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Economic Reforms and Sources of Productivity Growth in Selected Organised Manufacturing Labour Intensive and Capital Intensive Industries in India - A Comparative Study

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ABSTRACT

This study uses the non parametric data envelopment technique to investigate the impact of economic reforms on Total Factor Productivity Growth in Selected 20 Indian Organised Manufacturing Industries by classifying them into Labour Intensive and Capital Intensive industries; by using non parametric DEA technique to four-digit panel data for the period 1990 to 2011. The study reveals that the Labour Intensive Industries have negative Total Factor Productivity Growth as -6.1% deteriorated mainly due to Technological Change which is -4%. Meanwhile, the Capital Intensive Industries have positive Total Factor Productivity Growth of 6.7%, mainly contributed by Efficiency Change of 1.6% and Technological Change of 5.0%. Eight out of ten Organised Manufacturing Capital Intensive Industries have shown positive Total Factor Productivity Growth during the economic reform period, whereas seven out of ten Organised Manufacturing Labour Intensive Industries showed negative Total Factor Productivity Growth due to lack of technological change.

Keywords: Efficiency change; new economic policy; pure efficiency change; scale efficiency change; technological change; total factor productivity change.
JEL Classification: C14, D20, D22, D24, L16

Industrialization is an economic process by which structural transformation of subsistence economy is achieved. The present day rich countries have achieved rapid economic development through the process of Industrialization. The underdeveloped countries of today, thus, consider industrial growth as the basic means by which their acute poverty and problem of high unemployment could be mitigated.[1] Industrialization promotes innovation and technological development, promotes capital formation through higher wage incomes and diverts surplus farm labour to modern industry.[2] Industrialization is viewed as a prerequisite to economic development. The process of economic development, it is argued, "is an increase in income per head or is an increase in the role of industrial activity to that in agriculture."[3] Viewing economic development as an increase in industry relative to agriculture, however, represents a "crude agriculture versus industry model."[4]

The 1990s reforms in India were specifically targeted to the manufacturing sector. The emphasis on the manufacturing sector was due to the realisation that the sector offers greater prospects for capital

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accumulation, technical change and linkages and hence job creation, especially for the semi-skilled and poorly educated segment of the labour force, which comprises most of India's working poor (Sen 2009). There is apprehension about the role that agriculture can play in the growth process, given that the primary commodities have been facing a long-run decline in prices in the world market (Sarris and Hallam 2006). As a result, the prospect for the agriculture sector as a major employment provider and driver of economic growth are bleak in the Indian context. Thus, key to India's future economic growth and poverty reduction depends on the growth performance of a dynamic outward oriented manufacturing sector which can attract the large pool of surplus labour employed in low productivity work in agriculture.

Industrial sector in India has been undergoing significant changes both in structure and pattern owing to the policy changes. Since the early 1950s until the early 1980s the evolution of manufacturing sector was guided by protected industrial and trade policies, which restricted the growth of the economy in general and manufacturing sector, in particular under pre reform industrial policy and trade policy regime, manufacturing sector was characterized by extensive public sector participation, regulation of the private sector firms, restriction on foreign investment, high tariff and non-tariff restrictions on imports, which held up the growth of the manufacturing sector in India. This has been replaced through the adoption of New Economic Policy (NEP) in 1991.

The process of economic reforms has led to gradual decline of industrial licensing, removal of import licensing for all manufacturing Industries, reduction of tariff and relaxation of foreign investment rules. The reforms in respect to the industrial sector were intended to free the sector from barriers to entry and from other restrictions to expansion, diversification and modification so as to improve its efficiency, productivity and competitiveness.

After the liberalization and globalization Indian economy derived both positive and negative benefits from the industry. In India, industry is a corner stone for accelerating economic development; within the industry manufacturing industry occupy important place in Indian economy by accelerating economic development through providing large number of employment, contributing to output and export. Liberalisation and Globalization forms more open economic environment. In an open economy, development of a nation much depends on capital inflow and export and import activity. India is now one of the open economic nations. To boost economic growth, Indian government encourages the participation of foreign and private investors by opening up of domestic economy to globe. The foreign direct investment (FDI) and foreign technology actively boost the productivity performance and the extent of its impact may vary across different industries. In fact, different kinds of industries evince different reactions from economic reform.

One of the important objectives of India's economic reform process was to expand the international competition and thus compel the Indian Industries to improve their efficiency and productivity growth through adoption of new technology. Reforms also provided an opportunity to import better quality of required materials, components, Foreign Direct Investment (FDI) and advanced technology, so that industries can achieve more productivity growth. In this background present study tries to examine the impact of economic reform on the productivity performance of selected organised manufacturing industries by classifying them into Labour Intensive and Capital Intensive Industries.

Literature Review

Several studies over the past decades have attempted to estimate the productivity performance of Indian Manufacturing sector (Brahmananda, 1982; Ahluwalia, 1991; Balakrishnan and Pushpangadan, 1994; Srivastava, 1996; Unel, 2003 and Goldar, 2004). Some of these studies also examined the impact of Economic Reforms on the growth of Industrial Productivity. Some studies found that the Economic Reform Create Positive impact on Total Factor Productivity Growth (TFPG) of Indian Manufacturing Sector (Majumdar, 1996; Krishna and Mitra,1998; Sharma, 1999; and Unel, 2003; Pattnayak and Thangaveu, 2005) whereas, Balakrishnan et al. (2000) and Goldar and Kumar (2003), and Das(2004) found that economic reform adversely affected Industrial Productivity in India. The Change in the Productivity growth is an important subject matter of modern economic growth and sustainability of a country. There are two main types of productivity

namely partial productivity and total factor productivity (Hesmati, 2003; Hoque and Falk, 2000). Partial productivity is a simple measurement, but it does not figure the total productivity of all inputs. In contrast total factor productivity assesses the entire inputs to the total output in the production process. It explain how output changes due to the changes of all inputs (Mady, 1992). Solow (1957) pioneered measuring total factor productivity growth (TFPG) as a geometric mean index.

Productivity is defined as the efficiency with which inputs are transformed into output in the production process (VandenBerg, 2001). While there are large number of studies on productivity growth, studies on the sources of productivity growth are very much limited in Indian Literature. Total Factor Productivity (TFP) measures by how much productivity grows or decline over time. When the output is more(less) in relation to the given inputs, then the Total Factor Productivity is said to have increased (Decreased). There may be various reasons for this productivity change.

Many of the earlier Indian Studies on Industries have not considered the sources of changes in the productivity growth. In the traditional methodology of estimating Total Factor Productivity Growth (TFPG), the sources of Total Factor Productivity Growth were ignored.[5] The present study attempts to employ a non parametric approach Data Envelopment Analysis (DEA) to estimate Total Factor Productivity Change and its sources during Economic Reform Period by classifying the Selected Indian Organised Manufacturing Industries into Labour and Capital Intensive Industries to know whether both type of industries derived equal benefits from Economic Reforms or not.

Materials and Methods

The study is based on panel data collected from various issues of Annual Survey of Industries (ASI), Central Statistical Organisation (CSO), Ministry of Statistics and Program Implementation, Government of India, New Delhi, for the period of 22 years from 1990 to 2011. Gross Value Added figures have been used as an index of output. Converting nominal gross value added to real one, the annual current value has been deflated by a Wholesale Price Index (WPI) of Manufacturing Product (Base 2004-05=100), WPI for all manufactured product has been used as a proxy. The total employees and the Gross Fixed Capital were considered as the measures of labour and capital input. The Gross Fixed Capital was deflated by the Price Index of Machinery and Machine Tool Products (Base 2004-05=100), using Machinery and Machine Tool Products Price Index as a Proxy. Thus, the real gross fixed capital was included in the function.

To measure productivity growth of the Selected Organised Indian Manufacturing Industries, we employed non parametric approach Data Envelopment Analysis (DEA), based on Malmquist Productivity Index. Malmquist Productivity Index estimate Total Factor Productivity Growth (TFPG) from the changes of two distances function within two periods of time. The concept of Malmquist Productivity Index can be described in the following figure 1.

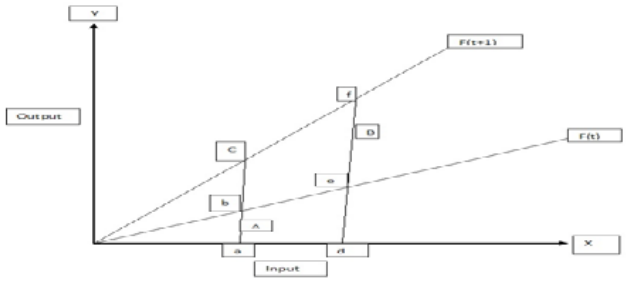


Figure 1: Concept of Distance Function in Malmquist Index

Suppose a firm is operating at the point A, producing Y outputs by employing X inputs in the period of t, A= (X^t Y^t), with possibility production function F (t). Then the firm forward the production to point B in the period t+1, B= (X^{t+1}, Y^{t+1}) with possibility production function F (t+1). Shifting of the production from A to B within the two periods provides four distance function; D^t (a) = aA/ab, D^{t+1}(A) = aA/ac, D^t (B) =dB/de and D^{t+1}(B) =dB/df, then we obtain:

$$MI^{t+1}(A,B) = \frac{dB/df}{aA/ab}\left[\left(\frac{aB/de}{dB/df}\right)\left(\frac{aA/ab}{aA/ac}\right)\right]^{1/2}$$

$$= \frac{dB/df}{aA/ab}\left[\left(\frac{df}{de}\right)\left(\frac{ac}{ab}\right)\right]^{1/2} \quad ...(1)$$

From this equation, it can be seen that the efficiency term captures the change in the distances from the frontier function in t and t+1, and the technological

1. See Fujitha (1994), Ahluwalia (2002), and Panagariya (2004) for detailed discussion on Indian Economic Reforms.

growth related to the geometric mean of the vertical movement of the frontier function from the two periods of time (Fare etal., 1994)

Malmquist Productivity Index ($M I^t$) for the period t is given by

$$MI^t(Y^{t+1},Y^t,X^{t+1},X^t) = D_i^t (Y^{t+1}, X^{t+1}) / D_i^t (Y^t, X^t) \quad ...(2)$$

The Malmquist Productivity Index (MI^{t+1}) for period t+1 similarly can be formulated as:

$$MI^{t+1} (Y^{t+1},Y^t,X^{t+1},X^t) = D_i^{t+1} (y^{t+1}, X^{t+1}) / D_i^{t+1} (Y^t, X^t) \quad ...(3)$$

Since equation (2) and (3) relies completely on the constant returns to scale (CRS) assumptions, thus the Malmquist Index based on output oriented and input oriented will be the same. Hence, these equations can be rewritten as:

$$MI (Y^{t+1}, Y^t, X^{t+1}, X^t) = (MI^t (Y^{t+1}, Y^t, X^{t+1}, X^t) * MI^{t+1} (Y^{t+1}, Y^t, X^{t+1}, X^t)^{1/2} =$$

$$D_c^{t+1} (Y^{t+1}, X^{t+1}) / D_c^t (Y^t, X^t) \quad [D_c^t (Y^{t+1}, X^{t+1}) / D_c^{t+1} (Y^{t+1}, X^{t+1}) * D_c^t (Y^t, X^t) / D_c^{t+1} (Y^t, X^t)]^{1/2} \quad ...(4)$$

$D_c^{t+1} (Y^{t+1}, X^{t+1}) / D_c^t (Y^t, X^t)$ → TE (Technical Efficiency)

$[D_c^t (Y^{t+1}, X^{t+1}) / D_c^{t+1} (Y^{t+1}, X^{t+1}) * D_c^t (Y^t, X^t) / D_c^{t+1} (Y^t, X^t)]^{1/2}$ → TP (Technical Progress)

Technical Efficiency (TE) is catching up firms to the production frontier, while the Technical Progress (TP) is the moving forward of the frontier itself on CRS technology. If the assumption subject to variable Returns to Scale (VRS) technology is assumed, then the Malmquist Index Decomposes Total Factor Productivity Growth (TFPG) into two components namely technical efficiency change (EFCH) and technological change (TECH).

TFP can grow when the industry uses its existing technology and factor inputs more efficiently. The firm can produce more while using the same level of labour and capital and technology, or more generally by increase in 'technical efficiency'

TFP of an industry can also grow when the industry adopts innovations like modifications, improved design or what is known as 'technological change.' Therefore, TFP changes from one period to the other comprise technical efficiency and technological progress. Further the technical efficiency change (EFCH) can be decomposed to scale change (SECH) and pure efficiency change (PECH). The improvement of productivity over the period occurs if the geometric mean is greater than one (expanding its frontier outward the best practice frontier), constant if the value is equal to one (industry is technically efficient and producing on the frontier) and decreasing if the value is less than one (industry producing at a point less then efficient).

Identification of Labour Intensive and Capital Intensive Industries from Indian Organized Manufacturing Sector

In this paper we use the National Industrial Classification (NIC2004) at a disaggregate 4-digit level in order to assess the Labour Intensity and Capital Intensity of the Organised Manufacturing Sector.[6] The time period chosen for the study is from 1990 to 2011.The 4- digit industries are spread across the 23, 2-digit divisions 15 to 37 (see appendix 1 for details). These 23 divisions constitute the entire manufacturing sector of India. Taken into consideration all the 141 4-digit industries at the NIC 2004 classification in the organized manufacturing sector were consideration. However to build a continuous time series at NIC 2004, we had to merge as well as delete some 4-digit industries. These 4-digit industries belong to the organized manufacturing sector, as documented in the Annual Survey of Industries (Central Statistical Organization, Government of India).

For examining productivity performance growth in Indian Organised Manufacturing Industries, Classified industries are as Labour Intensive and Capital Intensive industries. For identifying Labour Intensive and Capital Intensive Industries, the labour-Capital ratio (L/K) ratio for all industries for every year, and for each industry an average (L/K) ratio was calculated for the period 1990 to 2011. The average (L/K) ratio for all industries taken together was found to be 5.40 all the industries with average (L/K) ratio greater than 5.40 were considered as Labour Intensive Industries and all those Industries with a ratio less than 5.40 were labelled Capital Intensive Industries. Ten industries from Labour

6 Organised manufacturing industries comprise those industrial units which are registered as 'factories', i.e., they employ 10 or more workers with power or 20 or more workers without power.

Table 1. Selected 4-digit Organised Manufacturing Labour Intensive Industries NIC-2004

Sl No	Industry Code NIC 2004	Name of the Industry
1	1730	Knitted and Crocheted Fabrics
2	1723	Cordage, Rope, Twine and Netting
3	1810	Wearing Apparel, Except Fur Apparel
4	1729	Other Textiles N.e.c.
5	1912	Luggage, Handbags and the Like, Saddlery &Harness
6	1920	Footwear
7	3610	Furniture
8	2811	Structural Metal Products
9	3691	Jewellery and Related Articles
10	3592	Bicycles and Invalid Carriages

Source: National Industrial Classification 2004, Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India.

Table 2: Selected 4-digit Organised Manufacturing Capital Intensive Industries NIC-2004

Sl No.	Industry Code NIC 2004	Name of The Industry
1	2511	Rubber Tyres and Tubes; Retreading and Rebuilding of Rubber Tyres
2	2320	Refined Petroleum Products
3	2710	Basic Iron and Steel
4	2720	Basic Precious and Other Non-ferrous Metals
5	2411	Basic Chemicals
6	3530	Air and Spacecraft and Related Machinery
7	3591	Motorcycles
8	2926	Agricultural and Forestry Machinery
9	2921	Machinery For Textile, Apparel and Leather Production
10	3110+3120	Electric Motors, Generators, Transformers and Electricity Distribution and Control Apparatus

Source: National Industrial Classification 2004, Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India.

Intensive Segment and ten industries from Capital Intensive Segment were selected. The share of total value added and export contribution was considered for selecting industries for analysis which represent competitive ability of the selected industries.

Industries Selected for Analysis

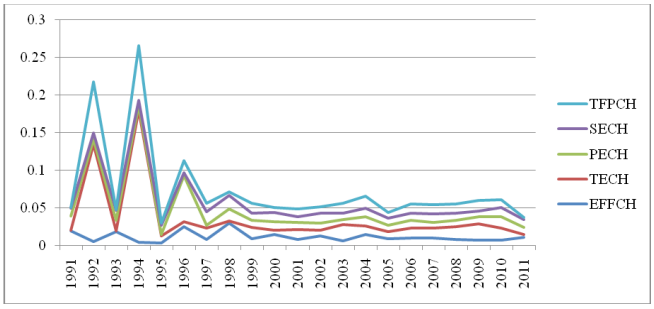
On the basis of above procedure the following industries have been selected for analysis. Name List of Selected Organised Manufacturing Labour Intensive Industries and Capital Intensive Industries are given in the table1 and table, National Industrial Classification (NIC-2004) were used for industry code.

Table 3. Malmquist index summary of Annual Means of selected organised manufacturing labour intensive industries

Year	EFFCH	TECH	PECH	SECH	TFPCH
1991	1.926	0.061	1.917	1.004	0.118
1992	0.532	12.938	0.670	0.794	6.884
1993	1.834	0.074	1.432	1.283	0.137
1994	0.419	17.554	0.650	0.645	7.358
1995	0.315	0.890	0.260	1.214	0.281
1996	2.478	0.648	6.167	0.402	1.606
1997	0.823	1.386	0.470	1.750	1.141
1998	2.979	0.170	1.671	1.783	0.507
1999	0.900	1.468	1.005	0.895	1.321
2000	1.428	0.522	1.216	1.175	0.746
2001	0.746	1.339	1.006	0.742	1.000
2002	1.286	0.674	1.019	1.262	0.868
2003	0.627	2.094	0.744	0.842	1.312
2004	1.427	1.109	1.247	1.144	1.583
2005	0.905	0.822	0.968	0.936	0.744
2006	0.968	1.306	1.101	0.879	1.264
2007	1.018	1.184	0.911	1.117	1.205
2008	0.789	1.669	0.859	0.919	1.317
2009	0.719	2.077	1.027	0.700	1.494
2010	0.692	1.572	1.586	1.181	1.088
2011	1.086	0.268	1.080	1.005	0.290
Mean	0.978	0.960	0.997	0.981	0.939

Source: Calculated Data Using DEA Method

Note: EFCH= Technical Efficiency Change, TECH= Technological Change, SECH=Scale Efficiency Change, PECH= Pure Efficiency Change and TFPCH=Total Factor Productivity Change.TFPG consist of two components namely EFCH and TECH. Then the EFCH can be decomposed to SECH and PECH



Source: From Malmquist Index Summary of Annual Means for Selected Organised Manufacturing Labour Intensive Industries

Figure 2. Trends of Total Factor Productivity Growth and its Components for Selected Organised Labour Intensive Industries, 1991-2011

Results and Discussion

(i) Total Factor Productivity Growth of Selected Indian Organised Manufacturing Labour Intensive Industries

TFPG defines the change of ratio inputs to the output in production during the period t to the period of t+1. A decision making unit (DMU) has positive TFPG if the index is greater than unity and negative if the index is less than unity. If the industry shows low productivity growth, it indicates that there is no reduction inefficiency of production or frontier production has not moved forward during the period of study. Meanwhile high productivity growth means industry is operating on the right track to catch their goal. Summary of Malmquist Index of the Labour Intensive Industries are shown in Table3.

There is fluctuation in Total Factor Productivity during the period of study. Positive TFPG is found in the years of, 1992, 1994, 1996, 1997, 1999, 2001, 2003, 2004, 2006, 2007, 2008, 2009 and 2010 with the highest growth at 7.358 for the period 1994. Average of Total Factor Productivity is 0.939 per annum indicating that the Labour Intensive Industries have negative growth of -6.1% during the period of study. The main contributor is the negative growth in the TECH of about -4%. Technological change associates with the ability of a firm to move forward the frontier of production. In other words, a full efficient industry can improve their productivity growth by moving forward the frontier itself. In DEA concept, the possibility of production function is a virtual function formed by a best practice of weighted against all the data. It is related to Technological Change which means adopting innovation such as technological management in production process, automation, the skill of the labour, on time process and product innovation like improved design, quality, durability of a product manufactured by industry, expenditure on Research and Development, Foreign Direct Investment inflow, collaboration of foreign entities in to industry through technical and financial collaboration, foreign equity participation, automation of production line and importing new machinery, modern Information and technological equipment from abroad. Trends of TFPG of Selected Labour Intensive Industries for the period of 1990-2011 can be observed below in Figure 2.

Table 4. Malmquist index summary of industries means for selected organised manufacturing labour intensive industries

Sl No.	Industry Code (NIC- 2004)	EFFCH	TECH	PECH	SECH	TFPCH
1	1730	0.926	0.876	0.937	0.988	0.811
2	1723	0.941	0.873	0.945	0.996	0.821
3	1810	0.944	0.918	0.957	0.986	0.866
4	1729	0.989	0.919	1.020	0.970	0.909
5	1912	0.934	0.951	0.963	0.970	0.888
6	1920	0.934	0.970	1.004	0.930	0.906
7	3610	0.944	0.989	0.965	0.978	0.934
8	2811	1.039	0.983	1.059	0.982	1.022
9	3691	1.121	1.067	1.114	1.007	1.196
10	3592	1.031	1.072	1.023	1.007	1.104
Mean		0.978	0.960	0.997	0.981	0.939

Source: Calculated data using DEA Method

Note that all Malmquist index averages are geometric means.

During the study period 1990-2011 productivity growth and its components shows a declining trend. A positive growth appears in period in 1992, 1994, 1996, 1997, 1999, 2001, 2003, 2004, 2006, 2007, 2008, 2009 and 2010. But negative growth in 1991, 1993, 1995, 1998, 2000,2002 and 2011 and a sharp declining was found period 1991 and period 2011 especially Technical Efficiency Change (EFCH). The Technical Efficiency Change (EFCH) is product of Scale Efficiency Change (SECH) and Pure Efficiency Change (PECH). PECH is more fluctuating in contrast to the SECH which has less variation over time. More over the value of SECH is unity, showing that there is no significant change of SECH over the years. This implies that growth of Labour Intensive Industry is much influenced by the forward shifting of the production frontier rather than catching up of the production frontier. So there is a need to adopt new technology to improve productivity performance of Labour Intensive Industry.

Table 4 shows the Index summary of Malmquist Index for Selected Organised Manufacturing Labour Intensive Industries. During 1990-2011, by sub industry three industries have positive Total Factor Productivity Growth those are Structural Metal Products, Jewellery and Related Articles and Bicycles and Invalid Carriages. Technical Efficiency Change (EFCH) is the main contributor with an average of 12.1%, indicating that Jewellery and Related Articles industry is operating in the peer of production frontier. Component of the EFCH comes from PECH 11.4% and SECH of 0.7%. Meanwhile 7 sub industries Knitted and Crocheted Fabrics (-18.9% an average), Cordage, Rope, Twine and Netting (-17.9%

Table 5. Malmquist index summary of Annual means for selected organised manufacturing capital intensive industries

YEAR	EFFCH	TECCH	PECH	SECH	TFPCH
1991	1.426	0.644	1.230	1.160	0.919
1992	0.680	2.726	0.945	0.719	1.852
1993	1.219	1.197	1.087	1.121	1.459
1994	0.849	0.928	0.958	0.886	0.788
1995	1.329	0.566	1.062	1.251	0.752
1996	1.101	0.890	0.905	1.217	0.980
1997	1.085	1.310	1.077	1.008	1.422
1998	0.866	1.167	1.016	0.852	1.010
1999	0.971	0.842	1.039	0.935	0.818
2000	1.139	0.842	0.979	1.163	0.959
2001	0.467	3.523	0.499	0.936	1.645
2002	1.708	0.353	1.910	0.894	0.603
2003	0.563	1.578	0.550	1.022	0.888
2004	2.418	0.741	1.905	1.269	1.792
2005	0.792	1.154	0.911	0.869	0.914
2006	1.154	0.991	1.048	1.101	1.144
2007	0.934	0.877	1.016	0.919	0.819
2008	1.094	0.821	0.986	1.109	0.899
2009	1.040	1.043	1.025	1.014	1.084
2010	0.895	1.512	0.900	0.995	1.353
2011	0.970	1.384	1.190	0.815	1.343
Mean	1.016	1.050	1.015	1.001	1.067

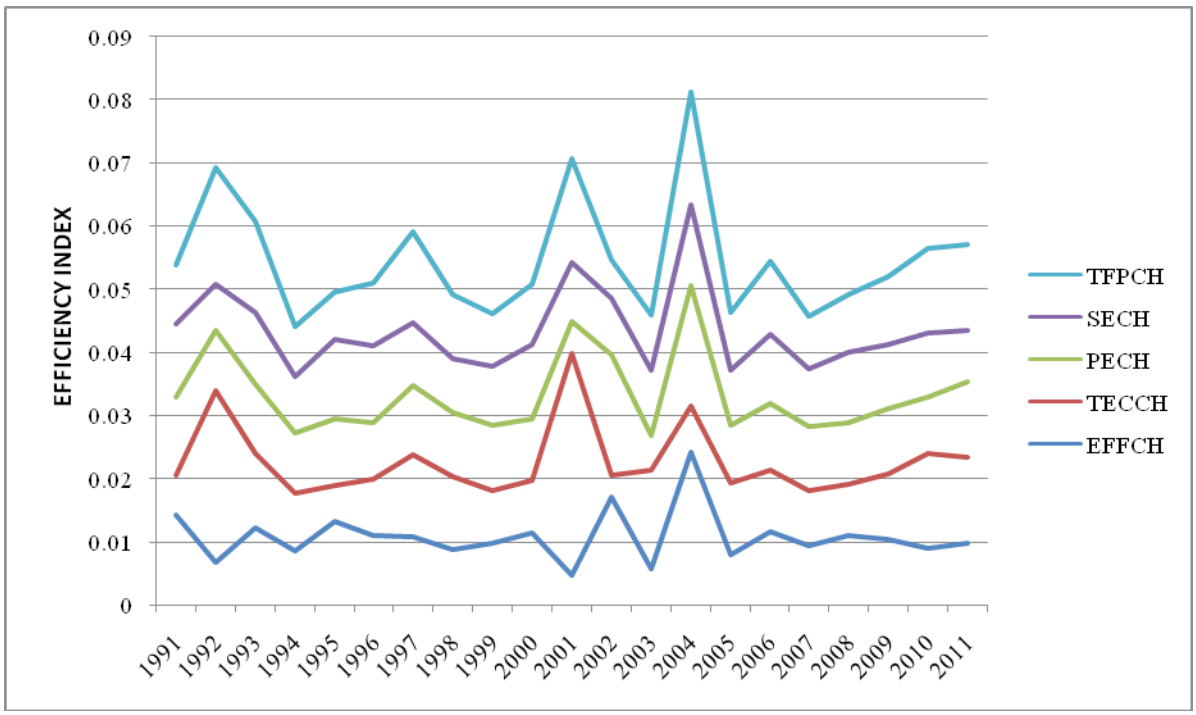
Source: Calculated Data Using DEA Method

Note: EFCH= Technical Efficiency Change, TECH= Technological Change, SECH=Scale Efficiency Change, PECH= Pure Efficiency Change and TFPCH=Total Factor Productivity Change.TFPG has two components namely EFCH and TECH. Then the EFCH can be decomposed to SECH and PECH.

an average), Wearing Apparel, Except Fur Apparel (-13.4% an average), Other Textiles N.e.c. (-9% an average), Luggage, Handbags and the Like, Saddlery and Harness (-11.2% an average), Footwear (-9.4% an average) and Furniture (-6.6% an average) shown negative growth. Total Factor Productivity Growth varies from -18.9% to -6.6%. The sub Industries lowest negative growth is found in the Furniture industry.

The main contributor of declining growth was the Technological Change (TECH). This implies that the economic reform has created negative impact on the productivity performance of selected organised manufacturing Labour Intensive Industries in India.

Total Factor Productivity Growth of Selected Organised Capital Intensive Industries in India presented in table5. Different to selected Labour Intensive Industries and Capital Intensive Industries in India Malmquist Index was found greater than unity; it means that the selected Capital Intensive Industries have positive Total Factor Productivity Growth (TFPG). Average Total Factor Productivity of the selected Organised Manufacturing Capital intensive Industries in India during the study period 1991-2011, is 6.7%, which is contributed by EFCH 1.6% and TECH 5.0%. This indicates that the industry is operating closer to frontier as well. The movement of the frontier occurs if the industry can produce larger output than the previous year by adopting Technological Change (TECH). Positive Total Factor Productivity Growth recorded eight out of ten industries .Efficiency Change in seven industries and technological change in six industries. Particularly, in the Pure Efficiency Change PECH, two industries have no growth (the index is equal to or closer to zero). PECH is measured by weighting against production function in Variable Returns to Scale and the production function of Constant Returns to Scale. Therefore, growth of PECH is the impact of management efficiency. Trends of TFPG in Selected Organised Capital Intensive Industries are presented in figure 3.



Source: From table 3 Malmquist Index Summary of Annual Means for Selected Organised Manufacturing Capital Intensive Industries

Figure 3. Trends of Total Factor Productivity Growth and its Components for Selected Organised Capital Intensive Industries, 1991-2011

Table 6. Malmquist index summary of industries means for selected organised manufacturing capital intensive industries

Sl No.	Industry Code (NIC- 2004)	EFFCH	TECCH	PECH	SECH	TFPCH
1	2511	1.015	0.944	0.990	1.026	0.959
2	2320	1.035	0.935	1.000	1.035	0.968
3	2710	1.039	0.992	1.058	0.982	1.031
4	2720	1.071	0.995	1.064	1.006	1.065
5	2411	1.018	1.084	1.012	1.006	1.103
6	3530	1.023	1.077	1.022	1.001	1.101
7	3591	0.989	1.124	1.000	0.989	1.111
8	2926	0.985	1.113	0.998	0.987	1.096
9	2921	1.000	1.134	1.004	0.996	1.134
10	3110+3120	0.989	1.130	1.002	0.986	1.117
Mean		1.016	1.050	1.015	1.001	1.067

Source: Calculated data using DEA Method.
Note that all Malmquist index averages are geometric means.

From the figures, TFPG and its components show a fluctuating trend. Efficiency change is negative in 1992, 1994, 1998, 199, 2001, 2003, 2005, 2007, 2010 and 2011. It is positive in 1991, 1993, 1995, 1996, 1997, 2000, 2002, 2004, 2006, 2008 and 2009, there is an overall increase from 1991 to 2011, with average of 6.7% per annum, Similar trend is shown by other components, with an average 1.6%, 5.0%,1.5%,0.1% and 0.7% for EFFCH,TECH, PECH ,and SECH respectively.

Total Factor Productivity Growth and It's components by sub industries are presented in table6. Selected Capital Intensive Industries have positive EFFCH average of 1.6%, TECH average of 5.0%, PECH average of 1.5%, SECH average of 0.1% and TFPCH average of 6.7%. Eight industries have positive TFPG varying from an average of 3.1% to average of 13.4% which are Basic Iron and Steel (3.1% an average), Basic Precious and Other Non-ferrous Metals (6.5% an average), Basic Chemicals (10.3% an average), Air and Spacecraft and Related Machinery (10.1% an average), Motorcycles (11.1% an average), Agricultural and Forestry Machinery (9.6% an average), Machinery For Textile, Apparel and Leather Production (13.4% an average) and Electric Motors, Generators, Transformers and Electricity Distribution and Control Apparatus (11.7% an average) . And two industries have negative growth Rubber Tyres and Tubes; Retreading and Rebuilding of Rubber Tyres (-4.1% an average and Refined Petroleum Products (-3.1% an average). The higher TFPG was observed in Machinery For Textile, Apparel and Leather Production Industry (an Average of 13.4%) and the lowest is found in Refined Petroleum Products Industry (an Average of 3.1%). This implies that the Economic Reform create positive impact on the productivity performance of selected organised manufacturing Capital Intensive Industries in India.

The result of output- oriented model of DEA-Malmquist Total Factor Productivity Growth and its components between Labour Intensive and Capital Intensive Manufacturing Industries are not identical. There are marked differences in TFPG. Capital Intensive Industries are performing better than the Labour Intensive Industries in Indian Organised Manufacturing Sector during reform the period. The labour intensive industries have not upgraded their technological progress, skill of labour and efficiency in management.

Conclusion

The study using the non parametric technique data envelopment analysis investigates the impact of economic reform and TFPG in Selected Organised Manufacturing Industries by classifying them into Labour Intensive and Capital Intensive industries, for the period 1990 to 2011. The labour Intensive Industries have negative TFPG of as -4%

mainly deteriorated by TECH. Meanwhile the Capital Intensive Industries have positive TFPG of 6.7%. Mainly contributed by EFFCH 1.6% and TECCH 5.0%.The study examined the TFPG and its components in 20 industries, ten industries from labour intensive segment and ten industries from capital intensive segment. The DEA result revealed that Capital Intensive Industries benefited from economic reforms by improving their TFPG compared to Labour Intensive Industries. Eight out of ten organised manufacturing Capital Intensive Industries shown positive productivity growth during the Economic Reform Period. These are Basic Iron and Steel, Basic Precious and Other Non-ferrous Metals, Basic Chemicals, Air and Spacecraft and Related Machinery, Motorcycles, Manufacture of Agricultural and Forestry Machinery, Machinery For Textile, Apparel and Leather Production, Electric Motors, Generators, Transformers and Electricity Distribution and Control Apparatus. And, in Labour Intensive Industries three out of ten industries showed positive TFP. Those Industries are Structural Metal Products, Jewellery and Related Articles and Bicycles and Invalid Carriages. The result indicate that the adoption of innovation such as technological management in production process, automation, the skill of the labour, on time process and product innovation like improved design ,quality, durability of a product, expenditure on Research and Development, Foreign Direct Investment inflow, collaboration of foreign entities in to industry through technical and financial collaboration, foreign equity participation, automation of production line and importing new machinery, modern Information and technological equipment from abroad towards capital intensive industries are the reasons for positive TFPG whereas the absence of these factor might be the reason of negative TFPG in selected Organised Manufacturing Labour Intensive Industries in India.

Labour intensive industries are facing lack of modern technology and products innovation, so government should support this sector by effective implementation of different industrial uplifting policy packages and programme measures to improve their technology, labour skill, and product design etc. This will help this sector to improve their tech.

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Appendix 1: National Industrial Classification (NIC 2004) Code for Manufacturing in India.

Industry Division	Name of the Industry
15	Manufacture of Food and Beverages
16	Manufacture of Tobacco Products
17	Manufacture of Textiles
18	Manufacture of Wearing Apparel
19	Tanning and Dressing of Leather
20	Manufacture of Wood and Wood Products
21	Manufacture of Paper and Paper Products
22	Publishing, Printing, and Reproduction of Recorded Media
23	Manufacture of Coke, Refined Petroleum etc
24	Manufacture of Chemical and Chemicals products
25	Manufacture of Rubber and Plastics
26	Manufacture of Other Non-Metallic Products
27	Manufacture of Basic Metals
28	Manufacture of Fabricated Metal Products
29	Manufacture of Machinery and Equipment
30	Manufacture of Office, Accounting, and Computer Machinery
31	Manufacture of Electrical Machinery
32	Manufacture of Radio and Television
33	Manufacture of Medical, Precision etc
34	Manufacture of Motor Vehicles, Trailers, and Semi-trailers
35	Manufacture of Other Transport Equipment
36	Manufacture of Furniture, Manufacturing n.e.c
37	Recycling

Source: National Industrial Classification 2004, Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India.