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India's Economic Reforms and the Manufacturing Sector

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India's Economic Reforms and the Manufacturing Sector

Introduction

The key elements of India's economic liberalisation programme initiated in 1991 were the abolition of the industrial licensing system, substantial liberalisation of foreign trade and foreign direct investment regimes, removal of ceilings on interest rates and associated reforms in the financial sector. This paper assesses the impact of the reforms on methods of financing investment and productive efficiency of the major industries in India's manufacturing sector.

Section 1 of the paper briefly sketches the scope and scale of the reforms. Section 2 identifies a set of testable hypotheses based on the literature on economic liberalisation. Section 3 discusses the methodology and data utilised in the statistical exercise designed to assess the impact of liberalisation on the manufacturing sector. Section 4 discusses the results of the exercise. Section 5 pulls together the conclusions of the paper.

The Reforms

The 1991 reforms have been analysed extensively (Joshi and Little 1998, Srinivasan 1996, Forbes 1999). The principal reform measures included; the abolition of licensing procedures for manufacturing investment, reduction in import tariffs on most goods other than consumer goods, liberal terms of entry for foreign investors, liberalisation of the capital market, the abolition of ceilings on interest rates and laying down of the Capital Issues Control Act (Table 1). The consensus appears to be that these

reforms were substantial though not radical. They were substantial insofar as they reduced bureaucratic control over economic activity, enhanced the role of the private sector and the price mechanism. But they hardly addressed the perennial problems posed by the inefficient public enterprises, and labour legislation and company laws which hamper efficiency and flexibility of operations. Even so, what has been achieved constitutes a major departure from the dirigiste regime which prevailed prior to 1991.

(Insert table 1 here)

In some respects the 1991 reforms are no more than a culmination of the attempts at liberalisation initiated in the mid eighties by Rajiv Gandhi, the then prime minister of India. The 1985 reforms, however, were piecemeal; they exempted firms with assets of a pre-designated amount from licensing requirements, but did not do away with industrial licensing entirely; they increased the range of capital goods and raw materials which could be imported without licenses, but did not abolish import licenses in total, nor did they reduce the level of import tariffs. The fairly stringent foreign investment regime was not also relaxed. The 1991 reforms in contrast were much broader both in scope and scale, and initiated a departure from the earlier regime of controls and permits towards a market oriented regime.

Although the Rajiv Gandhi reforms were piecemeal they do appear to have promoted growth and productive efficiency of the manufacturing sector. Growth rate of manufacturing output was around 8.5 per cent per annum during the second half of the eighties, substantially high by historical standards. Statistical studies (Ahaluwalia 1991, 1995, Srivastava 1996) though subject to

several limitations, suggest that many of the industry groups in the manufacturing sector experienced technical change and growth during this period. Estimated growth in total factor productivity (TFP), is put at around 2.7 per cent per annum between 1981-89, compared to a trend decline of 0.5 per cent per annum during 1960-80 (Ahluwalia 1995)¹. Another study estimates TFP growth of manufacturing firms between 1987-88 and 1991-92 to be 2 per cent per annum compared to -1.0 per cent between 1982-83 and 1986-87 (ICICI 1994).

There is ,therefore, reason to believe that the sector does respond to liberalisation and the impact of the relatively large scale 1991 reforms on growth and productive efficiency should be much more robust than that of the earlier limited attempts at liberalisation. These hopes were not entirely belied. The growth rate of manufacturing which had declined to -3.7 per cent in 1991-92, recovered to 4.2 per cent during the very next year. During the next four year period from 1993-94 to 1996-97 manufacturing output grew at an appreciably high rate of around 10.4 per cent per annum. This improved performance, however, appears to have ended abruptly when the economy slid into a recession in early 1997. There are a number of reasons for the decline in growth rates in the post 1997 period. Market forces set in train by the reforms appear to have worked with a vengeance. Removal of ceilings on interest rates led to the expected increase in interest rates which reduced investment and production. In addition, banks which sought to strengthen their balance sheets curtailed credit to risky ventures. The decline in production may, in fact, be due to the demise of firms which were unable to function in the new competitive environment. In addition, infrastructure bottlenecks appear to have held back investment.

The years since 1996-97 may be one of turbulence in product and financial markets with weak and inefficient firms struggling to cope with increased competition and new firms trying to establish themselves in the new found competitive market environment. In this respect, Indian experience appears to mirror that of other developing countries such as Chile which embarked on a programme of liberalisation. This aggregate picture, however, conceals developments at the micro level of the manufacturing sector. The objective of this paper is to analyse developments at the level of individual sectors and industries.

Data and methodology

We estimate three sets of productivity indicators - labour productivity, capital productivity, and growth in total factor productivity for fourteen manufacturing industries. In addition we estimate financial and profitability indicators for these groups of industries. These are estimated for three different groups of firms- foreign owned firms, locally owned Indian firms and state owned firms, in each of the fourteen industries. Sectors such as textiles are further divided into sub categories; e.g. the textile sector is divided into cotton textiles, manmade fibres and manufactured textiles. The choice of industries for analysis was dictated by the availability of data. We compare the productivity performance of the sectors prior to the reforms with those in the years following the reforms. Changes in the pattern of financing are analysed by examining the debt to equity ratios for the different groups of firms.

Earlier studies have utilised either aggregate data on Indian industries at the 2 digit level from the Annual Survey of Industries published by the Central Statistical Organisation, or firm level data

available from the Reserve Bank of India. Here, we utilise firm level panel data published by the Centre for Monitoring the Indian Economy (CMIE). Firm level data is preferred over aggregate industry level data, since the latter fails to account for firm-specific micro-level characteristics, which are influenced by the reforms. Also, panel data are much more informative, permit relatively larger degrees of freedom, and display little collinearity between variables.

The data covers the four year period from 1988-89 to 1991-92 for the pre-reform period and the six year period from 1992-93 to 1997-98 for the post-reform period. Two 'unbalanced' panel databases are created² - one for the 'existing' firms' and another for 'new' firms (Table 2).³ 'Existing' firms include firms which were incorporated before 1988-89. The second panel includes 'new' firms which were established after the year 1992. Only those firms for which data was available for at least three consecutive years during the sample period are included in the sample. Also, firms, which report zero or negative values for plant and machinery, value added and the wage bill, have been deleted from the sample. The final sample consists of 2417 firms. Empirical analysis was also carried out for a 'balanced panel' of 379 firms, for which data for all the variables were available for the entire sample period since a balanced panel may produce much more robust results than an unbalanced panel.

(Insert table 2 here)

Patterns of finance and profitability

As stated earlier the 1991 reforms instituted significant changes in the financial sector, including abolition of ceilings on interest rates. It is to be expected that interest rates would rise following the

abolition of ceilings. This, in fact, is the experience of countries such as China, Malaysia and Turkey following deregulation of financial markets. India's experience appears to be no different. The ratio of interest payments to the stock of debt, a measure of average cost of borrowed funds, rose from 15 per cent during the pre-reform period to nearly 20 per cent in the post-reform period for the manufacturing sector as a whole (table 3).

(Insert table 3 here)

There are, however, wide variations in the interest rates incurred between the sub-sectors. Firms in the food sector experienced the largest increase in interest cost with a rise of 140 percent. At the other end of the spectrum, firms in sectors such as paper and paper products, leather and non-metallic mineral products experienced little or no change in interest burden.

It is argued that if financial deregulation results in a reduction of market imperfections, variations in the cost and maturity of debt between sectors should also decline. This would follow if liberalisation results in a reduction in differences in rates of return on investment between sectors, and firms equate the marginal cost of borrowing to the marginal rate of return on investment. Cho (1988) produces evidence for the Korean manufacturing sector for the years 1972-84 in favour of this proposition. The Indian experience, however, runs counter to Cho's thesis. There is however, no reason to believe that liberalisation would necessarily equalise marginal rates of return to investment between sectors. The caveat that risk premia and transaction costs between sectors should not differ, which underlies Cho's thesis, is unlikely to hold given significant differences between sectors in their structure,

market orientation, product composition and entry and exit barriers dictated by scale and size considerations. At best, liberalisation could be expected to equalise rates of return to investment between firms within each of the sectors and hence reduce differences in costs of borrowing for firms within sectors but not across sectors. Here again age, product composition, and market orientation may differ substantially between firms within each of the sectors. Indeed, the standard deviation of the cost of borrowing for firms within each sector, except non-metallic mineral products, also shows an increase in the post-reform period (appendix 1).

There are several studies which suggest that new entrants may face higher interest costs than established and large firms because of relatively high costs of information and monitoring they impose on financial institutions (Jaramillo *et al* 1996, Hermes and Lensink 1997, 1998, Huisman and Hermes 1997). Here again the Indian experience runs counter to received wisdom. Most new firms, with the exception of firms in the drugs and electrical machinery sectors, appear to have incurred a lower interest cost than the established firms, during the post reform period (Table 3). It is likely that financial institutions are favourably disposed towards new entrants with prospects of high returns. New entrants have not only access to improved technology and imported inputs but they do not also suffer from the problems of excess labour and other inefficiencies suffered by established firms in the various sectors. In other words, a clean slate may command a premium in the market as opposed to a cluttered one. This is not to say that the perceptions of financial institutions will always turn out to be right, it is just that in a newly liberalised economic environment they are likely to favour new entrants as opposed to the established ones. Indeed, profitability, measured as a ratio of gross profits to plant and machinery assets,

is relatively high for new firms in eight out of fourteen sectors (table 4).

(Insert table 4 here)

A significant development following the reforms is the reduced dependence on debt as opposed to equity forms of financing by most firms in the manufacturing sector. The average debt-equity ratio declined from 5.0 to 3.8 per cent for the sector as a whole⁴ (chart 1). This decline in the debt-equity ratio in the post-reform period appears to have been influenced by a number of factors including relaxation of regulations governing share issues, the continued reluctance of banks to invest in private firms as opposed to buying safe treasury bills and the rise in interest rates. Reliance on equity as opposed to debt for their finances confers a number of advantages on private firms. Most importantly, their actions and their consequences are governed by market forces instead of the cumbersome and bureaucratically governed supervision of the banks. Following the reforms privately owned firms were also allowed relatively free access to foreign portfolio capital.

Productive Efficiency of Firms

1. Patterns of Finance and Productivity

There is reason to believe that the developments relating to patterns and sources of finance would have an impact on the productive efficiency of firms. Increased reliance on equity sources rather than debt subjects firms to the rigours of market forces and

compels them to promote efficiency of operations in more ways than one. Apart from the ever present threat of a flight from equity in the absence of growth and efficiency, reliance on equity also eliminates the problem of moral hazard associated with debt financing. Prior to the reforms, those who exercised managerial control over firms could finance operations with a limited amount of equity and rely heavily on debt. They could recoup their equity investments in the first few years of operations, often assisted by a range of tax incentives, and let the financial institutions which had provided them with loan capital bear the losses (Goswami 1996). It is likely that government owned institutional creditors failed to institute efficient mechanisms to monitor the performance of their debtor firms. A relatively low equity base also enables large shareholders to retain control over firms' operations and enjoy a disproportionate share of the firms' profits. It is noteworthy that most of the now well-known problems faced by enterprises in east Asia were often related to their heavy reliance on debt finance (Pomerleano 1998). It is also suggested that firms which rely heavily on debt will be inclined to diversify their production compared with those firms which rely on equity sources. This is because of their presumed inability to diversify risks through a judicious portfolio allocation of their assets (Saint Paul 1992). Such diversification though may deprive them of specialisation gains. The impact of the altered pattern of finance on productivity of the manufacturing sector is discussed later in the paper.

2. Impact of Trade and Licensing Reforms on Productivity

Equally important to the promotion of productive efficiency of the sector are the trade and industrial licensing reforms. Productive

efficiency of manufacturing firms following liberalisation can be expected to increase for a variety of reasons;

1. improved resource allocation
2. improved access to know-how and technology
3. externalities arising from the growing presence of foreign firms
4. access to technology embodied in new machinery and equipment
5. improved methods of organisation.

In sum, reforms can be expected to promote both allocative efficiency and X-efficiency. First, we note the observed trends in labour and capital productivity.

(Insert table 5 here)

Labour productivity, measured by the ratio of gross value added to the wage bill, appears to have increased virtually across the board in the post-reform period. The only exceptions are the government owned firms and the miscellaneous manufacturing sector, both of which experienced a decline in labour productivity. It is noteworthy that labour productivity registered by the new firms in the post reform period was higher than the average for the sector as a whole.

The record of the sector on capital productivity is, however, less impressive. At the aggregate level the sector experienced a decline in capital productivity (table 5). It is again noteworthy, that the estimated capital productivity of new firms in the post reform period at 2.2 is substantially above that for the old firms at 0.9. In general, new firms, unencumbered by the distortions in the economy of an earlier era, appear to have fared much better than the old firms. Also, noteworthy is the fact that in the case of textiles, paper,

leather, non-metallic mineral products, and transport equipment capital productivity increased in the post-reform period (table 6).

(Insert table 6 here)

The observed growth in labour productivity may be due to improvements in labour efficiency as well as growth in capital intensity of operations (Chart 2). It is an established fact that, in general, the Indian manufacturing sector has experienced a growth in capital intensity over the years (Golder 1986, Ahluwalia 1995, Srivastava 1996). The reasons for this growth in capital intensity are several, including, distorted factor prices which have favoured increased use of capital rather than labour, and a bias towards investments in inherently capital intensive industries imparted by the protectionist import substitution strategy. This tendency towards growth in capital intensity of operations appears to have continued unabated in the post-reform era. Almost all of the sub-sectors increased the capital intensity of operations in the post reform period compared with the pre-reform period. It is noteworthy that the capital intensity of operation of foreign firms is the lowest both in the pre-reform and the post-reform periods. The old firms set in their ways, appear to have faced up to competition from new firms and imports by following the traditional route of increasing the capital intensity of operations. The capital intensity of new firms may be ascribed to investments in plant and equipment embodying newer vintage of technology.

Estimates of partial productivity however, are an inadequate guide to over all efficiency of operations since they fail to distinguish between growth in output due to increased use of inputs and growth in output due to improved efficiency of operations. In the following

section, we estimate a more direct measure of efficiency namely, total factor productivity (TFP). TFP measures growth in output which is unrelated to growth in physical inputs such as capital and labour. It accounts for factors such as learning by doing, growth in organisational efficiency and disembodied technical progress.

Theoretically, TFP is the difference between the rate of growth of output and the rate of growth of appropriately weighted inputs. It can be estimated either by using the growth accounting approach or by utilising the production function approach. Here, we utilise the production function approach to analyse the impact of reforms on productive efficiency of the manufacturing sector. In particular, we estimate a Cobb-Douglas type production function of the following form,

$$Y_{it} = Ae^{\lambda(i,t,X_{it})} L_{it}^{\alpha} K_{it}^{\beta} \mu_{it} e_{it} \quad (1)$$

where $I(\text{firm}) = 1, 2 \dots 2417$, t (time) = $1, 2 \dots 10$, Y is real gross value added, L and K are labour and capital inputs while α and β are average wage and capital share respectively in the value added, λ is the rate of disembodied Hicks-neutral technical change, A is a scale factor, which can include once and for all shifts in the level of output, μ is a random error term and, X_{it} is a vector of financial variables that are expected to influence productivity. Here, X_{it} consists of the debt-equity ratio (DE) of firms in the sample. The production function is linearised by taking logarithms and converted into a ratio form by dividing through by labour which gives us the following estimating equation,

$$\ln(Y_{it} / L_{it}) = a + \lambda_1 t + \lambda_2 (DE_{it}) + (\alpha + \beta - 1) \ln(L_{it}) + \beta \ln(K_{it} / L_{it}) + \varepsilon_{it} \quad (2)$$

where a is logarithm of A and the coefficient of L_t tests for the assumption of constant returns to scale in the production function. If the standard theory understates the role of capital and if increasing returns exist, then the sum of the elasticities exceeds one and the coefficient of L_t will be positive.

(Insert table 7 here)

The *LIMDEP* package provides estimates based on OLS, fixed effect and random effect models⁵. F-test and log-likelihood ratio statistics were significant for all the industries rejecting the hypothesis that unobserved firm-specific differences are not significant. Given that firms included in the analysis differ vastly in terms of their organisational structure, historical development, vintage of the capital, and labour quality, these results are to be expected. The Hausman statistic rejected the null hypothesis that the random effect model is appropriate in the case of most industries and therefore, the analysis here presents the results of the fixed effect model. The fixed effect model eliminates the problem of aggregation and productivity differences between firms can be taken into account. It should be noted that owing to measurement errors in the regressors and correlation between values over two time periods, fixed effect estimates may be biased downwards (Grilliches and Hausman 1986). Estimates presented here are corrected for heteroskedasticity.

The estimates using the balanced panel data show a statistically significant increase in the capital coefficient (β) in the case of both foreign and Indian firms, but not for the government firms in the post-reform period (table7)⁶. The share of labour in output (α) shows a decline in the case of foreign firms in the post-reform

period. In the pre-reform period, statistically significant increasing returns to scale existed for foreign firms and decreasing returns for Indian firms. In the post reform period, the pattern seems to have been reversed. Contrary to expectations, average TFP growth is negative (-0.03) in the post-reform period. Whereas in the pre-reform period, TFP growth was positive for Indian and foreign firms, it turns out to be negative in the post reform period. Government firms continue to show a decline in TFP growth in the post-reform period. Note that Indian owned firms exhibit increasing returns to scale in the post-reform period.

Changes in the pattern of financing appear to exert a positive impact on efficiency only in the case of foreign owned firms. In the post-reform period a relatively high debt-equity ratio exerts a negative influence on productivity of firms belonging to beverages & tobacco, man-made fibres, manufactures of textiles, and foreign firms in chemicals, inorganic chemicals, drugs, hardware, software and miscellaneous manufacturing sectors. It is noteworthy that in many sectors, productivity of new firms is positively influenced by a relatively high debt-equity ratio, which suggests that in the early years of a firm's operations debt-holders are likely to monitor a firm's performance better than the market.

The variation in productivity growth within the manufacturing industries is substantial (chart 3 and appendix 3). In the pre-reform period productivity growth was positive in all sectors except food, chemicals and transport sectors. Estimates presented here show that productivity growth in the post-reform period was either negative or statistically insignificant in most industry groups. Among the sub-groups, foreign and new firms in the drugs and pharmaceutical sector, new firms in the non-electrical machinery

sector and software firms in the electrical machinery sector show a positive TFP growth (appendix 3).

Although growth of productive efficiency in general declined during the post-reform period, there are sectors such as software and pharmaceuticals which have registered a growth in efficiency. These are the so called 'sunrise' industries which have benefited from access to imported technology in the world market and the new distortion free competitive environment. Indeed, these are the success stories of the reforms.

The observed decline in TFP growth in general in the post reform period could be due to the following reasons;

1. It is reported that in the post-reform period most firms undertook lumpy investments in plant and machinery with a view to build up productive capacity. But due to the recession after 1996-97 this capacity may not have been fully utilised. Indeed, available evidence suggests that there was a substantial expansion of capacity in the Indian industry between 1993-97, and that almost 22 percent of installed capacity was unutilised in 1997-98 (Nitsure and Joseph 1999).
2. While entry into the manufacturing sector for new firms may have been eased after the reforms, exit or closure of uneconomic units appears to have been difficult to achieve. Stringent labour laws prohibit de-scaling of labour, and various sorts of subsidies to ailing firms keep them alive but inefficient.
3. Reforms cannot be expected to produce miracles over night. Efficiency growth occurs with a lag after the reforms as firms

need time to adjust to the new market environment. Ahluwalia (1991) notes that although the late seventies were characterised by the beginning of reform measures, improvement in productivity came about only in the first half of the eighties.

4. Public capital investment in key infrastructure sectors such as energy, transport and communication declined as a proportion of GDP from 4 percent in the second half of the eighties to around 3 percent in 1997-98. Sixty two percent of the company executives in the 1999 World Bank-CII survey ranked India's poor infrastructure as the top most obstacle for growth of the industrial sector (the World Bank 2000). Shortfalls in meeting demand for power was estimated at 11 percent for regular and 18 percent for peak time energy demand in 1997 (Government of India 1997). According to government estimates, India's ports have failed to keep up with the increase in demand and are over-stretched.
5. Diversification into unrelated areas was common within the industrial sector under the license regime, and these companies find it difficult to adjust to competition from specialised firms entering the market.
6. As Desai (1999) notes 'an average factory continued to be visited by the same number of inspectors, each looking for a cut; roads continued to have the same checkposts manned by policemen who collected money'. In short, there is little change in the way firms are administered by government bureaucracy. Indeed majority of the firms continue to make unofficial payments to public officials in departments such as electricity, telephone, income tax and customs (the World Bank 2000).

7. A relatively liberalised foreign investment climate coupled with a level of effective protection which is still the highest in the world and a large domestic market, has led to substantial amounts of 'tariff-jumping' foreign direct investment (WTO 1998, Brahmhatt *et al* 1996). Tariff jumping investment is likely to be privately profitable but socially inefficient is an established proposition in the literature.

8. Reforms though substantial have yet to go a long way. Although the average tariff rate for manufactured products was reduced from 145 percent in 1990-91 to 36 in 1997-98, the index of dispersion of tariff rates for the whole economy increased from 35 to 41 per cent during the same period (WTO 1998).

Conclusion

The impact of the reforms on the productive efficiency of the manufacturing sector appears to be mixed. There are signs that the reforms have had the desired effect. New firms unencumbered by the distortions of an earlier era have performed much better than the old firms. In general, the post-reform period appears to be one of turbulence and disequilibrium. Firms which have been shielded from competitive forces cannot be expected to adjust to a new era of competition in the short-term, especially so when entry for new firms is free and exit for ailing firms is blocked. The statistical results of this exercise reflect this state of flux in the Indian manufacturing sector.

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Endnotes:

1. As Golder (1997) however notes, most estimates of TFP in Ahluwalia's study are statistically insignificant. Also, the estimates of Ahluwalia (1991) have been challenged by Balakrishnan and Pushpangadan (1994) who criticise the way prices of intermediate inputs are measured. Using a double-deflation method to construct time series of value added, the Balakrishnan and Pushpangadan study (1994) detects no improvement in TFP in the eighties. Also Mohanty (1992) observed a negligible growth rate (0.0092 percent per annum) for TFP during 1970-71 to 1988-89 for the registered manufacturing sector.
2. A data set is said to be unbalanced when data for each of the variables may not be available for the entire sample period.
3. The relatively small number of foreign firms in the sample of new firms reflects the trend in the initial years of reforms, when multinational companies entered Indian market via non-equity collaborations or minority participation and were officially classified as locally owned firms.
4. A relatively high debt-equity ratio of the basic-metals sector is due to the substantial presence of government owned firms in the sector.
5. See Green (2000) for the explanation of fixed and random effect models in panel data.
6. Productivity estimates were also obtained after augmenting the production function with firms' capital imports, royalty payments and investment in research and development (see appendix 2).

Table 1: Major Reforms influencing the Indian Manufacturing Sector

Prior to 1991	Reforms
Industrial licensing, reserved several industries for the public sector	Abolished with a few exceptions.
MRTTP act restricting corporate investment	Relaxed.
Imports subject to quotas and tariffs	Removal of quotas except for consumer goods, substantial lowering of tariffs.
Restrictions on FDI, foreign equity discouraged	Many sectors opened up to FDI, automatic approval of foreign equity up to 51% in many sectors.
Control over foreign exchange	Largely liberalised current account, though restrictions on capital account remain.
Ban on foreign portfolio investment	Relaxed rules.
Severe restrictions on the timing and pricing of capital issues	Substantial capital market reforms.
Interest rate ceilings, subsidised lending	Ceilings largely removed, subsidised lending reduced.
Access to foreign technology restricted	Policies relating to technology relaxed.

Table 2: Sectoral Distribution of Firms in the Sample

Firms	Existing			New		
	All	Foreign	Govt Indian	Foreign	Govt	India
	n	n	t	n	n	n
Food Products	202	1	5	166		30
Beverages and Tobacco	37	2	2	30		3
Textile	414	1	5	366		42
Paper and Paper	108	4	2	94		8

Products							
Leather and Leather Products	29	2	1	21			5
Chemicals	292	22	16	236			18
Drugs	157	20	1	121			15
Non-Metallic Mineral Products	125	5	2	113			5
Basic Metals	313	7	8	287			11
Non-electrical Machinery	168	22	3	134			9
Electrical Machinery	334	26	12	258	5	1	32
Transport Equipment	141	5	5	129			2
Diversified	49	4	3	42			
Miscellaneous	48			39			9
Total	2417	121	65	2036	5	1	189

Table 3: Cost of Debt

	Interest/debt		
	Old Firms		New Firms
	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Post-reform</i>
Food	10.4	24.9	18.5
Beverages and Tobacco	15.9	18.3	14.0
Textile	14.6	16.2	14.7
Paper and Paper Products	15.1	15.3	13.8

Leather	15.0	15.2	14.8
Chemicals	14.8	25.6	15.5
Drugs	16.0	18.5	19.0
Non-metallic mineral products	16.9	16.7	9.3
Basic Metal	16.1	16.2	13.3
Non-electrical	18.5	19.8	22.3
Electrical	18.0	28.1	24.7
Transport	15.9	18.9	
Diversified	14.7	25.8	
Miscellaneous	13.7	15.9	13.1
Average	15.4	19.7	16.1

Note: Interest – total interest payment, total debt - all forms of debt including borrowings from banks, FDI, inter-corporate loans, fixed deposits from public, foreign loans, loans from government, and funds raised from the capital market through the issue of debt instruments such as debentures.

Table 4: Profitability Ratios

	Gross Profit Rate			Net Profit Rate		
	Old Firms		New Firms	Old Firms		New Firms
	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Post-reform</i>
Food	31.8	50.0	19.6	20.1	25.0	1.6
Beverages and Tobacco	65.3	69.2	95.5	15.0	-1.2	49.6
Textile	36.9	43.7	58.2	10.3	10.5	7.7
Paper and Paper Products	34.2	51.1	78.5	8.6	16.7	36.1
Leather	67.3	64.6	93.3	25.4	34.8	46.7

Chemicals	67.0	73.0	152.1	25.8	23.8	66.4
Drugs	95.8	139.8	172.4	31.0	58.5	57.3
Non-metallic mineral products	31.4	67.5	47.1	5.1	26.4	12.3
Basic Metal	53.5	63.2	87.8	14.4	17.0	30.7
Non-electrical	57.5	67.8	38.1	17.1	14.6	8.7
Electrical	66.1	80.9	92.5	18.2	19.9	29.3
Transport	52.4	79.0		18.5	52.6	
Diversified	55.3	47.4		13.3	12.7	
Miscellaneous	24.0	36.9	9.1	-8.4	15.5	5.9

Note: Gross profit rate = gross profits/real plant and machinery assets, Net profit rate = Profit after taxes, interest payments and depreciation/real plant and machinery.

Table 5: Partial Productivity Ratios

	Labour Productivity		Capital Productivity		Capital Intensity	
	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>
All firms	4.7	5.5	1.2	1.1	9.9	15.4
<i>Std.Dev.</i>	11.7	10.3	4.9	3.9	18.7	37.5
Old firms	4.7	5.5	1.2	0.9	9.8	15.4
<i>Std.Dev.</i>	11.8	10.4	4.9	3.7	17.9	38.1
New firms		5.9		2.2		16.4
<i>Std.Dev.</i>		7.0		5.3		27.9
Foreign Firms	3.2	3.4	2.0	1.4	4.9	5.8
<i>Std.Dev.</i>	2.5	2.3	7.2	2.7	6.6	6.0
Indian Firms	4.9	5.7	1.2	1.0	9.9	14.9

<i>Std.Dev.</i>	12.4	10.7	4.3	4.0	17.7	30.2
Govt firms	3.6	3.1	0.5	0.4	16.4	14.4
<i>Std.Dev.</i>	3.8	3.8	0.6	0.5	26.8	17.9

Notes: Labour productivity – ratio of real gross value added to real wage bill, capital productivity- ratio of real value added to real plant and machinery, capital intensity = ratio of real plant and machinery to real wage bill. Std Dev = standard deviation

Table 6: Partial Productivity Ratios: Sectoral Analysis

	Labour		Capital		Capital	
	Productivity		Productivity		Intensity	
	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>	<i>Pre-reform</i>	<i>Post-reform</i>
Food and food products	4.36	4.82	1.59	0.72	10.15	19.01
<i>Std Dev</i>	4.96	5.61	7.31	4.65	17.78	27.07
Beverges and Tobacco	3.64	4.78	0.96	0.88	5.51	9.67
<i>Std Dev</i>	2.97	4.69	0.74	1.12	6.42	14.46
Textiles-	3.83	5.76	0.78	1.01	10.20	20.24
<i>Std Dev</i>	3.81	13.26	2.16	6.47	22.15	41.09
Paper and Paper products	3.40	4.04	0.44	0.48	9.47	14.23
<i>Std Dev</i>	3.06	6.18	0.26	0.75	8.43	17.88
Leather and Leather Products	2.74	5.35	1.25	1.42	4.48	16.67
<i>Std Dev</i>	1.81	7.17	1.18	3.02	4.82	33.90
Chemicals	8.46	5.64	1.43	0.76	15.18	18.41
<i>Std Dev</i>	24.87	7.16	5.77	1.87	22.03	22.38
Drugs	3.23	4.53	1.69	1.54	4.20	7.68
<i>Std Dev</i>	2.65	5.61	1.80	2.33	6.28	15.63
Non-Metallic Mineral Products	4.06	4.36	0.44	0.52	17.06	24.11
<i>Std Dev</i>	3.08	3.84	0.41	1.88	16.29	53.78
Basic Metal	4.59	5.20	0.68	0.54	11.86	19.58
<i>Std Dev</i>	4.25	11.37	0.55	0.58	20.75	53.22
Non-electrical Machinery	2.92	3.76	1.19	1.35	4.84	6.67
<i>Std Dev</i>	3.80	8.27	1.33	3.09	8.38	14.59
Electrical Machinery	4.18	4.66	1.52	1.32	7.23	10.12
<i>Std Dev</i>	5.05	12.34	2.02	2.68	13.47	28.47
Transport	3.00	3.92	0.70	0.68	7.66	8.85
<i>Std Dev</i>	1.83	4.07	0.48	0.87	12.06	10.95
Diversified	3.33	4.16	0.98	0.55	7.36	12.04
<i>Std Dev</i>	2.91	3.80	1.86	0.40	7.95	14.08
Miscellaneous	15.51	12.77	16.03	3.51	11.11	9.47
<i>Std Dev</i>	19.35	33.46	30.19	7.28	25.96	14.50

Table 7: Production Function Estimation (Cobb-Douglas)

Dependent Variable: Logarithm (real output t/real labour input in value terms)

Eq.	Ownership	Per ^a	Time	Debt ^e q	K/L ^b	L ^c	Obs ^d	R ²	F test ^e	Haus ^f	LM ^g
Unbalanced Panel											
(1)	All	1	0.03 ^a (3.27))	0.00 (-1.29)	0.11 ^a (2.9 7)	- 0.07 ^c (- 1.9)	4379	0.6 6	7.09	43.3 9	1147. 1
(2)		2	-0.07 ^a (- 18.5)	0.00 (0.68)	0.13 ^a (8.7 3)	- 0.05 ^a (- 2.9)	1196	0.6 7	11.24	101. 6	7646. 1
(3)	Foreign	1	0.03 (1.29))	-0.01 ^c (-1.69)	0.19 ^b (2.0 6)	0.12 ^a (2.9 5)	376	0.6 9	8.50	15.8 1	161.6 0
(4)		2	-0.05 ^a (- 3.62)	-0.01 ^b (-2.17)	0.22 ^a (2.5 6)	- 0.15 ^b (- 1.9)	649	0.6 5	10.30	10.7	440.0 0
(5)	Indian	1	0.03 ^a (3.32))	0.00 (-1.29)	0.08 ^b (2.0 9)	- 0.11 ^b (- 2.4)	3821	0.6 6	6.35	44.1 6	945.5
(6)		2	-0.07 ^a (- 1)	0.00 (0.67)	0.13 ^a 0.04	-	1097	0.6 9	11.0	100. 5	6916

			17.8)		(8.6 ^b						
					6)	(-					
						2.3)					
(7)	Government	1	0.01 (0.16)	0.00 (-0.21)	0.22 (0.58)	- (-0.20)	178	0.6 3	6.52	0.44	49.84
(8)		2	-0.07 ^a (-3.27)	0.01 ^b (2.3)	- 0.08 (-0.5)	- 0.17 (-1.4)	341	0.6 7	11.4	15.0 1	181.6 5

Balanced Panel

(9)	All	1	0.05 ^a (3.8)	0.001 (-0.5)	0.10 ^c (1.68)	- 0.18 ^a (-2.8)	1516	0.6 7	8.97	13.0 1	517.0 4
(10)		2	-0.03 ^a (-5.6)	0.003 ^a (-2.9)	0.22 ^a (6.43)	0.15 ^a (3.8)	2274	0.8 1	27.06	65.9	2596. 6
(11)	Foreign	1	0.04 (1.28)	-0.07 ^a (-3.11)	0.15 (0.85)	0.12 ^a (4.41)	108	0.8 4	19.17	0.15	84.53
(12)		2	-0.01 (-0.7)	-0.04 ^a (-2.97)	0.29 ^a (2.94)	- 0.23 ^b (-2.2)	162	0.9 0	50.48	0.29	303.5 2
(13)	Indian	1	0.05 ^a (4.2)	0.001 (-0.56)	0.06 (1.02)	- 0.23 ^a (-3.6)	1304	0.6 6	8.75	14.6 3	424.2 5

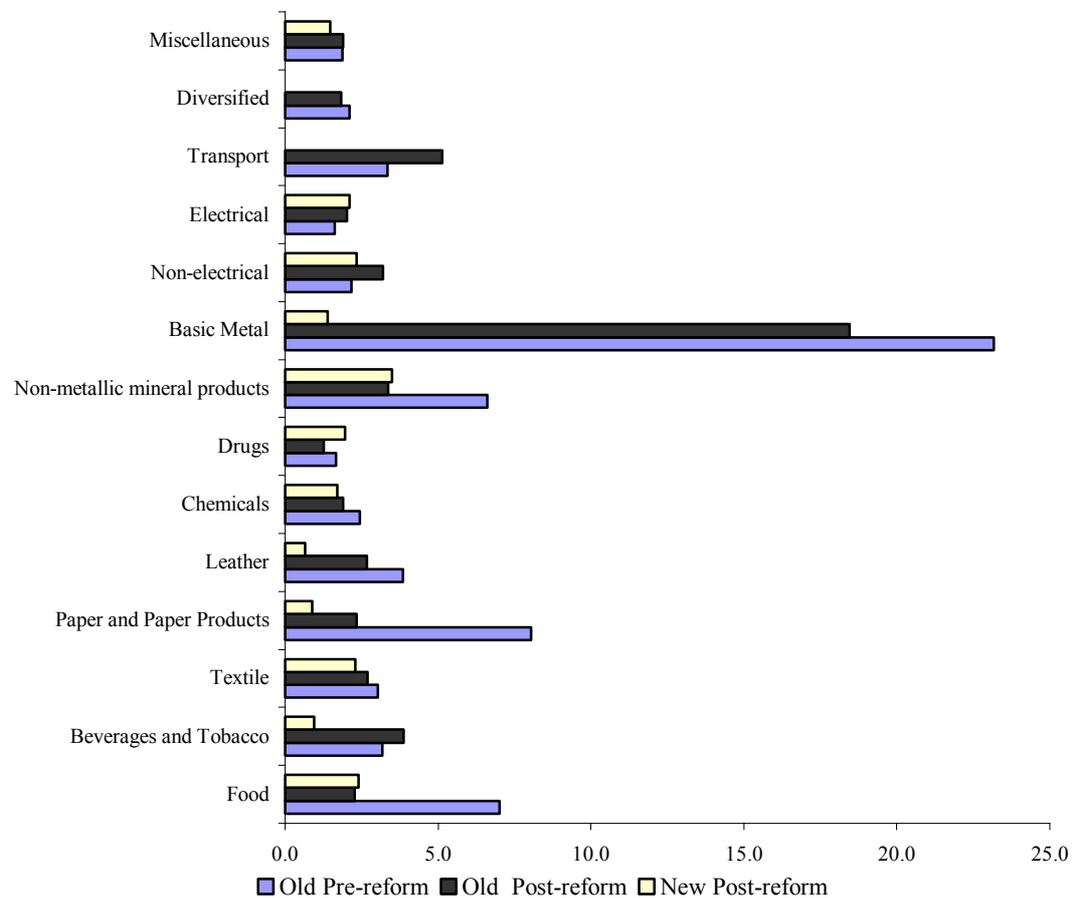
(14)		2	-0.03 ^a (-5.3)	- 0.002 ^a (-3.33)	0.23 a (6.44)	0.16 a (3.76)	1956	0.8 2	28.10	0.23	2267. 2
(15)	Government	1	-0.03 (-0.34)	0.001 (-0.14)	0.39 (0.68)	- 0.16 (-0.2)	100	0.5 9	6.12	0.69	5.18
(16)		2	-0.06 ^b (-2.38)	-0.003 (1.00)	- 0.05 b (-1.9)	0.20 (0.6)	150	0.6 9	13.31	0.56	48.10

Notes: Figures in parentheses are *t*-statistics, a,b,c significant at 1, 5, 10 percentage level respectively.

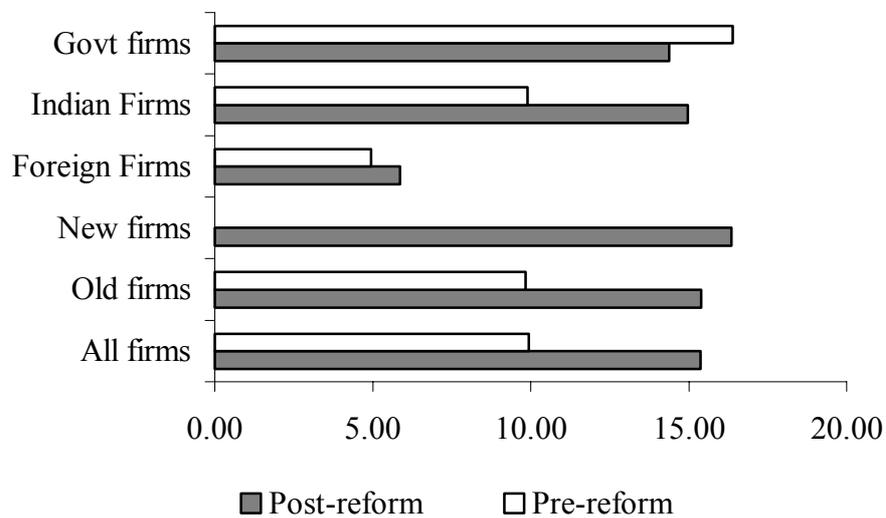
^a Period 1: 1988/89-1991/92, Period 2: 1992/93-1997/98

^{b, c} Logarithm of (real plant and machinery/real labour input) and logarithm of real labour input respectively, ^d Number of Observations, ^e F statistic tests for the inclusion of firm effects in the OLS model. ^f The Hausman test is distributed as a χ^2 statistic and tests for the validity of fixed effects versus random effects model, ^g Breusch and Pagan's LM statistic tests for random effects model versus OLS model. distributed as a χ^2 statistic.

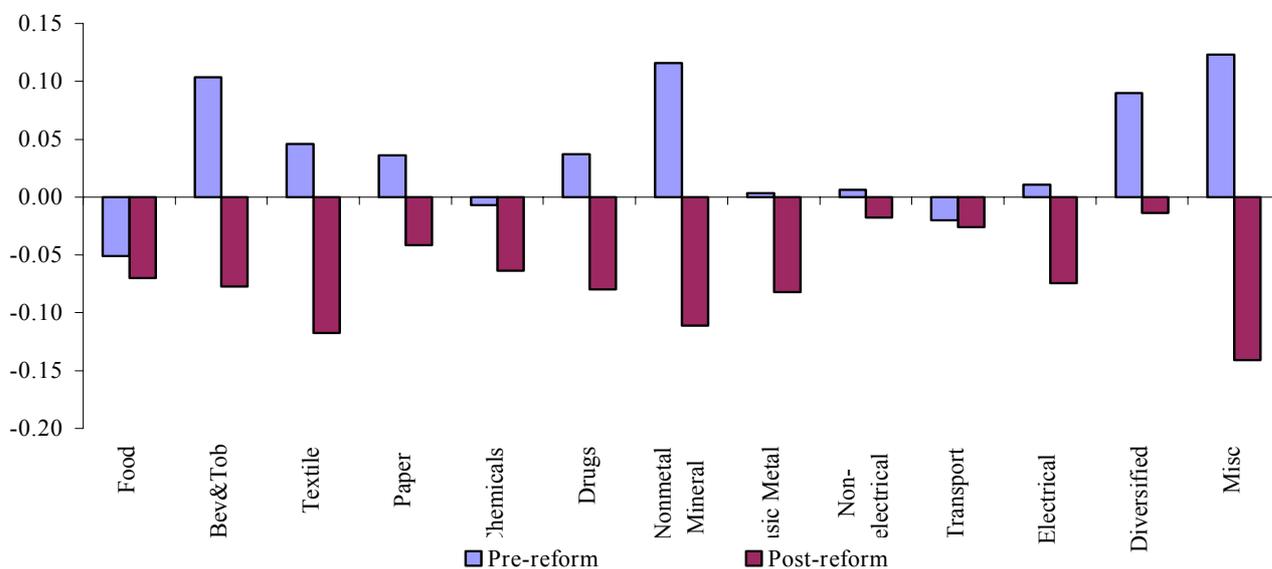
Chart 1: The Debt-Equity Ratios



Note: Debt to equity ratio = ratio of total outstanding debt to net worth of a firm at the end of the period where net worth is defined as the sum of equity capital, preference capital and reserves excluding revaluation reserves.

Chart 2: Capital Intensity**Chart 3**

TFP Growth: Sector-wise



Appendix 1
Standard Deviation of the ratio (interest/debt) within
Sectors

	Pre-reform	Post-reform
Food Products	14.1	85.7
Beverges and Tobacco	5.9	13.6
Textile	6.3	18.8
Paper and Paper Products	10.8	9.6
Leather and Leather Products	4.9	7.9
Chemicals	9.1	127.0
Drugs	5.7	23.0
Non-Metallic Mineral Products	25.4	18.8
Basic Metals	7.1	11.5
Non-electrical Machinery	12.3	24.2
Electrical Machinery	11.8	144.3
Transport Equipment	8.3	25.7
Diversified	4.7	81.4
Miscellaneous	5.2	10.7

Appendix 2
Dependant Variable = Log (real output/real labour input in
value terms)

	Entire Period	Pre- reform	Post- reform
Fixed effects			
Log (K/L)	0.215 ^a	0.084	0.219 ^a
Log (L)	0.022	-0.186 ^a	0.154 ^a
DEBTEQ	0.000 ^c	0.000	-0.002 ^a
TIME	-0.007 ^b	0.056 ^a	-0.029 ^a
Log (Capital imports/L)	0.010 ^b	-0.005	0.010 ^b
Log (Royalty/L)	-0.011 ^b	-0.026 ^b	-0.002
Log ((R & D)/L)	-0.005	-0.003	0.003
Obs	3790	1416	2274
Ad r ²	0.72	0.68	0.81
Hausman test	6.19	18.11	3.62

Appendix 3: TFP Growth Sector-wise

	Period	Entire Period	Pre-reform	Post- reform
1	Food	-0.04	-0.05	-0.07
2	Beverages and Tobacco	-0.01	0.10	-0.08
3	Textile	-0.06	0.05	-0.12
	<i>Old</i>	-0.05	0.05	-0.11
	<i>New</i>			-0.23
	<i>Cotton textile</i>	-0.07	0.03	-0.10
	<i>Man-made textile</i>	-0.06	0.01	-0.12
	<i>Manufacture of Textile</i>	-0.06	0.13	-0.14
4	Paper and paper products	-0.02	0.04	-0.04
5	Leather and leather products	-0.12		
6	Chemicals	-0.03	-0.01	-0.06
	<i>Foreign</i>	-0.01	0.01	-0.03
	<i>Indian</i>	-0.03	0.00	-0.06
	<i>Old</i>	-0.03	-0.01	-0.07
	<i>New</i>			-0.14
	<i>Inorganic Chemicals</i>	-0.02	-0.01	-0.11
	<i>Organic Chemicals</i>	-0.04	-0.13	-0.06
	<i>Fertilisers and pesticides</i>	-0.06	-0.14	-0.11
7	Drugs	0.00	0.04	-0.08
	<i>Foreign</i>	0.01	0.03	0.01
	<i>Indian</i>	-0.03	0.05	-0.11
	<i>Old</i>	-0.01	0.04	-0.08
	<i>New</i>			0.06
8	Non-metallic Mineral Products	-0.05	0.12	-0.11
9	Basic Metal	-0.05	0.00	-0.08
	<i>Old</i>	-0.05	0.00	-0.08
	<i>New</i>			-0.17
10	Non-electrical machinery	-0.01	0.01	-0.02

	<i>Old</i>	-0.01	0.01	-0.02
	<i>New</i>			0.11
	<i>Foreign</i>	-0.04	0.05	-0.11
	<i>Indian</i>	-0.01	-0.01	-0.01
11	Transport	-0.02	-0.02	-0.03
	<i>Automobile ancillaries</i>	-0.01	0.01	-0.01
	<i>Vehicles</i>	-0.05	-0.12	-0.11
12	Electrical machinery	-0.05	0.01	-0.07
	<i>Consumer Electronics</i>	-0.07	0.05	-0.11
	<i>Hardware</i>	-0.05	-0.05	-0.07
	<i>Software</i>			0.09
	<i>Rest</i>	-0.04	-0.01	-0.08
	<i>Foreign</i>	-0.04	0.06	-0.07
	<i>Indian</i>	-0.05	0.00	-0.08
	<i>Old</i>	-0.05	0.01	-0.08
	<i>New</i>			-0.04
13	Diversified	0.00	0.09	-0.01
14	Miscellaneous	-0.06	0.12	-0.14

Appendix 4

Definitions of the Variables

Output: Output can be measured either in terms of value added or in terms of gross output. If the latter is chosen then the production function needs to be specified in terms of labour, capital and material inputs. The advantages of a three-input production function are that it accounts for variation in the price of output relative to intermediate inputs and that technological progress may operate by conserving intermediate inputs. The estimates reported here are based on the production function with two-inputs and do not explicitly incorporate intermediate inputs. The three-input production function, with intermediate inputs as the third factor of production was estimated for all sectors. Most results do not differ in sign though the magnitude of the estimates, especially that of TFP growth is smaller, as is to be expected. A further choice arises between net value added and gross value added. However, from the data available it is difficult to make proper estimates of capital consumption and thus a gross estimates are used.

Output is defined as gross value added and is deflated by index numbers of wholesale prices for different sectors at the base year 1988-89.

Labour: Ideally the volume of labour in terms of the number of workers should be used in empirical analysis. However, none of the available data sources such as CMIE report data on volume of employment in each firm. In its absence labour input has been defined in value terms, i.e., by using values of wages and salaries at constant prices. Nominal values for wages and salaries have been deflated by the consumer price index for industrial workers. The major advantage of this variable is that it takes into account all types of workers - permanent and contractual. Most studies on the Indian manufacturing sector also define labour in terms of value in the absence of employment data at the firm level (Srivastava 1996 and ICICI 1994).

Capital Stock: The measurement of capital is controversial and the final results with respect to TFP estimates are sensitive to the estimates of capital stock. The data provides information on book values of gross fixed assets at current prices. In the present study value of gross fixed assets at constant prices has been taken as the measure of capital input. We use a gross measure rather than a net measure. From the available data it is difficult to make a proper estimate of capital consumption and hence of net capital stock. We exclude working capital, which is in accordance with many earlier studies on productivity in Indian manufacturing (Golder 1986, Sinha and Sawhney 1970).

We use the perpetual inventory method to calculate the capital stock. This involves assuming some base year capital stock as beginning capital stock and then deflated gross investment of each year is added to base year stock to arrive at each year's stock. Let K_0 denote the base year capital stock, I_t the gross investment at the base year prices in year t and D_t the amount of fixed assets discarded during year t , then we can write gross fixed capital stock in year N denoted as K_t , as

$$K_t = K_0 + \sum_{i=1}^T (I_i - D_i)$$

The rate of discarding fixed assets is assumed to be nil while estimating the capital stock figures. Gross investment in each year is defined as the difference between gross assets between two years:

$$I_t = (B_t - B_{t-1} + D_t) / P_t$$

Where B_t is the book value of fixed assets at the end of year t , D_t is the amount of depreciation allowances and P_t is the capital goods deflator.

Gross investment obtained in this manner is deflated to the base year price using gross fixed capital formation deflator. This is added to a benchmark estimate of 1988/89. For the benchmark year the book value of capital stock is used. This is a weakness since it does not take into account assets of different vintages bought at different points in time. However, in the absence of an information about the cumulative depreciation and the time pattern of acquisition of assets, appropriate price adjustments can not be made to the data. We therefore, use the book values of gross fixed assets at constant prices arrived by using perpetual inventory method as the estimates of capital stock.

Although the results reported in the paper were obtained by assuming the depreciation rate to be zero, the growth rates of TFP were also calculated by altering the depreciation rates of capital stock to crosscheck the results. The signs of the estimates do not alter but there is some variation in magnitude. E.g. the following TFP growth rates were obtained when the rate of depreciation was altered.

	Entire Period	Pre- reform	Post- reform
Rate of depreciation = 0%	-0.03	0.03	-0.07
Rate of depreciation = 15%	-0.02	0.05	-0.05
Rate of depreciation = 20%	-0.01	0.05	-0.04
Rate of depreciation =	-0.02	0.04	-0.05

$$\begin{array}{l} 25\% \\ \text{Rate of depreciation} = \\ 30\% \end{array} \left| \begin{array}{ccc} -0.01 & 0.04 & -0.04 \end{array} \right.$$