An empirical investigation of productivity dynamics and determinants of total factor productivity in selected manufacturing sectors: a panel data analysis

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Abstract

The present research is an effort to determine which factors influence total factor productivity (TFP) in selected sectors, viz. motor vehicles, trailers and semi-trailers#29; chemicals & chemical products#20; food products#10; tobacco and tobacco products#12. Using Translog index for TFP, it gives a complete picture better than atrial productivities. Panel data analysis was applied to determine the relation between TFP and its determinants. The determinants include capital intensity; credit; rate of growth of output, technology status, total emoluments and concentration ratio. Total factor productivity was low during the period 2006-2017. Results of 4-firm concentration ratio, highlighted moderate concentration for high-technology sector, viz. in automobile and chemicals & chemical products. Food Product sector had lowest concentration ratio, while Tobacco & Tobacco products was the most concentrated industry. Capital intensity; technology status, total emoluments and market concentration emerged as significant factors influencing TFP. The fixed model explained 68.18 percent of variation in TFP. These results highlight that TFP is influenced by capital intensity and technology status & market concentration. Earlier studies highlight the importance of total emoluments also. As we can say the fourth industrial revolution focuses on technology factors and market concentration.

Keywords: Market Concentration. Total factor Productivity. Indian Manufacturing Industries. Panel data Analysis. Capital Intensity.

1. Introduction

Manufacturing has an important role to play in the development of any economy. The manufacturing industry is a key element of high-quality economic development and its

productivity growth potential is higher than that of other industries. Through its own advantages, such as capital accumulation, scale economy, and technological progress it can produce greater spill over effects on other industries. A comparison between pattern of growth across sectors of China and India reveals that its growth from 1978 to 2007 can primarily be attributed to its manufacturing sector, while India's growth relied mainly on its service sector for growth. Essentially, China is looked upon as the manufacturing hub of the world. On the other hand, in India, there has been dramatic growth in the modern service sub-sectors like software, communication, and finance. However, it has been historically observed that since the time of industrial revolution, no country has become a major economy without first becoming an industrial power. The revival of the manufacturing sector is thus imperative for India to achieve an inclusive and sustainable growth. Nations can compete in the international market only if the firms are competitive. Changes occurring in the industrial sector should to be carefully analysed and efforts need to be made to optimize its contribution to the economy. The effect of improvement in the industrial sector goes far beyond its contribution to production. The manufacturing sector spurs demand for raw materials and intermediate goods and allied activities like transport, financial etc. Ahluwalia (1991) points out that Indian firms took decades to catch up to global productivity levels.

Structural economists like Kuznets (1971) have empirically demonstrated that growth is brought about by changes in sectoral composition of economies overtime. Along with rising levels of income, the demand for agricultural products relatively diminish, while that for industrial goods rise and, after reaching a significantly high level of income the demand for services increases sharply. From the perspective of supply side, Kaldor (1966) considered manufacturing as the engine of growth, because agriculture being subject to diminishing returns, is not able to sustain an increasing level of production and income. The manufacturing sector, being free from such limitations on expansion of production, is thus the key to sustained economic growth. Structural changes not only comprise of the process of economic development, they are also essential for sustaining economic growth. The classic dualism model (Lewisan model 1954), maintains that economic development is essentially a process of shifting resources from low to high productivity sectors, thereby raising economy-wide productivity.

In order to sustain high growth rate and development, India needs to reinvigorate its manufacturing sector. Indian government launched the make in India Champaign in 2014 to revive the manufacturing sector. The role of this sector is essential to address the problem of rising unemployment. In India 87 percent of manufacturing employment is in micro-

enterprises of less than 10 employees. The closest comparator being Korea, where less than half of employment is in micro-enterprises. There is a fairly high share of very large companies but there are few enterprises of intermediate size. The small scale of Indian industry took place by design due to pre-reform licensing system when only one major company was allowed to operate in many industries, while other industries were reserved for the small-scale industries. While these market entry restrictions are removed but their legacy continues to reduce competition, scale and productivity in many sectors. In addition, other regulations persist, notably those related to labour. Due to small size of so many manufacturing firms, India is reaping far smaller gains from scale economies than many other countries. Larger firms use newer technologies and achieve economies of scale and thus achieve higher productivity, while smaller establishments are much less productive.

To achieve greater growth in the manufacturing sector productivity needs to be effectively analysed. It is an important connotation of high-quality economic development to improve TFP. Effective measurement of TFP is a prerequisite for an objective and comprehensive understanding of the quality level of economic development. There are differences in research perspectives and considerations in the analysis of factors affecting TFP. TFP is not a specific factor, nor a factor that can be directly measured like capital, but a general concept which is the 'product' of various factors that are difficult to measure specifically. Therefore, the factors affecting TFP have neither a fixed range nor a standard mechanism, but diversity and uncertainty. This better explains the large differences in the research on related factors affecting TFP.

Productivity is sine-qua-non of modern Industry and has always attracted researchers to this evergreen area of research. In this research, an effort has been made to investigate empirically the factors influencing productivity, after identifying them from earlier literature. to explore this evergreen field of research, as improving productivity is important for all stakeholders as well as for the organization. As highlighted by Brynjolfsson & Hitt, (1998), the wealth of nations is determined by productivity growth.

In view of emerging role of manufacturing, it is important to analyse the performance of manufacturing not through the increase in value added, but through total factor productivity, which gives a realistic and practical picture. Productivity growth has been stagnant growth in advanced economies (e.g., Cette et al. 2016; Byrne et al. 2016). Decelerating in productivity has been experienced during post-crisis period across advanced economies, emerging market economies and low-income countries (Adler et al., 2017). Many earlier researchers' have exhaustively examined productivity growth in the period ranging

from 1980 to 2010 (Ahluwalia, 1991; Goldar and Kumari, 1993; Balakrishnan & Puspangagdan, 1994; Rao, 1996). As advocated by these authors, TFP rather than partial productivity present a holistic picture of growth.

These researchers have advocated divergent results. Ahluwalia, 1991 reported a turnaround in productivity in 1981. However, Balakrishnan & Puspangagdan, 1994 refuted the turnaround, using double deflation method registered manufacturing weights rather than single deflation as used by Ahluwalia. Rao's study (1996) reaffirmed Balakrishnan & Puspangagdan, 1994 results. A study Kaur and Kiran (2007) on TFP from 1981- 2003 supported that Indian manufacturing reported positive but low productivity growth during the entire period. However, there is deceleration in productivity in post-reform era, i.e. 1991 onwards. Krishna (2016) reported that Manufacturing TFP growth was less stable in India as compared to services; while the reverse was true for China. In view of these mixed results, it becomes important to examine productivity in selected sectors of Indian Manufacturing. The sectors considered are: Motor vehicles, trailers and semi-trailers#29; chemicals & chemical products#20; food products#10: and tobacco & tobacco products#12 for the same time period, viz. 2006 to 2017. In a study by Goel et al. (2017) labour productivity factor identification was done and various factors affecting labour productivity were identified. Among others they identify pay or emoluments as a very important factor that has an effect on employee productivity. Further, discussions have also been found whether the pay or emoluments affects productivity by Ahluwalia (1991) and Kaur and Kiran (2007)

Prior researchers have included capital intensity as an important determinant of TFP (Ahluwalia, 1991; Goldar, 1985, Rao 1996). There are insufficient studies linking TFP with market concentration, thus in this study this has been included as a determinant influencing productivity in panel data analysis. It becomes imperative to compute market concentration of selected sectors. For market concentration, as recommended by researchers (Bains, 1996) 4-firm concentration ratios were applied. This also gave facilitated in recognizing which of these selected sectors had high, medium or low concentration. Market concentration, is often taken as a proxy for the intensity of competition. Researchers argue that increase in concentration stifles competition, damages innovation and decelerates productivity. It is time to examine whether concentration has increased in registered manufacturing. Many researchers have associated rising concentration with productivity slowdown (Hall, 2015; Syverson, 2017). This was supported by Rumsey (2019) who concluded that since 2000, U.S. aggregate productivity growth has decelerated while product market concentration increased. The researchers' concluded that rising concentration, slower productivity growth, and wider

technology differences were associated with development in Internet and Information Technology (Covarrubias, Gutierrez, and Philippon (2020). Increased mergers and acquisitions are associated with increase in concentration (Grullon, Larkin, and Michaely (2019). In view of these developments across the globe, it would be important to examine the market power and productivity scenario of selected manufacturing industries. Zeng S et al (2022) examined TFP and high-quality economic development from 2007 to 2018 in China by investigating 11 Chinese provinces and cities in the Yangtze River Economic Belt. The differences in TFP growth between the upstream region, midstream region and downstream regions highlight an initial increase followed by deceleration. There are differences in the direction and extent of the impact of factors, viz. the level of openness, R&D investment, industrial structure, government expenditure and human capital on the TFP of the overall region, upstream region, midstream region and downstream region. The authors attribute the vast differences between provinces and cities in terms of industrial structure, opening-up, technological innovation to human capital and indigenous policies. These are translated in difference s in TFP across provinces and cities. Hence, it necessitates to include market concentration as a determinant of TFP.

Dougherty et al. (2009) are concerned about the relatively small size of many manufacturing firms in India, which result in far smaller gains from scale economies than many other economies. Larger establishments through use of newer technologies have higher productivity than the smaller ones. Despite having a share of 90% in manufacturing employment, they produce only 1/3rd of manufacturing output. Even after controlling for technology, industry, region and firms' age, TFP of large units is about twice as high in firms with more than 250 employees than in those with only up to 10 employees. Maiti (2019 argued that the joint effects of market size and competition arising out of trade cannot dominate the adverse effect of specialization in the presence of unions. The degree of specialization or comparative advantage that appears due to the increased market share of the most productive firms, who require fewer workers, thereby reducing the demand for workers with the trade. The drop-in demand weakens bargaining power and shifts away distributive share from workers. But the competitive can negate such adverse effects of trade, to a large extent. Prior studies have reported a positive association between total emoluments and TFP (Ahluwalia, 1991; Goldar, 1985; Kiran and Kaur, 2007). Thus, TE is also included as a determinant in this study. On the basis of earlier research, Table 1 highlights the determinants of TFP, which have been taken in the current study.

Table 1: Determinants of Productivity -Supportive literature

S. No.	Determinants of Productivity	References
1.	Capital Intensity	Ahluwalia (1991); Goldar (1985); Rao (1996); Kiran and Kaur (2007)
2.	Rate of Growth of Output	Ahluwalia (1991); Kiran and Kaur (2007)
3.	Market Concentration	Goswamy et al. (2004); Hall (2015); Syverson (2017); Autor et al. (2017) Rumsey (2019); Dougherty et al. (2009)
4.	Total Emoluments	Ahluwalia (1991); Kiran and Kaur (2007); Goel et al (2017)
5.	Technology Status	Bains (1985), Jin et al. (2015)
6.	Credit	Rosmah et al. (2020);
7.	Market structure	Zeng et al. (2022)

The Objectives of the study are:

O1: To analyse the trends in Total Factor Productivity in selected Indian manufacturing sectors.

O2: To analyse determinants of Total Factor Productivity for selected Indian manufacturing sectors.

O3: To analyse the market concentration for the selected Indian manufacturing sectors.

O4: Panel data analysis of determinants of Total Factor Productivity.

The structure of the paper is as follows. Section 1 provides background of the study with a brief analysis of productivity growth and also its potential determinants. Section 2 provides Review of Literature with 2.1 highlighting an overview of studies on Productivity and 2.2 covering Studies related with determinants of TFP. Section 3 describes the data, variables of the study and empirical methodology to construct TFP and its determinants. It also explains the details of panel data analysis. Section 4 illustrates the results of our TFP estimation and determinants of TFP in selected sectors in India It also provides the panel data analysis. Section 5 present the Conclusions of the study. This is followed by limitations and Implications of the study.

2. Review of Literature

For achieving these objectives, it will be necessary to examine the existing literature on TFP, and determinants of TFP.

2.1. Overview of studies on Productivity

There is rich literature on productivity analysing the differences in productivity levels among the developed and developing nations. Restuccia (2013) and Rogerson (2013) suggested that low TFP in developing countries existed due to misallocation across heterogeneous units. Acemoglu and Zilibotti (2001) have attributed the differences in productivity across U.S. and developing countries to technology skill mismatch. Romer (1993) and Prescott (1998) also considered technology as the main source of divergence in TFP. Acemoglu and Zilibotti (2001) suggested that average TFP in LDCs was twenty two percent lower than U.S level in nine least skill intensive sectors, while it was thirty percent lower in nine most skill intensive sectors.

Krugman (1994) maintained that rapid growth is attributable to the ability to mobilize resources than efficiency increase. He further expressed that reforms are likely to increase within firm productivity due to increased efficiency. Lending support Bernard, Redding and Schott (2006) concluded that improved competition forces firms to produce products they are more competent in. According to Leibenstein (1996) it reflected improved X-efficiency. Topalova (2011) and Khandelwal (2011) examined the effect of reforms on firm level productivity using Levinsohn (2003) and Pertin (2003). They found that a decrease in trade protection leads to higher productivity levels.

A number Indian studies have tried to evaluate the impact of liberalization policy on productivity, because the crux of the policy reforms was primarily to improve industrial productivity and eliminate inefficiency owing to concentration. Among the first generation of important work done in this context is by Ahluwalia (1991). The study at a disaggregate level in the seventies revealed poor performance of TFP growth till the end of seventies. However, a turnaround was reported in the first half of eighties, and TFP grew at 3.4 percent per annum in the first half of eighties, compared to virtual no growth in the previous decade reflecting a marginal decline of 0.3 percent per annum. This improvement in the TFP in the first half of eighties was due to improvement in labor productivity, measured as output per worker. Capital productivity however remained stagnant. Critics point out a bias in productivity estimation due to single deflation method used for value added. Thus, Balakrishnan and Pushangadan (2002) challenged Ahluwalia's claims that TFP accelerated after 1980 due to liberalization. Using double-deflation (DD) measure for estimation the results were contrary those reported by Ahluwalia (1991). Even Rao (1996) using value added production function

based on double deflation procedure and gross output production function supported Balakrishnan and Pushpangandan (1994) claims. A third generation of studies focused on the impact of trade policy reforms on productivity growth post 1991. Most of them have used gross output function to calculate TFP. They have used capital, labour, material, energy and also services to calculate TFP. Nearly all these studies reveal no improvement in productivity trend in the post-reform period. Trivedi (2011) reported that TFP growth in manufacturing grew at 1.88 percent per annum in the period 1980-1991; compared to 1.05 percent per annum from 1992-2007. Srivastava (1996) covering the period of 1980-81 to 1989-90 suggested existence of inter-industry differences in productivity & efficiency. Krishna (1998) and Mitra (1998) used panel data from CMIE database to examine the impact of liberalization on Indian firms from 1986 to 1993 report an increase in competition. The researchers reported a diminished evidence of increased productivity following reforms.

Kaur and Kiran (2007) estimate productivity changes in pre-liberalisation (1980-81 to 1990-91) and post liberalization 1991-92 to 2002-2003 period report that TFP grew at a rate of 1.24 percent for 1980-81 to 2002-03. Further a high TFP growth was reported in pre liberalization period over a lower TFP in post-reform. There have been several advancements in techniques of productivity growth, and efficiency, however it can also be inferred that productivity related studies report mixed results. Moving from Solow's (1957) classic work, there has been significant work for convergence of productivities in developed and emerging economies (Jorgenson and Nishimizu, 1978; Nishimizu and Page, 1982; Munnell, 1990). Different aspects covered include productivity and inefficiency (Farrell, 1957), research & development (Griliches, 1979), technological characteristics (Caves et al., 1980); productivity and liberalisation (Ahluwalia,1991; Krishna,1998; Mitra, 1998; Balakrishnan and Pushangadan, 2002; Kaur and Kiran, 2007). Thus, it was thought essential to examine the latest developments in productivity.

2.2. Studies related with determinants of TFP

Many researchers have been attracted to examine determinants of productivity. Some of often used determinants to be included in the present study emerged from mammoth literature covered across the globe. It is impertinent to mention the literature associated with these determinants to make the authors converge to which factors to include in this study.

Capital Intensity: Capital intensity is capital investment per employee. In order to introduce new products and to improve the older ones, capital investment should be enhanced

and as a result productivity of an industry could be improved. Explanation for the relationship between capital intensity and labour and capital productivity is provided by Izlam (1987). He argues that labour productivity increases with decreasing capital intensity owing mainly to the adaptation of higher levels of technology. A simple comparison of the figures on labour productivity and capital-labour ratio would indicate that if capital per worker can be used as an indicator of the degree of capital intensity, then there may exist a relationship between labour productivity and the level of technology. Hence a positive relationship between intensity of capital and labour productivity and a negative relationship between capital intensity and capital productivity can be expected. Ahluwalia (1991) has reported a significant association between capital intensity and TFP. The related hypothesis is:

HI: There is a positive relationship between capital intensity and TFP.

Rate of growth of output : Ahluwalia (1991) reveals that the growth of factories in an industry is negatively related to total factor productivity growth. Whether it could it be because of fragmentation stemming from the policies of protection of the small-scale sector. As per Verdoorn's law (1957), productivity growth is endogenous to output growth, due to the existence of increasing returns to scale. The study by Fase and Hevel (1988) presents causality tests on manufacturing output and labour productivity to examine the Verdoorn law. The findings suggest that a modified Granger test supports Verdoorn's law. Ahluwalia (1991) and Kiran and Kaur (2007) results also support a positive relationship between capital intensity and TFP.

H2: There is a positive relationship between rate of growth of total output and TFP.

Credit: Rosmah et al. (2020) examined the effect of financial inclusion on the firm's growth of the manufacturing sector for 513 firms in some ASEAN economies. The results don't suggest that higher access to credit guarantees higher sales, but rather access beyond the threshold level negatively affected the firm's growth. Manove, Padilla and Pagano (2001) refer to the "lazy banks" hypothesis, positing that banks try to minimize their costs & managers try to minimize their efforts by substituting proper borrower screening with collateral and other credit enhancements. Banks tend to allocate funds to the same set of industries or firms without considering their prospects. Arne and Mans (2003) through a panel study investigated whether Africa's manufacturing firms were credit constrained. The

study found out that banks allocated credit on the basis of expected profits, and provide limited access to loans to micro or small firms. Fowowe (2017) using data for 10,888 firms across thirty African countries indicated that the access to finance constraint exerts a significant negative effect on firm's growth. According to Peek (2014) unwillingness of banks to grant credit will have a greater adverse impact on exporting firms than the ones which produce only for domestic consumption. Olanrewaju et al. (2015) revealed that bank assets, lending rate, exchange rate (EXR) and real interest rate have low and positively significant effect on manufacturing output whereas, financial deepening and interest rate have negative. In view of rarity of studies linking credit with total factor productivity, it was thought of including it as a determinant of TFP.

H3: There is a positive relationship between credit and TFP.

Total emoluments: A study by Wakeford (2004) revealed that in the short run, real wages had a negative impact on labour productivity, but a long- run cointegrating relationship existed between real wages and productivity for the period 1983 to 2002. Several studies on Indian manufacturing suggest a direct link between wages and productivity. Results by Kathuria (2015) point out that for increasing the wage rate, TFP can be enhanced as it is positively and significantly related with the wage rate. Banga (2005) using panel data from 1991-98 suggest a positive relation between wage rate and productivity. Muralidharan et al (2013) using panel data: 1993-2008 too indicated a positive association of wage rate with productivity. Many studies have taken the relation with partial productivity and not TFP. The present study considers the impact of total emoluments on TFP. The related hypothesis is:

H4: There is a positive relationship between Total emoluments and TFP.

Technology status: Dash (2006) examined the structure and composition of small scale industry (SSI) sector in India. Analysis reveals that a large number of enterprises in this sector are technologically backward and a substantial number of workers underemployed. The study finds that the existence of sub-contracting phenomenon does not have much impact on labour productivity; and therefore it is only a short-term measure to raise employment and number of enterprises. Hence, a sustainable level of employment and productivity could be achieved if the state initiates policies to provide social security, marketing facility, technological upgradation, training and skills to workers and above all the

infrastructural support to the millions of tiny enterprises in the SSI sector. In another study by Jin et al (2015) it was confirmed that productivity concepts and related issues have advanced over this time frame into more complex and advanced forms. The advancement comes from productivity improvement efforts that respond to technology developments and market changes. The related hypothesis is:

H5: There is a positive relationship between technology status and TFP.

Market Concentration: Theoretical literature on market competition does not clearly establish that increased competition will result in consequent higher productivity. Empirical results by Kato (2009) indicated that the smaller the market share of a firm, the higher was the productivity growth and this effect was found to be more conspicuous in less concentrated market. In a later study, Autor et al.(2017) concluded that industries where concentration levels rose the most displayed faster rise in productivity levels in U.S. and international firms. Gopinath et al (2004) concluded that concentration may improve production in less developed countries, but may impede production in developed countries. Gisser (1982) examined the link amid concentration and productivity in Food Manufacturing industry in the U.S. and found the relationship to be monotonic. Based on these studies market concentration is taken as a determinant of TFP. The related hypothesis is:

H6: There is a positive relationship between Market Concentration and TFP.

3. Research Design and Methodology

3.1. Data Sources

Source of data to measure productivity is the Annual Survey of Industries (ASI) which is published by Central Statistical Organization (CSO), Government of India. Most of the earlier studies on productivity like Ahluwalia (1991) and Rao(1996) have also used this as their principal data base. However, to measure the industry wise concentration ration the sales of the top four firms in the industry is required so for that purpose data is obtained from Centre for Monitoring Indian Economy (CMIE) prowess data base. The Prowess database includes all companies traded on the National Stock Exchange and the Bombay Stock Exchange, and includes thousands of unlisted public limited companies and hundreds of

private limited companies. The study has used concentration ratios, TFP, growth rates and regression analysis.

Time Period Covered in the Study: The time period for the study chosen is from 2006 to 2017. Productivity analysis has been done for the selected industries in the manufacturing sector. Further to study the effect of market structure on productivity industry specific concentration ratio (CR4) has been calculated by taking the sales of top 4-firm in each industrial group for the selected time period. Lastly an inter industry comparison has been made after linking cr4 with the productivity in each group.

3.2. TFP calculation

Translog Index : In this study the measure of Total Factor Productivity (TFPG) used is derived from a Translog production function under the assumptions of competitive equilibrium. TFP is a discrete approximation to the Divisia index of technical change. It has the advantage that it does not make rigid assumptions about elasticity of substitution between factors of production (as for instance by the Solow Index) Translog index of total factor productivity is based on transcendental logarithmic production function characterized by constant return to scale. The same has been provided through equation (i).

$$\Delta \log TFP(t) = \Delta \log V(t)[(S_L(t) + S_L(t-1))/2]\Delta \log L(t) - [((1-S_L)(t))] + (1-S_L(t-1)))/2]\Delta \log K(t) \quad \text{.....(i)}$$

Where V, L, K, TFP and SL denote value added, labor, capital, total factor productivity and share of labor income in value added respectively.

To study the effect of market structure on productivity Cr4 or concentration ratio is calculated.. For this the Total sales of the four largest firms are added and then divided by the total sales of the industry which is converted to percentage.

Data variables and measurement:

It is important to explain the variables used for measurement of TFP as well as for determinants of TFP. The details are provided in Table 2.

Table 2: Data variables and measurement

Variable	Definition	Source
GVA	Gross Value Added	Annual Survey of Industries (ASI)
CR4	Concentration Ratio	CMIE Data and calculation

*Capital	PIAM	Computed
Investment	Investment is the net addition to capital stock within the country in the form of plant and machinery, building and other capital goods.	Annual Survey of Industries (ASI)
Labour	The present study uses total persons engaged from Annual Survey of Industries for the chosen time period. Total persons engaged as a measure of labour input include both workers and persons other than workers.	Annual Survey of Industries (ASI)
Total Emoluments	The share of total emoluments in value added is taken as the share of labour.	Annual Survey of Industries (ASI)
S_L respectively	The share of total emoluments in value added is taken as the share of labour.	Annual Survey of Industries (ASI)
S_K	Share of Capital $(1-S_L)$	Annual Survey of Industries (ASI)
TFP	Total Factor Productivity	Calculation from ASI data
Deflation- Capital	The data on capital has been deflated using wholesale price index of machinery (Base 2004-2005=100)	Wholesale price index of machinery (WPI)
Deflation-Gross value added	The data on gross value added has been deflated using industry specific wholesale prices (Base 2004-2005=100).	Industry specific wholesale prices.
Deflation-Total Emoluments	The data on total Emoluments has been deflated using industry specific wholesale prices. (Base 2004-2005=100).	Industry specific wholesale prices.

*Perpetual Inventory Method by Balakrishnan and Pushpangadan (1994). Capital series (Kaur & Kiran, 2007) Also used by Rao (1996)

Measurement of Output: The study has used gross value added (GVA). It is necessary to deflate data. GVA has been deflated by industry specific Indices.

Capital Input: Despite its importance in economic theory capital is the most difficult concept to measure empirically. There are conceptual problems involved in its measurement. The problem of defining and measuring capital is hardly settled as yet. Considerable differences are seen with regards to measurement of capital input. The difference in total factor productivity estimates between studies may be attributed largely to the difference in capital estimates. Perpetual inventory method has been used in the present study for estimating capital. This method has been used in a number of countries for estimating the capital series. In the Indian context this method has been used in various studies like Ahluwalia(1991), Balakrishnan and Pushpangadan (1994) and Rao (1996). Investment is the net addition to capital stock within the country in the form of plant and machinery, building and other capital goods. The investment figures are obtained using the formula as in eq. (ii).

$$It = (Bt - Bt\text{-}1 + Dt) / Rt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (ii)$$

Where B is the book value of fixed capital, D is the depreciation and R is an appropriate deflator for fixed capital. For R, wholesale price index of machinery (base 2005-06=100) has been used. Capital stock for any year may be calculated as shown in eq. (iii):

$$K_t = K_0 + \sum_{t=1}^{T} I_t \quad \text{.....(iii)}$$

Where I is investment in year t and K_0 is capital in bench mark year. The figures on fixed capital available in ASI are the book values of fixed assets. The use of un-deflated book value is inaccurate. The book values are therefore deflated by a machinery price index. The weakness of using deflated data is that it does not take into account assets of different vintages brought at different points of time. Therefore perpetual inventory method has been used. Assuming constant returns to scale the share of capital is obtained as one minus share of labour.

Labour Input: Labour is the single most important input to many production processes. Many arguments are put forward while specifying a measure of labour input. The present study uses total persons engaged from Annual Survey of Industries for the chosen time period. Total persons engaged as a measure of labour input include both workers and persons other than workers. It is argued that such workers are as much important for getting the work done as the workers who operate the machines therefore their services should be taken into account in measuring labour. The share of total emoluments in value added is taken as the share of labour.

Deflators for the Variables in Nominal Values: For the purpose of deflation, Base (2005-2006=100) has been taken in the present research. The data on capital has been deflated using wholesale price index of machinery. The data on gross value added and total emoluments has been deflated using industry specific wholesale prices.

Capital Intensity: Capital Productivity is the ratio of output to capital resources expended. In determining the performance of the economy much attention has been paid, of late, to the value of capital-output ratios. The concept of capital used in this study relates to gross fixed capital. Capital includes plant, equipment, buildings and construction.

Concentration Ratio CR4: The concentration ratio for market structure is estimated to measure concentration levels using CR4 ratio so that more weight age is given to top 4 firms in addition to its advantage of ease of calculation and estimation and hence greater accuracy. Concentration levels or market structure might have far reaching consequences on market performance such as productivity, technical progress, profitability etc. CR4 concentration ratio is defined as the market share of four largest firms. This ratio shows if the

industry comprises of a few large firms or many small firms. This ratio varies between zero to hundred percent. It is also an indicator of degree of competition in a particular industry. Lower the ratio indicates greater the competition in an industry. Ratio close to hundred means monopoly. An oligopoly is present when top five firms have more than 60 percent of total market sales. While 0-50 shows that the industry is perfectly competitive showing low concentration levels.

Rate of growth of output (RO): Based on study of Ahluwalia (1991), this study has also taken Rate of growth of output as another determinant of TFP.

Technology status (TS): Technology status has been included as dummy variable.

Credit (Cr): Credit access has been identified as a crucial obstacle to the development of private sector in developing countries. A string of theoretical research has shown the existence of a positive relationship between financial development and firm performance and also it translates to economic growth.

Total Emoluments (TE): Total of wages and salaries.

3.3. Panel Data Analysis

Panel data enables control over variables that cannot be monitored or variables which vary with time, but not across countries, viz. national policies, federal regulations, international agreements. Panel data analysis considers the individual heterogeneity of the firm, organization, and country.

Panel Data Analysis with Fixed Effects (FE)

Panel data analysis with fixed-effects (FE) is recommended if variables diverge over time. FE in this study has been used to discover the association between exogenous and endogenous variables within the sector (Reyna, 2007). Each sector has its own individual characters that might affect the exogenous or explanatory variables. While applying FE we assume that something within the sector may influence the exogenous or endogenous variables and they need to be controlled. FE eliminates the effect of time-invariant descriptions to examine the true relation (Stock and Watson, 2003; Kohler, and Kreuter, 2009).

The equation for the fixed effects model becomes: $Yit = \alpha i + \beta 1Xit + e$……..(1)

a) αi (i=1….n) is the strange intercept for each sector (n organization or country-specific intercepts).

b) Yit is dependent variable (DV); i = entity & t = time.

c) Xit represents one exogenous/explanatory variable.

d) β1 is the coefficient exogenous variable

e) e is the error term

Panel Data Analysis with Cross Section Random Effects (CSRE)

In random effects (RE) models the deviations are assumed to be accidental and uncorrelated with the explanatory or exogenous variables included in the model (Reyna, 2007). The vital difference between fixed and random effects is to examine whether overlooked individual effect exemplifies elements that are correlated with the repressors. However, it doesn't highlight that the effects are stochastic (Greene, 2008). RE assume that error term is not associated with exogenous variable, which allows time-invariant variables to act as explanatory variables.

The random effects model is: $Yit = + \alpha + \beta Xit + uit + \varepsilon it$……(2)

a) α is the constant or intercept

b) Yit Endogenous variable

c) β is the coefficient exogenous variable

d) uit= Between Organization or country error term

e) εit= within entry error

$$P_{i,t} = \alpha + \beta 1\ CI + \beta 2\ RO + \beta 3\ TE + \beta 4\ C + \beta 5 TS + B6F + \beta 7 CR + e \quad \text{……..(3)}$$

where P: represents the productivity growth; CI: capital Intensity; RO: rate of growth of output; TE: total emoluments; Cr: Credit; TS: technology status; CR: concentration ratio and e the common error term. For each indicator, i represents the country and t the period.

4. Data Analysis

4.1. Descriptive statistics

Table 2 indicates the descriptive statistics of three endogenous variables, viz. TFP growth rate; and six exogenous variables, i.e. Capital Intensity (CI); Rate of growth of output (RO); Concentration Ratio (CR); Technology status (TS); Credit (Cr) and Total Emoluments (TE). Jarque-Bera statistics is used to check normality of data series. Acceptance of null

hypothesis indicates that data series of particular variable is normally distributed (Jarque and Bera, 1987; Bowman and Shenton, 1975) and vice versa.

The JB statistics of Capital Intensity(K/L); Rate of growth of output (RO); Concentration Ratio (CR); Technology status (TS); Credit (Cr) and Total Emoluments (TE) indicate that the data series of the selected variables follow normal distribution (p-value>0.05). The value of Kurtosis should lie between ±3. However, some people take it as ±2 (Malhotra and Satyabhushab, 2009; Sekaran, 2006). According to the value of skewness and kurtosis, the data series of all variables follow normal distribution.

Table 2: Descriptive statistics

Mean	10.320	5.803	7.178	13.28			
Median	9.500	5.350	4.950	13.88			
Std. Dev.	6.681	3.238	5.604	2.5049			
CV (%)	64.7%	55.8%	78.1%	18.9%			
Skewness	0.1403	0.543	0.971	-0.5348			
Kurtosis	1.254	2.1703	2.273	2.1644			
Jarque-Bera	5.730	3.431	5.884	3.3773	3.431	5.884	3.431
Probability	0.0569	0.179	0.0194	0.1847			

In section 4.1 results of Market concentration is depicted through CR4 of selected industries. Productivity trends are highlighted in section 4.2. Section 4.3 highlights the Industry-wise trends in TFP and 4.4 Impact of Market Concentration (CR4) on Performance (Total factor Productivity).

4.2. Sector-wise trends in TFP

To understand which sector is growing at a faster rate, sector-wise trend rates of growth in value added were also calculated. The results are depicted through table 3. The trend based growth of log (GVA) for the period reveals that Motor Vehicles, Trailers and Semi-Trailers #29 sector was the fastest growing one with a growth rate of 6.64 percent. Tobacco sector#12 recorded a fairly high growth rate at 4.95 percent. However, Food products sector #10 recorded a moderately high growth rate at 4.48 percent. Tobacco Products#12 also depicted a moderate growth of 4.95 per cent per annum. Chemicals and Chemical Product#20 sector recorded a relatively lower growth rate of 3.54 percent. It was the slowest growing industry in the group. The results bear a testimony that all selected

sectors were growing industries, as positive growth rates were observed, if only value-added growth measures were used. The real growth could be estimated through growth in TFP.

Table 3: Sector-wise Growth Rates for Value Added

Sector-wise Growth Rates for value added							Growth rate
Group		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	
Chemicals & Chemical Products#20	Case Sequence	.035	.006	.897	6.077	0.000***	3.54
	(Constant)	6.725	.039		173.048	0.000***	
Food Products#10	Case Sequence	.044	.004	.966	11.244	0.000***	4.48
	(Constant)	6.509	.026		246.100	0.000***	
Motor Vehicles, Trailers and Semi-Trailers #29	Case Sequence	.064	.005	.976	13.340	0.000***	6.64
	(Constant)	6.349	.033		194.093	0.000***	
Tobacco Products#12	Case Sequence	.048	.004	.964	10.872	0.000***	4.95
	(Constant)	5.741	.030		190.367	0.000***	

***p-value≤.001; No of observations:9

After exploring the trends in value added for the selected industries, it becomes imperative to compute total factor productivity (TFP) for the same selected group of industries. TFP has been calculated at for the selected four industries from the year 2006-2017. TFP was calculated using Translog production function. TFP was low for all the selected industries. The results are shown through table 4.

Table 4: Sector-wise total factor productivity

Years	Tobacco Products #12	Food Products #10	Chemicals & Chemical Products#20	Motor Vehicles, Trailers and Semi-Trailers #29
2007-2008	-0.002	0.010	0.051	0.012
2008-2009	0.165	-0.039	-0.118	-0.044
2009-2010	-0.086	0.059	0.062	0.179
2010-2011	0.108	0.102	0.047	0.048
2011-2012	0.017	0.086	0.145	0.106
2012-2013	0.097	-0.012	-0.055	0.050
2013-2014	-0.008	0.031	0.015	-0.051
2014-2015	0.008	0.024	0.005	0.133

2015-2016	0.098	0.051	0.139	0.077
2016-2017	0.275	0.549	1.176	0.553

Productivity remained sluggish for most of the years for Chemicals and Chemical Products #20. It was it was marginally negative for 2008-2009 and for 2012-2013. Even Motor Vehicles, Trailers and Semi-Trailers #29, depicted sluggish growth for most of the years. For Food Products #10: also the productivity remained low and it was marginally negative for 2008-2009 and 2012-2013. TFP for Tobacco Products #12 remained low and it was negative for 2007-2008, 2009-2010 and 2013-2014. Thus, it can be inferred that TFP for most of the selected industries were low. Thus, both sectors high-technology and agri-based sector depicted low levels of TFP. Next step was to relate Market structure (CR4) with Performance (TFP).

4.3. Market concentration

Section 4.3 presents the Market structure measured for the selected group of industries. The concentration ratio, which is a common measure of market structure shows the combined market share of the largest firms in the market. CR4 has been used in the present study. The results of concentration ratios (CR) range between 0 to 100 percent. While 0 to 40 percent implies low concentration,40 to 70 percent implies medium concentration or an oligopolistic market structure, where small number of firms dominate the market. CR in the range of 70 to 100 percent is an indicator of high concentration ranging from oligopoly to monopoly. Indian market structure is u-shaped overall which is dominated by small number of large firms on one end indicating oligopoly and large number of small firms on the other end indicating competitive market. Data for CR4 has been collected with the help of CMIE prowess data for the relevant industries to get the top players for each industry for all years (2006-2017). Total sales of the four largest firms are added and then divided by the total sales of the industry which is converted to percentage. The results are depicted through table 5.

Table 5: Sector-wise CR4 Ratios

Years	Tobacco Products #12	Food Products #10	Chemicals & Chemical Products #20	Motor Vehicles, Trailers and Semi-Trailers #29
2006-2007	93.89	27.03	63.93	60.77
2007-2008	94.53	25.85	60.77	57.60
2008-2009	94.10	25.58	62.94	62.94

2009-2010	94.51	31.93	61.00	61.00
2010-2011	93.98	34.31	60.44	60.44
2011-2012	92.73	31.31	57.75	57.75
2012-2013	91.85	35.70	55.44	55.44
2013-2014	91.32	34.45	46.64	46.64
2014-2015	90.62	30.38	44.82	44.82
2015-2016	91.68	30.26	44.15	44.15
2016-2017	95.95	34.20	47.29	47.29

Motor Vehicles, Trailers and Semi-Trailers #29 depicted moderate CR in the range of 50 to 60 percent. However, a slight decrease is observed from 2013 to 2017, suggesting that over the years CR has decreased. Chemicals & Chemical Products #20 is also in the range of moderate concentration with CR between 45 to 63 percent. In this industry, a decline in CR is observed from 2012-13 to 2016-17. Thus, two industries covered in high-technology sector depict moderate CR. In agri-based Sector, Food Products #10 has low concentration, with levels ranging from 25 to 35 percent, while Tobacco products #12 depicted the highest concentration levels in the range of 90 to 96 percent. It can be inferred that all four industries possess different Concentration ratios. Having calculated CRs, it was important to understand the performance of these selected industries in two sectors.

4.4. Panel Data Analysis

There three main models for estimating the regression equation in panel data are, pooled model, random effects (RE) model and fixed effects (FE) model. The choice of model is reliant on the properties of the data and the results of tests. Pooled regression model has constant coefficients, implying to both intercepts and slopes. For this model, researchers can pool all of the data and can run an ordinary least squares (OLS) regression model with no assumption on individual differences. The FE model takes into consideration the individuality of each cross section unit included in the sample by allowing the intercept to vary for each firm, while assuming that the slope coefficient to be constant across firms. FE model is used to examine the impact of variables that vary over time. FE model explores the relationship between predictor and outcome variables within an entity (country, person, company, etc.). A random-effects model allows predicting something about the population from which the sample is drawn. We use fixed-effects (FE) whenever we are interested in analysing the impact of variables that vary over time. FE model explores the relationship

between predictor and outcome variables within the country in this case. The results of FE and RE are depicted through table 6 & 7.

Table 6: Fixed-Effect

FIXED-EFFECT Dependent Variable: TFP				
Method: Panel Least Squares				
Date: 04/25/22 Time: 14:44				
Sample: 2007-2017				
Periods included: 11				
Cross-sections included: 4				
Total panel (balanced) observations: 44				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.20848	7.001584	2.029323	0.0528
CAPITAL_INTENSITY	0.233943	0.102017	2.293173	0.0302*
CREDIT	0.206399	0.168228	1.226897	0.2309
TE	0.441790	0.450003	0.981750	0.3353
RO	-0.013136	0.011297	-1.162787	0.2555
TECH_STATUS	0.668225	0.315184	2.120111	0.0437*
CR	14.29976	7.252858	1.545442	0.0343*
	Effects Specification			
Period fixed (dummy variables)				
R-squared	0.781217	Mean dependent variable		0.093463
Adjusted R-squared	0.638166	S.D. dependent variable		0.212298
S.E. of regression	0.127703	Akaike info criterion		-0.986135
Sum squared residuals	0.424008	Schwarz criterion		-0.256239
Log likelihood	39.69496	Hannan-Quinn criterion		-0.715454
F-statistic	5.461116	Durbin-Watson statistics		1.640733
Prob. (F-statistic)	0.000061			

In case of FE significant determinants of TFP are Capital Intensity (CI); Concentration Ratio (CR); Technology status (TS). Rate of Growth of output (RO), Credit (Cr) and Total Emoluments (TE) don't emerge as significant determinants of TFP. The model explains 78.12 percent of variation in TFP. Durbin-Watson statistics is also 1.64 suggesting that problem of auto-correlation is not there.

Table 7: Random Effect

RANDOM EFFECT Dependent Variable: TFP		
Method: Panel EGLS (Period random effects)		
Date: 04/25/22 Time: 14:46		
Sample: 2007 2017		

Periods included: 11				
Cross-sections included: 4				
Total panel (balanced) observations: 44				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.52021	6.695384	-1.720620	0.0939
CAPITAL_INTENSITY	-0.197775	0.073932	-2.675088	0.0112*
CREDIT	0.119317	0.110909	1.075813	0.2892
TE	0.368471	0.237972	1.548378	0.1303
RO	-0.012632	0.011229	-1.124996	0.2680
TECH_STATUS	-0.548594	0.214385	-2.558922	0.0148*
CR	0.97641	0.116749	2.335646	0.0300*
	Effects Specification			
			S.D.	Rho
Period random			0.117821	0.4598
Idiosyncratic random			0.127703	0.5402
	Weighted Statistics			
R-squared	0.236611	Mean dependent variable		0.044532
Adjusted R-squared	0.088174	S.D. dependent variable		0.143353
S.E. of regression	0.136887	Sum squared residuals		0.674572
F-statistic	1.594018	Durbin-Watson statistics		1.502163
Prob.(F-statistic)	0.168754			
	Unweighted Statistics			
R-squared	0.225577	Mean dependent var		0.093463
Sum squared residuals	1.500851	Durbin-Watson stat		1.577976

In case of RE significant determinants of TFP include: Intensity (CI); Concentration Ratio (CR); Technology status (TS). Rate of Growth of output (RO), Credit (Cr) and Total Emoluments (TE) don't emerge as significant determinants of TFP. The model explains 78.12 percent of variation in TFP. Durbin-Watson statistics is also 1.57 suggesting that problem of auto-correlation is not there.

5. Conclusions of the study

The absence of consent amid researchers concerning the key determinants of TFP, with less focus on the Market Concentration for Indian manufacturing firms at the sector level has been the strategic motivating force for the current research. Inter-industry productivity highlights that though value added showed an increase during the period, however in terms of total factor productivity the picture is not rosy. TFP for all the industries were low. These results indicate that only analysing value added may not reflect a true image of the sector. A deep analysis covering TFP may be more suitable to analyse the industry growth. Results also highlight that Indian manufacturing reflects high to low concentration in different sectors. In

terms of market concentration, CR ranged between low to very high for agri-based sector, while it was moderate for high-technology sector covering Chemical and Motor vehicles. To have a complete perspective, PDA was also applied to understand the dynamics of Indian Manufacturing. Fixed effect model assumes that the explanatory variable has a constant relationship with the response variable across all observations. A random-effects model assumes that explanatory variables have fixed relationships with the response variable across all observations, but that these fixed effects may vary from one observation to another. This study points out that there is sluggish productivity performance of India's selected manufacturing sector. Examining the determinants has highlighted a need to focus on important predictors, vis, market concentration, capital intensity, technology status.

6. Limitations and Future Scope

In future, the study can be extended to cover more industries. Although there were difficulties in calculating concentration ratios and that was one reason why few industries were chosen for the study. Calculation of TFP needs capital series to be created and there are limitations of methodology in calculation of TFP. The study can be extended in terms of time period for the same group of industries too.

7. Implications of the study

The study gives us an insight in understanding why India's manufacturing growth has not been more dynamic. Perhaps one of the most persuasive explanation is that anti-competitive regulations have deterred firms' expansion leading to average size of firms being too small which may hinder firms from reaping economies of scale and fostering competition to large dominant firms on the other hand and restricting the entry of new large or medium sized firms. A number of national and international business surveys suggest that weaknesses in India's business environment have inhibited or distorted investment, thus reducing growth and employment creation. This study establishes the claim that in addition to commonly used variables like capital intensity, credit, total emoluments, firm size as reflected by market structure influences productivity. As reflected, concentration ratios have emerged significant determinant of TFP. Thus, this research sheds light on an important determinant that needs to be included for a holistic picture of Indian manufacturing. There have been growing public

policy deliberations on whether market power in the countries has emerged "too big", w.r.t market share taken by a few companies. Many studies at global level reflect the market concentration is on the rise, but what reflection emerge from it in terms of TFP has been not a part of earlier researches. The growing complex market structures across certain industries, provides a challenge to fully assess policy responses. This study provides some element in this direction.

The connection among market power, performance and productivity, is far-off from being so upfront. A key area for future exploration is to exploit this variable and asses firm and industry level productivity in the context of external factors influencing productivity rather than just internal factors. This in turn could have far reaching implications for policy makers.

8. References

ACEMOGLU, D.; ZILIBITTIF, A. *Productivity Differences*, The Quarterly Journal of Economics, MIT Press. vol. 116, n. 2, p. 563-606, 2001.

AHLUWALIA; I. J. Productivity and Growth in Manufacturing, Oxford University Press, Delhi, 1991.

AHLUWALIA, I. J. Industrial Growth in India: Stagnation since the Mid-Sixties, Oxford University Press, Delhi. Alfaro, L. & Chari A. 2014; Deregulation, Misallocation, and Size: Evidence from India, Journal of Law and Economics, University of Chicago Press, v. 57; n. 4; p. 897-936;1985

ARROW; K. *Economic Welfare and Allocation of Resources to Invention*; edited by Universities National Bureau Committee for Economic Research and the Committee on Economic Growth of the Social Science Research Councils, the Committee on Economic Growth of the Social Science Research Councils, Princeton. Princeton University Press; p. 467-92, 1962.

ATSUSHI KATO Product Market Competition and Productivity in the Indian Manufacturing Industry, The Journal of Development Studies, v.45, n. 10, p.1579-1593, 2009.

AUTOR D.; David D.; LAWRENCE F. K.; CHRISTINA P.; REENEN, J.V. Concentrating on the Fall of Labour Share. *American Economic Review*, vol. 107, n. 5, p. 180-85, 2017.

BAIN, J.S. Barriers to new competition: Their character and consequences in manufacturing industries. Cambridge, M.A, Harvard University Press, 1965.

BERNARD B. A.; BRADFORD J.; SCHOTT P. K. Trade costs, firms and productivity. *Journal of Monetary Economics*, vol. 53, n. 5, p. 917-937, 2006.

BYRNE, D. M.; FERNALD, J. G.: REINSDORF, M. B. Does the United States have a productivity slowdown or a measurement problem?, Brookings Papers on Economic Activity, n.1, p.109–182, 2016.

CETTE, G.; J FERNALD, J.; MOJON, B. The pre-Great Recession slowdown in productivity, *European Economic Review*, vol. 88, n.1 p. 3–20, 2016.

COVARRUBIAS M.; GUTIÉRREZ G.; PHILIPPON T. *From good to bad concentration?* U.S. industries over the past 30 years, Eichenbaum Martin S., Hurst Erik, Parker Jonathan A. (Eds.), NBER Macroeconomics Annual 2019, vol. 34, University of Chicago Press p. 1-46, 2020.

DOUGHERTY, S.; HERD, R.; CHALAUX, T. ' What is Holding Back Productivity Growth in India? Recent Microevidence ', *OECD Journal: Economic Studies*, 2009, n. 45, p. 67–88, 2009.

GISSER, M. Welfare Implications of Oligopoly in U.S. Food Manufacturing. American *Journal of Agricultural Economics*. vol. 64, n. 4, p. 616-624,1982.

GOEL, V.; AGRAWAL, R.; SHARMA, V. Factors affecting labour productivity: an integrative synthesis and productivity modelling. Global Business and Economics Review. 19. 299. 10.1504/GBER.2017.10004593. 2017.

GOPINATH, M.; PICK, D.; YONGHAI, L. An empirical analysis of productivity growth and industrial concentration in us manufacturing. *Applied Economics*. v. 36, n. 1, p. 1-7, 2004.

GRULLON, G.; LARKIN, Y.; MICHAELY, R. Are US Industries Becoming More Concentrated? *Working Paper* , p. 1–68, 2017.

HALL, R. E. Quantifying the Lasting Harm to the US Economy from the Financial Crisis. *NBER Macroeconomics Annual*, vol. 29, n 1, p. 71–128, 2015.

HSIEH, T. C.; KLENOW, P. J. *The Life Cycle of Plants in India and Mexico*. Unpublished paper, Stanford University, 2012.

IZLAM, R.: *Rural Industrialisation and Employment in Asia*. International Labour Organisation, ARTEP, New Delhi 1987.

JONG, BEOM JIN; CHOON, SEONG LEEM; CHOONG, HYUN LEE. Research issues and trends in industrial productivity over 44 years, International Journal of Production Research, DOI: 10.1080/00207543.2015.1064181 To link to this article: http://dx.doi.org/10.1080/00207543.2015.1064181. 2015.

ALI, J.; SINGH, S.; EKANEM, E. Efficiency and Productivity Changes in the Indian Food Processing Industry: Determinants and Policy Implications. *International Food and Agribusiness Management Review*, vol. 12, 2009.

KALDOR, N. *Causes of the Slow Rate of Economic Growth of The United Kingdom*: an Inaugural Lecture. Cambridge: Cambridge University Press, 1975.

KATHURIA, T. Productivity and wages in Indian manufacturing sector: Spatial variation and determinants, *International Journal of Applied Research*, vol. 2, n. 1, p. 735-743, 2016.

KIRAN, R.; KAUR M. Is Liberalization Associated with Higher Productivity? A Case Study of Punjab Manufacturing. *Vision: The Journal of Business Perspective*, 2007.

KRISHNA P.; MITRA D. Trade Liberalization, market discipline and productivity growth: new evidence from India. *Journal of Development Economics*, vol. 56, n. 2, p. 447-462,1998.

KRUGMAN P. The Myth of Asia's Miracle. *Foreign Affairs*, vol. 73, n. 6 p. 62-78, 1994.

KUZNETS S. *Economic Growth of Nations*: Total Output and Production Structure. Cambridge, Mass. Harvard University Press, 1971.

LEVINSOHN J.; PETRIN, A. Estimating Production Functions Using Inputs to control for Un-observables. *The Review of Economic Studies*, vol.70, n. 2, p.317-341, 2003.

LEWIS, A. W. Economic Development with Unlimited Supplies of Labour. *Manchester School*, vol. 22, n. 2, p.139-191, 1954.

MAITI, D. Trade, Labor Share, and Productivity in India's Industries. *ADBI Working Paper 926*. Tokyo: Asian Development Bank Institute. Available: https://www.adb.org/publications/trade-labor-share-and-productivity-india-industries. 2019.

MANI, S. *Changing Structure of India's Manufacturing Sector*, Centre for Development Studies, Trivandrum,1993.

NICKELL, S. Competition and Corporate Performance. *Journal of Political Economy*. vol. 104, n. 4, p. 724-46,1996.

PRESCOTT, E.C. Needed: A theory of total factor Productivity. *International Economic Review*, vol. 39, n. 3, p. 525-51,1998.

PUSHPANGADAN K. ; BALAKRISHNAN, P. Total Factor Productivity Growth in Manufacturing Industry A Fresh Look. *Economic and Political Weekly*, vol. 29, n. 31, p. 2028-35, 1994.

RAO, M. J. Manufacturing productivity growth: Method and measurement. *Economic and Political Weekly*, vol. 31, n.44, p. 2927-2936, 1996.

SHARMA, R.K.; DASH, A. Labour productivity in small scale industries in India. 2006.

RESTUCCIA D.; ROGERSON, R. Misallocation and Productivity. *Review of Economic Dynamics*, vol. 16, n. 1, p. 1-10, 2013.

ROMER, P.M. Idea gaps and object gaps in economic development. *Journal of Monetary Economics*. vol. 32, n. 3, p. 543-573, 1993.

SCHMITZ JR, JAMES A. What Determines Productivity? Lessons from the Dramatic Recovery of the U.S. and Canadian Iron Ore Industries Following Their Early 1980's Crisis. *Journal of Political Economy*, vol. 113, n.3, p. 582-625, 2005.

SRIVASTAVA, V. Liberalisation, *Productivity and Competition*: A Panel Study of Indian Manufacturing. New Delhi: Oxford University Press, 1996.

STIERWALD, A. *The Effect of Productivity and its Persistence*. Melbourne Institute of Applied Economic and Social Research, 2009.

SYVERSON, C. *Challenges to Mismeasurement Explanations for the U.S. Productivity Slowdown*. Working Paper, (February), p. 1–28, 2016.

TOPALOVA, P.; KHANDELWAL, A. Trade Liberalization and Firm Productivity: The case of India. *The Review of Economics Statistics* , vol. 93 , n. 3, p. 995-1009, 2011.

WAKEFORD, J. J. (2004), The productivity–wage relationship in South Africa: an empirical investigation. *Development Southern Africa*, vol. 21, n. 1, 109-132.

WILLIG, R.D. *Corporate Governance and Market Structure*. In Razin A.; Sadka E. Economic Policy in Theory and Practice. Palgrave Macmillan, London, 1987.

ZENG S; SHU X; YE W. Total Factor Productivity and High-Quality Economic Development: A Theoretical and Empirical Analysis of the Yangtze River Economic Belt,

China. *Int J Environ Res Public Health*. 2022 Feb 27, vol. 19, n. 5, p. 2783. doi: 10.3390/ijerph19052783. PMID: 35270474; PMCID: PMC8910435.

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