IMPACT OF ECONOMIC REFORMS ON EFFICIENCY AND PRODUCTIVITY GROWTH IN ORGANISED MANUFACTURING SECTOR

Dissertation submitted to Jawaharlal Nehru University in partial fulfillment of the requirements for the award of the Degree of

MASTER OF PHILOSOPHY

DEBASHIS PADHI

CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT

SCHOOL OF SOCIAL SCIENCES

JAWAHARLAL NEHRU UNIVERSITY

NEW DELHI- 110067

INDIA

2012

ABSTRACT

The 1991 liberalization in India has deregulated the Indian industries and exposed them to foreign competition. It represented both a change and an opportunity to the already protected manufacturing sector in India. However, there are diverse views on the issue of the effect of economic reforms on the output of manufacturing industries. It is often assumed that economic liberalization can lead to a remarkable change in productivity growth of industrial sector of any country. The general argument is that the very inefficient firm will exit and other firms will be forced to improve their performance. But, the infant industry argument states that the removal of protection by the Government will lead to bankruptcy of a large number of firms. Empirical studies have found a mixed result regarding the impact of trade liberalization on total factor productivity growth in the Indian manufacturing industries during 1990s. While some studies report that the liberalization policies improved the productivity of the manufacturing industry (Chand and Sen 2002; Unel 2003; Driffield and kambhampati 2003), other studies have found a negative trend or no significant improvement in productivity growth since the starting of economic reforms in 1991 (Trivedi et al. 2000; Goldar and Kumari 2003). Similarly, some studies also describe that economic reforms have improved the efficiency of the manufacturing industry (Permeswaran 2002; Driffield and Kambhampati 2003), where as other Studies have shown that there is an decline in efficiency of manufacturing sector (Mitra 2002; Ray 2002; Bhaumik and Bhaskar 2010).

Productivity growth can be brought about by improvement in technology or improvement in technical efficiency or by improving the economies of scale. Decomposition of total factor productivity (TFP) into all the three components will enable a better understanding of the relative contribution of the components to the total factor productivity and the main hindrances for the growth of manufacturing productivity after the economic reforms in India. The previous studies have concentrated mostly on a particular industry at aggregate level and have ignored to look into the sub national level for all the industries of manufacturing sector. Further, analysis of the impact of reforms on industrial performance of different states is essential to provide a wholesome understanding of the issue of reforms and industrialization. While studies (Mitra 2002; Trivedi et al. 2011) have examined the issue at state level, they have hardly attempted a decomposition of TFP into all its components. In order to examine performance of the entire

manufacturing industry during the reform period and the impact of economic reform, it can be better analyzed by taking all the manufacturing industries of major states of India and comparing them with pre-liberalized era. Our study takes up a comprehensive analysis of Indian manufacturing, using the stochastic frontier analysis method in our study, to investigate the impact of economic reforms on growth, productivity and efficiency of Indian industries. Since technical efficiency only partly explains the productivity of industries, it cannot account for change in productivity due to other factors like Scale efficiency change (SCE) and technological progress (TP). Hence, we also attempt a decomposition of total factor productivity into technological progress (TEC), (TP), and (SEC) to give a complete picture of the source of growth in productivity.

In order to have a better understanding about Indian manufacturing industries during both pre and post liberalized era, we have first calculated the share of output of different manufacturing industries in India for the whole sample period of 1980-81 to 2007-08. After that, we have applied Lee and Strazicich (2003) structural break test in the growth of output, wage and investment of different states for the whole sample period. The motivation behind this is to check the impact of economic reforms on different states as the economic, social, geographical and environmental situations are different among different states in India. . The result shows that in food industry, the share of Punjab and Maharashtra has been declined, where as Madhya Pradesh share has been increased from the pre to post reform period. Similarly the share of Andhra Pradesh and Madhya Pradesh in beverage industry has been declined significantly, and Karnataka has gained among all the states in post reform period. In cotton and jute industries the share of all the states has gone down except Tamilnadu, Rajasthan and Madhya Pradesh. Some states like Maharashtra in wood and wood product industries, Haryana in textile and basic metal industries, Rajasthan in metallic product industries, Gujarat in basic metal industries have performed well during the post reform period. Still in most of the industries the performance is not quite satisfactorily as they were expected during the post reform period.

From the analysis of the trend of investment we have found that for some states like Andhra Pradesh, Karnataka, Gujarat and Kerala an early change in pattern of investment is observed, for other states the change seems to be occurring very late. The rate of investment was high for the states like Gujarat, Haryana and medium for Tamilnadu, Andhra Pradesh, Maharashtra and

Punjab whereas it was very low in Karnataka, West Bengal, Bihar and Kerala during the whole period of 1980-2007. The reason is the determinants of private investments like availability of physical infrastructure, developed transport system; easily access to market, increase in profit share etc. vary across the states which affect the rate of investment significantly.

In case of growth in manufacturing output the states like Karnataka, Gujarat, Rajasthan and Andhra Pradesh have grown at a very significant rate where as West Bengal, Punjab, Bihar and Kerala have a minimal growth rate. Most of the states have accelerated their growth rate after their second structural break around 2002-03. The variation in growth rate may be due to different competitive environment, the difference in entry barrier's among the cross sectional units and increased amount of contract workers.

When we will consider the wages in different states during the post reform period, the growth rate of wages did not vary as compared to output and investment. The growth rate in wages was highest in Haryana but it was negative in Bihar and West Bengal. Most of the states performed well from 1980 to their respective first structural break where as in second phase, that period is between the two structural breaks; the industrial wage rate became negative in most of the sates. The situation changed in last phase that is from break two to last period. The factors like bargaining strength of labor with the existence of labor union, future expectation of price changes, technical knowhow skill of workers and well organized labor market could be the possible factors for the variations in wage rate for different states of India.

Next we have analyzed the performance of fourteen manufacturing industries in terms of efficiency against the background of economic policy reforms introduced in India since 1991. The results indicate the change in the policy environment has positive effect on technical efficiency in beverage, textile, chemical, rubber and metal industries, while for the rest of the industries, it show a decline trend. The decline in the level of technical efficiency indicates that the majority of the firms in these industries failed to catch up with shifting frontier technology which was pushed further by the entry of large and foreign companies, happened by the opening up economy during post liberalized era. And the other findings are marginal productivity of labor in the formal manufacturing sector in India is much lower than the marginal productivity of capital and material input. There was an increase in the returns to factors inputs during the post reform period. However the percentage change in the returns to material input is much more pronounced than that of labor and capital. The returns to scale in most of the industries are close to unity, which means the scale of operation in manufacturing industries (on average) close to their optimum levels. In other words, most of the manufacturing industries were operating much closer to their minimum point of long run average cost curve.

After calculating technical efficiency for each industry it doesn't make a clear picture about the performance of manufacturing sector during both pre and post liberalization era. In order to have a better understand about the total factor productivity and the factors that are contributing to its growth, we have extended our study to the fifth chapter. We used the empirical model of Kumbhakar (2002) which is described in the chapter-II to carry out the empirical estimation of the impact of economic reforms on productivity of Indian industries.

Then we have decomposed productivity into three components: technical progress (TP), technical efficiency changes (TEC), and scale efficiency change (SEC). The empirical result shows that Indian manufacturing suffers from both low level of TE level and low growth rate of this factor. On TP, the results show that every industry except paper wood and beverage industry experienced increasing technical progress for the whole sample period. The result show that SEC increased in eight industries over the sampling years and decreased in five industries. Average TFPG increased in every industry for the whole sample period.

The average rate of TFPG has been calculated during pre and post reform period for all the fourteen major industries in India Productivity improvement is recorded for only six out of fourteen manufacturing industries during the post reform period then the pre reform period. These industries are textile, wood, rubber, non metallic, basic metal and machinery industries. The rest of the industries show a decline trend in the change in TFPG between pre and post reform period. In terms of technical efficiency, beverage, textile, wood and paper industries have improved than the rest of the industries. Negative TEC observed in most of the industries because of the gap between frontier and actual production enjoyed by SMEs widened due to the opening up the economy after the economic reforms. Furthermore, the result also suggests that after the reforms, there is a lift in the restriction on investment by large industrial houses and foreign controlled companies. Following the reform, large domestic firms have led to keep innovating in response to new competition from foreign companies that entered the market. This helped to push production frontier of the Indian manufacturing sector much higher than it was before the reforms. This along with large number of new entrant SMEs resulted in negative TEC.

In terms of technological progress, industries like textile, wood, rubber, basic metal, machinery and other manufacturing industries are enjoying a higher technological progress during the post reform period in compare to pre reform period. In rest of the industries, TP shows a decline trend. The reason behind increase in TP in these above industries may be due to abolition of license by government and lifting restriction on investment by removing the asset limit through MRTP act. The government also increased the limit on foreign equity partition from 40 per cent to 51 per cent in 1998. Following this reform, capital investment in the Indian manufacturing sector, by both domestic firms and foreign multinationals, increased rapidly across industries. Increased capital investment in the manufacturing sector brought into the country new technological embodied capital, thus raising TP in an unprecedented way. However declining TP in the rest of the industries suggests that these industries didn’t cope with the process of development.

In term of scale efficiency, except beverage, cotton and basic metal industries, the rest are showing a negative change during the post reform era in compare to the pre reform. This may be due to some firms with insufficient production scale has entered the market during post reform period. For some industries, the return to scale is one. So we couldn’t able to calculate the SCE for these industries. From the table-5.2, it shows that TFP was higher in the pre reform period then the post reform. Six out of fourteen industries (textile, wood, rubber, non-metallic, basic metal and machinery industries) have been outperformed after the economic reforms compare to the regulation era. The reason for deceleration of productivity growth may be due to the non-adoption of new technologies after the reform period. Technical progress showed positive change where as TEC and SEC deteriorated for most of the industries during the deregulating era. The inference is that the TFP growth appeared to be relatively better during the protected era than the liberalized regime.

जवाहरलाल नेहरू विश्वविद्यालय

JAWAHARLAL NEHRU UNIVERSITY
Centre for the Study of Regional Development
School of Social Sciences
New Delhi-110067

26 July, 2012

DECLARATION

I, MR. DEBASHIS PADHI, hereby declare that the dissertation entitled **"Impact of Economic Reforms on Efficiency and Productivity Growth in Organised Manufacturing Sector"** submitted by me for the award of the degree of **Master of Philosophy** is my bonafide work and that it has not been submitted so far in part or in full, for any degree or diploma of this university or any other university.

DEBASHIS PADHI

CERTIFICATE

It is hereby recommended that the dissertation may be placed before the examiners for evaluation.

Prof. P.M. Kulkarni
(Chairperson)

Prof. Amaresh Dubey
(Supervisor)

Tel. :(011) 26704463 Ext. 2466, 2463 Gram: JAYENU Fax: 91-11- 26717586, 26197603

DEDICATED

TO MY PARENTS

Acknowledgements

*I express my deep sense of gratitude and profound respect to my supervisor **Prof. Amaresh Dubey** for his continual help and invaluable comments through the study period.*

I also thank our chairperson Prof. P.M. Kulkarni and other faculty members of the centre for the study of regional development (CSRD) for their support. I am also thankful to the staffs of library for their cooperation.

I also convey my thanks to all my seniors and friends, especially Biswa Bhai, Jagannath Bhai, Tapas Bhai, Devi Bhai, Bikash Swain, Dipak, Jata, Manas, Khirod, Bikash Malick, Subrat, Ravi, Kamal, Arvind, Shamim, Megha, Sanju yadav, Annu, Priya Sharma, and all other friends for their encouragement and support throughout this study period.

I thank my family members for their support and faith in me. Above all, I convey my prayer to the Almighty for all His blessings.

DEBASHIS PADHI

CONTENTS

List of Tables

List of Figures

ABBREVIATIONS

ASI	Annual Survey of Industries
WPI	Wholesale Price Index
SFA	Stochastic Frontier Analysis
TP	Technological Progress
TEC	Technical Efficiency Change
SEC	Scale Efficiency Change
TFP	Total Factor Productivity
SMEs	Small and Marginal Enterprises
AE	Allocative Efficiency
TE	Technical Efficiency
IMF	International Monetary Fund
NIC	National Industrial Code
CSO	Central Statistical Organization
NAS	National Account Statistics
SEZ	Special Economic Zone
DGP	Data Generating Process
GDP	Gross Domestic Product

CHAPTER-I

Introduction, Review of Literature and Objectives of the Study

1.1 Introduction

Manufacturing sector plays an important role in the overall development of the economy. Many countries in the past, i.e., mainly the western countries have experienced rapid economic development through the process of industrialization. Primarily the level of industrialization is judged by the share of manufacturing sector in the economy of a state. In developed economies like Japan, Mexico, Italy and Germany, the share of manufacturing sector in Gross Domestic Product (GDP) is more than 17 percent. Even for emerging economies like china, Indonesia, Korea, the share of manufacturing sector in GDP is more than 25 percent. Though India embarked upon a period of large scale industrialization under state control and planning after independence, its share of manufacturing sector in the GDP is only 13 percent (World Bank 2009).

The industrial development in India has seen several shifts in policies, which have been shaped by the state of progress and performance of industrial sector. Before 1980, based on the perception of Soviet Union success, it was thought that the key strategy for development was to focus on large and heavy industries under state control and central planning. The strategy also involved import substitution, rigid price controls and severe restriction on private initiatives. But this strategy failed to improve the performance of industrial sector in India, which saw revision in policy tools in the late 1970s. Ahulwalia (1991) stated that these policy changes included such as, reducing the barriers to entry and expansion, simplifying procedures, and providing easier access to better technology and intermediate material imports. There were some additional reforms during 1980s, but most of the structural reforms occurred since 1991, after the severe economic crisis in the fiscal year 1990-91.

The most important reforms undertaken during early 90s were (i) reduction or abolition of restrictions such as high tariff rates, import licensing, and quantitative restrictions on international trade; (ii) reducing the barriers to entry in foreign direct investment; (iii) abolition of industrial licensing for all most all industries; (iv) allowing private initiative in industries which are previously reserved for the public sector; (v) reduction in the tax rates along with simplifications of tax structures; (vi) introducing greater flexibility in interest rates and improving the supervision and regulation of the banking system. The basic idea behind such economic reforms is that the reduction in the size of the public sector and the lifting of the government controls and regulation on production, trade and investment would create more competitive environment, improve efficiency and hence growth. The pattern of industrialization is expected to be not only internationally competitive but also sufficiently labor-intensive (Goldar and Kumari 2003).

The 1991 liberalization in India has deregulated the Indian industries and exposed them to foreign competition. It represented both a change and an opportunity to the already protected manufacturing sector in India. However, there are diverse views on the issue of the effect of economic reforms on the output of manufacturing industries. It is often assumed that economic liberalization can lead to a remarkable change in productivity growth of industrial sector of any country. The general argument is that the very inefficient firm will exit and other firms will be forced to improve their performance. But, the infant industry argument states that the removal of protection by the Government will lead to bankruptcy of a large number of firms. Empirical studies have found a mixed result regarding the impact of trade liberalization on total factor productivity growth in the Indian manufacturing industries during 1990s. While some studies report that the liberalization policies improved the productivity of the manufacturing industry (Chand and Sen 2002; Unel 2003; Driffield and kambhampati 2003), other studies have found a negative trend or no significant improvement in productivity growth since the starting of economic reforms in 1991 (Trivedi et al. 2000; Goldar and Kumari 2003). Similarly, some studies also describe that economic reforms have improved the efficiency of the manufacturing industry (Permeswaran 2002; Driffield and Kambhampati 2003), where as other Studies have shown that there is an decline in efficiency of manufacturing sector (Mitra 2002; Ray 2002; Bhaumik and Bhaskar 2010).

Productivity growth can be brought about by improvement in technology or improvement in technical efficiency or by improving the economies of scale. Decomposition of total factor productivity (TFP) into all the three components will enable a better understanding of the relative contribution of the components to the total factor productivity and the main hindrances for the growth of manufacturing productivity after the economic reforms in India. The previous studies have concentrated mostly on a particular industry at aggregate level and have ignored to look into the sub national level for all the industries of manufacturing sector. Further, analysis of the impact of reforms on industrial performance of different states is essential to provide a wholesome understanding of the issue of reforms and industrialization. While studies (Mitra 2002; Trivedi et al. 2011) have examined the issue at state level, they have hardly attempted a decomposition of TFP into all its components. All these motivates the present study, which seeks to address the issue of decomposition of TFP into technical progress, technical efficiency change and scale efficiency change in the manufacturing industries at the state level.

This chapter is organized as follows. First, we touch upon the controversy of exact duration (1980s or 1990s) of the occurrence of reforms. Second, we spell out the theoretical consideration about impact of economic reforms on growth, productivity and efficiency of manufacturing industries in India. Next, we mention the motivation and the objectives of the study. We end this chapter by explaining the data source and methodology of our study.

1.1. The Reforms: Issues and Debates

In this section, we run through the controversy of reforms in 1980s vs. reforms of 1990s. Since, some reform measures were partially undertaken in 1980s before the all round reforms in 1990s, there is confusion as to whether the period 1980s should be considered in any analysis of the impact of reforms.

The controversy appears in the debate as whether the recent acceleration of economic growth in India can be attributed to the reforms implemented in the post-reform era or it is because of the initial steps that were taken throughout the 1980s. Rodrik and Delong (2002) argued that tentative measures taken under the Rajiv Gandhi Government in the 1980s led to disproportionately high growth, while the reforms undertaken in and after 1991 had a far smaller impact with respect to GDP growth. Delong (2001) commented that "under Rajiv Gandhi, the Government made some tentative moves to encourage capital-goods imports, relax industrial regulations and rationalize the tax system" (p. 5). He argued that the change in official attitude in the 80s, towards encouraging rather than discouraging entrepreneurial activities and integration into the world economy, have had a bigger impact on growth than any specific policy reforms.

Panagariya (2004) refuted this argument, arguing in favor of the 1990s reform by stating that "growth during the 1980s was fragile, highly variable over the years, and unsustainable. In contrast, once the 1991 reforms took root, growth become less variable and more sustainable with even slight upward shift in the mean growth rate" (p.7). In providing this argument, Panigariya (2004) drew support from Ahluwalia (2002), who acknowledged that while the growth record in the 1990s was only slightly better than that in the 1980s; the 1980s growth was unsustainable, fuelled by a build-up of external debt that culminated the crisis of 1991.

Srinivasan and Tendulkar (2003) provided an export-oriented view of the reforms undertaken in the 1980s by stating that the increase in Indian exports over the 1980s reform era was mostly due to an exchange rate depreciation attributed more too exogenous forces of policy reforms which aimed at reducing trade barrier.

From the above argument we can conclude that policy deregulations initiated during the mid 80s are only partial; the major economic reforms belong to the early 90s.

Since this study seeks to address the issue of impact of economic reforms on industrial performance of states in India, it is essential to be well conversant with the literatures to enable us to use them as a reference points for the analysis. This is what is precisely done in the next section.

1.3. Review of Literature

Existing literature have tried to access the impact of economic reforms on the different aspects of Indian industries, like employment, productivity, industrial growth, efficiency and competitiveness etc. These can be broadly grouped under the following three heads.

1) Impact of economic reforms on the growth

2) Impact of economic reforms on productivity

3) Impact of economic reforms on technical efficiency of Indian manufacturing sector.

In the following sub sections, we take up an excursion of literature in each of these groups.

1.3.1. Economic Reforms and Industrial Growth

In the following paragraphs, we review the literature on impact of reforms on industrial growth in India, where we focus upon the conclusions of these studies identifying the divergence among them and the reasons for their divergence.

The industrial growth rate, which remains negligible during 1965 to 1979, has recovered in 80s; and has been around 8 percent per annum (Nayar 1993). As stated earlier, economic reforms started partially in the period of 80s. Keeping in mind the performance of 80s, the advocate of economic reforms claimed that the industrial growth would further increase with the process of economic reforms. Berhman et al. (1995), Bhagvati (1995) have empirically highlighted their works that industrial growth has increased in the 90s. Unini et al. (2001) show that the industrial growth rate in India has increased 8.2 percent per annum during 1990-91 to 1995-96 against 7.5 percent per annum during the period of 1985-86 to 1990-91.

But again, Chandrasekhar (1996) and Choudhury (2002) have raised a number of issues against the economic reforms and have criticized them on the ground of performance. Chandrasekhar (1996) is very critical about the outcomes of economic reforms. According to him, "by having a close look of the estimates of capital formation in the post reform period it is impossible to establish any linkage between liberalization, private investment and industrial growth (p. 2541)". He further pointed out that economic reforms have only unleashed a consumption boom pulled by increase in easy consumer credit and this boom has increased the balance of payment vulnerability.

Chaudhury (2002) concludes that value added growth in the 1990s was inferior to that in the 1980s, that the industrial base had gone down, and employment growth in the 1990s was negative in five out of nine years and that the labor productivity stagnated after 1995-96, after having increased in the early 1990s. Here again no attention has been paid to the changes in protection, prices and costs that resulted from the reforms.

A positive picture has been drawn by Panagariya (2004), who argues that growth in the 1990s was more robust than that of the 1980s and that it was achieved through important policy changes. The main policy changes held responsible for accelerated growth are the liberalization of foreign trade, the reduction in industrial licensing and opening to foreign direct investment. Nagraj (2003) observes that there is no significant change in the industrial growth after the introduction of economic reforms. Goldar (2004) comments that the economic reforms did not have any impact on the pattern of industrial growth where the peak occurs after every six years.

In response to these critics, the advocates of the reforms suggested that the slow progress of reforms is the reason for its lack of positive impact on the industrial growth. They hope that the industrial growth will pick up with further relaxation of rules.

To sum up, the 1980s growth was not basically due to the policy changes that occurred during the mid 80s but it was mostly based on foreign aid where as the 1990s growth, though less than the 80s growth rate but it was mostly due to the policy changes that were initiated in the early 90s.

1.3.2. Economic Reforms and Manufacturing Productivity

Before going into the literature on reforms' impact on productivity, it is useful to explain briefly the measures of productivity that have been used in the literature.

There are two different way to measures productivity, such as (1) partial productivity (2) total factor productivity. Between these two, the second one is better indicator of productivity growth in the long run. When we define productivity as a ratio of the output of goods and services to input, it is known as partial factor productivity such as labor productivity, capital productivity etc. In contrast to this, the total factor productivity measures the contribution to other factor except labor and capital in the increase of production. Thus the TFP measures the increase in productivity through technological progress or increase in efficiency with which the resource are being used through innovation and improved management technique to increase the output from given combination of capital and labor.

In India, the TFP growth has remained a highly debated issue among the economists. There are several attempts has been made to estimate the TFP growth of Indian manufacturing sector from time to time by different economists. But the major work in this direction was done by Ahluwalia (1991). Her work had started a debate among the scholars about the TFP growth in India during 70s and 80s. In that debate, Ahluwalia (1991), Goldar (1998), Trivedi (1998), Krishna (1987) were of the view that TFP growth has increased in 80s. Ahluwalia (1991), in her study had estimated the TFP growth for manufacturing sector by using Cobb Douglas and Translog production function. She used time specific dummy variable to check the turnaround in TFP. Her analysis showed that the TFP has increased significantly after 1982-83.

Krishna (1987) in his review of studies during the 1960s and 1970s observes that there is a deceleration in the total factor productivity since the mid 1960s, where as Ahluwalia (1991) observes the same, a decline in total factor productivity during the 1970s, but there was a turnaround in the first half of the 1980s. She argued that increase in total factor productivity during this period is basically due to the increase in labor productivity, while capital productivity is more or less constant. Balkrishnan and Puspgandhan (1994) comments on it by saying that the result could be the opposite of it, if she uses proper indices such as double deflation method in measuring the total factor productivity (TFP) of manufacturing industries..

Most of the Studies on total factor productivity have used wholesale price index of manufacturing product as deflator. However, Balkrishnan and Puspagandhan (1994) point out that such a measure is valid only if both the price of material input and the price of the output are moving on the same direction; otherwise estimated productivity would vary inversely. Hence, they advocate the double deflation method, where the value of output is deflated by an output price index and the value of input by input price index. Rao (1996) argues that measuring TFP with single and double deflation of value added will lead to biased estimates and can be avoided if one relies on an accounting decomposition or an econometrically estimated decomposition. He developed a total factor productivity measure where the production function was separable for material and factor inputs. The principal conclusion that was derived in his study that there was a transition in the early 1980s from a high positive growth in productivity to a significant and negative rate, which is contrary of the conclusion of Ahluwalia's (1996) work.

Trivedi et al. (2002) analyze the total factor productivity of manufacturing sector by taking Annual Survey of Industries (ASI) data from 1973-74 to1997-98 and the principal findings of the study are that labor productivity in the six manufacturing industries selected for study has been higher than that for the manufacturing sector as a whole and labor productivity has been rising at a faster rate than capital productivity. International comparison shows that while labor productivity in Indian industries has been rising faster than in some industrialized countries. In terms of total factor productivity, the Indian manufacturing sector has recorded positive rates of growth, particularly since the second half of the 1980s, which compare favorably with those of East Asian economies.

Chand and Sen (2002) examine the impact of trade liberalization on the productivity growth of manufacturing sector by using ASI data for 30 industries over the period of 1973-88. Total factor productivity is computed by using Tronquist index and the result supports a key postulate of the new growth theories, that liberalization of the intermediate-good sectors has a larger favorable impact on TFP growth than that of the final-good sectors.

Das (2003) tries to explore the nature and magnitude of total factor productivity change under different trade regimes. The standard growth accounting methodology is applied to data compiled from the annual survey of industries for selected 3-digit use based manufacturing sectors over the period 1980-2000. The analysis focuses on overall period and four sub periods (1980-85, 1986-90, 1991-95 and 1996-00) to reflect the shift in trade regime. The variables that are used in the model are labor, capital, materials, energy and time. The result shows that at the three digit level the average growth rate of Total factor productivity over the 75 industries is around 0.08%. Only capital goods sectors registers a positive growth and it may be due to the easing of quantitative restrictions on imports of machinery and spare parts which has increased external competition and improved productivity. The worsening of TFP during 1990s may be due to structural and political factors.

Goldar and Kumari (2003) find total factor productivity growth in Indian manufacturing decelerated in the 1990s and due to the low level of effective protection to manufacturing industries have favorably affecting productivity growth. The results also suggest that gestation lags in investment projects and slower agricultural growth in the 1990s had an adverse effect on productivity growth. The analysis also reveals that underutilization of industrial capacity was an important cause of the productivity slowdown.

Unel (2003) analyze the productivity performance of registered manufacturing sector by applying growth accounting technique for the period of 1979-80 to 1997-98. The main finding of his study is labor productivity and total factor productivity (TFP) growth in manufacturing industries since 1980 were remarkably higher than that in the preceding two decades and a comparison between pre and post reforms period both labor productivity and TFP growth rates increased by 24 per cent and 46 per cent.

Mishra (2004) analyze the impact of India’s economic reforms on industrial structure and productivity. His study was based on the ASI data and covered both two and three-digit level of industries. To check the growth trend of labor output, capital and capital intensity, a semi-log model is fitted to the sample. The total period is divided into two sub periods i.e., pre- reforms period (1980-90) and post-reform period (1991-2002). The result of the study shows that capital output ratio was growing over the period of time. It means that labor is being replaced by capital which capital output ratio shows there might be fall in manual jobs. The result also reveals that instead of the elasticity of tends to become a very crucial coefficient to signify a great importance in the degree of labor productivity. The reasons for the low performance of manufacturing sector in India during the post reform period are not only the result of exogenous factor but also the consequence of the type of policy followed during that period.

Siggel (2007) tries to show the impact of the Indian reforms of the early 1990s on export and employment by using indicator of competitiveness. It is the ratio of total cost to the total output which is an indicator of export competitiveness. The time period of the study covers from 1987-88 to 1997-98 and the sources of data are annual survey of industries (ASI), IMF and World Bank. The results show that the level and structure of protection is drastically changed and nominal rate of protection is systematically lower than the tariff. Export competitiveness is significantly increased and comparative advantage is enhanced in some industries.

In final words we can conclude that on the topic of impact of economic reforms on total factor productivity (TFP) growth, the experts do not have homogeneous view but if we go with the majority, then we have to accept that TFP growth has declined in the post reform period, as compared to the pre reform period.

To sum up, we find that after the economic reforms the output growth has remained roughly the same, while the TFP has declined. However our interest is to make a comparison of TFP in different manufacturing industries between pre and post reform period with extending the time period from 1980-81 to 2007-08 to work out the performances of different industries in comparison to each other in the pre and post reform period and decomposing the TFP into its various components will help in understanding the source of the TFP growth which is not generally focused by most of the studies.

1.3.3. Economic Reforms and Technical Efficiency

Literatures on the Indian manufacturing sector are relatively scarce on efficiency as compared to the studies on productivity.

The studies of efficiency can be divided under the following grounds: aggregate level taking manufacturing sector as a whole, firm level and disaggregate level. Some of the firm level studies that have dealt with technical efficiency are Driffield and Kambhampati (2003), Parmeswaran (2002), Aggrawal (2001), Balkrishnan et al. (2000), Krishna and Mitra (1998) among others, whereas, Ray (2000.1997), Mitra et al. (2002), Singh (2001) and Majumdar (1996) among others, look at the issue from an aggregate industry view point. The method used by these studies mainly based on stochastic production frontier methods where as the studies by Ray and Majumdar is based on non-parametric method of data evolvement analysis (DEA). Among all, Trivedi et al. and Mitra studies on technical efficiency is both at state and industry wise disaggregate level.

Jha and Sahni (1992) use ASI data from 1960-61 to 1982-83 and find that in the four industries i.e., cement, cotton textiles, electricity, iron and steel industries which they have taken, there exists biased technical change which in turn affects the factors income distributions. The change has been towards the use of labor and materials factors and against the capital and energy in the electricity industries, where as it has an opposite bias in cotton textiles. The author finds that there is no sign of technical efficiency and all the industries are more or less relatively efficient. But the period of study is up to 1983, which gives us a better indication of what was the situation in the pre-reform period.

Majumdar (1996) has studied technical efficiency using non-parametric method for the manufacturing sector from the period of 1973-74 to the year of 1988-89. He is concluded that the enterprises owned by the central and state governments are less efficient than mixed or private sector enterprises. Between private and mixed sector industries, mixed sector enterprises are less efficient than the private sector. The analysis reveals that Government-owned enterprises are the major players for lack-luster industrial performance of India.

Ray (1993) uses the non-parametric method of Data Envelopment analysis (DEA) to measure the malmquist productivity indices for manufacturing sector over the period 1969-70 to 1983-84. He finds that, though there is an average decline at the rate of 2.89 percent in the manufacturing sector, still there exists a considerable regional variation. He has identified the factor leading to this decline in TFPG as regressive technical change.

Mitra (1999) uses stochastic frontier analysis in his study and finds low level of technical efficiency in most of the industries across states. He also have subdivided the whole period into two sub periods, i.e. pre-liberalized era and liberalized era, during these periods he finds a mixed picture with some industries facing a decline in technical efficiency with some other showing rise.

Aggarwal (2001) checks the performance of public sector enterprise in India using parametric methods and finds that the technical efficiency levels have been quite low in these units and that the reforms have not bought about major changes in their performance. Srivastava (2001) has estimated the technical efficiency of Indian manufacturing firms for the period 1980-81 to 1996-97. He finds that mean technical efficiency has gone down in the 1990s compared to the 1980s.

Permeswaran (2002) finds by using frontier analysis that changes in the policies have a favorable impact on technical efficiency and this efficiency could be a direct result of the access of technology imports. In the case of electrical machinery and electronics in the study, there is a significant of policy change on technical efficiency (on the basis of the dummy variable for 1991).

Ray (2002) tries to examine the effect of economic reforms on productivity and efficiency. While measuring the productivity and technical efficiency (TE) growth for the years 1985-86 through 1995-96 for each state, he uses tornqvist and malmquist indices and finds that the annual rate of productivity growth has been higher in the post reform period than the pre reforms. However, some states have actually experienced a slowdown in the productivity growth or even productivity decline after the reforms. Decomposition of the Malmquist productivity index shows that improvement in technical efficiency as well as faster rates of technical progress contributed to the observed acceleration in the growth rate. A subsequent regression shows that there is a tendency towards convergence in productivity growth rates across states. The analysis also reveals that the average technical efficiency (TE) is declining for seven states, no improvement in TE for six states and an increase in TE for the remaining. The all India average showed increase in technical efficiency.

Driffield and Kambhampati (2003) analysis six manufacturing sector i.e. transport, textiles, metals, machine tools, food and chemicals and employ frontier production function to examine the six Indian manufacturing groups. The data period covers from 1987-88 to 1994-95. The respective variable in their study are output, labor, capital, materials, time and two dummy variables for export and export. The study has found that there was an increase in overall efficiency in the post reform period in India in five out of six sectors. Middle aged firms with higher market share were likely to be more efficient than others.

Mukherzee and Ray (2004) analyze the state level data for aggregate manufacturing sector in India for the period 1986-87 to 1999-00 to study the efficiency dynamics of individual states. Using non-parametric method of DEA, examine that there is considerable variation in efficiency across states. The study explains that Government control and greater reliance on market have failed to create competitive environment for the efficient utilization of resources in India.

Sing and Agarwal (2006) examine the total factor productivity growth and its components in the sugar industry of Uttar Pradesh. The TFP growth is estimated by applying DEA-based malmquist productivity index on the panel data of 36 sugar mills for the period 1996-2003. He finds that the average TFP in the industry grew at a moderate rate of 1.6 percent per annum during the entire period. The decomposition of TFP growth into technical efficiency change and technical change reveals that TFP growth is primarily contributed by technical change rather than by technical efficiency change.

Bhaumik and Bhaskar (2010) try to show whether the post reform growth in Indian manufacturing industry is input driven or efficiency driven. They have used stochastic frontier approach as a tool for their analysis. They argue the advantage of this approach is that it can accommodate technical efficiency in to the analysis along with factor inputs and technical change. The study covers from 1989-90 to 2000-01, and uses plant-level data from annual survey of industries. The sample includes production unit of 15 major states due to some geographical and administrative constraints. The variables that they have taken in their model are output, labor, capital, plant age and two dummy variables for the control of owner ship and state/location. The null hypothesis of full efficiency is rejected for all the industries. The result shows that marginal productivity of capital in the formal manufacturing sector in India is much lower than the marginal productivity of labor. There are both increases in returns to factor of production and the growth in value added which is explained by the growth in the use of factor inputs. The result also shows that median technical efficiency declined in all but one of the industries between 1989-90 and 2000-01 and that change in technical efficiency explains a very small proportion of the change in gross value added.

Trivedi et al. (2011) analyze the performance of manufacturing sector at a disaggregate level by examining both regional as well as industries dimension. The period of study covers from 1980-81 to 2003-04 for this disaggregate analysis. Both growth accounting approach as well as production frontier approach has been used. The result shows that TFPG growth is higher in Frontier approach than the growth accounting approach. Among all states Maharashtra features as the best performing states among all the major 18 states of India. The result also reveals that the mean technical efficiency is lower in DEA method than the stochastic frontier approach. The lowest mean technical efficiency occurs in food and textile industries where as it is highest in metal and engineering goods industries among the six industries that is chosen in this study.

To sum up, we can conclude that on the topic of impact of economic reforms on efficiency of the manufacturing industries, the experts do not have homogeneous view, but if we go with the majority then we have to accept that technical efficiency has been declined in the post reform period as compared to the pre reforms. But the studies are not focusing both productivity and efficiency at the same time at the sub national level and also the time period that was taken in most of these studies is not large enough to capturing the accurate impact of reforms. This has been motivated to carry out the study by extending the time period and measuring efficiency and productivity of all the manufacturing industries at the sub national level.

1.4. Motivation and Objectives of the Study

From literature on the countries manufacturing sector, we find that not many studies focus on the efficiency and productivity question simultaneously as detail. Moreover, few studies have analyzed the impact of reforms on all industries across the major states, for which secondary data exists. Though many studies have attempted to look at the reforms, it has often been done with selected industries and/or with firm level data. In order to examine performance of the entire manufacturing industry during the reform period and the impact of economic reform, it can be better analyzed by taking all the manufacturing industries of major states of India and comparing them with pre-liberalized era. Our study takes up a comprehensive analysis of Indian manufacturing, using the stochastic frontier analysis method in our study, to investigate the impact of economic reforms on growth, productivity and efficiency of Indian industries. Since technical efficiency only partly explains the productivity of industries, it cannot account for change in productivity due to other factors like Scale efficiency change (SCE) and technological progress (TP). Hence, we also attempt a decomposition of total factor productivity into technological progress (TEC), (TP), and (SEC) to give a complete picture of the source of growth in productivity. We may therefore, write the objectives of the study as:

1) To examine the growth and structural change of manufacturing sectors in India.
2) To assess the impact of economic reforms on the efficiency of manufacturing industries in India.
3) To observe the impact of economic reforms on total factor productivity of manufacturing sector.

The analysis is based on the subdivision of the whole period (1980-81 to 2007-08) into pre reform period (1980-81 to 19993-94) and post reform period (1994-95 to 2007-08). The effect of reforms is not likely to be seen immediately with the policy announcements but is expected to materialize with a lag of time. Hence, we begin the sample period from 1993-94.

The thesis is organized according to the following chapter scheme. After this introduction, chapter-II explains the methodology and data source of the study. Chapter-III deals with the performance of the Indian manufacturing sector during 1980s to 2007. In this chapter the growth and the distribution of Indian manufacturing sector has been described in detail. Chapter-IV focuses on the impact of reforms on efficiency of the manufacturing industries during both pre and post reform period. Chapter-V analyses the impact of economic reforms on the total factor productivity growth of manufacturing industries in India. Finally, the chapter-VI provides conclusion and future scope of the study.

****

CHAPTER-II

Empirical Framework and Methodology

2.1. Introduction

In the previous chapter, existing literatures on Indian manufacturing sector examining the relationship between economic reforms and industrial performance of manufacturing sector have been discussed. The discussion was based on the type of empirical framework used and methods adopted in the literature. In order to estimate the threefold objective of our study, accordingly this chapter has been divided into following four sections. The first section discusses the empirical model in the form economic reforms and manufacturing growth. The second section describes the empirical model on measuring efficiency in manufacturing industries. In the third section we have described the empirical model on estimating total factor productivity of manufacturing industries. The end of the chapter is explaining about the data source of the study.

2.2. Empirical Model

To recapitulate, the study has three objectives. One, to examine the impact of economic reforms on the growth structure of manufacturing industries at the state level. Two, to assess the impact of economic reforms on the efficiency of manufacturing industries in India. Three, to observe the impact of economic reforms on total factor productivity of manufacturing sector.

In the following sub-sections, the empirical model and methodology used in the study for examining the threefold objective is described in detail.

2.2.1 The Impact of Economic Reforms on the Growth Structure of Manufacturing Industries

To examine our fist objective, i.e., the impact of economic reforms on growth and structure of manufacturing sector among the states of India, we have used a log linear model to compute the compound growth rate of output, wage and investment for the full sample period and the sub periods obtained from identifying the periods of structural change of manufacturing sector in different states following the reforms.

2.2.1.1 Lee and Strazicich - Break Test

We have used endogenous two-break unit root test proposed by Lee and Strazicich (2003) to identify the possible structural breaks in the time series data of manufacturing output, Wage and investment. In our study, we have assumed gross fixed capital formation as the proxy of investment, as the data on manufacturing investment at disaggregate level as quite difficult to get.. The test allows for endogenously multiple breaks in the series and also gives information about whether these breaks are significant or not. Endogenous break tests, such as Phillips-Perron (1988), Perron and Vogelsang (1992), Zivot and Andrews (1992) and two-break minimum test of Lumsdaine and Papell (1997) derive their critical values under the null hypothesis of no breaks so that, rejection of the null need not imply rejection of a unit root *per se*, but may imply rejection of a unit root without break. Unlike these tests, LS test is unaffected by breaks under the null and hence, rejection of the null, clearly, points to the existence of a trend-stationary series with break(s).

We consider the following data-generating process (DGP) to understand the LS testing process:

$$ly_t = \delta' z_t + e_t \qquad (1)$$

$$e_t = \beta e_{t-1} + u_t \; e_t = \beta_{et-1} + u_t \qquad (2)$$

Where ly_t is the dependent variable in period t, δ is a vector of coefficients, Z_t is a matrix of exogenous variables described as $Z_t = \{1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}\}'$ to allow for a constant term, linear time trend, and two structural breaks in level and trend and u_t is an error term. TB_j is the time period of the occurrence of breaks. D_{jt} denotes an intercept shift in the deterministic trend such that, DT_{jt}=1 for $t \geq TB_j + 1$, $j = 1, 2$, and zero otherwise. DT_{jt} refers to a change in slope of the deterministic trend such that, $DT_{jt} = t$ for $t \geq TB_j + 1, j = 1, 2$, and zero otherwise.

Following Lee and Strazicich (2003), a unit root test statistic can be obtained by estimating the following model

$$\Delta Y_T = \delta' \Delta Z_t + \emptyset \tilde{S}_{t-1} + \sum_{i=1}^{p} \gamma \Delta \tilde{S}_{t-i} + e_t \qquad (3)$$

Where Z_t reflects the deterministic components, $\tilde{S}_t = Y_t - \tilde{\psi}_x - Z_t \tilde{\delta}$, $t = 2 \ldots\ldots T$. $\widetilde{d}$, is a vector of coefficients in the regression of Dy_t on DZ_t and $\tilde{\psi}_x = Y_1 - Z_1 \tilde{\delta}$, where Y_1 and Z_1 denote the first observations of Y_t and Z_t respectively. e_t, is the contemporaneous error term which is assumed to be independent and identically distributed with zero mean and finite variance. The DS_{t-i} terms are added to eliminate the possibility of serial correlation

The unit root null hypothesis is described by $\phi = 0$ and the LM test t-statistic is defined by:

$\tilde{\tau}$ = t-statistic for the null hypothesis $\phi = 0$. (4)

While applying the test, correction for serial correlation in equation (3) is made by inclusion of augmentation terms $\widetilde{\Delta S}_{t-i}, i = 1 \ldots . k$. 'k' is determined by following the general to specific procedure described in Perron (1989). The procedure begins with a maximum number of $\widetilde{\Delta S}_{t-i}$ term, (*max k* = 8) and the last term $\widetilde{\Delta S}_{t-i}$ is examined to see if it is significantly different from zero at the 10% level. If it is insignificant, the last term is dropped and the model is re-estimated with k = 7 terms and so on, until either the maximum term is found or k = 0. After determining the "optimal" number of k, the unit root test statistic is estimated using equation (4). The process is repeated for each break point $\lambda_{j,}$ where $(\lambda j = TBj / T, j = 1, 2)$, to determine the LM test statistic with the minimum t-value.

As pointed out in the first chapter our objective is to investigate the impact of economic reforms on efficiency and productivity of manufacturing sector in India from 1980-81 to 2007-08. Hence, we need some empirical framework to enable us to pursue our objective. In this section, we set out the appropriate models with justification for it. In the next section, we discuss the methodology to be adopted to address the objectives of the study.

To examine the growth rate of various aggregates for the period of 1980-81 to 2007-08, we fit an exponential growth model in our study, i.e.

$$y_t = y_0 + y_0(1 + r)^t \qquad (1)$$

Where y_t= value of y at time t and Y_0= value of y at time 0.

Taking log on both sides of equation (1),

$$log y_t = \log(y_0) + log(y_0(1 + r))^t \qquad (2)$$

By putting y_0 = a and y_0 (1+r) = b then the equation (2) will be

$$lnY = lna + t\, ln\,(b) \qquad (3)$$

$$G = (antilog\,(b) - 1) * 100$$

Where Y= wage, gross output, gross fixed capital formation and t= time period, G= growth rate.

2.2.2 The Impact of Economic Reforms on the Efficiency of Manufacturing Industries in India

In the study of measurement of efficiency literature have employed either Stochastic Frontier Analysis (SFA) or Data Envelopment Analyses (DEA). Studies such as Ray (2002); Mukherzee and Ray (2004); Sing and Agarwal (2006) have used DEA, while other studies such as, Mitra (1999); Driffield and Kambhampati (2003); Bhaumik and Bhaskar (2012) have used SFA. Merit of SFA over DEA is that it allows estimating the noise tem along with the inefficiency component in the model where as in DEA only efficiency component can be estimated. Mortimer (2002) "SFA should have the advantage in coping with severe measurement error and where simple functional forms provide a close match to the properties of the underlying production technology" (p 3). On estimating the impact of reforms on efficiency of manufacturing industries we have used SFA in the study.

2.2.2.1 Stochastic Frontier Analysis (SFA)

Stochastic frontier analysis (SFA) is a method of econometric modeling. It has been introduced by Aigner, Lovell and Schmidt (1977). The production frontier model without random component can be written as:

$$y_i = f(x_i; \beta).TE_i$$

Where, y_i is the observed scalar output of the producer i, $i = (1, \dots . I)$, x_i is a vector of N inputs used by the producer i, $f(x_i, \beta)$ is the production frontier, and β is a vector of technology parameters to be estimated. TE_i denotes the technical efficiency defined as the ratio of observed output to maximum feasible output. $TE_i = 1$ shows that the *i-th* firm obtains the maximum feasible output, while $TE_i < 1$ provides a measure of the shortfall of the observed output from maximum feasible output.

A stochastic component that describes random shocks affecting the production process is added. These shocks are not directly attributable to the producer or the underlying technology. These shocks may come from weather changes, economic adversities or plain luck. We denote these effects with $ex\,p\{v_i\}$. Each producer is facing a different shock, but we assume the shocks are random and they are described by a common distribution. The stochastic production frontier will become

$$y_i = f(x_i; \beta).TE_i.\exp\{v_i\}$$

We assume that TE_i is also a stochastic variable, with a specific distribution function, common to all producers. We can also write it as an exponential, $TE_i = \exp\{-u_i\}$ where $ui \geq 0$, since we required $TE_i \leq 1$. Thus, we obtain the following equation:

$$yi = f(x_i; \beta).\exp\{-u_i\}.\exp\{v_i\}$$

Now, if we also assume that $f(x_i, \beta)$ takes the log-linear Cobb-Douglas form, the model can be written as:

$$lny_i = \beta_0 + \sum_n \beta_n lnx_{ni} + v_i - u_i$$

Where $v_{i,}$ is the "noise" component, which we will almost always consider as a two-sided normally distributed variable, and u_i is the non-negative technical inefficiency component.

Advantage of stochastic frontier analysis:

First, SFA produces efficiency estimates or efficiency scores of individual producers. Thus one can identify those who need intervention and corrective measures. Second, since efficiency scores vary across producers, they can be related to producer characteristics like size, ownership, location, etc. Thus one can identify source of inefficiency. Third, SFA provides a powerful tool for examining effects of intervention. For example, has efficiency of the Indian manufacturing industries has changed after deregulation? Has this change varied across different industries group? Last but not the least, while estimating the optimization technique through the conventional econometric tools like regression analysis, we assume the deviation from the optimal ones is statistical noise term. But Stochastic Frontier Analysis is one such technique where we can model both to know their individual impacts separately.

To start with, the stochastic frontier model in logarithmic form can be written as:

$$logY(t) = \alpha + \beta t + \sum_j \gamma_j \, log \, X_{ij}(t) + \varepsilon_i(t)$$

$$\varepsilon_i(t) = V_i(t) + U_i(t)$$

Where, γ_j s are the elasticities of value added with respect to the inputs (capital, labor and material input), α is the intercept, β is the rate of Hicks-neutral technological progress, $Y_i(t)$ and $X_{ij}(t)$ are the level of value added and inputs of the *i*-th state at time t respectively, and $\varepsilon_i\,(t)$ is the error term comprising a random component, $V_i(t)$ and the component associated with TE, $U_i(t)$. The term $U_i(t)$ is assumed to be non-positive while $V_i(t)$ follows the usual properties.

TE of *i*-th state at time *t* is given by

$$TE_i(t) = Y_i(t)/Y_i * (t) = exp(U_i(t))$$

Where, $Y_i(t)$ is the observed level of output and $Y_i*(t)$ is the frontier level of output. There are various version of stochastic frontier model based on the assumption of error term. If u is assumed non-negative half normal $N(0, \sigma^2)$ the model is referred to as the normal-half normal model and if u is assumed truncated and half normal $N(\mu, \sigma^2)$ then the model is referred to as the normal-truncated normal model .We can also be assumed to follow other distributions (exponential, gamma, etc.). In panel data one can estimate efficiency without making any assumption about the distributional error term u_i. In our model we have assumed both u_i and v_i to be distributed independently of each other and the regressors. Maximum likelihood techniques will be used to estimate the frontier and the inefficiency parameter.

As we are using the panel data in our study, so we describe in detail about the methodology in panel data analysis.

2.2.2.2 Panel Data Models

A panel data contains more information than a single cross sectional data. And it is also expected that access to panel data will enable us to relax some of the strong distributional assumption which are used with cross sectional data. Let's discuss the panel data methods in production frontier model.

There are three difficulties that can be noted with cross sectional stochastic frontier models.

a) Maximum likelihood estimation of the stochastic production frontier model requires strong distributional assumption about both inefficiency and statistical noise error term; otherwise it will provide misleading result.

b) Maximum likelihood estimation also require an assumption that technical efficiency component in error term to be independent of the regressors, which is some time quite an unrealistic assumption.

c) The properties of consistency does not hold when we are calculating technical inefficiency component term, because the variance of the conditional mean of each individual producer does not go to zero as the size of cross sectional unit increases.

Each of these limitations is avoidable if we have access to panel data. First, having access to panel data will enable us to adapt conventional panel data estimation technique to measure the technical efficiency component measurement, rather than the techniques which are based on strong distributional assumption. Second, not all the panel data estimation technique requires the assumption of independence of technical inefficiency component in error term from the regressors. Finally, since adding more observation on each producer in panel data will able to estimate the technical inefficiency component of each producer, more consistently than in cross sectional data.

The first use of panel data models in stochastic frontier models goes back to Pitt and Lee (1981) who interpreted the panel data random effects as inefficiency rather than heterogeneity. This tradition continued with Schmidt and Sickles (1984) who used a similar interpretation applied to a panel data model with fixed effects. Both models have been extensively used in the literature. A main shortcoming of these models is that any unobserved, time-invariant, firm-specific heterogeneity is considered as inefficiency. In more recent papers the random effects model has been extended to include time-variant inefficiency. Cornwell et al. (1990) and Battese and Coelli (1992) are two important contributions in this regard. In particular the former paper proposes a flexible function of time with parameters varying among firms. However, in both these models the variation of efficiency with time is considered as a deterministic function that is commonly defined for all firms. We contend that the time variation of inefficiency may be different across firms. Even within a given firm, these variations could depend on unobserved factors thus can be assumed as a stochastic term rather than a deterministic function of time.

In this study, we have used time varying decay model against the time invariant model for panel data analysis. The reason behind to select this model is, inefficiency is a dynamic phenomenon and it should not be constant because learning and applying of management skills is a continuous process and it varies over time. That's why we use time varying stochastic frontier analysis in estimating the inefficiency of industries in manufacturing sector of India.

2.2.2.3 Time Varying Inefficiency Model for Estimating Panel Data

Consider the stochastic frontier production function for panel data,

$$Y_{it}, = exp(X_{it}\beta + V_{it} - U_{it}) \qquad (1)$$

Where, Y_{it}, denotes the production at the *t*-th observation $t = (1, 2, \ldots, T)$ for the *i*-th firm $i = (1, 2, \ldots, N)$. X_{it}, is a $(1\times k)$ vector of values of known functions of inputs of production and other explanatory variables associated with the *i*-th firm at the *t*-th observation; β is a $(k \times 1)$ vector of unknown parameters to be estimated; The V_{it}s are assumed to be $iid\ N\ (0, \sigma v^2)$ random errors, independently distributed of the U_{it}s. The U_{it}s are non-negative random variables, associated with technical inefficiency of production, which are assumed to be independently distributed, such that U_{it}, is obtained by truncation (at zero) of the normal distribution with mean, $Z_{it}\delta$, and variance, σ^2;

Z_{it}, is a $(1 \times m)$ vector of explanatory variables associated with technical inefficiency of production of *industries* over time; and δ *is* an $(m \times 1)$ vector of unknown coefficients. Equation (1) specifies the stochastic frontier production function in terms of the original production values. However, the technical inefficiency effects, the U_{it}s, are assumed to be a function of a set of explanatory variables, the $Z_{it}s$, and an unknown vector of coefficients, δ. The explanatory variables in the inefficiency model may include some input variables in the stochastic frontier, pro-vided the inefficiency effects are stochastic. If the first z-variable has value one and the coefficients of all other z-variables are zero, then this case represents the model specified in Stevenson (1980) and Battese and Coelli (1988, 1992). If all elements of the δ-vector are equal to zero, then the technical inefficiency effects are not related to the z-variables and so the half-normal distribution originally specified in Aigner, Lovell and Schmidt (1977) is obtained. If interactions between firm-specific variables and input variables are included as z-variables, then a non-neutral stochastic frontier, proposed in Huang and Liu (1994), is obtained. The technical inefficiency effect, U_{it}, in the stochastic frontier model (1) could be specified in equation (2),

$$U_{it} = Z_{it}\delta + W_{it} \qquad (2)$$

Where, the random variable, W_{it}, is defined by the truncation of the normal distribution with zero mean and variance, σ^2, such that the point of truncation is - $Z_{it}\delta$, i.e., $W_{it} \geq Z_{it}\delta$. These assumptions are consistent with U_{it} being a non-negative truncation of the $N\ (z_i, \delta, \sigma^2)$ distribution.

The assumption that the U_{it}s and the V_{it}s are independently distributed for all $t = (1, 2, \ldots, R)$ and $i = (1, 2, \ldots, N)$, *is* obviously a simplifying, but restrictive, condition. Alternative models are required to account for possible correlated structures of the technical inefficiency effects and the random errors in the frontier. The method of maximum likelihood is proposed for simultaneous estimation of the parameters of the stochastic frontier and the model for the technical inefficiency effects. The likelihood function and its partial derivatives with respect to the parameters of the model are presented in Battese and Coelli (1993). The likelihood function is expressed in terms of the variance parameters, $\sigma^2 s = \sigma^2 v + \sigma^2 \ and\ \gamma = \sigma^2 / \sigma^2 s$.

The technical efficiency of production for the *i*-th firm at the *t*-th observation is defined by equation (3),

$$TE_{it} = exp(-U_{it},) = exp(-Z_i\delta - W_{it}) \qquad (3)$$

The prediction of technical efficiencies is based on its conditional expectation, given the assumptions in the model.

2.2.3. Impact of Economic Reforms on Total Factor Productivity

Following recent developments in the measurement of productivity growth, a stochastic frontier production function is applied to decompose total factor productivity (TFP) growth in Indian manufacturing industries into technical progress, changes in technical efficiency and scale efficiency. In the "Solow" residual approach, technical progress is usually considered to be the unique source of TFP growth. Recent developments acknowledge that along with technical progress, changes in technical efficiency and scale efficiency can also contribute to productivity growth. Stochastic frontier models assume that firms do not fully utilize existing technology because of various non-price and organizational factors that lead to inevitable technical inefficiencies in production. Under these circumstances, TFP growth may arise from improvements in technical efficiency (TE) and scale efficiency without technical progress (TP). From a policy perspective, researchers acknowledge that the decomposition of TFP into efficiency changes, technical changes and change in scale efficiency provides useful information in productivity analysis. Policy makers can recommend policies that are more effective in improving the productivity of firms if they easily able to understand the sources of variation in productivity growth. For example, if low productivity growth results from slow TP, then a policy to induce technological innovation should be recommended to shift up the production frontier. If high rates of TP coexist with deteriorating TE, resulting in slow productivity growth, then a policy to increase the efficiency with which a known technology is applied is required, which might include improvements in learning-by-doing processes and in managerial practices.

Since Nishimizu and Page (1982) first proposed the decomposition of TFP into efficiency changes and technical changes, researchers have applied their approach to various datasets in order to investigate productivity growth.

This paper applies a stochastic frontier production model to decompose TFP growth in Indian manufacturing industries from 1980–2008. This paper decomposes TFP growth into three components: technical progress, changes in technical efficiency, changes, and scale effects. Despite an extensive literature on TFP growth in Indian manufacturing, very few studies have used a stochastic frontier production model to measure and decompose TFP growth. This study has attempted to decompose TFP growth in manufacturing industries using a stochastic frontier production model, and provides additional insights into understanding the recent debate on TFP growth. Previous studies on TFP growth in Indian manufacturing measured TFP as a residual of “Solow” growth accounting using aggregate data. Thus, these studies were not able to consider changes in technical inefficiency, scale efficiency which might have considerable effects on TFP growth. This study will enable us to examine each manufacturing industries individual TFP performance by using disaggregate level industry data that was largely ignored by most of the previous studies, which basically used aggregated data.

2.2.3.1 Empirical Analysis

To pursue the third objective, i.e., impact of economic reforms on manufacturing productivity, TFP is estimated from the same frontier production function model. Further, the estimated TFP is decomposed into its three components, i.e., technical progress (TP), technical efficiency change (TEC) and scale efficiency change (SEC) for measuring the source for the growth of productivity. Decomposition of TFP into its components gives a wholesome picture about the industrial performance than measurement of technical efficiency alone.

The components of productivity change can be estimated within a stochastic production frontier framework, and the time varying production frontier can be specified in Cob Douglas production form as

$$LnY = \beta_0 + \Sigma \beta_{ij}(lnX)_{ij} + v - u$$

Where *i*= (1, 2, 3… T), shows for the time period and *j*= (1, 2, 3… J), shows for number of industries. X is inputs that are used to produce *Y*. In our model *X*= (capital, labor and material input) and *Y*= output. The efficiency error, u, represents production loss due to firm specific technical efficiency and is assumed to be independent of statistical error, *v*, which is assumed to be $iid\ N\ (0, \sigma^2)$. To decompose the total factor productivity into TE, TP and SEC we have followed the method of Kumbhakar and Lovell (2000). This method has also been used by (Mahadevan 2001; Majumdar 1998; Kim and Srabanakumar 2012). The level of technical efficiency of industry *i* at time *t* (TE_{it}) is defined as the ratio of actual output to the potential output as

$$TE_{it} = exp(-u_{it})$$

The elasticity of output with respect to the *j*-th input is defined by

$\varepsilon_j = \partial ln\, f\ (x, t) / \partial ln\, x_j$, Where, j= labor, capital and material input. The elasticity of scale is defined as $RTS = \sum_j \varepsilon_j$, and RTS decreases, is constant and increases if $RTS < 1$, $RTS = 1$ and $RTS > 1$, respectively.

The rate of technological progress is defined by. $TP = \partial \ln f(x_{it,t}) / \partial t$, that is, technical change for the ith production unit can be calculated from the estimated parameters. However, if technical progress is non-neutral, then this technical change may vary for different input factors.

Hence following Coelli et al. (1998), we use the geometric mean between adjacent periods as proxy.

$$TP = \sqrt{[}\left(1 + \frac{\partial \ln f(x_{it,t}}{\partial t}\right) * \left(1 + \frac{\partial \ln f(x_{i,t+1,t+1}}{\partial t + 1}\right)]$$

2.2.3.2 Decomposition of TFP:

For the first time, Kumbhakar (2000) addressed the estimation of TFP change using micro panel data in a parametric framework. Before that, Solow (1957) measure of productivity change, and the index number analysis approach, was widely used for measuring TFP. This approach was nothing but the index of technical change when the constant return to scale (CRS) production technology and perfect efficiency are assumed. If efficiency change is omitted from the analysis, its omission will lead to an overstatement of the unexplained residual. Kumbhakar (2000) focuses on the parametric econometric modeling of production systems and estimation of TFP changes from the empirical production function. Furthermore, TFP change is decomposed into technical change, scale economies, technical and allocative- inefficiency components. The same methodology has been applied in our study for the manufacturing industries.

Output growth overtime is usually attributed to growth in inputs and improvement in TFP. While measuring the sources of output growth, the contribution of TFP is always estimated as a residual, after accounting for the growth of inputs. If the industries operate on their production frontier producing the maximum possible output or realizing the full potential of the technology, then implies that improvement of productivity arises from technological progress. Operation on the frontier can be achieved if industries follow the best practice methods of application of technology commonly referred as technical efficiency. Productivity improvements can be achieved in two ways: one can either improve the state of technology by innovation, which is commonly, referred as technological progress or alternatively, one can implement procedures, such as improved workers' education to ensure workers use the existing technology more efficiently, known as technical efficiency. Thus, the decomposition of TFP can be introduced in the production function,

$$y_{it} = f(x_{it}, t)\exp(-u_{it}) \qquad (1)$$

where y_{it} is the output of the i th firm $i = (1,2,3, \ldots \ldots N)$ in t th time period $t = (1,2,3, \ldots .., T)$; f (.) is the production frontier; x is a input vector; t is a time trend index that serves as a proxy of technical change; and $u \geq 0$ is the output oriented technical inefficiency. Notice the technical efficiency in equation (1) varies over time.

The production frontier f (.), is totally differentiated with respect to time to get,

$$\frac{dln\, f(x,t)}{dt} = \frac{\partial ln\, f(x,t)}{\partial t} + \sum_j \frac{\partial ln\, f(x,t)}{\partial x_j}\frac{dx_j}{dt} \qquad (2)$$

The first and second terms of the right hand side of equation (2) measure the change in frontier output caused by TP and by change in input use, respectively. From the output elasticity of input, $\varepsilon_j = (\partial\, ln\, f\, /\, \partial ln x_j)$, the second term can be expressed as $\sum_j \varepsilon_j\, \dot{x}_j$, where dot over a variable indicates rate of change. Thus equation (2) is rewritten as,

$$\frac{d\ln f(x,t)}{dt} = TP + \sum_j \varepsilon_j \;\; \dot{x}_j \qquad (3)$$

Total differentiating the logarithm of y in equation (1) with respect to time and using equation (3), the change in production can be represented as

$$\dot{y} = \frac{d\ln f(\dot{x},t)}{dt} - \frac{du}{dt} = TP + \sum_j \varepsilon_j \;\; \dot{x}_j - \frac{du}{dt} \qquad (4)$$

The overall productivity change is not only affect by technical progress (TP) and change in input use, but also by change in technical efficiency. Technical progress (TP) is positive (negative) if the exogenous technical change shifts the production frontier upward (downward), for a given level of inputs. If $-du/dt$ can be interpreted as the rate at which an inefficient producer catches up to the production frontier.

To examine the effect of TP and change in efficiency on TFP growth, $T\dot{F}P$ is defined as output growth unexplained by input growth:

$$T\dot{FP} = \dot{y} - \sum_j s_j \, \dot{x}_J \qquad (5)$$

Where, S_j, is the input j's share in production cost. By substituting equation (4) in equation (5), equation (5) is rewritten as

$$\dot{TFP} = TP - \frac{du}{dt} + \sum_j (\varepsilon_j - s_j \dot{x}_j$$

$$= TP - \frac{du}{dt} + (RTS - 1) \sum_j \lambda_j \, \dot{x}_j + \sum_j (\lambda_j - s_j) \, \dot{x}_j \qquad (6)$$

Where, RTS $(= \Sigma_j \, \varepsilon_j)$ denotes the measurement of returns to scale, and $\lambda_j = f_j \, x_j / \sum_j / \sum_t \varepsilon_t = \varepsilon_j / RTS$. The last component in equation (6) measures inefficiency in resource allocation resulting from derivation of input prices from the value of their marginal product. Thus, in equation (6), TFP growth can be decomposed into TP, the technical efficiency change (TEC) which is $(= -du/dt)$, scale components $(SCE = (RTS - 1) \, \Sigma_j \lambda_j \, \dot{x}_j)$, and the allocative efficiency change $(AE = \Sigma_j (\lambda_j - S_j) \, \dot{x}_j)$, the decomposition formula in equation (6) is drawn from Kumbhakar (2000). If technical inefficiency does not exist or is time-invariant, the above decomposition implies that technical inefficiency does not affect TFP growth, as in the Solow residual approach. If technology exhibits constant returns to scale, the TFP growth formula in equation (6) is identical to the formula that was derived by Nishimizu and Page (1982).

2.3. Data Sources

In order to examine the threefold objective of the study, data are drawn from the Annual survey of industries (ASI) published by Central Statistical Organization (CSO). The ASI data covers all factories employing 10 or more workers and using power, and those employing 20 or more workers but not using power on any day of the preceding 12 months, which are required to be registered under sections 2m(i) and 2m(ii) of the Factories Act 1948. We have used the 2-digit level data from the Annual Survey of Industries (ASI). The time period covers from 1980-2007. The EPWRF has published an electronic database collecting from the ASI up to the period 2002-03. The data for the period after 2002-03 are collected from Annual Series, published by the ASI for every year on the basis of National Industrial Code (NIC) 1998. The sample includes production units from the 14 largest Indian states.

There are many reasons for restricting ourselves to these states. First, these states have existed for the entire period of the data without any change in their geographical area or administrative setup. Second, around 95% of the Indian population resides in these states. Third, more than 90% of all factories are located in these 14 states. Data have been drawn on the following variables: gross output, net value added, employment, fixed capital stock, depreciation, and value of material input and gross value added.

2.3.1 Construction of Variables

Real gross output and real gross value added have been obtained by deflating the nominal figures by the wholesale price index for manufactured products (base 1993-94). Total number of persons engaged has been taken as the measure of labor input.

Net fixed capital stock at constant prices has been taken as the measure of capital input. The construction of the net fixed capital stock series has been done by the Perpetual Inventory method. This method has been followed from the study of Goldar and Kumari (1990). The steps in the construction of fixed capital series are as follows. (1) Implicit deflator for gross fixed capital formation for registered manufacturing is derived from the data on gross fixed capital formation in registered manufacturing at current and constant prices given in the *National Accounts Statistics* (NAS). The deflator series is constructed for the period 1980-81 to 2007-08. The base is shifted to 1993-94 so as to be consistent with the price series used for intermediate inputs and output. (2) From ASI data, gross investment in fixed capital in manufacturing is computed for each year by subtracting book value of fixed assets in the previous year from that in the current year and adding to that figure the reported depreciation in fixed assets in the current year. The rate of discarding has been taken as 2.6 per cent per annum based on some estimates available from a study of Chaturvedi and Baghchi (1985).

The reported series on materials has been deflated to obtain materials input at constant prices. Following a common practice among productivity studies, (Mitra (2002); Balakrishnan and Pushpangadan (1994)) a deflator for materials has been constructed with the help of an input-output table. The deflator is formed as a weighted average of price indices for various input-output sectors (for each sector, the best price series available from the official series on wholesale price indices has been used). The 1993-94 input-output table prepared by the CSO has been used for this purpose. The columns in the absorption matrix for 66 sectors belonging to manufacturing have been added together. The sum of the columns so obtained gives the purchases of materials made by manufacturing industries from various sectors including supplies made by one industry to another as well as intra-industry transactions. This information is used to construct the weights.

****

CHAPTER-III

Performance of the Indian Manufacturing Sector

3.1. Introduction

In the first chapter we set the background of the study placing debate on occurrence of economic reforms in India, followed by literature on impact of economic reforms on growth, productivity and efficiency of Indian industries- all of which helped us to set forth the objectives of our study. Before proceeding to examine the three objectives, we need to understand the role of manufacturing sector on the overall growth of an economy and what happened to Indian manufacturing sector after the independence of our country. In this chapter, we begin by a general discussion on the role of manufacturing sector on economic growth, followed by its importance. Then, we proceed to the analysis of structural change and the distribution of industries in the country as a whole as well as across the states, following the process of economic reforms.

3.2. Role of Manufacturing Sector on Economic Growth

The economic activities of a country can be divided into three sectors, primary, secondary and tertiary. The development of all these sectors is essential for the attainment of higher level of economic development. But among these, the development of manufacturing sector has been mentioned as the most crucial determinant for the overall development of the country. There is a well defined statistical relation between the growth of manufacturing and growth of GDP. Empirically, it has been the fast growing economies tend to have a relatively rapid manufacturing growth and, conversely, slowing growing economies tends to have a slow growth of manufacturing sector. The relationship is not found for agriculture. Service sector on the other hand, do tend to grow in line with national income, but its role has been seen as a passive in responding to growth in productive activities of a country (Weiss 2002).

There should be some criteria for considering production of manufacturing sector as more valuable in economic terms as compared to the production of other sectors. The economic theory suggest that the production of any one sector can be referred as more valuable in economic terms than the production of other sector only if it satisfies following two conditions. It should generate externalities and it should have the potential of long run productivity growth.

The term externality was popularized by Rosenstein Rodan. He used this concept to explain the theory of big push. Externality simply denoted the effects created by individual producer that were felt elsewhere in the country. The externalities can be divided into two groups, technological externalities and pecuniary externalities. The technological externalities are also known as real externalities. These are the direct external effect that does not arise as a result of market transaction, for which prices are charged. Knowledge transfer and improvement in the skill of labor are the leading example of technological externalities. Against these, pecuniary externalities operate through market mechanism, so that their effects are manifested in price term. The central importance of both types of externalities is that where the net benefits accounted from these two exceed the benefits received by the private producer. These both kinds of externalities are realized in manufacturing sector.

The second important quality that a sector must have to be entitling as the engine of growth is the applicability of the dynamic increasing return to scale. The dynamic increasing returns to scale ensure the long run productivity growth, which is an essential ingredient of sustainable development. Now, if we go through the economic literature, then we will find that all most all the economist agree that manufacturing is the only sector that enjoy the increasing return to scale in the long run. But this is not enough to entitle it as an engine of growth. For this, the applicability of dynamic increasing return to scale is required. The dynamic increasing return to scale means the cumulative relation between the growth of output and growth of productivity. And manufacturing sector is the only sector that ensures the applicability of increasing return to scale because it has the highest potential of technological adoption and modification, learning by doing and specialization.

In sum we can say that manufacturing sector has all the essential qualities, which a sector must have to be entitled with as an engine of growth. It means that the development of manufacturing sector is an essential prerequisite for the attainment of the higher level of economic development of the economy. In the next section, we present the share of output of different state in total output of manufacturing sector in India.

In order to track the changes in industrial performance during both pre and post reforms periods and identifying the year of such changes for different states, we begin by looking at the share of output of manufacturing industries for different states during the pre and post-reform period.

3.3. Share of Output at the State Level

Here we have analyzed the manufacturing output data of various states during both pre- and post- reform period for each of these manufacturing industries. From table 2.1, it confirms that some significant changes had taken place in food industry from the pre-to the post-reform period. The most notable changes occurred in Punjab and Madhya Pradesh, where we see a decline in Punjab's share by 3.45 percent and a rise in Madhya Pradesh share by 3.5 percent. Maharashtra is the biggest contributor to food industry among all of the states, but it has also lost its share around 1.2 percent. Next to Punjab, Andhra Pradesh is the second best performing state in contributing output to food industry. If we shift our focus to beverage industry, the biggest contributor to its output is Andhra Pradesh, which is contributing around 19 percent of the whole share of its output. But its share has declined during the post reform period, from 23 percent to 16 percent. The next worst performed state is Madhya Pradesh, who lost its share by 6 percent during the deregulation and liberalized era. State like Karnataka is the sole gainer among all these states. Less developed states like Bihar, Orissa, Rajasthan, have lost their share slightly in the post reform period.

In cotton and jute industries, the share of all the states has gone down, except Tamilnadu, Rajasthan and Madhya Pradesh. Other states have not done well in this industry, may be due to increase in foreign competition through opening up trade, or due to lack of institutional support. If we analyses rest of these industries by clubbing together, the winner states are Maharashtra (in wood and wood product industries), Haryana (in textile industries, basic metal and other manufacturing industries). It contributes significantly to the share of total output of these industries. Rajasthan has a better advantage in metallic product industries where as Gujarat in basic metal industries. West Bengal of course, is the most notable looser state, with loses almost in every industries, especially in transport industry and other manufacturing industries. The other significant declining states include Maharashtra, Uttar Pradesh and Tamilnadu. If we see the table 2.1 very carefully, one of the interesting points could be noted here is that, after the reforms most of these industries have not done well as they were expected. Whether it is due to the decline in efficiency level of these industries after reforms is the reason behind it or not, we will test this hypothesis in our next chapters.

Table- 3.1: Share of Output of Different Manufacturing Industries during both Pre and Post Reform Period at State Level

(Figures are in percentage)

States	food and food products			beverage and tobacco			cotton, jute and fiber textiles		
	Whole period	Whole period	post reform	Whole period	pre reform	post reform	Whole period	pre reform	post reform
Andhra	12.73	10.97	13.36	18.93	23.35	16.83	4.39	4.50	4.34
Bihar	1.11	1.48	0.97	3.40	4.45	2.91	0.18	0.31	0.11
Gujurat	10.82	10.52	10.93	3.98	4.58	3.70	19.38	19.89	19.13
Haryana	3.61	3.48	3.66	2.18	1.79	2.37	2.49	2.66	2.40
Karnatak	5.60	5.45	5.65	11.50	8.28	13.03	2.70	2.77	2.67
Keral	3.67	3.58	3.71	2.46	3.12	2.15	1.21	1.21	1.21
MP	7.56	4.98	8.49	6.20	10.20	4.31	5.31	4.23	5.83
Maharastra	18.06	18.87	17.76	14.90	14.21	15.23	16.41	19.60	14.87
Orissa	1.05	0.87	1.12	0.74	0.71	0.76	0.28	0.56	0.15
Punjab	5.71	8.24	4.79	4.97	4.20	5.34	6.70	6.94	6.58
Rajasthan	3.03	2.63	3.17	2.34	1.12	2.91	8.58	7.37	9.16
Tamilnadu	8.69	9.18	8.52	7.11	7.07	7.13	20.64	15.74	22.98
UP	13.55	14.38	13.26	14.84	12.68	15.86	4.05	5.36	3.42
WB	4.81	5.35	4.61	6.43	4.24	7.47	7.70	8.86	7.15
India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Continued….

States	textile products(apparel)			wood and wood products			paper and paper products		
	Whole period	pre reform	post reform	Whole period	pre reform	post reform	Whole period	pre reform	post reform
Andhra	1.53	1.16	1.58	5.05	4.74	5.15	10.05	9.78	10.20
Bihar	0.05	0.12	0.04	1.93	3.98	1.23	1.03	1.63	0.71
Gujarat	5.07	7.24	4.76	8.04	7.21	8.33	9.38	7.93	10.13
Haryana	9.06	1.78	10.10	5.09	4.09	5.43	3.78	5.55	2.87
Karnataka	12.06	7.13	12.77	9.64	13.35	8.38	7.26	8.30	6.73
Kerala	1.63	3.63	1.34	7.75	14.27	5.53	4.10	4.42	3.94
MP	0.54	0.53	0.54	3.60	7.74	2.19	3.53	5.08	2.72
Maharashtra	15.56	29.00	13.64	20.70	13.59	23.13	22.82	22.28	23.10
Orissa	0.13	0.18	0.12	3.28	5.42	2.55	2.83	3.77	2.33
Punjab	7.31	14.31	6.31	1.44	1.29	1.50	3.58	2.29	4.25
Rajasthan	2.96	2.31	3.05	2.34	0.62	2.92	1.00	0.73	1.14
Tamilnadu	31.13	20.47	32.65	12.17	6.93	13.96	12.74	13.36	12.42
UP	8.52	7.44	8.67	9.17	6.11	10.21	11.72	8.31	13.50
WB	4.45	4.70	4.42	9.79	10.64	9.50	6.18	6.57	5.98
India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

States	leather and leather products			chemical products			rubber and plastic products		
	Whole period	pre reform	post reform	Whole period	pre reform	post reform	Whole period	pre reform	post reform
Andhra	1.25	2.50	0.85	6.20	5.02	6.59	6.58	4.64	6.96
Bihar	1.04	2.23	0.65	0.88	1.90	0.54	5.38	8.93	4.68
Gujarat	2.43	0.55	3.04	30.41	23.10	32.84	26.00	13.79	28.41
Haryana	5.16	1.75	6.27	1.49	1.75	1.40	1.11	1.73	0.99
Karnataka	4.29	3.45	4.56	3.33	2.68	3.55	4.99	1.37	5.71
Kerala	2.25	0.04	2.96	3.25	3.33	3.22	6.51	8.32	6.16
MP	3.49	3.76	3.41	3.26	3.58	3.16	1.49	0.83	1.62
Maharashtra	2.96	4.26	2.53	25.85	30.96	24.15	24.30	26.57	23.86
Orissa	0.03	0.06	0.02	1.25	1.38	1.21	0.59	0.43	0.62
Punjab	2.39	1.89	2.56	2.30	2.99	2.07	0.84	1.29	0.75
Rajasthan	1.11	0.40	1.35	2.82	2.33	2.98	1.32	1.40	1.30
Tamilnadu	42.92	51.51	40.12	7.28	8.88	6.75	9.29	12.46	8.66
UP	18.04	14.62	19.15	7.18	7.41	7.10	6.37	10.19	5.62
WB	12.64	12.98	12.53	4.50	4.70	4.44	5.21	8.06	4.66
India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Continued.....

States	non metallic products			basic metal and alloys			machinery products		
	Whole period	pre reform	post reform	Whole period	pre reform	post reform	Whole period	pre reform	post reform
Andhra	12.22	10.81	12.72	6.19	4.34	6.91	6.10	6.63	5.92
Bihar	3.96	5.65	3.36	14.23	18.42	12.61	1.26	2.22	0.95
Gujarat	12.11	9.52	13.03	8.36	5.29	9.56	9.68	8.85	9.95
Haryana	2.56	3.49	2.22	4.00	3.50	4.19	6.23	5.80	6.37
Karnataka	6.66	6.90	6.57	4.58	3.53	4.99	9.43	8.20	9.83
Kerala	1.52	1.79	1.42	0.77	0.69	0.80	1.10	1.49	0.97
MP	14.38	15.67	13.93	12.18	11.85	12.31	3.70	4.10	3.56
Maharashtra	10.02	11.48	9.50	15.74	14.66	16.16	27.44	27.59	27.39
Orissa	3.77	4.91	3.37	7.23	7.98	6.94	0.54	0.63	0.51
Punjab	1.19	0.28	1.51	3.97	5.40	3.41	3.29	3.59	3.20
Rajasthan	11.76	8.30	12.99	2.77	2.83	2.74	2.24	2.15	2.27
Tamilnadu	10.37	11.51	9.96	5.13	4.38	5.43	11.38	11.66	11.29
UP	5.75	6.44	5.50	6.24	6.50	6.14	11.79	9.47	12.56
WB	3.75	3.25	3.92	8.60	10.62	7.82	5.83	7.62	5.24
India	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

States	transport equipment			other machineries		
	Whole period	pre reform	post reform	Whole period	pre reform	post reform
Andhra	1.34	1.79	1.24	1.82	3.38	1.66
Bihar	4.96	8.65	4.09	0.05	0.35	0.02
Gujarat	3.33	2.37	3.56	10.39	8.04	10.63
Haryana	16.57	10.37	18.03	14.07	3.46	15.16
Karnataka	5.38	3.84	5.74	11.19	11.12	11.20
Kerala	0.43	0.63	0.38	0.81	2.98	0.59
MP	2.19	1.92	2.25	0.32	0.38	0.32
Maharashtra	32.32	31.24	32.58	37.21	35.99	37.34
Orissa	0.06	0.20	0.03	0.01	0.14	0.00
Punjab	4.86	7.54	4.23	1.06	2.61	0.90
Rajasthan	1.26	1.58	1.18	3.06	2.16	3.15
Tamilnadu	16.38	16.06	16.45	11.64	10.05	11.80
UP	6.56	5.92	6.72	5.31	9.20	4.92
WB	4.36	7.89	3.52	3.04	10.13	2.31
India	100.00	100.00	100.00	100.00	100.00	100.00

Source: calculation is based on ASI data.

3.4. Growth and Structural Change

To look into the industrial performance and its change in different states after and before reforms, we use Lee and Strazicich (2003) test to check the breaks in three variables, investment, output and wages. The methodology of this break test has been already discussed in the chapter-II. The result reveals different years of occurrence of such changes for different states. Then, we divide the sample for each state according to the year of changes and compute the trend for each sub-period. The result for each variable is analyzed as follows:

3.4.1 Investment

The growth trend of investment is analyzed for the whole sample period as well as for the two sub periods identified for each state according to the structural change /breaks for the different industrial variables like, investment, output and wage.

The trend for the whole sample period shows that growth rate has been varying across states. The variation is more clearly seen when we use structural breaks. It shows different periods of change for different states. While for states like Andhra Pradesh, Karnataka, Gujarat and Kerala have an early change in the pattern of investment is observed, where as for the rest of the states, the change seem to be occurring very late.

In order to understand the nature of structural change in investment, we also divide the whole sample period according to the breaks and compute trend growth for all states. On the basis of the trend in full and sub periods we classify the states as (i) reform oriented states, (ii) intermediate reformer states and (iii) lagging reformer states. This classification is followed from the work done by Bajpai and Sachs (1999).

States like Gujarat, Haryana, Tamilnadu and Uttar Pradesh have done extremely well for the whole time period of 1980-2007. The compound growth rate of investment for both Gujarat and Haryana is around 10 percent where as Tamilnadu, Andhra Pradesh, Maharashtra and Punjab have managed to keep their growth rate around 7 percent. The biggest looser states are Karnataka, west Bengal, Bihar and Kerala. These states didn't do well for the whole time period. The structural break respective to each states in the following table explains about sudden change in the structure of the growth of investment. It is quite clearly evident from the table that during the period of complete break the change in growth of investment is relatively bigger in compare to the partial break.

Several possible determinants of private investment have been identified in the literature, like availability of physical infrastructure, developed transport system, easily access to market, supply of financial assistance by the local institution and no local disturbance. , increase in the share of profit during this period, declining share of depreciation, issue of new capital in the stock market by the non-government private companies. To the extent these factors vary across states, the investment is also expected to vary. Bhattacharya et al. (2004) and Ahluwalia (2000) argued that the decontrol of investment licensing is the cause of inequality in the allocation of private investment in the post reform periods.

Ferro et al. (2004) argued that states and centre provide various types of incentives to attract private investment through Special Economic Zone (SEZ), Export Oriented Units (EOUs), Software Technology Park (STP), Industrial Growth Centers, Electronic Hardware Technology Parks (EHTP) and Free Trade & Warehousing Zones (FTWZs) etc. The incentives are in the areas of labor laws, environmental protection, taxation and administrative approvals and available in incentive packages as well as in special deals.

Though the federal system in India forces all the states to face certain common macroeconomic policies such as monetary policy and trade policy, but still states have extensive control over local administrative regulations, provisioning of infrastructure, state taxation, and provision of basic social services such as health and education and different states have different socio economic conditions. To the extent the states vary in these aspects, the impact of economic reform will also vary across states; since, these things are the very precondition for the economic reform to have its impacts.

3.4.2 Output

The main motive behind calculating the structural break for the 14 major industrial states of India is to check the impact of economic reforms on the growth structure of manufacturing output. As with investment, different periods of occurrence of structural changes in output are observed in different states. Accordingly, we divide the states into

(i) Early structural break states

(ii) Later structural break.

On the basis of structural break, states like Haryana, Tamilnadu, Rajasthan, Gujarat and Maharashtra are coming under the early structural break states where as the remaining states are grouped under the later structural break states for manufacturing output. The total time period has been divided into three sub periods i.e. starting period to the first break, period between the two breaks and second break to the last period. If we analyses the table very the table very closely, states like Karnataka, Gujarat, Rajasthan and Andhra Pradesh had grown at a very good rate where as states like west Bengal, Punjab, Bihar and Kerala had a minimal growth rate. Most of the states had accelerated their growth rate after their second structural break, which was around 2002-03 year for most of the states. In literature there is debate over the inequality in growth of manufacturing output for different states of India and the forces that are working behind it.

Bakert et al. (2005) in his cross country analysis argued that institutional quality, contract enforceability and protection of property are major determinants of inequality in the growth of manufacturing output. Gupta and Yuan (2009), explained that due to different competitive environment and the difference in entry barriers among the cross sectional units are reasons for different in growth structure. According to Gupta, (2011) increased amount of contract workers could be one of the reasons for this inequality among these states. As we know that contract labors are not unionized, so they have less bargaining position relative to the employees. The number of strikes, disputes and shut down of factories will be very less, so indirectly it helps to increase the industrial output. We could say that states using more amount of contract labor might have performed better in industrial output than others. Besides that the variations in the amount of foreign direct investment inflows and the level of technology also accounting inequality in the growth of manufacturing output. We can conclude here by saying that these are the forces which might be working for the inequality in manufacturing output among these 14 major industrial states of India.

3.4.3 Wage

Here, in our analysis, we are trying to observe the growth trend of industrial wages among different states of India for whole time period of 1980-2007 and the reasons for inequality in the growth of industrial wages of various cross sectional unit across India. The data of wages has been collected from annual survey of industries for all the major 14 industrial states of India. Structural break in industrial wages has been calculated for each of these states. The result from the following table states that structural break varies differently for different states. If we closely look at the table on wages of different states, the growth rate of wages across states didn’t vary much as compared to output and investment. The highest growth in industrial wages was occurred in Haryana (around 5 percent) where as it came to negative for Bihar and west Bengal. Most of the states did well in their first phases of growth (from period one to first break) in compare to the second one. As in the second phase the growth of industrial wages become negative for most of the states. The situation had changed in the last phases of growth (from break two to last period), where most of the states performed well in compare to the other phases. Growth rate of Bihar was outstanding (16 percent), but the worst performed state was west Bengal whose growth rate remain same i.e. negative, in all the three phases of structural break.

Though all the states are following the same fiscal and monetary policy in their economic decision process, still the economic variables will not move at the same rate for each different state. The reason is very simple, because these states have different cultural, social, geographical, political and environmental structure which affect the decision making process of a firm at a lager extent. Besides this, factor like bargaining strength of labor with the existence of labor union has determining the wages of industrial worker in a larger extent. And also other factors like future expectation of price changes; technical knowhow skill of workers and well organized labor markets affect the wage rate of a particular state very much. Besides that, demand for and supply of labor is one of the determinants of wages in manufacturing sector. Sometimes asymmetric information regarding labor market creates wage differential in different region. So, we can conclude here by saying that these factors may work differently in different states could be the reasons for inequality in growth of industrial wages across states in India.

Table-3.2: State Wise Structural Break in Manufacturing Output, Wage and Investment

Structural Break in State wise manufacturing Output, Wage and Investment in INDIA						
	Output		Wage		Investment	
State	**Break 1**	**Break 2**	**Break 1**	**Break 2**	**Break 1**	**Break 2**
Andhra Pradesh	**1993-94**	**2003-04***	**1989-90***	**2004-05(-)**	**1989-90***	**1994-95**
Bihar	**1991-92**	**2002-03***	**1999-00(-)**	**2004-05***	**1993-94(-)**	**1998-99***
Gujurat	**1992-93**	**1998-99***	**1995-96(-)**	**2001-02***	**1993-94**	**2002-03***
Haryana	**1990-91***	**1996-97**	**1993-94**	**2002-03***	**1997-98**	**2001-02**
Karnatak	**1997-98**	**2004-05***	**1998-99**	**2004-05*(-)**	**1990-91***	**1998-99**
Keral	**1989-90**	**1995-96***	**1992-93***	**2000-01**	**1990-91***	**1997-98**
Madhya Pradesh	**1996-97**	**2003-04***	**1993-94**	**2001-02***	**1991-92**	**2000-01**
Maharastra	**1994-95**	**2002-03***	**1993-94*(-)**	**2000-01**	**1996-97*(-)**	**1998-99**
Orissa	**1989-90**	**1996-97***	**1992-93**	**2000-01***	**1993-94(-)**	**2003-04***
Punjab	**1996-97**	**2002-03***	**1990-91**	**1999-00***	**1998-99(-)**	**2001-02***
Rajasthan	**1991-92***	**1999-00**	**1992-93**	**2001-02***	**1993-94(-)**	**2001-02***
Tamilnadu	**1992-93**	**1999-00***	**1997-98(-)**	**2004-05***	**1993-94(-)**	**2002-03***
Uttarparadesh	**1989-90**	**1997-98***	**1993-94(-)**	**2001-02***	**1997-98(-)**	**2003-04***
West Bengal	**1994-95**	**2000-01***	**1993-94*(-)**	**2001-02(-)**	**1989-90(-)**	**1999-00***

Note: This is based on Lee and Strazicich (2003) break test. Sign in the parenthesis indicates the direction of shift.

(+) indicates positive shift and (-) indicates negative shift. (*) indicates the major trend among these two.

Source: same as in table 3.1.

Table- 3.3: Annual Compound Growth Rate of Output, Wage and Investment of Different States on the Basis of Structural Breaks

State wise Compound annual growth rate of wage					
		wage			
State	**Structural break**	Whole period	Up to 1st break	between the break	from 2nd break to last period
Andhra Pradesh	1989-90, 2004-05	3.13	5.47	2.54	-1.79
Bihar	1999-00, 2004-05	-0.34	1.55	-2.25	16.26
Gujurat	1995-96, 2001-02	1.82	1.74	-2.19	7.96
Haryana	1993-94, 2002-03	5.33	5.05	2.63	9.99
Karnatak	1998-99, 2004-05	2.97	4.23	1.89	-5.47
Keral	1992-93, 2000-01	3.01	3.34	9.52	1.20
Madhya Pradesh	1993-94, 2001-02	1.46	1.78	0.53	4.67
Maharastra	1993-94, 2000-01	0.65	2.62	-2.73	2.42
Orissa	1992-93, 2000-01	2.79	3.46	1.67	6.14
Punjab	1990-91, 1999-00	3.97	7.68	1.01	6.17
Rajasthan	1992-93, 2001-02	2.78	4.47	0.65	5.21
Tamilnadu	1997-98, 2004-05	3.03	4.35	-2.63	9.61
Uttarparadesh	1993-94, 2001-02	1.65	3.73	-2.73	7.72
West Bengal	1993-94, 2001-02	-1.48	-1.05	-2.62	-2.09
India	1993-94, 1998-99	1.65	2.66	0.14	1.24

Continued….

.

State wise Compound annual growth rate of output					
		Output			
STATE	structural break	Whole period	Up to 1st break	between the break	from 2nd break to last period
AP	1993-94, 2003-04	8.93	9.43	7.39	17.17
BIH	1991-92, 2002-03	4.30	5.67	3.02	19.92
GUJ	1992-93, 1998-99	9.68	6.34	12.71	12.94
HAR	1990-91, 1996-97	9.96	9.69	12.29	10.44
KAR	1997-98, 2004-05	10.08	9.38	11.05	16.77
KER	1989-90, 1995-96	6.93	5.05	3.88	6.86
MP	1996-97, 2003-04	8.42	10.22	4.19	15.80
MAH	1994-95, 2002-03	7.48	6.65	4.94	14.59
ORI	1989-90. 1996-97	7.28	11.09	4.40	11.05
PUN	1996-97, 2002-03	5.21	8.39	3.34	12.46
RAJ	1991-92, 1999-00	8.78	10.47	9.26	8.68
TAM	1992-93, 1999-00	7.83	7.31	7.52	10.88
UP	1989-90, 1997-98	8.24	11.78	6.49	10.05
WB	1994-95, 2000-01	5.21	2.09	4.77	9.32
IND	1991-92, 1999-00	7.95	7.40	7.62	11.98

State wise Compound annual growth rate of Investment					
		investment			
STATE	structural break	Whole period	Up to 1st break	between the break	from 2nd break to last period
AP	1989-90, 1994-95	7.38	7.43	10.74	6.72
BIH	1993-94, 1998-99	3.29	6.50	-0.46	7.64
GUJ	1993-94, 2002-03	10.02	8.66	5.06	27.90
HAR	1997-98, 2001-02	10.69	12.50	6.39	17.53
KAR	1990-91, 1998-99	0.79	0.47	2.77	0.29
KER	190-91, 1997-98	3.75	2.56	10.10	1.12
MP	1991-92, 2000-01	4.56	0.52	-2.46	15.42
MAH	1996-97, 2001-02	7.05	11.73	-31.90	11.22
ORI	1993-94, 2003-04	6.38	13.49	-9.38	86.83
PUN	1998-99, 2001-02	7.10	8.84	-8.32	22.03
RAJ	1993-94, 2001-02	6.13	9.32	-3.36	22.92
TAM	1993-94, 2002-03	8.29	10.46	-3.75	20.94
UP	1997-98, 2003-04	8.38	13.39	-9.13	32.28
WB	1989-90, 1999-00	3.68	4.85	-11.55	22.31
IND	1991-92, 1999-00	7.51	8.41	1.21	15.99

Note: All the figures are in percentage.
Source: same as in table 3.1

3.5. Geographical Distribution

In order to have a clearer picture of the variation of industrial performance across states, we look at the geographical distribution of investment and labor productivity of manufacturing sector. Here we have not taken output and wage variable, because they mostly depend on the number of factories that are operating in the states and will not explain the reasons of distribution. In this section we have explained the geographical distribution of Investment, labor productivity, capital-output ratio and capital productivity of manufacturing sector in India during pre and post liberalization period. The year 1984-85 is representing the pre liberalization era where as year 2007-08 is explain the economic scenario of post liberalization era.

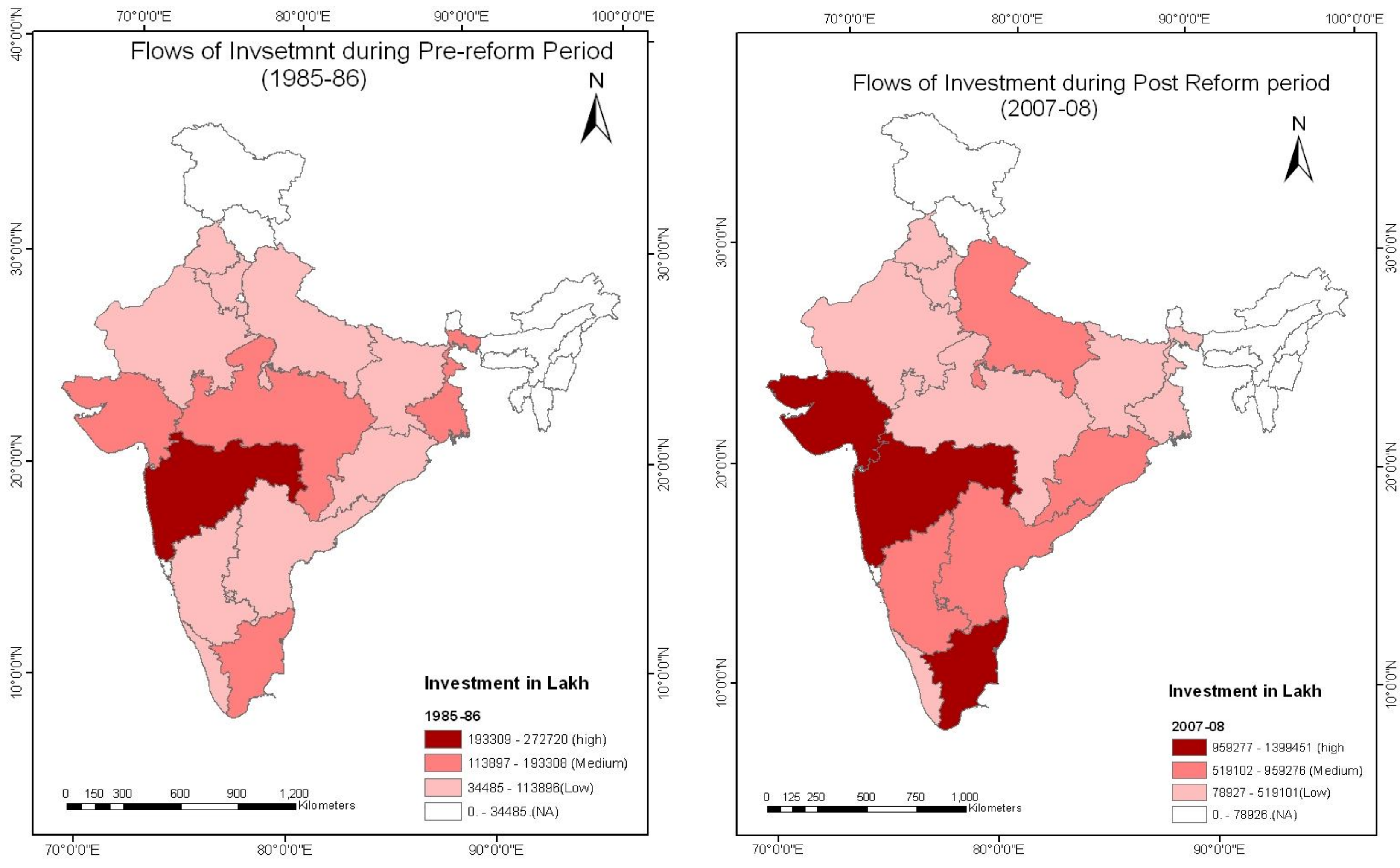
3.5.1. Investment

Before the economic reforms, Maharashtra was attracting more public and private investment in compare to other states. It is one of the major contributing states to the share of industrial output in India. Mumbai, the capital is regarded as hub of financial and business activity of the country. Power, transport and communication are the major determinants of attracting investment, was already presented there during the pre reforms period. Next to Maharashtra, the well performed states in terms of contributing total investment to manufacturing sector are Gujarat, Madhya Pradesh, Tamilnadu and west Bengal. Except Madhya Pradesh, the rest of the three states are coastal states of India. As we know transport facility is one of the necessary conditions to attract public as well as private investment. So it could be one of the reasons for these states to perform well in terms of investment, before the liberalized era. The rest of the states are coming under the low category, as they could not perform well. The reasons are may be due to lack of physical infrastructure, in availability of market, inadequate human capital, lack in supply of financial assistance and presence of social disturbance.

If we look the post reform era, both Tamilnadu and Gujarat did well along with Maharashtra. The reasons behind improvement in performance of Gujarat are due to (i) reforms in its state owned enterprises through privatization, closure, merger and restructuring, (ii) fiscal reform that consist of measure, which is aiming towards to reduce the fiscal deficit, including tax and expenditure reforms (iii) creating a policy environment for private sector. Similarly the government of Tamilnadu has taken some important step to boost its investment like; it has focused more on strengthening its industrial and social infrastructure.

The state government has given the single window operating system to the chief executives of various industrial complex, growth centers and industrial estate to grant clearance regarding establishment of new industries (Bajpai and Sachs 1999). The medium performed states are Uttar Pradesh, west Bengal, Orissa and Karnataka. Though Orissa is concerned as one of the less developed state in India still, it has been the leader in power sector reforms at the all India level. Keeping in view the policy of the other state government to attract private entrepreneurs, Orissa government has worked out an innovative policy to provide basic infrastructure project to these entrepreneurs for its development. The lower performed state have not done well after the economic reforms because most of them are land locked state their by reducing their ability to attract foreign investment.

Figure 3.1: Geographical Distribution of Investment during Pre and Post Reform Period



3.5.2. Labor Productivity

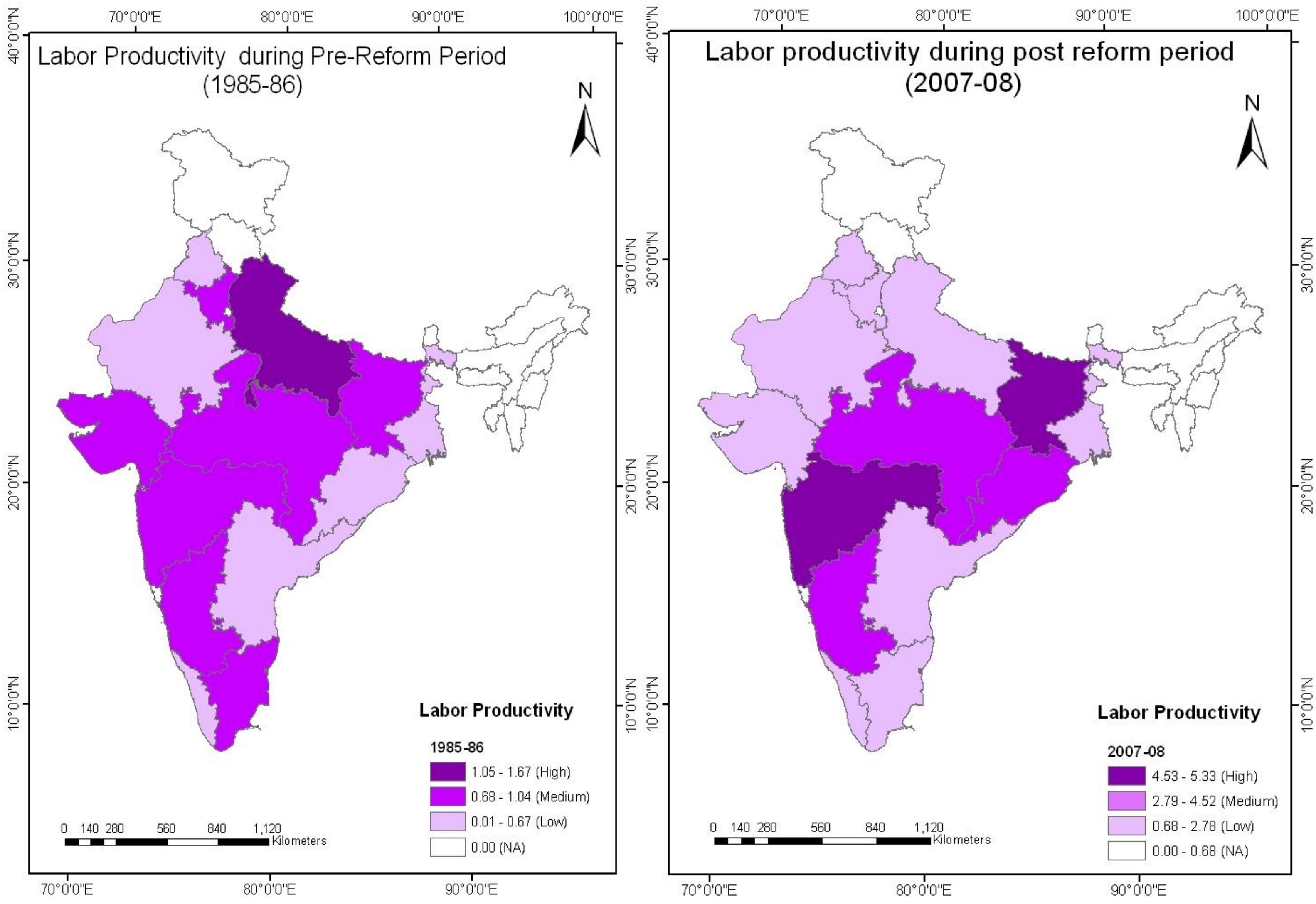
Labor productivity is generally defined in terms of turnover per worker. Calculation of labor productivity is important from the view points of measuring the contribution of workers to output. It can also serve as an indicator of wages, which theoretically, move in direction of productivity changes. So, an attempt has been made to compare the distribution of labor productivity at state level, in the manufacturing sector of India during pre and post liberalization period.

If we closely follow the map, during the pre reform period, Uttar Pradesh had highest labor productivity in the manufacturing sector in comparison to other states of India. Next to it, states like Haryana, Bihar, Madhya Pradesh, Maharashtra and Tamilnadu were the medium ranged performed state. The reasons could be that, these states were the well performed states in terms of industrial output before the reform period and they might follow capital intensive technique which was helping to enhance the growth in labor productivity. States like Orissa, Rajasthan, Tamilnadu and west Bengal didn't do well might be due to lack of working environment, unavailability of adequate capital and poor job security for working labor in these states.

But after the reforms, labor productivity of both Maharashtra and Bihar has increased and states like Orissa, Karnataka and Madhya Pradesh have performed well in compare to the deregulation period. Labor productivity of some states (Gujarat, Tamilnadu, Kerala, and Uttar Pradesh) has gone down.

It could be quite relevant to know about various factors which may affect the level of productivity in a particular unit. It is generally assumed that the enterprises with higher capital intensity, easy access to required inputs such as raw materials, capital and other infrastructure facilities show higher level of productivity as compared to the enterprises which suffer from the problems of unavailability of these inputs. Besides, it is also assumed that female workers are less productive as compare to their male counter parts. So these could be the reasons for some states to not perform well after the reform period.

Figure 3.2: Geographical Distribution of Labor Productivity during Pre and Post Reform Period

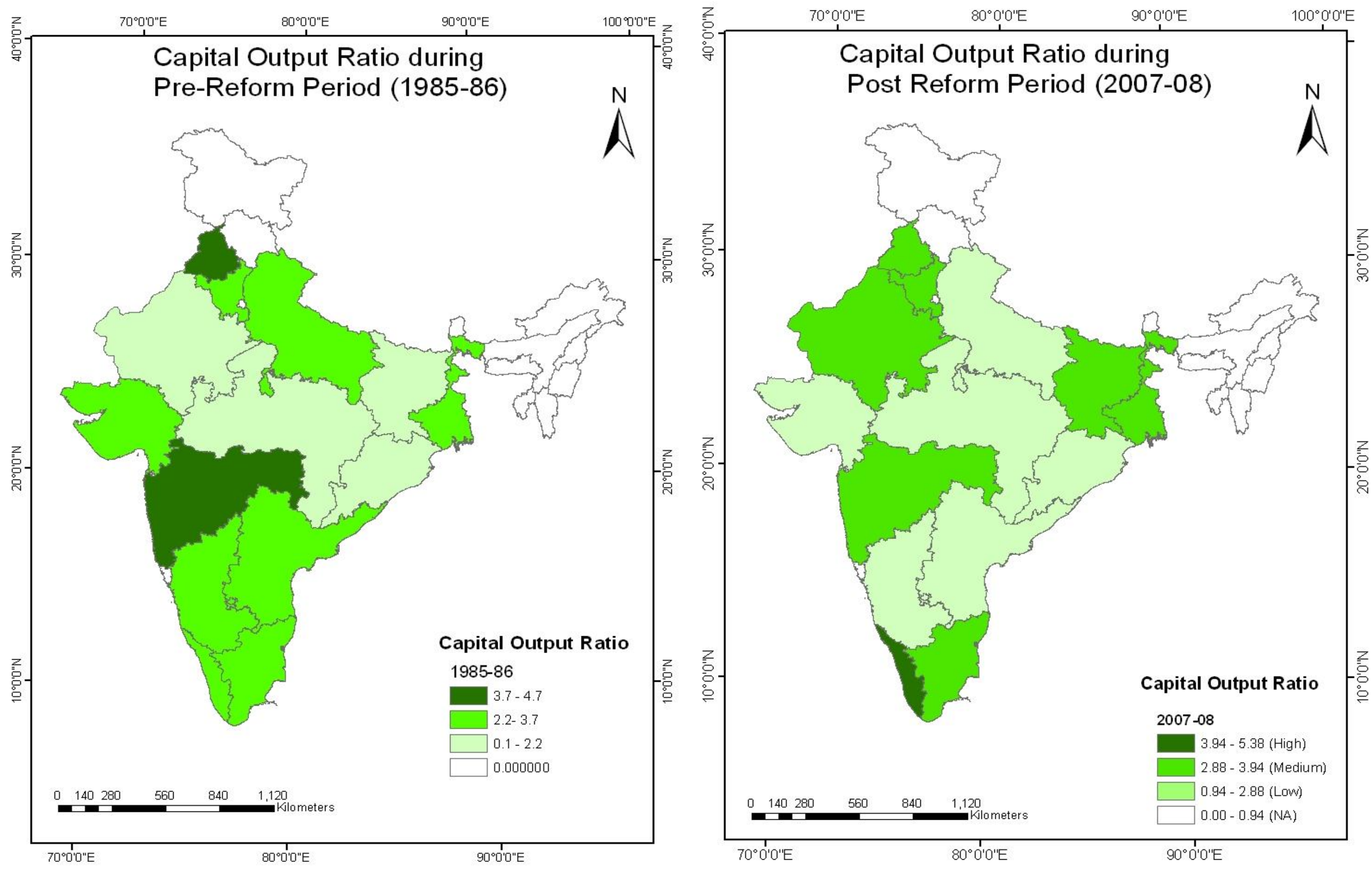


3.5.3. Capital-Output Ratio

From the above analysis in all India level we can find that in the period of Pre-reform, the share of capital -output ratio was high for the states like Punjab and Maharashtra; for the states like Haryana, Uttar Pradesh, West Bengal, Gujarat Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu the share of capital-output ratio was medium whereas it was lower in Rajasthan, Madhya Pradesh, Bihar and Orissa. A higher capital-output ration indicates a larger amount of capital is needed for producing a certain level of output. But in post reform period, in Maharashtra and Punjab capital-output ratio was medium; it became high for Kerala after reform. In case of Andhra Pradesh and Karnataka, Uttar Pradesh and Gujarat the capital-output ratio became lower in post reform period from medium in pre reform period and it changed to medium from low in Rajasthan and Bihar. The scenario of all other states remained same in the post reform period. The data was unavailable for Jammu and Kashmir, Himachal Pradesh and all the north-eastern states. So the capital has become more efficient in states like Andhra Pradesh and Karnataka, Uttar Pradesh and Gujarat, Maharashtra and Punjab where the capital-output ratio has declined in the post reform period.

High capital-output ratio in states like Punjab and Maharashtra may be due to use of obsolete and traditional technology which implies inefficiency. The states with medium and low capital-output ratio may have a good industrial base from the beginning or may have improved their economic and regulatory environment by pursuing policies and offering incentives, more conducive for industrial growth, such as, attracting more FDI, less stringent tax and licensing policies etc.

Figure 3.3: Geographical Distribution of Capital Output Ratio during Pre and Post Reform Period

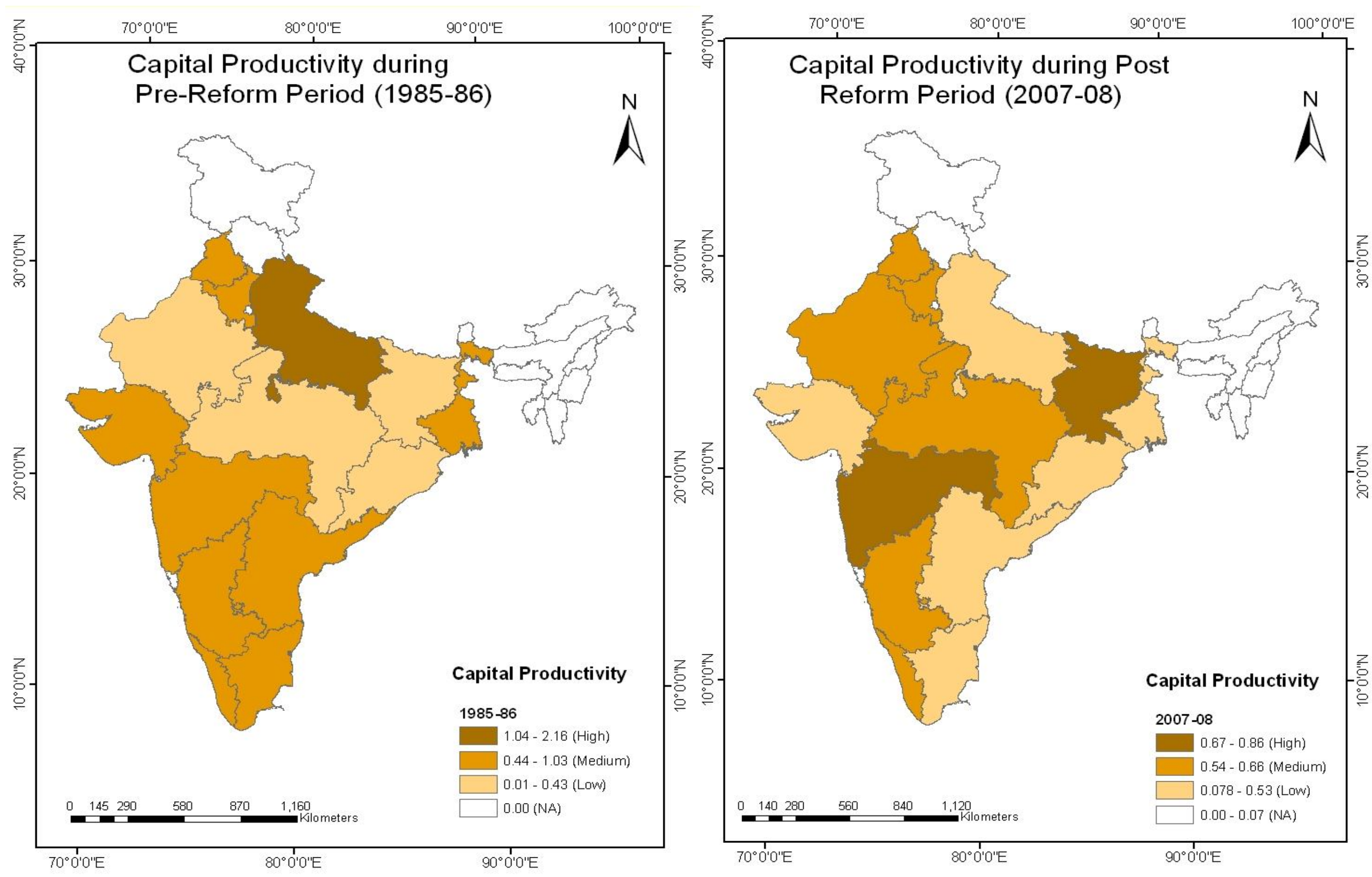


3.5.4. Capital Productivity

Considering the distribution of capital productivity of different states during the Pre-reform period capital productivity was higher in Uttar Pradesh only; in the states like Punjab, Haryana, Gujarat, West Bengal, Maharashtra, Karnataka, Andhra Pradesh, Kerala and Tamil Nadu the capital productivity was medium where it was lower Rajasthan, Madhya Pradesh, Bihar and Orissa. During the post reform period it was higher in Maharashtra and Bihar. The capital productivity increased from lower in Pre reform period to medium in post reform period in the states like Rajasthan and Madhya Pradesh whereas it decreased from medium to lower in Gujarat, West Bengal and Andhra Pradesh and from higher to lower in Uttar Pradesh. The scenario remained unchanged in all other states. The data was unavailable for Jammu and Kashmir, Himachal Pradesh and all the north-eastern states. Capital productivity is defined as value added (in real terms) per unit of net fixed capital stock (in real terms).

Interesting thing is that in many states the capital productivity has been declined during the post reform period and in some other states it has been increased but marginally. The reasons are increase of capital stocks by product unit in the sectors, reallocation of production to sectors that are more capital intensive and price increase of capital goods relative to the price of other products. Real net fixed capital stock has increased faster after the reform. Capital intensity that is net fixed capital stock in real terms per worker has gone up. The rise in capital intensity has been associated with addition to capital stock. A rise in capital intensity may mean technological up gradation. It also may mean substitution of capital for labor.

Figure 3.4: Geographical Distribution of Capital Productivity during Pre and Post Reform Period



3.6. Conclusion

Manufacturing sector plays an important role in stimulating economic growth and it is the only sector that enjoys the increasing return to scale in long run. In order to find out the effect of reform in manufacturing sector we have to revisit the changes in industrial performance in different states during both Pre reform and post reform periods. From our analysis we found that in food industry, the share of Punjab and Maharashtra has been declining, where as the hare of Madhya Pradesh has increased from the pre to post reform period. Similarly the share of Andhra Pradesh and Madhya Pradesh in beverage industry has been declined significantly, and Karnataka has gained among all the states in post reform period. In cotton and jute industries the share of all the states has gone down except Tamilnadu, Rajasthan and Madhya Pradesh. Some states like Maharashtra in wood and wood product industries, Haryana in textile and basic metal industries, Rajasthan in metallic product industries, Gujarat in basic metal industries have performed well during the post reform period. Still in most of the industries the performance is not quite satisfactorily as they were expected during the post reform period.

From our analysis of the trend of investment we found that for some states like Andhra Pradesh, Karnataka, Gujarat and Kerala an early change in pattern of investment is observed, for other states the change seems to be occurring very late. The rate of investment was high for the states like Gujarat, Haryana and medium for Tamilnadu, Andhra Pradesh, Maharashtra and Punjab whereas it was very low in Karnataka, West Bengal, Bihar and Kerala during the whole period of 1980-2007. The reason is the determinants of private investments like availability of physical infrastructure, developed transport system; easily access to market, increase in profit share etc. vary across the states which affect the rate of investment significantly. In case of growth in manufacturing output the states like Karnataka, Gujarat, Rajasthan and Andhra Pradesh have grown at a very significant rate where as West Bengal, Punjab, Bihar and Kerala have a minimal growth rate. Most of the states have accelerated their growth rate after their second structural break around 2002-03. The variation in growth rate may be due to different competitive environment, the difference in entry barrier s among the cross sectional units and increased amount of contract workers. When we will consider the wages in different states during the post reform period, the growth rate of wages did not vary as compared to output and investment. The growth rate in wages was highest in Haryana but it was negative in Bihar and West Bengal. Most of the states performed well from period one to first break where as in second phase that is from break one to break two the industrial wage rate became negative in most of the sates. The situation changed in last phase that is from break two to last period. The factors like bargaining strength of labor with the existence of labor union, future expectation of price changes, technical knowhow skill of workers and well organized labor market affected the wage rate.

Before the economic reform Maharashtra, Gujarat, Madhya Pradesh, Tamilnadu and West Bengal, were performing well in manufacturing investment. In the post reform era Gujarat, Tamilnadu, and Maharashtra performed well. The reasons are in Gujarat significant steps like reforms in its state owned enterprises through privatization, closure, merger and restructuring; fiscal reforms like reduction of fiscal deficit including tax and expenditure reform; creation of policy environment for private sector. Similarly Tamilnadu focused more on strengthening its industrial and social infrastructure and setting up of single window operating system. The medium performed states are Uttar Pradesh, West Bengal, Orissa and Karnataka.

During the pre reform period, Uttar Pradesh had highest labor productivity putting Haryana, Madhya Pradesh, Bihar, Maharashtra and Tamilnadu in medium range. But after the reform labor productivity of Maharashtra and Bihar has increased where as Orissa, Karnataka and Madhya Pradesh have performed well in comparison to Gujarat, Tamilnadu, Kerala and Uttar Pradesh where it has gone down. The states with higher capital intensity, easy access to required inputs such as raw materials, capitals and other infrastructure facilities show higher level of productivity.

In the case of capital productivity, the stats of north India have performed well in comparison to other states; it may be due to the effect of green revolution, as they have better access to new technology and have better human capital as compared to others. After the reforms, Maharashtra and Kerala have done extremely well than the others. Similarly in case of capital output ratio Punjab and Maharashtra during pre reform period did well, it may be due to use of obsolete and traditional technology which implies inefficiency and the other states with medium and low capital-output ratio may have better economic and regulatory environment than these two.

****

CHAPTER-IV

Economic Reforms and Efficiency of Manufacturing Industries

4.1. Introduction

This chapter deals with the empirical analysis of the study. In order to test the objective, impact of economic reform on efficiency of manufacturing industries, we have proceeded in two stages. In the first stage, we carried out to describe the empirical model of our study. In the second stage, we have reported the estimated result of the empirical analysis. Accordingly, this chapter divided into the following sections. Section 4.2 describes the data source and variables of the study. Section 4.3 explains empirical model of the study. In section 4.4 we have reported and analyzed the estimated result and section 4.5 summarizes the analysis.

4.2. Data and Description of Variables

Before going into the analysis, it is essential to describe the data and variables used in the study. As it has been discussed in chapter -II, data set used in the study is annual data from the period of 198-81 to 2007-08 collected from ASI. The whole data has been subdivided into two parts, i.e., Pre reform period (1980-1993) and Post reform period (1994-2007). The post reform period has been taken as from 1994 onwards because; as the economic reforms took some time lag to make its full impact on Indian economy or we can call it the gestation lag period. That is the reason for which we extended the starting point of economic reforms into two periods.

The variables employed in the study are output, capital, material input, and labor after deflating them with appropriate deflator. The construction of this variable has been already explained in the chapter-III. Additionally, we have used a time variable along with these variables as a proxy to check the impact of technological progress on the growth of manufacturing industries. Hence, in the next section we turn to the empirical analysis of the study.

4.3. Empirical Analysis

We have already discussed in the chapter-III that in the literatures (Mitra (1999); Driffield and Kambhampati (2003); Bhaumik and Bhaskar (2010)), the technical efficiency has been estimated with the help of production function. In this study, we are using Cobb-Douglas production function to measure the level of efficiency in the manufacturing industries. Its advantage over other production functions i.e., Translog, CES production function, is that it is easy to calculate, degrees of freedom is less affected unlike the Translog production function and the return to scale is easily calculated from the input coefficients. We start the estimation with a Cobb-Douglas production function, which with natural logs is specified as follows:

$$LnY = \beta 0 + \Sigma \beta_{ij} lnX_{ij} + v - u \qquad (1)$$

Where *i= (1, 2, 3,…T*) time period and *j= (1,2.3,……J)* number of industries. *X* is inputs that are used to produce *Y*. In our model *X*= (capital, labor and material input) and *Y*= output. Along with these inputs we have also used time as an independent variable in our model to check the impact of technological progress on the growth of manufacturing output. The standard distributional assumptions are: (i) the noise term *(V)* is independently normally distributed with zero mean and constant variance (ii) the inefficiency term is independently distributed as a truncated half normal distribution. (iii) The inefficiency and noise components are assumed to be independent of each other and are also independent of the inputs. The null hypothesis of our study is that there is no technical efficiency in the model.

As it has been already mentioned in the chapter-II, the time varying technical efficiency model is carried out to estimate the technical efficiency of manufacturing industries. As we are talking about the efficiency of manufacturing industries, so it is useful in this context to explain briefly the concept of efficiency and its types and why we have opted to estimate technical efficiency alone.

4.3.1 Technical Efficiency

In simple words, we can define efficiency, as the relationship between what an organization produces and what it could feasibly produce, under the assumption of full utilization of available resources. Kumbhakar and Lovell (2000) have described efficiency as the ability of decision making unit to obtain the maximum output from a set of inputs or to produce an output using the lowest possible amount of inputs. Efficiency generally referred as economic efficiency in literatures.

Economic efficiency can be decomposed into two, (i) technical efficiency (TE), which measures the ability of a firm to obtain the maximum output from given inputs, and (ii) allocative efficiency (AE), which measures the ability of a firm to use inputs in optimal proportions given their prices. This can be explained in a different way like, if the only information available is input and output quantities, and there is no information on input and output prices, then the type of efficiency that can be measured is technical efficiency. If price information on inputs and outputs is available, in addition to input and output quantities, then the type of efficiency that can be measured is allocative efficiency. Efficiency estimation provides an indication of the percentage by which potential output could be increased, or potential cost could be decreased, in relation to the corresponding production frontier.

If we look back to the review of literature on technical efficiency of manufacturing sector in India, a few studies focus on the efficiency question in detail. Moreover, not many have analyzed the impact of reforms on all industries across all states, for which secondary data exists. Though many studies have attempted to look at the reforms, it has often been done with selected industries and/or with firm level data. In order to examine the complete performance of all manufacturing industries during the reform period and the reform's impact, the study analyses a disaggregated view of the manufacturing sector rather than of the aggregate level. That is the reason for which we have taken this task to show the level of efficiency in each state and in each industries of the manufacturing sector in both pre and post reform period. In our study we have only concentrated on technical efficiency as the price of the factor inputs are required to calculate allocative efficiency and we don't have the price of the factor inputs that are used in the model. So this is the reason for us to stick with only technical efficiency only. In the next section equation (1) was estimated and its result on technical efficiency is reported in the table-4.1 and 4.2.

Table- 4.1: Estimated Result of Stochastic Frontier Production Function for Indian Manufacturing Industries

Industry	year	capital (β1)	machinary (β3)	labor (β2)	time (α)	constant (βo)	wald χ^2 (prob>χ^2)	time varying inefficiency (τ)	$\lambda=\sigma u^2/\sigma v^2+\sigma u^2$	returns to scale	mean technical efficiency
food and food products	1980-2007	0.54***(0.48)	0.27***(.03)	0.09**(0.03)	0.01***(0.01)	0.73 (0.14)	1739.1	(-)0.04*** (0.01)	0.67	0.90	0.85
	1980-1993	0.07***(0.01)	0.87***(0.01)	0.06***(0.01)	(-)0.01**(0.01)	0.13***(0.03)	3023.2	0.03 (0.04)	0.16	1.00	0.98
	1994-2007	0.74***(0.09)	0.12*(0.05)	0.03 (0.05)	0.01* (0.01)	0.96*(0.42)	184.13	(-)0.02 (0.01)	0.65	0.86	0.78
beverage , tobacco and related products	1980-2007	0.33***(.04)	0.68***(0.37)	0.02*(0.01)	(-)0.01***(0.01)	0.41* (0.14)	1080.5	0.02 (0.01)	0.12	1.03	0.84
	1980-1993	0.07*(0.04)	0.78***(0.03)	0.16***(0.03)	0.14 (0.12)	6.77 (11.40)	1163.5	(-) 0.01 (0.01)	0.66	1.01	0.56
	1994-2007	0.66***(0.07)	0.41***(0.05)	0.01 (0.01)	(-)0.01***(0.01)	(-)0.16 ((0.18)	770.99	0.08*(0.04)	0.34	1.07	0.95
cootton, jute and fiber textile products	1980-2007	0.29***(0.04)	0.53***(0.04)	0.14***(0.03)	0.01*(0.01)	0.35** (0.16)	1827.4	(-)0.03***(0.01)	0.96	0.96	0.92
	1980-1993	0.09***(0.02)	0.81***(0.02)	0.12***(0.02)	(-)0.01***(0.01)	0.15 (0.11)	18653	(-)0.01 (0.03)	0.02	1.02	0.97
	1994-2007	0.45***(0.08)	0.56***(0.06)	0.06 (0.04)	0.01 (0.01)	(-)0.29 (0.24)	939.44	(-)0.01 (0.02)	44	1.01	0.89
textile products (including apparel)	1980-2007	0.49***(0.04)	0.53***(0.03)	0.04 **(0.01)	(-)0.01 (0.01)	0.21* (0.11)	3420.1	0.01 (0.01)	0.83	1.06	0.86
	1980-1993	0.38***(0.05)	0.23***(0.03)	0.58***(0.05)	(-)0.02***(0.01)	(-)0.04 (0.17)	1295.5	0.02*(0.02)	0.28	1.19	0.77
	1994-2007	0.25***(0.05)	0.76***(0.03)	0.03*(0.01)	0.01***(0.01)	(-)0.01 (0.11)	4089.5	0.02 (0.04)	0.47	1.04	0.96
wood and wood products	1980-2007	0.15***(0.03)	0.82***(0.33)	0.01(0.04)	(-)0.01**(0.01)	0.37***(0.08)	3313.8	(-0.05)**(0.02)	0.99	0.97	0.96
	1980-1993	0.08***(0.01)	0.86***(0.02)	0.04*(0.02)	0.02***(0.01)	0.13***(0.03)	11342	(-)0.83***(0.09)	0.33	0.98	0.96
	1994-2007	0.37***(0.08)	0.65***(0.05)	0.02 (0.06)	0.01 (0.01)	(-)0.02(0.19)	887.14	0.01(0.02)	0.24	1.02	0.88
paper, paper products and printing	1980-2007	0.54***(0.05)	0.47***(0.04)	(-)0.09(0.04)	(-)0.01***(0.01)	0.49**(0.17)	1131.2	0.01(0.01)	0.21	1.01	0.89
	1980-1993	0.06*(0.03)	0.73***(0.03)	0.25***(0.04)	(-)0.02***(0.01)	0.63***(0.09)	3809.8	(-)0.01 (0.02)	0.38	1.04	0.96
	1994-2007	0.76***(0.09)	0.37***(0.05)	(-)0.16*(0.01)	(-)0.01 (0.01)	0.14 (0.29)	394.47	0.01 (0.02)	0.21	0.97	0.76
leather and leather products	1980-2007	0.05 (0.03)	0.95***(0.21)	0.01(0.01)	0.01(0.01)	0.11(0,09)	6004.1	(-)0.02 (0.04)	0.06	0.95	0.96
	1980-1993	(-)0.03 (0.01)	1.03***(0.01)	(-)0.01 (0.01)	(-)0.01***(0.01)	0.31***(0.04)	28119	0.01 (0.16)	0.43	1.03	0.99
	1994-2007	0.35***(0.11)	0.50***(0.05)	0.23**(0.07)	0.01 (0.01)	(-)0.02 (0.44)	667.12	(-)0.01 (0.05)	0.05	1.08	0.83

Continued….

Industry	year	capital (β1)	machinary (β3)	labor (β2)	time (α)	constant (βo)	wald χ^2 (prob>χ^2)	time varying inefficiency (τ)	$\lambda=\sigma u^2/\sigma v^2+\sigma u^2$	returns to scale	mean technical efficiency
chemical and chemical products	1980-2007	0.28***(0.04)	0.67***(0.03)	0.11***(0.03)	0,02**(0,01)	(-)0.07 (0.24)	2329.2	(-)0.03**(0.01)	0.51	1.06	0.64
	1980-1993	0.22***(0.04)	0.74***(0.02)	0.06*(0.03)	(-)0.01 (0.01)	0.12 (0.21)	4740.7	0.08***(0.02)	0.21	1.02	0.83
	1994-2007	0.34***(0.08)	0.60***(0.05)	0.07 (0.05)	0.01 (0.01)	0.07 (0.49)	257.8	(-)0.01 (0.01)	0.61	0.94	0.88
rubber and plastic products	1980-2007	0.21***(0.04)	0.69***(0.03)	0.13**(0.04)	0.01***(0.01)	(-)0.03 (0.09)	7511.6	(-)0.02 (0.02)	0.91	1.03	0.97
	1980-1993	0.13***(0.02)	0.74***(0.03)	0.17***(0.03)	(-)0.01**(0.01)	0.08 (0.08)	8423	0.01 (0.03)	0.06	1.03	0.95
	1994-2007	0.43***(0.05)	0.54***(0.04)	0.08 (0.07)	0.01***(0.01)	(-)0.20 (0.19)	1871.7	(-)0.01 (0.09)	0.06	0.97	0.98
non metalic products	1980-2007	0.25***(0.02)	0.74***(0.03)	0.16***(0.27)	(-)0.01***(0.01)	(-)0.31 (0.11)	3356.8	0.04***(0.01)	0.07	1.15	0.88
	1980-1993	0.37***(0.02)	0.54***(0.03)	0.08*(0.33)	(-)0.01 (0.01)	0.32***(0.08)	5761.9	0.11***(0.01)	0.12	0.99	0.89
	1994-2007	0.16**(0.05)	0.87***(0.04)	0.19***(0.03)	(-)0.01 (0.01)	(-)0.57*(0.22)	1235.6	(-)0.01 (0.03)	0.21	1.22	0.86
basic metal and alloys	1980-2007	0.20***(0.01)	0.52***(0.02)	0.11***(0.01)	0.01***(0.01)	1.10***(0.14)	3129.5	(-)0.01 (0.01)	0.68	0.83	0.91
	1980-1993	0.16***(0.01)	0.55***(0.03)	0.26***(0.04)	0.01**(0.01)	0.41***(0.10)	3116.6	(-)0.06**(0.02)	0.89	0.97	0.95
	1994-2007	0.31***(0.03)	0.46***(0.03)	0.07***(0.02)	0.01* (0.01)	0.95***(0.22)	846.29	0.01 (0.02)	0.45	0.84	0.92
metal, machinarary electrical and non electrical	1980-2007	0.83***(0.06)	0.25***(o.03)	(-)0.01(0.03)	(-)0.01***(0.01)	(-)0.05(0.23)	1618.1	0.03***(0.01)	0.18	1.08	0.87
	1980-1993	0.86***(0.04)	0.47***(0.04)	(-)0.31***(0.05)	(-)0.03***(0.01)	0.33 (0.19)	1473.9	0.06***(0.01)	0.71	1.02	0.78
	1994-2007	0.69***(0.07)	0.32***(0.04)	0.01*(0.48)	0.01**(0.01)	(-)0.53*(0.18)	1277.1	(-)0.01 (0.04	0.12	1.02	0.94
transport equipment	1980-2007	0.11***(0.02)	0.74***(0.02)	0.15***(0.03)	0.01**(0.01)	0.22*(0.11)	4450.2	(-)0.04*(0.01)	0.58	1.00	0.94
	1980-1993	0.09***(0.01)	0.75***(0.01)	0.14***(0.02)	(-)0.01**(0.01)	0.38***(0.08)	5947.4	0.01 (0.01)	0.26	0.98	0.91
	1994-2007	0.18*(0.06)	0.68***(0.04)	0.16*(0.06)	0.01 (0.01)	0.07 (0.19)	1293.5	(-)0.01 (0.04)	0.42	1.02	0.92
other manufacturing industries	1980-2007	0.39***(0.04)	0.64***(0.02)	0.02(0.03)	0.01*(0.01)	(-)0.05 (0.09)	3900	(-)0.03*(0.01)	0.34	1.03	0.92
	1980-1993	0.17*(0.06)	0.37***(0.04)	0.61***(0.05)	0.01***(0.01)	-)0.31***(0.07	1784.3	(-)0.08**(0.03)	0.49	1.15	0.85
	1994-2007	0.44***(0.07)	0.58***(0.03)	0.09*(0.04)	0.02* (0.01)	(-)0.22 (0.24)	841.88	(-)0.06* (0.03)	0.41	1.11	0.83

Notes: The values in the parentheses reported after the coefficient estimates are robust standard error.
(*) significance at 10% level, (* *) significance at 5% level, (***) significance at 1% level.
Source: Calculation is based on ASI data

Table-4.2: Year Wise Average Technical Efficiency in Indian Manufacturing Industries

Industry	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
20,21	0.915	0.911	0.908	0.904	0.901	0.897	0.893	0.889	0.885	0.880	0.876	0.871	0.866
22	0.789	0.794	0.798	0.803	0.807	0.811	0.815	0.819	0.823	0.827	0.831	0.835	0.839
23,24,25	0.952	0.951	0.949	0.948	0.946	0.944	0.943	0.941	0.939	0.938	0.936	0.934	0.932
26	0.848	0.850	0.851	0.853	0.855	0.857	0.858	0.860	0.862	0.863	0.865	0.867	0.868
27	0.986	0.985	0.984	0.983	0.983	0.982	0.981	0.980	0.979	0.977	0.976	0.975	0.974
28	0.886	0.887	0.887	0.888	0.888	0.889	0.889	0.890	0.890	0.891	0.891	0.892	0.892
29	0.972	0.972	0.971	0.970	0.970	0.969	0.968	0.968	0.967	0.966	0.966	0.965	0.964
30	0.772	0.764	0.757	0.749	0.740	0.732	0.723	0.714	0.705	0.696	0.686	0.676	0.666
31	0.984	0.984	0.983	0.983	0.982	0.982	0.981	0.980	0.980	0.979	0.979	0.978	0.977
32	0.809	0.817	0.825	0.833	0.840	0.847	0.854	0.860	0.866	0.872	0.878	0.883	0.888
33	0.970	0.969	0.969	0.968	0.967	0.966	0.965	0.965	0.964	0.963	0.962	0.961	0.960
34,35,36	0.824	0.829	0.834	0.839	0.843	0.848	0.852	0.856	0.860	0.864	0.868	0.872	0.876
37	0.974	0.972	0.971	0.970	0.969	0.967	0.966	0.964	0.963	0.961	0.959	0.957	0.956
38	0.957	0.956	0.954	0.952	0.951	0.949	0.947	0.945	0.943	0.941	0.939	0.936	0.934

Continued….

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0.861	0.856	0.851	0.845	0.839	0.834	0.828	0.821	0.815	0.808	0.801	0.794	0.787	0.780	0.772
0.842	0.846	0.849	0.853	0.856	0.859	0.862	0.865	0.869	0.872	0.874	0.877	0.880	0.883	0.886
0.930	0.928	0.926	0.924	0.921	0.919	0.917	0.914	0.912	0.910	0.907	0.904	0.902	0.899	0.896
0.870	0.871	0.873	0.874	0.876	0.877	0.879	0.880	0.882	0.883	0.885	0.886	0.887	0.889	0.890
0.972	0.971	0.969	0.968	0.966	0.964	0.962	0.961	0.958	0.956	0.954	0.952	0.949	0.947	0.944
0.893	0.893	0.894	0.894	0.895	0.895	0.896	0.896	0.897	0.897	0.898	0.898	0.899	0.899	0.900
0.963	0.963	0.962	0.961	0.960	0.959	0.959	0.958	0.957	0.956	0.955	0.954	0.953	0.952	0.951
0.656	0.645	0.635	0.624	0.612	0.601	0.589	0.578	0.566	0.553	0.541	0.528	0.516	0.503	0.490
0.977	0.976	0.975	0.975	0.974	0.973	0.972	0.972	0.971	0.970	0.969	0.968	0.967	0.966	0.966
0.893	0.898	0.903	0.907	0.911	0.916	0.919	0.923	0.927	0.930	0.933	0.936	0.939	0.942	0.945
0.959	0.958	0.957	0.956	0.955	0.954	0.953	0.952	0.951	0.950	0.949	0.948	0.946	0.945	0.944
0.879	0.883	0.886	0.889	0.893	0.896	0.899	0.902	0.905	0.908	0.910	0.913	0.915	0.918	0.920
0.954	0.952	0.950	0.947	0.945	0.943	0.940	0.938	0.935	0.932	0.929	0.926	0.923	0.920	0.917
0.932	0.929	0.927	0.924	0.921	0.918	0.915	0.912	0.909	0.906	0.903	0.899	0.896	0.892	0.888

Note: 20,21-Food Products, 22-Beverage, 23,24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Source: same as in table 4.1

4.4. Estimation of Results

This study has estimated a three input-output function framework for each of the 14 industry group using equation (1). For estimating the production function, the standard panel data approach has been followed. Based on yearly efficiency level, we have computed average level of efficiency over the period of 1980-81 to 2007-08. Keeping in the view of policy changes, which was initiated in the early 1990s, the time period has been further divided into two sub-periods: i) 1980-1993, the period of regulation regime ii)1993-2007, the period of deregulation and liberalization. We have taken 1993 as the break point in our study, because, though reform has already started in 1990-91, but its impact has not felt in the same year and it would take some time or we can call it the gestation lag period. That's why we have extended the break point for two more years in our study.

The maximum likelihood estimates, together with standard errors, are reported in the table 4.1. The sign of the coefficients of the stochastic frontier model for food industry are as expected. Except the intercept term, all the variables are coming significant. The positive coefficient of capital, labor and material input confirms the expected positive relationship between output and these three explanatory variables. Among these three inputs, the coefficient of material input (0.54) has come out highly significant for the whole time period. It explains that if there is one unit change in material input, then it will lead to an increase in 0.54 unit of total output in food industries. The time variable also positively affecting the explanatory variable, but its impact is very minimal. The estimate for variance parameter Lambda (λ), which is 0.67, indicates that the inefficiency effect is likely to be highly significant in the analysis of the value of output of the food industry. Time varying inefficiency term Etta (τ) is coming significant at 1 per cent level, which further explains that the inefficiency has been increasing over the period of time. Here the null hypothesis, which specifies that the inefficiency effect are absent from the model is strongly rejected. If we have see carefully the two sub periods of our sample, then it is clearly evident that during the pre liberalized period, material input was significantly contributed more to output than the post reform period. After the reforms, capital input has contributed more to total output than the rest of the independent variable.

The reason may be due to introduction of new techniques of production, inflows of Foreign Direct Investment, extensive use of capital intensive method through etc. One of the interesting thing is that, the mean technical efficiency in the pre liberalized era was about 0.98 was quite higher than the post reform period (0.78). So it is clear that, the food industry has not performed well after economic liberalization.

In the beverage industry, the estimated coefficients of all the variables are significantly affecting the dependent variable. The estimated coefficient for capital, labor and material input are 0.33, 0.02 and 0.68 respectively for the whole sample period. The coefficient of time indicates that the value of output has tended to increase by a small and significant rate over the twenty eight time period. The value of Etta (τ) has come out positive and significant, which explains that the inefficiency decreases over the period but not at a significant rate. The value of Lambda (λ) is 0.12, which is close to zero. It states that the beverage industry is technically efficient for the whole period. But the picture was quite different during both pre and post reform period. Material input was contributing more to output than capital, which was inversed in post reform period. The average technical efficiency is 0.56 during regulated era again against 0.95 in deregulated liberalized era.

The estimated coefficient for the cotton, jute and fiber textile industries are positive and significant as expected. Among all these explanatory variables material input has highly contributed to the total output, i.e. 1 percent increase in material input will positively affect the total output by 0.53 per cent respectively. The time varying inefficiency (τ) has come out negative and significant for the whole time period. It explains that the inefficiency in cotton and jute textiles has increased over the period of time. The value of Lambda (λ), 0.96 explains that the jute textile industry is highly inefficient, which further specifies that the null hypothesis is strongly rejected. The long run returns to scale to factors of production is less than unity. It means there is decreasing returns to scale operates in the model. Between the two sub periods, cotton and jute industries has performed well during the pre liberalizing era than the post liberalizing. It is clearly visible when we compare the value of mean technical efficiency of two sub periods, i.e. 0.97 against 0.89. Technological progress negatively affecting the growth of output but at a very marginal rate of 0.01 during pre reform period, where as it comes insignificant during post reform period.

Among the rest of the industries (wood, textile, paper, leather, chemical, metallic, machinery and other manufacturing industries) except chemical industries and textile industries, all of the remaining industries have a high level of technical efficiency. In both paper and metal industries the coefficient of labor has come out negative. Either it may be due to the extensive use of labor or due to lack of human capital the coefficient has come out negative. Besides this, the estimated coefficient all the explanatory variables, in these remaining eleven industries are being significant and the signs are as expected. Impact of time variable over the over the growth of output has statistically less significant, around 0.01 percent in most of the industries except basic metal and leather industries. The returns to scale to factors are close to unity, which states that the factors are operating in the minimum point of their long run cost curve. The value Lambda (λ) in both rubber industry and basic metal industry is close to zero, which means there is a presence of very low level of technical efficiency in these two industries. In the rest of the industries its value is quite high which further justify our argument of choosing stochastic frontier model to test the inefficiency of manufacturing industries. The time varying inefficiency term, Etta (τ) is coming significant for wood, metal and machinery, chemical and non metallic industries. Besides, metal and machinery industries, its value has come out negative for the rest of the industries. It means inefficiency component has been increasing over time for these industries for the whole period as well as after the reforms.

After the post liberalization, capital output is contributing more to the total manufacturing output than both capital and material input in most of these industries, which further explains that these industries have shifted their production process from labor intensive technique (in pre-reform period) to capital intensive technique in order to compete with foreign firms. Then the question arises here, does it improve the efficiency level of the existing firms? The answer is yes, but not for all the industries. We can support our argument if we closely observe the table 4.2.

In table 4.2, technical efficiency for all the manufacturing industries is calculated for each year. Here, we are reporting the summery measures of these estimates. The average technical efficiency of 14 major states of India has been reported for each year in the table 4.2. Except 22, 26, 28 (beverage, textile, paper) and machinery industries (34, 35&36), the technical efficiency of all the remaining industries have been decreasing over time. The highest level of technical efficiency has been archived by 37 (transport industries) in the year 1980, where as the lowest level of technical efficiency has been achieved by 30 (chemical and chemical product industries in the year 2007. The trend of the mean technical efficiency scores shows that it is lower in the post reform period (1993-94 to 2007-08) for four industries which are 22, 24, 26, and (34, 35, 36) i.e. beverage, textile, paper and machinery industries where as in the rest of the industries, TE has been increased. From the table 4.2, the absolute value of mean technical efficiency of transport industries, rubber industries, chemical industries and textile industries has been increased after the deregulation period. This variation in technical efficiency could be due to difference in degree of competitiveness among industries, difference in managing quality, large variation in input quality and changing ownership form of these industries. For better understanding we are showing the trend of average technical efficiency of 14 major manufacturing industries for the whole sample period as well as pre and post reform period in the following figures.

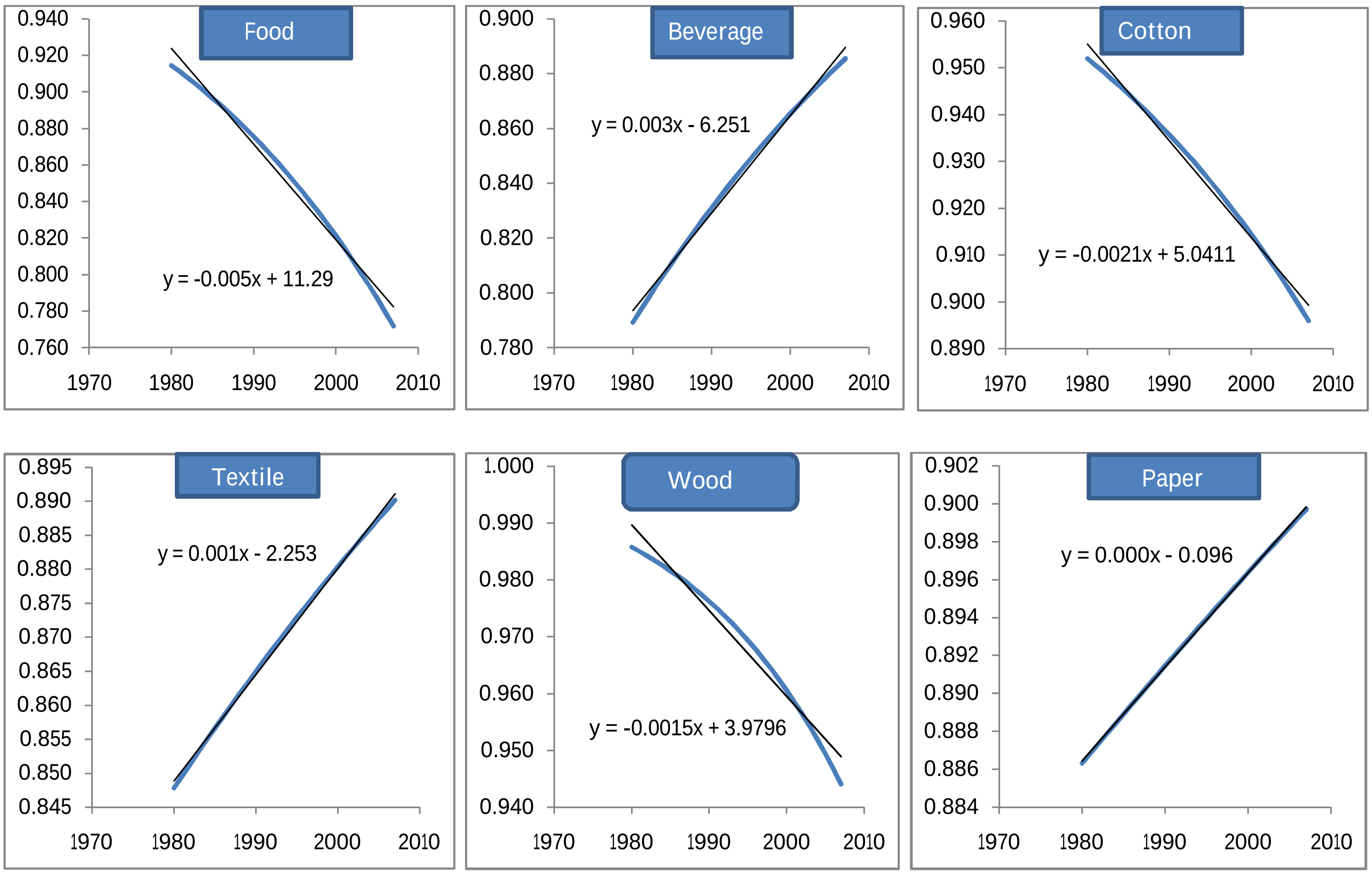
Table 4.3: Slope Coefficients of the Growth Trend Line of Technical Efficiency of Manufacturing Industries

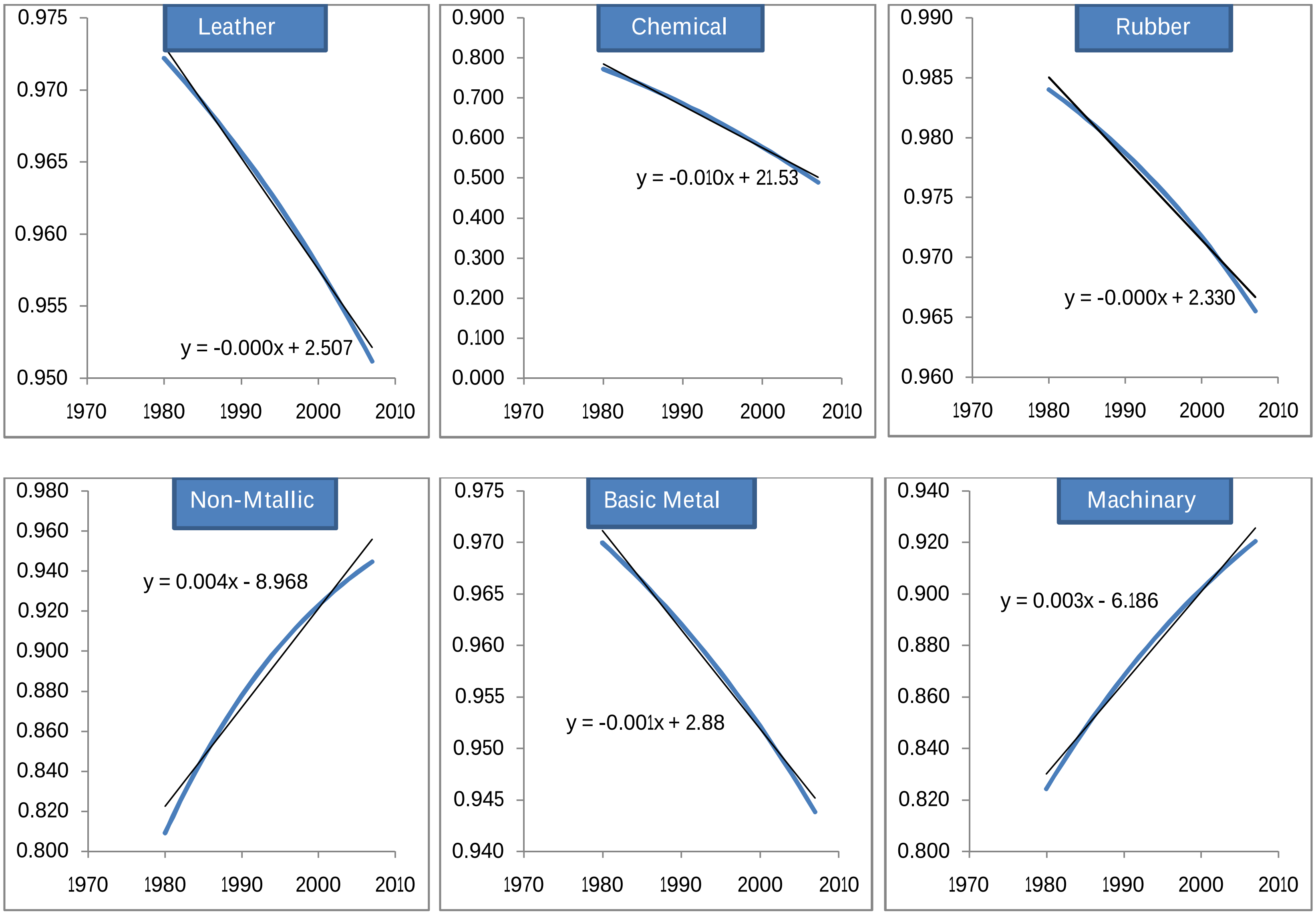
Industry	WHOLE PERIOD	UP TO PRE REFORM	UP TO POST REFORM
20,21	-0.0052	-0.0041	-0.0065
22	0.0036	0.0041	0.0031
23,2,25	-0.0021	-0.0017	-0.0025
26	0.0016	0.0017	0.0014
27	-0.0015	-0.001	-0.0021
28	0.0005	0.0005	0.0005
29	-0.0008	-0.0007	-0.0009
30	-0.0105	-0.0089	-0.012
31	-0.0007	-0.0006	-0.0008
32	0.0049	0.0065	0.0036
33	-0.001	-0.0008	-0.0011
34,35,36	0.0035	0.0042	0.0029
37	-0.0021	-0.0015	-0.0027
38	-0.0025	-0.002	-0.0032

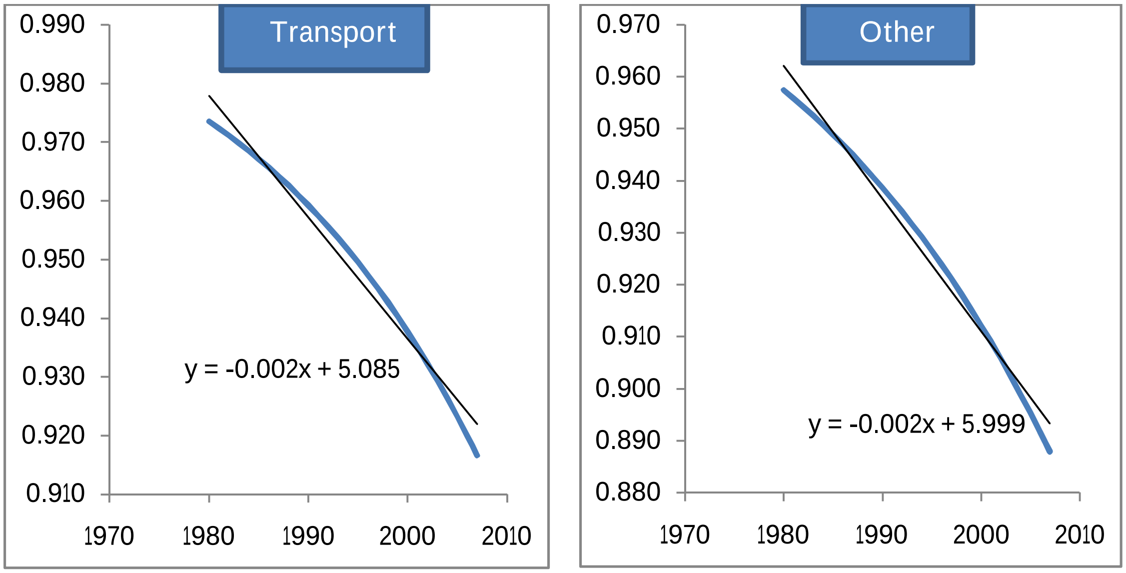
Note: 20,21-Food Products, 22-Beverage, 23,24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Source: same as in table 4.1

Figure 4.1: Growth Trend of Average Technical Efficiency in Manufacturing Industries from the Period of 1980-2007




Leather
0.975
0.970
0.965
0.960
0.955
0.950
1970
1980
1990
2000
2010
y = -0.000x + 2.507
Chemical
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
1970
1980
1990
2000
2010
y = -0.010x + 21.53
Rubber
0.990
0.985
0.980
0.975
0.970
0.965
0.960
1970
1980
1990
2000
2010
y = -0.000x + 2.330
Non-Mtallic
0.980
0.960
0.940
0.920
0.900
0.880
0.860
0.840
0.820
0.800
1970
1980
1990
2000
2010
y = 0.004x - 8.968
Basic Metal
0.975
0.970
0.965
0.960
0.955
0.950
0.945
0.940
1970
1980
1990
2000
2010
y = -0.001x + 2.88
Machinary
0.940
0.920
0.900
0.880
0.860
0.840
0.820
0.800
1970
1980
1990
2000
2010
y = 0.003x - 6.186



Source: calculation is based on ASI data

In table-4.3 we have reported the slope coefficient of the growth of technical efficiency (TE) in manufacturing industries for the whole sample period as well as for two sub periods. Along with this table we have also presented the diagrams of growth trend of TE of various industries in figure-4.1 for better understanding about the concept. From table-4.3, it is clearly evident that in beverage, textile, paper, non-metallic and machinery industries, the rate of change in technical efficiency has been increasing for the whole sample period among the rest of the industries. The rate of change in technical efficiency is highest in non-metallic industries with 0.0049, where as it is lowest in paper industries with 0.0005. Industries with decreasing technical efficiency, chemical industry is highest with the slope coefficient of 0.0105 among rest the industries.

If we compare both pre and post reform period, same industries which have increasing rate of technical efficiency in the whole sample period have the same rate in both pre and post liberalizing era, but the rate of change in technical efficiency has increased over all the industries, which further explains that the rate of change in TE is lower in post reform period than the pre reform. It supported our argument that Indian industries are incapable in competing with foreign firms after the liberalizing era. The gap of TE has been increased between industries during post liberalized era than the pre liberalized period. To see the cross industry comparison of the growth technical efficiency, please go through the appendix for better understanding about it.

4.5. Conclusion

We analyzed the performance of fourteen manufacturing industries in terms of efficiency against the background of economic policy reforms introduced in India since 1991. The results indicate the change in the policy environment has positive effect on technical efficiency in beverage, textile, chemical, rubber and metal industries and the rest of the industries show a decline trend. The decline in the level of technical efficiency indicates that the majority of the firms in these industries failed to catch up with shifting frontier technology which was pushed further by the large and foreign companies, happened by the opening up economy during post liberalized era.

The other major findings are:

Marginal productivity of labor in the formal manufacturing sector in India is much lower than the marginal productivity of capital and material input. One plausible reason may be due to the over utilization of labor in these industries. There was an increase in the returns to factor inputs during the post reform period. However the percentage change in the returns to material input is much more pronounced than that of labor and capital. The returns to scale in most of the industries are close to unity, which means the scale of operation in manufacturing industries (on average) close to their optimum levels. In other words, more than average manufacturing industries were operating much closer to their minimum point of long run average cost curve. There was noticeable decline in the mean technical efficiency of some industries in the post reform period.

The reasons might be due to (i) inadequate access to infrastructure, (ii) non acquisition of technological capabilities (iii) increase in cost of labor .(iv) if a plant does not have reliable supply of electricity, capital and labor become idle, level efficiency will fall down and (v) according Bhaumik and Kumhakar (2010), the 1991 reform was incomplete because of two reasons. First, though the reforms facilitated greater competition by easing product market entry and greater access to better technology, but no incentives were given to the already established large scale unproductive firm for adoption of efficiency enhancing technologies. Second, no credit incentives were supported to the sick industries for enhancing their productive skills.

After calculating technical efficiency of each industry it doesn't make a clear picture about the performance of manufacturing sector during both pre and post liberalization era. In order to have a better understanding about the total factor productivity and the factors that are contributing to its growth, we have extended our study to the fifth chapter. The study uses the same empirical model that is explained here along with the decomposition of methodology to carry out the empirical estimation of our third objective i.e., impact of economic reforms on productivity of Indian industries.

******

CHAPTER - V

Total Factor Productivity in Manufacturing Industries

5.1. Introduction

In the previous chapter, we estimated our second objective of impact of economic reforms on efficiency of manufacturing industries with the help of SFA. Here, we have just extended our study by calculating Total Factor Productivity (TFP) and decomposing it with the help of the same methodology that was explained in the chapter III. To examine the objective of economic reforms on the total factor productivity of manufacturing industries in India, we carry out stochastic frontier analysis in order to get total factor productivity and its decomposition components. Accordingly, this chapter is divided into following sections. Section-5.2 describes about data and variables of the study. Section-5.3 explains the empirical analysis of the study. In section-5.4 we have reported the estimated result of the analysis. Section-5.5 pursues the interpretation of the estimated result of the study during reform the post period and section-4.7 summarizes the analysis.

5.2. Data and Description of Variables

For our analysis we use industry level panel data of fourteen manufacturing industries. These industries have faced greater reduction in trade protection in 1990s along with industrial policy reform. Hence, analysis of these manufacturing industries assumes significance. The industry level data are obtained from ASI for the period from 1980-81 to 2007-08 at sub national level as before. The use of panel data allows us to have not only more number of observations, but also enable us to look into the pattern of distribution of technical efficiency among industries and its change over time. The panel consists of 392 observations of different states for each industry. The constructions of variables are already explained in the chapter-II and the same variables are used as before, i.e., labor, capital, material input and the manufacturing output that we already taken in the chapter-III. In the next section, we turn to the empirical analysis of the study.

5.3. Empirical Analysis

In this section, production frontier approach is used to measure the technical efficiency for the manufacturing sector and is extended to calculate the TFP with the help of its decomposition form as technical efficiency alone cannot explain the true performance of the manufacturing industries.

Here, the components of productivity change are estimated within a stochastic production frontier framework. As in chapter-II, we start with a time varying production frontier which can be specified in Cob Douglas production function form as

$$LnY = \beta_0 + \Sigma\, \beta_{ij}(lnX)_{ij} + v - u \qquad (1)$$

Where *i*= (1, 2, 3, …., T) time period and *j*= (1,2.3,……, J) number of industries. X is inputs that are used to produce *Y*. In our model *X*= (capital, labor and material input) and *Y*= output. The efficiency error, u, represents production loss due to firm specific technical efficiency and is assumed to be independent of statistical error, v, which is assumed to be *iid N* (0, σ^2). To decompose the total factor productivity into TE, TP and SEC we have followed the method of Kumbhakar and Lovell (2000), which is also been used by other studies (Kim and Saravanakumar 2012; kalirajan 2004). This methodology has been already explained in the Chapter-II.

In the next section the estimated result are reported in table-5.1 and 5.2. The result for technical efficiency change is reported, which is followed by the results for technological progress and scale efficiency change. In the end, TFP of each manufacturing industries are explained. For some industries the scale efficiency is not calculated as it has already been explained in the methodology part of the chapter-II.

5.4. Estimation of Result

The estimates of technical efficiency (TE) and technological progress (TP) and Scale efficiency (SC) are derived from equation (1), and the sectoral TFP growth is not calculated as a residual but is obtained by summing changes in TE, TP and SE. If we analyze table-5.1, it is clear that TFP growth has increased in most of the industries in the post reform period than the pre-reform period. Some authors argue that growth in TFP happened because of institutional reforms started in early 1980s (Goldar and kumara 2003; Panigaria 2004). The decomposition of TFP growth into technical efficiency change, technological progress and scale efficiency change helps to understand the source of TFP growth. The decomposition analysis reveals that output growth, induced by reform, can be attributed to productivity growth, of which technological progress is the most dominant component. The negative sign of technical efficiency change indicates that the capital realization declined. Within the manufacturing sector, there is heterogeneity among the industries on the basis of technical efficiency change.

5.4.1 Change in Technical Efficiency (TEC)

The estimates of TEC is positive in the beverage and tobacco (0.0001), textiles (0.0002), paper (0.0001), nonmetallic (0.0002) and other manufacturing industries (0.0002) and is negative in the food (-0.0005), chemical (-0.0005), rubber (-0.0001) and basic metal industries (-0.0002), where as in the rest of the industries it's mean value for the whole sample period, comes close to zero. The annual TEC presents a different picture from the mean TEC during the period of 1981 to 2007. In the food industries, the mean TEC was estimated at (-0005), but yearly estimates shows significant improvement in the year of 1998, 2000, 2004 and 2006, then the rest of the period. In the beverage and tobacco industries, there was an improvement in TEC from 1981 to 1989. After that it shows a mixed picture. In cotton and jute industries there was negative in TEC in all years, there was slight change in the TEC by (-0.0004) between the first and last period of sample years. In textile industries, TEC has become positive in most of the years and its value was highest in the year 2000 and was lowest in the year 1990. In wood industries TEC has been decreased in most of the years and its value has come down to -0.0001 in 2007. A similar trend is observed in leather industries where the mean TEC is equal to zero. In chemical industries the mean TEC is -0.005 for the whole sample period, but yearly TEC fluctuated within a small range throughout the period. Similarly a slight fluctuation is observed in rubber and basic metal industries, which has negative mean TEC for the whole sample period.

Negative mean TEC is observed in most of the industries except textile, paper, tobacco and non metallic industries for several years. This might reflect the fast growth of Indian manufacturing sector. As the production frontier of the economy as continuously shifted upward by large firms, the gap between frontier and actual production enjoyed by Small and Marginal Enterprises (SMEs) widened. There by causing deterioration in average TE. Mean while positive mean TECs in tobacco, textiles, paper and non-metallic industries suggest that the SMEs were catching up fast to frontier firms, narrowing the gap between SMEs and the frontier firms. In these industries, technology transfers between the firms were more pronounced than the other industries that experienced a widening TE gap.

Economic theory suggests that TE is related to factors such as skill of workers, managerial expertise and input mix among others. This means that India's manufacturing firms must enhance on-the-job training to lift the skill level of their workers and hire high quality managers to put existing frontier production process into practice (Kim and Muthuswami 2012).

5.4.2 Technical Progress (TP)

Table-5.1 presents the average of the rates of Technological Progress (TP) of Indian manufacturing industries by year. The average rate of TP has increased continuously for all industries throughout the sample period. The average annual growth rates of TP were highest in the textile industries (0.0439), followed by other manufacturing industries (0.0417) and non metallic industries (0.0384). The average annual growth rate of TP were slowest in paper industries (0.0104), followed by wood (0.0147) and beverage industries (0.0159). In the rest of the industries the value of TP varies in between 0.02 to 0.03 for the whole sample period.

The textile industries led steadily in TP throughout these years, but the large gap in TP between industries narrowed rapidly over the years. The gain in TP was almost impressive in other manufacturing industries, which jumped from the lowest and negative TP in 2000 to the second highest in 2007. Every industry experienced increasing TP, particularly in the post reform period, except food and textile industries. This widespread increase in TP was possible by increase in investment resulting from the series of economic reforms implemented by the Indian government since 1985.

5.4.3 Change in Scale Efficiency

Table - 5.1 explains the average rates of Scale Efficiency Change (SEC), which measures the effect of input changes on productivity growth, and it is zero if returns to scale is constant, and greater (or less) than the zero if Return to Scale (RTS) is increasing (or decreasing), given positive input growth. When return to scale is equal to 1, change in scale efficiency is not calculated. Return to scale for each industry has been already reported in table-4.1, chapter-IV. The average efficiency is the lowest in the basic metal industries with -0.0057 followed by food and wood product industries with -0.0025 and -0.0008. The average SEC was fastest in the non metallic industries (0.0056), followed by textile and chemical industries with 0.0034 and 0.0018 respectively. In the rest of the industries it is positive except cotton industries. Generally SEC increased in non metallic, textile, chemical, beverage and rubber industries over the whole sampling years but decreased in other industries. There was a slight decrease in SEC for basic metal and food industries for the whole sample years.

The Indian government implemented the reform process in 1991 to make the manufacturing sector more competitive. The reform expanded the market across borders, to enable the manufacturing sector to realize scale economies. However the estimated SEC was meager and negative in most of the industries and for most years. This may have resulted in more firms with an insufficient production scale entering the market after government deregulation, thus reducing the overall SEC, even though some firms did move closer to the economies of scale with increased investment.

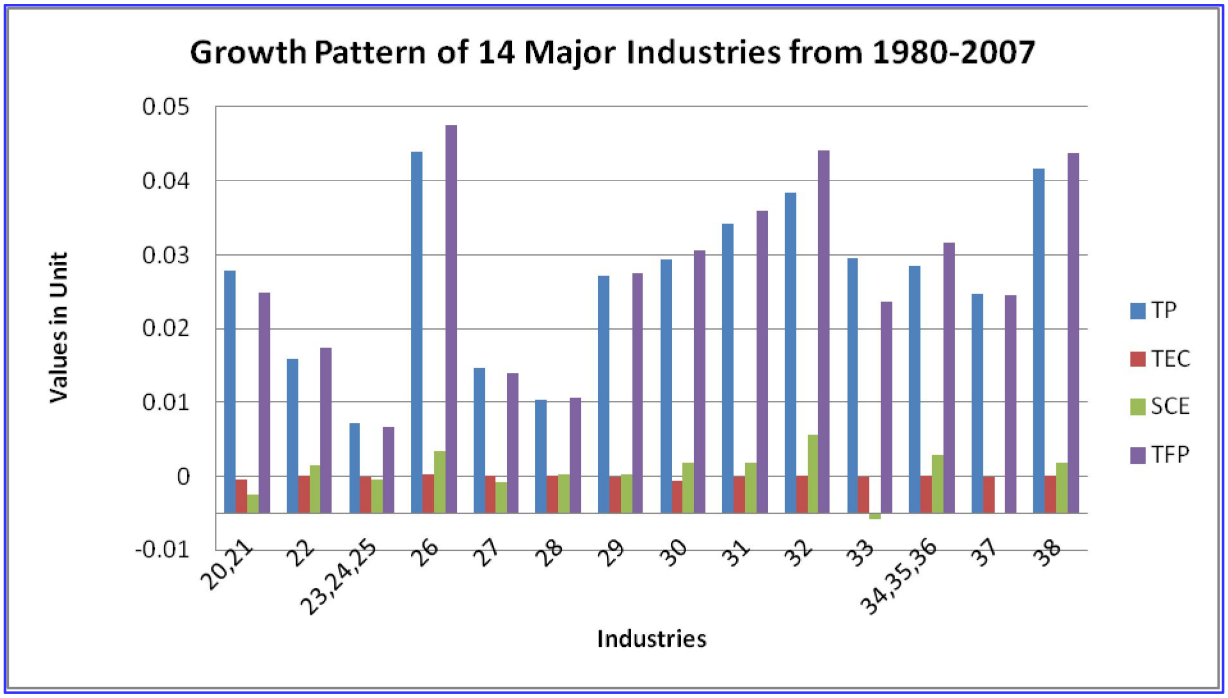
5.4.4 Total Factor Productivity (TFP)

Table-5.1 describes the average rate of TFP, which is calculated as the sum of TEC, TP and SEC. Average TFP was fastest in the textile industries with 0.0475, followed by non metallic and other manufacturing industries with 0.0442 and 0.0437 respectively. Average TFPG was slowest in cotton textile industries with 0.0068, followed by paper and wood industries with 0.0107 and 0.0139 respectively. In the rest of the industries, TFP varies from 0.02 to 0.03 for the whole sample years.

Decomposition shows that TP was the key component that determined TFP, than the rest of the components and setting the tone of Indian manufacturing productivity growth. However, all other factors are also contributing significantly to TFPG. But TEC and SEC were deteriorated for some of the industries during the whole sampling period. The decomposition suggests the urgent need to improve TE in Indian manufacturing industries. To do so, the quality of the workers in these industries should be improved by enhancing the education system providing on-the-job training to the employees.

The priority of policy makers should be to create productivity boosting policies, even though the decomposition shows the importance of a balanced performance of the three productivity components in improving overall productivity. SEC should be emphasized to boost TFP in basic metal, food and wood product industries, where as lagging TEC in chemical, rubber, food and basic metal industries should be addressed. The slow TP in paper, wood and beverage industries respectively should be increased.

Figure 5.1: Growth Pattern of Manufacturing Industries for the Whole Sample Period



Note: 20,21-Food Products, 22-Beverage, 23,24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Source: calculation is based on ASI data

The figure 5.1 explains the growth and composition of TFP for the fourteen major industries from 1980 to 2007. From the above figure it clearly shows that TFP in Textile industries (26), the manufacturing industries (38) and non metallic products have did extremely well in compare to other industries. The slowest performed industries are wood (27), paper (28) and cotton textiles (23, 24, and 25). Among the three components of TFP, TE has outperformed among all where TEC shows least important in improving TFP in these industries. The figure 4.1 is supporting our result that we have reported above.

Table 5.1 Technical Progress, Technical Efficiency Change, Scale Efficiency Change and Total Factor Productivity in Indian Manufacturing

	Food and Food Products				Beverage , Tobacco and Related Products				Cotton, Jute and Fiber Textile Products			
YEAR	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP
1981	0.0252	-0.0044	-0.0035	0.0174	0.0207	0.0030	0.0028	0.0266	-0.0127	-0.0022	-0.0007	-0.0156
1982	0.0573	-0.0077	-0.0035	0.0461	-0.0055	0.0002	-0.0013	-0.0066	-0.0126	-0.0062	-0.0004	-0.0193
1983	0.0231	-0.0106	-0.0015	0.0109	0.0095	0.0022	0.0043	0.0160	0.0090	-0.0059	-0.0010	0.0022
1984	-0.0039	0.0225	-0.0017	0.0169	0.0561	-0.0097	0.0018	0.0482	0.0260	0.0167	-0.0013	0.0414
1985	0.0247	-0.0044	-0.0016	0.0187	0.0609	0.0041	0.0019	0.0668	-0.0476	-0.0009	-0.0004	-0.0489
1986	0.0324	0.0045	-0.0022	0.0347	0.0377	-0.0035	0.0007	0.0348	-0.0547	-0.0001	0.0008	-0.0540
1987	0.0285	-0.0044	-0.0033	0.0208	0.0138	0.0040	0.0033	0.0210	0.0252	-0.0014	-0.0011	0.0227
1988	0.0433	-0.0013	-0.0029	0.0391	0.0100	0.0020	0.0011	0.0131	0.0311	0.0024	-0.0011	0.0324
1989	0.0679	-0.0078	-0.0057	0.0544	-0.0241	0.0024	0.0010	-0.0207	0.0469	-0.0010	-0.0013	0.0446
1990	0.0517	0.0109	-0.0030	0.0596	-0.0046	-0.0034	0.0033	-0.0047	0.0387	-0.0065	-0.0005	0.0317
1991	0.0215	-0.0060	-0.0031	0.0124	0.0267	0.0027	0.0009	0.0303	0.0137	-0.0045	-0.0008	0.0084
1992	0.0194	0.0142	-0.0028	0.0308	0.0256	0.0048	0.0020	0.0323	0.0181	0.0130	-0.0003	0.0307
1993	0.0250	-0.0007	-0.0030	0.0213	0.0368	0.0006	0.0011	0.0385	0.0307	-0.0004	-0.0006	0.0297
1994	0.0301	-0.0083	-0.0039	0.0179	0.0402	-0.0117	0.0034	0.0319	0.0375	-0.0004	-0.0016	0.0355
1995	0.0509	-0.0065	-0.0041	0.0403	0.0176	0.0036	0.0002	0.0214	0.0246	-0.0008	-0.0011	0.0227
1996	0.0509	0.0021	-0.0032	0.0498	0.0084	-0.0058	0.0012	0.0037	0.0323	-0.0129	0.0002	0.0196
1997	0.0196	-0.0088	-0.0012	0.0096	0.0354	0.0042	0.0026	0.0422	0.0609	-0.0069	-0.0004	0.0536
1998	-0.0251	0.0099	-0.0030	-0.0183	-0.0095	-0.0039	0.0017	-0.0117	-0.0680	0.0157	0.0022	-0.0501
1999	-0.0079	-0.0084	-0.0030	-0.0193	-0.0194	0.0041	0.0003	-0.0150	-0.1012	-0.0032	0.0001	-0.1044
2000	0.0263	0.0155	0.0004	0.0422	0.0144	-0.0004	0.0026	0.0166	0.0045	0.0090	-0.0005	0.0130
2001	0.0445	-0.0043	-0.0015	0.0386	-0.0010	0.0032	-0.0002	0.0020	-0.0054	-0.0004	0.0008	-0.0049
2002	0.0612	-0.0012	-0.0027	0.0573	0.0065	-0.0033	0.0003	0.0036	0.0254	-0.0002	-0.0011	0.0241
2003	-0.0027	-0.0075	-0.0003	-0.0105	0.0058	0.0032	0.0023	0.0113	-0.0004	-0.0006	0.0011	0.0001
2004	-0.0068	0.0067	-0.0008	-0.0010	0.0141	-0.0023	0.0000	0.0118	-0.0173	-0.0061	0.0007	-0.0227
2005	0.0216	-0.0080	-0.0041	0.0096	0.0320	0.0030	0.0033	0.0383	0.0372	-0.0039	-0.0024	0.0309
2006	0.0365	0.0092	-0.0032	0.0425	0.0213	-0.0041	0.0002	0.0175	0.0493	0.0084	0.0000	0.0577
2007	0.0353	-0.0073	0.0003	0.0283	0.0006	0.0033	-0.0007	0.0031	0.0022	-0.0018	0.0008	0.0012
1981-07	***0.0278***	***-0.0005***	***-0.0025***	***0.0248***	***0.0159***	***0.0001***	***0.0015***	***0.0175***	***0.0072***	***0.0000***	***-0.0004***	***0.0068***

	Textile Products (including apparel)				Wood and Wood products				Paper, Paper Products and Printing			
YEAR	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP
1981	0.0296	0.0019	-0.0023	0.0292	0.0108	-0.0026	-0.0011	0.0072	0.0216	0.0006	0.0009	0.0230
1982	0.0138	0.0041	0.0072	0.0251	0.0392	0.0032	-0.0010	0.0414	0.0012	-0.0049	0.0004	-0.0032
1983	-0.0013	0.0010	0.0066	0.0063	-0.0166	-0.0020	0.0009	-0.0177	-0.0096	0.0008	0.0004	-0.0084
1984	0.0070	-0.0056	0.0004	0.0018	-0.0190	0.0025	-0.0012	-0.0176	0.0320	0.0079	0.0004	0.0403
1985	-0.0671	0.0017	0.0030	-0.0625	0.0953	-0.0015	-0.0004	0.0934	-0.0270	0.0003	0.0002	-0.0266
1986	-0.0252	-0.0001	0.0008	-0.0246	0.1016	0.0012	-0.0017	0.1011	-0.0349	-0.0008	0.0002	-0.0354
1987	0.0681	0.0014	0.0074	0.0769	0.0290	-0.0018	-0.0008	0.0264	0.0187	0.0003	0.0004	0.0194
1988	0.0460	0.0041	0.0020	0.0520	0.0929	0.0022	-0.0032	0.0919	0.0178	-0.0059	0.0002	0.0121
1989	0.0622	0.0006	0.0068	0.0696	0.0520	-0.0013	0.0013	0.0521	0.0380	0.0007	0.0005	0.0392
1990	0.0932	-0.0123	0.0053	0.0862	-0.0317	-0.0015	0.0007	-0.0326	0.0484	-0.0010	0.0004	0.0479
1991	-0.0021	0.0023	-0.0008	-0.0006	-0.0117	-0.0040	0.0006	-0.0152	0.0198	0.0007	0.0002	0.0207
1992	-0.0048	0.0011	0.0031	-0.0005	-0.0785	0.0066	-0.0012	-0.0730	-0.0160	-0.0019	0.0001	-0.0178
1993	0.0607	0.0018	0.0057	0.0681	-0.0848	-0.0015	-0.0014	-0.0877	-0.0121	0.0008	0.0002	-0.0111
1994	0.0713	-0.0001	0.0071	0.0782	-0.0253	0.0024	-0.0003	-0.0233	0.0445	0.0099	0.0006	0.0550
1995	0.0525	0.0016	0.0030	0.0570	-0.0178	-0.0006	0.0007	-0.0178	0.0670	0.0001	0.0006	0.0677
1996	0.0539	-0.0032	0.0036	0.0543	0.0765	-0.0001	-0.0037	0.0726	0.0176	-0.0066	0.0002	0.0112
1997	0.0876	0.0018	0.0023	0.0918	0.0013	-0.0014	0.0010	0.0009	-0.0291	0.0005	-0.0004	-0.0290
1998	0.0462	0.0005	0.0039	0.0507	-0.0557	-0.0043	-0.0045	-0.0645	-0.0505	-0.0054	-0.0006	-0.0566
1999	0.0469	0.0015	0.0039	0.0523	-0.0117	-0.0068	0.0008	-0.0177	-0.0160	0.0008	0.0012	-0.0139
2000	0.1083	0.0052	0.0008	0.1143	0.0538	0.0129	-0.0013	0.0655	0.0299	0.0090	0.0006	0.0395
2001	0.0521	0.0004	0.0033	0.0559	0.1452	-0.0009	-0.0031	0.1412	0.0246	0.0002	-0.0002	0.0246
2002	0.1359	-0.0055	0.0105	0.1409	0.0158	0.0011	0.0023	0.0191	0.0467	-0.0021	0.0004	0.0449
2003	0.0169	0.0012	-0.0057	0.0125	0.0186	-0.0008	-0.0041	0.0137	-0.0548	0.0003	-0.0006	-0.0550
2004	0.0317	-0.0060	0.0031	0.0289	-0.0291	-0.0005	0.0057	-0.0240	-0.0969	0.0004	-0.0003	-0.0968
2005	0.0609	0.0019	0.0066	0.0694	-0.0607	-0.0021	-0.0063	-0.0692	0.0653	0.0003	0.0012	0.0668
2006	0.0872	0.0029	0.0073	0.0974	0.0774	0.0032	0.0001	0.0807	0.0903	-0.0028	0.0004	0.0879
2007	0.0525	0.0012	-0.0019	0.0518	0.0304	-0.0010	-0.0005	0.0290	0.0432	0.0004	0.0002	0.0438
1981-07	***0.0439***	***0.0002***	***0.0034***	***0.0475***	***0.0147***	***0.0000***	***-0.0008***	***0.0139***	***0.0104***	***0.0001***	***0.0003***	***0.0107***

	leather products				***chemical and chemical products***				***rubber and plastic products***			
YEAR	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP
1981	0.0918	-0.0010	0.0033	0.0941	0.0513	-0.0118	0.0046	0.0441	0.0058	-0.0005	0.0022	0.0076
1982	-0.0082	0.0026	-0.0022	-0.0079	0.0647	0.0080	0.0009	0.0737	0.0195	-0.0018	0.0033	0.0210
1983	0.0007	-0.0005	0.0003	0.0005	0.0284	-0.0127	0.0015	0.0173	0.0156	-0.0015	-0.0003	0.0138
1984	0.0445	-0.0004	0.0011	0.0452	0.0392	0.0153	0.0025	0.0570	-0.0510	0.0039	0.0009	-0.0462
1985	0.0398	-0.0008	0.0008	0.0398	0.0650	-0.0121	0.0028	0.0557	-0.0684	-0.0004	0.0054	-0.0634
1986	0.0741	0.0013	0.0020	0.0774	0.0609	0.0126	0.0029	0.0764	0.0054	0.0004	0.0011	0.0068
1987	0.0028	-0.0006	-0.0030	-0.0008	0.0395	-0.0120	0.0019	0.0294	0.0343	-0.0004	0.0021	0.0360
1988	0.0472	0.0006	0.0043	0.0521	0.0350	0.0157	0.0024	0.0531	0.0963	-0.0008	0.0066	0.1021
1989	0.0567	-0.0007	-0.0025	0.0536	0.0265	-0.0110	-0.0005	0.0150	0.0489	-0.0009	-0.0018	0.0461
1990	0.0580	-0.0015	0.0039	0.0604	0.0341	0.0078	0.0026	0.0445	0.0541	0.0018	0.0021	0.0580
1991	0.0016	-0.0014	-0.0039	-0.0037	0.0613	-0.0119	0.0046	0.0540	0.0138	-0.0005	-0.0007	0.0125
1992	-0.0164	0.0039	0.0027	-0.0098	0.0347	0.0146	0.0005	0.0499	0.0335	0.0005	0.0030	0.0370
1993	0.1123	-0.0005	0.0021	0.1138	-0.0065	-0.0111	0.0001	-0.0174	0.0793	-0.0005	0.0019	0.0807
1994	0.1168	0.0007	0.0013	0.1189	0.0219	0.0096	0.0030	0.0345	0.0460	0.0009	0.0006	0.0475
1995	0.0594	-0.0004	0.0006	0.0596	0.0515	-0.0116	0.0036	0.0436	0.0479	-0.0003	0.0036	0.0512
1996	0.0234	-0.0022	-0.0002	0.0210	0.0277	0.0082	0.0007	0.0367	0.0593	-0.0004	0.0014	0.0603
1997	0.0171	-0.0013	-0.0032	0.0126	0.0200	-0.0124	0.0016	0.0092	0.0393	-0.0007	0.0012	0.0399
1998	0.0095	0.0003	0.0052	0.0150	-0.0203	0.0118	0.0001	-0.0084	-0.0821	-0.0031	-0.0039	-0.0891
1999	-0.1478	-0.0017	-0.0027	-0.1521	-0.0070	-0.0125	0.0042	-0.0153	-0.0273	-0.0025	0.0060	-0.0237
2000	-0.0755	0.0045	0.0019	-0.0691	0.0282	0.0193	0.0029	0.0503	0.0958	0.0070	0.0011	0.1039
2001	0.1231	-0.0007	-0.0003	0.1220	-0.0026	-0.0107	-0.0012	-0.0145	0.0556	-0.0004	0.0022	0.0574
2002	0.0163	0.0000	0.0002	0.0165	0.0243	0.0056	-0.0003	0.0296	0.0889	0.0001	0.0006	0.0896
2003	-0.0477	-0.0010	-0.0001	-0.0487	0.0161	-0.0121	0.0038	0.0078	0.0418	-0.0005	0.0024	0.0437
2004	0.0948	0.0010	0.0025	0.0983	0.0642	0.0133	0.0042	0.0817	0.0176	-0.0008	-0.0028	0.0141
2005	-0.0085	-0.0010	-0.0017	-0.0112	0.0129	-0.0119	-0.0020	-0.0010	0.0832	-0.0012	0.0059	0.0879
2006	0.0120	0.0014	-0.0006	0.0127	-0.0110	0.0100	0.0025	0.0014	0.0865	0.0017	0.0055	0.0937
2007	0.0334	-0.0008	-0.0031	0.0295	0.0322	-0.0123	-0.0016	0.0183	0.0852	-0.0009	-0.0013	0.0830
1981-07	***0.0271***	***0.0000***	***0.0003***	***0.0274***	***0.0293***	***-0.0005***	***0.0018***	***0.0306***	***0.0343***	***-0.0001***	***0.0018***	***0.0360***

	Non Metallic Products				Basic Metal and Alloys				Metal, Machinery, Electrical			
YEAR	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP
1981	0.0411	0.0042	0.0115	0.0568	0.0290	-0.0016	-0.0091	0.0183	0.0167	0.0033	0.0050	0.0250
1982	0.0821	-0.0067	0.0081	0.0835	0.0407	0.0046	-0.0001	0.0453	0.0206	-0.0018	0.0022	0.0210
1983	0.0497	0.0053	0.0078	0.0629	0.0032	-0.0004	-0.0070	-0.0043	0.0094	0.0028	0.0037	0.0159
1984	0.0263	-0.0030	0.0082	0.0314	0.0030	-0.0007	-0.0088	-0.0066	0.0240	-0.0019	0.0024	0.0246
1985	0.0643	0.0043	0.0100	0.0785	0.0491	-0.0009	-0.0053	0.0429	0.0462	0.0025	0.0046	0.0534
1986	0.0598	0.0005	0.0027	0.0630	0.0555	0.0016	-0.0052	0.0519	0.0188	0.0000	0.0007	0.0194
1987	0.0230	0.0020	0.0026	0.0277	0.0307	-0.0006	-0.0024	0.0276	0.0408	0.0017	0.0052	0.0477
1988	0.0562	-0.0042	0.0112	0.0631	0.0412	0.0003	-0.0104	0.0311	0.0698	-0.0029	0.0044	0.0714
1989	0.0598	0.0031	0.0025	0.0654	0.0321	-0.0007	-0.0073	0.0240	0.0424	0.0021	0.0032	0.0477
1990	0.0157	0.0020	0.0004	0.0181	0.0210	-0.0023	-0.0047	0.0140	0.0309	-0.0145	0.0033	0.0197
1991	0.0294	0.0006	0.0105	0.0406	0.0285	-0.0019	-0.0078	0.0188	0.0142	0.0060	0.0043	0.0245
1992	0.0233	-0.0089	0.0006	0.0150	0.0356	0.0055	-0.0057	0.0354	0.0021	0.0044	0.0026	0.0092
1993	-0.0169	0.0046	-0.0010	-0.0134	-0.0067	-0.0005	0.0063	-0.0009	-0.0013	0.0028	0.0014	0.0029
1994	0.0098	-0.0042	0.0076	0.0131	0.0019	0.0007	-0.0101	-0.0074	0.0307	-0.0050	0.0039	0.0296
1995	0.0699	0.0044	0.0170	0.0913	0.0757	-0.0004	-0.0105	0.0648	0.0727	0.0035	0.0045	0.0807
1996	0.0508	-0.0038	0.0010	0.0480	0.0108	0.0005	0.0036	0.0149	0.0411	-0.0060	0.0017	0.0368
1997	0.0184	0.0041	0.0032	0.0258	0.0179	-0.0004	-0.0100	0.0075	0.0065	0.0043	0.0008	0.0116
1998	0.0043	0.0011	-0.0137	-0.0083	-0.0098	-0.0044	0.0066	-0.0077	-0.0049	-0.0006	0.0036	-0.0019
1999	0.0468	0.0016	0.0147	0.0631	-0.0334	-0.0022	-0.0048	-0.0403	-0.0109	0.0031	0.0013	-0.0065
2000	0.0691	-0.0060	0.0103	0.0735	0.0037	0.0044	-0.0031	0.0049	-0.0007	0.0002	0.0008	0.0004
2001	0.0367	0.0037	0.0023	0.0427	0.0188	-0.0014	-0.0041	0.0133	0.0088	0.0020	0.0010	0.0117
2002	0.0632	-0.0041	0.0098	0.0689	0.0627	0.0002	-0.0007	0.0622	0.0432	0.0029	0.0032	0.0493
2003	0.0318	0.0039	-0.0014	0.0342	0.0452	-0.0018	-0.0130	0.0304	0.0150	0.0003	0.0011	0.0164
2004	0.0456	-0.0073	0.0145	0.0528	0.0531	0.0052	-0.0083	0.0500	0.0421	-0.0110	0.0030	0.0341
2005	0.0243	0.0055	-0.0012	0.0286	0.0401	-0.0005	-0.0109	0.0287	0.0673	0.0039	0.0045	0.0757
2006	0.0100	-0.0022	0.0105	0.0183	0.0667	-0.0043	-0.0176	0.0448	0.0491	-0.0014	0.0034	0.0510
2007	0.0425	0.0040	0.0020	0.0484	0.0826	-0.0022	-0.0041	0.0763	0.0762	0.0031	0.0033	0.0826
1981-07	***0.0384***	***0.0002***	***0.0056***	***0.0442***	***0.0296***	***-0.0002***	***-0.0057***	***0.0237***	***0.0286***	***0.0001***	***0.0029***	***0.0316***

Continued….

	Transport Equipment				Other Manufacturing Industries			
YEAR	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP
1981	0.0145	-0.0022		0.0123	-0.0398	-0.0053	-0.0017	-0.0468
1982	0.0184	-0.0026		0.0157	-0.0208	0.0126	0.0014	-0.0068
1983	0.0129	-0.0058		0.0071	0.0141	-0.0016	0.0010	0.0135
1984	0.0305	0.0102		0.0407	0.0121	-0.0014	0.0006	0.0113
1985	0.0193	-0.0026		0.0167	0.0657	-0.0031	0.0029	0.0655
1986	0.0114	0.0038		0.0153	0.0664	-0.0047	0.0030	0.0648
1987	0.0402	-0.0016		0.0386	0.0500	0.0079	0.0028	0.0607
1988	0.0509	0.0026		0.0534	0.0370	-0.0031	0.0021	0.0360
1989	0.0601	-0.0008		0.0593	0.0325	0.0025	0.0027	0.0377
1990	0.0271	-0.0018		0.0253	0.0808	-0.0034	0.0053	0.0827
1991	-0.0147	-0.0029		-0.0176	0.0477	0.0083	0.0001	0.0561
1992	0.0252	0.0054		0.0305	0.0041	-0.0009	0.0016	0.0049
1993	0.0529	-0.0009		0.0520	0.0457	-0.0013	0.0003	0.0446
1994	0.0564	0.0010		0.0574	0.0524	0.0013	0.0041	0.0578
1995	0.0999	-0.0008		0.0991	0.1021	-0.0014	0.0050	0.1058
1996	0.0526	-0.0037		0.0488	0.0480	-0.0031	-0.0002	0.0448
1997	-0.0496	-0.0044		-0.0539	-0.0157	-0.0036	-0.0007	-0.0200
1998	-0.1705	0.0007		-0.1697	-0.0273	0.0097	0.0000	-0.0176
1999	-0.0591	-0.0069		-0.0660	0.0174	-0.0004	0.0030	0.0200
2000	0.0695	0.0152		0.0847	0.0273	-0.0006	0.0014	0.0281
2001	-0.0267	-0.0007		-0.0274	0.0382	-0.0044	0.0035	0.0372
2002	0.0825	-0.0007		0.0819	0.0850	-0.0032	0.0027	0.0844
2003	-0.0293	-0.0018		-0.0311	0.1231	0.0032	0.0091	0.1354
2004	-0.0064	0.0007		-0.0056	0.0785	-0.0032	-0.0038	0.0714
2005	0.1608	-0.0027		0.1581	0.0409	0.0070	0.0003	0.0482
2006	0.0760	0.0022		0.0782	0.0917	-0.0012	0.0047	0.0952
2007	0.0637	-0.0030		0.0607	0.0683	-0.0019	-0.0005	0.0659
1981-07	***0.0248***	***-0.0002***		***0.0246***	***0.0417***	***0.0002***	***0.0019***	***0.0437***

Source: calculation is based on ASI data

5.5. Total Factor Productivity during Pre and Post Reform Period

The average rate of TFPG has been calculated for both the pre reform and post reform period for all the fourteen major industries in India. The result is presented in table-5.2, Productivity improvement is recorded for only six out of fourteen manufacturing industries during the post reform period then the pre reform period. These industries are textile, wood, rubber, non metallic, basic metal and machinery industries. The rest of the industries show a decline trend in the change in TFPG between pre and post reform period.

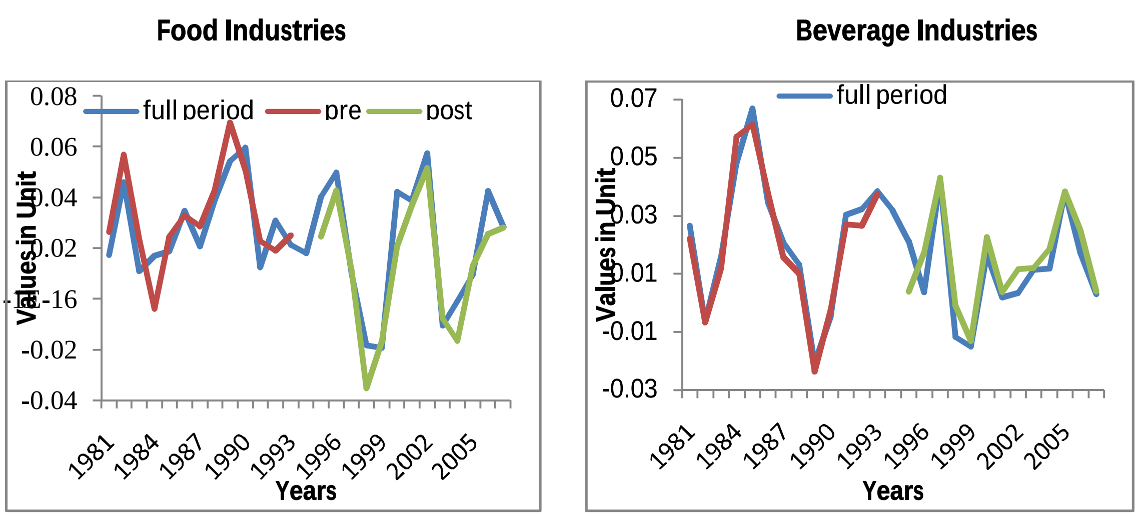
In terms of technical efficiency, beverage, textile, wood and paper industries have improved than the rest of the industries. Negative TEC observed in most of the industries because of the gap between frontier and actual production enjoyed by SMEs widened due to the opening up the economy after the economic reforms. Furthermore, the result also suggests that after the reforms, there is a lift in the restriction on investment by large industrial houses and foreign controlled companies. Following the reform, large domestic firms have led to keep innovating in response to new competition from foreign companies that entered the market. This helped to push production frontier of the Indian manufacturing sector much higher than it was before the reforms. This along with large number of new entrant SMEs resulted in negative TEC.

In terms of technological progress, industries like textile, wood, rubber, basic metal, machinery and other manufacturing industries are enjoying a higher technological progress during the post reform period in compare to pre reform period. In rest of the industries, TP shows a decline trend. The reason behind increase in TP in these above industries may be due to abolition of license by government and lifting restriction on investment by removing the asset limit through MRTP act. The government also increased the limit on foreign equity partition from 40 per cent to 51 per cent in 1998. Following this reform, capital investment in the Indian manufacturing sector, by both domestic firms and foreign multinationals, increased rapidly across industries. Increased capital investment in the manufacturing sector brought into the country new technological embodied capital, thus raising TP in an unprecedented way. However declining TP in the rest of the industries suggests that, these industries didn’t cope with the process of development.

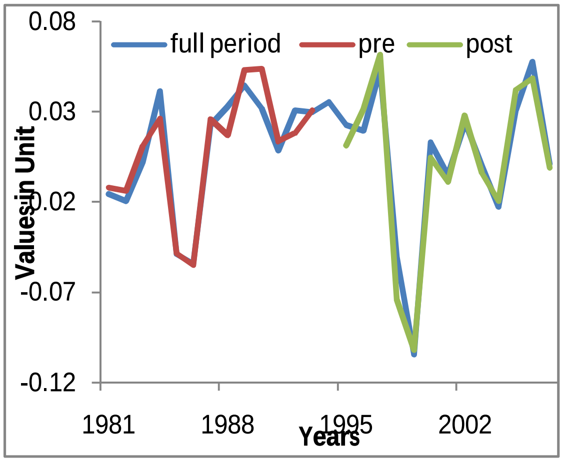
In term of scale efficiency, except beverage, cotton and basic metal industries, the rest are showing a negative change during the post reform era in compare to the pre reform. This may be due to some firms with insufficient production scale has entered the market during post reform period. For some industries, the return to scale is one. So we couldn't able to calculate the SCE for these industries. From the table-5.2, it shows that TFP was higher in the pre reform period then the post reform. Six out of fourteen industries (textile, wood, rubber, non-metallic, basic metal and machinery industries) have been outperformed after the economic reforms compare to the regulation era. The reason for deceleration of productivity growth may be due to the non-adoption of new technologies after the reform period. Technical progress showed positive change where as TEC and SEC deteriorated for most of the industries during the deregulating era. The inference is that the TFP growth appeared to be relatively better during the protected era than the liberalized regime.

In order to support our argument, in the figure-5.2 we have shown the growth trend of TFP of each manufacturing industry during pre reforms, post reforms and for the whole sample period in India. The pre reform era consists from 1980-1993 where as the post reform era is from 1994 to 2007. Among the all fourteen major manufacturing industries, textile, wood, rubber, non metallic, basic metal and machinery industries have performed well during the post liberalizing era than the pre reform period.

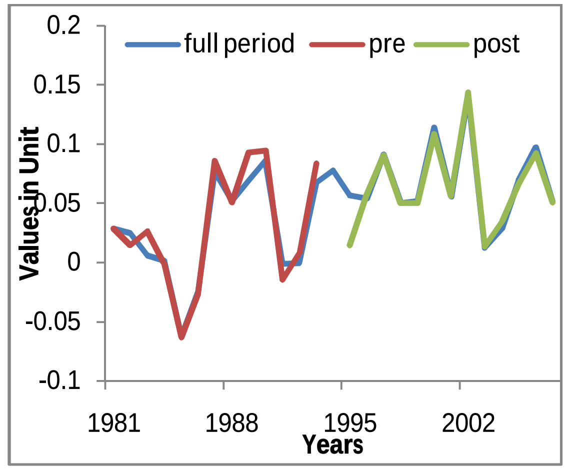
Figure 5.2: Total Factor Productivity Growth of Manufacturing Industries in India



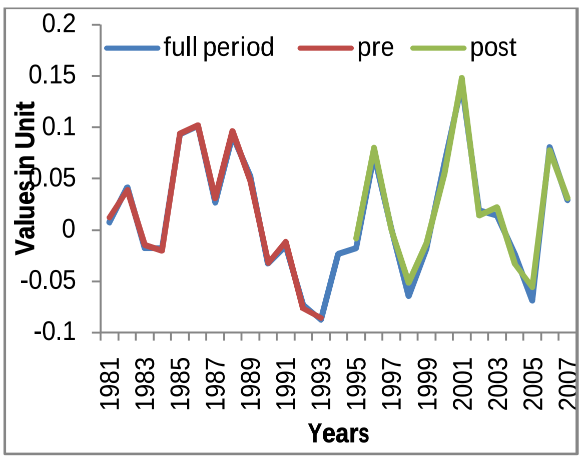
Jute and Cotton industries



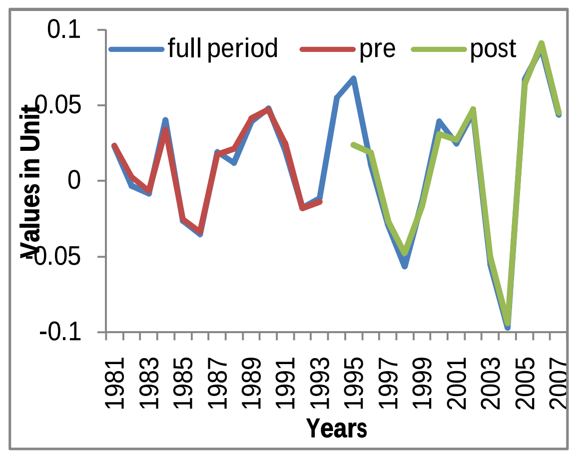
Textile Industries



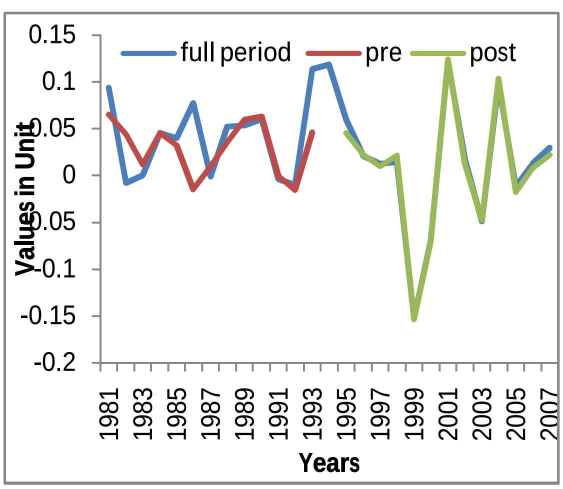
Wood Industries



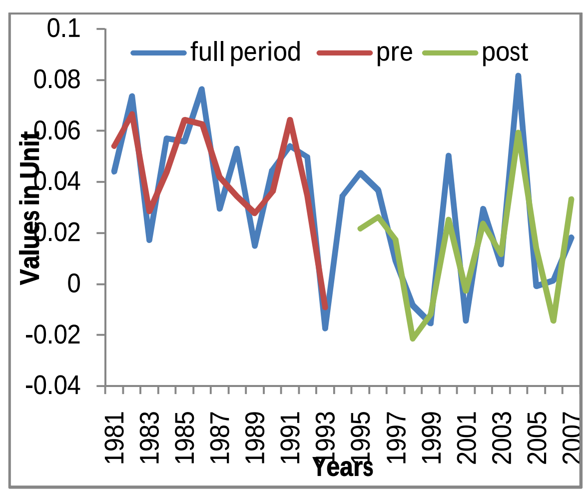
Paper Industries



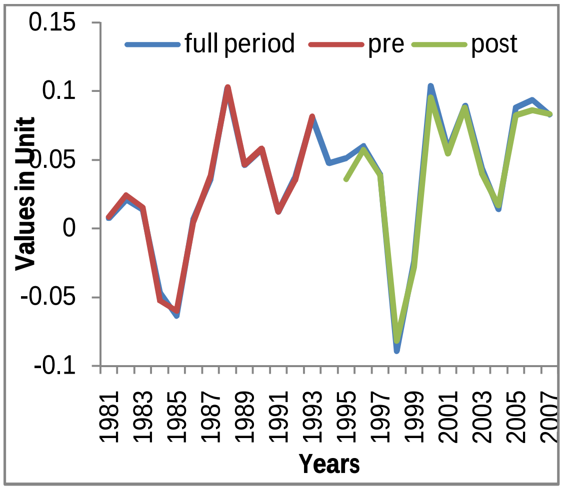
Leather Industries



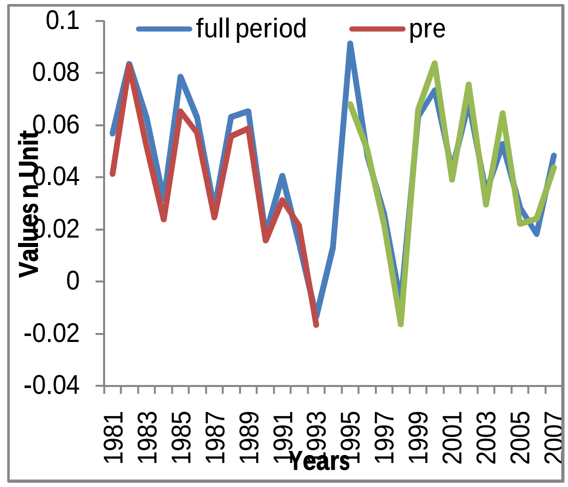
Chemical Industries



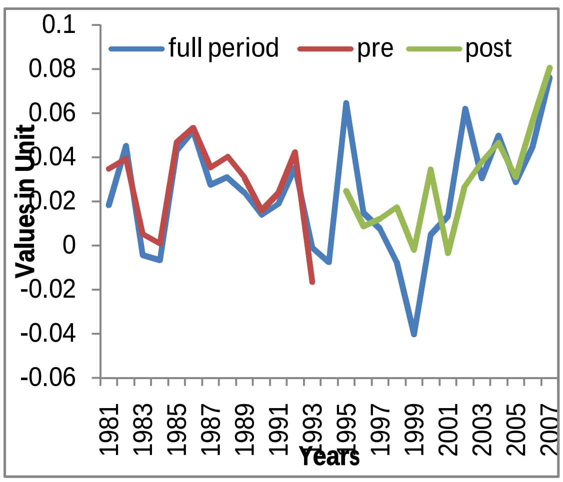
Rubber and Plastic Industries



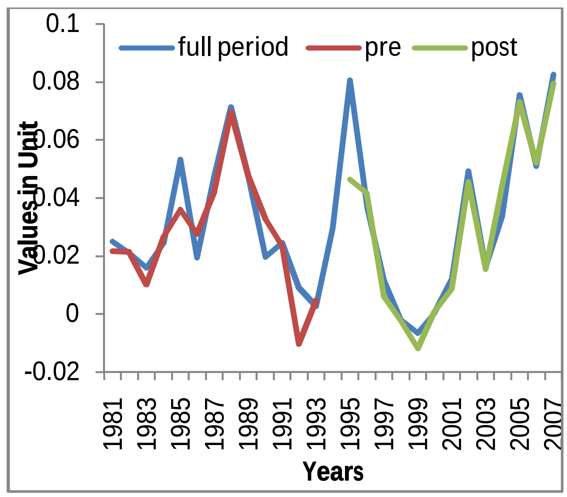
Non-Metallic Industries



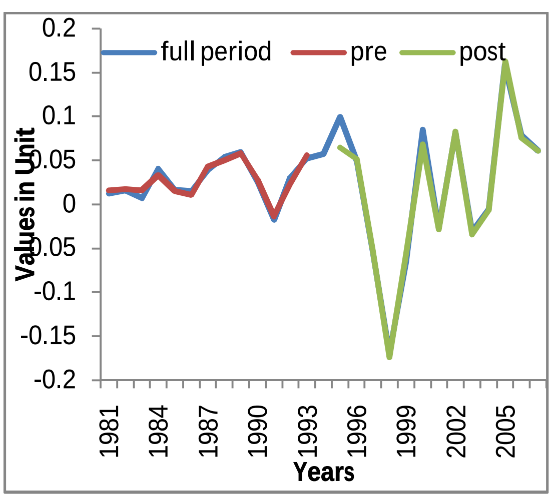
Metal Industries



Machinery Industries



Transport Industries



Other Manufacturing Industries

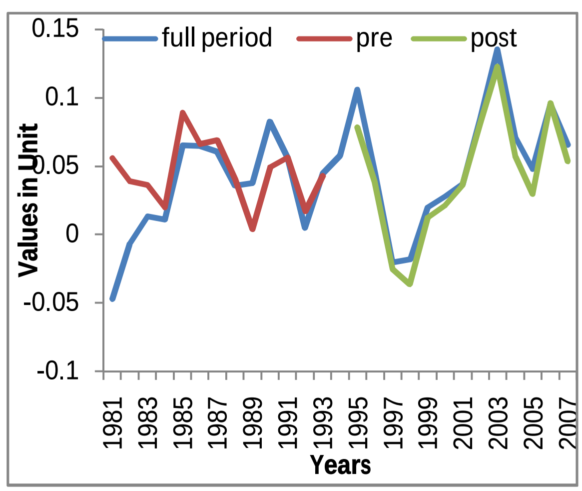


Table 5.2: The Average Rate of Total Factor Productivity Growth during Both the Pre and Post Reform Period

	pre reform				*post reform*				*change*			
INDUSTRY	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP	TP	TEC	SCE	TFP
20,21	0.032013	0.00002	0.000250	0.03228	0.022239	-0.00465	-0.00389	0.013697	-0.00977	-0.004670	-0.004139	-0.01858
22	0.020262	0.00000	0.000914	0.021176	0.008089	0.004027	0.002218	0.014334	-0.01217	0.004027	0.001304	-0.00684
23,24,25	0.009196	0.00005	0.000064	0.009306	0.002205	-0.00086	0.00013	0.001476	-0.00699	-0.000906	0.000066	-0.00783
26	0.021541	0.00014	0.008107	0.029787	0.060914	0.001295	0.001609	0.063818	0.039373	0.001157	-0.006498	0.034031
27	0.013732	0.00003		0.013759	0.019513	7.26E-05	0.000933	0.020518	0.00578	0.000046		0.006759
28	0.007529	-0.00022	0.001536	0.008846	0.007146	0.002273	-0.0007	0.008719	-0.00038	0.002492	-0.002236	-0.00013
29	0.029135	0.00062		0.029755	0.007164	-0.002	0.001373	0.006534	-0.02197	-0.002623		-0.02322
30	0.041084	-0.00008	0.001191	0.0422	0.016172	-0.00086	-0.00134	0.013971	-0.02491	-0.000784	-0.002533	-0.02823
31	0.022067	-0.00005	0.002160	0.024173	0.044715	-0.00024	-0.00064	0.043832	0.022648	-0.000189	-0.002800	0.019659
32	0.039519	-0.00001		0.039508	0.037659	-0.00031	0.006784	0.044136	-0.00186	-0.000296		0.004629
33	0.027902	-0.00024	-0.000572	0.027088	0.033556	0.000662	-0.00569	0.028524	0.005654	0.000903	-0.005123	0.001435
34,35,36	0.025753	0.00023	0.001168	0.027149	0.028798	-0.00073	0.002762	0.030829	0.003044	-0.000959	0.001594	0.00368
37	0.02682	0.00024		0.027055	0.017508	-0.00133	0.000424	0.016604	-0.00931	-0.001563		-0.01045
38	0.038493	0.00068	0.006065	0.045242	0.049531	-0.0103	0.004377	0.043607	0.011038	-0.010986	-0.001688	-0.00164

Note: 20-21 Food Products, 22-Beverage, 23, 24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.
Source: calculation is based on ASI data

5.6. Conclusion

In this chapter we adopted a stochastic frontier analysis to decompose productivity into three components: technical progress (TP), technical efficiency change (TEC), and scale efficiency change (SEC). The empirical result of this study show that Indian manufacturing suffers from both low level of TE and low growth rate of this factor. On TP, the results show that in each industry except paper wood and beverage industries experienced increasing technical progress for the whole sample period. The result show that SEC increased in eight industries over the sampling years and decreased in five industries, for transport industries we couldn't able to calculate it because in this industry RTS comes to one. Average TFPG increased in every industry for the whole sample period. But if we compare both pre and post reform period, there is positive change in TFPG only for six out of fourteen industries during the post reform period. The inference that we can draw here is that TFPG hasn't increased much during the post liberalizing era than the protective regime.

The result shows that TP was the key component in determining TFPG, than the other component and setting the tone of Indian productivity growth. However, all other factors also contributed significantly to TFPG, both individually and additively. The result suggests that to promote productivity, necessary steps are required to take in each industry. Industries with slow TP should emphasize research and development to speed up innovation process. Meanwhile, in industries where TEC is low, a policy to enhance the efficient use of existing technology is recommended to catch up with frontier technology. This study suggests that more firms with an insufficient production scale entered the market after government deregulation, and this pushed the overall scale efficiency, even though some firms enjoyed economies of scale, lowered the SCE during the post reforms period as well as for whole sample period. So, necessary policy should be taken to improve the scale efficiency of Indian manufacturing industries.

*****

CHAPTER-VI

Summary, Conclusion and Limitations of the Study

6.1 Introduction

The present study is intended to analyze and empirically verify the impact of economic reforms on growth, efficiency and productivity of manufacturing industries. Seeking for the clue about the reforms appropriate impact, we placed the debate by analyzing the controversy of exact duration (1980s or 1990s) of the occurrence of reforms through the survey of literature. In chapter-I, we presented the historical backgrounds along with theoretical and empirical literature in detail. In chapter-II, we explained the empirical model, methodology and data source of the study. In chapter III, we discussed the growth performance and distribution of Indian manufacturing sector. In chapter-IV, the empirical framework along with the results of the study of the second objective- impact of economic reforms on efficiency of manufacturing industries was presented. In chapter-V, the empirical study and results of the third objective-impact of economic reform on productivity of Indian industries was discussed. In the following paragraphs we sum up the whole study.

6.2 Summary and Conclusion

In chapter-I, we have surveyed the existing Indian literature on the countries manufacturing sector, we find that not many studies focus on the productivity and efficiency question as detail. Moreover, no study analyses the impact of reforms on all industries across all states, for which secondary data exists. Though many studies have attempted to look at the reforms, it has often been done with selected industries and/or with firm level data. Again, very few studies have decomposed the total factor productivity of Indian manufacturing industries into technological progress (TP), technical efficiency (TE) and scale efficiency change (SCE). All these motivated us to carry out this study to have a better knowledge and understanding regarding growth, productivity and efficiency of Indian manufacturing industries.

In the second chapter we have spelled out the empirical model, methodology and data source of the study to carry out the threefold objective. To examine our fist objective, i.e., the impact of economic reforms on growth and structure of manufacturing sector among the states of India, we have used a log linear model to compute the compound growth rate of output, wage and investment for the full sample period and the sub periods obtained from identifying the periods of structural change of manufacturing sector in different states following the reforms. For testing our second objective, i.e., the impact economic reforms on efficiency of manufacturing industries we have used a stochastic frontier analysis in the study and For the third objective, the same specification of stochastic frontier analysis is used to estimate TFP and the decomposition of TFP is carried out by using the parametric econometric modeling of production function developed by Kumbhakar (2000) as it is scale neutral unlike Solow's (1957) measure of productivity change which assumes constant return to scale (CRS) production technology and perfect efficiency.

In the third chapter, we have analyzed the share of output of different manufacturing industries in India for the sample period of 1980-81 to 2007-08. After that, we have applied Lee and Strazicich (2003) structural break test in the growth of output, wage and investment of different states for the whole sample period. The motivation behind this is to check the impact of economic reforms on different states as the economic, social, geographical and environmental situations are different among different states in India. . The result shows that in food industry, the share of Punjab and Maharashtra has been declined, where as Madhya Pradesh share has been increased from the pre to post reform period. Similarly the share of Andhra Pradesh and Madhya Pradesh in beverage industry has been declined significantly, and Karnataka has gained among all the states in post reform period. In cotton and jute industries the share of all the states has gone down except Tamilnadu, Rajasthan and Madhya Pradesh. Some states like Maharashtra in wood and wood product industries, Haryana in textile and basic metal industries, Rajasthan in metallic product industries, Gujarat in basic metal industries have performed well during the post reform period. Still in most of the industries the performance is not quite satisfactorily as they were expected during the post reform period.

From the analysis of the trend of investment we have found that for some states like Andhra Pradesh, Karnataka, Gujarat and Kerala an early change in pattern of investment is observed, for other states the change seems to be occurring very late. The rate of investment was high for the states like Gujarat, Haryana and medium for Tamilnadu, Andhra Pradesh, Maharashtra and Punjab whereas it was very low in Karnataka, West Bengal, Bihar and Kerala during the whole period of 1980-2007. The reason is the determinants of private investments like availability of physical infrastructure, developed transport system; easily access to market, increase in profit share etc. vary across the states which affect the rate of investment significantly.

In case of growth in manufacturing output the states like Karnataka, Gujarat, Rajasthan and Andhra Pradesh have grown at a very significant rate where as West Bengal, Punjab, Bihar and Kerala have a minimal growth rate. Most of the states have accelerated their growth rate after their second structural break around 2002-03. The variation in growth rate may be due to different competitive environment, the difference in entry barrier s among the cross sectional units and increased amount of contract workers.

When we will consider the wages in different states during the post reform period, the growth rate of wages did not vary as compared to output and investment. The growth rate in wages was highest in Haryana but it was negative in Bihar and West Bengal. Most of the states performed well from 1980 to their respective first structural break where as in second phase, that period is between the two structural breaks; the industrial wage rate became negative in most of the sates. The situation changed in last phase that is from break two to last period. The factors like bargaining strength of labor with the existence of labor union, future expectation of price changes, technical knowhow skill of workers and well organized labor market could be the possible factors for the variations in wage rate for different states of India.

In the fourth chapter we have analyzed the performance of fourteen manufacturing industries in terms of efficiency against the background of economic policy reforms introduced in India since 1991. The results indicate the change in the policy environment has positive effect on technical efficiency in beverage, textile, chemical, rubber and metal industries, while for the rest of the industries, it show a decline trend. The decline in the level of technical efficiency indicates that the majority of the firms in these industries failed to catch up with shifting frontier technology which was pushed further by the entry of large and foreign companies, happened by the opening up economy during post liberalized era. And the other findings are marginal productivity of labor in the formal manufacturing sector in India is much lower than the marginal productivity of capital and material input. There was an increase in the returns to factors inputs during the post reform period. However the percentage change in the returns to material input is much more pronounced than that of labor and capital. The returns to scale in most of the industries are close to unity, which means the scale of operation in manufacturing industries (on average) close to their optimum levels. In other words, most of the manufacturing industries were operating much closer to their minimum point of long run average cost curve.

After calculating technical efficiency foe each industry it doesn’t make a clear picture about the performance of manufacturing sector during both pre and post liberalization era. In order to have a better understand about the total factor productivity and the factors that are contributing to its growth, we have extended our study to the fifth chapter. We used the empirical model described in the chapter II to carry out the empirical estimation of the impact of economic reforms on productivity of Indian industries.

In fifth chapter we have decomposed productivity into three components: technical progress (TP), technical efficiency change (TEC), and scale efficiency change (SEC). The empirical result shows that Indian manufacturing suffers from both low level of TE level and low growth rate of this factor. On TP, the results show that every industry except paper wood and beverage industry experienced increasing technical progress for the whole sample period. The result show that SEC increased in eight industries over the sampling years and decreased in five industries. Average TFPG increased in every industry for the whole sample period.

The average rate of TFPG has been calculated during pre and post reform period for all the fourteen major industries in India Productivity improvement is recorded for only six out of fourteen manufacturing industries during the post reform period then the pre reform period.

These industries are textile, wood, rubber, non metallic, basic metal and machinery industries. The rest of the industries show a decline trend in the change in TFPG between pre and post reform period. In terms of technical efficiency, beverage, textile, wood and paper industries have improved than the rest of the industries. Negative TEC observed in most of the industries because of the gap between frontier and actual production enjoyed by SMEs widened due to the opening up the economy after the economic reforms. Furthermore, the result also suggests that after the reforms, there is a lift in the restriction on investment by large industrial houses and foreign controlled companies. Following the reform, large domestic firms have led to keep innovating in response to new competition from foreign companies that entered the market. This helped to push production frontier of the Indian manufacturing sector much higher than it was before the reforms. This along with large number of new entrant SMEs resulted in negative TEC.

In terms of technological progress, industries like textile, wood, rubber, basic metal, machinery and other manufacturing industries are enjoying a higher technological progress during the post reform period in compare to pre reform period. In rest of the industries, TP shows a decline trend. The reason behind increase in TP in these above industries may be due to abolition of license by government and lifting restriction on investment by removing the asset limit through MRTP act. The government also increased the limit on foreign equity partition from 40 per cent to 51 per cent in 1998. Following this reform, capital investment in the Indian manufacturing sector, by both domestic firms and foreign multinationals, increased rapidly across industries. Increased capital investment in the manufacturing sector brought into the country new technological embodied capital, thus raising TP in an unprecedented way. However declining TP in the rest of the industries suggests that these industries didn’t cope with the process of development.

In term of scale efficiency, except beverage, cotton and basic metal industries, the rest are showing a negative change during the post reform era in compare to the pre reform. This may be due to some firms with insufficient production scale has entered the market during post reform period. For some industries, the return to scale is one. So we couldn’t able to calculate the SCE for these industries. From the table-5.2, it shows that TFP was higher in the pre reform period then the post reform. Six out of fourteen industries (textile, wood, rubber, non-metallic, basic metal and machinery industries) have been outperformed after the economic reforms compare to the regulation era. The reason for deceleration of productivity growth may be due to the non-adoption of new technologies after the reform period. Technical progress showed positive change where as TEC and SEC deteriorated for most of the industries during the deregulating era. The inference is that the TFP growth appeared to be relatively better during the protected era than the liberalized regime.

6.3 Limitations of the Study and Scope for Further Research

The finding of the study about the impact of economic reforms on growth, efficiency and productivity of manufacturing industries cannot be taken as conclusive conjectures since the study does not incorporate the effect of other variables such as import competitions, government regulations, and educational attainment of the workers and age and size of the industries, its location and ownership pattern, which are not included in our model. Accounting for the effect of all such relevant variables can be a good basis for the future studies.

As noted in the empirical studies of Chapter-II, the study has chosen stochastic frontier analysis to address the problem. The divergences in result of different studies suggest that no single study has been able to properly address all these problems. The main shortcomings of SFA are its high vulnerability to outlying observations and the rather arbitrary choice of the distributional assumption regarding the inefficiency component of the error term (Hahn 2004). The time period (1980-2007) that we have taken in our study could be one of the drawbacks, because larger sample size could have given better results. So, one can extend the present study by including other factors that are affecting productivity and efficiency of Indian industries along with applying a more suited method and extending the whole sample period will give a clear picture about Indian manufacturing industries

******

REFERENCES

Agarwal, R.N. (2001), "Technical Efficiency and productivity Growth in the Central Public Sector Enterprises in India during 1990s". Discussion paper No. 28/2001, Institute of Economic Growth, New Delhi.

Ahluwalia, M.S. (2002), "Economic Reforms in India Since 1991: Has Gradualism Worked"? *Journal of Economic Perspectives*, 16(3), 67-88.

Ahluwalia, M.S. (2002), State-Level Performance under Economic Reforms, *in Economic Policy Reforms and the Indian Economy*. Anne O. Krueger (Ed.), New Delhi: Oxford University Press.

Ahulwalia, M.S. (2002), "Economic performance of states in post reform period". *Economic Political Weekly*, 35(19), 1637-1648.

Ahulwalia, I.J. (1991), *Productivity and Growth in Indian Manufacturing*. New Delhi: Oxford University Press.

Aigner, D., Lovell, K., and Schmidt, P. (1977), "Formulation and Estimation of Stochastic Frontier Function Models". *Journal of Econometrics*, 6(1), 21-37.

Alvarez, A., Arias, C., and Greene, W. H. (2004), "Accounting for Unobservable in Production Models: Management and Inefficiency". Working Paper No. E2004/72.

Bajpai, N., and Sachs, D.J (1999), "The progress of Policy Reform and Variation in performance at the sub-national level in India". Development Discussion Paper. No 730.

Balakrishnan, P., and Pushpangadan K. (1994), "Total Factor Productivity Growth in manufacturing industry: A fresh look". *Economic Political Weekly*, 29(31), 2028-2035.

Balasubramanyam, V.N., and Mahambre, V. (2001), "India's Economic Reforms and the Manufacturing Sector". Lancaster University Working Paper No. 2001/10.

Battese, G., and Coelli, T. (1992), "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India". *Journal of Productivity Analysis,* 3(1-2), 153-169.

Battese, G., and Coelli, T. (1995), "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data". *Empirical Economics,* 20(2), 325-332.

Bekaert,G., Harvey, R.C., and Lundbald, C. (2005). Does Financial Liberalization Spur Growth? *Journal of Financial Economics*, 77(3), 3-55.

Bera, A.K., and Sharma, S.C. (1999), "Estimating Production Uncertainty in Stochastic Frontier Production Function Models". *Journal of Productivity Analysis,* 12(3), 187-210.

Bhanumurthy.R.N., and Singh, P. (2009), "Understanding Economic Growth in Indian States". IEG Discussion Paper series No.137/2009.

Bhatacharya, B. B., and Sakhivel, S. (2004), "Regional Growth and Disparity in India: Comparison of pre and post reform decades". *Economic Political Weekly*, 39(10), 1071-1077.

Bhaumik.S., and Kumbhakar,S. (2010), "Is the post reform growth of Indian manufacturing sector efficiency driven? Empirical evidence from plant level data". *Journal of Asian economic,* 21(2), 219-232.

Bradford, J. D. (2001), *India since Independence: An Analytic Growth Narrative*. Dani Rodrik (ED.) Modern Economic Growth: Analytical Country Studies.

Chandrasekhar, C.P. (1996), "Explaining Post- Reform Industrial Growth". *Economic and Political Weekly*. 31(35-37), 2537-2545.

Chaturvedi, D.N,. and Bagchi, A. (1985), "Age Structure of Fixed Capital in the Indian Economy, 1970-71 to 1980-81". *Journal of Income and Wealth*, 7(1), 82-103.

Chaudhuri, S. (2002), “Economic Reforms and Industrial Structure in India”. *Economic and Political Weekly*, 37(2), 155-16.

Coelli, T.J,. Rao, D.S., and Battese, G.E. (1998), *An Introduction to Efficiency and Productivity Analysis*. Kluwer Academic Publishers

Das, K.D. (2003), “Manufacturing Productivity under Varying Trade Regimes: India in the 1980s and 1990s”. ICRIER Working Paper No. 107.

Farsi, M., and Filippini, M. (2004), “Regulation and Measuring Cost Efficiency with Panel Data Models Application to Electricity Distribution Utilities”. *Review of Industrial Organization*, 25 (1), 1-19.

Ferro, M.D., Rosenblatt and Stern, N. (2004), *Policies for pro-poor growth in India*. Kausik Basu (ED.), New Delhi: Oxford University press.

Goldar, B., and Kumari, A. (2003), “Import Liberalization and Productivity Growth in Indian Manufacturing Industries in the 1990s”. *Developing Economies*, 41(4), 436-460.

Goldar, B. (2004), “Productivity Trends in Indian Manufacturing in the Pre-and Post-reform periods”. ICRIER, Working Paper No 137.

Greene, W. (2002), “The Behavior of the Fixed Effects Estimator in Nonlinear Models”. Working Paper, Department of Economics, Stern School of Business, New York University.

Gupta, N., and Yuan, K. (2009), “On the growth effects of stock market liberalization”. *The review of Financial studies*, 22(11), 7715-52.

Hahn, R. F. (2004), “Measuring Performance: A Multiple-Stage Approach”. WIFO Working Papers, No. 228.

Horrace, W., and Schmidt, P. (2000), “Multiple Comparisons with the Best, with Economic Applications”. *Journal of Applied Econometrics*, 15(1), 1-26.

Jha, R,. and Sahni, B.S. (1992), "Measures of Efficiency in Private and Public Sector Industries: The case of India". *Annals of Public and Cooperative Economics,* 63(3), 489-495.

Kalirajan, K., and Bhide, S. (2004), "The Post-reform Performance of the Manufacturing Sector in India". *Asian Economic Papers*, 3(2), 126-157.

Kambhampati, U. S. (2003), "Trade liberalization and the efficiency of firms in Indian manufacturing". *Review of Development Economics,* 7(3), 419-430.

Kumbhakar, S. C. (1991), "Estimation of technical inefficiency in panel data models with firm- and time-specific effects". *Economics Letters*, 36(1), 43-48.

Kumbhakar, S., and Lovell, C. A. K. (2000), *Stochastic frontier analysis*. New York: Cambridge University Press.

Lee. J., and Strazicich. M. (2003), "Minimum LS Unit Root Test with Two Structural Breaks". *Review of Economics and Statistics,* 85(4), 1082-1089.

Majumdar, S. K. (1996), "Assessing Comparative Efficiency of the State-Owned, Mixed, and Private Sectors in Indian Industry". *Public Choice*, 96(1), 1-24.

Mitra, A (1999), "Total factor productivity growth and Technical Efficiency in Indian industries: A Study of Panel data for fifteen major states". IEG, Working Paper No. E/203/99.

Mukherjee, K,. and Ray, S.C.(2005), "Technical Efficiency and Its Dynamics In Indian Manufacturing: An Inter State Analysis". *Indian Economic Review,* 40(2), 101-125.

Nishimizu, M., and Page, J.M. (1982), "Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia". *Economic Journal*, 92(368), 920-936.

Pandey, M. (2004), "Impact of Trade Liberalization in Manufacturing Industry in India in the 1980s and 1990s". ICRIER Working Paper no. 140, Pitt, M., and Lee, L. (1981), "The Measurement and Sources of Technical Inefficiency in Indonesian Weaving Industry". *Journal of Development Economics*, 9(1), 43-64.

Polachek, S., and Yoon, B. (1996), "Panel Estimates of a Two-Tiered Earnings Frontier". *Journal of Applied Econometrics*, 11(2), 169-178.

Ray, S. (2002), "Did India's Economic Reforms improve Efficiency and Productivity? A Nonparametric Analysis of the Initial Evidence from Manufacturing"**.** *Indian Economic Review*, 37(1), 23-57.

Ray, S., and X, Hu. (1993), "A Nonparametric Decomposition of the Malmquist productivity index: A Study of Airline's Data". A paper presented in the third European Workshop on Productivity, CORE, Belgium, October.

Schmidt, P., and Sickles, R. (1984), "Production Frontiers and Panel Data". *Journal of Business and Economic Statistics*, 4(2), 367-374.

Siggel, E. (2007), "Economic Reforms and their Impact on the Manufacturing Sector: Lesson from the Indian experience". *Asia-Pacific Development Journal*, 14(1), 73-105.

Solow, R. M. (1957), "Technical Change and the Aggregate Production Function". *Review of Economics and Statistics*, 39(3), 312-20.

Srinivasan, T.N., and Tendulkar, S.D. (2003), '*Reintegrating India with the World Economy"*. Washington DC: Institute for International Economics.

Srivastava, V. (2001), "The Impact of India's Economic Reforms on Industrial Productivity, Efficiency and Competitiveness: A Panel Study of Indian Companies 1980-97". New Delhi, NCAER.

Statistics World Bank. (2009). Retrieved from http://data.worldbank.org/indicator/NY.GDP.MKTP.CN

Stevenson, R. (1980), “Likelihood Functions for Generalized Stochastic Frontier Functions”. *Journal of Econometrics*, 13(1), 57-66.

Trivedi, p., Lakshmanan, L., Jain, R., and Gupta, K.Y. (2011), “Productivity, Efficiency and Competitiveness of the Indian Manufacturing Sector”. Development research Group 37, Department of Economic Analysis and Policy, Reserve Bank of India.

Trivedi, P., Prakash. A., and Sinate, D. (2002), “Productivity in Major Manufacturing Industries in India: 1973-74 to 1997-98”. Development research Group 20, Department of Economic Analysis and Policy, Reserve Bank of India.

Unel, Bulent. (2003), “Productivity Trends in India’s Manufacturing Sectors in the Last Two Decades”. IMF Working Paper, WP/03/02.

APPENDIX- I

Figure 4.2A Growth of Average Technical Efficiency of Manufacturing Industries during the Period of 1980-2007.

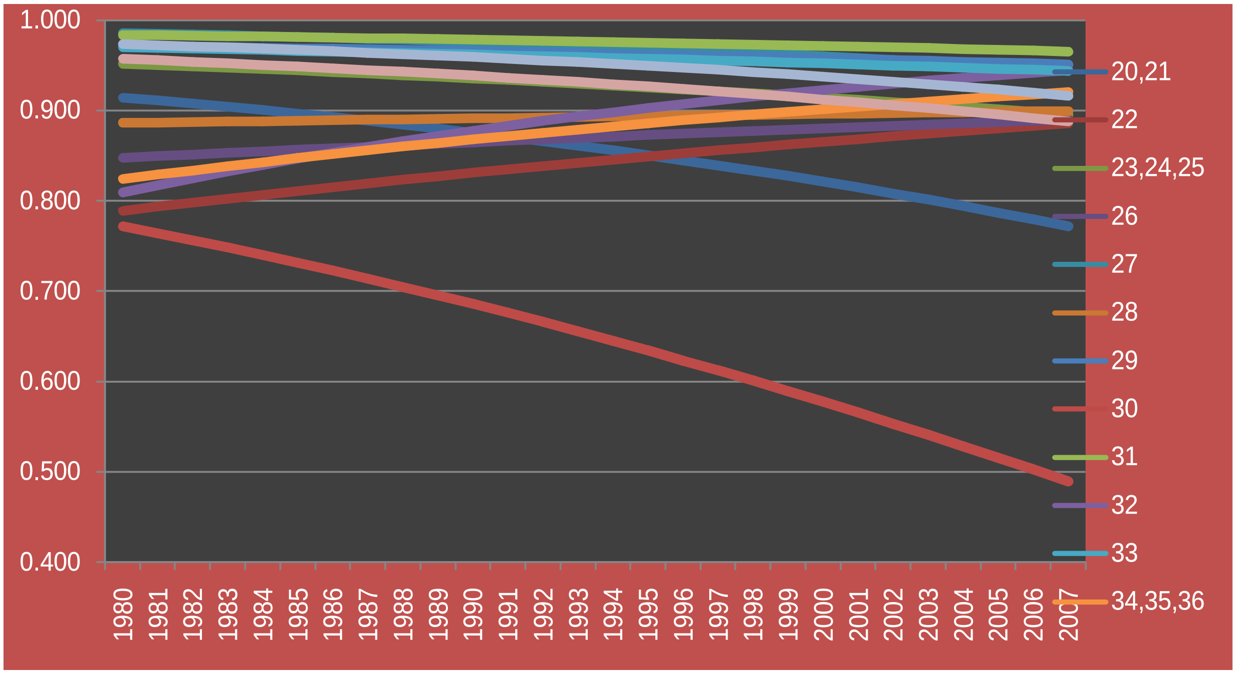


Figure 4.3A Growth of Average Technical Efficiency of Manufacturing Industries during the Pre reform Period

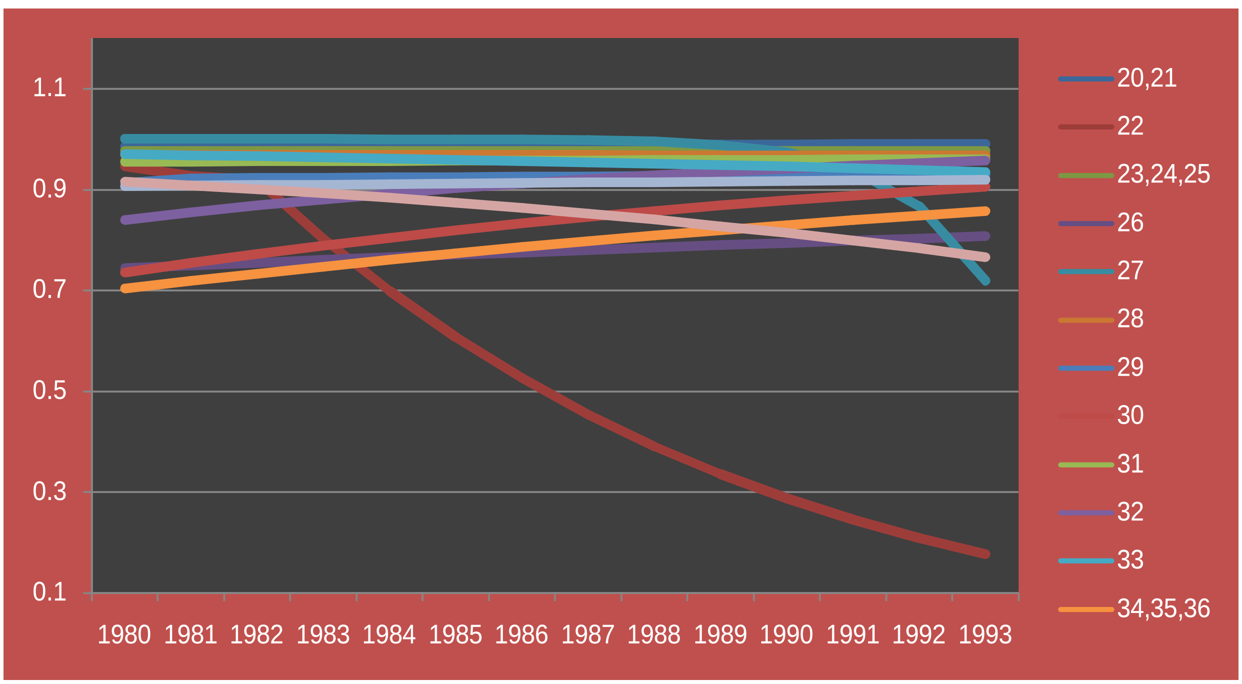
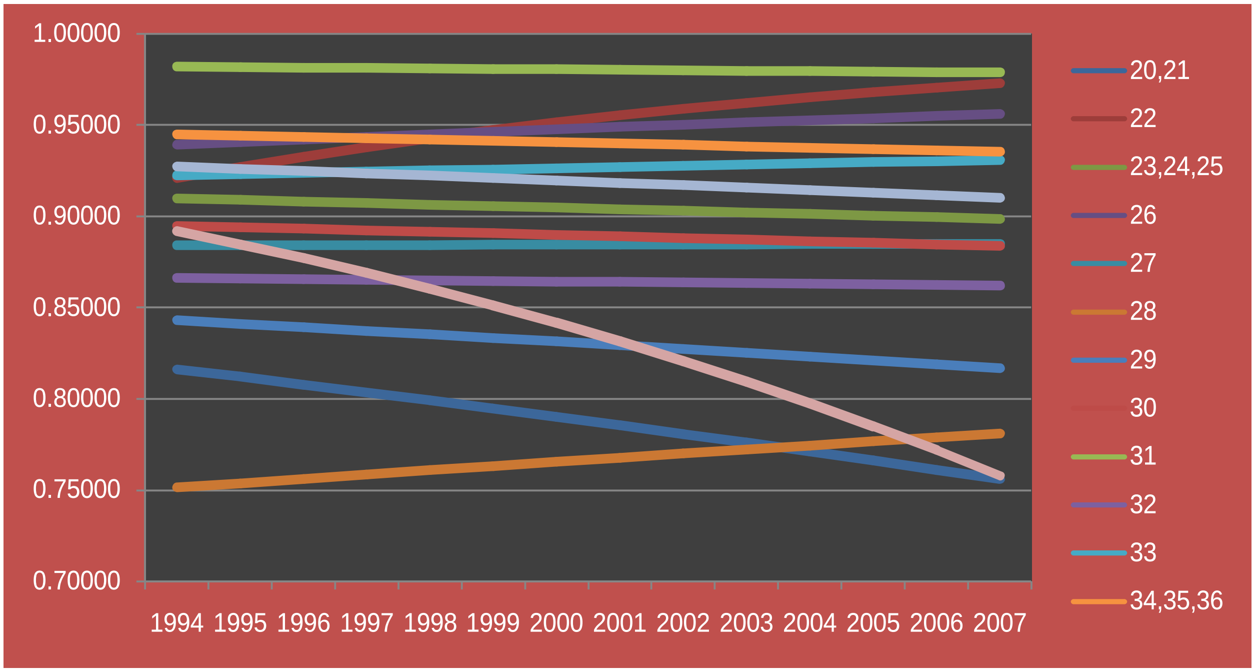


Figure 4.4A Growth of Average Technical Efficiency of Manufacturing Industries during the Post reform Period



Note 1: 20,21-Food Products, 22-Beverage, 23,24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Note 2: these figures are explained in the chapter –III, section 4.4

APPENDIX-II Table 3.4A: Flows of Investment (Gross Fixed Capital Formation) in India during Pre and Post Reform Period

Year	AP	BIH	GUJ	HAR	KAR	Keral	MP	MAH	Orissa	PUN	RAJ	TAM	UP	WB	India
1980-81	54578	552	1006	14777	50786	18549	112423	156786	27533	17329	26152	68508	40673	54168	797972
1981-82	44907	932	994	21764	48214	23345	115892	189645	26178	25052	27552	128925	155565	94717	1094446
1982-83	62541	1378	1379	28982	60177	46518	97271	200117	31419	34330	34462	113066	69720	75669	1129935
1983-84	140440	837	2539	28555	100649	37873	100842	229443	41340	42387	56868	127578	78940	73649	1396207
1984-85	83119	711	1177	38295	64356	23550	201465	291857	40032	40642	61415	137351	84346	72205	1327495
1985-86	74593	769	1498	55561	73831	36912	157480	272720	41451	34486	73148	143572	100314	146379	1437074
1986-87	96520	1051	2132	37907	59671	34532	96162	251768	70701	34289	40297	127895	93205	75561	1336762
1987-88	107635	1056	1686	36424	62777	32696	138238	278502	224425	61332	57931	120006	128457	99113	1621707
1988-89	92814	903	1520	49693	85205	31746	115473	312628	88814	65857	56833	191409	178175	94220	1605088
1989-90	97991	1091	2064	47407	89763	25664	138436	412648	34723	77260	38253	181813	185959	102320	1747711
1990-91	211298	1430	2872	32099	96288	37067	122334	401527	72430	63622	72438	271189	167526	177473	2155525
1991-92	185603	1915	2448	67770	20764	31892	107277	412890	123704	56716	131522	219344	221488	280035	2295238
1992-93	210688	1250	2601	74046	106624	38537	312925	586779	108959	69835	88206	288519	214985	218129	2703343
1993-94	160300	2040	4502	126993	100378	44918	237481	582249	160526	85845	94956	400207	232335	188395	3068761
1994-95	230230	3616	4055	96467	175001	48719	467151	643321	124084	95619	129835	698552	465494	142497	4084080
1995-96	273829	2108	9953	172245	182974	62914	315113	942474	149080	139870	143964	447083	478943	148740	4663354
1996-97	265334	1989	6322	145686	299989	69171	258044	1316066	100564	90203	133103	446822	518032	113666	4587760
1997-98	235108	1431	8068	107522	314300	54176	279341	799098	76374	93563	130519	301355	416079	107501	3864834
1998-99	201488	3002	7543	175289	839766	94165	228461	610289	70215	81660	132891	405702	576465	93488	4564394
1999-00	218961	-264	7289	226638	394094	62835	138280	678872	-26774	89208	123010	365979	258536	27749	3259883
2000-01	148603	1971	3774	168457	234728	45523	158919	592037	39917	69905	85044	403035	224375	112734	2857766
2001-02	174344	945	19879	149511	243001	56088	424563	475135	109343	66301	84482	281166	264355	138827	4549555
2002-03	170284	1628	4278	174838	197080	42396	108949	517872	96309	159557	75228	441437	210619	441437	3226645
2003-04	240201	856	4722	129312	180955	36070	188650	852185	48378	75256	105981	511481	330562	94812	3351670
2004-05	262429	1451	4806	216999	333440	58037	348442	809370	119150	133526	132175	545055	346337	346337	4277033
2005-06	419389	1579	14463	246335	603643	57323	383875	1088758	390526	186387	137578	778636	619763	168625	6685063
2006-07	614363	2334	10756	291164	548037	84708	423518	1372686	376258	238614	258844	908798	758981	220550	7405566
2007-08	759838	2257	11976	387692	689605	78927	474978	1399451	619743	240209	233187	1101959	904250	331757	8644857

Source: Annual survey of Industries

Table 3.5A: Share of Capital Output Ratio of Different States during Pre and Post Reform Period

Year	AP	BIH	GUJ	HAR	KAR	Keral	MP	MAH	Orissa	PUN	RAJ	TAM	UP	WB	India
1980-81	2.95	0.93	3.64	3.66	2.55	4.06	1.69	4.71	2.11	3.87	2.84	4.76	3.66	4.12	3.16
1981-82	2.96	1.31	4.12	4.42	2.76	4.15	1.65	4.97	2.34	4.64	3.06	4.37	2.89	3.83	3.30
1982-83	3.53	1.45	4.19	4.50	2.78	3.60	1.61	5.08	1.87	4.67	2.88	4.70	3.67	3.97	3.43
1983-84	2.84	1.28	3.28	3.99	2.67	2.82	1.42	4.13	1.58	4.12	2.60	3.53	3.16	3.62	2.91
1984-85	2.95	1.45	3.39	4.08	2.60	2.90	1.45	3.95	1.59	4.23	2.40	3.72	3.44	3.50	2.96
1985-86	2.96	1.56	3.08	3.75	2.62	2.83	1.54	4.32	1.77	4.77	2.30	3.44	3.53	3.18	3.00
1986-87	2.81	1.52	2.88	3.98	2.62	3.27	1.62	4.15	1.49	5.03	2.40	3.71	3.93	3.59	3.03
1987-88	2.96	1.65	2.78	4.37	2.49	3.42	1.71	3.95	0.91	4.72	2.37	3.74	3.69	3.45	2.94
1988-89	3.03	1.98	3.43	4.06	2.48	3.62	1.85	3.86	1.16	5.14	2.48	3.56	3.52	3.39	3.06
1989-90	3.30	2.03	3.53	4.48	2.98	4.06	2.22	3.64	1.26	5.63	3.02	4.06	3.46	3.40	3.27
1990-91	1.31	2.13	2.65	4.50	3.16	3.53	2.24	3.87	1.47	5.18	2.90	3.63	3.58	2.87	2.91
1991-92	1.51	1.94	3.22	4.10	3.54	4.06	2.87	3.51	1.22	4.67	2.37	3.73	2.87	2.25	2.82
1992-93	1.56	2.08	2.88	4.22	3.52	4.32	1.98	3.47	1.33	4.74	2.52	3.51	3.47	2.00	2.78
1993-94	1.58	1.62	2.21	3.55	3.29	3.67	2.10	3.13	1.17	4.20	2.08	3.25	3.24	1.85	2.52
1994-95	1.78	1.57	2.28	3.81	3.00	3.44	1.64	3.05	1.07	3.69	1.83	2.64	2.39	1.83	2.35
1995-96	1.89	1.46	1.66	3.59	2.91	3.49	1.89	2.78	1.05	3.44	1.85	2.76	2.26	1.88	2.23
1996-97	2.37	1.47	1.71	3.28	2.30	3.60	1.84	2.17	0.93	3.40	1.79	2.48	2.06	1.90	2.09
1997-98	2.05	1.89	1.59	3.19	1.85	3.49	2.04	2.33	1.54	3.60	1.82	2.73	1.94	1.94	2.12
1998-99	1.57	1.34	1.39	2.43	1.03	3.03	1.41	2.47	0.82	0.57	1.76	1.93	0.99	2.87	1.59
1999-2000	1.77	1.60	1.44	2.82	1.31	3.33	1.67	2.16	1.01	0.57	1.25	2.12	1.38	1.70	1.71
2000-01	1.99	1.36	1.51	2.73	1.49	3.65	1.95	2.35	1.00	0.54	1.87	2.33	1.63	1.98	1.88
2001-02	1.90	1.33	1.50	2.82	1.60	3.19	1.72	2.32	1.00	3.84	1.93	2.34	1.98	1.64	1.93
2002-03	2.31	1.58	1.91	3.22	1.77	3.77	2.14	2.47	1.21	3.14	2.11	2.28	2.46	2.26	2.23
2003-04	2.10	0.96	2.01	3.43	1.96	4.06	2.33	2.37	0.96	3.76	2.21	2.40	2.64	1.93	2.22
2004-05	2.41	2.32	2.52	3.84	2.54	4.12	2.39	3.11	1.21	4.06	2.46	2.76	2.91	2.91	2.76
2005-06	2.61	2.28	2.21	4.02	2.34	5.09	2.15	3.14	1.01	3.43	2.80	2.80	2.76	2.68	2.64
2006-07	2.74	2.46	2.39	3.90	2.91	5.28	2.43	3.36	1.05	3.40	2.88	3.05	2.98	3.18	2.86
2007-08	2.53	2.94	2.69	3.75	2.83	5.38	2.73	3.56	0.97	3.71	2.91	3.03	2.88	3.09	2.92

Source: same as in table 3.4

Table 3.6A: Share of Capital Productivity of Different States during Pre and Post Reform Period

Year	AP	BIH	GUJ	HAR	KAR	Keral	MP	MAH	Orissa	PUN	RAJ	TAM	UP	WB	India
1980-81	0.55	0.20	0.67	0.75	0.66	0.73	0.47	1.06	0.48	0.57	0.55	0.93	0.78	1.01	0.67
1981-82	0.62	0.34	0.71	0.89	0.63	0.73	0.47	1.08	0.38	0.70	0.58	0.84	0.54	0.86	0.68
1982-83	0.73	0.30	0.71	0.85	0.68	0.70	0.45	1.05	0.34	0.68	0.58	0.95	0.72	0.94	0.70
1983-84	0.69	0.32	0.71	0.80	0.80	0.64	0.39	0.96	0.35	0.69	0.70	0.78	4.02	0.86	0.90
1984-85	0.69	0.37	0.64	0.83	0.70	0.75	0.34	0.91	0.25	0.68	0.52	0.86	2.43	0.83	0.78
1985-86	0.56	0.39	0.60	0.73	0.72	0.60	0.36	1.03	0.34	0.76	0.43	0.71	2.15	0.74	0.75
1986-87	0.52	0.36	0.57	0.77	0.69	0.67	0.33	0.93	0.32	0.70	0.47	0.77	1.33	0.78	0.67
1987-88	0.53	0.45	0.57	0.82	0.62	0.77	0.39	0.84	0.20	0.67	0.48	0.76	3.48	0.86	0.82
1988-89	0.53	0.60	0.71	0.73	0.60	0.74	0.46	0.90	0.29	0.76	0.45	0.78	0.62	0.68	0.66
1989-90	0.62	0.56	0.65	0.80	0.76	1.02	0.50	0.80	0.34	0.87	0.57	0.88	0.70	0.63	0.69
1990-91	0.26	0.53	0.49	0.84	0.79	0.73	0.56	0.83	0.39	0.84	0.61	0.85	0.68	0.63	0.62
1991-92	0.29	0.51	0.56	0.78	0.89	0.89	0.58	0.73	0.27	0.78	0.47	0.83	0.63	0.49	0.59
1992-93	0.31	0.49	0.65	0.68	0.84	0.83	0.40	0.80	0.29	0.68	0.51	0.77	0.70	0.43	0.59
1993-94	0.31	0.44	0.49	0.66	0.82	0.75	0.46	0.79	0.24	0.77	0.37	0.77	0.67	0.47	0.57
1994-95	0.39	0.40	0.57	0.69	0.75	0.84	0.37	0.73	0.24	0.67	0.40	0.56	0.52	0.44	0.54
1995-96	0.44	0.41	0.40	0.69	0.70	0.69	0.47	0.67	0.24	0.57	0.38	0.60	0.45	0.43	0.51
1996-97	0.51	0.47	0.42	0.65	0.60	0.69	0.40	0.52	0.19	0.69	0.35	0.54	0.51	0.42	0.48
1997-98	0.52	0.64	0.26	0.59	0.42	0.60	0.52	0.50	0.31	0.62	0.33	0.52	0.39	0.40	0.44
1998-99	0.40	0.48	0.29	0.48	0.26	0.66	0.33	0.56	0.22	0.57	0.34	0.41	0.21	0.64	0.37
1999-00	0.35	0.54	0.32	0.50	0.31	0.59	0.32	0.49	0.29	0.57	0.29	0.41	0.29	0.34	0.38
2000-01	0.37	0.30	0.28	0.44	0.34	0.57	0.42	0.49	0.23	0.54	0.41	0.47	0.32	0.36	0.38
2001-02	0.39	0.27	0.25	0.51	0.35	0.53	0.35	0.47	0.21	0.68	0.39	0.45	0.38	0.29	0.37
2002-03	0.41	0.43	0.33	0.59	0.40	0.60	0.44	0.48	0.28	0.53	0.39	0.41	0.45	0.40	0.42
2003-04	0.42	0.29	0.36	0.63	0.41	0.62	0.46	0.51	0.23	0.58	0.40	0.45	0.46	0.36	0.43
2004-05	0.47	0.88	0.44	0.71	0.56	0.58	0.53	0.53	0.39	0.55	0.46	0.47	0.49	0.49	0.51
2005-06	0.47	0.57	0.43	0.73	0.57	0.59	0.44	0.72	0.28	0.49	0.51	0.50	0.48	0.39	0.52
2006-07	0.55	0.48	0.40	0.68	0.64	0.44	0.59	0.76	0.31	0.56	0.64	0.54	0.53	0.44	0.55
2007-08	0.51	0.84	0.08	0.63	0.61	0.66	0.64	0.85	0.32	0.66	0.57	0.54	0.51	0.47	0.52

Source: same as in table 3.4

Table 3.6A: Share of Labor Productivity of Different States during Pre and Post Reform Period

Year	AP	BIH	GUJ	HAR	KAR	Keral	MP	MAH	Orissa	PUN	RAJ	TAM	UP	WB	India
1980-81	0.22	0.49	0.47	0.57	0.44	0.37	0.60	0.61	0.54	0.41	0.45	0.48	0.29	0.39	0.45
1981-82	0.24	0.79	0.51	0.63	0.46	0.36	0.69	0.68	0.46	0.47	0.49	0.52	0.31	0.40	0.49
1982-83	0.30	0.83	0.52	0.61	0.52	0.46	0.73	0.70	0.46	0.49	0.56	0.60	0.42	0.57	0.56
1983-84	0.41	0.83	0.68	0.62	0.72	0.51	0.75	0.84	0.62	0.51	0.86	0.65	2.80	0.44	0.84
1984-85	0.45	0.96	0.66	0.68	0.63	0.59	0.74	0.89	0.47	0.53	0.70	0.70	1.82	0.46	0.78
1985-86	0.41	1.00	0.76	0.72	0.72	0.57	0.79	1.05	0.62	0.58	0.68	0.71	1.67	0.52	0.82
1986-87	0.41	0.92	0.81	0.80	0.72	0.63	0.73	1.03	0.79	0.52	0.76	0.76	1.06	0.51	0.77
1987-88	0.39	1.03	0.85	0.83	0.76	0.71	0.93	1.00	0.83	0.58	0.79	0.75	3.05	0.64	1.00
1988-89	0.43	1.31	0.98	0.88	0.81	0.73	1.12	1.19	1.36	0.63	0.83	0.87	0.64	0.50	0.85
1989-90	0.44	1.31	0.90	0.93	0.92	0.89	1.07	1.30	1.40	0.79	0.90	0.93	0.83	0.50	0.90
1990-91	0.53	1.22	0.99	1.06	0.99	0.64	1.29	1.43	1.37	0.81	1.14	1.03	0.88	0.62	0.98
1991-92	0.52	1.29	0.92	1.01	1.09	0.81	1.06	1.23	1.24	0.90	1.03	0.86	0.98	0.59	0.93
1992-93	0.53	1.09	1.36	0.91	1.02	0.62	1.12	1.52	1.20	0.73	1.08	0.85	0.94	0.61	0.98
1993-94	0.61	1.32	1.34	1.09	1.03	0.60	1.29	1.76	1.07	0.98	1.04	0.96	1.00	0.75	1.10
1994-95	0.71	1.28	1.59	1.16	1.15	0.57	1.39	1.78	1.16	0.99	1.36	0.98	1.24	0.70	1.17
1995-96	0.77	1.48	1.73	1.35	1.15	0.81	1.75	1.85	1.28	0.94	1.38	1.00	1.19	0.69	1.26
1996-97	0.74	1.15	1.87	1.55	1.30	0.80	1.50	1.91	1.05	1.17	1.32	1.04	1.46	0.71	1.30
1997-98	1.05	2.57	1.48	1.63	1.31	0.77	1.99	1.94	1.14	1.15	1.42	0.94	1.43	0.68	1.35
1998-99	1.07	2.66	2.16	1.04	1.50	1.19	1.80	5.22	1.49	1.29	1.41	1.10	1.48	0.79	1.67
1999-00	0.97	2.60	2.42	1.94	1.51	0.99	2.01	35.80	1.85	1.49	2.19	0.61	1.70	0.88	1.72
2000-01	0.89	1.75	2.28	1.69	1.56	0.95	2.10	2.42	1.70	1.05	2.04	1.28	1.68	0.89	1.60
2001-02	1.01	1.64	2.53	2.01	1.71	0.52	2.36	2.31	1.69	1.30	1.94	1.17	1.77	1.01	1.60
2002-03	1.11	2.86	3.15	2.16	1.99	1.06	2.39	2.59	1.99	1.31	1.78	1.17	1.88	2.44	1.96
2003-04	1.06	1.95	3.48	2.29	2.12	0.95	2.62	3.04	2.29	1.24	1.86	1.32	1.87	1.22	1.96
2004-05	1.38	5.35	3.62	2.39	2.54	0.91	4.60	3.37	3.09	1.13	1.97	1.29	1.93	2.37	2.35
2005-06	1.36	7.12	4.18	2.28	2.31	0.88	2.92	4.29	3.19	1.07	2.07	1.47	1.96	1.32	2.42
2006-07	1.86	3.30	3.73	2.34	4.39	0.67	3.98	4.60	3.71	1.34	2.73	1.32	2.34	1.49	2.60
2007-08	1.91	5.34	0.70	2.19	3.92	1.01	4.20	5.20	4.53	1.58	2.21	1.62	2.78	1.72	2.57

Source: same as in table 3.4

APPENDIX-III

TABLE-5.4A

INDUSTRY-SPECIFIC TECHNICAL PROGRESS (TP) IN MANUFACTURING INDUSTRIES IN INDIA FROM 1981-2007

Industry	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*
20,21	0.0252	0.0573	0.0231	-0.0039	0.0247	0.0324	0.0285	0.0433	0.0679	0.0517	0.0215	0.0194	0.0250	0.0301
22	0.0207	-0.0055	0.0095	0.0561	0.0609	0.0377	0.0138	0.0100	-0.0241	-0.0046	0.0267	0.0256	0.0368	0.0402
23,24,25	-0.0127	-0.0126	0.0090	0.0260	-0.0476	-0.0547	0.0252	0.0311	0.0469	0.0387	0.0137	0.0181	0.0307	0.0375
26	0.0296	0.0138	-0.0013	0.0070	-0.0671	-0.0252	0.0681	0.0460	0.0622	0.0932	-0.0021	-0.0048	0.0607	0.0713
27	0.0108	0.0392	-0.0166	-0.0190	0.0953	0.1016	0.0290	0.0929	0.0520	-0.0317	-0.0117	-0.0785	-0.0848	-0.0253
28	0.0216	0.0012	-0.0096	0.0320	-0.0270	-0.0349	0.0187	0.0178	0.0380	0.0484	0.0198	-0.0160	-0.0121	0.0445
29	0.0918	-0.0082	0.0007	0.0445	0.0398	0.0741	0.0028	0.0472	0.0567	0.0580	0.0016	-0.0164	0.1123	0.1168
30	0.0513	0.0647	0.0284	0.0392	0.0650	0.0609	0.0395	0.0350	0.0265	0.0341	0.0613	0.0347	-0.0065	0.0219
31	0.0058	0.0195	0.0156	-0.0510	-0.0684	0.0054	0.0343	0.0963	0.0489	0.0541	0.0138	0.0335	0.0793	0.0460
32	0.0411	0.0821	0.0497	0.0263	0.0643	0.0598	0.0230	0.0562	0.0598	0.0157	0.0294	0.0233	-0.0169	0.0098
33	0.0290	0.0407	0.0032	0.0030	0.0491	0.0555	0.0307	0.0412	0.0321	0.0210	0.0285	0.0356	-0.0067	0.0019
34,35,36	0.0167	0.0206	0.0094	0.0240	0.0462	0.0188	0.0408	0.0698	0.0424	0.0309	0.0142	0.0021	-0.0013	0.0307
37	0.0145	0.0184	0.0129	0.0305	0.0193	0.0114	0.0402	0.0509	0.0601	0.0271	-0.0147	0.0252	0.0529	0.0564
38	-0.0398	-0.0208	0.0141	0.0121	0.0657	0.0664	0.0500	0.0370	0.0325	0.0808	0.0477	0.0041	0.0457	0.0524

Continued….

1995	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	***1981-2007***
0.0509	0.0509	0.0196	-0.0251	-0.0079	0.0263	0.0445	0.0612	-0.0027	-0.0068	0.0216	0.0365	0.0353	***0.0278***
0.0176	0.0084	0.0354	-0.0095	-0.0194	0.0144	-0.0010	0.0065	0.0058	0.0141	0.0320	0.0213	0.0006	***0.0159***
0.0246	0.0323	0.0609	-0.0680	-0.1012	0.0045	-0.0054	0.0254	-0.0004	-0.0173	0.0372	0.0493	0.0022	***0.0072***
0.0525	0.0539	0.0876	0.0462	0.0469	0.1083	0.0521	0.1359	0.0169	0.0317	0.0609	0.0872	0.0525	***0.0439***
-0.0178	0.0765	0.0013	-0.0557	-0.0117	0.0538	0.1452	0.0158	0.0186	-0.0291	-0.0607	0.0774	0.0304	***0.0147***
0.0670	0.0176	-0.0291	-0.0505	-0.0160	0.0299	0.0246	0.0467	-0.0548	-0.0969	0.0653	0.0903	0.0432	***0.0104***
0.0594	0.0234	0.0171	0.0095	-0.1478	-0.0755	0.1231	0.0163	-0.0477	0.0948	-0.0085	0.0120	0.0334	***0.0271***
0.0515	0.0277	0.0200	-0.0203	-0.0070	0.0282	-0.0026	0.0243	0.0161	0.0642	0.0129	-0.0110	0.0322	***0.0293***
0.0479	0.0593	0.0393	-0.0821	-0.0273	0.0958	0.0556	0.0889	0.0418	0.0176	0.0832	0.0865	0.0852	***0.0343***
0.0699	0.0508	0.0184	0.0043	0.0468	0.0691	0.0367	0.0632	0.0318	0.0456	0.0243	0.0100	0.0425	***0.0384***
0.0757	0.0108	0.0179	-0.0098	-0.0334	0.0037	0.0188	0.0627	0.0452	0.0531	0.0401	0.0667	0.0826	***0.0296***
0.0727	0.0411	0.0065	-0.0049	-0.0109	-0.0007	0.0088	0.0432	0.0150	0.0421	0.0673	0.0491	0.0762	***0.0286***
0.0999	0.0526	-0.0496	-0.1705	-0.0591	0.0695	-0.0267	0.0825	-0.0293	-0.0064	0.1608	0.0760	0.0637	***0.0248***
0.1021	0.0480	-0.0157	-0.0273	0.0174	0.0273	0.0382	0.0850	0.1231	0.0785	0.0409	0.0917	0.0683	***0.0417***

Note: 20-21 Food Products, 22-Beverage, 23, 24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Source: calculation is based on ASI data

TABLE-5.5A

INDUSTRY-SPECIFIC TECHNICAL EFFICIENCY CHANGE (TEC) IN MANUFACTURING INDUSTRIES IN INDIA FROM 1981-2007

Industry	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
20,21	-0.0044	-0.0077	-0.0106	0.0225	-0.0044	0.0045	-0.0044	-0.0013	-0.0078	0.0109	-0.0060	0.0142	-0.0007	-0.0083
22	0.0030	0.0002	0.0022	-0.0097	0.0041	-0.0035	0.0040	0.0020	0.0024	-0.0034	0.0027	0.0048	0.0006	-0.0117
23,24,25	-0.0022	-0.0062	-0.0059	0.0167	-0.0009	-0.0001	-0.0014	0.0024	-0.0010	-0.0065	-0.0045	0.0130	-0.0004	-0.0004
26	0.0019	0.0041	0.0010	-0.0056	0.0017	-0.0001	0.0014	0.0041	0.0006	-0.0123	0.0023	0.0011	0.0018	-0.0001
27	-0.0026	0.0032	-0.0020	0.0025	-0.0015	0.0012	-0.0018	0.0022	-0.0013	-0.0015	-0.0040	0.0066	-0.0015	0.0024
28	0.0006	-0.0049	0.0008	0.0079	0.0003	-0.0008	0.0003	-0.0059	0.0007	-0.0010	0.0007	-0.0019	0.0008	0.0099
29	-0.0010	0.0026	-0.0005	-0.0004	-0.0008	0.0013	-0.0006	0.0006	-0.0007	-0.0015	-0.0014	0.0039	-0.0005	0.0007
30	-0.0118	0.0080	-0.0127	0.0153	-0.0121	0.0126	-0.0120	0.0157	-0.0110	0.0078	-0.0119	0.0146	-0.0111	0.0096
31	-0.0005	-0.0018	-0.0015	0.0039	-0.0004	0.0004	-0.0004	-0.0008	-0.0009	0.0018	-0.0005	0.0005	-0.0005	0.0009
32	0.0042	-0.0067	0.0053	-0.0030	0.0043	0.0005	0.0020	-0.0042	0.0031	0.0020	0.0006	-0.0089	0.0046	-0.0042
33	-0.0016	0.0046	-0.0004	-0.0007	-0.0009	0.0016	-0.0006	0.0003	-0.0007	-0.0023	-0.0019	0.0055	-0.0005	0.0007
34,35,36	0.0033	-0.0018	0.0028	-0.0019	0.0025	0.0000	0.0017	-0.0029	0.0021	-0.0145	0.0060	0.0044	0.0028	-0.0050
37	-0.0022	-0.0026	-0.0058	0.0102	-0.0026	0.0038	-0.0016	0.0026	-0.0008	-0.0018	-0.0029	0.0054	-0.0009	0.0010
38	-0.0053	0.0126	-0.0016	-0.0014	-0.0031	-0.0047	0.0079	-0.0031	0.0025	-0.0034	0.0083	-0.0009	-0.0013	0.0013

Continued……

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	***1981-07***
-0.0065	0.0021	-0.0088	0.0099	-0.0084	0.0155	-0.0043	-0.0012	-0.0075	0.0067	-0.0080	0.0092	-0.0073	***-0.0005***
0.0036	-0.0058	0.0042	-0.0039	0.0041	-0.0004	0.0032	-0.0033	0.0032	-0.0023	0.0030	-0.0041	0.0033	***0.0001***
-0.0008	-0.0129	-0.0069	0.0157	-0.0032	0.0090	-0.0004	-0.0002	-0.0006	-0.0061	-0.0039	0.0084	-0.0018	***0.0000***
0.0016	-0.0032	0.0018	0.0005	0.0015	0.0052	0.0004	-0.0055	0.0012	-0.0060	0.0019	0.0029	0.0012	***0.0002***
-0.0006	-0.0001	-0.0014	-0.0043	-0.0068	0.0129	-0.0009	0.0011	-0.0008	-0.0005	-0.0021	0.0032	-0.0010	***0.0000***
0.0001	-0.0066	0.0005	-0.0054	0.0008	0.0090	0.0002	-0.0021	0.0003	0.0004	0.0003	-0.0028	0.0004	***0.0001***
-0.0004	-0.0022	-0.0013	0.0003	-0.0017	0.0045	-0.0007	0.0000	-0.0010	0.0010	-0.0010	0.0014	-0.0008	***0.0000***
-0.0116	0.0082	-0.0124	0.0118	-0.0125	0.0193	-0.0107	0.0056	-0.0121	0.0133	-0.0119	0.0100	-0.0123	***-0.0005***
-0.0003	-0.0004	-0.0007	-0.0031	-0.0025	0.0070	-0.0004	0.0001	-0.0005	-0.0008	-0.0012	0.0017	-0.0009	***-0.0001***
0.0044	-0.0038	0.0041	0.0011	0.0016	-0.0060	0.0037	-0.0041	0.0039	-0.0073	0.0055	-0.0022	0.0040	***0.0002***
-0.0004	0.0005	-0.0004	-0.0044	-0.0022	0.0044	-0.0014	0.0002	-0.0018	0.0052	-0.0005	-0.0043	-0.0022	***-0.0002***
0.0035	-0.0060	0.0043	-0.0006	0.0031	0.0002	0.0020	0.0029	0.0003	-0.0110	0.0039	-0.0014	0.0031	***0.0001***
-0.0008	-0.0037	-0.0044	0.0007	-0.0069	0.0152	-0.0007	-0.0007	-0.0018	0.0007	-0.0027	0.0022	-0.0030	***-0.0002***
-0.0014	-0.0031	-0.0036	0.0097	-0.0004	-0.0006	-0.0044	-0.0032	0.0032	-0.0032	0.0070	-0.0012	-0.0019	***0.0002***

Note: 20-21 Food Products, 22-Beverage, 23, 24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Source: calculation is based on ASI data

TABLE-5.6A

INDUSTRY-SPECIFIC SCALEL EFFICIENCY CHANGE (SCE) IN MANUFACTURING INDUSTRIES IN INDIA FROM 1981-2007

Industry	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
20,21	-0.0035	-0.0035	-0.0015	-0.0017	-0.0016	-0.0022	-0.0033	-0.0029	-0.0057	-0.0030	-0.0031	-0.0028	-0.0030	-0.0039
22	0.0028	-0.0013	0.0043	0.0018	0.0019	0.0007	0.0033	0.0011	0.0010	0.0033	0.0009	0.0020	0.0011	0.0034
23,24,25	-0.0007	-0.0004	-0.0010	-0.0013	-0.0004	0.0008	-0.0011	-0.0011	-0.0013	-0.0005	-0.0008	-0.0003	-0.0006	-0.0016
26	-0.0023	0.0072	0.0066	0.0004	0.0030	0.0008	0.0074	0.0020	0.0068	0.0053	-0.0008	0.0031	0.0057	0.0071
27	-0.0011	-0.0010	0.0009	-0.0012	-0.0004	-0.0017	-0.0008	-0.0032	0.0013	0.0007	0.0006	-0.0012	-0.0014	-0.0003
28	0.0009	0.0004	0.0004	0.0004	0.0002	0.0002	0.0004	0.0002	0.0005	0.0004	0.0002	0.0001	0.0002	0.0006
29	0.0033	-0.0022	0.0003	0.0011	0.0008	0.0020	-0.0030	0.0043	-0.0025	0.0039	-0.0039	0.0027	0.0021	0.0013
30	0.0046	0.0009	0.0015	0.0025	0.0028	0.0029	0.0019	0.0024	-0.0005	0.0026	0.0046	0.0005	0.0001	0.0030
31	0.0022	0.0033	-0.0003	0.0009	0.0054	0.0011	0.0021	0.0066	-0.0018	0.0021	-0.0007	0.0030	0.0019	0.0006
32	0.0115	0.0081	0.0078	0.0082	0.0100	0.0027	0.0026	0.0112	0.0025	0.0004	0.0105	0.0006	-0.0010	0.0076
33	-0.0091	-0.0001	-0.0070	-0.0088	-0.0053	-0.0052	-0.0024	-0.0104	-0.0073	-0.0047	-0.0078	-0.0057	0.0063	-0.0101
34,35,36	0.0050	0.0022	0.0037	0.0024	0.0046	0.0007	0.0052	0.0044	0.0032	0.0033	0.0043	0.0026	0.0014	0.0039
37	-0.0022	-0.0026	-0.0058	0.0102	-0.0026	0.0038	-0.0016	0.0026	-0.0008	-0.0018	-0.0029	0.0054	-0.0009	0.0010
38	-0.0017	0.0014	0.0010	0.0006	0.0029	0.0030	0.0028	0.0021	0.0027	0.0053	0.0001	0.0016	0.0003	0.0041

Continued…..

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	***1981-07***
-0.0041	-0.0032	-0.0012	-0.0030	-0.0030	0.0004	-0.0015	-0.0027	-0.0003	-0.0008	-0.0041	-0.0032	0.0003	***-0.0025***
0.0002	0.0012	0.0026	0.0017	0.0003	0.0026	-0.0002	0.0003	0.0023	0.0000	0.0033	0.0002	-0.0007	***0.0015***
-0.0011	0.0002	-0.0004	0.0022	0.0001	-0.0005	0.0008	-0.0011	0.0011	0.0007	-0.0024	0.0000	0.0008	***-0.0004***
0.0030	0.0036	0.0023	0.0039	0.0039	0.0008	0.0033	0.0105	-0.0057	0.0031	0.0066	0.0073	-0.0019	***0.0034***
0.0007	-0.0037	0.0010	-0.0045	0.0008	-0.0013	-0.0031	0.0023	-0.0041	0.0057	-0.0063	0.0001	-0.0005	***-0.0008***
0.0006	0.0002	-0.0004	-0.0006	0.0012	0.0006	-0.0002	0.0004	-0.0006	-0.0003	0.0012	0.0004	0.0002	***0.0003***
0.0006	-0.0002	-0.0032	0.0052	-0.0027	0.0019	-0.0003	0.0002	-0.0001	0.0025	-0.0017	-0.0006	-0.0031	***0.0003***
0.0036	0.0007	0.0016	0.0001	0.0042	0.0029	-0.0012	-0.0003	0.0038	0.0042	-0.0020	0.0025	-0.0016	***0.0018***
0.0036	0.0014	0.0012	-0.0039	0.0060	0.0011	0.0022	0.0006	0.0024	-0.0028	0.0059	0.0055	-0.0013	***0.0018***
0.0170	0.0010	0.0032	-0.0137	0.0147	0.0103	0.0023	0.0098	-0.0014	0.0145	-0.0012	0.0105	0.0020	***0.0056***
-0.0105	0.0036	-0.0100	0.0066	-0.0048	-0.0031	-0.0041	-0.0007	-0.0130	-0.0083	-0.0109	-0.0176	-0.0041	***-0.0057***
0.0045	0.0017	0.0008	0.0036	0.0013	0.0008	0.0010	0.0032	0.0011	0.0030	0.0045	0.0034	0.0033	***0.0029***
-0.0008	-0.0037	-0.0044	0.0007	-0.0069	0.0152	-0.0007	-0.0007	-0.0018	0.0007	-0.0027	0.0022	-0.0030	***-0.0002***
0.0050	-0.0002	-0.0007	0.0000	0.0030	0.0014	0.0035	0.0027	0.0091	-0.0038	0.0003	0.0047	-0.0005	***0.0019***

Note: 20-21 Food Products, 22-Beverage, 23, 24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Source: Calculation is based on ASI data

TABLE-5.7A

INDUSTRY-SPECIFIC TOTAL FACTOR PRODUCTIVITY (TFP) IN MANUFACTURING INDUSTRIES IN INDIA

FROM 1981-2007

Industry	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
20,21	0.0174	0.0461	0.0109	0.0169	0.0187	0.0347	0.0208	0.0391	0.0544	0.0596	0.0124	0.0308	0.0213	0.0179
22	0.0266	-0.0066	0.0160	0.0482	0.0668	0.0348	0.0210	0.0131	-0.0207	-0.0047	0.0303	0.0323	0.0385	0.0319
23,24,25	-0.0156	-0.0193	0.0022	0.0414	-0.0489	-0.0540	0.0227	0.0324	0.0446	0.0317	0.0084	0.0307	0.0297	0.0355
26	0.0292	0.0251	0.0063	0.0018	-0.0625	-0.0246	0.0769	0.0520	0.0696	0.0862	-0.0006	-0.0005	0.0681	0.0782
27	0.0072	0.0414	-0.0177	-0.0176	0.0934	0.1011	0.0264	0.0919	0.0521	-0.0326	-0.0152	-0.0730	-0.0877	-0.0233
28	0.0230	-0.0032	-0.0084	0.0403	-0.0266	-0.0354	0.0194	0.0121	0.0392	0.0479	0.0207	-0.0178	-0.0111	0.0550
29	0.0941	-0.0079	0.0005	0.0452	0.0398	0.0774	-0.0008	0.0521	0.0536	0.0604	-0.0037	-0.0098	0.1138	0.1189
30	0.0441	0.0737	0.0173	0.0570	0.0557	0.0764	0.0294	0.0531	0.0150	0.0445	0.0540	0.0499	-0.0174	0.0345
31	0.0076	0.0210	0.0138	-0.0462	-0.0634	0.0068	0.0360	0.1021	0.0461	0.0580	0.0125	0.0370	0.0807	0.0475
32	0.0568	0.0835	0.0629	0.0314	0.0785	0.0630	0.0277	0.0631	0.0654	0.0181	0.0406	0.0150	-0.0134	0.0131
33	0.0183	0.0453	-0.0043	-0.0066	0.0429	0.0519	0.0276	0.0311	0.0240	0.0140	0.0188	0.0354	-0.0009	-0.0074
34,35,36	0.0250	0.0210	0.0159	0.0246	0.0534	0.0194	0.0477	0.0714	0.0477	0.0197	0.0245	0.0092	0.0029	0.0296
37	0.0123	0.0157	0.0071	0.0407	0.0167	0.0153	0.0386	0.0534	0.0593	0.0253	-0.0176	0.0305	0.0520	0.0574
38	-0.0468	-0.0068	0.0135	0.0113	0.0655	0.0648	0.0607	0.0360	0.0377	0.0827	0.0561	0.0049	0.0446	0.0578

Continued…..

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	***1981-07***
0.0403	0.0498	0.0096	-0.0183	-0.0193	0.0422	0.0386	0.0573	-0.0105	-0.0010	0.0096	0.0425	0.0283	***0.0248***
0.0214	0.0037	0.0422	-0.0117	-0.0150	0.0166	0.0020	0.0036	0.0113	0.0118	0.0383	0.0175	0.0031	***0.0175***
0.0227	0.0196	0.0536	-0.0501	-0.1044	0.0130	-0.0049	0.0241	0.0001	-0.0227	0.0309	0.0577	0.0012	***0.0068***
0.0570	0.0543	0.0918	0.0507	0.0523	0.1143	0.0559	0.1409	0.0125	0.0289	0.0694	0.0974	0.0518	***0.0475***
-0.0178	0.0726	0.0009	-0.0645	-0.0177	0.0655	0.1412	0.0191	0.0137	-0.0240	-0.0692	0.0807	0.0290	***0.0139***
0.0677	0.0112	-0.0290	-0.0566	-0.0139	0.0395	0.0246	0.0449	-0.0550	-0.0968	0.0668	0.0879	0.0438	***0.0107***
0.0596	0.0210	0.0126	0.0150	-0.1521	-0.0691	0.1220	0.0165	-0.0487	0.0983	-0.0112	0.0127	0.0295	***0.0274***
0.0436	0.0367	0.0092	-0.0084	-0.0153	0.0503	-0.0145	0.0296	0.0078	0.0817	-0.0010	0.0014	0.0183	***0.0306***
0.0512	0.0603	0.0399	-0.0891	-0.0237	0.1039	0.0574	0.0896	0.0437	0.0141	0.0879	0.0937	0.0830	***0.0360***
0.0913	0.0480	0.0258	-0.0083	0.0631	0.0735	0.0427	0.0689	0.0342	0.0528	0.0286	0.0183	0.0484	***0.0442***
0.0648	0.0149	0.0075	-0.0077	-0.0403	0.0049	0.0133	0.0622	0.0304	0.0500	0.0287	0.0448	0.0763	***0.0237***
0.0807	0.0368	0.0116	-0.0019	-0.0065	0.0004	0.0117	0.0493	0.0164	0.0341	0.0757	0.0510	0.0826	***0.0316***
0.0991	0.0488	-0.0539	-0.1697	-0.0660	0.0847	-0.0274	0.0819	-0.0311	-0.0056	0.1581	0.0782	0.0607	***0.0246***
0.1058	0.0448	-0.0200	-0.0176	0.0200	0.0281	0.0372	0.0844	0.1354	0.0714	0.0482	0.0952	0.0659	***0.0437***

Note 1: 20-21 Food Products, 22-Beverage, 23, 24&25- cotton, jute and woolen, 26-Textiles, 27-Wood, 28-paper, 29-Leather, 30-Chemical, 31-Rubber, Petroleum and coal, 32-Non-metalic, 33-Basic Metal, 34, 35&36-Metal and Machinery, 37-Transport, 38-Other Manufacturing.

Note 2: These above tables from 5.4 to 5.7 are calculated and presented here to support the analysis of chapter-V and also to show the industry wise growth of technological progress, technical efficiency change, scale efficiency change and total factor productivity growth during the whole sample period.

Source: Calculation is based on ASI data