Accounting Economic Growth Differential of Indian States

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ABSTRACT

This paper uses a combination of Growth Accounting Analysis and Regression Analysis to examine the economic growth experience of twelve major Indian States – six high-income and industrially developed; and six low-income and industrially underdeveloped, over the period 2000-21, through the decomposition of the total factor productivity in major sectors of the economy. The performance of the Low Income States has been perceptibly superior to that of the High Income States. All the sectors in each of the two categories of states have undergone a temporal deceleration in total factor productivity growth, thereby pointing toward the ineffectiveness of economic reform measures to induce progress in the states. However, in the overall Indian economy, various sectors (except Secondary and Tertiary-2) experienced productivity improvement over time. Further, total factor productivity contributed the most to output growth during the first decade (2000-01 to 2010-11), while labor acted as a prime mover during the second decade (2011-12 to 2020-21). The total factor productivity growth acted as the major source of economic growth in the aggregated Indian economy and signifies that although liberalization policies have shown desirable results at the aggregated level, there has been a considerable variation in the speed and extent of implementation of the reform measures across the states. Thus, for the states to surge ahead, it is imperative to address regional problems to enhance total factor productivity.

Keywords: *Factor share approach, Growth accounting, Kendrick index, Perpetual inventory method, Solow index, Total factor productivity, Trans log index.*

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Highlights of this paper:

- Total Factor Productivity (TFP) has undergone temporal deceleration in the Indian Economy.
- Economic Reforms in India in the 1990s have a considerable variation in the implementation across the high-income and low-income states.
- Deceleration points to the temporal ineffectiveness of the Economic Reforms in India.

1. INTRODUCTION

Seven decades of planning have hardly eliminated the inter-state differential in the level of development and rates of growth in the Indian States. Indian states have seen uneven economic growth that has polarized into two groups -a high-income clubs and low-income clubs. The high-income club constitutes states such as Gujarat, Maharashtra, Punjab, Haryana, Tamil Nadu, and Karnataka. The low-income club includes Orissa, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, and Uttar Pradesh. The states of Gujarat and Maharashtra are industrially driven and Punjab and Haryana, on the other hand, are India's 'bread basket', producing a large share of India's rice and wheat. Tamil Nadu is based on manufacturing and Karnataka has developed an independent growth engine of consulting in finance and information technology for the international market. States in the poorer club –Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, and Orissa have some agricultural activity but struggling hard with the natural calamities, and their contribution to the national GDP is minimal. Clearly, with no engine of growth, there is no economic mechanism by which these states can connect and benefit from a spillover effect of high-income states. This scenario has worrying implications for India's economic growth and regional development. While India has experienced unprecedentedly high GDP growth rates for the past several years, growth seems to have been fuelled by a few sectors of the Indian economy, and even worse, only a few states. India's growth hubs are not connected—either geographically or via a particular engine of growth. With only a handful of growth hubs with no spillover effects, the distribution of employment across the states is highly skewed, leaving pockets of poverty in the poorer state of India's uneven economic growth, therefore, threatening to exacerbate regional poverty. A question arises as to why economic growth differs across the states. It is suggested that this may happen as government policies influence the return to factors such as capital accumulation [King (1994); Levine and Renelt (1991); Young (1991)]. These studies may see the link between stable macroeconomic policies and economic growth, and the positive contribution of an open trade regime as robust findings.

2. GROWTH ANALYSIS

Studies about economic growth and its relationship have been pursued in the literature along three basic methods:

(i) The regression analysis estimates the parameters of underlying parameters;

(ii) The conditional regression analysis relies on a wide range of conditioning variables that influence the growth process;

(iii) The growth accounting analysis concentrates on dividing the sources of growth between the contribution of increases in the quantity of the factor inputs and the efficiency with which they are used. Each of these approaches has its uses and limitations.

Regression analysis is often used to estimate the relative role of the different factors, such as capital and labor, in the production process; but there are major issues of simultaneity, measurement error, and the choice of a specific functional form that generate considerable controversy. For many purposes, the use of each factor's share in total income is an equally valid and more straightforward means of measuring their relative importance. Finally, production function estimation often relies upon very simple measures of changes in technology -- a time trend plus

a catch-up term, for example. Yet, there is an increasing emphasis on differences in the technological component, total factor productivity, as critical to the explanation of differences in levels and rates of change of income per capita across countries. The more common objective of regression-based studies is to search for important regularities in the data: examining the correlation between economic growth, initial conditions, and the role of the government policy regime. These studies can be very useful in identifying important characteristics that distinguish the high and low-growth economies, but the methodology is limited as a means of providing insight into the channels through which the various factors operate. Thus, there is a substantial concern that the empirical results may reflect spurious correlations or the common influence of other unidentified factors.

Growth accounting offers a more structured framework for assessing the role of various factors in the growth process. It relies upon principles of cost minimization and marginal productivity analysis to use earnings as the basis for developing a set of weights to combine the various factor inputs into a total index. The focus is on obtaining quantity series for each input, which when multiplied by the input's weight yields its contribution to changes in output. A growth accounting exercise has the added benefit of forcing a more careful evaluation of the quality of the underlying data used in the analysis. It is, however, only an accounting framework in which the efficiency component is obtained as a residual; and, by its nature, it cannot identify the contribution of the more ultimate sources of growth, such as institutions and government policy that determine the environment within which economic activity takes place.

The recent regression studies reflect a particular interest in those policies that are commonly grouped under the heading of structural adjustment programs -- achieving a combination of stable macroeconomic policies and the enactment of liberalization policies that expand the scope for private markets. The studies have sought to go beyond the measurement of the proximate sources of growth to identify the role of the underlying institutional and other factors responsible for growth. They have been stimulated by the new literature on endogenous growth models, where there is a greater emphasis on efforts to explain changes in total factor productivity. A focus on the positive effects of improved education and physical investment, a convergence effect for countries that begin with a low level of GDP per capita, and negative effects due to large and distorting effects of government, and political instability. A primary difficulty of this type of analysis is in the interpretation of the results. The regressions provide little insight into the channels through which the various right-hand side variables affect growth, giving rise to concerns that they may reflect a reverse causal relationship or that the left and right-hand side variables are both influenced by the third set of other unspecified factors. Some of these concerns could be ameliorated if we could distinguish between effects on economic growth operating through changes in factor accumulation versus the efficiency with which they are used. This paper complements the existing research in two respects. First, we use an accounting framework to isolate the contributions to growth in output per worker of the accumulation of physical capital, improved education, and gains in the efficiency with which the factors are used. This involves the use of data on the stock of physical capital and measures on the educational attainment of the workforce, rather than relying on proxies, such as the investment rate or school enrollment rates, as is common with many of the prior studies. Second, we use these data to examine the correlation between economic growth and some of the posited fundamentals, but within a framework in which it can distinguish between their influence on factor accumulation and total factor productivity (TFP) growth. Thus, it is an attempt to combine the discipline of a growth accounting framework with the greater flexibility of the regression analysis to explore the channels through which government policies and institutional arrangements affect the growth process. The result is a decomposition of the growth in output per worker into two basic components of increases in capital per worker and gains in total factor productivity. All these suggest concluding that a growth accounting exercise yields substantially different implications about the relative roles of factor accumulation and TFP

growth than is often inferred from regression studies that rely on various proxies as measures of factor accumulation.

3. LITERATURE REVIEW

Several studies related to various aspects of growth accounting and total factor productivity have been conducted in India and elsewhere. Denison (1967) made an analytical comparison of sources of growth in the U.S. economy as against eight industrialized countries to observe that sources of growth vary in importance from time to time and place to place. Jorgenson and Griliches (1967) found that most of the growth in the U.S. was due to the growth in total inputs rather than a change in TFP. Bhattacharya (1972) analyzed the Indian economy to observe that the growth rate of output, as well as labor productivity in agriculture, was very low, and technological change virtually contributed nothing to output growth. Dholakia (1974) conducted a detailed study of the factor productivity of the Indian economy during the post-independence period and revealed that the observed increase in the growth rate of real national income was mainly due to an increase in the growth rate of TFP and labor input rather than capital. Using Solow and Translog indexes, Ahluwalia (1985) and Nagarajan (1985) estimated TFP for the manufacturing sector of India, which pointed toward a marginal deterioration in the rate of growth in TFP over time. Krishna (1991) examined the trends in output growth and TFP growth in the industrial sector in India from 1951 to 1986 and observed that the TFP growth in the organized manufacturing sector has grown at a meager rate of less than 0.1 percent per annum. Nehru and Dhareswar (1993) calculated TFP for a group of 92 developing and industrial countries' undergrowth accounting frameworks. As per their findings, TFP contributed more (than capital accumulation) to GDP growth in eight of the countries during the study span. By applying Kendrick, Solow, and translog indexes of TFP growth, Sethi (1997); Sethi (2005) observed that the major contributors to the growth rate of primary, secondary, and tertiary sectors of India were labor, capital, and TFP, respectively. And, for the aggregated economy, the maximum contribution was attributed to labor input. Through the growth accounting framework, Dholakia (2001) analyzed the sources of India's growth during the period 1960-61 to 2000-01 and found that 95 percent of the accelerated growth of GDP in the agricultural sector during the post-liberalization period had resulted from increased growth of TFP, while the remaining could be attributed to increased growth of factor inputs. Covering the period from 1960-61 to 1996-97, Sethi and Raikhy (2001) observed that for the Indian economy, the contribution of labor as a source of growth increased while that of capital decreased during the liberalization period. Gordon (2003) noticed a negative contribution of capital to the slowdown in growth in output (of private non-farm business, manufacturing, and private non-farm non-manufacturing sectors) in the case of the U.S. and Canada, although it was positive in the case of Japan, France, and Germany. Using Kendrick, Solow, and translog indexes, Saravanan (2008) measured total factor productivity growth (TFPG) for the manufacturing sector of 16 major states of India, spanning 1980-81 to 2005-06. The author observed that TFP growth has induced a slightly higher influence on the process of output growth during the 1990s *vis-à-vis* 1980s. Kumar and Kavita (2012) observed that the total factor productivity growth of the Indian manufacturing sector for all the states taken together and a few South-Indian states has declined during the post-reforms period *vis-à-vis the* pre-reforms period. Mamuneas and Ketteni (2012) found that although the contribution of TFP in output was positive in the case of Cyprus, the contribution of both labor and TFP was negative in each of the Euro Area and Greece.

Various other studies, such as due by Brahmananda (1982); Dholakia (1977); Dholakia (2001); Dholakia (1986); Dholakia (2009); Bosworth, Collins, and Chen (1995); Barro (1999); Goldar (2004); Pendse and Baghel (2008), *etc.*, have also dealt with the estimation of TFP in the context of Indian and other economies. Different studies have come out with varied conclusions regarding growth accounting, possibly due to differences in periods covered,

regions considered, methodologies adopted, and the concepts of factor inputs and outputs. Moreover, a growth accounting study has been reported by Sethi and Kaur (2013) in the context of the economies of Punjab and Haryana and Sinha and Sinha (2022) has done a growth accounting analysis of the economies of Bihar and Jharkhand. The present investigation was undertaken to estimate the relative contribution of various factor inputs and TFP in the overall growth of all the major states representing the rich club (Maharastra, Gujarat, Punjab, Haryana, Karnataka, and Tamil Nadu) and the low-income club (Orissa, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, and Uttar Pradesh) of the Indian economy for the period 2000-2021.

4. GROWTH ACCOUNT CONSTRUCTION

Construction of growth accounts needed i) Estimates of the economically-active population (labor force); ii) Measures of the educational attainment of the adult population to make it possible to adjust for improvement in skill; iii) Data set with estimates of the physical capital stock. These data are used to construct measures of real output per worker throughout 2000-2021 for a sample of 12 states, and the output growth is partitioned between the contribution of increases in the capital (broadly defined to include physical capital and educational skills) per worker and improvements in the efficiency with which the factors are used, total factor productivity (TFP). Growth accounts are consistent with a wide range of alternative formulations of the relationship between the factor inputs and output. The following three sub-sections discuss the measures of output, physical capital, labor, and education in greater detail and outline the decisions we made in constructing the final set of estimates:

A) *Measures of Output:* The basic source for the output measures is the Gross Domestic Product (GDP).

B) Physical Capital: The measure of the capital stock is based on a perpetual inventory estimation with a common fixed annual geometric depreciation rate. Estimates of the capital stock are normally viewed as unreliable because of a lack of information about the initial capital stock and the rate of depreciation. The use of a long time series on investment is significant because it reduces the importance of the assumption about the initial stock.

C) *Labor Inputs:* The measure of the quantity of labor is actual employment. The use of the labor force to measure growth in the labor input will tend to lower the residual growth in TFP in the faster-growing economies and reduce its variance across.

D) *Education:* Adjustments for labor quality are simpler than those of many growth accounting studies because we only take account of changes in educational attainment. Yet, an examination of the more detailed studies shows education to be by far the most important element in accounting for differences in labor quality. Lant Pritchett has pointed to the lack of direct evidence that improvements in education raise output growth. Furthermore, two studies that found a positive role in education used the initial enrollment rate or the initial level of educational attainment.

E)*The Decomposition of Output Growth*: The final step in the construction of indexes of growth in factor inputs and total factor productivity involves the choice of weights for aggregating the factor inputs.

Three basic variants of the underlying production relationship were considered: (i) the simple two-factor model in physical capital and labor; (ii) that incorporates years of schooling as an independent element in a three-factor production relationship with equal geometric weights, and (iii) that uses the education data to adjust the labor input for quality improvements. The major difference between the second and third formulations is that in the former the increased role of education comes at the expense of a reduced weight on the labor component. Since two different methods of adjusting were used for labor quality -- the first used years of schooling with elasticity, and the second employed the relative wage rates to construct an index of labor quality -- we had a total of seven different measures of the growth in the factor inputs and the residual of growth in TFP.

5. METHODOLOGY

Three principal approaches for measurement of productivity growth are used in the literature: (i)The Index Number Approach, (ii) Parametric Approach, and (iii) Non-Parametric Approach. This study is based on the first approach (of Index Numbers) for estimating productivity performance. Total factor productivity analysis for each of the two categories of twelve state economies and India was carried on by first converting time-series data on output (*i.e.*, real NDP/ NSDP) and each of the inputs *viz.*, labor and capital into index numbers (in line with Dholakia (1974); Sethi (1997); Sethi and Kaur (2013)) by taking 2011-12 as the base year. Depending upon the underlying production function (or the aggregation scheme assumed), the following indexes of TFP were then computed:

5.1. Kendrick Index

Kendrick's (1961) index of total factor productivity is an arithmetic measure of the rate of technological change, which consists of first computing an index of total factor input (TFI) as a weighted combination of the individual indexes of the factors of production, TFP is then obtained as the ratio of output (or income, Y_t) to total factor input:

$$A_t = Y_t /(\alpha_0 L_t + \beta_0 K_t) \quad (1)$$

Equation 1 shows the TFP as the ratio of output(Y_t) to total factor inputs labor (L_t) and capital (K_t). The sets of weights (*i.e.* α_0 and β_0) used in these indexes, respectively, were the relative shares of labor (L_t) and capital (K_t) in national income (a) during the base year, (b) averaged over base triennium, and (c) averaged over the entire study period. The index is based on a linear homogeneous production function of degree one. Besides constant returns to scale and neutral technical progress, it assumes an infinite elasticity of substitutability between labor and capital. The index can be generalized to allow for more than two factors. Although the index is easy to calculate and understand, it suffers from the inherent drawback that the underlying production function is assumed to be a linear one (which appears to be rather unrealistic) and that it does not allow for the possible diminishing marginal productivity of factors. Three variants of the Kendrick index, *viz.*, KI1, KI2, and KI3 were determined depending on the different sets of weights attached to the factors of production.

5.2. Solow Index

Solow's (1957) index is based on a restricted version of the Cobb-Douglas production function, rather than a practically unrealistic linear production function, and is expressed as

$$Y_t = A_t L^{\alpha} K^{(1-\alpha)} e^{u_t} \quad (2)$$

Equation 2 shows the restricted version of the Cobb- Douglas production function relating output (Y) to labor(L) and capital (K).

Taking log on both sides of Equation 2, we get

$$\ln Y_t = \ln A_t + \alpha \ln L_t + (1 - \alpha)\ln K_t + u_t \quad (3)$$

Equation 3 shows the logarithmic version of Equation 2. Where $\ln Y_t$, $\ln A_t$, $\ln L_t$, and $\ln K_t$ are the logarithm of corresponding terms in Equation 2. α and $(1-\alpha)$ refer to the elasticity of output concerning labor and capital respectively; A_t measures, the accumulated effect of technical change is assumed to be both disembodied and Hicks neutral. This index, too, makes the assumptions of constant returns to scale, the existence of perfect competition in factor markets, and payment to factors according to their marginal products. Solow's measure of productivity growth and Solow index of TFP is then given by

$$\ln A_t = \ln Y_t - (1 - \alpha)\ln K_t - \alpha \ln L_t \quad (4)$$

By taking $A_0 = 1$, a Solow index of TFP was generated as

$A_{t+1} = A_t (1+\ln A_t)$; t=0,1,2.....(n-1) .

5.3. Translog (Divisia) Index

This index is based on a more versatile translog production function, expressed as

$$\ln Y_t = \ln \beta_0 + \beta_1 \ln L_t + \beta_2 \ln K_t + \beta_{11}\{\ln L_t\}^2 + \beta_{22}\{\ln K_t\}^2 + \beta_{12}\{\ln L_t . \ln K_t\} + u_t \quad (5)$$

This index not only characterizes constant returns to scale but also allows for variable elasticity of substitution among the factor inputs. The basic equation of the translog index is given by

$$\ln(A_t / A_{t-1}) = \ln (Y_t / Y_{t-1}) - \{\beta_1 \ln(L_t/L_{t-1}) \} + \beta_2 \ln (K_t/K_{t-1})\} = g^{TL} \quad (6)$$

Where ln represents the natural logarithm and two β's represent the average share (averaged over two consecutive years) of labor and capital respectively. This index expresses TFP as the difference between the growth rate of output and the weighted average of growth rates of labor and capital inputs. This is equivalent to Tornquist's discrete approximation of the continuous Divisia index (Korres & Polychronopoulos, 2008).

From Equation 6, the translog index of TFP was generated through the relation

$$A_t = A_{t-1} \exp (g^{TL}) \quad (7)$$

Equation 7 generates the translog index of TFP.

6. DATA REQUIREMENT

Data requirements for this study are huge and complex as the comparable data sets for all the twelve states and India are not uniformly available and rigorous exercises were needed to make them comparable. Data on the requisite aggregates, *viz.*, Net Domestic Product (NDP) and Net Fixed Capital Stock (NFCS) (at both current and constant prices) for the overall Indian economy were sourced from various issues of National Accounts Statistics, while for the states, data on Net State Domestic Product (NSDP) were compiled from the various issues of the National Accounts Statistics and the respective Directorate of Economics & Statistics. Series on capital stock were obtained from the respective Directorate of Economics & Statistics and for the state of Bihar and Jharkhand were generated through the *perpetual inventory method* [as per the detailed methodology outlined in Sinha and Verma (2015); Sinha and Sinha (2020). Data on domestic product and capital stock were available in parts at differential base years; therefore, by making use of information in respect of the overlapping years, the time series were spliced together to get comparable series at 2011-12 constant prices. Data on the working force (taken as a *proxy* for the labor force) were compiled for different sectors/ sub-sectors of the respective states and the Indian economy in the census years of 2001, and 2011. Through the usual compound growth rate law, interpolations were made to generate regular time series on the working force in each of the activities. Information on distributive shares of factor incomes was compiled from various issues of National Accounts Statistics. It may be mentioned that the information was available in different formats for different periods and, therefore, could not be used as such due to non-comparability. Consequently, suitable adjustments had to be made to come out with a spliced time series on factor incomes into compensation to employees (as a reward for labor) and interest (as a reward for capital). It may further be pointed out that such data on factor incomes were not available at the states' level and, therefore, the same information (compiled at the national level) had to be used for the missing states. These data are used to construct measures of real output per worker from 2000 to 2021 for a sample of 12 states. Besides, the output growth is partitioned between the contribution of increases in capital per worker and improvements in the efficiency with which the factors are used, total factor productivity (TFP). Growth accounts are consistent with a wide range of

alternative formulations of the relationship between the factor inputs and output. It is only necessary to assume a degree of competition sufficient to ensure that the earnings of the factors are proportionate to their factor productivities. The shares of income paid to the factors can then be used to measure their importance in the production process. Clubbing of each of the aggregates (*viz*., income, capital stock, working force, and factor incomes) was then made in respect of five major components *viz*.,(i) Primary [PRM, comprising of Agriculture and Allied Activities; Forestry and Logging; Fishing; and Mining & Quarrying]; (ii) Secondary [SEC, comprising of Registered Manufacturing; Unregistered Manufacturing; Construction; and Electricity, Gas & Water Supply]; (iii) Tertiary-1 [TR1, comprising of Railways; Transport by Other Means; Storage; Communication; and Trade, Hotels & Restaurants]; (iv)Tertiary-2 [TR2, comprising Banking & Insurance; Residential Buildings and Dwellings; Public Administration; and Other Services]; (v)Aggregated Tertiary [TRT, comprising of TR1 and TR2]; and (vi) Overall Aggregate [AGG, comprising of PRM, SEC, and TRT].

Comparable data on the six major components were compiled for the states under study vis-*à-vis the* Indian economy as a whole for the period 2000-01 to 2020-21).

7. RESULTS

7.1. The Determinants of Economic Growth

The effort is to divide growth between factor accumulation and TFP gains and to examine the contribution of the policy indicators to changes in each of these components. The table below reports a set of simple regressions in which the rate of growth of output per worker is regressed on three alternative measures of capital accumulation: the estimate of capital-labor substitution from the growth accounting, the investment share, and the average share of investment in GDP based on the standard national accounts in national prices. There is a striking difference in the proportion of the variation in output explained by each of these indicators. When the changes are measured over the full 20-year period, the R^2 for the regression that incorporates the measure of capital-labor substitution is about twice that for the regressions that use the investment rate as a proxy for capital accumulation Furthermore, there is a substantial difference between the investment rate measured in national and international prices, and in our sample, the latter has a higher correlation with output growth. Presumably, this results because the investment rate is lower. Finally, when the output changes are measured over 10 years a larger portion of the variance is attributed to differences in the residual component of TFP. However, there is very little change in the relative role of capital accumulation and the investment rate.

These results interest in three respects:

i) They suggest that the growth accounting has resulted in a meaningful measure of the contribution of accumulation to output growth as reflected in the high correlation between the two series;

ii) It appears that the use of the investment rate in empirical studies as a proxy for capital accumulation has resulted in a substantial understatement of its importance in accounting for variations in growth rates across states;

iii) The significance of both capital-labor substitution and the investment rate, in the combined equation, is puzzling. In part, it seems to reflect a measurement problem in which the estimation of the capital stock has resulted in a misstatement of the amount of physical capital per worker. It may be over-estimated in the domestic price of investment goods is very high. As a test of this hypothesis, the ratio of investment to its GDP in the regressions. It is highly significant in an equation that includes both the capital stock and the investment rate in national prices, but not in an equation using investment.

7.1.1. Indexes For Output & Factor Input

Indexes for the five major components and the aggregate of the economies of High Income States, Low Income States, and India le were constructed by obtaining **a** time series of the Net State Domestic Product (NSDP)(Y); working force (L); and Net Fixed Capital Stock (NFCS)(K). Some of the low-income states did not have a series on capital stock, so these were generated through the *perpetual inventory method* [as per the detailed methodology outlined in Sinha and Verma (2015); Sinha and Sinha (2020)]. Tables -1, 2, & 3 provide time-series indexes with a base of 2000-01 on Y, L,& K for the five major sectors. These tables lead to the following results:

(i) High Income States: a)The secondary sector has experienced the fastest growth in respect of output (at 6.3 percent per annum) as well as in both the inputs (working force at a rate of 6.4 and capital stock at 10.1 percent per annum; Table 1) in comparison to low-income states and overall Indian economy. b) A relatively slower rate of growth in output *vis-à-vis* the rates in each of the factor inputs has pointed toward a deceleration in the productivity growth rate of the Tertiary-2 sector. c) A similar situation was witnessed in Tertiary-1 and Aggregated Tertiary sectors as well. d) In a primary sector as also in the overall High-Income economy, the pace of output growth was faster than that in the working force but slower than the growth rate in capital stock. e) Tertiary-2 was the lone exception, wherein the rate of growth in output (at 3.1 percent per annum) was significantly slower than that in the working force (at 6.1 percent per annum), but was faster than the rate in capital stock (at 2.6 percent per annum).

(ii) Low-income States: a) Output growth outstripped growth in inputs in all the sectors (except the Tertiary-2 sector), thereby indicating comparatively higher productivity performance Table 2.

b) Income growth was the fastest (equaling 9.6 percent per annum) in the Tertiary-1 sector, while growth in inputs was the fastest in the Tertiary-2 sector. c) Notably, capital stock in the secondary sector of the state experienced a U-shaped pattern, thus registering an overall rate of growth close to zero.

(iii) The overall Indian Economy: a) It has witnessed income to have grown at the fastest rate (equaling 7.9 percent per annum) in the Tertiary-2 sector, while both the inputs experienced the fastest growth rate in the Secondary sector Table 3. b) In the Tertiary sector as well as in the overall economy, the rate of output growth was higher than that in each of the inputs. c) However, in the Primary as well as Secondary sectors, growth in capital stock was faster than that in income.

(iv)In a majority of the activities in Low-income states as also in the overall Indian economy, output growth was faster than growth in inputs. But the Low Income States reported very lower capital growth (0.91%) in comparison to 6.35% in the High Income States and 5.50% in the overall Indian economy.

(v) Output growth experienced slower growth than growth in inputs in most of the sectors in the case of High Income States. However, capital growth was better in High-Income states than in the overall Indian economy.

Table 1. Time series indexes (with 2000-1 as base year) for NSDP (Y), working force (L), and NFCS (K) and major sectors - in high-income states.

Year	Primary			Secondary			Tertiary-1			Tertiary-2			Tertiary			Aggregated economy		
	Y	L	K	Y	L	K	Y	L	K	Y	L	K	Y	L	K	Y	L	K
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	1.142	1.019	1.083	1.112	1.029	1.246	1.084	1.061	1.107	1.058	1.076	0.913	1.067	1.068	0.994	1.103	1.033	1.038
2004-05	1.251	1.039	1.181	1.231	1.063	1.967	1.139	1.125	1.227	1.135	1.158	0.863	1.136	1.141	1.014	1.196	1.067	1.148
2006-07	1.352	1.059	1.303	1.438	1.101	2.080	1.264	1.194	1.363	1.223	1.247	0.867	1.238	1.220	1.073	1.314	1.104	1.225
2008-09	1.474	1.080	1.459	1.660	1.143	2.774	1.343	1.267	1.515	1.323	1.342	0.911	1.330	1.303	1.162	1.439	1.143	1.392
2010-11	1.615	1.101	1.632	1.870	1.190	3.885	1.370	1.344	1.829	1.427	1.444	0.940	1.407	1.393	1.309	1.563	1.184	1.647
2012-13	1.773	1.105	1.815	2.084	1.383	5.061	1.477	1.540	1.994	1.492	1.655	0.925	1.487	1.596	1.369	1.695	1.263	1.849
2014-15	1.873	1.109	1.951	2.428	1.610	6.378	1.550	1.765	2.504	1.509	1.896	1.038	1.523	1.829	1.647	1.806	1.355	2.210
2016-17	1.999	1.114	2.058	2.702	1.878	9.102	1.816	2.023	2.848	1.696	2.173	1.058	1.738	2.096	1.801	1.996	1.461	2.627
2018-19	1.962	1.119	2.260	3.349	2.196	9.262	2.072	2.318	3.274	1.875	2.489	1.175	1.945	2.401	2.046	2.180	1.584	2.855
2020-21	2.171	1.124	2.433	3.478	2.574	9.657	2.397	2.656	3.763	2.024	2.853	1.350	2.156	2.752	2.352	2.377	1.726	3.144
GR (%)	3.15	0.45	4.15	6.35	6.39	10.11	5.18	5.89	7.51	3.72	6.11	2.58	4.29	6.00	5.55	4.33	3.52	6.35

Note: GR: Growth rate.

Table 2. Time series indexes (with 2000-01 as base year) for NSDP (Y), working force (L), and NFCS (K) and major sectors - of low-income states.

Year	Primary			Secondary			Tertiary-1			Tertiary-2			Tertiary			Aggregated economy		
	Y	L	K	Y	L	K	Y	L	K	Y	L	K	Y	L	K	Y	L	K
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	1.029	1.032	1.031	1.044	1.016	0.794	1.296	1.071	1.049	1.134	1.115	1.027	1.195	1.094	1.035	1.084	1.043	0.848
2004-05	1.060	1.066	1.049	1.155	1.034	0.640	1.261	1.146	1.000	1.250	1.244	1.034	1.254	1.198	1.021	1.146	1.088	0.726
2006-07	1.160	1.101	1.094	1.451	1.054	0.521	1.565	1.228	0.996	1.415	1.387	1.096	1.472	1.312	1.058	1.336	1.138	0.642
2008-09	1.405	1.139	1.083	1.645	1.076	0.442	1.972	1.315	0.993	1.543	1.547	1.134	1.705	1.437	1.080	1.564	1.191	0.583
2010-11	1.554	1.178	1.094	1.829	1.099	0.380	2.267	1.408	0.962	1.869	1.726	1.165	2.019	1.575	1.088	1.772	1.249	0.537
2012-13	1.574	1.259	1.131	1.803	1.273	0.333	2.419	1.616	1.019	2.012	1.982	1.184	2.165	1.808	1.122	1.818	1.374	0.509
2014-05	1.718	1.347	1.181	2.109	1.474	0.312	2.686	1.856	1.030	2.166	2.275	1.235	2.362	2.076	1.157	2.024	1.515	0.501
2016-17	1.824	1.440	1.238	2.340	1.708	0.318	3.521	2.131	1.036	2.492	2.612	1.353	2.880	2.384	1.233	2.289	1.673	0.521
2018-19	1.713	1.541	1.344	2.612	1.980	0.343	3.890	2.446	1.072	2.916	2.999	1.452	3.283	2.737	1.307	2.442	1.850	0.559
2020-21	1.845	1.649	1.491	2.61	2.297	0.400	5.466	2.809	1.104	2.841	3.444	1.513	3.831	3.143	1.358	2.662	2.049	0.622
GR(%)	3.10	2.94	2.69	6.00	5.76	-0.06	9.65	6.11	1.28	6.63	6.72	3.26	8.04	6.45	2.62	5.99	4.37	0.91

Note: GR: Growth rate.

Table 3. Time series indexes (with 2000-01 as base year) for NDP (Y), working force (L), and NFCS (K) and major sectors - of India.

Year	Primary			Secondary			Tertiary-1			Tertiary-2			Tertiary			Aggregated economy		
	Y	L	K	Y	L	K	Y	L	K	Y	L	K	Y	L	K	Y	L	K
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	1.050	1.042	1.086	1.066	1.034	1.158	1.122	1.073	1.055	1.147	1.085	1.052	1.135	1.079	1.053	1.085	1.047	1.084
2004-05	1.151	1.086	1.176	1.205	1.070	1.332	1.236	1.152	1.106	1.321	1.178	1.110	1.281	1.165	1.109	1.211	1.097	1.173
2006-07	1.159	1.133	1.261	1.306	1.109	1.537	1.419	1.237	1.179	1.562	1.279	1.174	1.496	1.257	1.175	1.315	1.150	1.275
2008-09	1.309	1.181	1.352	1.491	1.150	1.766	1.579	1.328	1.291	1.820	1.388	1.253	1.709	1.357	1.261	1.496	1.206	1.394
2010-11	1.393	1.232	1.463	1.725	1.194	2.035	1.783	1.426	1.437	2.152	1.507	1.353	1.981	1.465	1.371	1.682	1.265	1.539
2012-13	1.446	1.269	1.534	1.748	1.324	2.314	1.920	1.554	1.582	2.422	1.635	1.462	2.190	1.594	1.488	1.786	1.329	1.682
2014-15	1.562	1.309	1.625	2.034	1.474	2.607	2.261	1.694	1.764	2.683	1.775	1.592	2.487	1.733	1.629	2.006	1.400	1.847
2016-17	1.693	1.351	1.684	2.447	1.646	3.105	2.788	1.846	1.960	3.093	1.926	1.729	2.952	1.885	1.779	2.322	1.477	2.055
2018-19	1.766	1.397	1.737	2.574	1.844	3.668	3.237	2.012	2.141	3.709	2.091	1.903	3.490	2.050	1.954	2.577	1.562	2.291
2020-21	1.814	1.445	1.823	2.852	2.072	4.120	3.741	2.194	2.434	4.263	2.269	2.154	4.021	2.230	2.214	2.853	1.655	2.556
GR(%)	2.94	1.82	3.12	6.00	4.75	7.50	7.89	4.18	5.75	7.48	4.18	4.92	7.67	4.18	5.11	5.88	2.75	5.50

Note: GR: Growth rate.

7.2. Total Factor Productivity

The three different indexes of Total Factor Productivity (TFP) (*viz.*, Kendrick, Solow, and Trans log) were constructed for each of the three economies: High Income States Table 4, Low-income States Table 5, and India Table 6. A broad look at the tables evinces that the three indexes of TFP were in close agreement with each other in the sense that each one of these exhibited a similar pattern of TFP changes over the study span. In all three economies, the TFP values portrayed wide fluctuations in both primary and secondary sectors in comparison to such fluctuations in the Tertiary sector. At the aggregated level, TFP values in the High Income States have fluctuated around unity, whereas in the Low Income States (as also in the overall Indian economy), the values happened to exceed even two at certain points in time. Thus, the temporal behavior of the TFP values could provide us with preliminary information that productivity performance in the case of the Low Income States and the overall Indian economy were almost similar and better than in the High Income States.

Conditions underlying these three indices should be examined for carrying out further analysis. The Kendrick index was the easiest to compute, but its major drawback lay in the rather unrealistic assumption of the underlying linear production function. Solow index is, undoubtedly, a refinement over the Kendrick index, but the (former) index happens to be restrictive in the sense that it is based on the restricted version of the Cobb-Douglas production function, which assumes not only constant returns to scale but also unitary elasticity of substitution between the factors of production. On the other hand, a limitation of the Trans log (Divisia) index lies in its computational complexity. Nevertheless, the index is based on a more versatile Trans log production function that allows for varying elasticity of substitution and factor combinations and is therefore capable of providing more realistic values of TFP. This study, thus, relies upon the results obtained through the Translog index for the subsequent analysis.

A broad look at the values of the Translog index reveals that in both the category of states as well the overall Indian economy, the pattern of productivity changes has all along been highly erratic in the primary sector during the study span. The likely reason could be that the agriculture sector depends primarily upon natural conditions, which, are quite uncertain. Nevertheless, the values have, in general, be more than unity in both the category of states during the entire study period. The rate of growth in TFP in this sector was computed to be 1.09, 0.32, and 0.56 percent in the High Income States, Low-Income states, and the overall Indian economy, respectively Table 7. Notably, the values of the TFP index were, in general, larger in the case of High Income States state in all the years (except during the early period of the second decade), thereby indicating that the High Income States have fared better than the Low Income States, as far as productivity in the primary sector is concerned. Over time, TFP in the primary sector has witnessed a sharp decline in both the High Income States (*i.e.*, from 1.87 percent in pre-reform to 0.90 percent in the second decade of this century) and the Low-income States (*i.e.*, from 2.95 percent in the first decade to -1.20 in the second decade) states, but has witnessed a slight improvement (from 0.14 percent in the first decade to 0.48 in the second decade) in case of the Indian economy as a whole.

As gauged from productivity performance in the secondary sector, the picture has been rather depressing, particularly in the High Income States. During the first decade of the study span, the TFP values for the Low Income States were better than those for the High Income States. During the second decade, growth in TFP happened to be negative in both the category of states, thus indicating that the new economic policy induced an unfavorable effect on productivity performance in the secondary sector of the states. During the last decade of the study span, the growth did pick up slowly in both categories of states. During this decade, the TFP values for the High Income States were, in general, less than one, thereby indicating the phase of technical retrogression. On the whole, the rate of TFP growth in the High Income States was negative (equaling -0.84 percent), whereas the same

in the Low Income States was 1.60 percent per annum. Thus, in comparative terms, the productivity performance in the secondary sector of Low-Income states was better than that of the High Income States. As far as the Indian economy is concerned, the pattern of TFP in the sector has been very erratic throughout the study period, with an overall rate of growth of just 0.62 percent per annum. Even the services sector of the High Income States has undergone technical retrogression. During the entire study span, the TFP growth in aggregated Tertiary sector of the High Income States was at a rate of (-)1.56 percent, against a rate of 1.95 percent in the Low Income States and 3.23 percent in India Table 7. In comparative terms, the productivity performance of the High-Income states was far inferior in the Tertiary-1 sector; the TFP rate of growth in the sector was (-)1.31 percent as against a rate of 4.66 percent in the Low-Income states and 3.18 percent in India. Similarly, concerning the TFP growth in the Tertiary-2 sector, the performance of the High-Income states (at a rate of -2.17 percent) was far more dismal compared to that of Jharkhand (at a rate of -0.03 percent), and the aggregated Indian economy (at a rate of 3.12 percent). At the aggregated level, TFP experienced changes in the High-Income states in a far more erratic manner Table 4 *vis-à-vis* those in the Low Income States Table 5, while the pattern was fairly consistent (and rising upwards) at the country level Table 6. The overall rates of growth rate in TFP were computed to be 0.13, 2.46, and 2.47 percent per annum in the High Income States, the low-income States, and the Indian economy, respectively Table 7.

We may thus say that at the aggregated level, the productivity performance of the Low-Income states agreed with that at the country level, whereas the performance of the High-Income states, in comparative terms, was in shambles. Nevertheless, in both the category of states, all the sectors were observed to have experienced a deceleration in TFP growth during the second decade *vis-à-vis* the first decade, while at the country level, TFP growth showed an improvement in all the sectors (except Secondary and Tertiary-2).

Table 4. Kendrick, solow, and translog (Divisia) indexes of total factor productivity in high-income states.

Year	Primary					Secondary					Tertiary-1				
	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	1.092	1.090	1.094	1.092	1.091	1.038	1.036	1.039	1.039	1.039	1.008	1.007	1.011	1.007	1.007
2004-05	1.140	1.136	1.145	1.139	1.137	0.992	0.986	0.997	1.001	1.015	0.984	0.983	0.990	0.983	0.983
2006-07	1.165	1.160	1.174	1.161	1.160	1.111	1.104	1.117	1.126	1.139	1.014	1.012	1.023	1.012	1.013
2008-09	1.192	1.183	1.204	1.183	1.182	1.133	1.123	1.142	1.182	1.197	0.998	0.996	1.011	0.997	0.998
2010-11	1.223	1.212	1.240	1.215	1.212	1.086	1.072	1.098	1.185	1.206	0.915	0.911	0.936	0.914	0.920
2012-13	1.268	1.253	1.290	1.266	1.263	0.988	0.974	1.000	1.094	1.124	0.878	0.875	0.894	0.872	0.881
2014-15	1.285	1.268	1.311	1.293	1.289	0.952	0.938	0.964	1.073	1.104	0.776	0.772	0.796	0.769	0.784
2016-17	1.328	1.310	1.357	1.347	1.342	0.818	0.803	0.830	0.960	1.004	0.796	0.792	0.816	0.789	0.803
2018-19	1.233	1.213	1.264	1.269	1.266	0.933	0.918	0.945	1.056	1.100	0.792	0.787	0.811	0.785	0.800
2020-21	1.302	1.280	1.338	1.365	1.360	0.876	0.863	0.886	0.953	1.001	0.798	0.794	0.818	0.792	0.807
Year	**Tertiary-2**					**Tertiary**					**Aggregated economy**				
	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	0.984	0.984	0.993	0.983	0.984	1.009	1.009	1.008	1.010	1.010	1.067	1.067	1.068	1.068	1.067
2004-05	0.980	0.980	0.995	0.980	0.980	1.011	1.012	1.009	1.013	1.013	1.101	1.100	1.105	1.102	1.100
2006-07	0.982	0.982	1.000	0.982	0.983	1.032	1.033	1.031	1.035	1.034	1.160	1.159	1.166	1.162	1.159
2008-09	0.987	0.987	1.006	0.987	0.988	1.036	1.037	1.035	1.039	1.038	1.197	1.194	1.209	1.200	1.196
2010-11	0.990	0.990	1.010	0.990	0.990	1.019	1.019	1.018	1.020	1.020	1.207	1.202	1.228	1.214	1.211
2012-13	0.903	0.903	0.926	0.897	0.904	0.950	0.951	0.948	0.949	0.953	1.207	1.202	1.233	1.218	1.215
2014-15	0.797	0.797	0.818	0.785	0.798	0.844	0.845	0.843	0.836	0.847	1.158	1.151	1.190	1.178	1.176
2016-17	0.782	0.782	0.806	0.770	0.783	0.846	0.847	0.844	0.836	0.848	1.147	1.138	1.186	1.181	1.180
2018-19	0.754	0.755	0.778	0.741	0.756	0.827	0.828	0.825	0.816	0.828	1.154	1.146	1.194	1.190	1.189
2020-21	0.711	0.711	0.733	0.695	0.712	0.799	0.800	0.798	0.787	0.801	1.150	1.142	1.191	1.188	1.187

Note: KI1, KI2, and KI3 are three variants of the kendrick index; SI is the solow index, and TLI is the translog index.

Table 5. Kendrick, solow, and translog (Divisia) indexes of total factor productivity in low-income states.

Year	Primary					Secondary					Tertiary-1				
	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	0.997	0.997	0.997	0.997	0.997	1.074	1.076	1.073	1.078	1.081	1.219	1.219	1.217	1.224	1.219
2004-05	1.001	1.002	1.001	1.002	1.002	1.208	1.212	1.205	1.229	1.237	1.150	1.148	1.136	1.154	1.150
2006-07	1.056	1.056	1.056	1.056	1.056	1.529	1.536	1.523	1.583	1.602	1.368	1.359	1.337	1.377	1.368
2008-09	1.260	1.261	1.258	1.267	1.265	1.731	1.740	1.723	1.829	1.856	1.648	1.632	1.597	1.664	1.648
2010-11	1.359	1.362	1.356	1.372	1.369	1.910	1.922	1.900	2.068	2.102	1.827	1.797	1.747	1.848	1.827
2012-13	1.305	1.308	1.300	1.320	1.318	1.658	1.670	1.649	1.879	1.921	1.744	1.704	1.647	1.758	1.744
2014-15	1.344	1.348	1.338	1.362	1.360	1.694	1.708	1.684	1.996	2.043	1.752	1.695	1.626	1.761	1.752
2016-17	1.345	1.349	1.338	1.364	1.361	1.632	1.645	1.621	1.967	2.016	2.070	1.989	1.893	2.095	2.070
2018-19	1.174	1.177	1.168	1.184	1.188	1.576	1.589	1.566	1.923	1.975	2.040	1.950	1.846	2.061	2.040
2020-21	1.165	1.168	1.161	1.176	1.181	1.357	1.369	1.348	1.633	1.698	2.557	2.431	2.290	2.614	2.557
Year	**Tertiary-2**					**Tertiary**					**Aggregated economy**				
	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	1.017	1.017	1.022	1.018	1.017	1.101	1.101	1.100	1.106	1.101	1.088	1.091	1.078	1.093	1.095
2004-05	1.005	1.005	1.015	1.006	1.005	1.069	1.070	1.067	1.074	1.072	1.144	1.149	1.124	1.163	1.166
2006-07	1.021	1.021	1.033	1.022	1.021	1.153	1.155	1.15	1.165	1.159	1.311	1.318	1.280	1.355	1.361
2008-09	0.998	0.998	1.013	0.998	0.998	1.228	1.231	1.224	1.247	1.238	1.496	1.505	1.454	1.572	1.579
2010-11	1.084	1.084	1.105	1.090	1.085	1.339	1.343	1.334	1.368	1.353	1.644	1.656	1.592	1.758	1.767
2012-13	1.016	1.017	1.041	1.017	1.017	1.263	1.268	1.257	1.293	1.283	1.558	1.571	1.503	1.699	1.710
2014-15	0.953	0.954	0.979	0.950	0.955	1.211	1.217	1.205	1.239	1.235	1.591	1.605	1.530	1.762	1.774
2016-17	0.955	0.955	0.982	0.953	0.957	1.294	1.300	1.286	1.331	1.321	1.639	1.654	1.574	1.831	1.841
2018-19	0.974	0.974	1.004	0.973	0.976	1.292	1.299	1.283	1.331	1.321	1.585	1.600	1.522	1.774	1.787
2020-21	0.826	0.826	0.854	0.816	0.830	1.322	1.329	1.312	1.365	1.353	1.560	1.574	1.497	1.743	1.757

Note: KI1, KI2, and KI3 are three variants of the kendrick index; SI is the solow index, and TLI is the translog index.

Table 6. Kendrick, solow, and translog (Divisia) indexes of total factor productivity in India

Year	Primary					Secondary					Tertiary-1				
	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	0.990	0.989	0.991	0.988	0.989	1.007	1.006	1.008	1.007	1.007	1.051	1.051	1.050	1.053	1.051
2004-05	1.024	1.023	1.027	1.023	1.023	1.074	1.072	1.076	1.075	1.075	1.086	1.087	1.083	1.090	1.087
2006-07	0.977	0.975	0.981	0.972	0.974	1.094	1.091	1.097	1.098	1.097	1.165	1.166	1.161	1.172	1.166
2008-09	1.045	1.042	1.050	1.040	1.040	1.172	1.168	1.176	1.183	1.181	1.200	1.200	1.197	1.208	1.201
2010-11	1.049	1.046	1.056	1.043	1.042	1.269	1.262	1.274	1.289	1.284	1.247	1.247	1.248	1.258	1.248
2012-13	1.049	1.045	1.056	1.042	1.042	1.151	1.145	1.156	1.164	1.166	1.228	1.228	1.230	1.237	1.229
2014-15	1.085	1.079	1.093	1.079	1.078	1.198	1.192	1.204	1.216	1.215	1.318	1.317	1.321	1.333	1.319
2016-17	1.137	1.131	1.146	1.132	1.130	1.266	1.258	1.272	1.294	1.289	1.482	1.480	1.488	1.509	1.485
2018-19	1.148	1.143	1.157	1.143	1.141	1.169	1.160	1.175	1.194	1.196	1.577	1.576	1.584	1.611	1.581
2020-21	1.132	1.126	1.141	1.129	1.126	1.152	1.144	1.158	1.176	1.179	1.649	1.646	1.661	1.696	1.660
Year	**Tertiary-2**					**Tertiary**					**Aggregated economy**				
	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI	KI1	KI2	KI3	SI	TLI
2000-01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2002-03	1.057	1.057	1.058	1.059	1.057	1.055	1.056	1.055	1.058	1.056	1.027	1.027	1.029	1.027	1.027
2004-05	1.121	1.121	1.125	1.127	1.121	1.107	1.108	1.107	1.112	1.108	1.085	1.085	1.089	1.087	1.085
2006-07	1.222	1.222	1.227	1.232	1.222	1.201	1.201	1.200	1.210	1.202	1.114	1.113	1.120	1.116	1.113
2008-09	1.312	1.312	1.319	1.327	1.312	1.271	1.272	1.270	1.284	1.273	1.196	1.194	1.205	1.200	1.194
2010-11	1.429	1.429	1.437	1.450	1.429	1.364	1.365	1.363	1.382	1.366	1.264	1.261	1.277	1.272	1.264
2012-13	1.482	1.482	1.491	1.506	1.482	1.387	1.388	1.386	1.406	1.388	1.263	1.259	1.279	1.271	1.264
2014-15	1.512	1.512	1.521	1.538	1.512	1.447	1.448	1.446	1.470	1.449	1.331	1.327	1.351	1.346	1.335
2016-17	1.606	1.606	1.616	1.638	1.607	1.578	1.579	1.577	1.609	1.580	1.437	1.432	1.463	1.463	1.448
2018-19	1.774	1.775	1.784	1.816	1.774	1.713	1.714	1.712	1.754	1.717	1.484	1.477	1.516	1.522	1.504
2020-21	1.879	1.879	1.885	1.927	1.878	1.805	1.805	1.805	1.856	1.812	1.525	1.517	1.562	1.578	1.556

Note: KI1, KI2, and KI3 are three variants of the kendrick index; SI is the solow index, and TLI is the translog index.

Table 7. Estimates of average annual growth rates in total factor productivity in major sectors of the high-income states, the low income states, and India.

		The high income states					The low income states					India				
Sector	**Index**	**2000-2001**	**2005-06**	**2010-11**	**2015-16**	**2020-2021**	**2000-2001**	**2005-06**	**2010-11**	**2015-16**	**2020-2021**	**2000-2001**	**2005-06**	**2010-11**	**2015-16**	**2020-2021**
PRM	KI	1.88	0.20	0.61	0.19	0.62	2.90	-1.52	-0.17	-1.25	0.26	0.17	1.16	-0.74	0.29	0.47
	SI	1.89	0.80	1.27	0.90	1.10	2.97	-1.54	-0.15	-1.26	0.29	0.13	1.22	-0.25	0.49	0.57
	TLI	1.87	0.79	1.27	0.90	1.09	2.95	-1.48	-0.13	-1.20	0.32	0.14	1.19	-0.23	0.48	0.56
SEC	KI	0.83	-1.87	0.28	-1.26	-1.28	7.20	-2.65	1.47	-0.99	0.74	2.18	-0.41	1.10	-0.06	0.43
	SI	1.72	-1.70	0.27	-1.79	-1.07	8.03	-1.58	1.22	-0.68	1.48	2.39	-0.28	1.67	0.17	0.63
	TLI	1.90	-1.41	0.24	-1.59	-0.84	8.22	-1.40	1.13	-0.61	1.60	2.35	-0.25	1.56	0.16	0.62
TR1	KI	-0.58	-1.34	-1.01	-0.79	-1.26	5.65	2.74	5.66	4.79	4.36	2.31	3.52	4.01	3.74	2.99
	SI	-0.56	-1.37	-0.75	-0.68	-1.22	5.94	3.19	6.17	5.29	4.79	2.40	3.76	5.03	4.29	3.32
	TLI	-0.51	-1.27	-0.68	-0.63	-1.13	5.83	3.10	5.99	5.11	4.66	2.32	3.59	4.81	4.10	3.18
TR2	KI	0.08	-2.91	-1.65	-2.75	-2.24	0.41	-2.38	4.36	0.32	-0.08	3.81	2.94	4.06	3.11	3.16
	SI	0.09	-3.09	-1.41	-2.80	-2.32	0.44	-2.53	4.83	0.40	-0.05	3.97	3.05	4.01	3.15	3.25
	TLI	0.09	-2.89	-1.31	-2.61	-2.17	0.41	-2.35	4.53	0.40	-0.03	3.81	2.93	3.86	3.03	3.12
TRT	KI	0.39	-2.14	-1.07	-1.79	-1.56	2.60	-0.16	4.93	2.32	1.85	3.28	3.22	4.34	3.49	3.20
	SI	0.41	-2.31	-1.16	-1.92	-1.67	2.78	-0.10	5.42	2.56	2.04	3.41	3.38	4.67	3.73	3.39
	TLI	0.40	-2.16	-1.08	-1.79	-1.56	2.68	-0.06	5.08	2.42	1.95	3.29	3.24	4.48	3.58	3.28
AGG	KI	1.96	-0.55	-0.28	-0.65	-0.10	5.09	-0.35	3.56	1.32	2.06	2.25	2.29	2.57	2.20	2.16
	SI	2.05	-0.22	0.05	-0.43	0.11	5.76	0.06	3.58	1.48	2.47	2.32	2.63	3.64	2.82	2.56
	TLI	2.01	-0.20	0.03	-0.40	0.13	5.82	0.09	3.38	1.42	2.46	2.26	2.54	3.51	2.72	2.47

Note: 1. KI: Kendrick index; SI: Solow index; TLI: Translog index.
PRM: Primary sector; SEC: Secondary sector; TR1: Tertiary 1; TR2: Tertiary 2; TRT: Tertiary total; and AGG; Aggregate.

7.3.Growth Accounting

An accounting of the average annual rate of growth in the domestic product is needed after having determined the year-to-year changes in TFP indexes and growth in factors of production and TFP (as measured through the translog index). In other words, our interest lay in making a decomposition of economic growth into components associated with changes in factor inputs and the *Solow residual* (which reflects technological progress and other elements). Growth accounting analysis was done for each of the three economies and presented below for the High Income States Table 8, the Low Income States Table 9, and India Table 10.

Table 8. Growth accounting in respect of major sectors during different periods–high-income states.

Time-period	Av. annual growth rate (%) in	Primary	Secondary	Tertiary-1	Tertiary-2	Tertiary	Aggregated economy
2000 – 01 to 2010 - 11	Labour	0.50 (10.44)	1.35 (21.63)	1.97 (62.71)	3.66 (102.85)	2.83 (82.8)	1.25 (28.0)
	Capital	2.37 (49.43)	3.03 (48.40)	2.00 (63.64)	-0.01 (-0.04)	0.39 (11.37)	1.30 (29.18)
	TFI	2.87 (59.87)	4.38 (70.03)	3.99 (126.35)	3.66 (102.81)	3.22 (94.17)	2.55 (57.18)
	TFP	1.92 (40.13)	1.88 (29.97)	-0.83 (-26.35)	-0.10 (-2.81)	0.20 (5.83)	1.91 (42.82)
	NSDP	4.79 (100.00)	6.26 (100.00)	3.15 (100.00)	3.56 (100.00)	3.42 (100.00)	4.47 (100.00)
2011 – 12 to 2020 -21	Labour	0.17 (6.70)	6.35 (92.69)	5.10 (84.52)	6.56 (150.57)	6.03 (120.77)	3.54 (76.53)
	Capital	1.30 (51.12)	1.75 (25.57)	1.93 (31.97)	0.09 (2.04)	0.70 (14.09)	1.29 (27.86)
	TFI	1.47 (57.82)	8.10 (118.26)	7.03 (116.49)	6.65 (152.61)	6.74 (134.86)	4.83 (104.38)
	TFP	1.07 (42.18)	-1.25 (-18.26)	-1.00 (-16.49)	-2.29 (-52.61)	-1.74 (-34.86)	-0.20 (-4.38)
	NSDP	2.53 (100.00)	6.85 (100.00)	6.04 (100.00)	4.36 (100.00)	5.00 (100.00)	4.63 (100.00)
2000 01 to 2020 - 21	Labour	0.28 (8.57)	4.63 (69.61)	4.02 (79.82)	5.56 (136.22)	4.93 (110.72)	2.75 (60.19)
	Capital	1.67 (50.28)	2.19 (32.99)	1.96 (38.79)	0.06 (1.42)	0.60 (13.37)	1.29 (28.30)
	TFI	1.95 (58.85)	6.82 (102.60)	5.98 (118.61)	5.62 (137.64)	5.52 (124.09)	4.05 (88.49)
	TFP	1.36 (41.15)	-0.17 (-2.60)	-0.94 (-18.61)	-1.54 (-37.64)	-1.07 (-24.09)	0.53 (11.51)
	NSDP	3.31 (100.00)	6.64 (100.00)	5.04 (100.00)	4.08 (100.00)	4.45 (100.00)	4.57 (100.00)

Note: TFI: Total factor input; TFP: Total factor productivity; NDP: Net state domestic product.

In the High-Income states, the average annual rate of growth in real NSDP during the entire study span was at a rate of 4.6 percent per annum, of which the contribution of labor (60.2 percent) was much larger than that of capital (28.3 percent), thereby leaving a contribution of just about 11.5 percent attributable to TFP growth Table 8. Labour has been the prime mover of growth in virtually all sectors (except for the primary sector, wherein labor could account for only 8.6 percent as against an accounting of 50.3 percent due to capital). Notably, the contribution due to TFP growth has drastically fallen from 42.8 percent during the first decade of this century to as bad as (-)4.4 percent during the second decade. The findings are a clear indication of the rather dismal performance of the High - Income states' economy on the productivity front. The primary sector was the lone sector which has portrayed a consistent picture of the contribution of TFP (40.1 percent during the first decade *versus* 42.2 percent during the

second decade of this century). Unfortunately, the contributions due to TFP in the overall rate of growth have slipped during the successive spans rather sharply, not only in the secondary sector (from 30.0 to -18.3 percent) but in the services sector (from 5.8 to -34.9 percent) as well.

In the Low-Income states also, labor has been the prime mover of NSDP growth in all the sectors Table 9. But there existed a glaring point of difference! The contribution of TFP (equaling 47.6 percent) was more than four times that (equaling 11.5 percent) of the High- Income states. Although the contribution of TFP to the growth rate of output has temporally declined in all the sectors, on the whole, the contributions in each of the sectors of the Low- Income states were, in general, larger than the corresponding contributions of the High- Income states. As an exceptional case, the contribution of TFP to the rate of growth of output of the primary sector was substantially higher (at 41.2 percent) in the High Income States as compared to that (11.1 percent) in the Low- Income States.

Table 9. Growth accounting in respect of major sectors during different time spans– low-income states.

Time-period	Av. annual growth rate (%) in	Primary	Secondary	Tertiary-1	Tertiary-2	Tertiary	Aggregated economy
2000 – 01 to 2010 - 11	Labour	0.85 (19.31)	0.74 (12.2)	2.28 (27.88)	5.44 (86.90)	3.88 (55.16)	1.64 (28.69)
	Capital	0.41 (9.39)	-2.13 (-35.26)	-0.12 (-1.51)	0.01 (0.09)	0.13 (1.82)	-1.61 (-28.11)
	TFI	1.27 (28.70)	-1.39 (-23.06)	2.16 (26.37)	5.44 (86.99)	4.00 (56.98)	0.03 (0.58)
	TFP	3.14 (71.30)	7.43 (123.06)	6.03 (73.63)	0.81 (13.01)	3.02 (43.02)	5.69 (99.42)
	NSDP	4.41 (100.00)	6.04 (100.00)	8.18 (100.00)	6.26 (100.00)	7.03 (100.00)	5.72 (100.00)
2011 – 12 to 2020 -21	Labour	2.09 (91.54)	5.87 (95.36)	5.18 (50.03)	6.66 (90.12)	6.12 (69.22)	4.13 (64.84)
	Capital	1.34 (58.63)	0.89 (14.44)	0.54 (5.20)	0.18 (2.40)	0.41 (4.64)	0.77 (12.15)
	TFI	3.42 (150.17)	6.75 (109.80)	5.72 (55.23)	6.83 (92.52)	6.53 (73.86)	4.90 (76.99)
	TFP	-1.14 (-50.17)	-0.60 (-9.80)	4.63 (44.77)	0.55 (7.48)	2.31 (26.14)	1.46 (23.01)
	NSDP	2.28 (100.00)	6.15 (100.00)	10.35 (100.00)	7.39 (100.00)	8.85 (100.00)	6.39 (100.00)
2000 01 to 2020 - 21	Labour	1.66 (55.10)	4.10 (67.04)	4.18 (43.52)	6.23 (89.12)	5.35 (65.07)	3.27 (53.22)
	Capital	1.02 (33.79)	-0.15 (-2.49)	0.31 (3.23)	0.12 (1.69)	0.31 (3.81)	-0.05 (-0.79)
	TFI	2.68 (88.89)	3.94 (64.55)	4.49 (46.75)	6.35 (90.81)	5.66 (68.88)	3.22 (52.43)
	TFP	0.33 (11.11)	2.17 (35.45)	5.11 (53.25)	0.64 (9.19)	2.56 (31.12)	2.92 (47.57)
	NSDP	3.01 (100.00)	6.11 (100.00)	9.6 (100.00)	7.00 (100.00)	8.22 (100.00)	6.14 (100.00)

Note: TFI: Total factor input; TFP: Total factor productivity; NDP: Net state domestic product.

As far as the productivity performance in aggregated Indian economy (having grown at a rate of 5.8 percent) is concerned, the contribution of labor (37.1 percent) was perceptibly larger than that of capital (20.1 percent). Notably, TFP (with a contribution of 42.8 percent) happened to be the prime mover of growth. However, the contribution of the source (*i.e.*, TFP) has come down marginally from 45.7 percent during the first decade to 41.8 percent during the second decade of this century Table 10. Over the two time spans, the Secondary sector has witnessed the biggest loss (from 46.2 to -0.3 percent) in productivity, followed next by the Primary sector (from

15.1 to 3.7 percent). The performance of the services sector (aggregated as well as disaggregated) has remained fairly consistent.

Table 10. Growth accounting in respect of major sectors during different time spans – India.

Time-period	Av. annual growth rate (%) in	Primary	Secondary	Tertiary-1	Tertiary-2	Tertiary	Aggregated economy
2000 – 01 to 2010 - 11	Labour	1.09 (31.43)	1.38 (24.56)	2.37 (40.43)	4.08 (52.28)	3.26 (46.92)	1.74 (32.80)
	Capital	1.82 (53.50)	1.57 (29.25)	1.20 (20.58)	0.01 (0.15)	0.46 (6.61)	1.12 (21.46)
	TFI	2.90 (84.93)	2.95 (53.81)	3.57 (61.01)	4.10 (52.43)	3.72 (53.53)	2.86 (54.26)
	TFP	0.42 (15.07)	2.50 (46.19)	2.22 (38.99)	3.57 (47.57)	3.12 (46.47)	2.34 (45.74)
	NDP	3.32 (100.00)	5.45 (100.00)	5.78 (100.00)	7.66 (100.00)	6.84 (100.00)	5.20 (100.00)
2011 – 12 to 2020 -21	Labour	1.09 (43.28)	4.66 (75.00)	3.23 (37.78)	3.94 (53.36)	3.73 (47.13)	2.39 (38.73)
	Capital	1.33 (53.05)	1.57 (25.26)	1.72 (20.08)	0.26 (3.45)	0.71 (8.99)	1.20 (19.42)
	TFI	2.42 (96.33)	6.24 (100.26)	4.95 (57.86)	4.20 (56.81)	4.44 (56.12)	3.59 (58.15)
	TFP	0.09 (3.67)	-0.02 (-0.26)	3.60 (42.14)	3.19 (43.19)	3.47 (43.88)	2.58 (41.85)
	NDP	2.51 (100.00)	6.22 (100.00)	8.56 (100.00)	7.39 (100.00)	7.91 (100.00)	6.17 (100.00)
2000 01 to 2020 - 21	Labour	1.09 (38.95)	3.53 (59.30)	2.93 (38.62)	3.99 (53.33)	3.57 (47.3)	2.17 (37.1)
	Capital	1.50 (53.75)	1.57 (26.40)	1.54 (20.25)	0.17 (2.28)	0.62 (8.28)	1.17 (20.09)
	TFI	2.59 (92.70)	5.10 (85.70)	4.47 (58.87)	4.16 (55.61)	4.19 (55.58)	3.34 (57.19)
	TFP	0.20 (7.30)	0.85 (14.30)	3.13 (41.13)	3.32 (44.39)	3.35 (44.42)	2.50 (42.81)
	NDP	2.79 (100.00)	5.95 (100.00)	7.60 (100.00)	7.48 (100.00)	7.54 (100.00)	5.84 (100.00)

Note: TFI: Total factor input; TFP: Total factor productivity; NDP: Net domestic product.

In a nutshell, TFP was the main contributor to the output growth of both categories of states during the first decade, whereas the slot got occupied by the labor force during the second decade. However, in the overall Indian economy, TFP has continued to remain the prime source of economic growth during the entire study span.

8. CONCLUSIONS AND POLICY IMPLICATIONS

This paper tries to analytically gauge the contribution of total factor productivity to output expansion in major sectors of the developing states of the High Income States and the Low Income States *vis-à-vis* the overall Indian economy. The performance of the Low Income States has been perceptibly superior to that of the High Income States as per the main finding of the TFP analysis. Nevertheless, all the sectors in each of the two categories of states have undergone a temporal deceleration in TFP growth, thereby pointing toward the ineffectiveness of economic reform measures to induce technical progress in the states. However, in the overall Indian economy, various sectors (except Secondary and Tertiary-2) experienced productivity improvement over time. Further, TFP contributed the most to output growth of both the category of states during the first decade (2000-01 to 2010-11), while labor acted as a prime mover during the second decade (2011-12 to 2020-21). Whereas, on the other hand, it

was the TFP growth that acted as the major source of economic growth in the aggregated Indian economy during the entire study span. The findings, thus, signify that although liberalization policies have shown desirable results at the aggregated level, there has been a considerable variation in the speed and extent of implementation of the reform measures across the states. Therefore, for the states (particularly the High Income States) to surge ahead, it is imperative to address regional problems to enhance TFP, which has become virtually synonymous with economic growth. The provision of better health infrastructure, and increased skill formation activities *via* education and training programs might help in this direction.

REFERENCES

Ahluwalia, I. J. (1985). *Industrial growth in India: Stagnation since mid-sixties*. Delhi: Oxford University Press.

Barro, R. J. (1999). Notes on growth accounting. *Journal of Economic Growth, 4*(2), 119-137.

Bhattacharya, D. (1972). *The role of technological progress in Indian economic development*. Calcutta: The World Press Pvt. Ltd.

Bosworth, B., Collins, S. M., & Chen, Y.-C. (1995). Accounting for differences in economic growth. The Brookings Institution Working Paper No.115.

Brahmananda, P. R. (1982). *Productivity in the Indian economy*. Bombay: Himalaya Publishing House.

Denison, E. F. (1967). *Why growth rates differ*. Washington: The Brookings Institution.

Dholakia, B. H. (1974). *The sources of economic growth in India*. Baroda: Good Companions.

Dholakia, B. H. (1977). Growth of factor inputs and total factor productivity in public sector enterprises. *Vikalpa, 2*(2), 121-129.

Dholakia, R. H. (1986). Sources of economic growth in India implied by the seventh five-year plan, 1985-90. *Indian Economic Journal, 33*(4), 161-167.

Dholakia, B. H. (2001). Sources of India's accelerated growth and the vision of the Indian Economy in 2020, presidential address at Gujarat Economic Association in August 2001. *Indian Economic Journal, 49*(4), 27-46.

Dholakia, R. H. (2009). Regional sources of growth acceleration in India. *Economic and Political Weekly, 44*(47), 67-74.

Goldar, B. (2004). Indian manufacturing: Productivity trends in pre-and post-reform periods. *Economic and Political Weekly, 39*(46/47), 5033-5043.

Gordon, R. J. (2003). *Productivity growth, inflation, and unemployment- the collected essays of Robert J. Gordon*. Cambridge: Cambridge University Press.

Jorgenson, D. W., & Griliches, Z. (1967). The explanation of productivity change. *The Review of Economic Studies, 34*(3), 249-283.

Kendrick, J. W. (1961). *Productivity trends in the United States*. Princeton: Princeton University Press.

King, R. (1994). *Capital fundamentalism, economic development, and economic growth*. Paper presented at the In Carnegie-Rochester Conference Series on Public Policy, North-Holland.

Korres, G. M., & Polychronopoulos, G. (2008). *Productivity and regional growth in Europe*. Paper presented at the International Conference on Applied Economics.

Krishna, K. L. (1991). *Industrial growth and productivity in India" in Uma Kapila (ed.), Indian economy since independence*. Delhi: Academic Foundations.

Kumar, S., & Kavita. (2012). Productivity and growth in the Indian manufacturing sector since 1984-85 to 2004-05s: An analysis of Southern region states. *Zenith International Journal of Business Economics & Management Research, 2*(4), 146-161.

Levine, R., & Renelt, D. (1991). Cross-country studies of growth and policy: Methodological, conceptual and statistical problems. Policy Research Working Paper No. 608 (Washington D.C: The World Bank).

Mamuneas, T., & Ketteni, E. (2012). Growth accounting: A European comparison. *Cyprus Economic Policy Review, 6*(2), 67-79.

Nagarajan, N. (1985). Technological changes and economic growth. *Journal of Income and Wealth, 8*(2), 150-164.

Nehru, V., & Dhareswar, A. (1993). A new database on physical capital stock: Sources, methodology, and results. *Journal of Economic Analysis, 8*(1), 37-59.

Pendse, N. G., & Baghel, L. M. S. (2008). *Technological change and productivity growth in the manufacturing sector of India.* New Delhi: Sarup & Sons.

Saravanan, P. (2008). Measurement of productivity growth- A parametric approach. Retrieved from: www Dynamics.mse.ac.in/Frontier/h8Padma.pdf.

Sethi, A. S. (1997). *Dynamics of national income.* New Delhi: Deep and Deep Publications.

Sethi, A. S., & Raikhy, P. S. (2001). *Changing sources of economic growth in India: Implications for second generation reforms", in Dutt, R. (eds.) Second Generation Reforms in India.* New Delhi: Deep and Deep Publications.

Sethi, A. S. (2005). Globalization and the changing productivity performance in the Indian economy ¾ a sectoral analysis, in B.S. Bhatia and Balram Dogra (eds), Global Competitiveness and Productivity (pp. 40-46). New Delhi: Deep & Deep Publications Pvt. Ltd.

Sethi, A. S., & Kaur, S. (2013). Growth accounting analysis in India with specific reference to the economies of Punjab and Haryana. *The Journal of Income and Wealth, 35*(2), 147-168.

Sinha, J. K., & Sinha, A. K. (2020). Trend and growth of capital stock in Bihar during 1980 -2017. *The Journal of Humanities, Arts, and Social Science, 4*(1), 57-66.Available at: https://doi.org/10.26855/jhass.2020.01.008.

Sinha, J. K., & Verma, A. (2015). Trend and growth of fixed capital stock in Bihar. *The Journal of Income and Wealth, 37*(2), 136-146.

Sinha, J. K., & Sinha, A. K. (2022). Growth accounting analysis of the Indian Economy – with special reference to the Economy of Bihar and Jharkhand. *International Journal of Applied Business and Management, 3*(1), 13-37.

Solow, R. M. (1957). Technical change and the aggregate production function. *The Review of Economics and Statistics, 34*(3), 312-320.

Young, A. (1991). Learning by doing and the dynamic effects of international trade. *Quarterly Journal of Economics, 106*(2), 369-405.Available at: https://doi.org/10.2307/2937942.