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Indian manufacturing industry in the era of globalization: A Cobb-Douglas production function analysis

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Abstract

Background/Objective: Indian economy has been witnessing an uptrend in growth rate since 1990's. The main objective of the paper is to investigate the factors influenced on output.
Methods/Statistical analysis: The study used output as a depended variable and number of workers, fixed capital and factories are independent variables are considered for regression analysis. We have used Cobb-Douglas production function. The study used Annual Survey of Industry data, and 69 industries data used for analysis. Also, for the aggregate industry-wise analysis the selected 69 three-digit industries are grouped into 12 industries as mentioned in the ASI two-digit classification.
Findings: Manufacture of Beverages, tobacco and related products, Textile products, Metal products and manufacture of Other Manufacture Industries employment per unit has been growing at a constant rate during study period. The study found workers influenced output in machinery equipment other than transport equipment industry in post globalisation period. As far as fixed capital is concerned, it influenced output growth in pre globalization period. Results shows that, in pre globalization period factories were influenced output growth in Beverages and tobacco and related products, Wood and wood products, Paper and paper products, basic chemical industry and transport industry. As far as factory is concerned, total study period (pre and post globalisation period together) shows that only a few industries viz, manufacture of food products, beverages tobacco and related products, wood and wood products, Basic chemical industry, non-metal products and metal products have reported influence of factory on output. However, in post globalization period, food products, rubber, plastic petroleum, Non-metal products and metal products have reported more influence on output.
Improvement/Application: Government has to give some incentives in regard to fixed capital to those industries not having sufficient level of fixed capital.

Key words**:** Globalisation, Indian Manufacturing Industry

1. Introduction

Rapid industrialization is an important way of faster development. The manufacturing industry plays a vital role in industrial structure of the Indian economy. At present, the service and industrial sector are the major contributors to the Indian economy and about 75 per cent of India's Gross Domestic Product (GDP) comes from these two sectors. India's manufacturing industry evidenced a healthy growth rate since 1950s. Initiation of economic reforms like Liberalization, Privatization and Globalization in 1991s has been provided many challenges and opportunities to Indian industries. With reforms Indian economy have potential to emerge as a global manufacturing hub, but demands hardworking labour to avail the opportunities of LPG in order to transform this potential into a reality. Indian manufacturing industry is facing higher competition at international market. As a result the domestic market has also become more competitive and export market finding difficult to survive [1, 2]. The main objective of the paper is to investigate the factors leading to changes in output. To make the assessment of change, we have employed Cobb-Douglas production function for the analysis. We also studied the Globalization impact on Indian manufacturing industry and compared to pre globalization scenario.

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2. Methodology

To obtain the objective of the study is to investigate the factors influenced manufacturing output (i.e., workers, fixed capital and number of factories). Literature suggests that production functions are widely used [2, 3] in both theoretical and empirical studies. In empirical studies this production is used as benchmark. The Cobb Douglas function is mathematically specified as

where, Q = Output, L= Labour, K= capital

In order to accommodate three-variables the equation follows

$$Q = AL^{\alpha}K^{\beta}M^{\gamma} \quad \text{----------(1)}$$

Where Q,L,K,M represents output, workers, fixed capital and factories respectively.

While it is a non-linear equation, in order to make it in linear we follow natural logarithms to be estimated regression equation is follows

$$\ln Q = a_0 + a_1 \ln K + a_2 \ln L + a_3 \ln M + u_t \quad \text{---------- (2)}$$

Where a_0 is constant and a_1, a_2, a_3 are coefficients of the above said equation i.e., α, β and γ. In general, the Cobb-Douglas production function assumes constant and unitary elasticity of substitution between workers, fixed capital and number of factories. The implications of the production function is related to returns to scale which depends on the parameters α, β and γ. There is increasing (decreasing) returns to scale if $\alpha + \beta + \gamma > (<) 1$ and constant returns to scale if $\alpha + \beta + \gamma = 1$.

After finding the appropriate form of the production function by testing above specifications against each other, we analysed if the growth rate of output is due to differences in each industry. For this analysis, first we define y as the rate of growth of output, x as the vector of growth rate of inputs and sigma is an error term satisfying the classical assumptions.

To investigate if the growth rate of output (y) can be attributed to differences in industries, the above specification can be modified as follows.

$Y_{it} = \alpha_{it} + X_{it}'\beta + u_{it}$ (i=1, ….N, t=1,……,T) ----------(3)

Where y is output x is a vector of inputs (workers, fixed capital and number of factories) α and β are coefficients to be estimated an u_{it} is an error term satisfying the classical assumptions. Equation 2 is the group fixed effects model and assumes that differences in each industry can be captured in the constant term. This form is also called the Least Square Dummy Variable (LSDV) model and estimation of the model is straight forward [4, 5]. In a similar fashion the time fixed effects model can also estimated by specifying the model as

$y_{it} = \alpha_{it} + \beta x_{it} + \gamma_{it,}$ where (i= 1……..N and t = 1,……..,T) ---------- (4)

By adding a new random variable, y_{it} that captures the differences in industries can specify the alternative proposition that differences in growth rates between are random rather than parametric shifts in the regression function as in the fixed effects model.

2.1. Waldtest

Suppose a Cobb – Douglas Production function has been estimated in the form

Log Q = A +αlogL+βlogk+γlogM+Ut

Where Q, L, K and M denote: Q- Output, L-Workers, K-Fixed capital and M-Number of factories respectively. The hypothesis of CRS is than tested by the restricted

α + β +γ = 1

The sum of the co-efficiency log (K) Log (L) Log (M) appears to be excess of one, but to determine whether the difference is statistically relevant. We conducted the hypothesis test of Constant Return (CR). To carry out a Wald test we have to check with multiple co-efficient restrictions. As our hypothesis is normalized or homogeneous are restrictions an association standard error. The Wald test result explains whether we should reject or accepts the null hypotheses regarding to check out the CRS return to scale.

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2.2. Selection of the industries

From the reported 171 three- digit industries in the Annual Survey of Industry (ASI), out of which, we have selected 69 industries for the analysis. Remained are not considered due to unavailability of the data. For the aggregate industry-wise analysis the selected 69 three-digit industries are grouped into 12 industries as mentioned in the ASI two-digit classification. For the detailed comparative analysis the entire study period divided into two periods viz, pre globalisation period covered from 1980-81 to 1990-91 and post- globalization period from 1991-92 to 2002-03 and total study period covered from 1980-81 to 2002-03.

2.3. Data and data source

Annual data on number of factories, number of workers employed, fixed capital, value of output collected from Economic and Political Weekly Research Foundation (EPWRF) released in 2001 and for the rest of five years data collected from Annual summary Reports of ASI, various issues. The study followed the National Industrial Classification (NIC) 1998-99. According to National Industrial Classification (NIC) 1998-99 the study has converted 4 digit industries into 3 digit industries. The study 1980-81 prices were converted to 1993-94 prices.

3. Result and discussion

Manufacture of food products industry for the period 1980-81 to 2002-03 the output elasticities of workers, fixed capital and number of factories were estimated to be as -0.234, 0.742 and 0.372 respectively. Over the total period of study holding, the fixed capital and factories are constant, a 1 per cent increase in the workers input led on the average to about a 0.2 per cent decrease in the output. However, holding the workers and the number of factories input constant, a 1 per cent increase in the fixed capital input led on the average to about a 0.7 per cent increase the output. Similarly, holding the workers and fixed capital inputs constant, a 1 per cent increase in the number of factories in put led on the average to about a 0.4 per cent increase the output, details are presented in Table1. Adjusted R^2 and F statistics are explained that the above model is fit for the fixed effect model of the panel data analysis which is also called the Least Square Dummy Variable (LSDV) method. As we foreseen from the results the remaining manufacturing industries following same trend. As our methodology define on traditionally Cobb-Douglas production function as explained earlier. We restricted the elasticity of the above variable or parameters are constant return to scale. In order to test the hypothesis or literature [4] explained. We followed the hypothesis testing and find it is a statistically significant where we can reject the null hypothesis. Similarly, during pre & post globalization period the estimated results shows that the selected variable viz; workers is negatively effecting the output growth. But fixed capital is found to be more influence the output growth. The number of factories is also effecting the output growth.

Table 1. Manufacture of food products

Total Study Period (From 1980-81 To 2002-03)					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	4.449411 (4.009288)* [0.0001]	-0.233479 (-1.330505) [0.1849]	0.742086 (22.66935)* [0.0000]	0.372136 (2.278219)** (0.0238)	207
Adjusted R^2 : 0.966004; F- Statistics : 533.1353					
Pre Globalization Period (From 1980-81 To 1990-91)					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	5.24878 (4.886147)* [0.0000]	-0.209900 (-1.380236) 0.1711]	0.860359 (21.85769)* [0.0000]	0.022405 (0.115686) [0.9082]	99
Adjusted R^2 : 0.990321; F- Statistics : 912.5261					
Post Globalization Period (From 1991-92 To 2002-03)					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	3.489307 (1.44007) [0.1531]	-0.093731 (-0.266194) [0.7907]	0.540422 (5.823633)* [0.0000]	0.650775 (1.917903)*** [0.0581]	108
Adjusted R^2 : 0.931575; F- Statistics : 133.4325					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively, 2). * indicate that significant at 1% level 3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

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In the Manufacture of Beverages, tobacco and related products for the period 1980-81 to 2002-03 the output elasticities of workers, fixed capital and no. of factories were estimated to be as -0.229, 0.183 and 1.974 respectively. Over the total period of study, holding the fixed capital and factories constant, a 1 per cent increase in the workers input led on the average to about a 0.23 per cent decrease in the output. During pre and post globalization the industry was found to be operating at constant return to scale, these details are available in Table2.

Table 2. Manufacture of beverages, tobacco and related products

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.344970 (0.843306) (0.4014)	-0.229257 (-0.630489) (0.5301)	0.182315 (1.764091)*** (0.0813)	1.974116 (4.290889)* (0.0000)	92
Adjusted R^2 : 0.854464; F- Statistics : 90.04545					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	0.148813 (0.087460) (0.9308)	0.400818 (1.485783) (0.1458)	0.389485 (5.203536)* (0.0000)	0.830388 (2.213015)** (0.0331)	44
Adjusted R^2 : 0.978446; F- Statistics : 326.3383					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	6.933124 (1.453080) (0.1538)	0.030752 (0.040219) (0.9681)	-0.126543 (-0.448497) (0.6562)	6.933124 (1.453080) (0.1538)	48
Adjusted R^2 : 0.702725; F- Statistics : 19.51709					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively.
2). * indicate that significant at 1% level, 3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

Table 3 explained about the Manufacture of Textile products for the period 1980-81 to 2002-03 the output elasticities of workers, fixed capital and no. of factories were 0.068, 0.526 and 0.404 respectively. During the total study period the industry was found to be operating at constant to return to scale. And also according to our hypothesis testing and it is find statistically significant. During pre globalization results suggest that if we increase the no. of factories it led to decrease the output growth. In the post globalization period workers, fixed capital and no. of factories are statistically insignificant. In the pre globalization period the industry was operating constant return to scale and in the post globalization period the industry was operating at increase return to scale.

Table 3. Manufacture of textile products

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	3.182344 (1.955254)*** (0.0532)	0.067884 (0.237713) (0.8124)	0.525845 (6.287714)* (0.0000)	0.404089 (1.100935) (0.2734)	115
Adjusted R^2 : 0.809281; F- Statistics : 70.10527					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	6.858078 (4.013193)* (0.0002)	0.053670 (0.255062) (0.7998)	0.561128 (9.184389)* (0.0000)	-0.299666 (-1.239342) (0.2214)	55
Adjusted R^2 : 0.950017; F- Statistics : 147.6245					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.990542 (0.832801) (0.4088)	0.407106 (0.493869) (0.6235)	0.304832 (0.912888) (0.3655)	0.281227 (0.279836) (0.7807)	60
Adjusted R^2 : 0.605042; F- Statistics : 13.91185					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively, 2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

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The Manufacture of Textile products for the total study period (1980-81 to 2002-03), the industry was operating at decrease return to scale was presented in the Table4. Similarly, during pre & post globalization period, workers, is found to be negatively effecting the output growth. Which fixed capital influence was found to be more in the output growth. No. of factories seem to truly effect the output growth. The study found that the industry in pre and post globalization is operating at decreasing return to scale and increase return to scale respectively.

Table 4. Manufacture of wood and wood products

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	5.895836 (3.852584)* [0.0002]	-0.475047 (-2.399755)* [0.0181]	0.583102 (10.34803)* [0.0000]	0.56902 (3.020625)* [0.0032]	115
Adjusted R^2 : 0.857435; F- Statistics : 98.94782					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	11.60471 (4.484017)* [0.0000]	-1.280961 (-3.443609)* [0.0012]	0.642916 (5.797527)* [0.0000]	0.72043 (2.444579)* [0.0183]	55
Adjusted R^2; F- Statistics :					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	4.288041 (1.405858) [0.1657]	-0.008748 (-0.029082) [0.9769]	0.316813 (2.446592)* [0.0179]	0.554825 (1.320472) [0.1925]	60
Adjusted R^2 : 0.769282; F- Statistics : 29.10335					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively., 2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

In the Manufacture of paper and paper products and printing for the (1980-81 to 2002-03) total study period, the industry was operating at decrease return to scale. During pre globalization period, the selected variable viz; workers were negatively effecting the output growth. But fixed capital and no. of factories are more influenced the output growth. In the post globalization period the workers and fixed capital was found to be influence the output growth. But factories negatively influenced the output growth. If we increase the 1 per cent of factories input it led on the average to about 0.1 per cent decrease the output, these details are presented in Table 5.

Table 5. Manufacture of Paper and Paper Products and Printing

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	4.032803 (1.910949)*** (0.0582)	0.059335 (0.151911) (0.8795)	0.662941 (9.069169)* (0.0000)	0.081465 (0.184046) (0.8542)	138
Adjusted R^2 : 0.607544; F- Statistics : 27.51044					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	10.14270 (4.530743)* (0.0000)	-1.208867 (-4.825893)* (0.0000)	0.892194 (18.41988)* (0.0000)	0.765897 (3.286551)* (0.0017)	66
Adjusted R^2 : 0.962812; F- Statistics : 184.4705					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	6.175483 (1.836502)* (0.0710)	0.364934 (0.687160) (0.4945)	0.276807 (1.291978) (0.2011)	-0.063720 (-0.093966) (0.9254)	72
Adjusted R^2 : 0.422341; F- Statistics: 12.488732					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively., 2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

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In the Manufacture of Basic chemical Industry for the industry was (1980-81 to 2002-03) operating at constant return to scale. During pre and post globalization results suggest that, if we increase the workers input, it led to the increase the output growth. If we increase the fixed capital input it led to more increase the output growth in pre and post globalization periods. Factories are also influenced the output growth in both periods. During pre globalization period the industry was found to be operating at decrease return to scale and in the post globalization period the industry was found to be operating at increase return to scale as mentioned in Table 6.

Table 6. Manufacture of basic chemical industry

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.608431 (0.887059) (0.3765)	-0.017390 (-0.077967) (0.9380)	0.647908 (13.97817)* (0.0000)	0.596238 (2.277722)* (0.0241)	161
Adjusted R^2 : 0.872428; F- Statistics : 122.5767					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	-1.021333 (-0.371729) (0.7113)	0.213890 (0.780094) (0.4381)	0.690041 (7.702436)* (0.0000)	0.542720 (1.670128)*** (0.0996)	77
Adjusted R^2 : 0.857358; F- Statistics : 51.75583					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.383273 (0.455202) (0.6503)	0.589538 (1.656321)** (0.1021)	0.467087 (5.474233)* (0.0000)	0.023755 (0.056782) (0.9549)	84
Adjusted R^2 : 0.715736; F- Statistics : 24.22018					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively., 2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

The Manufacture of Rubber plastic petroleum Industry for the (1980-81 to 2002-03) total study period, the industry was operating at constant return to scale and these details are available in Table 7. In the post globailsation period workers were negatively influenced the output growth, but fixed capital has more influenced the output growth. During pre and globalization period, the industry was found to be operating constant return to scale.

Table 7. Manufacture of rubber, plastic petroleum

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	0.948764 (0.298693) (0.7662)	-0.078244 (-0.178401) (0.8590)	0.638506 (5.586230)* (0.0000)	0.732960 (1.340434) (0.1849)	69
Adjusted R^2 : F- Statistics :					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	-2.349065 (-0.271015) (0.7884)	1.112378 (1.005412) (0.3236)	0.719007 (2.579530)* (0.0157)	-0.745133 (-0.488174) (0.6294)	33
Adjusted R^2 : 0.634297; F- Statistics : 12.10054					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.507933 (1.089102) (0.2848)	-0.254712 (0.790657) (0.4354)	0.450063 (4.989102)* (0.0000)	1.105240 (3.491883)* (0.0015)	36
Adjusted R^2 : 0.958571; F- Statistics : 162.9626					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively., 2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

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In the case of Manufacture of Non-Metal products, for the total study period, the industry was operating at decrease return to scale. Similarly, during pre & post globalization period workers, fixed capital and no. of factories were influenced the output growth. During the pre and post globalization period industry was found to be operating at increase return to scale, and details are presented in Table 8.

Table 8. Manufacture of non-metal products

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.376773 (1.071508) (0.2857)	0.133915 (0.776016) (0.4390	0.622708 (17.19918)* (0.0000)	0.353862 (2.602116)* (0.0102)	161
Adjusted R^2 : 0.889688; F- Statistics: 144.3807					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.428747 (0.658109) (0.5127)	0.192866 (0.855479) (0.3953)	0.744913 (14.27513)* (0.0000)	0.066613 (0.328669) (0.7434)	77
Adjusted R^2 : 0.974938; F- Statistics : 329.4948					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	5.448664 (2.621732)** (0.0106)	0.013329 (0.049131) (0.9609)	0.268277 (2.162054)** (0.0338)	0.553790 (2.408364)* (0.0185)	84
Adjusted R^2 : 0.722976; F- Statistics : 25.06809					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively.,2). * indicate that significant at 1% level, 3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

Manufacture of Metal products and parts, for the total study period, the industry was found to be operating at decrease return to scale. During pre globalization period, if we increase the workers, it led to decrease the output growth. But, post globalization period, it was not happened like that. During pre and post globalization periods the industry was found to be operating at increase return to scale and decrease return to scale and information is available in Table 9.

Table 9. Manufacture of metal products

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.516076 (1.571528) (0.1190)	-0.047109 (-0.196994) (0.8442)	0.721268 (22.86369)* (0.0000)	0.464243 (2.015259)** (0.0464)	115
Adjusted R^2 : 0.948413; F- Statistics: 300.4101					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.931449 (1.417245) (0.1630)	-0.007903 (-0.021225) (0.9832)	0.858018 (11.83569)* (0.0000)	0.011277 (0.025086) (0.9801)	55
Adjusted R^2 : 0.958635; F- Statistics : 179.7769					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.030950 (1.46004) (0.1503)	0.209114 (0.596037) (0.5537)	0.396230 (4.404477)* (0.0001)	0.524835 (1.711005) (0.0930)	60
Adjusted R^2 : 0.910647; F- Statistics : 86.89994					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively.,2). * indicate that significant at 1% level, 3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

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Manufacture of machinery and equipment other than transport equipment industry for the total study period, the industry was found to be operating at decrease return to scale. In the case of pre globalization results suggest that, if we increase the 1 per cent workers input it led to the 0.3 per cent increase the output growth. Suppose we increase the 1 per cent of the input of factories it led to increase the 0.30 per cent output growth. Similarly, fixed capital, if we increase a 1 per cent of fixed capital input, it led to an increase at 0.73 per cent of output growth. But in the post globalization period factories were negatively influenced the output growth and the details are presented in Table10.

Table 10. Manufacture of machinery and equipment other than transport equipment

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.183888 (2.629993)* (0.0094)	0.250800 (2.138536)** (0.0341)	0.836902 (30.84643)* (0.0000)	-0.279270 (-2.125655)** (0.0352)	161
Adjusted R^2 : 0.935144; F- Statistics : 257.3319					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	-0.714160 (-0.467435) (0.6417)	0.289452 (1.798068)*** (0.767)	0.738528 (14.53799)* (0.0000)	0.303323 (1.507351) (0.1364)	77
Adjusted R^2 : 0.941915; F- Statistics : 137.9371					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.681434 (2.181560)** (0.0323)	0.509038 (2.559852)** (0.0125)	0.547608 (11.87850)* (0.0000)	-0.232361 (-1.394731) (0.1673)	84
Adjusted R^2 : 0.914098; F- Statistics : 99.13470					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively.
2). * indicate that significant at 1% level, 3). ** indicate that significant at 5% level
4). *** indicate that significant at 10% level.

Table 11 provides the information about Manufacture of Transport equipment parts Industry, for total study period (1980-81 to 2002-03) the industry was found to be operating at decrease return to scale. During pre globalization period, workers, fixed capital and no. of factories were influenced the output growth. But, post globalization period, if we increase a 1 per cent of factories input it led on average about a 0.23 per cent decrease the output.

Table 11. Manufacture of Transport Equipment Parts

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	2.603269 (2.396461)* (0.0187)	-0.108923 (-1.140432) (0.2573)	0.879446 (14.69956)* (0.0000)	0.186981 (1.114576) (0.2682)	92
Adjusted R^2 : 0.896824; F- Statistics : 132.8316					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	5.713910 (2.775821)* (0.0086)	-0.764123 (-2.992556)* (0.0049)	0.913842 (10.94808)* (0.0000)	0.800209 (3.660245)* (0.0008)	44
Adjusted R^2 : 0.930449; F- Statistics : 96.87506					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	5.840164 (2.936688)* (0.0054)	0.212434 (1.558008) (0.1269)	0.510085 (4.296021)* (0.0001)	-0.238713 (-0.792196) (0.4328)	48
Adjusted R^2 : 0.888103; F- Statistics : 63.71734					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively., 2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level, 4). *** indicate that significant at 10% level.

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Manufacture of other manufacture Industry for total study period, the industry was found to be operating at decreasing return to scale. During pre globalization period, workers, fixed capital were influenced the output growth and factories were negatively influenced the output growth. But, post globalization period, if we increase a 1 per cent of factories input it led on the average to about a 0.2 per cent increase the output. During the pre and post globalization period's industry was found to be operating at decreasing return to scale and the details are presented in Table 12.

Table 12. Manufacture of other manufacture industry

Total Study Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.548490 (1.565058) (0.1197)	0.178377 (1.512306) (0.1325)	0.857152 (18.40510)* (0.0000)	-0.120906 (-0.53281) (0.5905)	161
Adjusted R^2 : 0.908888; F- Statistics : 178.3418					
Pre Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	1.782644 (1.263465) (0.2108)	0.552240 (3.380510)* (0.0012)	0.580715 (9.046714)* (0.0000)	-0.407441 (-2.525007)* (0.0139)	77
Adjusted R^2 : 0.946184; F- Statistics : 149.4693					
Post Globalization Period					
Variables	Constant	Workers	Fixed capital	No. of factories	Total observations
Output	-1.092414 (-0.528929) (0.5984)	0.299205 (1.488852) (0.1408)	0.853977 (7.0722715)* (0.0000)	0.191714 (0.387903) (0.6992)	84
Adjusted R^2 : 0.851627; F- Statistics : 53.93354					

Note: 1). Figures in brackets indicate t-statistics & p-values respectively.
2). * indicate that significant at 1% level
3). ** indicate that significant at 5% level
4). *** indicate that significant at 10% level.

Table 13 shows that the Food product industry, Wood and wood products, Paper and Paper Products and Printing, Basic chemical, Rubber, Plastic Petroleum, Non-Metal Products, Machinery and equipment and Transport Industry fall in the workers per factory. Particularly after 1990's there is a fall in the rate of employment for the workers in food products industry, but in case of paper and paper products and printing industry shows that up and downs were there in the workers per factory during 1980-81 to 1997-98, particularly after 1997-98 there is a fall in the rate of employment for the workers. Basic chemical industry also fall in the worker per factory particularly in 1990-91, same thing happen in case of rubber, plastic petroleum industry. In the case of non – metal products industry shows that fall in the workers per factory. Particularly in 1983-84 there was a fall in the rate of employment for the workers but the fixed capital rate has been gradually increased in all industries during the study period, (1980-81 to 2002-03). These manufacture industries gradually converted into capital intensive industry particularly in the 1990's. Here, we can say that industries were converting labour intensive into capital intensive industries.

Manufacture of Beverages, tobacco and related products, Textile products, Metal products and manufacture of Other Manufacture Industries employment per unit has been growing at a constant rate. Above said industries provided more employment opportunities to the workers. But, at the same time fixed capital investment rate also has been gradually increased in the study period, (1980-81 to 2002-03). These all manufacture of industries gradually converted into capital intensive industry particularly in the year 1991-92.

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Table 13. Industry wise an average workers per factory and fixed capital per factory

Years	Food Products		Wood and Wood Products		Paper and Paper Products		Basic Chemical Industry		Rubber, Plastic Petroleum		Non-Metal Products		Machinery and Equipment		Transport equipment	
	Workers per Factory	Fixed Capital per Factory	Workers per Factory	Fixed Capital per factory	Workers per Factory	Fixed Capital per Factory	Workers per Factory	Fixed Capital per Factory	Workers per Factory	Fixed Capital per Factory	Workers per Factory	Fixed Capital per Factory	Workers per Factory	Fixed Capital per factory	Workers per Factory	Fixed Capital per Factory
1980-81	67.68	9.74	15.39	1.64	44.48	21.43	64.38	86.20	31.92	14.12	45.59	13.12	56.21	17.64	178.98	82.87
1981-82	65.51	10.06	15.15	1.87	46.05	22.78	51.45	69.83	30.01	15.10	39.98	15.49	42.44	15.74	162.51	63.23
1982-83	66.04	10.63	17.29	2.33	51.43	28.39	67.52	90.02	32.43	14.03	50.68	20.61	56.34	22.47	181.96	69.92
1983-84	52.08	12.95	16.95	4.50	49.01	50.16	60.88	101.44	32.99	24.63	46.52	26.58	57.17	30.40	187.49	81.67
1984-85	49.15	13.83	16.60	2.92	46.46	44.27	59.75	101.76	32.81	25.23	43.69	26.76	58.12	34.53	197.97	101.72
1985-86	46.93	15.02	16.48	3.39	44.12	37.49	60.52	116.32	31.64	25.45	41.72	32.55	51.13	41.18	170.45	99.89
1986-87	47.18	19.15	14.32	3.52	42.78	49.31	59.06	136.63	31.93	31.62	41.61	43.79	49.16	46.22	178.97	104.38
1987-88	47.35	19.40	16.84	5.94	43.81	48.94	58.97	142.18	31.54	41.75	40.15	53.64	55.07	59.91	157.37	135.83
1988-89	46.39	25.15	17.31	5.97	42.07	71.43	58.31	169.25	31.14	41.23	39.06	62.77	51.39	73.26	154.06	140.96
1989-90	49.18	27.95	16.62	6.96	40.89	58.39	57.82	179.66	30.65	53.56	39.26	67.77	46.46	68.57	129.81	133.46
1990-91	45.74	33.99	15.55	6.46	41.33	71.96	53.23	237.81	30.95	42.56	37.44	77.08	45.13	76.38	134.43	114.32
1991-92	48.20	38.83	14.60	7.36	42.87	79.01	54.08	267.17	28.93	74.77	37.15	74.23	42.96	96.99	131.97	170.27
1992-93	48.88	41.99	15.63	9.31	41.84	90.28	53.47	280.80	29.96	93.21	35.60	80.28	42.77	96.52	126.91	184.91
1993-94	48.40	56.41	15.98	14.53	39.24	100.13	49.65	307.50	30.07	113.46	32.50	98.10	43.38	128.14	119.56	164.15
1994-95	50.12	65.61	15.63	15.61	43.46	219.60	52.93	429.33	30.95	112.00	33.58	142.99	44.30	124.91	133.54	234.88
1995-96	49.22	71.79	16.18	18.07	44.11	161.61	52.00	535.47	31.07	142.04	33.19	144.12	48.11	183.86	158.75	256.32
1996-97	49.40	75.22	17.31	22.68	50.01	248.19	54.72	616.08	33.58	287.12	32.33	196.68	43.72	188.91	153.65	302.06
1997-98	50.68	97.98	15.69	20.35	40.51	225.54	55.52	703.88	31.28	203.24	30.90	199.72	44.14	244.17	130.98	378.53
1998-99	46.77	100.62	11.14	14.37	31.78	214.39	45.83	632.00	28.34	206.51	28.71	241.09	39.38	270.85	59.69	207.41
1999-00	47.84	113.41	11.95	19.21	37.91	257.57	51.52	764.59	30.61	198.67	30.61	309.38	41.19	312.68	70.19	328.44
2000-01	46.22	115.45	11.60	25.75	32.86	248.91	49.24	775.46	27.60	187.35	30.33	248.19	41.87	313.08	74.85	327.23
2001-02	46.02	124.16	12.48	26.87	32.95	252.05	46.40	801.18	28.36	209.68	30.80	297.37	39.25	330.71	61.56	299.02
2002-03	44.92	125.54	12.78	30.67	33.71	303.02	47.82	760.02	28.99	223.42	43.29	265.75	40.98	385.33	73.19	379.15

Source: The authors calculated on the data source of EPWRF and ASI various issues.

Continue table-13……*Table 13. Industry wise an average workers per factory and fixed capital per factory*

Years	Beverages, Tobacco and Related		Textile Products		Metal Products		Other Manufacture Industry	
	Workers perFactory	Fixed capital per Factory	Workers per Factory	Fixed capital per Factory	Workers per Factory	Fixed Capital per Factory	Workers per Factory	Fixed Capital per Factory
1980-81	49.84	20.68	25.65	3.93	22.61	4.88	26.43	5.84
1981-82	46.67	18.79	25.66	4.25	22.02	4.46	21.08	4.33
1982-83	44.55	23.20	29.75	5.00	24.97	5.74	35.57	7.92
1983-84	51.84	26.28	31.48	8.06	23.37	8.10	28.32	8.09
1984-85	54.86	27.43	26.73	6.85	24.64	7.57	33.46	10.65
1985-86	53.42	32.24	28.93	8.51	22.75	7.17	30.91	13.32
1986-87	52.79	39.06	25.25	11.08	21.83	10.82	34.96	13.66
1987-88	60.48	51.98	27.24	15.84	23.92	13.50	32.98	18.39
1988-89	57.15	81.21	26.89	19.65	25.66	17.79	36.08	16.48
1989-90	50.60	76.57	32.88	18.52	25.15	14.66	36.85	28.42
1990-91	50.43	81.83	29.35	21.42	24.37	18.60	38.71	28.01
1991-92	54.58	101.71	25.74	22.72	24.37	20.26	38.76	28.08
1992-93	54.51	136.46	26.60	33.10	23.70	28.97	40.17	41.91
1993-94	51.01	125.69	29.32	26.98	21.72	32.75	41.18	63.35
1994-95	58.96	232.34	27.65	51.58	23.78	36.91	42.72	61.31
1995-96	52.63	254.55	29.63	60.96	24.87	48.77	46.95	83.47
1996-97	52.46	333.41	31.26	68.75	27.05	58.35	48.92	103.69
1997-98	54.10	392.79	33.03	67.03	23.39	62.81	48.90	131.88
1998-99	52.18	320.40	32.00	73.07	22.75	49.81	54.20	101.85
1999-00	48.57	419.91	35.94	116.31	23.55	56.59	61.20	119.64
2000-01	55.70	510.65	40.28	112.32	23.95	55.82	51.81	127.38
2001-02	58.58	553.30	38.44	104.11	22.87	59.71	58.33	156.35
2002-03	62.78	590.44	39.96	111.98	24.65	70.52	58.04	177.07

Source: The authors calculated on the data source of EPWRF and ASI various issues

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A study [6] pointed out that trade reforms helped promote industrial growth by providing better access to inputs and capital goods by encouraging foreign investment. The encouraged rapid growth in export-oriented industries and since these industries is moral labour-intensive; this had a favorable effect on employment. In general trade liberalization seems to have encouraged the growth of labor-intensive industries and labour intensive methods of production and this leads to increase in employment elasticity, resulting in faster growth in employment in manufacturing industry.

4. Conclusion

In the study we found workers influenced output in one industry namely, machinery equipment other than transport equipment industry in post globalisation period. However, in pre globalization period workers were influenced output in only other manufacture industry. As far as fixed capital is concerned, it influenced output growth in pre globalization period. However, the post globalization period only few industries have not reported influence of fixed capital on output growth viz, Manufacture of beverages, tobacco and related products and manufacture of textile products.

As far as factory is concerned, total study period (pre and post globalisation period together) shows that only a few industries viz, manufacture of food products, beverages tobacco and related products, wood and wood products, Basic chemical industry, non-metal products and metal products have reported influence of factory on output. In the pre globalization period a few factories have reported influence of factory on output namely, Beverages and tobacco and related products, wood and wood products, paper and paper products, Basic chemical industry and transport industry. However, in post globalization period, food products, rubber, plastic petroleum, Non-metal products and metal products have reported more influence on output.

Government has to give some incentives in regard to fixed capital to those industries not having sufficient level of fixed capital. For instance, all industries (except manufacture of beverages, tobacco and related products and manufacture of textile products) have reported that fixed capital influencing output considerably. It can be inferred that prospects of fixed capital influences output growth of the industries. Therefore, it should be ensured that industries in manufacturing sector having sufficient level of fixed capital.

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