Manufacturing Productivity During Economic Reforms in India

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Abstract

The present study analyzed the trends in growth rates of output (value added), capital intensity, employment, wage share, and share of emoluments as well as partial productivity indices of inputs for all India manufacturing at disaggregated two digit level industrial groups over the period from 1981- 1982 to 2007- 2008. A correlation test was performed to depict the relationship among the growth rates of the relevant key variables. The empirical test of efficiency revealed that there was a significant hint of an upward shift of the productivity locus both for workers and employees on account of positive intercept dummy coefficients.

Keywords: **manufacturing, productivity, economic reforms, intertemporal shift, workers, growth rate**

JEL Classification: C13, D24, L6

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The manufacturing sector is an important sector in the Indian economy, comprising about 31% of the non-agricultural sector, which makes up 75% of the overall GDP in India (Kaliranjan & Bhide, 2004). India's post independence development plans emphasized industrialization as a very important instrument for sustained growth. Its sustained growth is crucial for generating employment opportunities required to absorb the rapidly expanding workforce. The share of industry in total employment increased from 16.2% in 1999-2000 to 21.9% in 2009-10. A significant development in the Indian economy in the post 1990s period was the acceleration of the reform process that was initiated in the 1980s. The reforms were initiated to improve the efficiency, productivity, and international competitiveness of the Indian industry. Thus, the impact of economic reforms on manufacturing productivity has been a subject of research inquiry, but the findings are controversial and inconclusive. Policy reforms and infrastructure development resulted in significant improvements in total factor productivity.

The industrial and trade reforms undertaken during the 1980s had a positive impact on the performance of the manufacturing sector. The reform process was more aggressively pursued during the 1990s. The sole objective of these highly liberalized policies was to augment productivity and efficiency in Indian industries by creating a competitive environment. For development economists and policy makers, productivity has been a matter of both curiosity and concern. Cross-country disparities in real income, growth rates, and standard of living have been attributed to differences in productivity performance. Productivity is one of the key determinants of cost and price competitiveness of firms and industries of a nation. This, in turn, determines the competitive edge of the exports

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of these firms and industries in the global markets. It seems too important to analyze the productivity of the manufacturing sector. For development economists and policy makers, productivity has been a matter of both curiosity and concern. Productivity is one of the key determinants of cost and price competitiveness of firms and industries of a nation. Hence, it is too important to analyze the productivity of the manufacturing sector. The purpose of our present study is to make an objective assessment of the impact of the series of reforms implemented in 1991 on labour productivity growth and performance of major industry groups (two digit level) in India on the basis of industry level ASI summary results data.

There is a vast literature on productivity growth, its components, and determinants of the organized manufacturing sector in India. Several studies like Goldar (1986), Upender (1996), Balakrishnan and Pushpangadan (1994, 1995), and Rao (1996) measured the productivity trends and growth of the Indian manufacturing sector during the post independence period. Most of them have discussed the measurement of the total factor productivity (TFP) growth rate both at aggregate and disaggregate levels, and studies, for example, Joshi and Little (1994) and Srivastava (1996) examined the impact of the reforms on the Indian manufacturing sector at the aggregate level. A number of studies have also argued that manufacturing experienced a surge in productivity in the 1980s (Balakrishnan & Pushpangadan, 1994; Trivedi, Prakash, & Sinate, 2000 ; Unel, 2003). A majority of the studies, including Goldar (2000, 2004), Trivedi et al. (2000), Goldar and Kumari (2003), and Das (2004) found a fall in productivity growth in the post-reforms period. Ghosh and Neogi (1993) attempted to study the effect of technological advancement as reflected in strictly rising capital intensities on the production of labour. Adhikary and Mazumdar (2006) examined the impact of economic reforms on labour productivity growth and performance of major industry groups at the two-digit level in West Bengal. Kumar and Basu (2008) estimated the productivity growth using the Malmquist Productivity Index in the Indian food-processing industries during the time period spanning 1988-89 to 2004-05. The study evaluated the contribution of technological change, technical change, and scale efficiency change to TFP growth in the Indian food processing industries by using firm level data collected from CMIE. Kumar and Managi (2009) applied non - parametric linear programming method to measure TFP at the State level over the period from 1993 to 2005. Sehgal and Sharma (2011) attempted to analyze the intertemporal and inter-industry comparison of total factor productivity by applying the DEA technique. The study revealed that technical efficiency change was the key driver of TFPG in the manufacturing sector of Haryana during the pre- reforms period; however, the picture turned around during the post reforms period. The results also revealed a positive impact of the liberalization policy on technological advancement of the manufacturing sector of the State.

Arora and Kumar (2012) applied bootstrapped Malmquist Productivity Index as a technique to obtain the TFP growth in the Indian sugar industry for the period from 1974/75 to 2004/05. Empirical analysis revealed that TFP growth was statistically significant during both sub-periods and that the TFP growth was contributing significantly to output growth. Ghose and Chakraborty (2012) estimated total factor productivity growth (TFPG) of the Indian pharmaceutical industry by estimating a production function with four inputs for 1973-74 to 2003-04. There was a significant increase in TFPG in the Indian pharmaceutical industry over the period under study. Gupta (2012) investigated the patterns of variations in Indian industrial performance at both industry and state levels by applying stochastic frontier analysis to an unbalanced panel of 15 Indian states, 22 industries at the two digit level for the period spanning 1992-2002. The study estimated, for each industry group, the relative ranking of states based on their technical efficiency scores and also ascertained how these rankings had changed over time.

Deb and Ray (2013) applied the non-parametric method of data envelopment analysis to construct the Biennial Malmquist Index of total factor productivity for Indian states to determine if the states had experienced improvement in manufacturing productivity during the post-reforms years. Results showed that at the all-India level, the total factor productivity growth rate in manufacturing was higher during the post-reforms period. Babu and Natarajan (2013) assessed the extent of regional manufacturing performance in India by analyzing the trends in labour and total factor productivity for the organized manufacturing sector of 15 major Indian states. Estimates of total factor productivity growth (TFPG) showed that for the entire period, TFP had improved across the states, with the exception of Tamil Nadu and West Bengal.

Most of the earlier studies done so far are aggregate or disaggregate analysis; the coverage of most of the earlier studies is not till 2007-08. The present study has made a detailed analysis of the change in growth rates of inputs and output and also partial productivity and capital intensity for the sub periods, Period I (1981- 82 to 1990-91) and Period II (1991-92 to 2007-08) to analyze the adjustment process of manufacturing sector in India during the reforms period. A correlation test was carried out to find out a rough indication of the relationship among growth rates of labour productivity, capital intensity, employment, value-added, and wage share. The impact of reforms on the efficiency of major two digit industries was studied in terms of the intertemporal shift (in between 1981 and 2007) of a logarithmic production function in per-capita (or intensive) form.

Database and Measurement of Variables

➲ **Data Sources :** The present study used the data from Annual Survey of Industries (ASI) compiled by Central Statistical Organization (CSO), Government of India. We selected 14 major two digit level industry groups following NIC 1987 code (Appendix 1). A concordance between NIC 1998 and NIC 1987 two digit level was made to build a comparable and continuous time series at the two digit level NIC 1987 classification. Suitable price indices deflators were constructed with the help of the official series on wholesale price indices (Index Numbers of Wholesale Prices in India, prepared by the Office of the Economic Advisor; Ministry of Industry). The price indices of machinery and equipments were used to deflate nominal fixed capital as provided by ASI.

➲ **Measurement of Variables:** We measured labour in terms of (a) number of workers engaged in production and, (b) number of employees. Capital series for productivity analysis was generated by using perpetual inventory accumulation method (The steps used are depicted in the Appendix 2). The gross measure of value added was obtained by adding depreciation to net value added. The data on gross value added was deflated using industry specific wholesale prices (at 1993-94 prices).

➲ **The Variables Used in this Study:** Y: Value added; K: Capital stock at constant price; Y/K : Average product of capital; Y/L_1: Average product of workers; Y/L_2 : Average product of employees; K/L_1: Capital intensity with respect to workers; K/L_2: Capital intensity with respect to employees; W/Y : Wage share in value added; E/Y : Share of emoluments in value added.

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Methodology

➲ **Model Specification for Estimation of Growth Rate :** We estimated the growth rates of relevant variables for all industry groups by using the following semi-logarithmic equation :

$$\ln Y_t = \alpha_0 + \beta_1 t + \beta_2 D.t + u_{1t} \qquad (1)$$

where,

D is a temporal dummy with the following specifications.

D = 1 for post-1991 observations (1991-2007),

D = 0 for pre-1991 observations (1981-1990),

t = 1, 2... 27 represent time points.

Y_t is the concerned time series variable, that is, value added, average product of labour, capital intensity, and so forth and u_{1t} is the disturbance term. The estimate of β_1 & $(\beta_1 + \beta_2)$ yield the average annual exponential growth rates of the relevant variables in Period I (1981- 1990) and Period II (1991- 2007) respectively.

The growth rates of all relevant variables for the entire period (27 years) were estimated by using equation (2)

$$\text{In } Y_t = \alpha_1 + \beta.t + u_{2t} \qquad t = 1, 2..., 27 \qquad (2)$$

➲ **The Industry Level Correlation Test :** The pair - wise correlation coefficients between the growth rates of relevant variables for the 14 industry groups were calculated separately for both sub - periods and were tested for their significance by using the following the *t*-statistic.

$$r\sqrt{n-2} \;/\sqrt{1-r2} \sim t_{n-2}$$

Where the symbols have their usual meanings ; r is the simple correlation coefficient computed between the growth rates of different variables, that is, labour productivity, capital intensity, employment, value added, and wage share, taken any two at a time separately for the two periods. The database for computation of the correlation matrix is presented in the Table 1.

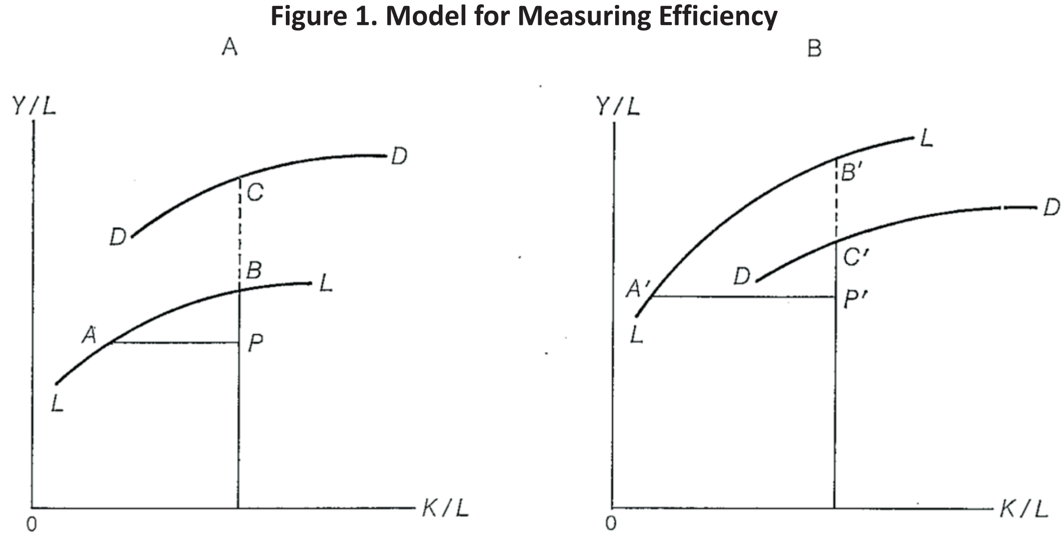
➲ **Measuring Industry - Level Efficiency - A Non-Frontier Approach :** The study is entirely based on industry level data. In the present context, it is worth mentioning that the average production function approach is more appropriate than the frontier approach (which is suitable for firm level data) in measuring industry level efficiency. The average production function is a suitable measure to capture the intertemporal shifts in industry level efficiency under a comparative-static framework (Ghosh & Neogi, 1993).

In the Figure 1, the labour productivity locus, *LL* shifts to the curve *DD* after implementation of the reform programmes. The movement from *A* to *C* is composed of two parts: (a) a movement from *A* to *B* implies that higher capital intensity increases labour productivity on the presumption that reforms augment the capital intensity via new technology, (b) the movement from *B* to *C* represents the rise in productivity due to more efficient input usage in the reform period. In the Figure 1, the drop in productivity from *B'* to *C'* is due to inefficient use of inputs even though productivity rises by *P'C'* . Hence, an increase in productivity does not necessarily imply a more efficient use of inputs.

The same empirical relationship between the observed labour productivities (*Y/L*) and capital labour ratios (*K/L*) across industries can be demonstrated by estimating the following two non linear equations. In the present context, due to presence of heteroscedasticity at higher values of *K/L*, we opted for the following specifications involving logarithms of the variables. The temporal dummy was used to capture the inter *A* temporal shift.

$$\text{In}\left(\frac{Y}{L}\right) = \alpha + \beta_1 \text{In}\left(\frac{K}{L}\right) + \beta_2 \text{In}\left[\left(\frac{K}{L}\right)\right]^2 + \beta_3 D \qquad (3)$$

Figure 1. Model for Measuring Efficiency



Source: Ghosh & Neogi (1993)

$$\text{In}\,(Y/L) = \alpha + \beta_1\,\text{In}\,(K/L) + \beta_2\,\text{In}\,[(K/L)]^2 + \beta_3 D + \beta_4\,\text{In}\,(K/L)\,D \qquad (4)$$

where,

D represents the temporal dummy with D =1 for 2007 observations and D = 0 for 1981 observations. The traditional theory of production implies that β_1>0 while β_2<0 , β_3<0 implies a downward shift of the productivity locus. Finally, β_4 <0 implies that for larger *K/L* values, the process becomes inefficient.

Empirical Findings

➲ **Estimates of Relative Rates of Growth of Output and Input Coefficients:** Using equations (1) and (2), the average annual exponential growth rates of the relevant key variables were estimated and are reported in the Table 1.

Highest growth in value added was recorded for the manufacturing of rubber, plastic, and petroleum products #31 followed by manufacturing of transport equipment and parts #37 in Period I. Regarding the growth rate of value added, no well defined pattern was observed for the manufacturing of NIC codes 20-21, 22, (23+24+25), 26, 28. Growth rate of value added was lower for the industry groups having codes 27, 28, 30, 31, 32, 35-36, 37 in Period II. Negative growth rate in value added was recorded for chemicals and chemical products (30) in the reform period.

Employment in terms of workers (L_1) registered positive growth rates for almost all periods and in all industries except the manufacturing of food products # 20-21, textiles (23+24+25), paper and paper products (28) , wood and wood products (27) , and beverages and tobacco (22). Manufacturing of food products (20-21), beverages and tobacco (22) witnessed a negative growth rate for Period I in contrast to manufacturing of wood and wood products (27) having negative growth for Period II and the entire period also. Again, employment in terms of employees (L_2) registered positive growth rates for most of the industries in all periods except the manufacturing of beverages and tobacco (22), textiles (23+24+25), wood and wood products (27), paper and paper products (28), basic metals and alloys (33). Fixed capital stock (in real terms) was growing at a much faster pace than value added in all sub periods and over all industries except food products (20-21) and transport equipment and parts #37. In addition, average product of capital registered negative growth rates in most of the industrial groups during the reforms period.

Capital intensities registered a significantly positive growth rate in contrast to negative growth rate accompanied by average product of capital in reform years. Without considering the isolated cases, for example, codes 20-21, 22, 26, 28, 31, employment declined while capital stock was rising over time, resulting in a rise in capital intensity in the reform period. Growth rate of capital intensity almost increased for major industrial groups except the industries with codes 20-21, 22, 26, 31, 32 in the second sub period on account of lower employment growth during the reforms period. Productivity growth of workers and employees was higher for industrial groups with codes 20-21, 22, 23-25, 26, 27, 28,31,37 in the pre - reforms period, while six groups of industries having codes, 29, 30, 32, 33, 34, 35-36 depicted higher growth in the reforms period. Share of wages and emoluments in value added grew negatively in almost all periods for most of the industrial groups**.**

➲ **Results of the Correlation Test :** The Table 2 reveals that the coefficients between labour productivity growth and employment are both negative and insignificant in contrast to significantly positive correlation between labour productivity growth and output growth in both pre-reforms as well as the reforms period. The correlation between labour productivity and capital intensity has fallen with reforms for both workers and employees. It is striking to note that wage share and labour productivity are significantly negatively correlated in both the periods. The correlation coefficient between productivities of capital and labour is significantly positive in both the periods, though the same has increased more in the reforms period.

Table 1. Average Annual Growth Rates (Exponential) in Percentage											
Code	L_1	L_2	K	Y	Y/L_1	Y/L_2	Y/K	K/L_1	K/L_2	W/Y	E/Y
20-21	-1.28	2.05	10.57	17.88	19.16	15.83	7.31	11.85	8.52	-10.93	-12.92
	0.37	2.93	9.63	17.33	16.95	14.39	7.7	9.25	6.69	-12.48	-12.75
	0.76	**6.26**	**9.41**	**17.2**	**16.44**	**14.05**	**7.79**	**8.65**	**6.26**	**-12.84**	**-12.71**
22	-1.47	-1.41	12.45	6.89	8.36	8.3	-5.56	13.93	13.86	-5.31	-3.51
	0.095	0.18	12.47	6.48	6.39	6.3	-5.98	12.37	12.29	-4.37	-2.96
	0.046	**0.55**	**12.47**	**6.38**	**5.95**	**5.83**	**-6.08**	**12.01**	**11.92**	**-4.15**	**-2.84**
23-25	-5.02	-5.78	5.89	1.79	6.81	7.58	-4.12	10.91	11.68	-2.37	-2.61
	-3.38	-3.96	7.59	2.86	6.24	6.83	-4.72	10.97	11.55	-3.03	-3.09
	-2.99	-3.53	7.99	3.12	6.11	6.65	-4.87	10.98	11.52	-3.18	-3.21
26	8.37	8.62	15.28	14.74	6.37	6.12	-5.33	6.9	6.65	-1.25	-0.45
	9.62	9.57	16.03	14.34	4.73	4.77	-1.68	6.41	6.45	-0.52	0.10
	9.91	**9.8**	**16.2**	**14.25**	**4.35**	**4.46**	**-1.95**	**6.29**	**6.4**	**-0.35**	**0.23**
27	0.029	0.26	8.85	9.32	9.29	9.07	0.47	8.82	8.59	-1.11	0.74
	-0.64	-0.44	8.42	3.76	4.41	4.2	-4.65	9.06	8.86	-1.89	-0.38
	-0.8	**-0.6**	**8.32**	**2.45**	**3.26**	**3.06**	**-5.86**	**9.12**	**8.92**	**-2.07**	**-0.65**
28	-3.97	-3.79	5.92	1.71	5.68	5.5	-4.21	9.89	9.7	-3.89	-1.92
	-3.53	-3.36	6.37	1.55	5.08	4.92	-4.81	9.9	9.73	-4.09	-2.19
	-3.43	**-3.27**	**6.47**	**1.52**	**4.94**	**4.78**	**-4.95**	**9.9**	**9.74**	**-4.14**	**-2.26**
29	5.07	4.68	11.01	4.53	-0.54	-0.16	-6.48	5.95	6.32	1.71	1.44
	4.42	4.3	14.33	7.38	2.95	3.08	-6.95	9.91	10.03	-0.63	-1.09
	4.27	**4.21**	**15.11**	**8.05**	**3.78**	**3.84**	**-7.05**	**10.83**	**10.89**	**-1.17**	**-1.68**
30	8.85	8.84	10.51	1.56	6.31	6.32	4.65	1.67	1.67	0.63	1.58
	5.41	5.44	11.86	-1.97	6.46	6.42	0.004	6.45	4.75	-0.033	-1.97
	4.59	4.64	12.18	11.09	6.49	6.45	-1.09	7.58	7.53	-4.22	-2.80
31	1.8	0.28	14.81	15.83	14.04	15.56	1.03	13.01	14.53	-8.5	-9.78
	2.35	1.36	13.08	12.72	10.36	11.35	-0.37	10.73	11.72	-5.29	-5.61
	9.5	**1.61**	**12.68**	**11.98**	**9.50**	**10.36**	**-0.69**	**10.20**	**11.07**	**-4.54**	**-4.63**
32	2.15	1.98	11.75	6.92	4.76	4.93	-4.83	9.59	9.76	-0.62	-1.18
	1.51	1.48	10.38	6.44	4.93	4.95	-3.95	8.88	8.9	-1.05	-1.43
	1.35	**1.36**	**10.06**	**6.32**	**4.97**	**4.96**	**-3.74**	**8.71**	**8.7**	**-1.15**	**-1.48**
33	0.44	-0.28	5.41	5.74	5.29	6.02	0.33	4.96	5.68	-3.74	-3.46
	0.23	-0.059	7.17	6.7	6.48	6.76	-0.46	6.94	7.23	-4.65	-3.81
	0.18	**0.008**	**7.58**	**6.94**	**6.75**	**6.94**	**-0.65**	**7.41**	**7.6**	**-4.86**	**-3.89**
34	5.09	2.3	9.07	4.62	-0.48	2.31	-4.46	3.98	6.78	-2.14	1.15
	4.18	2.39	9.86	5.58	1.4	3.19	-4.28	5.68	7.47	-2.67	0.19
	7.82	**7.53**	**9.58**	**13.47**	**5.65**	**5.95**	**3.89**	**6.08**	**2.05**	**-1.57**	**-0.29**
35-36	3.69	3.55	8.86	9.6	5.91	6.05	0.74	1.76	5.31	-1.64	-1.32
	2.72	2.62	8.69	8.69	5.97	6.07	0.0016	5.17	6.07	-1.66	-1.56
	2.72	**2.62**	**8.69**	**8.69**	**5.98**	**6.07**	**0.016**	**5.97**	**6.07**	**-1.66**	**-1.56**
37	8.53	8.28	10.24	17.92	9.39	9.63	0.82	1.72	1.96	-5.35	-3.69
	3.91	3.82	9.74	12.31	8.4	8.48	0.19	4.11	5.91	-5.27	-3.18
	2.82	**2.77**	**9.62**	**10.98**	**8.17**	**8.21**	**0.043**	**6.79**	**3.95**	**-5.25**	**-3.06**

1st row: Period 1 growth rates, 2nd row: Period 2 growth rates, 3rd row: Period 3 growth rates for each industry codes.

Note: The industry codes are listed in the Annexure I.

Source: Calculation based on ASI Data

Table 2. Pair-wise Correlation Coefficient

	L_2	Y	Y/L_1	Y/L_2	Y/K	K/L_1	K/L_2	W/Y	E/Y
Period I									
L_2	1								
Y	0.39	1.00							
Y/L_1	-0.09	0.68**	1.00						
Y/L_2	-0.13	0.68**	0.97**	1.00					
Y/K	0.24	0.42	0.70**	0.67**	1.00				
K/L_1	-0.66**	0.10	0.48	0.48	-0.17	1.00			
K/L_2	-0.74**	-0.01	0.29	0.36	-0.32	0.93**	1.00		
W/Y	0.26	-0.63**	-0.83**	-0.85**	-0.49*	-0.51*	-0.40	1.00	
E/Y	0.24	-0.64**	-0.86**	-0.87**	-0.53*	-0.54*	-0.42	0.95**	1.00

*Significant at the 5% level ** Significant at the 1% level

	L_2	Y	Y/L_1	Y/L_2	Y/K	K/L_1	K/L_2	W/Y	E/Y
Period II									
L_2	1								
Y	0.42	1.00							
Y/L_1	-0.01	0.57*	1.00						
Y/L_2	-0.05	0.57*	0.98**	1.00					
Y/K	0.29	0.56*	0.84**	0.82**	1.00				
K/L_1	-0.53*	0.01	0.26	0.26	-0.30**	1.00			
K/L_2	-0.59*	-0.04	-0.05	0.01	-0.55	0.89**	1.00		
W/Y	0.25	-0.55*	-0.85**	-0.84	-0.67**	-0.32	-0.10	1.00	
E/Y	0.12	-0.54*	-0.96**	-0.94**	-0.78**	-0.31	-0.02	0.93**	1

*Significant at the 5% level ** Significant at the 1% level

Note: The variables used are defined in the "The variables used in the study" section

Table 3. Inter-Temporal Shift of Productivity Locus Between 1981-82 & 2007-2008

Dependent variable: log(Y/L)

Method: Least Squares; No. of Industries: 14 for each Cross Section

		Coefficients of Independent Variables						
		Const	**log (K/L)**	**[log(K/L)]^2**	**D**	**log (K/L)D**	**R^2**	**Adjusted R^2**
Workers	Linear	-4.61	-0.226	-0.0725	1.38	___	0.56	0.50
			(-0.339)	(-0.805)	(2.54)*			
	Quadratic	1.31	2.40	0.206	-3.37	-1.37	0.60	0.53
			(1.38)	(1.07)	(-1.13)	(-1.62)		
All Employees	Linear	-3.06	0.514	0.0052	0 .614		0.80	0.78
		(1.42)	(0.142)	(0.111)	(2.29)*			
	Quadratic	-0.665	1.51	0.104	-1.20	-0.477	0.81	0.78
		(1.63)	(1.08)	(1.08)	(-1.16)	(-1.16)		

Figures in the parentheses represent t - values * Significant at the 5% level

➲ **Analysis of Regression Results:** Empirically, efficiency at the industry level was tested by simultaneously estimating models (3) and (4) for two distinct time points - 1981-82 and 2007-08 respectively, and the results of the same are reported in the Table 3. The cross sections were so chosen so that they represent two extremes regarding the industrial policy regime. For both types of workers, we found almost similar results in terms of significance of the coefficients.

The overall percentage explained by the independent variables is higher for all employees in both the equations relative to those of the workers (Adjusted R^2 being 0.78 for all employees in both the equations as against [a]djusted R^2 = 0.50 in Model (3) & Adjusted R^2 = 0.53 in Model (4) for the workers). The positive and statistically significant coefficient of the intercept dummy in equation (3) indicates a significant hint of an upward shift of the productivity locus both for workers and employees. Moreover, the inclusion of the slope dummy results a negative and insignificant coefficient to the intercept dummy, implying the loss of efficiency due to higher value of capital intensity. As a result, the production process becomes inefficient.

Research Implications

Productivity growth is essential not only to increase output, but also to improve the competitiveness of an industry both in the domestic and international markets. The growth of an economy is governed by two distinct sources of growth that is, input–driven and productivity–driven. The input–driven growth is achieved through the increase in factors of production, which is certainly subjected to diminishing returns and is not sustainable in the long run. The productivity-driven growth is the growth in output that cannot be explained by the growth in total inputs. It is normally credited to the improvement in knowledge, organizational structure, human resource management, skills attainment, information technology, and efficient use of factors of production. Productivity growth is accepted as a key characteristic of economic dynamism. It becomes pertinent to analyze the productivity performance of the industrial sector which is facing stiff competition from the outside world in the era of globalization and liberalization, where the role of the government is restricted. The sole objective of highly liberalized policies was to augment productivity and efficiency in Indian industries by creating a competitive environment. The study has attempted to make an assessment towards the success of policy measures undertaken during the reforms period. The impact of economic reforms on the Indian manufacturing sector has been assessed in terms of value added, employment, wage share, capital intensity, and average productivity of employees. The empirical test of efficiency was performed to capture the intertemporal shift of the productivity locus.

Conclusion

The paper examines the trend in growth rate of inputs and output and emphasizes on the computation of partial productivity indices of the variables of interest in the 1980s and 1990s. The estimates obtained indicate that during the 1990s, a decade of major industrial & trade reforms, there was acceleration in productivity growth for the group of industries with codes 20-21, 22, 23-25, 26, 27, 28, 31, 37 in the pre - reforms period and other six groups of industries having codes, 29, 30, 32, 33, 34, 35-36 in the reforms period.

However, a close examination revealed that:

(1) There is a declining trend of employment in terms of workers and employees for most of the industries during the reform era,

(2) We observed a rising trend of capital intensity in the reforms period on account of lower employment growth,

(3) Fixed capital has been growing at a much faster pace than value added in the two sub- periods. The consistent rise in capital stock in excess of workers is suggestive of unutilized capacity,

(4) Declining trend of wage share for all industries is indicative of a fall in relative importance of workers in the production process,

(5) Most of the industries witnessed negative average product of capital during the reforms period. The correlation test suggests the existence of a negative correlation coefficient between growth rates of labour productivity and wage share, which establishes the evidence that rising labour productivity is accompanied by falling wage share.

The empirical test of efficiency was carried out to capture the intertemporal shift of the productivity locus at two extreme time points of the entire study period. The significant upward intertemporal shift of the productivity locus is in favour of efficiency promotion as a result of policies undertaken during the reforms period. Finally, it may be concluded that economic reforms have had a detrimental effect on the Indian manufacturing sector in terms of value added, employment, and wage share.

Limitations of the Study and Scope for Further Research

The present study emphasized the computation of partial productivity indices of inputs for all India manufacturing at disaggregated two digit level industrial groups over the period from 1981-82 to 2007-2008. The estimation of total factor productivity growth (TFPG) can provide a better measure as compared to partial productivity measurement. Output growth occurs due to input growth and improvement in total factor productivity growth. So, the sources of output growth can be assessed by using three factors: input growth, changes in capacity realization, and technical progress. Again, an analysis of determinants of productivity growth is useful in identifying the policy needed for improving the growth of productivity in the manufacturing sector.

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Appendices

Appendix 1. National Industrial Classification (1987)

NIC Code	Description of Industry
20-21	Manufacture of food products
22	Manufacture of beverages and tobacco & related products
23-25	Manufacture of textiles
26	Manufacture of textiles products
27	Manufacture of wood and wood products
28	Manufacture of paper and paper products
29	Manufacture of leather and leather products
30	Manufacture of chemicals and chemical products
31	Manufacture of rubber, plastic, and petroleum products
32	Manufacture of non-metallic minerals
33	Manufacture of basic metals and alloys
34	Manufacture of metal products
35-36	Manufacture of machinery & machine tools
37	Manufacture of transport equipment and parts

Appendix 2 : Measuring Capital Stock

Since measurement of true economic depreciation is a complex phenomenon, we used estimates of gross fixed capital stock for the present study. Gross fixed capital at constant prices was derived by perpetual inventory accumulation method (Goldsmith, 1951).

The capital stock at any year is calculated as:

$$K_t = K_0 + \Sigma^{T}_{t=1} I_t$$

Where I_t is the investment in year t and K_0 is the base period capital stock that is estimated by doubling the book-value of fixed capital stock for the benchmark year (1980-81). Investment figures were obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t) / R_t$$

where,

B is the book value of fixed capital,

D is the depreciation, for R wholesale price index of machinery (Base: 1993-94 =100) is used.