Growth in Organized Manufacturing and its Productivity in West Bengal During 1981-82 to 2010-11: A Comparative Study of Some Selected States in Eastern India vis-à-vis All India

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Abstract:
This paper attempts to estimate the growth of output and productivity in the organized manufacturing industry in West Bengal and compare the results with those of three selected states in eastern India namely Assam, Bihar and Orissa vis-a-vis all India during 1981-82 to 2010-2011, during the pre- and post-reform periods (1981-82 to 1990-91 and 1991-92 to 2010-11)) and over the decades during this period. So far as the growth in organized manufacturing is concerned, annual growth rates, average annual growth rates as well as trend growth rates of output are estimated for that sector in West Bengal and in the three selected states in eastern India as well as in all India and compared the results obtained. The study further estimates the partial as well as the total factor productivity growth (TFPG) of the organized manufacturing industries in West Bengal and in three states mentioned above as well as in all India. To estimate the trend growth rates separate semi-logarithmic trend is fitted using ordinary least square method. In order to estimate the total factor productivity growth production function estimation approach is used in this study. The more generalized form of production function, namely, Translog Production function is used for the purpose.

Key words: Partial Factor Productivity and Total Factor Productivity

1. Introduction

West Bengal has lost its earlier fame as one of the highly industrialized states in India. It was once the second most industrialized state in India in terms of value-added and was at the top in terms of number of factories and employment even in the mid-1960s in spite of its rapid slow down from the very beginning of independence of the country. Thereafter, the state started to lose its industrial primacy among the states in India since the mid-1960s and the recessionary effect on industry in the state was not only the most severe but long drawn as well (Bagchi 1998). The growth rate of its manufacturing output has been drastically low compared to even that of other industrially less developed states in

eastern India. The slow growth of organized manufacturing in West Bengal was a damaging consequence of the license permit raj (Bagchi, 1970, Chandrasekhar, 1998).
The Liberalization, Privatization and Globalization (LPG) policies that started in the early 1980s, and were strengthened in the 1990s, opened the organized manufacturing industries to greater competition from within and abroad. One of the major components of economic reforms has been the deregulation and relicensing in the manufacturing sector. The justification provided for this was to encourage competition, which, in turn, was expected to enhance the efficiency and productivity performance of the organized manufacturing industries. Some researchers believe that productivity is the most effective way to the increase in standard of living of the masses (Balakrishnan and Pushpangadan, 1998) and is therefore an acute measure of welfare (Krugman, 1990). The increase in productivity may be caused by several factors like investment in human capital, improving infrastructure, efficiency in capacity utilization etc. It has been observed that total factor productivity growth (TFPG) in the organized manufacturing sector in West Bengal remains more or less same during the pre-and post-reform period. However, the growth rate of output in the organized manufacturing industries in the state increased during the same period. The increase in the growth rate of output in that sector of the state during the post-reform period is not, therefore, due to TFPG but due to other factors.

2. Literature Survey

Over the past three decades, several studies have also been made to assess the performance of the organized manufacturing industries in India based on productivity (Brahmananda, 1982; Goldar, 1986; Ahluwalia, 1991; Balakrishnan and Pushpangadan, 1994; Dholakia and Dholakia, 1994; Rao, 1996a; Shrivastava, 1996; Balakrishnan, Pushpangadan and Suresh Babu, 2000; Goldar, 2002; Pal, 2002; Goldar and Kumari, 2003; Goldar, 2004). Most of the studies on productivity in India have focused on the growth of TFP in the organized manufacturing sector. A number of studies (Brahmananda, 1982; Ahluwalia, 1991; Dholakia and dholakia, 1994; Majumdar, 1996; Rao, 1996a; Pradhan and Barik, 1999; Trivedi et al, 2000) have observed a decline in the TFPG during 1970s and up to mid-1980s with a turnaround taking place in the post mid-1980s, perhaps owing to the more openness of trade and industrial policies. Balakrishnan and Pushpangadan (1994) argue that the TFPG during 1980s was higher because real value added (used as output) is obtained by using single deflation method. This turnaround (in 1980s) will disappear if double deflation method is used.
In the post-reform period also two different results are found from different studies. Studies by Krishna and Mitra (1998), Patnayak et al (2003), Unel (2003) and Tata Services Ltd. (2003) found an acceleration in TFPG, whereas studies by Trivedi et al (2000), Balakrishnan, Pushpangadan and Suresh Babu (2000), Goldar (2000), Srivastava (2001), Ray (2002), Goldar (2002), Pal (2002), Goldar and Kumari (2003), Goldar (2004,2006), Das (2004), Kumar (2004), Trivedi (2004), Rodrik and Subramanian (2004) and RBI (2004) find a deceleration in TFPG. The relaxation of the restrictive protection policies in respect of industries appears to be the main reason for the acceleration in TFPG as mentioned by the first group whereas the slowdown in the growth of agriculture

is the main reason behind the deceleration in TFPG in the organized manufacturing during the post-reform period as mentioned by the second group.

3. Research Gap

Most of the works as we know done till date in India have focused on the measurement of growth and productivity of the organized manufacturing industries at the all India level. Very few works have been devoted to the estimation of the same at the state level and fewer works on the same for the states in eastern India like West Bengal, Bihar, Orissa and Assam, which are relatively industrially less developed than many of the states in northern, western and southern India. Measuring the growth rates of output, partial input productivities and total factor productivity of the organized manufacturing industries in West Bengal and other states in eastern India as well as in all India, comparing the results obtained and assessing the impact of TFPG on output growth need to be done to get a clear idea of the technological progress and its impact on the output (GVA) growth during the last three decades that include pre-and post-economic and financial reforms.

4. Objective: The objectives of this study are as follows:

1) To estimate the growth rates of (a) output (gross value added), (b) partial input productivities and (c) TFP in the organized manufacturing industries in West Bengal and in few other states in eastern India vis-à-vis all India during the period 1981-82 to 2010-11 for the entire period, pre-and post-reform periods and over the decades during the period 2) To compare the growth rates of output, partial input productivities and TFP in West Bengal manufacturing with those in other mentioned states in eastern India vis-à-vis all India and the role of these factors such as labour and capital and technological progress in the output growth in West Bengal and in other states in eastern India along with all-India. 3) To decompose the output growth into the contribution of the inputs' (labour and capital) growth and the growth of technological progress or the TFP growth.

5. Data Base and Research Methodology

Data Sources

The study is based on the data collected from the various issues of Annual Survey of Industries (ASI), published by Central Statistics Office (Industrial Statistics Wing), Kolkata, Ministry of Statistics and Programme Implementation, Government of India, the National Accounts Statistics published by the Central Statistical Organization, Ministry of Statistics and Programme Implementation, Govt. of India and Handbook of Statistics on the Indian Economy, Published by Reserve Bank of India.

6. Variables used

The variables used in this study are output, labour and capital. To make the values of output and capital comparable over time and across different states, suitable deflators have been used. The definition of the variables and the deflators used and various issues involved in the selection of these variables are presented below.

Output

There is a strong debate on the use of Gross value added (GVA) or gross output as a measure of output. Studies by Goldar (1986), Ahluwalia (1991), Balakrishnan and Pushpangadan (1994, 1998) used value added as a measure of output. Norsworthy and Jang (1992) justify the use of value added as a measure of output on the ground that it is very useful in national income estimation as it avoids the problems of double counting or multiple counting in intermediate inputs. Diewart (2000) argued that value added is preferred to gross output as the latter includes cost of intermediate inputs that may vary greatly across industries. According to Griliches and Ringsted (1971), use of value added allows comparisons between the firms that are using heterogeneous raw materials. The use of gross output that demands the inclusion of raw materials as an input in the model might reduce the role of labour and capital in the growth process (Hossain and Karunakara, 2004).

Some studies (Rao, 1996; Pradhan and Barik, 1998; Ray, 2002; Trivedi, 2004; Mukherjee and Ray, 2004) have used gross output function framework by rejecting implicitly maintained hypothesis of separability of intermediate inputs like material inputs and fuel from labor and capital. They argued that a production function relating to labor and capital is meaningful only when material inputs are separable from the primary inputs. TFP growth based on value added measure is often greater than the output measure due to an upward bias created by the omission of intermediate goods and services. This bias, however, can be corrected if the ratio of inputs to gross output remains constant (Star, 1974).

In our study, we have used GVA as the measure of output. Gross output is not taken here as a measure of output in order to avoid the possibility of double counting. Again, productivity estimation in our study assumes output to be a function of labour and capital only. It is; therefore, appropriate to take value added as a representative of output instead of the value of output itself. However, it may appear true that net value added might have been a better measure of output, but since the depreciation figures are not reliable as the entrepreneurs often provide us with inflated figures in order to avoid taxes, we have preferred gross value added as a measure of output to net value added.

If value added is used as a measure of output, nominal output needs to be converted into real output either by single deflation or by double deflation. In case of single deflation, nominal value added is deflated by the output price index, which means that, both nominal output and nominal inputs are deflated by the same output price index, whereas in case of double deflation nominal output is deflated by the output price index and the nominal inputs by the input price index. If both output and input prices change in the same proportion, then the ratio of input-output prices remains same and in such a situation, the estimation of the growth of output and productivity by single deflation and double deflation will give the same result.

Goldar (1986) and most of the other notable studies used single deflation method based on output price index for the estimation of real value added. However, the study by Balakrishnan and Pushpangadan (1994) for Indian manufacturing sector was the first of its kind to use the double deflation method. They have pointed out that deflating value added by a single deflator (as has been done by Goldar, 1986 and Ahluwalia, 1991) would be fruitful only if the prices of material inputs did not change relative to the change in prices of output. The study at the aggregate level for the Indian manufacturing sector refutes the claim made by Ahluwalia (1991) that there was a positive turnaround in TFPG in 1980s. It is, they argue, due to the over-estimation of productivity for the use of single deflation method in the event of declining relative prices in 1980s.

Goldar (2000), however, claimed that the estimates of TFPG using double deflated value added or gross output function framework are sensitive to the base year of the price indices chosen for deflation. Thus, the finding of a very low or even negative TFP growth in the 1980s by Balakrishnan and Pushpangadan and also by others may have a lot to do with the choice of base year price indices with base 1970-71=100. On the other hand, the studies by Trivedi et al (2000) have used price indices with base 1981-82=100, instead of the price indices with base 1970-71=100, and have found a significant positive growth in TFP in Indian manufacturing in the 1980s.

In our study, however, we have used single deflation method instead of double deflation since in our study the material inputs and fuels have been left out of the consideration due to non-availability of input price data, particularly at the state level. The real value added is obtained here by deflating nominal value added by Wholesale Price Index (WPI) for the manufacturing products.

Labour

Generally, the number of hours worked or the number of workers employed are used as a measure of labour input. A large number of studies have preferred to use the number of hours worked as measure of labour input as it measures more accurately the part time as well as full time employees in terms of actual hours worked. However, the measures suffer from the limitation that if a mix of skilled and unskilled workers is employed as labour input, the productivity of the skilled workers will be much higher than that of unskilled workers. Therefore, appropriate labour measure would require incorporating the quality of labour inputs accounting for the age, sex, education, employment status of the worker (Mahadeven, 2003). Some researchers have made an uncomfortable assumption that efficiency differences among different classes of labour are largely reflected in their remuneration, i.e., labourers are paid their remuneration according to their marginal productivity. This assumption, is, however, not valid for a developing country like India where remuneration does not vary according to the level of efficiency, as there exists huge surplus labour in the country.

In our study, therefore, we have taken total number of persons engaged as labor input. Further as workers, supervisors, managers, storekeepers, office bearers, all working proprietors, and their family members who are activity engaged in the work of factory even without any pay have a significant contribution on the productivity, total number of persons engaged is preferred to all other measures as labor input.

Capital

The measurement of capital is the most complex of all input measurements. Actually, there is no universally accepted method for the measurement of capital and, as a result, several methods have been applied to estimate capital stock in several studies. In many studies, capital is treated as a stock concept and is, therefore, measured by the book value of fixed capital assets. Some studies have used the perpetual inventory accumulation method (PIAM) to construct capital stock series from annual investment data. Goldsmith (1957) was the first to introduce the PIAM.

However, it is essential to point out that each of these measures has certain limitations.

For example, the book value method has the following three limitations:

1) The use of 'lumpy' capital data underestimates or overestimates the amount of capital expenditure;

2) The book value may not truly represent the physical stock of machinery and equipment used in the production;

3) It does not address the question of capacity utilization.

Perpetual inventory method also does not address the question of capacity utilization.

Despite these limitations, several studies in the Indian manufacturing sector have used the PIAM method to get the series of capital stock. In this study, we have also used the PIAM to obtain the fixed capital stock series. 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 as given in National Accounts Statistics (NAS). The deflator series is constructed for the period 1981-82 to 2010-11. The base is shifted to 1980-81 so as to be consistent with the wholesale price index (WPI) used to estimate real value added.

2) From ASI data, gross investment in fixed capital in registered 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. To obtain real gross investment, the nominal figures have been deflated using the implicit deflator for fixed investment mentioned above.

3) To construct capital stock series for the manufacturing sector, ASI data on 1980-81 have been considered as the benchmark year of capital stock. The capital stock series for the manufacturing sector, in the subsequent years has been arrived at by adding the real investment figures to the stock of capital of the previous year.

Let B_t and B_{t-1} denote the book value of fixed capital in the year t and t-1 respectively, D_t the reported depreciation in the year t and P_t is the implicit deflator for fixed capital in the year t. The real gross investment in the year t, denoted by I_t, may be obtained as

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

The relationship between gross fixed capital in the year t, denoted by K_t, the benchmark capital stock, K_o and the rate of obsolescence for each year at a uniform rate of 'δ', is given by the equation-

$$K_t=K_{t-1}-\delta K_{t-1}+I_t$$

Let us assume that the rate of obsolescence for each year at a uniform rate is 5% as found in TSL and Unel study. Then the capital stock series can be written as-

$$K_1=K_o-0.05K_o+I_1$$

$$K_2=K_1-0.05K_1+I_2$$, and so on.

7. Methodology

The present study analyses the growth in organized manufacturing industries and its productivity in West Bengal and in three states in eastern India, namely Assam, Bihar, Orissa and also in all India. The study covers a period of thirty years from 1981-82 to 2010-11 and the entire period is broadly divided into two sub-periods like pre-reform period (1981-82 to 1990-91) and the post-reform period (1991-92 to 2010-11). The post-reform period is- again sub-divided into two decades-1991-92 to 2000-01 and 2001-02 to 2010-11.

To measure growth performance of output and productivity annual growth rates, average annual growth rates as well as the trend growth rates have been calculated for the above-mentioned periods. The annual growth rates are calculated on a year-to-year basis using the formula $g_t= (X_t-X_{t-1})/X_{t-1},$ where X denotes the variable for which growth rate is measured. To compute average annual growth rates, a simple average of annual growth rates are taken. Regarding the methodology for estimating the trend growth rates, we have fitted semi-logarithmic (logy=a+bt) trend equation using ordinary least square method.

However, the productivity performances of the organized manufacturing industries can be analyzed in the following way. Productivity that is defined as the ratio of output to input(s) is of two types:

1) Partial or single factor productivity; and
2) Total factor Productivity

The partial or single factor productivity is defined as the ratio of output to the quantity of the factor of production for which productivity is to be measured (e.g. labour productivity and capital productivity). The partial or single factor productivity of labor or capital is measured by the ratio Y/L (output/employment) or Y/K (output/capital), i.e., output per unit of input(s) or the average product of the factor concerned. The trend growth rates of labor productivity (output-labour ratio), capital productivity (output-capital ratio) and capital intensity (capital-labour ratio) have been also calculated in the study. Partial factor productivity is however considered to be one of the oldest and widely used measures of productivity (Trivedi et al, 2000). Partial factor productivity can be changed by substituting one factor of production for another (Majumdar, 2004). Improvements in partial factor productivity could be achieved by changing the economies of scale (Mahadevan, 2004). Partial factor productivity, though easy to compute, has certain limitations also. Output is actually produced by a combination of factor inputs. Hence, partial factor productivity gives us only a partial view of productivity.

On the other hand, total factor productivity (TFP) is defined as the ratio of output to a weighted sum of inputs used in the production process. Total factor productivity growth (TFPG) measures the growth in output that is not accounted for by the growth in inputs. In other words, TFPG is the residual growth of output, which is not explained by growth of factor inputs. Growth in output can therefore be decomposed into two parts-one contributed by the changes in the factor-inputs like labor and capital, and the other contributed by the changes in all the residual factors such as changes in technology, economies of scale, capacity utilization, quality of factors of production, learning by doing etc.(Trivedi et al , 2000). The second part indicates the state of dynamism in the economy.

There are mainly two different approaches to measure total factor productivity growth-

1) Growth accounting approach
2) Production function estimation approach

Growth accounting measure estimates the TFP growth by subtracting the weighted input growth from the output growth. The difference so obtained includes the effects of technological progress, scale of production, capacity utilization, learning by doing, technical efficiency etc. Christensen and Jorgenson (1973), Denison (1962, 1974, 1979), Jorgenson and Griliches (1967), Kendrick (1961, 1973), Kendrick and Grossman (1980) and Solow (1957) have adopted the conventional growth accounting approach. The growth accounting method of estimation of TFP rests on two restrictive assumptions, namely, existence of perfect competition in the factor market and constant returns to scale (CRS). However, these two assumptions do not hold good for a developing country like India where market structures are imperfectly competitive. Therefore, a direct econometric estimation of production function is undertaken. The production function estimation approach that does not make any restrictive assumption like CRS and exhibits non-unitary or non-constant elasticity of substitution is chosen for this purpose.

According to Hulten (2000), the production function approach to productivity measurement can be treated as complementary to the growth accounting approaches. The widely accepted advantag

e of the production function approach is that the assumptions of CRS and perfect competition need not be imposed. The estimates of the parameters of the production function directly provide us the information about the factor shares. Further, if more flexible forms of production functions are used, returns to scale or homotheticity property of production functions can be directly tested. Christensen, Jorgenson and Lau (1971, 1973) developed a production function that was more flexible than Cobb-Douglas production function (CDPF) and CES. This type of production function is known as Transcendental logarithmic or the translog production function. In this production function, technology does not have to be Hicks-neutral type; it does not have to proceed at a constant rate and the elasticity of substitution need not be unity (as in the case of CDPF) or constant (as in the case of CES function). The Translog production function is written in the form:

$$LnY=\alpha+\beta_L lnL+\beta_K lnK+\beta_T T+1/2\beta_{LL}(lnL)^2+1/2\beta_{KK}(lnK)^2+1/2\beta_{TT}T^2+\beta_{LK}(lnL)(lnK)+\beta_{LT}(lnL)T+\beta_{KT}(lnK)T$$

In this equation, Y denotes output (i.e. real value added), L labor, K capital and T denotes time (Year).

Total factor productivity growth (TFPG) can be derived from the production function mentioned above in the following way:

$$TFPG=\delta lnY/\delta T=\beta_{T}+\beta_{KT}lnK+\beta_{LT}lnL+\beta_{TT}T$$

Where β_T= the rate of autonomous total factor productivity growth;
β_{TT}= the rate of change of TFPG;
β_{LT}, β_{KT}= the bias in TFPG

If both β_{LT} and β_{KT} are zero, then the TFPG is Hicks-neutral type. If β_{LT} is positive, the share of labor increases with time and there is labor using or capital saving bias. Similarly, if β_{KT} is positive, the share of capital increases with time and there is capital using or labor saving bias.

Using Translog production, we followed backward elimination technique to get the best-fitted production function for four different states in Eastern India as well as for all India. We have applied three criteria to obtain the best-fitted production function:

1) The best-fitted production function should contain all the variables, namely, capital input, labor input and time.
2) The best-fitted production function should be observationally robust in the sense that all the coefficients should be significant and its estimated values will not change significantly even when one or two observations either from the beginning or from the end of the sample set are excluded from the model or included in the same.
3) The chosen form should have the desired property that the contributions of the inputs to the estimated output are positive.

Our target is to find out TFPG that is obtained by differentiating the best-fitted production function with respect to time. We have also tested whether the excluded coefficients are jointly insignificant. We ignore the result that fails the F-test that is given by-

$$F_{q,\,n-k}=\{(R_g^2-R_c^2)/(1-R_g^2)\}\,(n-k)/q$$

where n, k and q are respectively the number of observations, the number of coefficients in the general form of production function and the number of independent linear restrictions, that is, the number of coefficients assumed zero in the present case. R^2g and R^2c are respectively the R^2 value for the general case regression and for the final form regression. It may be mentioned here that dropping of few terms may not leave the resulting form of production free from the influence of variables K, L and T but in this way the severe effect of multicollinearity may be avoided substantially.

8. Results and Findings

The estimation results show that the trend in the growth rate of output of the organized manufacturing sector has increased in West Bengal while it has declined in all-India, Assam and Orissa during the post-reform period (1991-92 to 2010-11). Trend growth rate of output in this sector has, however, remained more or less same in Bihar during the pre- and post-reform period. The trend in the growth rate of labour productivity, on the other hand, increased in Bihar while it has declined in Assam, Orissa and all-India during the post-reform period although it has remained more or less same in West Bengal during both the pre and post-reform period. But the growth rate of TFP decreased in all-India and it has increased in Orissa during the post-reform period although it remained more or less same in Assam, Bihar and West Bengal during the pre and post-reform period. The trend in the growth rate of capital productivity, however, increased in the post-reform period in all-India and W.B. and the growth rates are also statistically significant. The growth rate of capital productivity in all other states in our study, whether increased or declined remained statistically insignificant during that period. So the trend growth rate of output in these states, whether increased or declined, depends upon the combined effect of the growth of labour productivity and TFP during this period. But the growth rate of capital productivity (0.92%) in India was very low and the slow growth rate of capital productivity in India as a whole during the post-reform period has been remaining insufficient to offset the declining effect of both the labour productivity and TFP growth during 1991-92 to 2010-11. As a result the growth rate of output in the organized manufacturing sector in India which was achieved during 1980s could not be sustained during the period after 1991. On the other hand, the increase in the growth rate of manufacturing output in W.B. during the post-reform period was mainly due to the increase in the growth rate of capital productivity (1.08%) during that period because the growth rate of labour productivity as well as TFP in that sector of the state almost remained same during the pre-and post-reform period.

In appendix, Tables 1 through 4 shows that the annual growth rates of output, labor productivity (Y/L), capital productivity (Y/K) and capital intensity (K/L) in the organized manufacturing sector fluctuated widely over the years in all the four states in our study as well as in all-India. The maximum growth rates of the above components were achieved in different years and again the maximum growth rates of most of the above components occurred during the post-reform period. Annual growth rate of TFP shown in Table 5, however, decelerated steadily in all-India although it has fluctuated in all the four states in our study. The lower portion of Tables-1 through 5 shows the average annual growth rates of the aforesaid components during the entire period (1981-82 to 2010-11), the pre-reform period (1981-82 to 1990-91), the post-reform period (1991-92 to 2010-11) and also in two sub-periods (decades) of the post-reform period (1991-92 to 2000-01 and 2000-01 to 2010-11). It is found that the average annual growth rate of output has increased in W.B. during the post-reform period although the average annual growth rate of labour productivity as well as capital intensity in the state remained more or less same during that period. The average annual growth rate of output, labour productivity and capital intensity of the organized manufacturing industries, however, declined in Assam, Orissa and all-India during the post-reform period while they have increased in Bihar during the same period of time. A positive relationship between the growth rate of labour productivity and capital intensity has also found in almost all the states in our study including in India as a whole. The average annual growth rate of TFP of the organized manufacturing industries has, however, remained more or less same in W.B., Assam and Bihar during the post-reform period while it has declined in all India and increased in Orissa during the same period of time. The average annual growth rates of almost all the above mentioned components show their maximum growth rates during the last decade in the post-reform period.

Tables 6 through 10 shows the trend growth rates of output (GVA), labor productivity (Y/L), capital productivity (Y/K), capital intensity (K/L) and TFP in the organized manufacturing industries in W.B., Assam, Bihar, Orissa and all India. The trend growth rate of output (GVA) has increased in W.B. from 0.95% in the pre-reform period to a moderate rate of 2.72% in the post-reform period. The trend in the growth rate of output (GVA) has, however, declined respectively from 11.32%, 13.55% and 7% in Assam, Orissa and all India during the pre-reform period to 5.51% 7.49% and 6.4%, during the post-reform period. The above growth rate of output has, however, remained more or less same in Bihar during the pre-and post-reform period (3.9% in the pre-and 3.8% in the post-reform period). The trend in the growth rates of the partial factor productivity of labour that were respectively 11.89%, 11.93% and 6.79%, in Assam, Orissa and all India during the pre-reform period have declined to 4.79%, 6.88% and 5.18% during the post-reform period. The growth rate of labour productivity, however, remained more or less same in W.B. during the pre-and post reform period (4.66% & 5.09% respectively during the pre-and post-reform period). Whereas the growth rates of the same was 3.78% in Bihar during the pre-reform period and it has increased to 6.5% during the post-reform period. However, the trend growth rates of TFP that were respectively 3.97%, 2.24%, 5.91% in W.B. Assam and Bihar during the pre-reform period have become 4.16%, 2.25% and 6.01% during the post-reform period. It is clear that the growth rates of TFP remained almost same in these states during both the pre and post-reform period. But the growth rate of TFP in the organized manufacturing industries in India as a whole has declined from 6.2% in the pre-reform period to 4.14% in the post-reform period whereas it was negative (-0.27%) in Orissa during the pre-reform period and has increased to massive 8.02% during the post-reform period. So we may say that the increase in the growth rate of output in W.B. during the post-reform period is mainly due to the increase in the growth rate of capital productivity as the trend growth rate of labour productivity as well as TFP in W.B. manufacturing has remained more or less same during the pre-and post-reform period. Whereas, the reduction in the growth rates of output in Assam and all-India during the post-reform period is mainly due to the reduction in the growth rates of labour productivity and TFP during that period. However, the trend growth rate of output remained more or less same in Bihar during the pre-and post-reform period because even if the trend growth rate of TFP has increased in the state during the post-reform period, the trend growth rate of labour productivity has declined in that state during the same period. Further, the trend in the growth rate of output has declined in

Orissa during the post reform period because although TFPG rates increased at a higher rate in the state, the growth rates of labour productivity has declined more or less at the same rate during that period. We have already noticed that although the trend growth rate of capital productivity was statistically significant in all-India the growth rate was very meager. However, the trend growth rate of output in the organized manufacturing sector in W.B. has increased in the post-reform period as the growth rate of capital productivity has the significant contribution in the growth rate of output. Further, the growth rate of capital productivity has no significant role in the growth of organized manufacturing output in all other states in our study during the post-reform period. .

So far as the contribution of the TFP growth and input growth in the growth of total output is concerned, it has been observed that the contribution of TFP growth in output growth was significantly high while the contributions of input growth were found to be negligible or even negative during the entire period, pre-and post-reform period as well as during three different decades in our study. It may be mentioned here that despite the declining contribution of input, the higher growth in industrial production, in these states, during the above mentioned periods could be maintained by the growth in TFP in the form of efficient use of better technology and knowledge. This implies that better quality of input and improved technology were the major contributors to the industrial growth in these states during these periods.

9. Conclusion

So far as our study is concerned we see that the growth of output in the organized manufacturing sector as a whole in West Bengal has accelerated during the post-reform period, specifically during the last phase (2001-02 to 2010-11) of the post-reform period which may be due to the increase in the productivity of capital along with better capacity utilization in the state. However, the growth rate of output in the organized manufacturing sector in West Bengal during the post-reform period is still much lower than those of other industrially less developed states in eastern India and that in all India probably due to the increase in rapid growth of output and productivity along with increase in larger scope of employment in unorganized manufacturing sector in the state. Growth rate of output (GVA) in the organized manufacturing sector in all India, Assam and Orissa has, however, declined during the post-reform period compared to that in the pre-reform period, implying that in India and in these states, the industrial sector failed to achieve sustained growth momentum after 1991. On the other hand, the growth rate of TFP in the organized manufacturing sector remained more or less same in W.B., Assam and Bihar during the pre and post-reform period whereas it has decelerated in all-India and increased in Orissa during the post-reform period. However, the deceleration in the growth rate of output and productivity in the organized manufacturing industries in all-India during 1990s does not seem to have been caused by import liberalization policies. Rather, the relaxation of the restrictive protection policies in respect of industries appears to have had a favourable impact on productivity growth in Indian industries.

The explanation for the deterioration in the rate of growth of output and productivity in organized manufacturing sector in all-India during the post-reform period seems to lie in the adverse effect of certain factors that more than offset the favourable influence of the reforms. Two factors that seem to have had an adverse effect on industrial productivity in the post-reform period are: a) decline in the growth rate of agriculture and b) deterioration in capacity utilization in the industrial sector (Goldar and Kumari, 2003). The deterioration in productivity growth in manufacturing industry in the post-reform period may in part be attributable to a slowdown in the growth of agriculture during the post-reform period. Again, the slower agricultural growth may have led to a slow growth in demand for industrial product, which in turn may have caused under-utilization of capacities with an adverse effect on productivity in the organized manufacturing industry.

Appendix

Table 1: Annual growth rate of output (gva) of the organized manufacturing industries in India and in few states in eastern India

Year	India	Assam	Bihar	Orissa	W.B.
1981-82	9.53	5.80	22.32	-4.77	-2.42
1982-83	9.53	2.68	26.41	22.11	6.64
1983-84	12.97	46.23	14.58	-3.92	-2.86
1984-85	-0.01	31.23	-24.30	-21.30	4.54
1985-86	0.14	23.20	0.01	35.00	-1.66
1986-87	7.70	1.41	0.30	18.39	-4.02
1987-88	6.67	-9.55	26.02	13.29	18.97
1988-89	16.53	-11.60	20.65	68.89	-15.10
1989-90	9.20	56.73	-6.33	9.35	-3.57
1990-91	8.40	-9.56	-5.74	-6.73	22.08
1991-92	-3.54	-4.45	10.52	1.96	5.12
1992-93	16.71	-0.48	-3.82	3.05	1.53
1993-94	15.74	-7.00	66.13	3.85	17.38
1994-95	8.83	4.06	-37.70	9.73	-4.97
1995-96	18.83	23.92	16.22	17.57	10.23
1996-97	8.90	-7.35	6.65	22.26	14.40
1997-98	-1.57	0.74	41.63	10.51	20.78
1998-99	-11.80	6.94	-11.20	-42.40	-34.90
1999-00	6.00	8.53	-2.45	12.66	-9.82
2000-01	-11.40	-21.50	-42.10	-12.80	-4.93
2001-02	0.19	-25.70	-12.20	-11.60	10.20
2002-03	14.10	171.80	66.89	19.78	10.83
2003-04	10.03	17.73	6.71	22.71	3.89
2004-05	15.68	-7.06	72.35	54.88	17.82
2005-06	11.64	-7.93	-27.00	-0.71	-12.40
2006-07	18.63	0.19	-16.90	29.83	11.11

2007-08	14.22	-13.40	74.42	37.86	15.34
2008-09	2.76	-11.70	-22.20	15.00	7.42
2009-10	14.20	52.46	0.08	-6.36	17.75
2010-11	10.91	24.43	28.82	11.95	3.09
AVERAGE:1981-82 To 2010-11 (Total Period)	7.99	11.36	9.62	11.00	4.08
AVERAGE:1981-82 TO1990-91 (Pre-reform Period)	8.07	13.66	7.40	13.03	2.26
AVERAGE:1991-92 TO 2010-11 (Post-reform Period)	7.95	10.21	10.74	9.99	4.99
AVERAGE:1991-92 TO 2000-01 (Decade-1)	4.67	0.34	4.39	2.64	1.48
AVERAGE:2001-02 TO2010-11 (Decade-2)	11.24	20.08	17.09	17.34	8.50

Source: Authors' own calculation

Table 2: Annual growth rate of labor productivity(y/l) of organized manufacturing industries in India and in few states in eastern India

Year	India	Assam	Bihar	Orissa	W.B.
1981-82	14.50	8.80	26.18	-8.74	5.55
1982-83	5.84	8.57	25.23	20.10	3.93
1983-84	12.90	39.90	18.28	-2.52	-14.10
1984-85	2.03	38.20	-21.90	-22.60	22.00
1985-86	5.39	19.00	1.75	25.50	11.80
1986-87	8.20	9.72	-2.08	23.60	1.42
1987-88	1.88	-4.72	14.93	2.02	23.50
1988-89	17.20	-21.90	22.17	75.80	-18.20
1989-90	3.93	49.50	-1.69	6.61	-0.27
1990-91	8.09	1.21	-4.89	-3.08	21.50
1991-92	-4.00	-14.50	11.12	-8.12	1.84
1992-93	9.89	-8.14	-5.30	-1.91	2.57
1993-94	15.70	8.18	77.43	0.97	20.70
1994-95	4.24	-4.71	-38.10	4.25	-6.13
1995-96	7.26	4.13	18.53	16.00	-0.13
1996-97	16.70	3.68	10.39	32.60	28.30

1997-98	-6.15	-13.60	68.74	11.80	6.96
1998-99	2.75	47.20	-8.97	-27.00	-20.70
1999-00	11.40	7.22	-3.68	21.20	4.90
2000-01	-9.39	-20.50	-33.40	-10.50	-1.73
2001-02	3.26	-24.60	-5.26	-1.63	15.10
2002-03	11.40	172.00	73.49	17.20	12.20
2003-04	11.00	14.50	11.33	16.00	8.64
2004-05	7.70	-11.40	62.40	32.80	17.20
2005-06	3.58	-14.5	-27.50	0.10	-12.10
2006-07	4.65	-5.61	-16.10	15.50	12.30
2007-08	12.90	-11.90	64.70	21.20	14.20
2008-09	-5.18	-20.60	-25.80	-0.27	0.80
2009-10	9.70	53.00	4.13	-12.30	13.20
2010-11	3.02	11.00	-0.17	-9.95	-7.23
Average:1981-82 to 2010-11 (Total period)	6.35	10.64	10.53	7.83	5.60
Average:1981-82 TO1990-91 (Pre-reform Period)	8.00	14.84	7.80	11.67	5.72
Average:1991-92 TO 2010-11 (Post-reform Period)	5.52	8.55	11.89	5.90	5.54
Average:1991-92 to 2000-01 (decade-1)	4.84	0.89	9.67	3.93	3.65
Average:2001-02 to2010-11 (decade-2)	6.20	16.20	14.12	7.87	7.43

Source: Authors' own calculation

Table 3 Annual growth rate of capital productivity(y/k) of organized manufacturing industries in India and in few states in eastern India

Year	India	Assam	Bihar	Orissa	W.B.
1981-82	8.54	28.68	28.05	-3.02	-9.15
1982-83	9.17	18.45	20.90	13.56	2.30
1983-84	-3.43	33.93	14.88	-14.80	-6.24
1984-85	-6.59	-10.10	-26.00	-27.30	-1.70
1985-86	-1.71	28.00	4.40	30.20	-13.90
1986-87	5.09	-26.30	3.31	3.12	25.90

1987-88	-4.86	10.41	24.47	-35.50	-4.49
1988-89	11.90	-46.40	29.20	44.67	-25.70
1989-90	0.90	98.22	-5.84	13.31	-8.35
1990-91	-3.93	-4.73	-1.18	8.11	17.17
1991-92	-7.07	-17.80	4.18	-12.50	-13.80
1992-93	4.45	-6.20	-4.78	-5.54	-15.60
1993-94	8.55	9.40	51.09	-0.51	2.63
1994-95	-7.22	-14.30	-48.20	-17.90	-9.65
1995-96	1.52	-4.76	10.51	4.56	8.50
1996-97	7.00	27.35	8.47	1.42	9.34
1997-98	-7.68	-47.50	76.23	45.35	26.39
1998-99	-2.66	104.80	-21.80	-19.10	64.09
1999-00	5.86	1.97	10.55	34.17	-45.00
2000-01	-9.36	-63.00	-48.80	-25.90	-1.74
2001-02	-2.25	20.03	-10.40	-9.74	-18.60
2002-03	14.50	67.36	64.35	38.79	16.32
2003-04	4.21	6.82	5.30	-19.70	6.13
2004-05	10.30	-8.60	79.40	60.24	19.00
2005-06	3.14	-6.49	-30.50	-25.20	-11.70
2006-07	5.74	-2.99	-19.40	9.73	11.72
2007-08	1.53	-17.40	69.83	-1.45	3.86
2008-09	-16.40	-15.70	-40.30	-7.15	-14.10
2009-10	-6.68	54.44	-9.14	-41.70	-14.00
2010-11	-2.39	16.14	-23.10	-11.20	7.11
Average:1981-82 to 2010-11 (total period)	0.67	7.78	7.19	0.96	0.22
Average:1981-82 TO1990-91 (Pre-reform Period)	1.51	13.00	9.22	3.23	-2.42
Average:1991-92 TO 2010-11 (Post-reform Period)	0.25	5.17	6.18	-0.17	1.54
Average:1991-92 to 2000-01 (decade-1)	-0.66	-1.02	3.75	0.39	2.52
Average:2001-02 to2010-11 (decade-2)	1.17	11.35	8.61	-0.74	0.57

Source: Authors' own calculation

Table 4 Annual growth rate of capital intensity (k/l) of organized manufacturing industries in India and in few states in Eastern India

Year	India	Assam	Bihar	Orissa	W.B.
1981-82	5.52	-15.5	-1.46	-5.9	16.19
1982-83	-3.05	-8.34	3.58	5.77	1.6
1983-84	17	4.46	2.96	14.37	-8.38
1984-85	9.22	53.8	5.49	6.59	24.16
1985-86	7.22	-7	-2.53	-3.59	29.84
1986-87	2.96	49	-5.22	19.82	-19.4
1987-88	7.08	-13.7	-7.66	58.22	29.35
1988-89	4.74	45.9	-5.44	21.54	10.06
1989-90	3	-24.6	4.4	-5.92	8.82
1990-91	12.5	6.24	-3.75	-10.3	3.68
1991-92	3.3	4.11	6.66	5.04	18.19
1992-93	5.21	-2.07	-0.55	3.84	21.47
1993-94	6.6	-1.11	17.43	1.48	17.57
1994-95	12.4	11.2	19.57	27.06	3.9
1995-96	5.65	9.33	7.26	10.98	-7.95
1996-97	9.09	-18.6	1.77	30.72	17.35
1997-98	1.66	64.6	-4.25	-23.1	-15.4
1998-99	5.56	-28.1	16.33	-9.71	-51.7
1999-00	5.23	5.14	-12.9	-9.68	90.7
2000-01	-0.04	115	30	20.85	0.01
2001-02	5.63	-37.2	5.68	8.98	41.51
2002-03	-2.72	62.5	5.56	-15.5	-3.55
2003-04	6.47	7.2	5.73	44.57	2.37
2004-05	-2.34	-3.04	-9.48	-17.1	-1.5
2005-06	0.42	-8.51	4.28	33.81	-0.44
2006-07	-1.03	-2.69	4.07	5.22	0.51
2007-08	11.2	6.7	-3.02	22.99	9.92
2008-09	13.5	-5.76	24.38	7.41	17.38
2009-10	17.6	-0.93	14.61	50.51	31.61
2010-11	5.55	-4.39	29.75	1.37	-13.4
Average:1981-82 to 2010-11 (total period)	5.83	8.79	5.11	10.01	9.15

Average:1981-82 TO1990-91 (Pre-reform Period)	6.62	9.03	-0.96	10.06	9.59
Average:1991-92 TO 2010-11 (Post-reform Period)	5.44	8.67	8.15	9.99	8.93
Average:1991-92 to 2000-01 (decade-1)	5.46	15.96	8.14	5.75	9.42
Average:2001-02 to2010-11 (decade-2)	5.42	1.39	8.16	14.22	8.44

Source: Authors' own calculation

Table 5 Annual growth rate of total factor productivity of organized manufacturing industries in India and in few states in Eastern India

Year	India	Assam	Bihar	Orissa	W.B.
1981-82	7.11	2.27	6.09	-1.69	3.98
1982-83	6.94	2.26	6.11	-1.16	4.00
1983-84	6.84	2.27	6.11	-0.84	4.01
1984-85	6.70	2.26	6.12	-0.35	4.03
1985-86	6.54	2.27	6.10	0.36	4.07
1986-87	6.37	2.25	6.08	0.58	3.98
1987-88	6.26	2.24	6.09	-1.18	4.05
1988-89	6.10	2.27	6.06	-1.03	4.10
1989-90	5.96	2.28	6.06	0.01	4.11
1990-91	5.85	2.25	6.03	1.57	4.13
1991-92	5.69	2.28	6.06	1.73	4.19
1992-93	5.57	2.29	6.07	2.19	4.25
1993-94	5.43	2.26	6.11	2.87	4.29
1994-95	5.33	2.28	6.20	2.38	4.31
1995-96	5.23	2.31	6.22	2.70	4.31
1996-97	5.07	2.29	6.21	2.70	4.33
1997-98	4.92	2.32	6.11	4.86	4.31
1998-99	4.70	2.26	6.17	7.31	4.02
1999-00	4.53	2.26	6.11	9.00	4.18
2000-01	4.34	2.26	6.17	9.11	4.16
2001-02	4.18	2.26	6.16	10.08	4.26
2002-03	4.00	2.26	6.17	11.64	4.25
2003-04	3.86	2.26	6.17	10.52	4.24
2004-05	3.70	2.27	6.15	11.56	4.24

2005-06	3.57	2.28	6.18	11.11	4.23
2006-07	3.45	2.30	6.19	11.19	4.23
2007-08	3.33	2.29	6.20	10.50	4.27
2008-09	3.26	2.31	6.33	10.37	4.34
2009-10	3.18	2.31	6.38	9.03	4.44
2010-11	3.07	2.34	6.62	8.82	4.43
Average:1981-82 to 2010-11 (total period)	5.04	2.28	6.16	4.86	4.19
Average :1981-82 TO1990-91 (Pre-reform Period)	6.47	2.26	6.08	-0.37	4.05
Average :1991-92 TO 2010-11 (Post-reform Period)	4.32	2.28	6.20	7.48	4.26
Average:1991-92 to 2000-01 (decade-1)	5.08	2.28	6.14	4.49	4.23
Average:2001-02 to2010-11 (decade-2)	3.56	2.29	6.26	10.48	4.29

Source: Authors' own calculation

Table 6 Trend Growth Rate of Output (GVA) of Organized Manufacturing Industries in India and in few states in Eastern India

YEAR	INDIA	ASSAM	BIHAR	ORISSA	W.B.
1981-82 TO 2010-11 (Total Period)	6.72 (sig*)	5.13 (sig*)	3.93 (sig*)	7.81 (sig*)	2.82 (sig*)
1981-82 TO 1990-91 (Pre-reform Period)	7.00 (sig*)	11.32 (sig*)	3.90 (sig**)	13.55 (sig*)	0.95 (Not sig)
1991-92 TO 2010-11 (Post-reform Period)	6.40 (sig*)	5.51 (sig*)	3.80 (sig*)	7.49 (sig*)	2.72 (sig*)
1991-92 TO 2000-01 (Decade-1)	5.22 (sig**)	2.17 (sig***)	2.18 (Not sig)	1.95 (Not sig)	0.45 (Not sig)
2001-02 TO 2010-11 (Decade-2)	11.82 (sig*)	6.54 (not sig)	9.23 (sig**)	18.82 (sig*)	7.42 (sig*)

Source: Authors' own calculation

(sig*, sig & sig*** indicate 1%, 5% and 10% levels of significance respectively.)**

Table 7 Trend Growth Rate of labor productivity(Y/L) of Organized Manufacturing Industries in India and in few states in eastern India

YEAR	INDIA	ASSAM	BIHAR	ORISSA	W.B.
1981-82 To 2010-11 (Total Period)	5.66 (sig*)	4.45 (sig*)	6.18 (sig*)	7.11 (sig*)	4.97 (sig*)
1981-82 To 1990-91 (Pre-reform Period)	6.79 (sig*)	11.89 (sig***)	3.78 (sig**)	11.93 (sig*)	4.66 (sig*)
1991-92 To 2010-11 (Post-reform Period)	5.18 (sig*)	4.79 (sig*)	6.50 (sig*)	6.88 (sig*)	5.09 (sig*)
1991-92 To 2000-01 (Decade-1)	5.75 (sig*)	3.03 (sig***)	6.96 (sig**)	5.84 (sig*)	3.31 (sig**)
2001-02 To 2010-11 (Decade-2)	5.89 (sig*)	2.01 (Not sig)	6.72 (sig***)	9.04 (sig*)	6.15 (sig*)

Source: Authors' own calculation
(sig*, sig** & sig*** indicate 1%, 5% and 10% levels of significance respectively.)

Table 8 Trend Growth Rate of capital productivity(Y/K) of Organized Manufacturing Industries in India and in few states in eastern India

YEAR	INDIA	ASSAM	BIHAR	ORISSA	W.B.
1981-82 To 2010-11 (Total Period)	0.55 (sig*)	-1.70 (sig*)	2.01 (sig*)	0.17 (Not sig)	-0.86 (sig***)
1981-82 To 1990-91 (Pre-reform Period)	0.35 (Not sig)	1.22 (Not sig)	5.47 (sig*)	-0.66 (Not sig)	-0.38 (sig**)
1991-92 To 2010-11 (Post-reform Period)	0.92 (sig**)	-1.46 (Not sig)	0.77 (Not sig)	0.25 (Not sig)	1.08 (not sig)
1991-92 To 2000-01 (Decade-1)	-0.17 (Not sig)	-3.99 (Not sig)	0.48 (Not sig)	1.93 (Not sig)	4.40 (Not sig)

2001-02 TO 2010-11 (Decade-2)	0.81 (Not sig)	0.94 (Not sig)	0.86 (Not sig)	-4.19 (Not sig)	1.01 (Not sig)

Source: Authors' own calculation
(sig*, sig** & sig*** indicate 1%, 5% and 10% levels of significance respectively.)

Table 9 Trend Growth Rate of capital Intensity (K/L) of Registered Manufacturing Industries in India and in few states in eastern India.

YEAR	INDIA	ASSAM	BIHAR	ORISSA	W.B.
1981-82 To 2010-11 (Total Period)	5.12 (sig*)	6.15 (sig*)	4.17 (sig*)	6.94 (sig*)	5.83 (sig*)
1981-82 To 1990-91 (Pre-reform Period)	6.44 (sig*)	10.67 (sig*)	-1.69 (sig**)	12.60 (sig*)	8.49 (sig*)
1991-92 To 2010-11 (Post-reform Period)	4.26 (sig*)	6.25 (sig*)	5.73 (sig*)	6.63 (sig*)	4.01 (sig*)
1991-92 To 2000-01 (Decade-1)	5.92 (sig*)	7.02 (sig**)	6.48 (sig*)	3.90 (sig***)	-1.09 (not sig)
2001-02 To 2010-11 (Decade-2)	5.07 (sig*)	1.07 (Not sig)	5.86 (sig*)	13.23 (sig*)	5.14 (sig*)

Source: Authors' own calculation
(sig*, sig** & sig*** indicate 1%, 5% and 10% levels of significance respectively.)

Table 10 Trend Growth Rate of Total Factor Productivity of Registered Manufacturing Industries in India and in few states in eastern India

YEAR	INDIA	ASSAM	BIHAR	ORISSA	W.B.
1981-82 To 2010-11 (Total Period)	4.84 (sig*)	2.25 (sig*)	5.96 (sig*)	4.97 (sig*)	4.12 (sig*)
1981-82 To 1990-91 (Pre-reform Period)	6.20 (sig*)	2.24 (sig*)	5.91 (sig*)	-0.27 (sig**)	3.97 (sig*)
1991-92 To 2010-11 (Post-reform Period)	4.14 (sig*)	2.25 (sig*)	6.01 (sig*)	8.02 (sig*)	4.16 (sig*)

1991-92 To 2000-01 (Decade-1)	4.91 (sig*)	2.26 (sig*)	5.98 (sig*)	4.38 (sig*)	4.16 (sig*)
2001-02 To 2010-11 (Decade-2)	3.42 (sig*)	2.27 (sig*)	6.06 (sig*)	10.11 (sig*)	4.19 (sig*)

Source: Authors' own calculation
(sig*, sig** & sig*** indicate 1%, 5% and 10% levels of significance respectively.)

Measurement of Total Factor Productivity Growth by estimating the parameters of the Translog Production Function using backward elimination technique

INDIA

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.997	.994	.993	4.941E-02	
2	.997	.994	.993	4.966E-02	1.905

a Predictors: (Constant), LNKXT, LNL, T^2, LNK^2
b Predictors: (Constant), LNKXT, LNL, T^2
c Dependent Variable: LNY

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.575	4	2.644	1082.837	.000
	Residual	6.104E-02	25	2.442E-03		
	Total	10.636	29			
2	Regression	10.572	3	3.524	1429.077	.000
	Residual	6.412E-02	26	2.466E-03		
	Total	10.636	29			

a Predictors: (Constant), LNKXT, LNL, T^2, LNK^2
b Predictors: (Constant), LNKXT, LNL, T^2
c Dependent Variable: LNY

Coefficients

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-6.246	2.381		-2.623	.015
	LNL	1.364	.208	.313	6.544	.000
	LNK^2	-5.564E-03	.005	-.165	-1.122	.272

	T^2	-1.058E-03	.000	-.491	-4.587	.000
	LNKXT	5.702E-03	.001	1.405	6.953	.000
2	(Constant)	-4.183	1.522		-2.749	.011
	LNL	1.156	.096	.265	12.081	.000
	T^2	-8.717E-04	.000	-.405	-5.419	.000
	LNKXT	4.841E-03	.000	1.192	16.616	.000

a Dependent Variable: LNY

Translog Production Function is written as-

$LNY=\alpha+\beta_L LNL+\beta_K LNK+\beta_T LNT+1/2\beta_{LL}(LNL)^2+1/2\beta_{KK}(LNK)^2+1/2\beta_{TT}T^2+\beta_{LK}(LNL)(LNK)+\beta_{LT}(LNL)T+\beta_{KT}(LNK)T$ where $TFPG=\delta LNY/\delta T=\beta_T+\beta_{TT}T+\beta_{LT}LNL+\beta_{KT}LNK$ = 0.004841*LNK-0.0008717*2*T

ASSAM

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.895	.801	.759	.2524	
2	.893	.798	.765	.2494	
3	.892	.797	.773	.2452	
4	.892	.795	.780	.2413	
5	.883	.780	.772	.2456	1.619

a Predictors: (Constant), LNKXT, LNL, LNK, T^2, LNLXT
b Predictors: (Constant), LNKXT, LNL, LNK, LNLXT
c Predictors: (Constant), LNKXT, LNK, LNLXT
d Predictors: (Constant), LNK, LNLXT
e Predictors: (Constant), LNK
f Dependent Variable: LNY

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.153	5	1.231	19.316	.000
	Residual	1.529	24	6.371E-02		
	Total	7.682	29			
2	Regression	6.126	4	1.532	24.615	.000
	Residual	1.556	25	6.222E-02		
	Total	7.682	29			
3	Regression	6.119	3	2.040	33.924	.000
	Residual	1.563	26	6.012E-02		
	Total	7.682	29			
4	Regression	6.109	2	3.055	52.451	.000
	Residual	1.572	27	5.824E-02		

	Total	7.682	29			
5	Regression	5.993	1	5.993	99.339	.000
	Residual	1.689	28	6.033E-02		
	Total	7.682	29			

a Predictors: (Constant), LNKXT, LNL, LNK, T^2, LNLXT
b Predictors: (Constant), LNKXT, LNL, LNK, LNLXT
c Predictors: (Constant), LNKXT, LNK, LNLXT
d Predictors: (Constant), LNK, LNLXT
e Predictors: (Constant), LNK
f Dependent Variable: LNY

Coefficients

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	7.749	5.964		1.299	.206
	LNL	-.475	.674	-.110	-.706	.487
	LNK	.756	.516	.930	1.466	.156
	T^2	1.317E-03	.002	.720	.645	.525
	LNLXT	1.994E-02	.023	4.046	.853	.402
	LNKXT	-2.231E-02	.029	-4.700	-.758	.456
2	(Constant)	6.948	5.765		1.205	.239
	LNL	-.162	.461	-.037	-.351	.729
	LNK	.473	.268	.582	1.765	.090
	LNLXT	6.510E-03	.011	1.321	.620	.541
	LNKXT	-4.640E-03	.011	-.977	-.433	.669
3	(Constant)	5.176	2.726		1.899	.069
	LNK	.463	.262	.570	1.768	.089
	LNLXT	5.909E-03	.010	1.199	.580	.567
	LNKXT	-4.098E-03	.010	-.863	-.393	.698
4	(Constant)	5.718	2.315		2.470	.020
	LNK	.414	.226	.509	1.828	.079
	LNLXT	1.942E-03	.001	.394	1.415	.168
5	(Constant)	2.643	.813		3.250	.003
	LNK	.719	.072	.883	9.967	.000

a Dependent Variable: LNY

Translog Production Function is written as-
$LNY=\alpha+\beta_L LNL+\beta_K LNK+\beta_T LNT+1/2\beta_{LL}(LNL)^2+1/2\beta_{KK}(LNK)^2+1/2\beta_{TT}T^2+\beta_{LK}(LNL)(LNK)+\beta_{LT}(LNL)T+\beta_{KT}(LNK)T$ where $TFPG=\delta LNY/\delta T=\beta_T+\beta_{TT}T+\beta_{LT}LNL+\beta_{KT}LNK = 0.001942*LNK$

BIHAR

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.880	.774	.727	.2157	
2	.873	.763	.725	.2167	
3	.863	.745	.716	.2202	1.650

a Predictors: (Constant), LNKXT, LNLXLNK, LNL, T^2, LNK^2

b Predictors: (Constant), LNKXT, LNLXLNK, T^2, LNK^2

c Predictors: (Constant), LNKXT, LNLXLNK, LNK^2

d Dependent Variable: LNY

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.832	5	.766	16.470	.000
	Residual	1.117	24	4.653E-02		
	Total	4.948	29			
2	Regression	3.774	4	.944	20.095	.000
	Residual	1.174	25	4.696E-02		
	Total	4.948	29			
3	Regression	3.687	3	1.229	25.341	.000
	Residual	1.261	26	4.850E-02		
	Total	4.948	29			

a Predictors: (Constant), LNKXT, LNLXLNK, LNL, T^2, LNK^2

b Predictors: (Constant), LNKXT, LNLXLNK, T^2, LNK^2

c Predictors: (Constant), LNKXT, LNLXLNK, LNK^2

d Dependent Variable: LNY

Coefficients

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	88.984	73.161		1.216	.236
	LNL	-13.420	12.103	-7.537	-1.109	.279
	LNK^2	-.573	.460	-9.018	-1.248	.224
	T^2	1.767E-03	.001	1.203	1.747	.093
	LNLXLNK	1.149	.958	9.227	1.199	.242
	LNKXT	2.320E-03	.002	.663	1.342	.192
2	(Constant)	7.901	2.238		3.530	.002
	LNK^2	-6.471E-02	.028	-1.018	-2.329	.028
	T^2	1.179E-03	.001	.803	1.362	.185
	LNLXLNK	8.727E-02	.035	.701	2.502	.019
	LNKXT	2.978E-03	.002	.851	1.826	.080

3	(Constant)	7.905	2.275		3.475	.002
	LNK^2	-4.137E-02	.022	-.651	-1.861	.074
	LNLXLNK	6.323E-02	.031	.508	2.068	.049
	LNKXT	4.737E-03	.001	1.354	4.673	.000

a Dependent Variable: LNY

Translog Production Function is written as-

$LNY=\alpha+\beta_L LNL+\beta_K LNK+\beta_T LNT+1/2\beta_{LL}(LNL)^2+1/2\beta_{KK}(LNK)^2+1/2\beta_{TT}T^2+\beta_{LK}(LNL)(LNK)+\beta_{LT}(LNL)T+\beta_{KT}(LNK)T$ where $TFPG=\delta LNY/\delta T=\beta_T+\beta_{TT}T+\beta_{LT}LNL+\beta_{KT}LNK = 0.004737*LNK$

ODISHA

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.980	.961	.953	.1624	1.499

a Predictors: (Constant), LNKXT, LNL, LNK, T^2, T
b Dependent Variable: LNY

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.620	5	3.124	118.473	.000
	Residual	.633	24	2.637E-02		
	Total	16.253	29			

a Predictors: (Constant), LNKXT, LNL, LNK, T^2, T
b Dependent Variable: LNY

Coefficients

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	-15.528	6.194		-2.507	.019
	LNL	1.184	.479	.316	2.473	.021
	LNK	1.022	.328	1.050	3.113	.005
	T	.505	.172	5.933	2.929	.007
	T^2	4.359E-03	.002	1.638	2.321	.029
	LNKXT	-4.669E-02	.018	-7.650	-2.617	.015

a Dependent Variable: LNY

Translog Production Function is written as-

$LNY=\alpha+\beta_L LNL+\beta_K LNK+\beta_T LNT+1/2\beta_{LL}(LNL)^2+1/2\beta_{KK}(LNK)^2+1/2\beta_{TT}T^2+\beta_{LK}(LNL)(L$

NK)+β_{LT}(LNL)T+β_{KT} (LNK)T where TFPG=δLNY/δT=β_T+β_{TT}T+β_{LT}LNL+β_{KT}LNK = 0.505+0.004359*2*T-0.04669*LNK

WEST BENGAL

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.958	.918	.900	9.133E-02	
2	.958	.918	.904	8.952E-02	
3	.954	.910	.899	9.196E-02	1.565

a Predictors: (Constant), LNKXT, LNLXLNK, LNL^2, T^2, LNK^2
b Predictors: (Constant), LNKXT, LNLXLNK, T^2, LNK^2
c Predictors: (Constant), LNKXT, LNLXLNK, LNK^2
d Dependent Variable: LNY

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.231	5	.446	53.481	.000
	Residual	.200	24	8.342E-03		
	Total	2.431	29			
2	Regression	2.230	4	.558	69.577	.000
	Residual	.200	25	8.014E-03		
	Total	2.431	29			
3	Regression	2.211	3	.737	87.156	.000
	Residual	.220	26	8.456E-03		
	Total	2.431	29			

a Predictors: (Constant), LNKXT, LNLXLNK, LNL^2, T^2, LNK^2
b Predictors: (Constant), LNKXT, LNLXLNK, T^2, LNK^2
c Predictors: (Constant), LNKXT, LNLXLNK, LNK^2
d Dependent Variable: LNY

Coefficients

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	5.137	1.329		3.864	.001
	LNL^2	-1.762E-02	.128	-.353	-.138	.892
	LNK^2	-4.358E-02	.139	-1.620	-.313	.757
	T^2	5.426E-04	.001	.527	.876	.390
	LNLXLNK	9.822E-02	.271	1.592	.362	.720
	LNKXT	1.613E-03	.002	.669	1.042	.308
2	(Constant)	5.215	1.178		4.426	.000

	LNK^2	-2.447E-02	.011	-.910	-2.254	.033
	T^2	4.685E-04	.000	.455	1.560	.131
	LNLXLNK	6.098E-02	.016	.988	3.859	.001
	LNKXT	1.767E-03	.001	.733	1.695	.102
3	(Constant)	4.858	1.187		4.092	.000
	LNK^2	-3.131E-02	.010	-1.164	-3.069	.005
	LNLXLNK	6.885E-02	.015	1.116	4.476	.000
	LNKXT	3.197E-03	.001	1.326	6.267	.000

a Dependent Variable: LNY

Translog Production Function is written as-

$LNY=\alpha+\beta_L LNL+\beta_K LNK+\beta_T LNT+1/2\beta_{LL}(LNL)^2+1/2\beta_{KK}(LNK)^2+1/2\beta_{TT}T^2+\beta_{LK}(LNL)(LNK)+\beta_{LT}(LNL)T+\beta_{KT}(LNK)T$ where $TFPG=\delta LNY/\delta T=\beta_T+\beta_{TT}T+\beta_{LT}LNL+\beta_{KT}LNK = 0.003197*LNK$

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