policy') covered the areas of macro-economic stabilisation policies and structural adjustment policies.

The balance of payments position had reached its nadir in 1990-91 during the post-Gulf war period. This was accompanied by widening fiscal deficits and growing inflation and falling foreign exchange reserves. According to official statistics, the convertible foreign currency assets had declined to US $ 3,368 mn in March 1990 from $ 5,924 mn in March 1987. The worst was reached in June 1991, when foreign exchange reserves had dwindled to just Rs 2,000 crore (equivalent to US $ 1 bn at the time).[1]

Beyond this proximate source of short-run crisis, it was believed by both influential economists and policy-makers that the productivity in most Indian industries had become one of the lowests by international standards. They also believed that macro-economic imbalances and micro-economic inefficiencies had fed one another in a highly complex manner.

Let us briefly outline the major policy changes which are called economic reforms, or liberalisation in a nutshell. The broad policy measures are:[2] (1) macro-economic stabilisation measures which include (a) management of the balance of payments crisis, (b) fiscal deficit management, and (c) monetary policy correctives; (2) major sectoral structural adjustment reforms, which include (a) trade policy (and associated

policy) reforms, (b) industrial policy reforms, (c) policy reforms relating to the public sector, (d) policies for attracting foreign direct investment (including NRIs), technology and equity participation, (e) administrative reforms for faster investment approvals through the Reserve Bank of India, (f) tax structure reforms, (g) tariff reforms for both capital goods and consumer goods, (h) financial sector reforms, (i) reforms in the civil aviation sector, and (j) reforms in agriculture and related areas; and (3) measures to share social costs of reforms which include reform of the public distribution scheme (PDS), establishment of a national renewable fund (NRF) and the like.

The NIP of July 1991 effected some very fundamental policy changes such as near abolition of licensing, easing of the rigours of MRTP and FERA, reduced list of industries to be reserved for the public sector, automatic approvals of foreign technology agreements and for 51 per cent foreign equity, defining a new role of state electricity boards, private investment in infrastructure, protection of consumers' interest, new liberal locational policy for industry, freer import of capital goods, reduced tariff for consumer goods, transport subsidy for backward areas, national renewal fund, de-regulation in small scale industrial units, and radically liberal policy measures for attracting FDI, new technology and NRI investment. The sole objective of these highly liberalised policy measures, with which we are concerned here, was to enhance productivity and efficiency in Indian industries by creating a competitive environment.

There was a decline in virtually all macro-economic aggregates in the crisis year of 1991, including overall and sectoral industrial investment. From Table 1 we find that there is a recovery in investment in major industrial sectors between 1990-91 and 1993-94. According to the report of the ministry of industry, the largest share of investment occurred in five major industry groups, whose order of ranks is as follows: (i) chemical, (ii) textile, (iii) processed food, (iv) non-metallic mineral products, and (v) electrical machinery. Among these, we have taken four major industry groups except processed foods. The table shows that during August 1991 to December 1993, total approved investment was of the order of Rs 2,56,158 crore. The share of these four groups accounts for 36 per cent of total investment and their distribution is as follows: (i) chemical (17 per cent), (ii) textile (13 per cent), (iii) NMMP (9 per cent), and (iv) electrical machinery (7 per cent).

Regarding the FDI during this period, the figures from the same sources show that the total value of FDI approved was Rs 870 crore for chemical, Rs 110 crore for glass and ceramics, and Rs 870 crore for electrical machinery (there is no figure for textile). Total approved FDI for this period was Rs 13,200 crore. However, the problem is the slow pace of actual inflow of funds compared to approved FDI. It is estimated from these figures that only about 25 per cent have been actually invested during this period. But in the designated industries the number of units has increased over time, and this increase in itself can be said to be an indicator of increased competition. In this paper we have tried through several statistical exercises to find out whether this supposedly increased competitiveness has led to higher efficiency.

For this purpose we have studied the performance of some selected firms from four industry groups, namely, (i) chemical, (ii) textile, (iii) non-metallic mineral products, and (iv) electrical machinery. The performance indicators chosen by us to verify the impact of economic reforms on the firms from the above groups are productivity, TFP growth, input growth and efficiency. The major limitations of the present study may be mentioned here. First, number of years for which firm level as well as industry level data are available is confined to the period from 1989 to 1995. It may also be argued that the time period of just four full years of operationalising the economic reforms is too short for proper evaluation of changes of economic performance of Indian industries. However, our study will still show the impact of economic reforms without begging the question of whether they will be more effective or less potent in the long run [Bagchi 1990].

In some recent studies [Coondoo, Neogi and Ghosh 1993; Ghosh and Neogi 1993] covering the period from 1974-75 to 1988-89 with ASI data, it is observed that although capital intensity has been rising at a very fast rate, labour productivity (LP) has lagged behind in Indian manufacturing industries. Even if labour productivity rises, it is not a reflection of pure productivity increase, because this may be due to rise in capital labour ratio (K/L) during the period. It is also found that technical efficiencies of Indian manufacturing industries have been declining over time up to the late 1980s [Neogi and Ghosh 1995]. The use of TFPG for the performance appraisal of firms will help us to understand the effect not only of technological progress but also of the efficiency of factor use. Besides TFPG, we have also studied the changes in general level of efficiency of each industry group in terms of the shift of aggregate production function over different time spans. Finally, we have also estimated the technical efficiencies (TE) of these industries using frontier production function (FPF) model with the help of corrected ordinary least square (COLS) method.

The organisation of this paper is as follows. Section II deals with the model specifications which is divided into two parts: First part deals with the measurement of TFPG and the second deals with the efficiency measurements both by average production function approach and by FPF approach. The last part of Section II deals with the data. Empirical results are analysed in Section III. Summary and conclusions are briefly discussed in Section IV.

II
Model Specification

Measurement of TFPG

Productivity growth is recognised as the most important force behind economic development and is often compared with the importance of capital accumulation. The most common measure in this context is the factor productivity. But the problem with such a measure is that the changes in the partial productivities depend on the use of other factors. Naturally in a two-input parlance, the rise/fall in capital/labour productivity may be the result of rise/fall in the use of labour/capital. This problem of productivity measurement can be resolved by the analysis of total factor productivity growth (TFPG) which separates the effect of increase in the use of inputs from the other factors which influence the growth of output. TFPG encompasses not only the effect of technical progress but also the effect of increase in efficiency with which resources are utilised.

Basically, two types of measures of TFPG are found in literature depending upon the assumption underlying the production function. The most common approach is to derive the TFPF from the translog production function which is appropriate for discrete time point analysis. This measure of TFPG is

$$TFPG(1) = \log V(t) - [(S_l(t) + S_l(t-1))/2] \log L(t) - [(\{1-S_l(t)) + (1-S_l(t-1))\}/2] \log K(t) \quad (1)$$

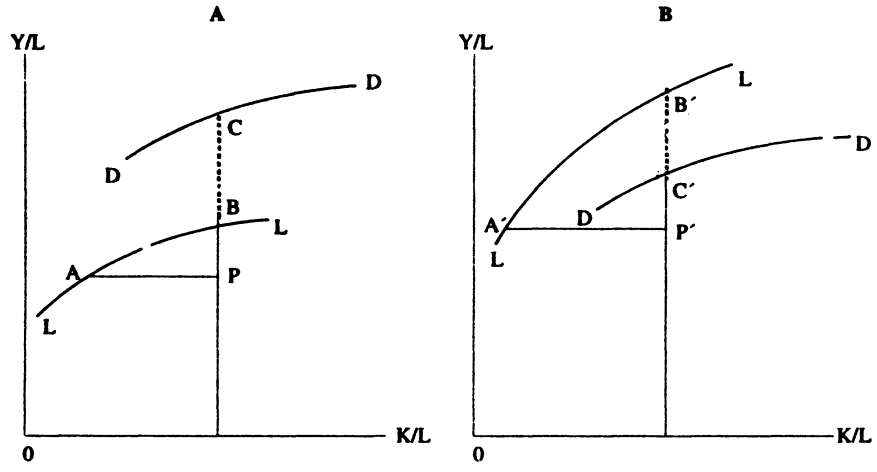
where, V(t), L(t), K(t) and S_l are value added, labour in number, capital and share

TABLE 1: INDUSTRYWISE DISTRIBUTION OF PROPOSED INVESTMENT AUGUST 1991 TO DECEMBER 1993.

Industry	Proposed Investment (Rs Crore)	Percentage to Total
Chemical	43492	17.0
Textile	33400	13.0
Processed Food	26454	10.3
Non-metallic Mineral Products	22914	8.9
Electrical Mach	18067	7.1
All Manufacturing	256158	100.0

Source: *Annual Report 1993-94*, Ministry of Industry, Government of India.

FIGURE 1: MODEL FOR MEASURING EFFICIENCY



of wages and salaries in total value added respectively.

This measure of TFPG (equation 1) is based on the assumption on competitive equilibrium and constant returns to scale where the output elasticity of capital is taken as one minus the output elasticity of labour. However, this assumption may be relaxed without any harm. An alternative measure of share of capital which can be directly calculated from the share of profit (profit before tax) in total value added could be used to find TFPG. This model can be written as

$$TFPG(2) = \log V(t) - [\{S_i(t) + S_i(t-1)\}/2] \log L(t) - [\{S_k(t) + S_k(t-1)\}/2] \log K(t) \quad (2)$$

where S_k = profit before tax/net value added.

In both the approaches it is assumed that competitive equilibrium is prevailing and the factor prices are paid according to their marginal products so that factor shares in total value added are their respective elasticities. But this is a strong assumption in a country like India where the market is not competitive. Hence an alternative measure of TFPG is defined which is based on translog production function.

The third measure of TFPG is defined as follows. Assuming that the firms have the same input aggregator F(K,L), but different managerial and other unobservable factors that affect the productivity of firms, we have the following regression equation:

$$\log Y_{it} = a_{i0} + b_i t + \alpha_k \log K_{it} + \alpha_l \log L_{it} + \alpha_{kk} (\log K)^2 + \alpha_{ll}(\log L)^2 + \alpha_{kl} \log K \log L + \varepsilon_{it} \quad (3)$$

where $\varepsilon_{it} = \varepsilon_{it-1} + u_{it}$; a_{i0} = initial efficiency level; $b_i t$ = rate at which efficiency level of firm changes over time.

To apply OLS procedure to estimate the parameters it is assumed that a_{i0} and $b_i t$ are fixed for each firm. But in reality these may vary across firms.

Taking the first difference of equation 3 we have

$$\log Y_{it} = b_i + \alpha_k \Delta \log K + \alpha_l \Delta \log L + \alpha_{kk} \Delta (\log K)^2 + \alpha_{ll} \Delta (\log L)^2 + \alpha_{kl} \Delta \log K \log L + u_{it} \quad (4)$$

If iid of u_is are satisfied then we can treat b_i as fixed effect. The following procedure will lead to consistent estimates of the coefficients. We transform the variables by subtracting from them the firm average over time. The transformation leads to eliminate the b_i term from the equation. Then the third estimate of TFPG can be defined as

$$b_i + u_{it} = \Delta \log Y_{it} - [\alpha_k \Delta \log K + \alpha_l \Delta \log L + \alpha_{kk} \Delta (\log K)^2 + \alpha_{ll} \Delta (\log L)^2 + \alpha_{kl} \Delta \log K \log L] \quad (5)$$

Hence, the firmwise estimates of TFPG(3) are

$$TFPG_i(3) = b_i + u_{it}.$$

MEASUREMENT OF EFFICIENCY

Average production function approach: In an LDC like India, the market is not competitive enough and the dissemination of information regarding various measures of economic reforms which directly or indirectly affect the firms is biased. Naturally, the benefits of such measures may be reaped by a few firms. In such a case the average production function approach may also be a good measure for a preliminary investigation of the effects of liberalisation on the general level of efficiency of the firms in the aggregate.

In this study, a technique is said to be efficient (inefficient) when there is an upward (downward) shift of the productivity locus due to the adoption of new technology. Figures 1(a and b) graphically represent the concept of efficiency and inefficiency respectively resulting from new technology adoption in a comparative static framework. In Figure 1(a), the curve LL is the labour productivity locus prior to the adoption of new technology at time t_0. After adoption, the curve shifts to DD at time t_1 with corresponding higher values of Y/L. Let A be the observed position of an industry on the old curve LL which shifts to C on DD after adoption. This movement from A to C can be divided into two parts. The first is from A to B which means that with more capital deepening, process productivity increases to B. But after adoption, productivity rises to C. Naturally the segment CB represents the gain in productivity due to efficient use of inputs with the help of advanced technology.

On the other hand, any downward shift of the locus is the consequence of inefficient use of inputs. The movement from A to C in Figure 1(b) is composed of two parts: A′ to B′ and B′ to C′. Here as a reverse case of Figure 1(a), the drop in productivity from B′ to C′ is due to inefficient use of inputs even when productivity rises by P′C′. Thus, rise in productivity does not necessarily mean efficient use of inputs when technology adoption augments capital labour ratio.

This phenomenon of efficiency can be shown empirically from the relationship between the observed LPs and capital labour ratios across firms for two different time points. This analysis is basically a macro relationship between LP and K/L ratios across firms over different time spans. The functional specification of this relationship is

$$LP = f(K/L).$$

The empirical test employs multiple regression of two non-linear equations of the forms

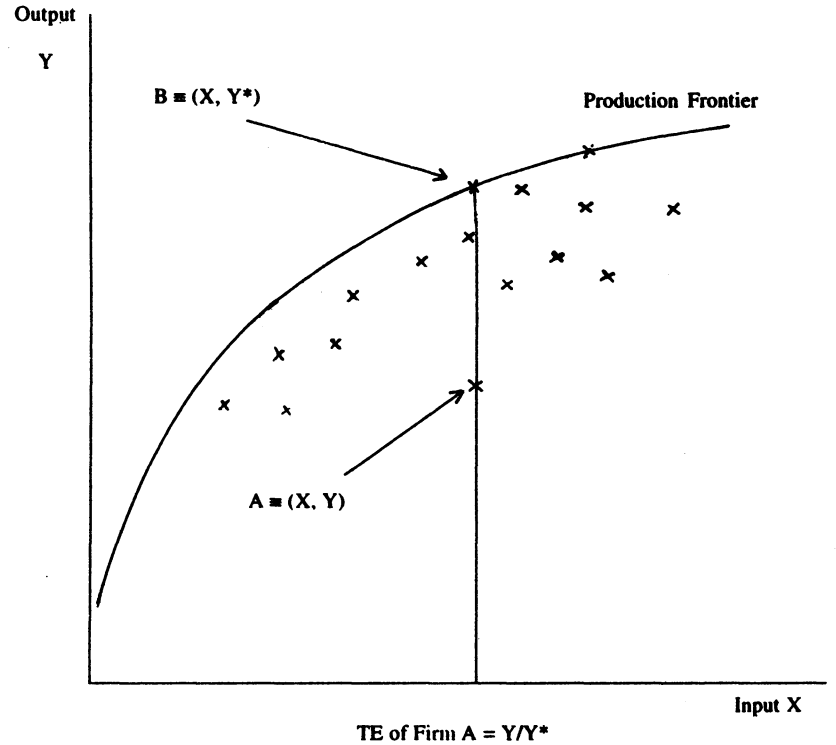
$$\log (Y/L) = \alpha + \beta_1 \log (K/L) + \beta_2 [\log (K/L)]_2 + \beta_3 D \quad (6)$$

$$\log (Y/L) = \alpha + \beta_1 \log (K/L) + \beta_2 [\log (K/L)]_2 + \beta_3 D + \beta_4 \log (K/L) D \quad (7)$$

where D represents the temporal dummy with D = 1 for latter years and D = 0 for others.

The standard form of the production function dictates that the value of β_1 should be greater than zero while the value of β_2 should be negative. If the function shifts upwards (a special case where it moves in a northeastern direction), the value of β_3 will be positive. But if $\beta_3 < 0$, this implies a downward shift of the productivity locus. Whether it shifts in a south-eastern or southern direction, the production process becomes more inefficient in both the cases. Finally, β_4 represents the slope dummy of the curve. If $\beta_4 < 0$, it implies that for large values of K/L the process becomes more inefficient. Positive values of β_3 and β_4 imply opposite results.

FIGURE 2: TECHNICAL EFFICIENCY OF FIRMS IN INPUT-OUTPUT SPACE



TE of Firm A = Y/Y*

Frontier production function approach: The extent by which a firm lies below its production frontier which sets the limit to the range of maximum obtainable output, can be regarded as a measure of inefficiency. The Debreu-Farrell measure of TE is the beginning point of any discussion on frontier and efficiency measurement. Farrell's (1957) approach is, however, non-parametric in the sense that it simply constructs the production frontier from the observed input output ratios by linear programming technique. A parametric approach to FPF incorporating specific functional form was first used by Aigner and Chu (1968). The parameters of the functions

$$\log Y = \log f(x) - u$$

could be estimated by applying linear or quadratic programming algorithm. But the estimates of this approach have no statistical property.

In deterministic frontier approach a distributional assumption of the 'u' term could be introduced. A deterministic model with statistical properties of estimates is called deterministic statistical approach to FPF model. The parameters of such model can be estimated through corrected ordinary least square (COLS) method. COLS method was first noted by Richmond (1974) and is based on OLS result. Let us consider a simple C-D production function in its linear form:

$$\log Y = \alpha_0 + \sigma\alpha_i \log X - u \qquad (8)$$

Let μ be the mean of u and the equation can be written as

$$\log Y = (\alpha_0 - \mu) + \sigma\alpha_i \log X - (u - \mu) \qquad (9)$$

Since the distributional specification of the error term is half normal, it satisfies all the usual conditions except normality. The parameters of this equation should first be estimated by OLS and then correct the constant term by shifting it up until no residual is positive and at least one is zero. We have used this method to estimate the FPF for each year. The efficiency is calculated as the ratio between the observed and frontier output for each firm, i e, Y/Y* (Figure 2) and the average level of efficiency of each year gives the industrywise level of efficiency.

THE DATA

Firm level information on production and technological issues are hardly available from any published government sources. The standard practice of the economists is to study the performance of manufacturing industries from the data given by *Annual Survey of Industry* (ASI), government of India. But these data relate to the aggregate industry level. It is even more difficult to get the firm level data for the current period, particularly during the post-reform period. However, some private sources like CMIE and Bombay Stock Exchange (BSE) publish some selective information from the balance sheet accounts of the companies which are members of the BSE. In true sense these are not plant level data. However, there is no other alternative than to use the BSE data which are generally used with some modifications.

The data have been collected from different issues of BSE Directory. The firm level panel data for the years 1989 to 1994 have been used for four major industrial groups, namely, (1) textile (135 firms), (2) electrical machinery (43 firms), (3) non-metallic mineral products (60 firms), and (4) chemical (38 firms). Data on variables such as net sales, fixed assets, wages and salaries and profit before tax, are used for our purpose. Output is taken as the value of net sales assuming that no inventory remains for the next year. Value added is constructed multiplying output of a firm by two-digit industry level ratio of value added and output

TABLE 2. GROWTH RATES OF VALUE ADDED, INPUTS, LABOUR PRODUCTIVITY AND TFP

	Growth of							
Year	VA	K	L	K/L	Y/L	TFP1	TFP2	TFP3
1	2	3	4	5	6	7	8	9
Textile								
1989-92	6.92	6.46	0.31	6.14	6.70	0.51	-0.26	1.79
1991-94	-0.34	10.14	1.23	8.83	-1.61	-6.12	-5.94	-4.67
1989-94	5.37	7.90	0.77	7.09	4.62	-1.37	-1.41	-0.39
Electrical								
1989-92	9.87	9.08	1.98	8.33	7.69	3.45	4.92	0.57
1991-94	8.59	0.58	4.54	-3.53	3.86	-0.59	0.73	-3.29
1989-94	8.60	10.48	2.54	8.56	5.89	1.43	3.01	-1.57
Non-Metal								
1989-92	15.55	-0.26	-2.94	2.93	19.31	9.62	11.27	5.16
1991-94	4.56	7.70	1.04	6.75	4.15	2.01	2.62	-0.70
1989-94	8.04	3.98	-1.95	6.12	10.99	1.96	3.10	-0.89
Chemical								
1989-92	-8.76	13.56	7.87	5.35	-15.61	-16.51	-16.81	-12.58
1991-94	12.37	14.87	6.15	8.54	6.16	1.92	1.05	7.61
1989-94	0.27	14.37	6.15	7.96	-5.82	-7.32	-7.63	-0.76
Total								
1989-92	3.34	6.13	0.66	5.52	2.66	0.51	0.68	-2.36
1991-94	5.05	9.48	2.32	7.03	2.68	-2.37	-2.05	-0.98
1989-94	3.61	8.45	1.01	7.39	2.58	-1.09	-0.65	-2.18

taken from the ASI (factory sector). The nominal values are converted into real terms using the wholesale price index numbers for each of these groups taken from 'Wholesale Prices in India', government of India. Number of labour is constructed dividing wages and salaries of a firm by two-digit SIC wage rates available in ASI. Capital is taken as real value of fixed assets (deflated by wholesale prices of machinery and machine tools taken from the 'Wholesale Prices in India', government of India).

III
Empirical Results

We have divided the entire period into three different time spans, (1) 1989-92, (2) 1991-94, (3) 1989-94. The first sub-period denotes the performance of the firms during the pre-reform years. The second sub-period covers the crucial four years after the reform of 1991 and the third covers all these six years. It may be noted that there are overlapping years in the first two sub-periods for better understanding of the impact of economic reforms.

Table 2 presents the growth rates of various economic indicators of the industrial groups for these three time spans. The table shows that the annual average growth rates of value added during the post-reform period are lower than those during the pre-reform period. It is evident that the growth rate of value added for all the industries together has marginally increased from 3.34 per cent during 1989-92 to 5.05 per cent during 1991-94, i e, the post- reform period. But if we examine the industrywise growth rates of value added during these period, it is found that the growth rates for all the industries have fallen during the post-reform period except chemical industry. The textile industry in particular has achieved a negative growth rate of value added (–0.34 per cent). Although the electrical industry shows very high growth rate in value added, here again the growth rate has fallen during the post-reform period from 9.87 per cent to 8.59 per cent. The non-metallic mineral industry shows a significant fall in growth rate from 15.55 per cent to 4.56 per cent. However, the chemical industry alone has registered a substantial jump in value added from –8.76 per cent to 12.37 per cent during the post-reform period. It should be noted that the high growth rate for the total during the post-reform period is due to both high weightage of the chemical industry in the total value added and also the unusual jump in its growth rates.

Regarding the growth rate of capital, it is found that chemical industry registered the highest growth of the order of 15 per cent during the post-reform period. The growth rate of capital in textile and non-metal industries are 10.14 per cent and 7.70 per cent respectively during 1991-94. All the industries have achieved high growth rates during this period of reform except electrical industry where the figure shows a growth rate of only 0.58 per cent. The growth rate of employment has registered only marginal increase during 1991-94 for textile, electrical and non-metal industries, and a marginal fall

TABLE 3. LOGARITHMIC RELATION BETWEEN LP AND K/L WITH A TEMPORAL DUMMY

Period	Independent Variables					
	Intercept	LN(K/L)	$(LN(K/L)^2$	LN(K/L)*D	D	R^{-2}
			Textile			
1989-92	6.0119	–0.0229	0.0358	–	0.0058	0.78
	(2.64)	–(0.06)	(1.94)	–	(0.13)	
	6.19	–0.0770	0.0392	–0.0415	0.4605	0.78
	(2.70)	(–0.18)	(2.07)	(–0.79)	(0.80)	
1991-94	0.8653	0.9354	–0.0071	–	–0.2841	O.75
	(0.37)	(2.22)	(-0.38)	–	(–5.68)	
	0.8697	0.9239	–0.0061	–0.0213	–0.0495	0.75
	(0.37)	(2.18)	(-0.32)	(–0.38)	(-0.08)	
1989-94	3.4489	0.4431	0.148	–	–0.1196	0.73
	(1.30)	(0.93)	(0.69)	–	(–2.29)	
	3.6808	0.3850	0.0181	–0.0315	0.2269	0.72
	(1.36)	(0.78)	(0.81)	(–0.52)	(0.34)	
			Chemical			
1989-92	8.8110	–0.0529	0.0213	–	–0.4509	0.60
	(2.89)	(–0.11)	(1.08)	–	(–3.66)	
	8.7596	–0.1020	0.0260	–0.1147	(0.8642)	0.61
	(2.88)	(0.21)	(1.30)	(–1.19)	(0.78)	
1991-94	9.5226	0.1955	0.0240	–	0.2417	0.47
	(2.80)	(0.35)	(1.06)	–	(1.88)	
	8.2889	–0.0370	0.0196	–0.0997	1.3904	0.47
	(2.29)	(-0.06)	(0.85)	(-1.01)	(1.22)	
1989-94	11.040	–0.3838	0.0334	–	–0.3237	0.49
	(2.92)	(–0.61)	(1.29)	–	(–2.48)	
	9.4166	–0.2119	0.0305	-0.1857	1.8100	0.51
	(2.47)	(–0.34)	(1.20)	(–1.83)	(1.54)	
			Electrical			
1989-92	–2.1281	1.7979	–0.0555	–	0.0485	0.44
	(–0.39)	(1.89)	(–1.37)	–	(0.36)	
	–1.4057	1.7051	–0.0530	0.0853	–0.9047	0.44
	(0.25)	(1.77)	(–1.30)	(0.68)	(-0.65)	
1991-94	1.4838	1.1184	–0.0243	–	0.0860	0.53
	(0.36)	(1.60)	(0.84)	–	(0.75)	
	3.4522	0.8554	–0.0165	0.1754	–1.8996	0.54
	(0.80)	(1.20)	–(0.57)	(1.59)	(-1.52)	
1989-94	-0.2074	1.4284	-0.0380	–	0.0423	0.49
	(–0.04)	(1.69)	(–1.06)	–	(0.33)	
	0.3510	1.4024	–0.0402	0.1879	–2.0765	0.50
	0.07	1.67	(–1.13)	(1.60)	(–1.56)	
			Non-Metal			
1989-92	29.1340	–3.6999	0.1791	–	0.2964	0.20
	(3.34)	(–2.38)	(2.60)	–	(1.90)	
	32.0590	-4.1238	0.1935	0.2073	–2.0429	0.21
	(3.59)	(–2.61)	(2.79)	(1.45)	(–1.26)	
1991-94	23.5300	–2.6578	0.1329	–	–0.1704	0.18
	(2.47)	(–1.58)	(1.81)	–	(–1.07)	
	25.0010	–3.0225	0.1534	–0.2201	2.3354	0.18
	(2.62)	(-1.79)	(2.06)	(–1.42)	(1.32)	
1989-94	22.3870	–2.3958	0.1171	–	0.0493	0.10
	(2.44)	(–1.48)	(1.66)	–	(0.29)	
	22.4560	–2.4165	0.1184	–0.0191	0.2665	0.09
	(2.43)	(–1.48)	(1.65)	(–0.12)	(0.15)	
1989-92	4.3210	0.5087	0.0035	–	0.0236	0.46
	(2.26)	(1.54)	(0.24)	–	(0.41)	
	4.3743	0.5118	0.0028	0.0261	–0.2678	0.46
	(2.28)	(1.54)	(0.19)	(0.48)	(-0.44)	
1991-94	1.6688	0.9841	-0.0173	–	–0.1265	0.46
	(0.83)	(2.85)	–1.17	–	(-2.25)	
	1.6057	0.9905	–0.174	–0.0100	–0.0149	0.46
	(0.79)	(2.86)	(–1.17)	(–0.19)	(-0.03)	
1989-94	3.9589	0.5842	–0.0003	–	–0.0813	0.42
	(1.71)	(1.45)	(–0.02)	–	(–1.34)	
	3.9619	0.5845	–0.0004	0.0018	-0.1013	0.42
	(1.71)	(1.45)	(–0.02)	(0.03)	(–0.15)	

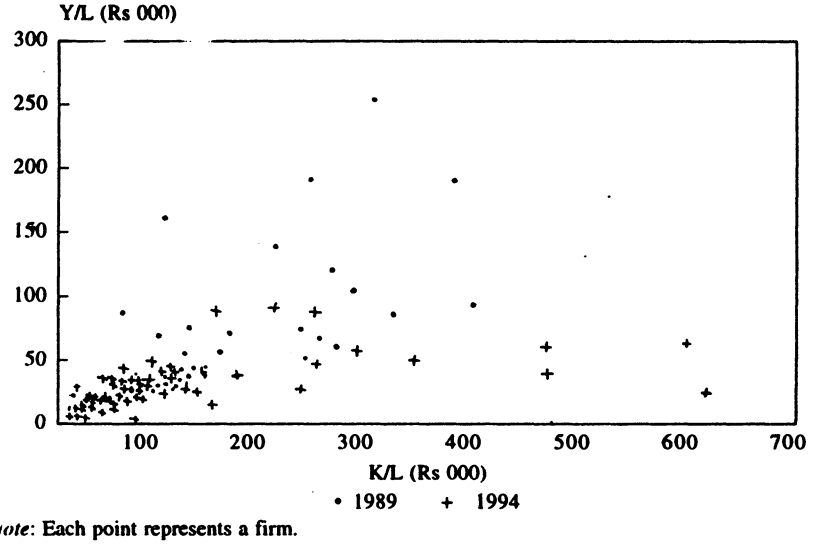
in chemical industry. But all the growth rates are much lower compared to those of capital.

Regarding the growth rate of K/L ratio, it is observed that except electrical industry, the figures show sharp rise during 1991-94. Interestingly, in the electrical industry a sharp decline is noted from 8.33 per cent to -3.53 per cent. On the other hand, the growth rates of LP show the same features as in the case of value added. The figure for all industries shows stagnating LP growth in these three time spans which is around 2.6 per cent per annum. On the whole, therefore, it is found that capital intensity is rising at very fast rate whereas the value added and LP are lagging behind the former. Fast rising capital intensities across board may be the outcome of the sudden spurt in capital investment in the private corporate sector through equity during the first couple of years after 1991. It has been observed that as a result of de-licensing there was a growing trend in number of foreign collaborations approvals in India during 1990 to 1993 and the amount of foreign equity investment rose from Rs 12 bn in 1990 to Rs 68.9 bn in 1993 (which implies a rise of 32 times in just three years). Coming to TFP growth, it is found that TFPG rates have fallen sharply during the period after reform compared to the pre-reform period, except the chemical industry where TFPG(1) improved from -16.51 per cent to 1.92 per cent. In some cases TFP growth rates have become negative during the post-reform period. The same picture is observed for other two measures of TFPG. This confirms the robustness of our TFPG estimates by different methods. In particular, the textile industry, where the growth rate of K/L ratio is the highest (8.83 per cent) among all these industries during 1991-94, registers the sharpest decline in TFPG (from 0.51 per cent to -6.12 per cent).

Therefore, the table suggests that the productivity growth (both LP and TFP) in general is lower than input growth during the post-reform period. This finding could be identified as a symptom of inefficient use of productive resources, particularly capital. This is further consolidated from the scatter diagrams of K/L and Y/L for these industries (Figures 3 to 6). As evident from the figures, there exists some homogeneity among the LPs for the lower values of K/L, while for higher values a wide variation is observed. Another observation is that the points in the scatter diagrams shifted towards south-eastern direction in the latter year. This shift indicates that (i) the industries have become more capital intensive than before, and (ii) the productivities have fallen in the latter year relative to K/L ratio. However, non-metallic mineral industry shows no such downward shift of the points.

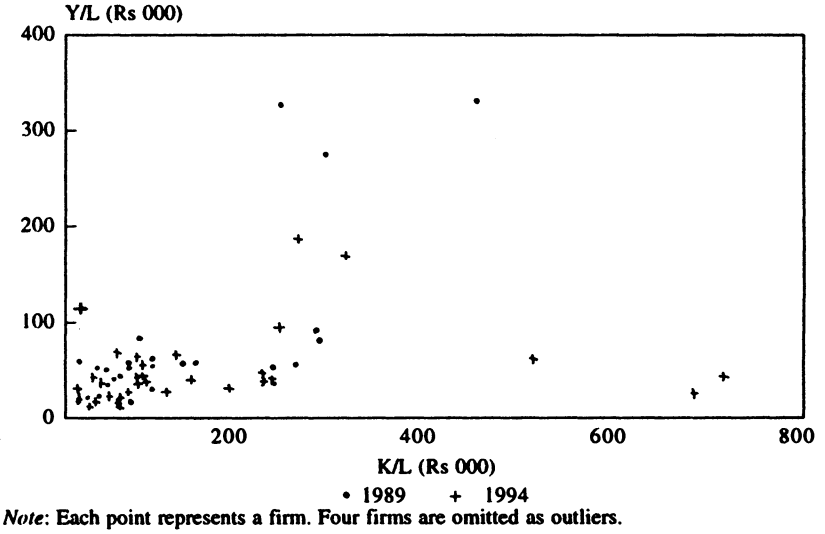
As said earlier, we have now tried to unearth the phenomenon of inefficiency in

FIGURE 3: SCATTER DIAGRAM OF CROSS-SECTION DATA ON LP AGAINST K/L: TEXTILE



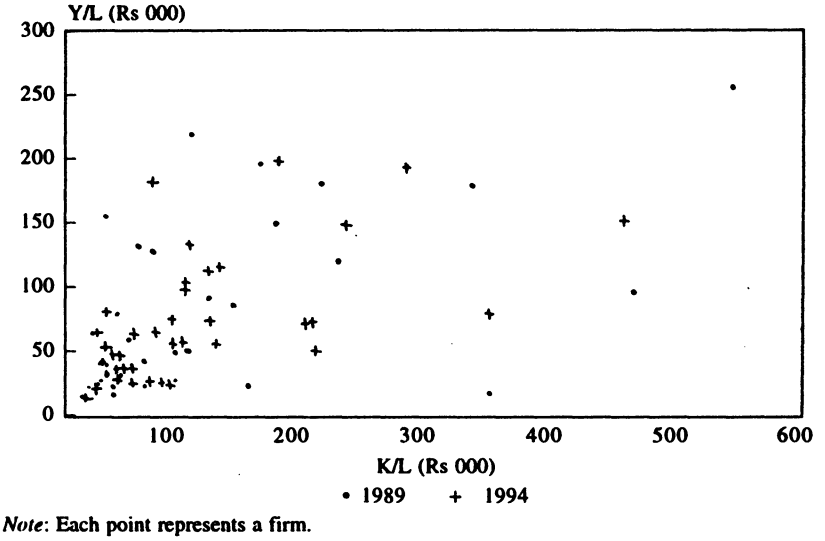
Note: Each point represents a firm.

FIGURE 4: SCATTER DIAGRAM OF CROSS-SECTION DATA ON LP AGAINST K/L: CHEMICAL



Note: Each point represents a firm. Four firms are omitted as outliers.

FIGURE 5: SCATTER DIAGRAM OF CROSS-SECTION DATA ON LP AGAINST K/L: ELECTRICALS



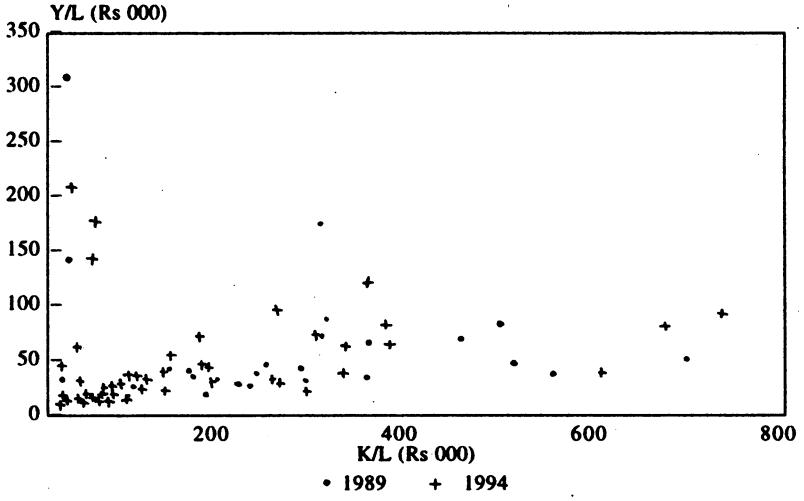
Note: Each point represents a firm.

terms of the shift of the fitted curves for equations 6 and 7, showing the relationship between LP and K/L for three different time spans. Table 3 presents the values of the coefficients of the variables with corresponding t-statistics and $\bar{R}^2$ It is found from this table that for the textile industry, the coefficients of the intercept dummy for equation 6 for the years 1991-94 and 1989-94, are negative and statistically significant at 5 per cent level. The chemical industry shows significantly negative coefficient (significant at 5 per cent level) of the dummy variables for the years 1989-92 and 1989-94 corresponding to equation 6. It gives a positive shift for 1991-94, but significant only at 10 per cent level. Electrical industry also shows a downward shift of the curve during 1991-94 and 1989-94. However, the coefficients are not statistically significant at very high levels. The coefficient of the dummy variable for all industries taken together shows a negative and statistically significant value (at 5 per cent level) for the period 1991 to 1994 corresponding to equation 7. In other sub-periods, the coefficients are negative but not statistically significant. We have produced here two diagrams showing the fitted relationship between log (LP) and log (K/L) with a temporal dummy: Figures 7 and 8 for textile and chemical respectively. This analysis on the whole suggests that general level of efficiency have been falling during the period from 1989 to 1994, and particularly during the post-liberalisation period. Therefore, even after four years of economic reform as a result of which increasing foreign capital and higher technology have intruded into Indian industry, our study reveals significant technological retrogression in the aforesaid industries.

To understand the decline of general level of efficiency more specifically across the industries, firm level technical efficiencies through frontier production function have been estimated. This will help us to understand the managerial inefficiency at the firm level, assuming that uniform technological changes have occurred in the manufacturing sector. In other words, given equal benefits of foreign and domestic technological development across board as a result of globalisation, there exist some differences of performance among the firms. To analyse the performance differentials and to get an idea about the impact of liberalisation on competitiveness, we have estimated the TEs of the individual firms and obtained their frequency distribution.

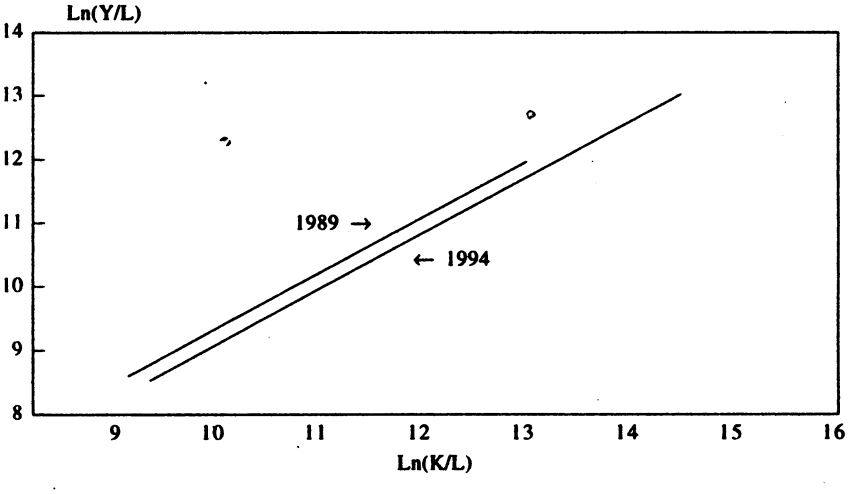
Table 4 presents the industrywise and yearwise values of mean TEs. It also shows the industrywise mean TEs for both pre- and post-reform periods. It is observed that the level of TEs of each of the industry groups is too low and there is no sign of improvement

FIGURE 6: SCATTER DIAGRAM OF CROSS-SECTION DATA ON LP AGAINST K/L: NON-METAL



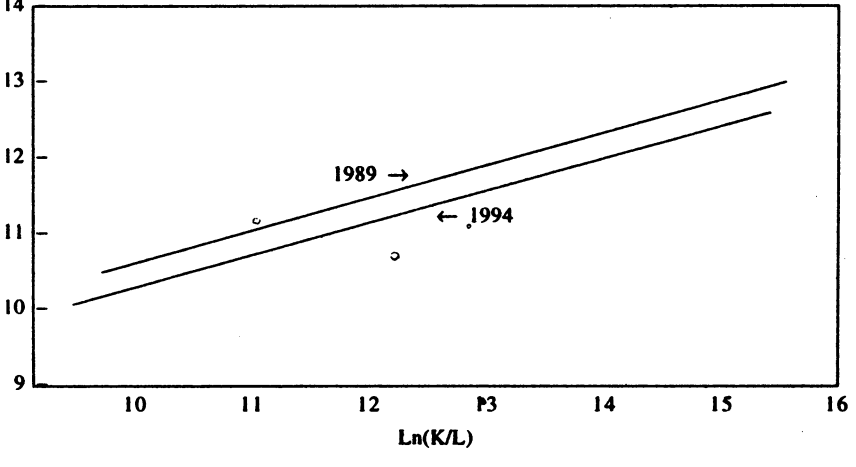
Note: Each point represents a firm. Three firms are omitted as outliers.

FIGURE 7: FITTED RELATION OF LN(LP) AND LN(KL) WITH TEMPORAL DUMMY: TEXTILE



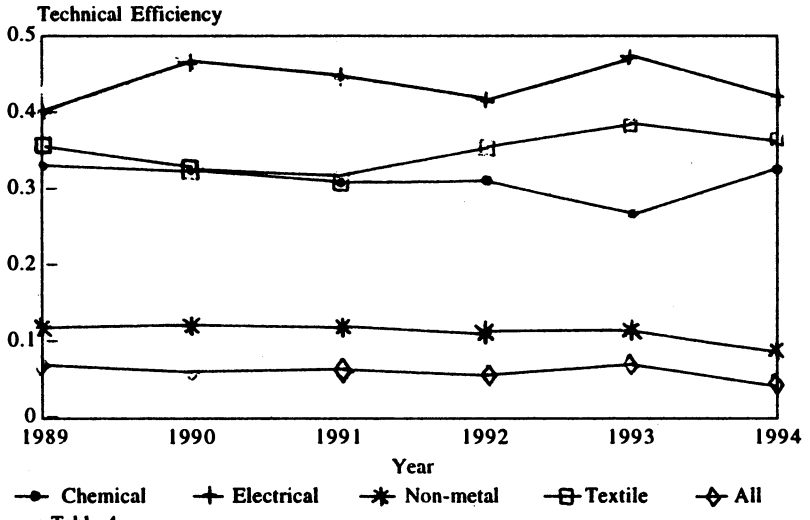
Note: Relation corresponds to equation 6.

FIGURE 8: FITTED RELATION OF LN(LP) AND LN(KL) WITH TEMPORAL DUMMY: CHEMICAL



Note: Relation corresponds to equation 6.

FIGURE 9: ESTIMATED TECHNICAL EFFICIENCIES OF SELECTED INDUSTRIES



Source: Table 4.

during the post-reform period. In some cases, the levels of TEs are even lower in 1991-94 than those in 1989-92. Since this is a relative efficiency measure, the figures imply that most of the firms are too inefficient relative to the few 'best practice' firms in each of the groups. The poorest performance is found in case of non-metallic mineral products. The groupwise TEs are plotted in Figure 9. The figures indicates that there are substantial variations among interindustry efficiency performances over 1989 to 1994. It is obvious that the level of efficiency for all the industries under study is low and there is no significant improvement during post-reform period.

Table 5 presents the frequency distribution of four different ranges of TEs in each of the industry groups during all these six years. The main findings are noted below. First, it is clear from this table that about 90 per cent of the firms in all the groups except electrical machinery lie below 50 per cent efficiency level. The worst performance of individual firms is found in non-metallic mineral products. On the other hand, better performance by the electrical industry may be due to the fact that higher degree of competition has occurred in case of durable consumer goods items which constitute a significant share in this group. Second, no perceptible improvement is visible as to the percentage of firms getting out of the 0-50 per cent range of efficiency. Third, the most retrogressive feature is that only a couple of firms operate at 80-100 per cent range of efficiency in each of the groups without any exception. Hence, from the distributions of TEs of the firms in each of the groups, it is found that only a very few firms are doing better in terms of efficient utilisation of resources. Hence, one may conclude that the degree of competition among the firms is miserably low and there exists an oligopolistic type of market structure in Indian industry even after four years of economic reforms. Similar conclusions are reached by a somewhat different (qualitative) approach in a recent work by Wadhva (1994). The present study shows that the basic purpose of liberalisation, that is, to create a competitive environment, is not yet fulfilled.

IV
Summary and Concluding Remarks

The major findings of the present study may be summarised below. First, substantial investment has been made in five major industrial groups, namely, (i) chemical, (ii) textile, (iii) processed food, (iv) non-metallic mineral products and (v) electrical machinery. Second, capital intensities in terms of capital-

TABLE 4: ESTIMATED TECHNICAL EFFICIENCIES OF SELECTED INDUSTRIES

	Technical Efficiencies						Average Technical Efficiencies	
Industry	1989	1990	1991	1992	1993	1994	1989-1992	1991-1994
Chemical	0.3275	0.3210	0.3033	0.2979	0.2739	0.3040	0.3124	0.2948
Electrical	0.3995	0.4706	0.4482	0.4134	0.4691	0.4211	0.4329	0.4380
Non-metal	0.1063	0.1146	0.1142	0.1073	0.1024	0.0849	0.1106	0.1022
Textile	0.3441	0.3247	0.3002	0.3464	0.3840	0.3620	0.3289	0.3482
Total	0.0601	0.0554	0.0579	0.0505	0.0596	0.0552	0.0560	0.0558

TABLE 5: FREQUENCY DISTRIBUTION OF TECHNICAL EFFICIENCY OF FIRMS

Efficiency Interval		1989	1990	1991	1992	1993	1994
				Textile			
0-20	N	11	10	20	13	12	12
	P	8.15	7.41	14.81	9.63	8.89	8.89
20-50	N	112	118	109	111	98	107
	P	82.96	87.41	80.74	82.22	72.59	79.26
50-80	N	9	4	5	9	22	13
	P	6.67	2.96	3.70	6.67	16.30	9.63
80-100	N	3	3	1	2	3	3
	P	2.22	2.22	0.74	1.48	2.22	2.22
				Electrical			
0-20	N	8	3	6	7	5	4
	P	18.60	6.98	13.95	16.28	11.63	9.30
20-50	N	24	22	23	23	21	24
	P	55.81	51.16	53.49	53.49	48.84	55.81
50-80	N	7	15	12	12	12	12
	P	16.28	34.88	27.91	27.91	27.91	27.91
80-100	N	4	3	2	1	5	3
	P	9.30	6.98	4.65	2.33	11.63	6.98
				Chemical			
0-20	N	9	10	10	11	15	12
	P	23.68	26.32	26.32	28.95	39.47	31.58
20-50	N	25	24	26	24	20	23
	P	65.79	63.16	68.42	63.16	52.63	60.53
50-80	N	2	2	0	2	2	2
	P	5.26	5.26	0.00	5.26	5.26	5.26
80-100	N	2	2	2	1	1	1
	P	5.26	5.26	5.26	2.63	2.63	2.63
				Non-Metal			
0-20	N	56	55	54	56	56	57
	P	93.33	91.67	90.00	93.33	93.33	95.00
20-50	N	2	4	5	2	2	2
	P	3.33	6.67	8.33	3.33	3.33	3.33
50-80	N	1	0	0	1	1	0
	P	1.67	0.00	0.00	1.67	1.67	0.00
80-100	N	1	1	1	1	1	1
	P	1.67	1.67	1.67	1.67	1.67	1.67

N = Number of firms, P = Percentage of firms in the group.

labour ratios have been growing at fast rates during the whole period from 1989 to 1994, particularly during the post-reform period. But the annual average growth rates of value added are much lower in the post-reform period relative to pre-reform period across board. Similar feature is observed regarding the labour productivity growth in all these industries. Hence, a divergence between input growth and output growth has taken place during this period. Third, total factor productivity growth (TFPG) which is a reflection not only of pure technical progress but also of the growth of overall efficiency with which factors are combined, have fallen very sharply during the period of reforms with the exception of chemical industry. Fourth, from the relationship between LP and K/L, it is found that there is a downward shift of the scatter points during the latter year which indicates a general downfall of efficiency of firms during the period. This is confirmed from the fitted relationship with a temporal dummy which is negative and statistically significant in most of the cases. Fifth, it is found that the level of TEs for all the industries is very low and there is no significant improvement of this level during the post-reform period. Finally, it is observed from the distribution of the TEs that most of the firms lie below 50 per cent level of efficiency and only a very few firms lie around the frontier.

It may be recalled that economic reforms were undertaken in order to create a competitive environment which was supposed to increase the level of productivity and efficiency of Indian industry. Even if in lower scale some evidences of higher foreign investment and technological collaborations have been confirmed. But the present study does not find any indication of rise in productivity and efficiency during the post-reform period. Hence, competitive environment, which is the major determinant for efficiency improvement, has not yet been created through reform. Our study also suggests that Indian industry is still under the grip of monopoly elements. Only a limited number of big firms are lying on the frontier level while most firms are gradually losing out of the market. Hence, appropriate policy intervention is urgently called for in order to create proper competitive environment.

Although we have not found any positive impact of the ongoing liberalisation process on the performance of selected Indian industries, it should be admitted that this study only provides some observations of the post-reform period. The time may be too short for the development of a competitive environment in Indian industry, and the overall performance of Indian firms is not as good as was expected by the policy-makers. However, we think that a more broad based study in this line incorporating both trade and financial aspects should be undertaken from time to time during the coming years for better monitoring of industrial policy.

Notes

[The earlier version of the paper was presented in the conference on 'Economic Reforms in India', organised by Indian Statistical Institute, in January 1997. We are indebted to Amiya Kumar Bagchi for his encouraging comments and valuable suggestions. We also thank Sugata Marjit and Dipankor Coondoo for constructive comments. The usual disclaimer applies.]

1 The gravity of the crisis and immediate necessity of taking corrective actions by the then new government can be found in Manmohan Singh (1992).

2 The detailed account of these policy measures can be found in Government of India (1991, 1992), Centre for Monitoring Indian Economy publications, Economic Survey for 1991-92 and 1992-93, and a host of other discrete references cited in earlier chapters.

3 The current global wave towards liberal economic policy has created such an impression among the policy-makers in the developing countries that it is being understood as synonymous with the economics of efficiency. Indian policy-makers were convinced by the success story of the gang of four, namely, South Korea, Hong Kong, Taiwan and Singapore. The purpose of such economic reforms is to create a competitive environment through free entry and exit which are effected by gradual de-regulation and de-licensing. The economics of liberalisation essentially rests on the neoclassical concept of optimality under free market economy where there is no externality. This would lead, on theoretical virtues, to efficient utilisation of resources from which naturally follows a Pareto-optimal system of production and distribution in the long run. During the initial phases, it would raise the productivity and efficiency of the factors used in the production process. This is the most desired goal expected to be fulfilled by the reform package. Questions very often raised against the feasibility of applying the liberal economic model into the LDCs mainly centre around the nullifications of the assumptions underlying the neo-classical model as such.

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