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Measurement and productivity growth of the Indian industrial sector: Review of literature

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Abstract
By utilizing the existing literature, the present study gives the report on productivity growth and various techniques utilized in the industrial sector of India. Meanwhile, most of the studies confined to productivity growth either at regional level or at national level. Interestingly the more studies have been conducted during and after economic reform. Primarily, Translog index method, Growth accounting approach, Malmquist productivity index, Levinsohn-Petrin method, Data Envelope method, and stochastic frontier analysis along with descriptive statistics techniques have been applied for measuring productivity growth. By using different methods, some studies have shown growth in productivity whereas some encountered deceleration growth in productivity. The reason of variation in productivity growth has different sphere. As some of the studies has pointed out economic liberation has positive and negative impact on different manufacturing industries in India.

Keywords: Productivity growth, industrial sector, different methodology

Introduction
Generally, productivity is defined the relationship between output volume and inputs volume as well. It is the magnitude of efficiency in production inputs likely the case of labour and capital are being used in an economy. Productivity is considered as a key tool of economic performance and competitiveness (Krugman, 1994) [14]. Productivity is the measure of production efficiency because it analyzes the physical and human resources for generating income and output. In simple word, productivity can be defined in terms of efficiency of inputs being used in the production process. A change in productivity refers to the change in volume of input and output used. More simplicity, productivity is usually expressed as the ratio between output and input. Productivity growth is the measurement of an increase in value of output produced from various combinations of inputs over time. To be precise more, productivity growth depends on efficiency of different inputs. First of all, the problem with regard to the measurement of productive efficiency was solved by Farrell (1957) [8]. He defined the three type of efficiency such as price (related to inputs prices), technical (producing optimal output with available inputs) and structural efficiency (comparison of industrial performance with the efficient production function that is constructed from its own firms) that is required for productivity. Moreover, it takes account of all inputs simultaneously and avoids the problem of index number in the measurement of productive efficiency in the literature. Thus, productivity is the relationship between a flow of output produced and inputs used during a specified period. In this study we have present the literature on industrial productivity growth with different tools have applied as well.

Objective of the Study
- To analyze the literature on productivity growth in the industrial sector of India
- To discuss the methods being utilized for pertaining growth in the industrial sector of India

Let us discuss the growth and method in productivity in detail with respect to industrial sector in India. The detail gives us the brief snap of trend in growth and methods utilized as well.

Ahluwalia (1991) [1] defined the total factor productivity growth in Indian manufacturing industries for the period 1964-65 and 1985-86. This study used pooled cross section and time series data for explaining the total factor productivity growth. The results of this study were drawn by Translog measure of production function. This study found that total factor productivity was increased to 3.4 percent per annum over time in the study. The author also underlined this productivity reversal in the productivity growth due to economic regime or liberalization polices initiated since 1980s in India.

Balakrishnan and Pushpangaden (1994) [3] pointed out the total factor productivity (TFP) in the manufacturing sector by adjusting changes in the relative price of material inputs across 3- digit industries in India for the period 1970-71 to 1988-89. More precisely this study discussed the relative price of the material that can affect the measurement of the value- added. For the measurement of real value-added measures, this study used single and double deflation methods. The TFP based on the single deflation method was varied on account of

83.0 percent in 1980-81 and 106.8 percent in 1988-89. In the case of the double deflation method, TFP was discontinued as it was 76.8 percent and 154.9 percent in 1972-73 and 1982- 83 respectively.

Dholakia and Dholakia (1994) [7] revealed the growth of Total Factor Productivity in the manufacturing industries in India for the period 1970-1990. This study investigated the TFPG during 1980-1990 in comparison to 1970-1980 in the context of single deflation method and double deflation method of real value added and it was a debate over these two measures of value added. The data regarding different inputs was taken from Central Statistics Organization Transactions matrix from 1973-74 for both registered and unregistered manufacturing sector and for output the data was taken from National Account Statistics. Majumdar (1996) [15] underlined the productivity trends in Indian industry for the period from 1950-51 to 1992-93.

Srivastava (1996) [23] tried to define the firm level productivity in Indian manufacturing for the period 1980-81 and 1989-90. The author divided period further into 1980-81 to 1989-90 i.e. pre and post-reform period respectively. The author refined data and reduced to 1941 firms due to various issues. The growth of total factor productivity was low in pre-reform ranging from 0.02 percent and 1 percent whereas it was highest during post-reform period between from 0.10 percent and 2 percent.

Rao (1996) [20] attempted to define the method of measurement of manufacturing productivity growth in India for the period 1973-74 and 1992-93. The results of this study were drawn by the growth accounting approach and econometric production function. The study divided the period into two sub-periods. The study found that the growth of total factor productivity was (TFP) just 2 percent over the period. Similarly, the index of TFP based on the double deflation method was 2.2 percent over time and it was 4.6 percent and -0.2 percent for periods one and two respectively.

Mongia and Sathaye (1998) [18] elaborated the productivity growth in aluminum, cement, fertilizer, glass, paper, iron, and steel industries along with total manufacturing during the period from 1973 to 1993 in India. During 1973-93, output grew by 7.73 percent, gross fixed capital 8.04 percent, and labor force 1.98 percent. The study also pointed out that the productivity growth rate of labor and capital decreased by 5.64 percent and 0.29 percent respectively. Total factor productivity indexes were not uniform during the entire period as on an average productivity growth rate based on Translog, Solow and Kendrick were 2.54 percent, 2.66 percent, and 2.74 percent respectively.

Pattnayak and Thangavelu (2001) [19] assessed the productivity trend in 3-digit across 10 organized manufacturing industries in India during the period from 1980-81 to 1996-97. The period was sub-divided into three parts such as 1980-81 to 1984-85, 1986-89 to 1990-91 and 1991-92 to 1996-97. The results were analyzed by two type of deflators' growth accounting specification developed by Harberger (1991, 1998). The study concluded that before liberalization productivity growth was negative or sluggish but after trade openness and liberalization regime of 1990s improved the total factor productivity growth.

Goldar and Kumari (2003) [10] defined the growth of total factor productivity in Indian manufacturing across 17 two-digit industries group during 1981-82 to 1997-98. The period had divided into two sub-periods as from 1981-82 to 190-91 and from 1990-91 to 1997-98. For the interpretation of total factor productivity growth, the study used Translog specification. The study found that there were divergence in total factor productivity during sub-periods as it was 1.89 percent and 0.69 percent per annum during respective periods. This study concluded that lowering of effective protection to industries had contributed positively to productivity whereas underutilization of industrial capacity was attributed to productivity slowdown in the manufacturing industries.

Hashim (2004) [12] conducted a study relating to cotton yarn, man-made textiles, and garments in terms of unit cost growth and total factor productivity in India. Apart from this, this study also touched on the determinants of total factor productivity in selected industries. Total factor productivity is measured by the Translog multilateral index given. This study used panel data around 16 states in cotton yarn and 13 in each man-made textiles and garment industry. The study identified major determinants that were output per firm, capacity utilization, electricity available, road density, credit disbursement by commercial banks, the nominal rate of protection, and non-tariff barriers for products and machinery.

Manjappa and Mahesha (2008) [16] enunciated the total factor productivity growth in ten manufacturing industries comprising capital and labor-intensive industries for the period 1994-2004. This study aimed to explore the impact of trade liberalization on the total factor productivity in Indian industries. The study used Data Envelope Analysis based on Malmquist Productivity Index (MPI). The study found that the TFPG in capital-intensive industries was 1.7 percent per annum whereas it was -0.9 percent in labor-intensive industries during the entire period. Total factor productivity growth was mainly by the contribution of technical progress (frontier shift) rather than by technical efficiency change (catching-up effect) in the case of capital-intensive industries.

Das and Kalita (2009) [4] attempted to define the aggregate productivity growth for 2-digit organized manufacturing industries for the period 1986-2000. This study used the Domar aggregation technique for analyzing total factor productivity growth. For the period 1986-90, some industries like basic chemicals, heavy machinery, electrical machinery and transport equipment were depicted positive TFP growth say 2 percent per annum. However, the leather

industry was negative growth of TFP and the average TFP growth was 1.74 percent per annum during the same period. In the third period of 1991-95, the TFP growth in five industries as in cotton textiles, textile products, basic chemicals, rubber and plastics and basic metal was negative.

Hashim *et al.* (2009) [13] interpreted the partial and total factor productivity across 2-digit manufacturing industries in India during 1992-93 to 2005. The study also gave insight about J-curve hypothesis of liberalization and productivity from import liberalization. The time period was further divided into sub-period as from 1992-93 to 1997-98, form 1998-99 to 2001-02 and finally form 2002-03 to 2005-06. The results were drawn by Translog and J- curve analysis. The study found that total factor productivity was 0.81 percent per annum over time. The growth of partial factor productivity such as of capital, labour, energy, material and services was 1.2, 5.6, 5.0, 0.7, and 1.41 percent respectively in all industries during the same.

Sehgal and Sharma (2011) [21] made comparison of inter-temporal and inter-industry over the total factor productivity in organized manufacturing in Haryana (State) in India for the period 1981-82 to 2007-08. This period was known period one and this period further divided into pre-reform period from 1981-82 to 1991-92 (say period one) and post-reform period from 1992-93 to 2007-08 (say period two). The findings were analyzed by Malmquist productivity index. During post reform period, technological shift was greater than efficiency in all respective industries except for food and beverages and cotton and textiles indicating that growth in total factor productivity was mainly due to innovation regardless of improvement in efficiency. The study concluded that there was no unique pattern of productivity growth in manufacturing sector of the state like Haryana over time.

Ghose (2012) [9] underlined the total factor productivity growth of Pharmaceutical industries in India over the period from 1973-74 to 2003-04.The total factor productivity growth discovered a significant increase in the Indian pharmaceutical industry over time. Among the determinant of total factor productivity, the firm size and capital intensity were positive moreover profit per unit of output also positive and it also can be taken as a prime explanatory variable among other inputs. The study underlined that partial elasticity was positive for capital and material, capital and fuel consumption, and the number of workers and fuel consumption.

Thomas and Narayanan (2012) [24] depicted the relationship between productivity heterogeneity and firms level exports in India for the period 1990 to 2009. The study hypothesizes that there is self-selection of most productive firms attributed to export and firms learn by exporting where firms become more productive once they enter in the exports market. This study aimed to find the level of export from the heterogeneity productivity of the firms. The sample of this study was taken from 2481 manufacturing firms. This study found that exporting firms were more productive as compared to non-exporters firms and they were doing more exports than non-productive firms. But this productivity difference was small when compared to other countries in the world.

Babu and Nataranjan (2013) [2] assessed the performance of regional registered manufacturing in India by examining the trends in labour and total factor productivity across 15 states for the period 1980-2008. There are variations in productivity growth that can be explained by variations in infrastructural development at the regional level in India. The study also found that there was a marked increase in the share of the manufacturing sector in state income such as in Gujarat, Punjab, Haryana, and Bihar. The share of states' investment to total investment was varied over time. It was highest in the case of Maharashtra and Gujarat as their combined share was around 34 percent of total investment in the manufacturing sector during the pre- reform era.

De and Nagaraj (2014) [5] examined the relationship between productivity and firm size in the context of India. The sample of this study takes from 39751 manufacturing firms. The results of this study were analyzed by Levisohn and Petrin 2003 method of intermediate input as parameter to control the correlation between input and unobserved productivity level and Wooldridge method of Generalized Method of Moments for total factor productivity, Generalized Least Square method, random effect model for small firms size and productivity, t-test, dynamic model given by Arellano and Bond 1991, Arellano and Bover 1995 Blundell and Bond 1998, and also Probit model, Standard Deviation and Standard Errors. This study finds that there is positive correlation between firms and productivity.

Deb and Ray (2014) [6] compared the total factor productivity across 20 states during pre and post-reform periods 1970-71 to 2007-08 in the manufacturing industries in India. For the construction of total factor productivity, the study used the Biennial Malmquist productivity index that was based on data envelopment analysis. The study found that growth in total factor productivity at the Indian level was higher in the post-reform period. After the reform, there was a declining trend in productivity growth no dought that the majority of the states revealed accelerated productivity growth. During the reform period, the major component of productivity growth was attributed to technical progress.

Mangla and Azad (2015) [17] surveyed the existing literature on the measurement of industrial productivity in India. This study explored that there are so many methods used in different studies such as Translog index method, Growth accounting approach, Malmquist productivity index, Levinsohn-Petrin method, Data Envelope method, and Stochastic frontier analysis. The study pointed out that the main determinants of industrial productivity were growth rate of output, an effective rate of protection, non-tariff barriers, investment to capital stock ratio, real effective exchange rate, agriculture output growth rate, terms of trade, inflation rate, and investment in fixed assets.

Goldar (2015) [11] detailed the total factor productivity growth in Indian manufacturing industries particularly for the period 1999-2000 to 2011-12. The study used 2-digits national industrial classification and total factor productivity was measured by Translog index. The total factor productivity growth was not unique over time. There was a negative sign of its growth in tobacco products, publishing printing and reproduction of recorded media, coke, refined petroleum products, nuclear fuel, and manufacturing of furniture whereas it was positive in the rest of the industries. The share of imported material in total material was highest in the manufacturing of coke, refined petroleum products, and nuclear fuel says 7 percent whereas it was lowest in the manufacturing of food products and beverages say 3.3 percent.

Sharma (2017) [22] examined the growth of the manufacturing sector of India for employment, value-added, and labor productivity during the period from 2001-02 to 2013-14 along with the reason for variation in

manufacturing performance across 20 states. The study found that the regional variation was persisted but show a declining trend during the post-2007-08 periods. The declining trends were discovered among the states like Uttrakhand, Himachal Pradesh, and Assam. The dominant share in employment and value-added was observed in Gujarat, Maharashtra, Tamil Nadu, and Andhra Pradesh. Regional variations were more in manufacturing performance among the states like West Bengal, Kerala, and Uttar Pradesh.

Conclusion

Now we have reached at conclusion that there are many studies having increases or decreases in productivity growth in manufacturing sector in India during different time period. Most of the studies are available after economic reform. Inspite of this different methods have been used in different studies such as Translog index method, Growth accounting approach, Malmquist productivity index, Cobb-Douglass production function, Levinsohn-Petrin method, Data Envelope method, and Stochastic frontier analysis. Some studies have been identified higher industrial productivity during the post-reform period due to the impact of economic liberalization in India. Besides, the present analysis has also seen the variation in productivity in manufacturing industries either at regional level of national level. Moreover, some of the studies discussed the variations at regional level and there are some studies that are discussed the productivity differences in the manufacturing sector in India. At the same time some studies indicated that about the decomposition of total factor productivity growth into the efficiency and technological changes and estimate the bias in technology change in order to estimate the improvement in growth.

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