Growth Decomposition of Indian Economy, 1981-2007

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ABSTRACT

The present paper attempts to evaluate the economic performance of India for the period of 1981-2007, using the conventional growth accounting technique, also known as “Solow growth model”. In particular, it examines the relative contributions of factor accumulation and productivity growth in the economic growth of the economy. The main objective is to check if the growth is sustainable. Also, an attempt is made to find the proximate explanation of any major ups and downs that happened in the economy during this period. The paper concludes by arguing that the recent spectacular performance of the Indian economy is mainly fuelled by improvement in TFP.

Keywords: Emerging economies, India, Economic growth, Total factor productivity.

1.0 Introduction

The last decade of the twentieth century witnessed much turmoil and crises all over the world. These crises changed the world order by throwing many giant players in the scrap and positioning new entrants on the higher position. The stagnancy in the economic performance of the developed economies increased the role of the emerging economies in global economic development. Now these economies are also looked as shock absorbers of the world economy against financial and economic fluctuations. These developments have been shifting the world’s centre of gravity towards emerging countries of which India is an important member. The emergence of India as a major force in the world economy has been one of the most significant developments of the past quarter century. The country gained attention of the world when it maintained its growth momentum while the so-called ‘Asian Tigers’ stopped roaring. In 2001, Jim O’Neill, chief economist of Goldman Sachs, came up with the acronym ‘BRIC’ for four emerging economies, Brazil, Russia, India and, China, respectively. He predicted that the growth generated by the large developing countries, particularly the ‘BRIC’, could become a much larger force in the world economy than it is now.

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It is in this context that the present paper attempts to investigate the growth determinants of Indian economy by using the growth accounting framework. The main objective is to check the sustainability of Indian economic growth in the long run. The paper is organised as follows: section 2 outlines the literature review; section 3 highlights the methodology used for the decomposition of growth; section 4 provides the sources of data, and section 5 summarises the results and analysis. The last section concludes the study.

2.0 Literature Review

The origin of the term total factor productivity (TFP) can be traced to the "Abramovitz residual," which refers to the growth of output unaccounted for by the factor inputs (Abramovitz, 1956). The growth accounting approach goes back to Solow (1957) who suggested that the GDP growth can be decomposed into three shares: the capital, the labour and the TFP shares. The latter is computed as the residual of GDP growth once capital and labour contributions were removed. It was Solow who first put the growth economics into growth accounting with an interpretation in terms of the distinction between shifts of and moves along the aggregate production function.

However, Domer (1961) argues that the TFP as residual obtained at industry and firm level is more promising. Jorgenson and Griliches (1967) brought a major development in the growth accounting exercise by producing a sophisticated index of capital input growth (measuring capital services) and also corrected labour quality for changes in education. Fan, Zhang, and Robinson (1999) expanded the traditional Solow approach by including a third source of economic growth; structural change. Denison (1962) refined the approach by developing an explicit measurement to quantify the contribution of labour quality. Hsieh (2002) used factor prices (the dual approach of growth accounting) rather than physical stocks of inputs in estimating the TFP. Bosworth and Collins (2003) argues that the results from growth accounting exercise should not be misconstrued as providing the fundamental causes of growth.

Rodrik and Subramanian (2004) used a simple growth accounting framework to project India's future potential output growth rate through 2025. With mentioning upside potential and downside risks, they estimated annual growth, close to 7% for aggregate output. Bosworth, Collins and Virmani (2007) examine India’s economic growth during 1960-2004, using the growth accounting analysis on sectoral level and conclude that much of country’s growth is attributable to resource movements from less productive sector (agriculture) to more productive areas (industries and services).
Recently, Das, Erumban, Aggarwal and Wadhawa (2010) applied growth accounting using labour services and capital services (to allow for differences in the quantity of services delivered per unit of these inputs) while measuring the productivity of Indian economy.

3.0 Data Sources

The GDP and labour force data were taken from World Development Indicators database, World Bank. The capital stock data were taken from Central Statistical Organisation (CSO); capital stock data for India is till 2007 only. For labour force, data is in headcount. Measure of educational attainment, average year of schooling, was taken from Robert Barro and Jong-Wha Lee (2001). They have compiled measures of educational attainment with an interval of five year. Assuming a normal distribution, annual data for average year of schooling has been constructed here. GDP and capital stock data were taken in Indian Rupees. The labour force data was in head count.

Time period for growth decomposition has been taken from 1981 to 2007. The reason behind taking this time frame is that growth accounting demands a fairly long period for any meaningful result. This period also witnessed drastic changes in the economic history of the country. This time period is also well before the recent global financial crisis which hampered the economic growth of the country in the last couple of years. Otherwise it would get reflected in the TFP (being the residual part in the growth accounting exercise).

4.0 Methodology

The study attempts to quantify the sources of economic growth of India over the last two decades with the help of growth accounting. Growth accounting allows decomposition of output growth into the growth of various inputs (explained part) and productivity, the residual or unexplained part. It is an appropriate first step in looking at any economy and yields useful benchmarks estimates for future research.

The appropriate use of growth accounting techniques depends on the availability of reliable statistics on output and factor inputs. With reference to the developing countries, this may pose some constraints on the application of more elaborate approaches, including those comprising multiple production factors (i.e. in addition to labour and capital). In view of these constraints, this research work is limited to the traditional measure of TFP.
Under the assumptions of competitive factor markets, full input utilisation and constant returns to scale\(^3\), we assume the production function takes a simple Cobb-Douglas functional form:

\[ Y = A K^\alpha (LH)^{1-\alpha} \]

\(Y\) is the total production; the monetary value of all goods produced in a year. \(K\) and \(L\) are capital stock and labour input, respectively. \(A\) is the TFP which has the Hicks’ neutral form\(^4\). The ‘\(\alpha\)’ and ‘\(1-\alpha\)’ are the output elasticity of capital and labour, respectively. This allows to use the observed output share in the estimation of TFP growth. The share of capital, ‘\(\alpha\)’, is assumed equal to 1/3rd in this study. This is in accordance with assessments of the evidence both by growth accounting practitioners and by econometricians (Senhadji, 1999).

\(H\) is a measure of educational attainment, or human capital, used to adjust the workforce for improvements in educational attainment. Average year of schooling is used as proxy to reflect this improvement in skills. A simple index of educational attainment takes a form:

\[ H = e^{sL} \]

It is assumed that each year of schooling, \(s\), raises the average worker’s productivity by a constant percentage, ‘\(a\)’. Earlier empirical studies have estimated schooling average 7% in high-income countries and 10% for Latin America and Asia. Following these studies, we are assuming a 10% return to average schooling year which gives about 10% human capital growth rate per year.

Though questions have been raised regarding the relationship between education and growth, the general finding is that more educated individuals tend to have higher employment rate and earnings and produce more output relative to those who are less educated. In this context, education is deemed as an investment that enables individuals to be equipped with knowledge and skills that improve their employability and productive capacities that would lead to higher earnings in the future.

The results were shown in a form that decomposes output per worker \(\Delta \ln(Y/L)\) into the contributions of increases in capital per worker \(\Delta \ln(K/L)\), increases in education per worker \(\Delta \ln(H)\) and the balance goes in TFP; \(\Delta \ln(A)\). To describe the relative changes of factor inputs, contributing in total output growth, log-changes has been used.

\[ \Delta \ln(Y/L) = \alpha \left[ \Delta \ln(K/L) \right] + (1-\alpha) \Delta \ln H + \Delta \ln A \]

The unknown part, TFP, can be easily calculated as a residual from the above equation:

\[ \Delta \ln A = \Delta \ln(Y/L) - \alpha \left[ \Delta \ln(K/L) \right] - (1-\alpha) \Delta \ln H \]
5.0 Results and Analysis

Based on the above mentioned methodology, the growth accounting is carried out for the Indian economy. Five year average of different components of growth is calculated to get the trend of these components reducing the effect of annual fluctuation, if any. We also attempt to throw light on the major events that influenced the economy in any particular sub-period.

The growth decomposition results for India clearly show the impressive performance of Indian economy since 1981 (Table 1 and Figure 1). Barring the crisis period of early nineties, the economy registered a consistent healthy growth. The output per worker also registered a remarkable growth. This is mainly associated with an increase in TFP. The TFP growth showed a consistent increasing trend which further speeded up in the last 8-10 years. It clearly indicates quality improvement with long lasting growth.

<table>
<thead>
<tr>
<th>Period</th>
<th>Growth in Output (% a year)</th>
<th>Growth in Output per worker (%)</th>
<th>Physical capital per worker (%)</th>
<th>Education per worker (%)</th>
<th>TFP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-85</td>
<td>5.01</td>
<td>2.77</td>
<td>1.16</td>
<td>0.47</td>
<td>1.14</td>
</tr>
<tr>
<td>1986-90</td>
<td>5.72</td>
<td>3.46</td>
<td>0.77</td>
<td>0.58</td>
<td>2.11</td>
</tr>
<tr>
<td>1991-95</td>
<td>4.58</td>
<td>2.9</td>
<td>0.86</td>
<td>0.53</td>
<td>1.51</td>
</tr>
<tr>
<td>1996-2000</td>
<td>6.34</td>
<td>3.87</td>
<td>1.20</td>
<td>0.69</td>
<td>1.98</td>
</tr>
<tr>
<td>2001-07</td>
<td>7.37</td>
<td>5.45</td>
<td>1.52</td>
<td>0.58</td>
<td>3.36</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations

On the other hand, the physical capital per worker growth remained moderate. It seems that the country has achieved its growth with relatively little emphasis on capital accumulation. Keeping in view country’s infrastructural deficiencies, slow growth of capital per worker (and its reducing share in output per worker growth) indicates that country lacks enough investment in capital stock to maintain and speed up the output growth and to reduce widespread unemployment and poverty. The human capital growth remained low throughout the period for India. Keeping in view India’s low literacy rate, low growth in its human capital in the last two decade is a matter of concern.

The sectoral growth of Indian economy is shown in Figure 2. Though, the decomposition exercise is not done sector wise here, still it seems that major productivity improvement happened in services sector. The increasing trend in TFP is mainly
accompanied by service sector growth during the same period. This finding is consistent with the studies of Rodrik and Subramanian (2004) and Virmani (2004).

Figure 1: Output Growth and its Components for India, 1981-2007

Note: Figures are five year average.

Figure 2: Sectoral Growth Rates in GDP, 1996-07

Source: Annual Survey, 2006-07

Here, results also show steep hike in TFP growth after 2000. From 1981 to 2007, significant reallocation of resources from low productivity to higher productivity sectors
(especially from agriculture to services) has happened which is evident by observing the changes in GDP composition of the economy (Figure 3). Therefore these structural changes in the economy might be one of the main reasons behind high TFP improvement. This reaffirms the findings of Wallack (2003).

**Figure 3: Contribution in GDP by Industry of Origin**

The results found no major improvement in TFP in nineties in comparison to TFP growth in eighties, even when large scale liberalisation initiated in 1991-92. It means economic reforms initiated in early nineties though boosted the output growth but no such improvement happened in productivity of the economy. On this issue, findings are consistent with Rodrik and Subramanian (2004) but differ from that of Pallikara (2004). However, Indian economy has registered consistent growth in TFP since 1991-95 which has further speed up in recent years. Also, significant rise happened in Indian exports during this period (Figure 4). Growth in exports also indicates quality improvements in the production process. This affirms that quality dimension have also played an important role in recent improvement in TFP growth.

In the first half of the 80s, the average output growth was 5% which was quite remarkable. The output per worker registered a healthy growth of 2.76%, mainly fuelled by TFP and capital per worker growth. During this period a major turnaround happened in Indian economy. For the first time, the government made attitudinal shift in its policies towards the private sector, giving more space to them to contribute in country’s
economic growth. Access to foreign technology, foreign goods and private and public capital was made easy. This attitudinal shift in government policies might be the reason of growth in TFP and capital.

Figure 4: Average Annual Export of India, 1981-2007

![Graph showing average annual export of India from 1981 to 2007.](image)

*Source: World Development Indicators Database, World Bank.*

In 1986-90, the average GDP growth further improved and reached near to 6%. The output per worker also registered a growth of 3.11%. This time, the major share in this growth came from TFP with sharp reduction in capital’s share. It clearly indicates that the economy lacked enough capital investment to reap the advantage of reforms initiated in the early 80’s. Unsustainable fiscal expansion policy of the 80’s with high growth in import of essential commodities and slow and stagnant growth in export seems the reason behind this reduction of capital growth. The education per worker (human capital) registered moderate improvement in growth rate.

The early years of 90s were the toughest period for the economy. External shocks, especially the Gulf crisis, made the situation worse for the country which was already facing severe drought and unfavourable balance of payment. The rising prices of the petroleum products shoot up the country’s import bill, making the Balance of Payment crisis more severe. The current account deficit (% share to GDP) rose to more than 3% during this period (Economic Survey, 1993-94). During the 1991-95, the GDP rate declined to 4.58%. The output per worker grew by 3.17%, improving its earlier
performance. The average capital per worker also registered a moderate growth of .86%. The average human capital growth remained constant. But the average growth of TFP declined to 1.51%.

Later on, stabilisation programme and reforms at both micro and macro levels were implemented to make the economy more open and efficient. Currency devaluation against US dollar to correct the balance of payment, dismantling industrial licence system, liberal foreign investment policy, radical changes in capital market governance were some of them. The impacts of these measures got reflected in the improved performance of the economy in later years. In 1996-2000, the average GDP growth was 6%. The average output per worker soared to 3.87%, mainly fuelled by the TFP. The capital per worker also registered a strong growth of 1.20%. The human capital growth registered moderate growth of 0.69% improving its share in total growth. It provides evidence that the economy positively responded to the series of reforms initiated in the early 90’s. In the last 2-3 years of 90s, the economy faced tuff situations at different levels. In 1997, the economy registered a sudden drop in output growth due to sharp decline in agriculture and industrial growth.

The start of the twenty first century was the continuation of the problems for the world and Indian economy as well. The turbulent and unfavourable international environment hurt the economy severely. The East Asian crisis and its contamination to other countries, unusual volatility in capital and foreign exchange markets of industrial countries, severe financial crisis of Russia and currency devaluation in Brazil were the culprits. The world economy which was already facing deceleration in output growth was severely hurt by the aftermath of the terrorist attack on World Trade Centre of the US in September11, 2001. On domestic front, poor performance by agriculture sector increased the inflation with the sharp increase in the food grain prices.

Still, during the period 2001-07, the average output per worker touched its highest point of 5.65% with strong TFP growth of 3.49%. The average capital per worker also registered a growth of 1.58%. It was industry and the services sector which performed well and compensated for agriculture in total out per growth. In the last 4-5 years, the economy has performed well and its performance is second only to China. This growth came when most of the giant economies of the world were moving towards the recession. Keeping in view all these unfavourable incidents that happened during this five year period, the economy’s performance is certainly remarkable. With strong TFP growth in such a hostile condition indicates economy’s improved productivity and strong and sound macroeconomic base.
6.0 Conclusion

The paper attempts to examine the sources of economic growth of India for the period 1981-2007. The findings of the growth decomposition exercise, done here, show that the recent spectacular performance of the India economy is mainly fuelled by improvement in TFP. Furthermore, the economy has achieved its growth with relatively little emphasis on capital accumulation and more substantial gains in TFP. However, it is very important for the country to improve the quality of life of the vast majority of their population and remove unequal regional growth. Attention is also needed towards infrastructural development.

Better economic structure and policies, and favourable environment to increase productivity have helped the Indian economy to maintain their high growth rates in the long run. It also saved (or minimized the effects of) its growth momentum from external volatility quite well during this. But situations have changes. With increased deregulation, the integration of the Indian economy with the world economy has reached to the higher level. This integration is backed by technological developments in communications and innovation of highly sophisticated financial instruments. All these will take the real test of economy’s immunity to resist more acute external crises. The recent financial crisis is one of them which proved quite fatal the economy.

7.0 Limitations and Scope for Future Research

The growth accounting exercise is viewed as a preliminary step for the analysis of fundamental determinants of economic growth. It basically examines the proximate sources of growth. The final steps involve the relations of factor growth rates, factor shares and technological change to elements such as government policies, initial levels of physical and human capital, natural resources, level of R&D, business prospects (to capture also economies of scale effect), structural shift/efficiency (with respect to the organized- versus unorganized-sector GDP, private- versus public-sector capital formation, and non-agricultural- versus agricultural-sector GDP) and so on. Future research in this regard would be quite beneficial in suggesting policies to further speed up the growth momentum the economy.

Endnotes


3. Assumption of constant returns to scale imposes the feature of allocative efficiency on production function. Ideally, production function should be tested if it has the feature of allocative efficiency or not. But this assumption brings uniformity while comparing different economies. It has been relaxed in some studies by adopting more general production functions such as the translog function (see for e.g. Young, 1994; Hu and Khan, 1997).

4. Hicks neutral’ is an attribute of effectiveness variable, which affects labour and capital in the same way.

5. For an assessment on the implications of reforms on Indian economy & debate on factors underlying the observed growth in India after reforms, see Wallack (2003); Rodrik and Subramaniam, (2005);Panagariya (2008); Kohli, (2006a and 2006b).

References


