Economic reform and Productivity Growth in Indian Paper and Paper Products Industry: A Nonparametric Analysis

Chirayil, Anish

Erode Arts College, (Autonomous), Erode-9

December 2008

Economic Reform and Productivity Growth in Indian Paper and Paper Products Industry: A Nonparametric Analysis

Anish C. Aniyan**

Abstract

This paper applied the Malmquist Productivity Index in order to estimate total factor productivity growth and its components (efficiency change and technological progress) in Indian paper and paper products industry during pre and post-reform period. The obtained estimates of TFP change at the aggregate and sectoral level, indicates that the net impact of economic reforms on the productivity growth of paper and paper products industry was negative. It was evident in the study that the negative TFP change was decreased (from -8.6% to -5.2%) in the post-reform period in paper and paper products industry at the aggregate level. It was found in this study that the technical efficiency change and the technical change was the deteriorating factor for productivity change in Indian paper and paper products industry. Among similar trends were observed at the sub-sectoral level also. Further, the results of this study suggest that specific policies should be implemented in order to improve efficiency as well as technical progress, thus ultimately facilitating long-run productivity growth.

Key words: Indian Paper Industry; Economic Reforms; Productivity; Malmquist Index.
JEL Classification: L60; O25; D24.

** **Doctoral Research Scholar in Economics, Erode Arts College (Autonomous), Erode-9.** anish.anishaniyan@gmail.com.

Economic Reform and Productivity Growth in Indian Paper and Paper Products Industry: A Nonparametric Analysis

I INTRODUCTION

Indian Paper industry is the 15th largest industry in the world. It provides employment to nearly 1.5 million people and contributes Rs. 25 billion to the government policy's kitty. The government regards the paper industry as one of the 35 high priority industries of the country.

Paper industry is primarily dependent on forest-based raw materials. The first paper mill in India was set up at Sreerampur, West Bengal, in the year 1812. It was based on grasses and jute as raw material. Large Scale mechanized technology of papermaking was introduced in India in early 1905. Since then the raw material for the paper industry underwent a number of changes and over a period of time, besides wood and bamboo, other non-conventional raw materials have been developed for use in the papermaking. The Indian Pulp and Paper industry at present is very well developed and established. Now, the paper industry is categorized as forest-based, agro-based and other (waste paper, secondary fibre, baste fibres and market pulp).

Growth of paper industry in India has been constrained due to the high cost of production caused by inadequate and high cost of raw materials, power cost and concentration of mills in a particular area. Government has taken several policy measures to remove the bottlenecks of availability of raw materials and infrastructure development.

Goldar and Kumari (2003) analysed the impact of liberalisation on the productivity growth of Indian manufacturing industries and found productivity accelerated in paper, paper products, printing and publishing industry in the 1990s. **Pattnayak and Thangavelu (2005)** studied the economic reform and productivity growth in Indian manufacturing, including paper and paper products industry and found a little increase in the growth of TFP of paper and paper product industry during post-reform period. **Sindhu and Balasubramanyam (2006)** computed Malmquist index of productivity growth of Indian paper and paper products industry during pre-reform period. The rate of growth was

3.1 per cent and this was due to the improvement in technical change.

Several studies have attempted to estimate the relationship between economic reforms and productivity growth in the Indian manufacturing sector. Some studies have reported that policies of liberalization improved the productivity of the manufacturing industry (See Majumdar 1996; Fujita 1994; Sharma 1999; Unel 2003; TSL 2003; Banga and Goldar 2007), whereas some have detected negative effects, or at least no significant improvement, in productivity growth since the onset of economic reforms in 1991 (See Trivedi ***et al.*****,** 2000; Balakrishnan ***et al.*****,** 2000; Unni and Rani 2001; Goldar 2004; Das 2004). Thus, the topic of the effects of economic reforms on productivity growth remains a critical focus of research.

While there have been numerous studies conducted on productivity growth, only a relatively few studies have concerned themselves with the sources of productivity growth in the Indian economy. The traditional Tornqvist index, which is applied to calculate total factor productivity growth, is incapable of decomposing the productivity change into movements along and changes in frontier, because the Tornqvist index assumes that the observed output is the consequence of the best practice frontier. Conversely, the Malmquist index decomposes the total productivity growth into 'efficiency change' and 'technical progress'. TFP can be increased by using its existing technology and factor inputs more efficiently—this is referred to as 'efficiency change'. The TFP of an industry can also increase when the industry adopts innovations or technological improvements, and this process is referred to as 'technological change'. Therefore, changes in TFP from one period to the next are the products of both efficiency change and technological progress.

Most previous studies conducted in India have failed to consider the sources of such changes in productivity growth[1]. This paper has attempted to assess the effects of economic reforms on productivity growth in Indian paper and paper products industry. We utilize the Malmquist index, which can demonstrate that the reform has positive effects on efficiency change or technical progress, as well as total factor productivity.

The paper is organized as follows. A brief summary of relevant Indian economic reforms is presented in Section II, and the methodology utilized to estimate the Malmquist productivity index is provided in Section III. Section IV shows the data sources and gives a

[1] Sindhu and Balasubramanyam (2006), and Singh and Agarwal (2006) applied DEA method.

summary description of the variables. The results of productivity growth in Indian paper and paper products industry are evaluated in Section V. Section VI contains a summary and conclusion.

II. ECONOMIC REFORMS OF INDIA: AN OVERVIEW

In late 1970s, they started implementing some reforms such as "reducing the barriers to entry and expansion, simplifying procedures, and providing easier access to better technology and intermediate material imports" (Ahluwalia, 1991). There were some additional reforms during 1980s, but the most radical reforms were initiated since 1991, after the severe economic crisis in the fiscal year 1990/91. the major policy changes initiated in the industrial sector since July 1991 include removal of entry barriers, reduction of areas reserved exclusively for public sector, rationalization of approach towards monopolistic and restrictive practice, liberalization of foreign investment policy, far-reaching liberalization of import policy with respect to intermediate and capital goods, measures to bring about regional balance, especially the development of backward areas and encouraging the growth of employment intensive in small and tiny sector (Madheswaran ***et al.,*** 2007).

Trade policy of a country consist a set of policy measures that have impact upon its international trade and economic relations with the other country. Free trade policy permits international flow of goods and services without any artificial impediments. If trade is left free, there will be no tariff or no-tariff restrictions and every country is likely to specialise in the production and export of the product. The benefits of specialization make the optimum use of factor resources. Haberler points out that free trade can contribute in the process of growth in different ways; (i) it enables the unrestricted import of raw materials and capital goods which are essential for industrial expansion, (ii) free trade assists in an easy transfer of advanced technical know-how and entrepreneurship from the advanced to the less-advanced countries, (iii) free trade facilitates large scale international capital movements to speed up the process of growth and (iv) free trade promotes competition, efficiency and productivity can create such capacities in the poor countries, which enable them to achieve higher levels of production, employment and income.

Protectionism is a trade policy which advocates protection of home industries from foreign competition. A free exchange of goods may be positively harmful to economically backward countries, a country may enjoy very great national advantage but may not be able to exploit them due to lack of skill, and insufficient infrastructure. The policy of protection has been well expressed in the following words "Nurse the baby, Protect the child and Free the adult."

Indian economy was under the protected trade policy regime till July 24, 1991 and the policy measures were liberalised and entered in free trade regime after 1991. These two policies led to different impact on Indian manufacturing in general and Indian paper and paper products in particular.

III. THE MALMQUIST PRODUCTIVITY INDEX

The measurement of the Malmquist productivity index is based on distance functions. For simplicity, $z^t = \left(x^t, y^t\right)$ *and* $z^{t+1} = \left(x^{t+1}, y^{t+1}\right)$, where x^t is the vector of inputs used in production and y^t is the vector of outputs. Now, for each time period $t=1,\ldots..T$, the output distance function is defined as follows:

$$D^t\left(z\right) = \inf\left\{\theta : y^t / \theta \in P^t\left(x\right)\right\} \qquad (1)$$

where superscript t and D^t denote that technology in period t is used as the reference technology. θ is scalar, and its value is the efficiency score for each production activity. It satisfies $0<\theta \leq 1$ for a non-negative output level, with a value of 1 indicating a point of the frontier, and thus a technically efficient production activity. This output distance function is defined as the reciprocal of the maximal proportional expansion of output vector y^t with the given input vector x^t in relation to the technology at t.

The Malmquist productivity index is defined as follows:

$$TFP = M^t = \frac{D^t\left(z^{t+1}\right)}{D^t\left(z^t\right)} \qquad (2)$$

This formulation is called the output-oriented Malmquist productivity index in period t, $M^t(z^{t+1},z)$, where the technology in period t is the reference technology for two differing pairs of outputs and inputs. Alternatively, we can define M^{t+1} where the technology in period $t+1$ is employed as the reference technology.

Consistent with the study of Fare ***et al.,*** (1994), the output-based Malmquist productivity index is defined as the geometric mean of two output-distance functions, in order to avoid selecting an arbitrary benchmark:

$$M\left(z^{t+1}, z^{t}\right) = \left[M^{t}.M^{t+1}\right]^{1/2} = \left[\left(\frac{D^{t}\left(z^{t+1}\right)}{D^{t}\left(z^{t}\right)}\right)\left(\frac{D^{t+1}\left(z^{t+1}\right)}{D^{t+1}\left(z^{t}\right)}\right)\right]^{1/2} \quad (3)$$

Equation (3) can be rewritten as:

$$M\left(z^{t+1}, z^{t}\right) = \left(\frac{D^{t+1}\left(z^{t+1}\right)}{D^{t}\left(z^{t}\right)}\right) \mathrm{X} \left(\frac{D^{t}\left(z^{t+1}\right)}{D^{t+1}\left(z^{t+1}\right)}\right)\left(\frac{D^{t}\left(z^{t}\right)}{D^{t+1}\left(z^{t}\right)}\right)^{1/2} \quad (3`)$$

where the ratio outside the brackets measures the change in relative efficiency between *t* and *t+1,* and the geometric mean inside the brackets measures the shift in frontier. That is, the Malmquist productivity index can be decomposed into change in efficiency and change in technical progress.[2]

In a previous empirical work, Fare ***et al.,*** (1994) utilized non-parametric linear-programming techniques. As can be seen in (3`), we must solve four different linear programming problems: $D^{t}(z^{t})$, $D^{t}(z^{t+1})$, $D^{t+1}(z^{t})$, *and* $D^{t+1}(z^{t+1})$. Calculating the Malmquist index relative to the variable returns to scale technology. $D_{j}^{t}\left(z^{t}\right)$ for each industry, $j \in k = 1,.....,K,$ one of the four different linear programming problems, can be stated as[3]:

$$\left[D_{j}^{t}\left(z_{j}^{t}\right)^{-1} = \max_{\theta, w} \theta_{j}\right] \quad (4)$$

subject to $\theta_{j} y_{m,j}^{t} \leq \sum_{k=1}^{K} w_{k}^{t} y_{m,k}^{t}$ $\quad m = 1,....., M$ (4a)

$$\sum_{k=1}^{K} w_{k}^{t} x_{n,j}^{t} \leq x_{n,j}^{t} \quad n = 1,.....,N \quad (4b)$$

$$w_{k}^{t} \geq 0 \; k = 1,....,K \quad (4c)$$

where $n = 1,....,N$ are inputs, $m = 1,....,M$ are outputs, and w_{k}^{t} is an intensity variable indicating the production intensity of a particular activity. (Here, each industry is an

[2] See Fare ***et al.,*** (1994) for a graphical explanation.

[3] Ray and Desli (1997) emphasized the importance of variable-returns-to-scale (*VRS*) in using a reference technology. In some cases, however, the *VRS* method has an infeasible solution (Ray and Desli, 1997, p.1037). In response to Ray and Desli (1997), Fare ***et al.,*** (1997) commented that constant-returns-to-scale captures long-run results, whereas the *VRS* is appropriate for the short-run. Since our study analyzes the long-run productivity trend for 1980-81 to 2004-05, we use the method of Fare ***et al.,*** (1994).

activity). These intensity variables are used as weights in taking convex combinations of the observed outputs and inputs in both (4a) and (4b). From Equation 4, the reciprocal of the output distance function can be used to find the maximum of θ, which gives the maximal proportional expansion of output given constraints (4a)–(4).

For the other distance functions, the computation of $D^{t+1}(z^{t+1})$ is exactly the same as (4), where $t + 1$ is substituted for t. Two other distance functions require information from two periods, $D^t(z^{t+1})$ can be computed by replacing $y^t_{m,j}$ and $x^t_{n,j}$ in (4a) and (4b) with $y^{t+1}_{m,j}$ and $x^{t+1}_{n,j}$, respectively, and $D^{t+1}(z^t)$ is the same as $D^t(z^{t+1})$, where the t and $t + 1$ superscripts are exchanged.[4]

IV. DATA SOURCES AND DESCRIPTIVE SUMMARY

This paper covers the period of 25 years, from 1980-81 to 2004-05. The principal data source utilized here in was the Annual Survey of Industries (ASI), published by the Central Statistical Organization of India[5]. The ASI considers only registered manufacturing sectors. In the ASI, the paper and paper products industry is classified under 7 sub-sectors, at three and four-digit industrial classification levels.

Value added was taken as a measure of output, which was deflated by the wholesale prices index of paper and paper products using 1981-82 = 100 as a base. Thus, the real value added was considered in this paper. The total number of persons engaged in industrial units is taken as the measure of labour input.

To construct capital stock, we used the gross fixed capital formation series. Capital stock was calculated as follows:

$$K_{i,t} = (1 - \delta)K_{i,t-1} + I_{i,t-1}$$

where $K_{i,t}$ is capital stock of sector i at period t, I_{it} is capital formation and δ is the depreciation rate. The series on fixed capital formation were deflated by the WPI of machine and machine tools, and we employed a uniform 5% deprecation rate.

[4] See Coelli (1996), p.27 for more details.

[5] The latest ASI data are available up to 2004-05. In this study we used the consistent time series compiled by the Central Statistical Organisation.

The standard Perpetual Inventory Method has been used here in constructing the initial capital stock. The initial capital stock series is initialized via the following equation:

$$K_{i,o} = I_{i,0} / (g_i + \delta)$$

where $I_{i,0}$ is the first-year investment data available in the sample, g_i is the average growth in the sample years of the investment series, and δ is the depreciation rate.

Unit Root Test

The stationary of the data were checked using unit root test.

To avoid spurious results, it is necessary to check the time series data for stationary using unit root test. Keeping this in mind the unit root test has been carried out for the data. ADF (Augmented Dickey-Fuller) test is used for co-integrating the data. According to Engle-Granger test, even though the regression parameters are individually non-stationary, the unit root test performed on residuals is stationary means then the regression result is not spurious (Gujarati, 2003).

In this paper we have checked the unit root of 1 per cent critical τ value of different levels. The stationary of a variable is proved only when the estimated value is lesser than the critical value at 1 per cent levels of significant.

Table 1 Unit Root/Co-integration results (Pre-liberalisation period)

Code	UT(-1) (τ)	D(UT(-1)) (τ)	Critical Value (1%)	Results
2101	-	-4.1888	-2.8622	Stationary
2102	-4.1618	-	-2.8270	Stationary
2109	-	-4.7264	-2.8622	Stationary

Table 1 presents the result of Augmented Dickey-Fuller (ADF) test. From the table we can infer that the sub-sectors of Manufacture of Containers (2102) is stationary at levels. Among the other product groups becomes stationary only at first difference.

From the table 2 we can infer that the product groups Manufacture of Paper and Paper Board Articles etc. (2109) is stationary at levels. Among the rest of the sun-sectors becomes stationary only at first difference.

Table 2 Unit Root/Co-integration results Post-liberalisation period

Code	UT(-1) (τ)	D(UT(-1)) (τ)	Critical Value (1%)	Results
2101	-	-3.2474	-2.8270	Stationary
2102	-	-5.4417	-2.8270	Stationary
2109	-3.9037	-	-2.7989	Stationary

V. EFFICIENCY IMPROVEMENT OR TECHNICAL PROGRESS?

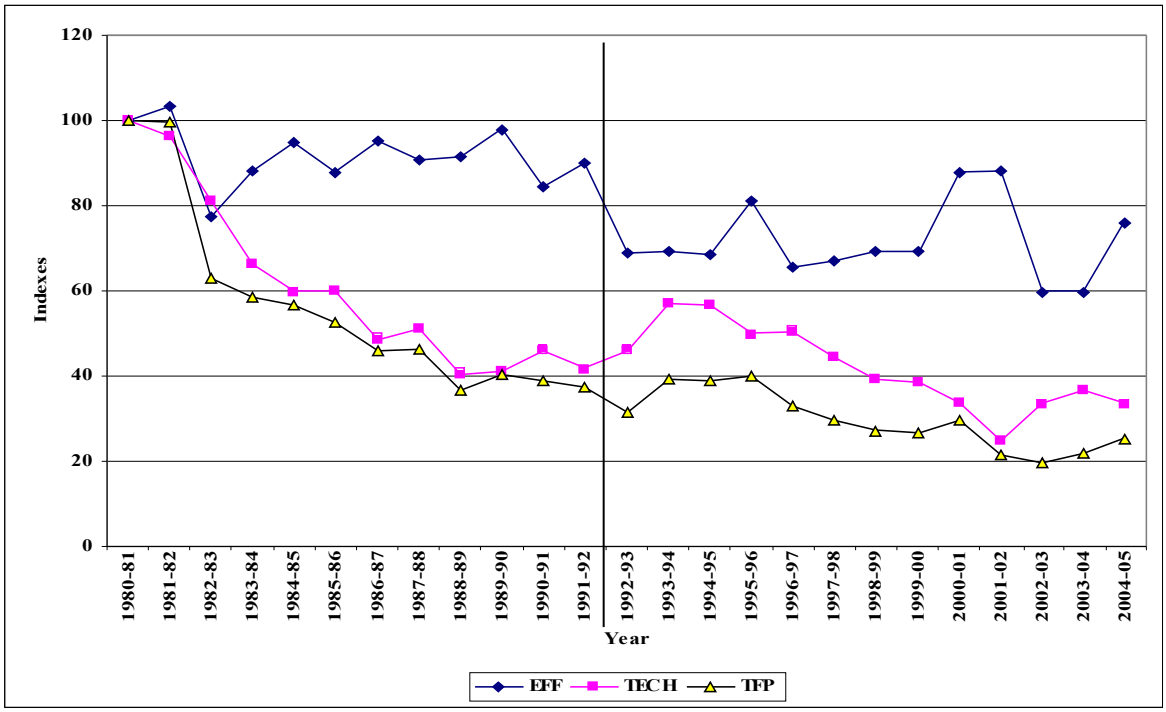
We estimated the Malmquist productivity index and its two components for 7 Indian paper and paper products industry over the pre (1980-81 to 1991-92) and post (1992-93 to 2004-05) liberalization periods[6] using one output and two inputs: labour and capital. Coelli's (1996) computer program, DEAP 2.1, which adopts the non-parametric linear-programming techniques of Fare ***et al.*****,** (1994), was employed in the estimation of the Malmquist productivity index and its two components.

Figure 1 shows the movement of cumulative indices for efficiency change (EFF), technical progress (TECH) and total factor productivity (TFP). If this figure it can be seen that, while TFP as well as TECH remained unchanged in the pre-reform period, rather than EFF changed and the similar pattern continued in the post-reform period. In the post-reform period, TECH increases though negative and EFF decreases, but TFP as measured with the addition of TECH and EFF remains nearly unchanged. However, even though there was a fall in EFF, and slight increase in TECH results in a modest increase in TFP.

Figure 1 illustrates that the economic reforms exert negative effect on efficiency change and technological progress in Indian paper and paper products industry, this was due to negative impact on total factor productivity. The worrying fact is that grate fall in efficiency change during post-reform period when compared to pre-reform period. The falling efficiency change requires more attention. The improvement in TECH can be converted into productivity growth only with the support of efficient improvements. Therefore, specific policies must be instituted for better use of resources through efficient improving measures such as education, training, etc., in order to attain productivity growth.

[6] To compare the performance prior to the July 1991 reforms and that following them, the conventional practice is to draw the line at 1990-91 and thus to divide the time period into the decades of the 1980s and 1990s. However, this division does not accurately reflect the division into periods prior to and following the July 1991 reforms. Indeed, because 1991-92 was the crisis year and the 1991 reforms were a response to, rather than the cause of, the crisis, the conventional practice creates a profound distortion by including the year 1991-92 in the post-1991-reform period. The July 1991 reforms and subsequent changes could not have begun to bear fruit prior to 1992-93. Therefore, 1991-92 is taken as the dividing line between the two periods. The start of the post-1991-reform period is 1992-93 (Panagariya 2004).

Fig. 1. Cumulative Malmquist Productivity Indices of Indian Paper and Paper Products Industry



Note: EFF, TECH and TFP denote the cumulative indexes of efficiency change, technical change and total factor productivity change, respectively.

Table 3 shows the average growth rates of EFF, TECH and TFP in each sub-sectors of Indian paper and paper products industry[7]. The final row in Table 3 illustrates that the growth rate of TFP is slightly higher in the post-reform period (-8.6 %) than in the pre-reform period (-5.2%).

Two of 7 sub-sectors evidenced positive TFP growth in the post-reform period, whereas one sub-sector had positive TFP growth in the pre-reform period. Only one sub-sector Manufacture of Pulp, Paper, Board and Newsprint (2101) evidenced positive TFP growth in both periods. The interesting feature is noticed from the results all sub-sectors though negative but it increased the level of productivity growth during post-reform period.

[7] Figures in Table 1 are calculated by subtracting 1 from the average Malmquist indices for the period Note that values of the Malmquist index or any of its components that are less than 1 denote deterioration in performance, whereas values greater than 1 denote improvement in the relevant performance.

TABLE 3
Average Annual Growth Rates of EFF, TECH and TFP in Indian Paper and Paper Products Industry during Pre and Post- Reform Period (%)

	Pre-Reform			Post-Reform		
NIC Code	**EFF**	**TECH**	**TFP**	**EFF**	**TECH**	**TFP**
2101	3.5	0.3	3.8	-2.6	5.5	2.7
2102	-0.2	-13.8	-13.9	-9.5	-2.9	-12.2
2109	-4.0	-12.2	-15.7	-3.5	-2.7	-6.1
Mean	**-0.23333**	**-8.56667**	**-8.6**	**-5.2**	**-0.03333**	**-5.2**

Note: EFF is efficiency change, TECH is technological progress, and TFP is total factor productivity

After reform, all sub-sectors, except for Manufacture of Pulp, Paper, Board and Newsprint (2101) attained technological regress, but there is no sub-sectors EFF improvements in the post-reform period, whereas four in the pre-reform period. The reform process has little increase access to superior technology in the Indian paper and paper products industry through higher foreign participation, as well as grate access to importation of higher quality raw materials and capital equipment. However, the negative contribution of efficiency and technologies were not converted into productivity gains. It could, therefore, be concluded that there must be a corresponding increase in efficiency to convert technological progress into productivity growth.

VI. CONCLUSION

This study applied the Malmquist productivity index to estimate TFP growth and its components (efficiency change and technological progress) in Indian paper and paper products industry at the sub-sectoral level. The estimation of productivity changes in the Indian paper and paper products industry during the period 1980-81 to 2004-05 reveal contradictory results at the aggregate and sub-sectoral levels. The average TFP growth rate at the aggregate level was -8.6% in the pre-reform period, but was -5.2% in the post-reform period; this would tend to suggest that those economic reforms effected little increase in total factor productivity[8]. This declining trend is applicable to all the sub-sectors except Manufacture of Pulp, Paper, Board and Newsprint (2101).

Productivity growth during the pre-reform period was attributed to efficiency change both at the aggregate and sectoral level. During the post-reform period, Indian paper and paper products industry as whole witnessed a fall in the productivity change mainly due to the greater fall in the efficiency change.

When compared to protected regime, the productivity change seems to be better thus favours the policy of free trade that may be more useful for Indian paper and paper products industry for better factor utilization. However, the change in efficiency was insufficient, leading to under-utilization of resources. Deteriorating efficiency might be attributable to a failure to achieve technology mastery, or might be due to short-run cost-minimizing behaviour in the face of quasi-fixed vintage capital. The growth in technological progress failed to contribute to the productivity growth of Indian paper and paper products industry, owning principally to failure to improve efficiency.

The results of this study suggest the need for the implementation of specific policies to improve technical progress and efficiency change, in order to precipitate a long-run balance in TFP growth. Technological progress should be encouraged in industries with slow technical progress (regress), industries with slow efficiency change rates should be encouraged to use existing technology more effectively via increased education and training.

[8] The present study supports the findings of **Pattnayak and Thangavelu (2005) Sindhu and Balasubramanyam (2006)**.

Appendix - A

S.No	NIC Code87 (NIC 98)	Name of the sub-sectors
1.	280 (2101)	Manufacture of Pulp, Paper and Board incul. Manufacture of Newsprint.
2.	281 (2102)	Manufacture of Containers and Boxes of Paper and Paper Board
3.	282+283 (2109)	Manufacture of Paper and Paper Board Articles and Pulp Products + Manufacture of Special Purpose Whether (or) not Printed etc.

Note: NIC: 3 and 4-digits industry code of National Industrial Classification.

Reference:

Ahluwalia, I.J. (1991), "Productivity and Growth in Indian Manufacturing," Oxford University Press, Delhi.

Banga, Rashmi and Goldar, Bishwanath. 2007. "Contribution of Services to Output Growth and Productivity in Indian Manufacturing: Pre-and Post Reforms." *Economic and Political Weekly* 42, no.26: 2769 – 2777.

Balakrishnan, Pulapre; K. Pushpangadan; and M. Suresh Babu. 2000. "Trade Liberalization and Productivity Growth in Manufacturing: Evidence from Firm Level Panel Data." *Economic and Political Weekly* 35, no.41: 3679-3682.

Coelli, Tim. 1996. "A guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program." *CEPA Working Paper* 96/08, University of New England, Australia.

Das, Deb Kusum. 2004. "Manufacturing Productivity under Varying Trade Regimes, 1980-2000." *Economic and Political Weekly* 39, no.5: 423-433.

Fare, Rolf; S. Grosskopf; M. Norris; and Z. Zang. 1994. "Productivity Growth, Technical Progress, and Efficiency Change in Industrialised Countries." *American Economic Review* 84**,** 66-83.

Fare, R Rolf; S. Grosskopf; and M. Norris. 1997. "Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries: Reply." *American Economic Review* 87**,** 1040-1044.

Fujita, Natsuki. 1994. "Liberalization Policies and Productivity in India." *The Developing Economics* 32, no.4: 509-524.

Goldar, Bishwanath and, Anita Kumari. 2003. "Import Liberalization and Productivity Growth in Indian Manufacturing Industries in the 1990s." *The Developing Economies* 41, no.4: 436-460.

Goldar, B. N. 2004. "Indian Manufacturing: Productivity Trends in Pre and Post-Reform Periods." *Economic and Political Weekly* 39, nos.46 & 47: 5033-5043.

Majumdar, Sumit K. 1996. "Fall and Rise of Productivity in Indian Industries: Has Economic Liberalisation Had an Impact?." *Economic and Political Weekly*, November, 30: M46-M53.

Madheswaran, S; Hailin Liao; and Badri Naryan Rath. 2007. "Productivity Growth of Indian manufacturing Sector: Panel Estimation of Stochastic Production frontier and Technical Inefficiency." *The Journal of Developing Area* 40, no.2, Spring: 35-50.

Panagariya, Arvind. 2004. "Growth and Reforms during 1980s and 1990s." *Economic and Political Weekly* 36, 2581-2594.

Pattnayak S.S and Thangavelu S.M. (2005), "Economic Reform and Productivity Growth in Indian Manufacturing Industries: an interaction of Technical Change and Scale Economies", Economic Modelling, Vol.22, pp. 601-615.

Ray, S.C. and E. Desli. 1997. "Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries: Comment." *American Economic Review* 87, 1033-1039.

Sharma, Kishore. 1999. "Productivity Growth in Developing Countries: An International Comparison." T*he Current State of Economic Science,* Vol. 3, International Economics, Financial Economics, ed. Shri Bhagwan Dahiya, Spell Bound Publications, Rohtak, India.

Sindhu, J, and V.N. Balasubramanyam. 2006. "India's Growth Performance: The Enigmatic Decade of the Eighties." *The Indian Economic Journal* 54, no.3: 7-24.

Singh S.P, and Shivi Agarwal. 2006. "Total Factor Productivity Growth, Technical Progress and Efficiency Change in Sugar Industry of Uttar Pradesh." *The Indian Economic Journal* 54, no.2: 59-82.

TSL. 2003. "Reforms and Productivity Trends in Indian Manufacturing Sector." Department of Economics and Statistics, Tata Services, Mumbai.

Trivedi, Pushpa; Anand Prakash; and David Sinate. 2000. "Productivity in Major Manufacturing Industries in India: 1973-74 to 1997-98." Development Research Group Study No. 20. Mumbai: Department of Economics 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, No WP/03/02.*

Unni. Jeemol; N. Lalitha and U. Rani. 2001. "Economic Reform and Productivity Trends in Indian Manufacturing." *Economic and Political Weekly* 36, no.41: 3914-3922.