Determinants of Industrial Productivity in India Before and After Liberalisation - An application of Discriminant Function

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Abstract

A well developed industrial sector covering various different areas is vital to economic development of a country. Since a variety of different industrial sectors are connected with each other thorough inter dependence of demand and supply, a well balanced industrial growth is at the centre of economic development. Estimation and analysis Productivity growth and productivity differential in manufacturing sector have been the most popular areas of applied economic research as it is based on the well-defined analytical framework of the standard economic theory of productivity. The reference period chosen for the study covers both pre and post liberalization period. The pre liberalization period covers between 1972-73 and 1990-91 and post liberalization period between 1991-92 and 2009-10. In this paper, a Discriminant Function Analysis is applied to find out the dominant factors which determine the productivity in manufacturing sector of Indian states. It was found that time factor was the first dominant factor to determine the pre and post liberalization period labour productivity. Both in the pre and post liberalization period capital productivity was dominated by wage rate. In determining the total factor productivity net value added was the prime factor between pre and post liberalization period.

Introduction

Supporting start-up industries and encouraging diversity in the Industrial Sector contribute towards a positive economic climate. In Globailized World Industries are expose to more risk and can be affected by external factors that are difficult to control. Providing encouragement and support to industry are essential if it is to grow and develop. By providing incentive to industries, an economy grows in tandem which in turn encourages further industrial development.

Since the economic reform period of 1991-92, the manufacturing sector has played a significant role in India economy contributing nearly 16 percent to

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GDP. Encouraged by an increasing presence of multinationals, scaling up of operations by domestic companies and an ever expanding domestic market, Indian manufacturing sector has been averaging a 9 percent growth in the last four years. India is fast emerging as a global manufacturing hub. Be it automobiles or computer hardware, consumer durables or engineering products, all are being manufactured by multinationals in India. India has become the global manufacturing hub for luxury brands over 1991-92 and 2009- 10 with US $500 million production. India has all the requisite skills in product, process and capital engineering, thanks to its long manufacturing history and higher education system. India's cheap, skilled manpower is attracting a number of companies, planning diverse industries, making India a global manufacturing powerhouse (Adhikary Maniklal and Ritwik Mazumder, 2009).

In order to have growth and equality of income distribution, India's manufacturing sector has to grow from its current percent of GDP closer to 30 percent. Most of empirical works find that the productivity growth plays a very important role in boosting up growth in the manufacturing sector as well as the standard of living of population. In transition economies, efficiency gains and improvements in productivity of the industrial sector are among the most important factors for successful economic reforms. Both at the firm and industrial level, the growth of productivity positively influences profitability through reduction of costs and hence price which ultimately strengthens the competitiveness of firms as well as the industry. The productivity growth has traditionally been regarded as one of the main sources of income growth along with capital accumulation and the deepening human resource skills. Advocates of liberalization argue that opening up local markets to foreign competition and foreign direct investment will help to improve the productivity of domestic industry resulting in more efficient allocation of resources and greater overall output. The productivity and efficiency are the two most important aspects to determine the relative performance of firms. It is necessary in this connection to recognize those factors which are exogenous to the system of production and which can account for inter-firm variations in efficiency and productivity.

Productivity growth and productivity differential in the manufacturing sector have been one of the most popular areas of applied economic research based on the well-defined analytical framework of the standard economic theory of the production function. But the primary weakness of this approach of measuring performance of production units through productivity growth is that it does not allow for the distinction between changes in technology and those in the efficiency due to application technology in the production system. The productivity across firms in an industry may vary due to technological differences, due to differences in the environment in which the production unit or in the firm operates (Arora and Singh. 2008).

The Productivity of an organization is defined as the ratio of output to resources used in the production process. The measurement of productivity is used to assess the extent to contribution of a given input to the total output. Some of the most common types of productivity measurements include labor productivity, machine or capital productivity and each one is measured in terms of partial productivity ratio. The most commonly used and widely reported partial productivity ratios are labour productivity ratio and capital productivity ratio. The inverse of these partial productivity ratios implies unit requirement of factor concerned for per unit output. The study of a partial productivity ratio is very helpful in measuring the saving of that particular factor over a period of time. Productivity may be measured for all the factors of production taken together. This is called total factor productivity and is generally used for measuring changes in productivity due to reasons other than those of factors employed. Measures of productivity describe how well the resources of an organization are being used to produce an output. They are very useful in achieving and maintaining high level of performance in any organization particularly in improving the efficiency of various operations within the organization. Productivity measures are also used for planning, monitoring, and improving performance at national levels (Laxminarayan, 2003).

Methodolgy

The reference period chosen for the study covers both pre and post liberalization period. The pre liberalization period covers between 1972-73 and 1990-91 and post liberalization period between 1991-92 and 2009-10. Data for the study such as net value added, total emoluments, fixed capital and number of employees were collected from secondary sources. They were collected from the sources such as Annual Survey of Industries and Economic Survey. Data relating to the states were aggregated and were deflated by GDP deflator.

Labour productivity **(PFPL)** was measured as a ratio of value added to total number of persons employed. Capital Productivity **(PFPK)** was measured as a ratio of value added to gross fixed capital. Total factor productivity indices were calculated by applying direct method of sqare root of **(PFPLXPFPK)**, where **PFPL** represents partial factor productivity of labour and **PFPK** represents partial factor productivity of capital. To identify the dominant factors which discriminate the performance of aggregate manufacturing sector among the Top Ten Richest States of India between pre and post liberalization period, the discriminant analysis was applied by taking partial factor productivity of labour (PFPL), partial factor productivity of capital (PFPK) and total factor productivity (TFP) as dependent variables and net value added, capital intensity, wage rate and time factor as independent variables. Selected variables were used to find out relative contribution in discriminating the groups. Wilk's lambda and 'F' value were used to find out whether the means of the two periods differ significantly. Using canonical discriminant function, coefficient of selected variables in discriminating the groups was found out. The functional form is represented as follows.

$Z = L1X1+L2X2+L3X3+L4X4$

Z = Discriminant total scores for pre and post-liberalization period (0 for pre-liberalisation period and 1 post- liberalization period)

Xi = Net value added, capital intensity, wage rate and time factor.

Results and discussion

The first step in the discriminant analysis was the estimation of univariate F-statistic and Wilks lamda. If the Wilks lamda approaches 0, it indicates significant mean difference between the pre and post liberalisation period. If it approaches 1, it indicates absence of mean difference. Table-1 shows the estimated F-value and Wilks lamda.

Table-1

WILKS LAMDA AND UNIVARIATE F- STATISTICS FOR PARTIAL AND TOTAL FACTOR PRODUCTIVITY

Variables	Wilks lamda			F- value		
	PFP_L	PFP_K	TFP	PFP_L	PFP_K	TFP
Net Value Added	0.974	0.983	0.931	0.944	0.628	2.686
Capital intensity	0.973	0.975	0.997	0.993	0.922	0.100
Wage Rate	0.952	0.956	0.989	1.799	1.657	0.407
Time Factor	0.964	0.976	0.936	1.342	0.872	2.470

Note: Calculations are based on ASI data

It was very clear that the Wilks lamda for net value added, capital intensity, wage rate and time factor were less than one. Hence the above said factors were capable to distinguish the pre and post liberalization period productivity.

Canonical Discriminant Co-efficients

To identify the significant factors determining productivity canonical discriminant co-efficients were calculated. The magnitude of canonical discriminant coefficients indicates the degree of contribution towards the pre and post liberalization period which is is presented in table-2.

Table-2

Canonical Discriminant Function for Partial and Total Productivity

Variables	Canonical discriminant coefficients			Ranks		
	PFP_L	PFP_K	TFP	PFP_L	PFP_K	TFP
Net Value Added (NV)	-0.115	-0.127	-0.137	3	4	4
Capital intensity(CI)	0.018	0.084	0.033	4	2	3
Wage Rate(WR)	0.161	0.150	0.142	1	1	1
Time Factor(TF)	0.051	0.055	0.068	2	3	2

Note: Calculations are done by the author based on ASI data

Based on the standardised canonical discriminant function which represented a linear composition of the data variability the group variability was estimated as follows.

Z(PFPL)= -0.115NV-0.018CI+0.161WR+0.051TF
Z(PFPK)= -0.127NV+.084CI+0.150WR+0.055TF
Z(TFPK)= -0.137NV+0.033CI+0.142WR+0.068TF

In the above function the variables such as capital intensity, wage rate and time factor had positive signs indicating that these variables had higher discriminating power between pre and post liberalization period. In other words these variables distinguished partial factor productivity of labour, partial factor productivity of capital and total factor productivity between pre and post liberalization period. The other variables having negative sign implied that these variables acted as a suppressor variables.

RELATIVE CONTRIBUTION OF VARIABLES

The relative contribution of selected independent variables to partial and total factor productivity were calculated and presented in table -3.

TABLE-3

Relative Contribution of Variables for Partial and Total Factory Productivity Variables Relative contribution

	PFP_L	PFP_K	TFP
Net Value Added	-17.11	27.91	55.92
Capital intensity	-1.93	15.54	-1.89
Wage Rate	25.93	41.85	18.36
Time Factor	93.11	14.69	27.61

Note: Calculations are done by the author based on ASI data

Time factor was the first dominant factor to determine the pre and post liberalization period labour productivity and it alone contributed 93.11 percent. Next to time factor, wage rate contributed 25.93 percent, net value added and capital intensity contributed negatively.

The pre and post liberalization period capital productivity was dominated by wage rate by contributing 41.85 percent. This was followed by net value added (27.91 percent), capital intensity (15.54 percent) and time factor (14.69 percent). In determining the total factor productivity net value added was the prime factor between pre and post liberalization period. Its contribution was 55.92 percent. Next to net value added, the time factor contributed 27.61 percent and wage rate contributed negatively to the extent of 1.89 percent.

References

Adhikary Maniklal and Ritwik Mazumder (2009), "Economic Reforms and Manufacturing Sector Productivity in West Bengal", in *Economic Reforms and Productivity Changes in Selected Indian Industries* (ed. by) Adhikary Maniklal and Ritwik Mazumder, Abhijeet Publication, New Delhi.

Laxminarayan, (2003), "*Productivity and Wages in Indian Industries",* Discovery Publishing House, New Delhi.

Arora, V. and Singh, P. (2008), "Economic Reforms and Productivity Growth in Indian Manufacturing Sector: An Interstate Analysis", *ICFAI Journal of Industrial Economics,* 5(.3): .35-45.

*Annual Survey of Industries. (*2011) Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India, New Delhi, accessed from Website : www.mospi.nic.in