

Impact of Economic Reforms on Productivity Performance of Manufacturing Sector in South India

M.Manonmani

The four southern states – Andhra Pradesh, Karnataka, Kerala and Tamil Nadu - contribute over 24.3 percent of the GDP of the country. They are emerging as the major destination for industrialization. This paper analyses the growth and determinants of partial and total factor productivity in the aggregate manufacturing sector of the southern states during 1991/92 – 2011/12. The annual trend rates revealed that labor productivity growth rate was maximum in the state of Tamilnadu (9.15percent). The indices of capital productivity had shown increasing trend in case of Andhra Pradesh, Kerala and Tamil Nadu except Karnataka. The total factor productivity was found to be increasing from the beginning of the post- liberalization period in all the southern states.

M.Manonmani is Professor in Economics, Avinashilingam Institute for Home Science & Higher Education for Women, Coimbatore-641043. E-mail: manomyil@yahoo.com

Introduction

Industrialization has been viewed as a pre-requisite to economic transformation of the society. It has been recognized that industrialization is the surest solution to the problem of raising the standard of living of the people. The progress of industrialization since 1951 has been a striking feature of Indian economic development. The process of industrialization launched as a conscious and deliberate policy under Industrial Policy Resolution of 1956 and vigorously implemented under the Five Year Plans, involved heavy investments in building up of capacity over the last 56 years, making India the 10th most industrialized country in the world. The industrial structure has been widely diversified covering broadly the entire range of consumer, intermediate and capital goods. The progress which India has made in the field of industrialization is clearly reflected in the commodity composition of India's foreign trade, in which the share of

imports of manufactured goods has steadily declined. On the other hand, industrial products particularly small engineering goods have become a growing component of India's export. Finally the rapid stride in industrialization has been accompanied by corresponding growth in technological and managerial skills for efficient operation of the most sophisticated industries and also for planning, designing and construction of such industries.

Estimating productivity level and growth rate as well as analyzing productivity determinants gained a renewed interest both among growth economists and trade economists.

One major objective of trade liberalization in India has been to enhance industrial productivity and input-use efficiency.

With the introduction of economic reforms in 1991, Indian industries have been witnessing profound changes in the basic parameters governing its structure and functioning. Relaxing of licensing rule, reduction in tariff rates, removal of restriction on import of raw materials and technology, price decontrol, rationalization of customs and excise duty, enhancement of the limit of foreign equity participation etc. are among those which have been introduced at early 90's. One major objective of trade liberalization in India has been to enhance industrial productivity and input-use efficiency. This has been made possible with the greater and cheaper access to imported know-

how, capital goods, intermediate goods and global capital, relaxing constraints on various input use and technology choices, increased domestic and international competitive pressures by bringing in technological dynamism in industries and permitting more efficient firms to grow and competing out inefficient ones. With the introduction of economic policy reforms, Indian industries have been undergoing structural reforms and facing hard competition from external markets. Growth of a firm depends on the efficient and rational use of the scarce resources available to it. In other words, it is the level of productivity of the factors of production that determines the sustainability of the firm. It was recognized that output growth could not be enhanced by continuous input growth in the long-run due to the nature of diminishing returns for input use. For sustained output growth, TFP (Total Factor Productivity) growth is essential (Sarbapriya Ray et.al, 2010).

Sandeep Kumar and Kavita (2012) in their study also stressed that productivity is a key and major factor in the success of any socio-economic system because of its direct relationship with economic welfare. The concept of productivity has come into greater prominence during recent years in the context of industrial development. If some production units can be used more efficiently, the net addition to the total national product will be much higher which will result in the process of industrial growth. Productivity increase is, thus, an indispensable and powerful stimulus to and the end – result of a complex socio-economic process of economic development. Since the

objective of productivity increment and economic growth is to satisfy the material needs of individual members as well as of society to the fullest possible extent, economic growth is positively correlated with productivity increase. The degree of general welfare, in its ultimate analysis, is therefore, the real barometer of a nation's progressive prosperity.

The liberalization, privatization and globalization (LPG) policies that started in early 1980s in India, and strengthened in the 1990s, opened the Indian manufacturing sector to greater competition from within as well as from outside. One of the major components of the economic reforms package has been the deregulation and delicensing in the manufacturing sector. The justification provided for this often centers on the reason of encouraging competition, which, in turn, is expected to enhance the efficiency and productivity performance of the manufacturing sector. Given that the main objective of reforming the manufacturing sector was to improve industrial productivity, it would be appropriate to probe how far the reforms have contributed to the productivity performance of the Indian manufacturing sector.

The economy of southern region plays a significant role in achieving higher GDP growth rate of the country. The four southern states – Andhra Pradesh, Karnataka, Kerala and Tamil Nadu – contribute over 24percent of the GDP of the country. They are emerging as the major destinations for industrialization. Further the southern states are galloping much ahead of the poorest but

populous northern states with higher economic growth rates. Attempt is made in this paper to analyze the growth and determinants of partial and total factor productivity in the aggregate manufacturing sector of southern states of India.

Data Base of the Study

The basic data source of the study on number of firms, fixed capital, wages, net value added and number of workers was the Annual Survey of Industries (ASI) published by Central Statistical Organization (CSO), Government of India. All the referred variables were normalized by applying Gross State Domestic Product (GSDP) deflator. The GSDP at current and constant prices were obtained from Economic Survey, published by Government of India, Ministry of Finance and Economic Division New Delhi. The reference period chosen for the study covers post-liberalization period between 1991-92 and 2011-12.

Productivity Indices

Labor productivity (PFPL) is measured as a ratio of net value added to total number of persons employed. Capital Productivity (PFPK) is measured as a ratio of net value added to gross fixed capital.

Total factor productivity (TFP), in a simple way, is defined as output per unit of inputs. It is the ratio of aggregate output index to aggregate input index and measures the efficiency of all inputs in a production process. In other words, TFP is the portion of output not explained by

the amount of inputs used in production. This is known as a residual (Melaku T. Abegaz, 2013) and is calculated by making use of the formula as follows.

TFP is the portion of output not explained by the amount of inputs used in production.

$$TFPDM = \sqrt{PFPK} \cdot \sqrt{PFPL}$$

Where TFPDM=Total Factor Productivity Index of Direct Method

PFPL=Partial Factor Productivity of labor

PFPK=Partial Factor Productivity of capital

To find out the annual trend rates in various factor productivity indices, the exponential growth function of the following form was used:

$$Y = AB^t$$

Where Y=Dependent variable

A=Constant co-efficient

B=Parameter

T=Time factor

The values of A and B were estimated by converting the exponential equation in to linear function of the form:

$$\text{Log} Y = \text{Log} A + t \log B.$$

After getting B (coefficient) the following method was being used to estimate the growth rate= [Antilog B – 1] x 100.

Linear Regression Models

The dependent variables were Labor Productivity (LP), Capital Productivity (CP) and Total Factor Productivity index of Direct Method (TFPDM) and the independent variables were Capital Intensity (CI), Growth Rate of Net Value Added (GRNVA), Size of the factories (SIZE) and skill of the workers (SKILL). The OLS model was used to estimate the models.

Model-1

$$LP = \beta_0 + \beta_1 \text{ SIZE} + \beta_2 \text{ SKILL} + \beta_3 \text{ CI} + \beta_4 \text{ GRNVA}$$

Model-2

$$CP = b_0 + b_1 \text{ SIZE} + b_2 \text{ LP} + b_3 \text{ SKILL} + b_4 \text{ CI} + b_5 \text{ GRNVA}$$

Model-3

$$TFPDM = \alpha_0 + \alpha_1 \text{ SIZE} + \alpha_2 \text{ LP} + \alpha_3 \text{ SKILL} + \alpha_4 \text{ CI} + \alpha_5 \text{ GRNVA}$$

Where

LP=Labor Productivity indices measured as the output -labor ratio

CP=Capital Productivity indices measured as the output -capital ratio

TFPDM =Total Factor Productivity indices computed by the direct method.

GRNVA =Growth rate of net value added in year 't' i.e. $(Q_t - Q_{t-1}) / Q_{t-1}$.

CI=Capital Intensity measured as the capital- labor ratio.

SIZE= Industry size calculated as the number of employees over the number of firms in the industry.

SKILL =Skill of workers calculated as the real wages by the number of workers.

$\beta_0, \alpha_0, \beta_0,$ = Constant coefficients of different models

$\beta_1, \beta_2, \beta_3, \beta_4$ = Coefficients of SIZE,

SKILL, CI, GRNVA respectively in model 1

b1, b2, b3, b4, b5 = Coefficients of SIZE , LP, SKILL, CI, GRNVA respectively in model 2

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ =Coefficients of SIZE, LP, SKILL , CI, GRNVA respectively in model 3

Partial & Total Factor Productivity Indices

Details regarding state-wise growth of labor productivity are presented in Table 1

Growth of Labor Productivity indices in the aggregate manufacturing sector of southern states shows that from the beginning to the end of the period it was maximum in Andhra Pradesh (18.53 fold) followed by Karnataka (9.54 fold) Kerala (6.39 fold) and Tamilnadu (9.32 fold).The annual trend rates calculated revealed that Labor Productivity growth rate was maximum in

Table 1 State-wise Growth of Labor Productivity (1991-92=100)

Year	Andhra Pradesh	Karnataka	Kerala	Tamilnadu
1991-92	100	100	100	100
1992-93	107	102	76	97
1993-94	120	91	79	114
1994-95	136	115	81	116
1995-96	351	363	279	356
1996-97	325	323	244	335
1997-98	381	278	226	282
1998-99	336	320	345	291
1999-00	321	313	196	325
2000-01	317	320	238	334
2001-02	360	357	229	294
2002-03	348	407	267	283
2003-04	453	439	251	329
2004-05	1017	981	504	600
2005-06	1038	816	523	705
2006-07	1465	1047	378	755
2007-08	1534	1066	590	775
2008-09	1493	1158	619	632
2009-10	1227	650	494	672
2010-11	1789	780	567	778
2011-12	1853	954	639	932
Constant(A)	92.046** (7.145)	118.828*** (3.032)	87.139** (6.660)	106.536** (7.314)
Parameter(B)	9.50** (12.946)	6.52*** (3.648)	8.91** (8.331)	9.15** (9.619)
R ²	0.903	0.425	0.794	0.837
F-value	167.600	13.307	69.402	92.530
D-W statistic	0.734	1.996	1.849	0.991

Source: Calculations are based on ASI data

Note: ** significant at 5% level

***significant at 10% level

Figures in parentheses indicate 't' values

the state of Andhra Pradesh (9.50 per cent) followed by Tamil Nadu (9.15 percent) Kerala(8.91 percent) and Karnataka (6.52 percent) which were statistically significant at 5 percent level. The co-efficient of determination (R^2) ranged between 0.425 and 0.903 across the states. The maximum R^2 was recorded by the state of Andhra Pradesh implying that more than ninety

per cent(90.3 %) of the variation in the growth of Labor Productivity in this state was due to the influence institutional factors and the remaining 0.7 percent was incidental. The significant growth rate of Labor Productivity in all the states might be due to reduction in working time, high minimum wage which stimulates laborers to work more in less time, keeping less productive

Table2 State-wise Growth of Capital Productivity (1991-92=100)

Year	Andhra Pradesh	Karnataka	Kerala	Tamilnadu
1991-92	100	100	100	100
1992-93	116	86	97	98
1993-94	119	77	89	105
1994-95	164	82	100	88
1995-96	216	75	90	99
1996-97	173	71	110	90
1997-98	197	49	74	81
1998-99	167	36	128	81
1999-00	181	43	80	83
2000-01	182	44	98	93
2001-02	185	43	88	85
2002-03	191	49	100	73
2003-04	210	55	111	86
2004-05	243	75	103	89
2005-06	242	67	109	97
2006-07	285	88	78	106
2007-08	263	81	122	104
2008-09	256	69	122	85
2009-10	255	55	108	94
2010-11	267	65	105	99
2011-12	288	53	108	102
Constant(A)	1.206** (15.837)	.854* (3.680)	.914** (14.868)	.911 (.219)
Parameter(B)	8.96** (8.575)	-0.041 (-1.801)	0.008 (1.498)	0.000 0.119
R^2	0.803	0.153	0.111	0.001
F-value	7.353	3.245	2.244	0.014
D-W statistic	1.248	1.042	3.071	1.066

Source: calculations are based on ASI data

Note: Figures in parentheses indicate 't' values

*significant at 1% level

** significant at 5% level

persons out of employment and advancement in technology.

In Table 2 growth of Capital Productivity across the southern states is presented.

The indices of Capital Productivity had shown increasing trend in case of all states except Karnataka where it had declined at the end of the period. Excepting Andhra Pradesh all the other states had recorded insignificant Capital Productivity annual trend rate. Andhra Pradesh recorded 8.96 percent growth rate which was statistically significant. The probable reason for the decline in Capital Productivity in Karnataka may be the differences in technology, differences in the efficiency in the production process and the differences in the environment in which the production units operate.

Details on growth of total factor productivity are presented in Table 3.

The Total Factor Productivity indices were found to be increasing from the beginning of the post-reform period in all the southern states. But the estimated growth rate of Karnataka was statistically insignificant. Statistically insignificant growth rate of 2.82 percent observed in the case of Karnataka might be due to the specific reason that increase of factor inputs without corresponding increase in the output and heavy dependence on IT based enterprises. The varying levels of magnitude of Total Factor Productivity explained the

fact that across the states the significant growth rate of 9.46 percent was recorded by Andhra Pradesh followed by Tamilnadu (8.98 percent) and Kerala (8.72 percent) which were statistically significant at 5 percent level. It might be due to the provision of better infrastructural facilities developed in these states in the post-reform period.

Table 3 State-wise Growth of Total Factor Productivity (1991-92=100)

Year	Andhra Pradesh	Karnataka	Kerala	Tamilnadu
1991-92	100	100	100	100
1992-93	112	94	86	98
1993-94	119	84	84	110
1994-95	150	97	90	101
1995-96	275	165	158	188
1996-97	237	152	163	173
1997-98	274	117	129	152
1998-99	237	107	210	154
1999-00	241	116	126	164
2000-01	240	119	153	176
2001-02	258	124	142	158
2002-03	258	142	164	144
2003-04	309	155	167	169
2004-05	497	271	228	231
2005-06	501	234	239	262
2006-07	646	304	172	283
2007-08	636	294	268	284
2008-09	619	282	275	232
2009-10	560	189	231	251
2010-11	589	209	245	288
2011-12	731	224	262	309
Constant(A)	1.054** (10.533)	1.007* (3.483)	.892** (11.172)	0.195 (.541)
Parameter(B)	9.46** (12.391)	2.82 (1.245)	8.72** (7.546)	8.98** (8.648)
R ²	0.895	0.079	0.760	0.806
F-value	153.547	1.550	56.941	74.781
D-W statistic	0.858	1.651	2.259	1.133

Source: Calculations are based on ASI data

Note: *significant at 1% level

** significant at 5% level

Figures in parenthesis are the 't' values

Determinants of Partial and Total Factor Productivity Growth

The regression coefficients of Labor Productivity (Model 1) are presented in Table 4

In Andhra Pradesh skill of the workers (LnSKILL), capital intensity (LnCI) and growth rate of net value added

Table 4 Regression Coefficients Based on Labor Productivity Model

Coefficients	Andhra Pradesh	Karnataka	Kerala	Tamilnadu
Intercept ($\hat{\alpha}_0$)	62.425*** (2.302)	28.659 (.094)	-74.213 (-.945)	-58.680 (-1.036)
LnSIZE ($\hat{\alpha}_1$)	-.633*** (-3.196)	-2.849 (-.862)	.434 (.467)	0.013 (.019)
LnSKILL ($\hat{\alpha}_2$)	.054 (.507)	3.011*** (4.113)	.683 (1.176)	0.900 (.981)
LnCI ($\hat{\alpha}_3$)	1.484** (9.280)	-.230 (-1.192)	.533 (1.030)	.430 (.991)
LnGRNVA ($\hat{\alpha}_4$)	.838*** (22.711)	0.052*** (2.320)	.288*** (2.848)	0.665*** (2.673)
R ²	.999	.919	0.918	.966
D.F.	4.724	31.753	31.550	78.711
D -W statistic	1.916	1.1283	1.946	1.661

Source: calculations are based on ASI data

Note: ** significant at 5% level

***significant at 10% level

(LnGRNVA) have positively affected labor productivity while size of its sector (LnSIZE) had shown negative relationship with labor productivity (LnLP). Verdoorn's law was proved with the positive and statistically significant co-efficient of net value added (LnGRNVA) with the dependent variable labor productivity (LnLP). In Karnataka, skill of the workers (LnSKILL) and growth rate of net value added (LnGRNVA) had contributed positively to labor productivity (LnLP). In this state also the Verdoorn's law was re-visited. In the state of Kerala all the factors such as size of the manufacturing sector (LnSIZE), skill of the labor force (LnSKILL), Capital Intensity (LnCI), growth rate of net value added (LnGRNVA) had shown positive influence over the labor productivity (LnLP). The results of regression analysis of Tamilnadu explained the fact that all the independent variables were able to contribute positively to the growth

of labor productivity (LnLP). But the co-efficient of growth of net value added (LnGRNVA) was statistically significant at 10 percent level. Also the Verdoorn's law was found applicable in this state.

Details on determinants of capital productivity based on regression Model 2 in the post-reform period in the southern states of India are presented in Table 5.

Out of the 5 independent variables, 3 [skill of the labor force (LnSKILL), labor productivity (LnLP) and growth rate of net value added (LnGRNVA)] were positively related with the dependent variable capital productivity in Andhra Pradesh. The contribution of labor productivity (LnLP) and size of the firm (LnSIZE) were statistically significant at 5 percent level in determining the capital productivity in the case of Karnataka. The other independent vari-

Table 5 Regression Co-efficients Based on Capital Productivity Model

Co-efficients	AndhraPradesh	Karnataka	Kerala	Tamilnadu
Intercept (b0)	242.204*** (3.868)	-299.181** (-6.470)	101.990** (16.438)	98.678** (25.33)
LnSIZE (b1)	-1.099 (-1.831)	29.911** (5.989)	-0.002 (-.009)	-0.085 (-1.327)
LnLP (b2)	.214 (1.918)	4.413** (8.172)	.478** (18.409)	.305** (12.352)
LnSKILL(b3)	.380 (1.740)	-3.379 (-1.615)	.036 (.609)	.113 (1.364)
LnCI (b4)	-.853** (-5.415)	-0.919*** (-2.565)	-.525** (-12.805)	-.353** (-8.484)
LnGRNVA (b5)	.076 (.911)	-.177** (-3.191)	-.007 (-.609)	.008 (1.445)
R ²	.928	.980	.978	.951
D.F.	35.821	134.649	125.461	54.743
D-W statistic	1.546	2.227	1.692	1.820

Source: Calculations are based on ASI data

Note: * significant at 1% level

** significant at 5% level

***significant at 10% level

Figures in parentheses indicate 't' values.

ables such as skill of the labor force (LnSKILL), capital intensity (LnCI) and growth rate of net value added (LnGRNVA) had negative relationships. The co-efficients of regression equation for the state of Kerala brought out the fact that skill of the labor force (LnSKILL) and labor productivity (LnLNLP) were positively related to capital productivity (LnCP) while size of the firm (LnSIZE) capital intensity (LnCI) and growth of net value added (LnGRNVA) had contributed negatively towards the growth of capital productivity (LnCP) of the state. The statistically significant factor determining capital productivity (LnCP) was found to be labor productivity (LnLP).

Regression results relating to Tamilnadu showed that labor produc-

tivity (LnLP) and capital intensity (LnCI) had influenced positively the growth of the dependent variable capital productivity (LnCP) but the co-efficient of labor productivity (LnLP) was statistically significant at 10% level.

The determinants of total factor productivity in the post-reform period based on the regression Model 3 are shown in Table 6.

In Andhra Pradesh excepting labor productivity (LnLP) and skill of workers (LnSKILL) the other variables such as industry size (LnSIZE), capital intensity (LnCI) and growth of net value added (LnGRNVA) had negatively contributed to the growth in TFP. In Karnataka the co-efficient of labor pro-

Table 6 Regression Co-efficients Based on Total Factor Productivity Model

Co-efficients	Andhra Pradesh	Karnataka	Kerala	Tamilnadu
Intercept (α_0)	122.778* (4.082)	1154.769* (3.461)	676.742* (3.804)	256.947 (1.492)
LnSIZE (α_1)	-.341* (-3.079)	-4.910** (-2.076)	-3.473* (-4.474)	.075* (.3400)
LnLP(α_2)	.361* (3.803)	1.373* (1.882)	1.382* (25.27)	.945 (.734)
LnSKILL (α_3)	.681* (3.983)	-.982* (-.393)	.845 (.416)	.343*** (.108)
LnLNCI (α_4)	-.715* (-3.190)	-21.779 (-.914)	-.527* (-15.120)	-1.183* (-12.543)
Ln GRNVA (α_5)	-.037 (-1.043)	.089 (1.020)	-.613 (-.402)	.070 (3.289)
R ²	0.994	.516	.327	0.802
D.F.	428.926	2.989	1.358	.244
D-W statistic	1.968	1.460	1.293	2.611

Source: Calculations are based on ASI data

Note: *significant at 1% level

** significant at 5% level

*** significant at 10% level

Figures in parentheses indicate 't' values.

ductivity (LnLP) and growth rate of net value added (Ln GRNVA) were positive implying the fact that their contributions were always positive across the reference period. Factors like size of the industry (LnSIZE), skill of the workers (LnSKILL) and capital intensity (LnCI) were negatively affecting TFP growth. In Kerala, excepting labor productivity (LnLP) and skill of the workers expressed in terms of real wage rate (LnSKILL) all the other factors affected the total factor productivity (LnTFP) negatively. In the case of Tamilnadu the TFP growth performance was mixed (positive/negative) due to the influence of the independent variables. The impact due to the changes in the independent variables was positive excepting capital intensity (LnCI).

Conclusion

The above analysis clearly explains the fact that labor productivity is an indicator of the efficiency with which labor is used in the production process. Differences in labor productivity arise from differences in the scale of production (LnGRNVA), the amount of capital available per worker (LnCI), the skills possessed by workers (LnSKILL), and other organizational characteristics including technology (LnCI) possessed by firms in the southern states of India. Efficiency of capital productivity and total factor productivity is always associated with labor productivity.

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