Efficiency and Scale Effects in Factor Productivity in India

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Abstract

Based on the time series secondary data for pre as well as post economic reform periods this study analysis the effect of economic reforms on factor productivity in India. Estimates of constant growth rate, factor productivity and its differentials have been obtained through the OLS method. The main result of this study is that as the result of economic reforms the more emphasis was given to the capital intensive technique and the role of capital has been estimated significant in the process of affecting the Indian economic growth levels.

Keywords: Economic Reform, Productivity, Economic Growth, Government Policy.

Introduction

The economic reforms programme adopted by the Indian government in 1991-92 aimed at rapid and substantial integration of the Indian economy with the global economy in a harmonized manner. Accordingly, the industrial policy in the post-reforms period mainly aimed at de-licensing, privatization, FDI promotion and trade liberalization in the manufacturing sector. As, we know that Indian economy has been undertaking significant liberalization initiatives since 1991-92 with a view to achieve faster GDP growth, our policy makers have made multidimensional efforts for the purpose and thus these efforts have affected the levels of economic growth. During these efforts the use of factors of production in the growth process has been assigned the important role. Domestic as well as foreign capital showed inflow in the Indian economy affecting the employment of labour in private as well as public sectors and thus the Indian economy got affected by the capital and labour at the large. The labour in private and public sector shows the increasing trend which affected the levels of economic growth in India. The present paper attempts to investigate how the economic reforms have affected the on factor productivity. The capital formation and employment level of private and public sector influenced the national income of India. Many studies regarding economic reforms have been conducted in different spheres. **Mitra et al (2002)** examined the effects of infrastructure on total factor productivity and technical efficiency of manufacturing industries in the Indian states. The last two decades have witnessed the role of economic reforms by affecting the employment in private and public sectors. Thus, the privatization changed the economic scenario of India. **Bhargava and Joshi (1990)** discussed the growth rates of GDP at both the aggregate and disaggregate levels. Similarly, **Nagraj (1989)** had compared growth in the past 1980 period with growth from the mid-1950s to mid-1960s and a period of stagnation between the mid-1960s to 1980-81. Having discussed the problem to be investigated, this study mainly has the following

Objectives

1. To estimate and analyze the growth rate of national income, employment and capital formation, and
2. To estimate factor productivity differentials of labour and capital and to decompose them into efficiency and scale effects.

The remainder subject matter of the paper has been organized as follows; section II describes the basic specification of models, data and variables to be used. Section III provides the analysis of estimated results regarding factor growth rate, national income growth and factor differentials, while section IV deals with the policy implications with some important suggestions.

Empirical Models, Data and Variables

This study considers and estimates the following three types of econometric models.

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Growth Models

To study the growth of national income and factors of labour and capital for the period considered, the constant growth model has been used as below

$$LnY = a + bT$$

Where Y is in logarithmic form of the dependent variable, like national income, employment and capital formation and T is the time in the form of years considered. In the equation b measures the constant growth rate. This growth model has been estimated both for the pre-economic reforms and post-economic reforms period separately.

National Income Growth Models

To study the impact of labour employed and capital on economic growth the following regression equation has been estimated;

$$NY = F (Empr, Empu, Cfpr, Cfpu)$$

Where, NY- National Income, Empr- Employment in private sector, Empu- Employment in public sector, Cfpr- Capital formation in private sector, Cfpu- Capital formation in public sector.

Considering private and public capital and private and public labour employment as a whole the following national income growth model has also been estimated.

$$NY = F (Gemp, Gcf)$$

Where, Gemp- Gross employment and Gcf- Gross capital formation.

The above econometric models of national income growth have been estimated in the log-linear form by the technique of Ordinary Least Squares method for the both the periods of pre-economic reforms and post-economic reforms. These models can be described as below;

$$\ln NY = \beta_0 + \beta_1 \ln Empr + \beta_2 \ln Empu + \beta_3 \ln Cfpr + \beta_4 \ln Cfpu \quad (1)$$

$$\ln NY = \beta_0 + \beta_1 \ln Gemp + \beta_2 \ln Gcf \quad (2)$$

Factor Productivity Differentials Model

It has been studied that in pre-economic reforms and post-reforms the factors of labour and capital productivity differentials have been found and these differentials need to be decomposed into efficiency and scale components. The efficiency component of the productivity differentials tells about the qualitative impact of the factor while the scale component describes the factor affecting productivity differentials of quantity. For the purpose of decomposition of factor productivity differentials, the national income growth equations for pre-reforms and post-reforms period have been estimated. To see how factor differentials between pre-reforms and post-reforms period can be decomposed into efficiency and scale components, let us consider the function for the two time period symbolizing as 0 for the pre-reforms and as 1 for the post-reforms periods by superscripts. Now for model-I the function for the post-reforms periods can be expressed as:

$$\ln NY^1 = \beta_0^1 + \beta_1^1 \ln Empr^1 + \beta_2^1 \ln Empu^1 + \beta_3^1 \ln Cfpr^1 + \beta_4^1 \ln Cfpu^1 \quad \ldots (3)$$

And for the pre-reforms period as;

$$\ln NY^0 = \beta_0^0 + \beta_1^0 \ln Empr^0 + \beta_2^0 \ln Empu^0 + \beta_3^0 \ln Cfpr^0 + \beta_4^0 \ln Cfpu^0 \quad \ldots (4)$$

On subtracting equation (4) from equation (3) we can obtain the percentage change in factor output between post-reforms and pre-reforms periods. The results can be expressed as follows

$$\ln NY^1 - \ln NY^0 = \beta_0^1 + \beta_1^1 \ln Empr^1 + \beta_2^1 \ln Empu^1 + \beta_3^1 \ln Cfpr^1 + \beta_4^1 \ln Cfpu^1 - \beta_0^0 + \beta_1^0 \ln Empr^0 + \beta_2^0 \ln Empu^0 + \beta_3^0 \ln Cfpr^0 + \beta_4^0 \ln Cfpu^0 \quad \ldots (5)$$

By making the necessary arrangements in equation (5), we get,

$$\ln NY^1 - \ln NY^0 = [(\ln Empr^1 - \ln Empr^0)\beta_1^0] + [(\ln Empu^1 - \ln Empu^0)\beta_2^0] + [(\ln Cfpr^1 - \ln Cfpr^0)\beta_3^0] + [(\ln Cfpu^1 - \ln Cfpu^0)\beta_4^0] + [(\beta_0^1 - \beta_0^0) + (\beta_1^1 - \beta_1^0)\ln Empr^1 + (\beta_2^1 - \beta_2^0)\ln Empu^1 + (\beta_3^1 - \beta_3^0)\ln Cfpr^1 + (\beta_4^1 - \beta_4^0)\ln Cfpu^1]$$

By measuring all the variables at their sample mean, the average percentage factor difference is seen to be the sum of the five terms enclosed by brackets. The first right hand term is the employment difference due to job opportunities in private sector (multiplied by the estimated scale parameters β_1^*) this is simply the scale effect. By a similar argument the second in bracket picks up other inputs difference due to difference in employment in public sector. The third difference in capital formation is due to investment in private sector. The fourth term difference in capital formation is due to investment in public sector. The final term shows the difference due to difference in efficiency. Same method has been used for gross factor approach equations.

Data

The secondary time-series data for the period 1973 to 2010 have been used from Central Statistics Office, Handbook of Statistics on Indian Economy and Directorate General of Employment and Training, Ministry of Labour and Employment Government of India.

Analysis of Variables

Variables used in this study have been analyzed as below

National Income (NY)

National income has been used as a proxy variable for economic growth both in models of constant growth and national income growth.

Time (T)

Time has been introduced as a trend variable in constant growth equations. It has been assumed that due to the time-series nature of data, the variable T plays a significant role in affecting the levels of national income.

Private Employment (Empr)

The private sector employment has been considered to be a determinant of the growth and it

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has been hypothesized that the private employment affects the growth positively.

Public Employment (Empu)

In case of public employment it has been assumed that it is also related positively with the levels of economic growth in a country like, India.

Private Capital Formation (Cfpr)

Private capital formation has been used as a determinant of the economic growth. It has been obtained as a total of capital of household sector and private corporate sector. It has been assumed that private capital formation is positively related with the economic growth.

Public Capital Formation (Cfpu)

This variable has also been used as an independent variable in the national income growth equation. It has been assumed that there is positive relationship between public capital formation and the economic growth.

Analysis of Results

Tables 1-5 depicts the estimated results of this study in the sphere of constant growth rate, national income growth estimates and decomposition of factor productivity differentials.

Table-1
Estimates of Constant Growth Rates

Parameters	Pre-Reforms Period	Post-Reforms Period
EMPR	0.02*	-0.01*
EMPU	0.01*	0.02*
CFPR	0.14*	0.16*
CFPU	0.15*	0.12*
NY	0.04*	0.07*

Note: *-Significant at 1% level

In all the Cases the Goodness of Fit is Highly Significant at 1% Level

The Table-1 shows that in pre-economic reforms period the private employment significantly increased by 2% while in post-reforms period the private employment significantly decreased by 1%. In case of public sector employment the increased in both in pre and post economic reforms period is positively significant. This employment increased more in post economic reforms period than the pre economic reforms period. Regarding private capital formation there has been noted the significant positive growth rate but the growth rate has been estimated higher for the post economic reforms period. Inversely speaking, the public capital formation has been increased by lower margin in the post economic reforms period. Clearly speaking in case of capital formation in it has been increased in the private sector and decreased in the public sector in the post economic reforms period, also the capital intensive technique has been used specially in private sector. Regarding national income, it has increased by 7% in post economic reforms period and by only 4% in pre economic reforms period.

Table -2
Estimates of National Income Growth

Parameters	Pre-Reforms Period (1973-1991)	Post-Reforms Period (1992-2010)	Total Period (1973-2010)
constant	2.76** (1.91)	-0.88 (0.15)	1.25*** (1.34)
Empr	-0.51 (0.74)	1.27 (0.69)	0.49 (2.08)
Empu	0.67 (0.84)	0.06* (4.93)	0.33 (1.01)
Cfpr	0.46* (5.72)	0.64* (4.93)	0.70* (11.44)
Cfpu	0.43* (2.91)	0.20 (0.77)	0.08 (0.76
R²	0.995*	0.989*	0.997*
Adj.R²	0.993*	0.986*	0.996*
F	719.583	310.389	3246.98
Chow Test	-	-	2.693

Note : Values in parentheses are the absolute t – ratios.
: *- Significant at 1% level.
: **- Significant at 5% level
: ***- Significant at 10% level

Table-2 shows the estimates of the effect of private employment, public employment, private capital formation and public capital formation on the national income. In all the estimated cases private sector capital formation has shown the significant positive growth impact. This impact has been found 64% in post-reforms period which was 46% in pre-

reforms period. The productivity of public capital formation was significantly 43% in pre-reforms period which decreased upto 20% and become insignificant in post economic reform period. As far as the productivity of public employment is concerned it was significantly positive in post-reforms period. The productivity of private employment was although

insignificant positive in post-reforms period. In case of the total period the role of private employment and capital formation was significantly positive. In all the fitted model the explanatory power has been observed to be highly statistically significant. The value of Chow-test shows that at 5% level of significance there is significant structural differences in the national income growth equations for pre and post reforms period. It enables us to decompose the factor productivity differentials into efficiency and scale effects, which have been resulted in Table-4.

Considering the gross employment and capital formation, the estimates of national income growth equation has been shown in table-3.

Table -3
Estimates of National Income Growth (Gross Factor Approach)

Parameters	Pre-Reforms (1973-1991)	Post-Reforms (1992-2010)	Total period (1973-2010)
constant	2.87** (2.24)	1.02 (0.40)	1.64** (2.19)
Gemp	-0.21 (0.40)	0.54 (0.69)	0.18 (0.68)
Gcf	0.86* (13.21)	0.80* (34.64)	0.87* (48.84)
R²	0.995*	0.987*	0.997*
Adj.R²	0.994*	0.986*	0.996*
F	1528.59	630.589	5093.47
Chow Test	-	-	7.81

Note: Values in parentheses are the absolute t – ratios.
: *- Significant at 1% level.
: **- Significant at 5% level

It is clear that the productivity of gross capital formation is highly statistical significant in pre-reforms and post-reforms period and also in the total period the productivity of employment has been found insignificant in all the cases. The explanatory power of the estimated models is highly significant. The value of Chow-test shows that there is a significant structural difference in the estimated national income growth equations for the pre and post reforms period.

Table -4
Factor Differential Decomposition into Efficiency and Scale Components

Parameter	Calculated at Pre-Reform Period mean $x*=\bar{x}^0, \beta*=\beta^1$	Calculated at post-Reform Period mean $x*=\bar{x}^1, \beta*=\beta^0$
Efficiency Effect		
Intercept $(\beta_0^1 - \beta_0^0)$	-3.64	-3.64
ln$Empr$ $(\beta_1^1 - \beta_1^0)$ ln$\bar{Empr}*$	4.96	5.21
ln$Empu$ $(\beta_2^1 - \beta_2^0)$ ln$\bar{Empu}*$	-1.21	-1.34
ln$Cfpr$ $(\beta_3^1 - \beta_3^0)$ ln$\bar{Cfpr}*$	0.96	1.52
ln$Cfpu$ $(\beta_4^1 - \beta_4^0)$ ln$\bar{Cfpu}*$	-1.22	-1.74
Total	-0.15	0.01
Scale Effect		
ln$Empr$ $(\ln\bar{Empr}^1 - \ln\bar{Empr}^0)\beta_1^*$	0.18	-0.07
ln$Empu$ $(\ln\bar{Empu}^1 - \ln\bar{Empu}^0)\beta_2^*$	0.01	0.13
ln$Cfpr$ $(\ln\bar{Cfpr}^1 - \ln\bar{Cfpr}^0)\beta_3^*$	1.96	1.41
ln$Cfpu$ $(\ln\bar{Cfpu}^1 - \ln\bar{Cfpu}^0)\beta_4^*$	0.45	0.97
Total	2.6	2.44

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Table-4 presents the results regarding factor productivity differentials into efficiency and scale components. In case of efficiency effects the role of private employment and private capital formation has been found to be increased in post-reforms period in comparison to pre-reforms period. The role of public sector employment and capital formation has been observed reduced. The scale effects show that role of private capital formation is more than the public capital formation in affecting the levels of economic growth. It is also clear that factor productivity differentials have been found higher due to employment in the private sector.

Table -5
Factor Differential Decomposition into Efficiency and Scale Components (Gross Factor Approach)

Parameter	Calculated at Pre-Reform Period mean $X^*=\bar{X}^0, \beta^*=\beta^1$	Calculated at post-Reform Period mean $X^*=\bar{X}^1, \beta^*=\beta^0$
Efficiency Effect		
Intercept $(\beta_0^1 - \beta_0^0)$	-1.85	-1.85
lnGemp $(\beta_1^1 - \beta_1^0)$ lnG$\overline{emp}$*	2.37	2.49
lnGcf $(\beta_2^1 - \beta_2^0)$ lnGcf*	-0.36	-0.53
Total	0.16	0.11
Scale Effect		
lnGemp $(lnG\overline{emp}^1 - lnG\overline{emp}^0)\beta_1^*$	0.09	-0.03
lnGcf $(lnG\overline{cf}^1 - lnG\overline{cf}^0)\beta_2^*$	2.20	2.37
Total	2.29	234

Table-5 reports the estimates of factor productivity differentials decomposition. While considering the gross employment and capital formation the overall efficiency differences are being amounted 11% at the post-reforms means which has been found to be 16% at pre-reforms means. According to the scale differences the differentials amount to be 229% and 234% at pre-reforms and post-reforms mean respectively.

Conclusions and Implications

It is alleged that the technology introduced by liberalization in the form of FDI is highly capital intensive and therefore may tend to reduce the employment potential of industrialization. The technology provided by liberalization is not labour augmenting, but actually it is labour saving. Due to this role of capital has been found more in the growth of the Indian economy. In the economic reforms period the private setor put more emphasis on capital formation rather than labour intensity while the public sector noticed to assign higher priority to the employment creation. The productivity of labour and capital increased due to economic reforms but the productivity of capital has been found to be much higher than the labour.

Regarding the policy implications the public sector must also come forward and should play a significant role in the process of economic growth. The public sector should step-up along the private sector so the policy of active public sector should be forwarded in the years to come so as to boost the possibility of economic growth. Besides, the private sector should also look inito the social aspect to labour employment. Along with the capital intensive technique the efficiency of labour input should also be welcome. There is need of a sound cooperation between private and public sector regarding use of labour and capital for the purpose of higher economic well being.

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