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SOURCES OF PRODUCTIVITY GROWTH IN INDIAN MANUFACTURING INDUSTRY

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Abstract:

This study investigated the sources of total factor productivity growth of selected Indian manufacturing sectors during the post-reform period. The study used pooled Annual Survey of Industries (ASI), published by the Central Statistical Organization of India data for1991-92 to 2017-18 for seven major Indian manufacturing sectors. The present study applied to measure the Malmquist Productivity Index (MPI), which is an application of DEA to the time series data to calculate the indices of TFP change, technology change, efficiency change and estimate the pure and scale efficiency change. The result of the study found that the Indian manufacturing industries experienced overall positive total factor productivity growth of 2.30 per cent. This positive productivity growth at the industries level there were six out of seven enjoyed. This was mainly due to the improvement in technical change at 3.40 per cent rather than technical efficiency at -1 per cent during the post-reform period. The case of scale and pure efficiency contributed negatively to the technical efficiency of the Indian manufacturing industry.

Introduction:

The realization of productivity growth in the industrial sector continues to drive the overall economic performance of the Indian economy. The Indian economy has now witnessed almost two decades of wide-ranging economic liberalization encompassing many sectors. The liberalization of trade and industrial policies was attempted to make India's manufacturing internally efficient and globally competitive. Industrial productivity performance has shown positive results - from a turnaround in the mid-1980s to improved performance in the 1990s. In this regard, enhancing India's productivity performance in broad industrial sectors strives to make the manufacturing sector dynamic. However, estimates of productivity growth have always raised questions in terms of its magnitude and direction. The observed productivity growth also has remained crucial for policy considerations Deb and Kalita (2009)[1] .

The Indian Manufacturing Industry has shown much promise, and the nation has put in much effort to support and sustain its growth. With growth comes competition, and with it comes the constant need for innovation and change, and it is up to the corporations how they can cope with these requirements. The Indian manufacturing sector is dynamic and employs India's large technically skilled population Shandilya et al. (2020)[2].

Manufacturing has emerged as one of the high growth sectors in India. It contributes about 15 per cent of the countries Gross Value Added (GDP). Under the National Manufacturing Policy 2015, ambitious programmes are underway to take this figure to 25 per cent and the total output from this sector to $1 trillion by 2022.

Review of Earlier Studies:

Krishna and Mitra (1998)[3] Trade liberalization, market discipline and productivity growth: new evidence from India. The effects on competition and productivity of the dramatic 1991 trade liberalization in India. Using firm-level data from several industries, find strong evidence of an increase in competition as reflected in the reductions in price-marginal cost markups and some evidence of an increase in the growth rate of productivity.

Kumar (2006)[4] A Decomposition of Total Productivity Growth: A Regional Analysis of Indian Industrial Manufacturing Growth. Total Factor Productivity (TFP) growth in industrial manufacturing is measured for 15 central Indian states from 1982-83 to 2000-01 using non-parametric linear programming methods. The findings of the present exercise indicate the improvement in TFP. The recent change in TFP is

1 Das, D. K., & Kalita, G. (2011). Aggregate productivity growth in Indian manufacturing: An application of Domar aggregation. Indian Economic Review, 275-302.,
2 Shandilya, S., Tiwari, S. P., & Lahkar, G. A Study on New Product Development in Indian Manufacturing Industries.
3 Krishna, P., & Mitra, D. (1998). Trade liberalization, market discipline and productivity growth: new evidence from India. Journal of development Economics, 56(2), 447-462..
4 Kumar, S. (2006). A decomposition of total productivity growth: A regional analysis of Indian industrial manufacturing growth. International Journal of Productivity and Performance Management.

governed by the technical progress in contrast to similar gain caused by improved technical efficiency in the pre-reform regime.

Sampathkumar and Saravanakumar (2010)[5] estimated the changes in Total Factor Productivity (TFP) of the Indian chemical sector from 1980-81 to 2001-02. The Malmquist indices of TFP growth are computed and decomposed into technical change and efficiency change. The obtained estimates of TFP change at the aggregate and sectoral levels indicate that the net impact of economic reforms on the productivity growth of the chemical sector was negative. It is evident from the study that the negative TFP change in the chemical sector at the aggregate level aggravated in the post-reform period. It is seen that technical change is the factor that leads to deterioration in the overall productivity of the Indian chemical sector. Similar trends are also observed at the sub-sectoral level.

Nataraj (2011)[6] studied the impact of trade liberalization on productivity: Evidence from India's formal and informal manufacturing sectors. Despite extensive literature investigating the impacts of trade on firm productivity, there is almost no evidence on how small firms react to trade liberalization. In addition, the study finds that although the decline in final goods tariffs did not significantly impact average formal sector productivity, it did increase productivity among the top quartiles of the distribution.

Rijesh (2019)[7] examined the impact of international trade on manufacturing productivity in India through the effects of economies of scale, reallocation, competition and spillover channels. To study the net impact of these effects, they constructed trade-related variables such as relative import price, import penetration and export intensity for a panel of 17 two-digit organized manufacturing sector industries from 1980 to 2013. During this period, the manufacturing sector witnessed considerable liberalization and openness and increased manufacturing growth and productivity, especially in recent decades. On the whole, the trade linked productivity gains is channelled through imports, which persist over time. This reveals that the impact of trade on manufacturing productivity in India is not static but dynamic.

Data and Methodology:

We have estimated productivity and its sources for seven Indian manufacturing industries. In this analysis, Total Factor Productivity is estimated for the manufacturing sector in seven significant sectors, for each sector of India from 1991-92 to 2017-18. The data used in this analysis for estimating productivity and its various sources come from the Annual Survey of Industries (ASI), published by the Central Statistical Organization of India.

Methodology:

Malmquist Productivity Index:

The Data Envelopment Analysis (DEA) is a particular mathematical linear programming model and test to assess efficiency and productivity of panel data to estimate changes in total factor productivity a break it down into two components, namely, Technological Change (TC) and Technical Efficiency Change (TEC). TFP growth measures how much productivity grows or declines over time. When there are more outputs relative to the number of given inputs, then TFP has grown or increased. TFP can grow when adopting innovations such as electronics, improved design, or 'Technological Change' (TC). TFP can also grow when the industry uses its existing technology and economic inputs more efficiently; it can produce more while using the same capital, labour, and technology by increasing 'Technical Efficiency' (TE). TFP change from one year to the next is therefore comprised of technological change and changes in technical efficiency. The TEC is decomposed into Pure Technical Efficiency Change (PTEC) and scales efficiency change (SEC).

The Malmquist (MPI)[8], which is an application of DEA to a panel data to calculate, was initially introduced by Caves et al. (1982) and was empirically used by Fare et al. (1992 and 1994). In order to avoid choosing the MPI of an arbitrary period, Fare et al. (1994) specified the Malmquist productivity change index as:

$$M_0\left(x^{t+1}, y^{t+1}, x^t, y^t\right) = \sqrt{\frac{D_0^t\left(x^{t+1}, y^{t+1}\right) D_0^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_0^t\left(x^t, y^t\right) D_0^{t+1}\left(x^t, y^t\right)}} \qquad (1)$$

Fare et al. (1994) further states that the MPI formula in equation (1) can be equivalently rewritten as:

5 Sampathkumar, T., & Saravanakumar, M. (2010). Sources of productivity growth in the Indian chemical industry. IUP Journal of Managerial Economics, 8(1/2), 112.

6 Nataraj, S. (2011). The impact of trade liberalization on productivity: Evidence from India's formal and informal manufacturing sectors. Journal of International Economics, 85(2), 292-301..

7 Rijesh, R. (2019). International trade and productivity growth in Indian industry: Evidence from the organized manufacturing sector. Journal of South Asian Development, 14(1), 1-39..

8 The output-oriented Malmquist indices of productivity change are computed using the Data Envelope Approach in this study. We used the computer software DEAP (Coelli, 1996) to calculate these indices.

$$M_0\left(x^{t+1}, y^{t+1}, x^t, y^t\right) = \frac{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_0^t\left(x^t, y^t\right)} \sqrt{\frac{D_0^t\left(x^{t+1}, y^{t+1}\right) D_0^t\left(x^t, y^t\right)}{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right) D_0^{t+1}\left(x^t, y^t\right)}} \quad (2)$$

The first ratio on the right hand side of equation (2) measures the changes in technical efficiency between period t and t+1 as a catching-up to the frontier effect. The second term measures the change in production technology (i.e., technical change), referred to as a shift in production frontier.

Technical Efficiency Change = EC = $\frac{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_0^t\left(x^t, y^t\right)}$ (3)

Technical Change = TC = $\sqrt{\frac{D_0^t\left(x^{t+1}, y^{t+1}\right) D_0^t\left(x^t, y^t\right)}{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right) D_0^{t+1}\left(x^t, y^t\right)}}$ (4)

The TFP growth rate can be estimated as:

TFPG (Per cent) = (TFPCH)*100

Further, it is to be noted that $M_0 > 1$ reflects a positive TFP growth between two consecutive years. Similarly, improvements in components of M_0 are associated with the values greater than the unity of these components, and deterioration is associated with less than unity. Furthermore, even if a sector experiences deterioration in efficiency, it could still end up with positive growth in TFP if the fall in its efficiency is smaller than the improvement in its technology (Kumar and Arora, 2009).

The total factor productivity change can be decomposed as,

TFP change = Technical efficiency change (catching up effect)
x Technical change (frontier effect)

Further technical efficiency change decomposed as,

Technical efficiency change = Scale efficiency change x Pure efficiency change[9].

Results and Discussion:

Table 1 presents the productivity growth sources in Indian manufacturing industries during the post-reform (1991-92 to 2017-18) period.

The Indian manufacturing industries found positive productivity growth at 2.30 per cent; this was observed that the technical progress at 3.40 per cent whereas negative technical efficiency of (-) 1 per cent. The argument that there is a productivity improvement is both increasing technical efficiency and technology change simultaneously. However, in the case of the Indian manufacturing industry, efficiency declined over a while.

At the industries level, the productivity improved in six out of seven industries, and highest being Manufacture of Basic Metals at 5.80 per cent. This improvement was mainly contributed by technical progress at 6 per cent while the negative contribution of (-) 0.30 per cent in technical efficiency.

Table 1: Sources of Total Factor Productivity Change in Indian Manufacturing Industries During Post-Reform Period

S.No	Sectors	PECH	SECH	EFFCH	TECHCH	TFPCH
1.	Manufacture of Food Products and Beverages	0.989	0.986	0.975	1.021	0.996
2.	Manufacture of Textiles	0.988	1.000	0.988	1.025	1.013
3.	Manufacture of Chemicals and Products	1.000	1.000	1.000	1.038	1.038
4.	Manufacture of Other Non-Metallic Mineral Products	0.986	0.992	0.978	1.033	1.010
5.	Manufacture of Basic Metals	1.001	0.996	0.997	1.060	1.058
6.	Manufacture of Machinery and Equipments N.E.C	1.000	1.000	1.000	1.033	1.033
7.	Manufacture of Other Transport Equipment	1.000	0.992	0.992	1.025	1.016
Indian Manufacturing Industries		0.995	0.995	0.990	**1.034**	**1.023**

Source: ASI: Annual Survey of Industries.

The productivity fall in other Manufacture of Food Products and Beverages at (-) 0.40 per cent. This was due to the technical efficiency's negative impact whereas the positive contribution of technical change at 2.10 per cent. The deteriorating technical efficiency of Manufacture of Food Products and Beverages was due to poor performance of both pure and scale efficiency change during the study period.

9 The similar methodology used by Shallu Sehgal and Suparn Sharma (2011) Muthusamy Saravanakumar, Taegi Kim (2012);

Thus, the table shows that the technology progressed at 3.40 per cent whereas the technical efficiency contributes negatively at (-) 1 per cent in the Indian manufacturing industry. The decline in technical efficiency was due to negative contributions of both pure and scale efficiency change.

Conclusion:

The Indian manufacturing industries experienced an overall positive productivity growth of 2.30 per cent. On the other hand, at the industries level, six out of seven enjoyed positive productivity growth. The positive growth of productivity was mainly due to the improvement in technical change at 3.40 per cent. In contrast, technical efficiency (-1 per cent) dampened the productivity growth of the Indian manufacturing industry during the post-reform period. With regards to scale efficiency and pure efficiency contributed negative value at (-) 0.50 per cent.

Of seven industries, six industries improved productivity, while only one industry reported productivity deterioration during the post-reform period. The highest productivity growth was found in Manufacture of Basic Metals at 5.80 per cent. It contributed mainly by technical change at 6 per cent whereas the technical efficiency contributes negatively at (-) 0.30 per cent during the study period.

The technical change improved all the industries of the Indian manufacturing industries during the post-reform period. The technical progress and no change in technical efficiency was evidenced in both Manufacture of Machinery and Equipments N.E.C and Manufacture of Chemicals and Products at 3.80 per cent in the productivity growth. The productivity deterioration in the Manufacture of Food Products and Beverages was due to technical progress at 2.10 per cent whereas, (-) 2.50 per cent in the technical efficiency during the post-reform period.

There was no improvement in the technical efficiency in all the Indian manufacturing industries during the post-reform period. This deterioration was mainly by the decline of both pure and scale efficiency in the study period. On the whole, the decline in technical efficiency at 1 per cent and positive technical change at 3.40 per cent in the Indian manufacturing industry. In other words, the positive sign of technical change andthe negative sign of technical efficiency in the Indian manufacturing industry after the introduction of economic reforms.

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