

Total Factor Productivity Trends in India: A Conventional Approach

SANJOY SAHA*

Abstract

The study attempts to estimate the aggregate Total Factor Productivity (TFP) for the Indian economy using the conventional growth accounting method. It has been observed that on an average the TFP has grown by 1.49 per cent during the study period but it is erratic in nature. Although during 1960s average the TFP growth in India was positive, it was very low and almost close to zero. Similarly, the economy experienced technological regress instead of technical progress during 1970s due to the average negative TFP growth. External shocks like war, drought, oil price-hike along with rigid rules and regulations during these periods could be the probable reasons for low productivity of the economy. However, the economy's overall productivity has increased considerably after the initiation of internal economic reforms measures during 1980s. The economy has been experiencing continuous rise in TFP growth since the introduction of external economic reforms. The study reveals that TFP estimates in India are not sensitive to factor shares.

Keywords: Total Factor Productivity, Growth Accounting Method, Technological Progress

Introduction

India's economic growth has more or less hovered around 3.5 percent for almost three decades since independence mainly due to the adoption of inward oriented and state-interventionist policies during this period (Poddar and Yi, 2007). It is popularly known as the period of 'Hindu Rate of Growth'.¹ However, with the initiation of internal economic reforms

* Sanjoy Saha (sanjoy.saha10@gmail.com) is an Assistant Professor in the Department of Economics, Debraj Roy College, Golaghat, Assam.

¹ The term was coined by Raj Krishna an Indian economist who taught at the Delhi School of Economics. This phrase "Hindu rate of growth" denotes India's low rate of GDP growth between the 1950s and 1980s.

during the mid-eighties there has been considerable step up in the growth rate of Indian economy and further after the introduction of broad based economic reforms Indian economy has moved to the path of high growth trajectory where the economy has been growing at an impressive rate of around 7 to 9 percent per annum.

There is no debate among the scholars regarding the fact that India is growing at a higher rate. However, there is no general consensus among the economists regarding how the economy is growing. Therefore, it is very important to study the underlying factors of economic growth in the economy. It is well established that an economy can grow mainly through two channels, one is through factor accumulation and the other is through productivity growth. But, there has been no clear agreement among scholars on the fact whether economic growth in India is caused by factor accumulation or productivity growth. *Das et al* (2010) have argued that rise in the economic growth during 1980-2004 has been mainly caused by the factor accumulation rather than productivity growth. On the other hand, several scholars (Bosworth et al, 2007 and Gupta, 2008) have found that output growth in India till 1980s is associated with factor accumulation while the acceleration in the economic growth in the post 1980s has been mainly due to the rise in the productivity growth.

There are different types of productivity measures which are mainly categorized as the single or partial factor productivity such as labour and capital productivity on one hand and total or multi-factor productivity. However, there is no agreement among the economists regarding the best measure of productivity. But, it is argued that if we want to throw light on productivity trend for a shorter period then labour productivity is a better measure. On the other hand, if we are interested in long term productivity trend then Total Factor Productivity² (TFP) serves as a better indicator than labour productivity (Sargent and Rodriguez, 2000). Therefore, the economists tend to focus more on total factor productivity and its determinants (Easterly and Levine, 2001).

There has been strong debate centering the phenomenal growth experience of East Asian Countries where some scholars (Krugman,

² TFP refers to that part of output which cannot be explained by the inputs used in the production process.

1994 and Young, 1995) have viewed that these economies cannot sustain their growth rate as it is propelled by factor accumulation rather than productivity growth. Economic growth achieved merely through factor accumulation is not sustainable in the long-run because of application of law of diminishing returns which says that if certain input say, labour is continuously increased holding other inputs constant, then output will increase at a decreasing rate. By increasing the labour input we can increase the output for a while. However, we cannot increase the labour indefinitely because after some point of time all labour will get employed and more growth of capital without corresponding increase in labour could result diminishing returns to capital which may eventually cause the output to fall even if the capital input grows at a constant rate (Sarel, 1996). Solow (1956) also observed that factor accumulation explains only a portion of observed cross-country output growth. Therefore, in order to have sustainable economic growth in the long-run the policy makers have to focus on productivity growth particularly total factor productivity rather than factor accumulation as it has been argued to be the crucial determinant of long-run economic growth (Ozane, 2001). Thus, sharp increase of economic growth rate of the Indian economy in the recent past makes a valid ground for studying the productivity performance of the economy.

There are a large number of studies (Ahluwalia, 1991; Dholakia, and Dholakia, 1994; Pradhan and Barik, 1999; *Balakrishnan et al*, 2000; Goldar and Kumari, 2003; Goldar, 2004; Unel, 2003; TSL, 2003 and Reddy, 2005) on total TFP for India's registered manufacturing sector. However, there is no conclusive agreement among the scholars regarding the trends of TFP neither for Indian manufacturing industries nor about the appropriate methodology for calculating TFP. There are only a few studies (Sivasubramonian, 2001; Virmani, 2004; Pallikata (2004); Bosworth and Virmani, 2007; Gupta, 2008 and *Das et al*, 2010) which have made an attempt to estimate the TFP at the aggregate level. Therefore, the main objective of the study is to estimate the TFP growth for the Indian economy as a whole using the conventional growth accounting method. The rest of the study is organized as follows; section II describes the data and methodology. Section III discusses the TFP trends and section IV concludes the study.

Data and Methodology

One can estimate total factor productivity for the economy as a whole, across states, sector and sub-sector as well. The major problem of calculating total factor productivity at the aggregate level in India is the data constrains that is one require data on output and inputs on a time series basis³.

TFP Growth in India

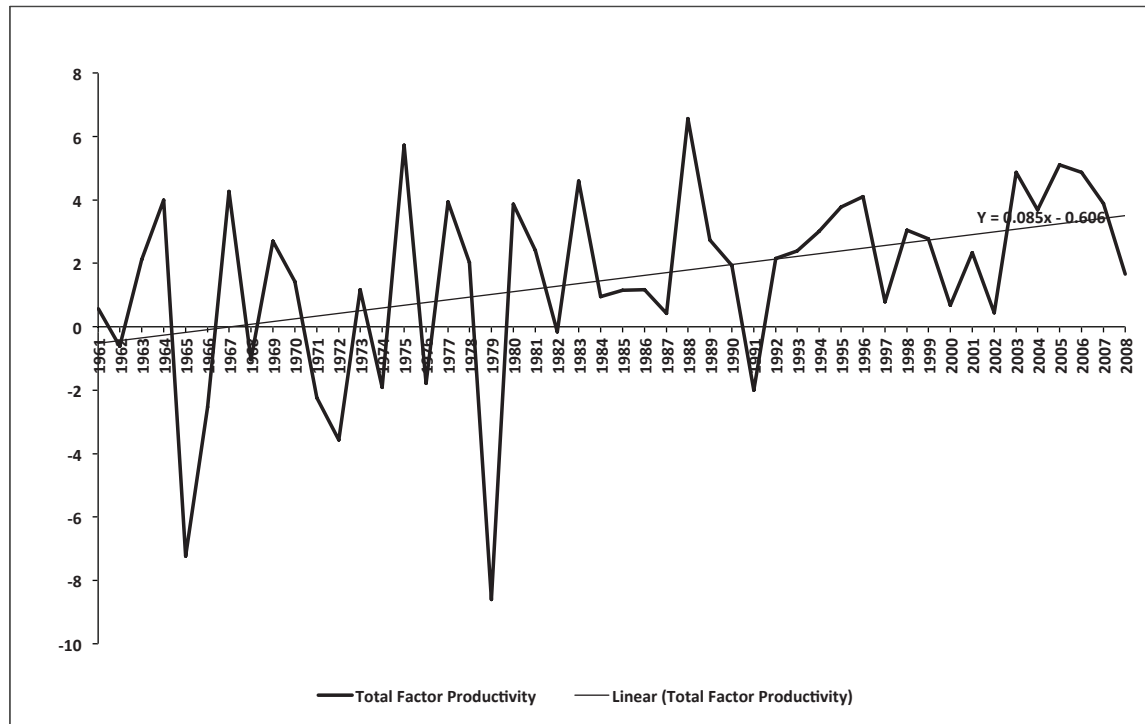
TFP is defined as increase in output growth which is not caused due to the factor accumulation. Thus, TFP may include all those factors which contribute to the generation of output other than labour and capital. This can happen because of several reasons such as, change in the quality of inputs, output, introduction of new techniques, inputs and outputs, better organization and so on. We have observed that TFP growth in India has been fluctuating during the study period (see figure 3.1). On an average TFP has grown by 1.49 during the study period 1961-2008. Whereas, during 1961 to 1970 the average TFP growth in India was although positive but it was very low and almost close to zero. Similarly, the economy experienced on an average negative TFP growth during the period 1971 to 1980 implying that there had been technological regress in the economy instead of technical progress.

Probable reasons for the low and negative TFP growth during the 1960s and 1970s could be assigned to mainly Indo-China, Indo-Pakistan war along external shocks like severe droughts and oil crisis and so on. Again, considerable inefficiency crept in the industrial sectors due to 'Permit or License Raj'⁴ causing TFP to fall. However, during 1980s when internal economic reforms were started in the economy along with the gradual withdrawal of several restrictive policies, the efficiency of

³ For more details data and methodology see Saha, (2012).

⁴ The term, License or Permit Raj refers to the elaborate licenses, regulations and accompanying red tape that were required to set up and run businesses in India. The large enterprises in seventeen industries were nationalized. Licenses were required not only for businesses for expanding productive capacity but also one had to have bureaucratic approval for laying off workers and for shutting down. When a business was losing money, the Government would prevent them from shutting down and to keep the business going, would provide assistance and subsidies. This gave birth to rampant corruption and inefficiency in the economy.

Figure 3.1
TFP Growth, 1961-2008



Source: Author's calculation

the economy had gone up and there was sharp jump in the TFP growth from negative 0.14 percent to positive 2.18 percent. When the economy went for broad based external economic reforms from 1991, the average TFP growth still remains positive but declined slightly by 11 percentage points from 2.18 percent during 1980s to 2.07 percent in the 1990s. Then again, in between 2001 to 2008 there has been considerable increase in TFP growth by 1.18 percentage points from 2.18 percent to 3.36 percent. Rise in TFP growth during 2001 to 2008 for the Indian economy could be attributed to several changes in the macro-economic factors which are generally conducive for productivity improvement.

The economy on an average has registered significant increase in the private sector credit from 24.61% during 1991-2000 to 39.35% during 2001-08. Besides that, gross fixed capital formation as a percentage of GDP has also increased by 6.39 percentage points during 2001-08 in comparison to the previous period 1991-2000. Again, there has been a considerable improvement in the health condition clearly reflected by the increase in the average life expectancy at birth from 59.84 years during

1991-2000 to 62.64 years during 2001-08. Similarly, the inflow of average foreign direct investment as a percentage of GDP has increased more than three times from 0.46 % during 1991-2000 to 1.48 % during 2001-08 and the average trade (export plus import) share as a percentage of GDP has also increased significantly from 22.09 % during 1991-2000 to 38.97 % during 2001-08. On the other hand, average population growth and dependency ratio has declined respectively by 0.32 and 7.26 percentage points from 1991-2000 to 2001-08. Again, there has been a significant decline in the share of agriculture value added as a percentage of GDP from 27.04 % during 1991-2000 to 19.63 % during 2001-08. Apart from that, average dependence foreign aid has also reduced considerably from 0.57 % during 1991-2000 to 0.19 % during 2001-08. Several studies [Austria (1998); Miller and Upadhyay (2000); Khatiwada and Sharma (2002); Pallikara (2004); Ahmed and Miller (2002); Lee (2004); Akilno (2005); Khan (2006); Razafimahefa (2006); Nachega and Thomson (2006); Njikam et al. (2006); Xu et al. (2008); Mahmood and Afza (2008); Loko and Diouf (2009) and Kumar et al. (2010)] have argued that increase in the credit facility, capital formation, capital inflows, trade shares, life expectancy at birth and decrease in the share of agriculture value added as a percentage of GDP, population growth, dependency ratio etc. increases productivity could be clearly seen from for period 2001 to 2008.

Table 3.1 compares the periodical averages of the present study with different other studies available on aggregate TFP. The calculated TFP growth figures of this study throw more or less the same trend with other studies available on aggregate TFP in India. However, the accuracy of TFP growth is heavily dependent on the precision with which the measures of labour and capital inputs are measured. Labour inputs can be measured with a relatively high degree of accuracy since they are usually readily from administrative sources; however, the same cannot be done for the capital input. Due to the unavailability of time series data on employment in India, Gupta (2008) has used total employment data from Total Economy Database as labour input. Pallikara (2004) has used labour force data from census through interpolation and extrapolation. Again, there have been considerable differences among the studies in using capital input.

The present study uses net fixed capital stock at constant (1999-00) prices data provided by CSO without any further adjustment. However,

Table 3.1						
Total Factor Productivity Growth of the Economy: Comparison						
Period	Deb et al	Our Estimates	Period	Deb et al	Bosworth and Maertens	Our Estimates
1980-85	1.71	2.14	1980-90	1.40	2.20	2.33
1986-90	1.10	2.56	1990-00	0.90	1.80	2.06
1992-96	1.77	3.09	2000-04	0.60	2.10	2.40
1997-04	0.76	2.33	-	-	-	-
1980-04	1.26	2.31	-	-	-	-
Period	Deb et al	Jorgenson & Vu	Our Estimates	-	-	-
1989-95	1.40	2.06	2.00	-	-	-
1995-03	0.81	2.49	2.54	-	-	-
Period	Gupta	Our Estimates	Period	Pallikara	Our Estimates	-
1961-04	1.50	1.28	1977-01	2.22	1.84	-
1961-70	0.32	0.36	1977-80	-0.42	-0.88	-
1971-80	-1.65	-0.14	1980-89	2.68	2.37	-
1981-90	2.32	2.18	1989-92	1.59	1.21	-
1991-95	3.67	1.87	1992-97	3.00	2.71	-
1996-00	3.83	2.28	-	-	-	-
2001-04	4.40	2.83	-	-	-	-
Source: <i>Das et al</i> (2010), Bosworth and Maertens (2010), Jorgenson and Vu (2005), Gupta (2008) and Pallikara (2004).						

most of the studies have generated the capital series using different depreciation rates assuming different average life of capital assets which another cause for getting different TFP estimates. There are different output measures also some people have used GDP at constant prices as output while some have used NDP at constant prices. The present study uses GDP at constant(1990-2000) as output measure and population ages 15-64 from World Development Indicators, World Bank as a measure of

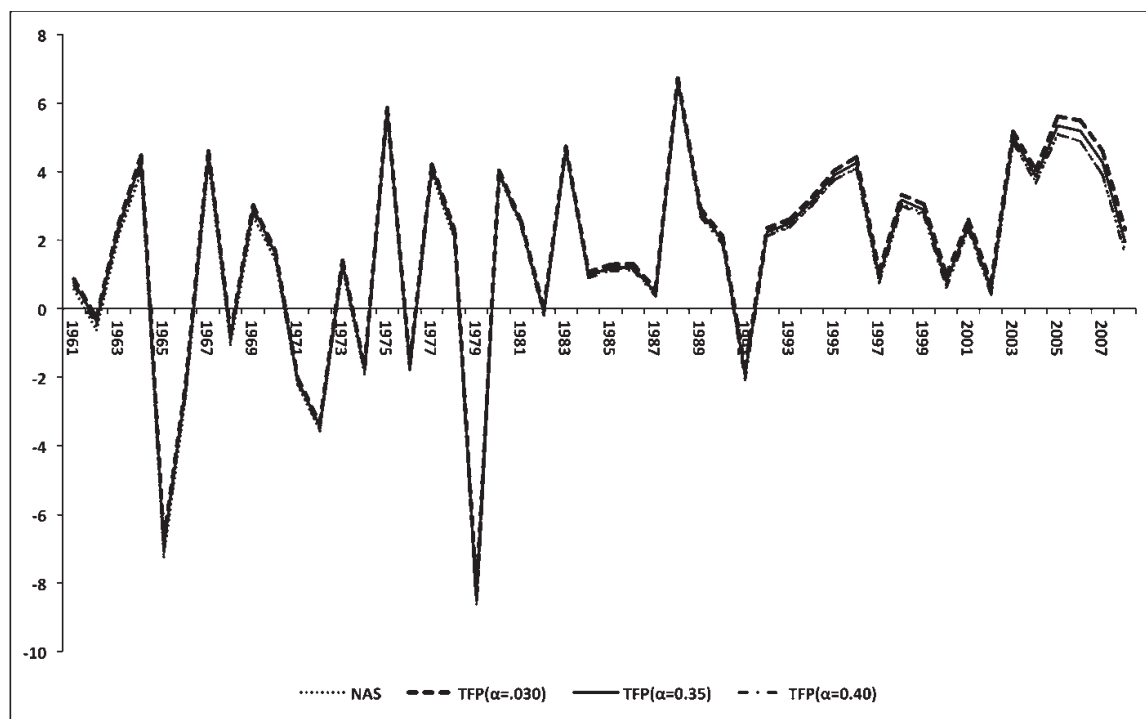
labour input which might have generated the difference of TFP estimates with other studies. Again, unlike other studies the present has not made any quality adjustment for inputs.

Sensitivity Analysis of TFP Growth with Fixed Capital Shares

The present study has calculated the labour and capital share using the National Accounts Statistics (NAS), CSO data with the assumption that out of the mixed income of the self employed 50 percent is labour income and 50 percent is capital income. Labour share is obtained by adding the 50 percent of the mixed income with the compensation of employees. Labour share minus one gives the capital share assuming the constant returns to scale. Several scholars (Collins and Bosworth, 1997, Sarel and Robinson, 1997, Young, 1995 and Krugman, 1994) have estimated TFP setting capital share to a 'bench mark' for the Cobb-Douglas production function.

Figure 4.1

TFP Growth Using NAS and Fixed Capital Shares, 1961-08



Source: Author's calculation

In this study a sensitivity analysis has also been undertaken for different values of capital share to see whether with the change in factor shares TFP estimates changes drastically for three different values of capital share i.e. α in the Cobb-Douglas production.

The results show that TFP estimates are not sensitive to different fixed weights for capital and labour. There may be minor differences among the estimates but they do not change their nature significantly which is clearly evident from the figure 4.1, which shows the same trends of different TFP growth estimates with three different values of $\alpha = 0.30, 0.35$ and 0.40 along with weights use from the NAS data. Thus, it is seen although TFP estimates differ significantly depending upon the adjustment nature of inputs but they are insensitive to capital and labour shares.

Conclusion

It has been observed that on an average TFP has grown by 1.49 percent during study period but is fluctuating in nature. During 1961 to 1970 the average TFP growth in India was although positive but it was very low close to zero. Similarly, the economy experienced on an average negative TFP growth during the period 1971 to 1980 implying that there had been technological regress in the economy instead of technical progress. External shocks like, war, drought, oil price hike along with inefficient rules and regulations during these could be the probable reasons for low productivity of the economy. However, the economy's productivity increased considerably after the initiation of internal economic reform measures during 1980s and it has further improved when the economy went for external economic reforms. Our study reveals more or less the same picture about the aggregate TFP for the economy with the other existing study. We have further observed that TFP estimates are not sensitive to factor shares.

References

- Ahluwalia, I.J. (1991): "Productivity and Growth in Indian Manufacturing", OUP, Delhi
- Ahmed, H and Miller, S.M. (2002): "The Level of Development and the Determinants of Productivity Growth: A Cross-Country Analysis", *Applied Economics*, 34(9), 1089-1095

- Akinlo, A.E. (2005): "Impact of Macroeconomic Factors on Total Factor Productivity in Sub-Saharan African Countries", WIDER Research Paper No. 2005/39
- Austria, Myrna S. (1998): "Productivity Growth in the Philippines after the Industrial Reforms", Discussion Paper Series No. 98-26, Philippine Institute for Development Studies
- Balakrishnan, P., K. Pushpangadan and M. Suresh Babu (2000): "Trade Liberalization and Productivity Growth in Manufacturing: Evidence from Firm Level Panel Data", *Economic and Political Weekly*, 35(41), 3679-3682
- Loko, B., and M.A. Diouf (2009): "Revisiting the Determinants of Productivity Growth: What's New?" IMF Working Paper No.09/225
- Bosworth B., and Maertens A. (2007), "Economic Growth and Employment Generation: The Role of the Service Sector", in "The Service Revolution in South Asia" ed. by Ejaz Ghani, Oxford University Press, 2010
- Bosworth, B., Collins, S. and Virmani, A., (2007): "Sources of growth in Indian Economy" NBER Working Paper No. 12901
- Collins, S. and Bosworth, B. (1997): "Economic Growth in South Asia: Accumulation versus Assimilation." *Brookings Papers on Economic Activity*, No.2, 135-191
- Das, D. K., Erumban, A. A., Agarwal, S. and Wadhwa, D (2010): "Total Factor Productivity Growth in the Reform Period: A Disaggregated Sectoral Analysis", Paper presented in the 1st World KLEMS conference at Harvard University
- Dholakia, B H and Dholakia, R H (1994): "Total Factor Productivity Growth in Indian Manufacturing", *Economic and Political Weekly*, 29(53), 3342-3344
- Easterly, W and Levine, R. (2001): "It's Not Factor Accumulation: Stylized Facts and Growth Models", *World Bank Economic Review*, 15(2), 177-219
- Goldar, Bishwanath (2004): "Productivity Trends in the Indian Manufacturing in the Pre-and Post-Reform Periods", ICRIER Working paper no.137
- Goldar, Bishwanath and Kumari, Anita (2003): "Import Liberalization and Productivity Growth in Indian Manufacturing Industries in the 1990s", IEG Working Paper No. E/219/2002
- Gupta, A. (2008): "Indian Economy-TFP or Factor Accumulation: A Comprehensive Growth Accounting Exercise", Working Paper Series, University of British Columbia
- Jorgenson, D and Vu, K (2005), "Information Technology and the World Economy", *Scandinavian Journal of Economics*, 107(4), 631-650

- Khan, Safdar Ullah (2006): "Macro Determinants of Total Factor Productivity in Pakistan", *State Bank of Pakistan Research Bulletin*, 2(2), 384-401
- Khatriwada, Yuba Raj and Sharma, Suman K. (2002): "Nepal: Country Study Report", Institute for Integrated Development Studies, Nepal
- Krugman, Paul. (1994): "The Myth of Asia's Miracle." *Foreign Affairs*, 73(6), 62-78
- Kumar, Saten, Pacheco, Gail and Rossouw, Stephanie (2010): "How to Increase the Growth Rate in South Africa", MPRA Paper No.26105
- Lee, Byoungki (2004): "Measuring Total Factor Productivity: Survey Report, Asian Productivity Organization, Tokyo
- Mahmood, A and Afza, T (2008): "Total Factor Productivity Growth in East Asia: A Two Pronged Approach", *European Journal of Economics, Finance and Administrative Sciences*, Issue-14, 93-111
- Miller, S. M., and Upadhyay, M. P., (2000): "The Effects of Openness, Trade Orientation, and Human Capital on Total Factor Productivity." *Journal of Development Economics*, 63(2), 399-423
- Nachegea, J.C. and F. Thomson (2006): "Economic Growth and Total Factor Productivity in Niger", IMF Working Paper No. 06/208
- Njikam, Ousmanou, Binam, Joachim Nymek and Tachi, Simon (2006): "Understanding Total Factor Productivity Growth in Sub Saharan Africa Countries", Working Paper Series, SISERA
- Ozanne, A.L. Garces (2001): "The Determinants of Total Factor Productivity: The High-Performing Asian Economies Revisited", Ph.D thesis, Univeristy of Otago. New Zealand
- Pallikara, R. (2004): Measuring Total Factor Productivity: Survey Report, Asian Productivity Organization, Tokyo
- Poddar, Tushar and Yi, Eva (2007): "India's Rising Growth Potential", Chapter One, BRIC
- Pradhan, G and Barik, K (1999): "Total Factor Productivity Growth in Developing Economies: A Study of Selected Industries in India", *Economic and Political Weekly*, 34(31), M92-M97
- Razafimahefa, I.F. (2006): "Determinants of Total Factor Productivity: The case of Sub-Saharan African Economies" Doctoral Dissertation, Kobe University, Japan
- Reddy, Y. V. (2006): "Importance of Productivity in India", inaugural address at the Annual Conference of Indian Economic Association held on December, 27, 2005, Andhra University

- Saha, Sanjoy (2012), "Productivity and Openness in Indian Economy", *Journal of Applied Economics and Business Research*, 2(2), 91-102
- Sarel, Michael (1996): "Growth in East Asia: What We Can and What We Cannot Infer", *Economic Issues*, International Monetary Fund
- Sarel, Michael and Robinson, David J. (1997): "Growth and Productivity in ASEAN Countries, IMF Working Paper No.97/97
- Sargent, Timothy C. and Rodriguez, Edward R. (2000): "Labour or Total Factor Productivity: Do We Need to Choose?" *Economic Studies and Policy Analysis Division*, Department of Finance, Canada
- Sivasubramonian, S. (2004): *The Sources of Economic Growth in India, 1950-51 to 1999-2000*", OUP, New Delhi
- Solow, Robert M. (1956): "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70(1) 65-94
- Tata Services Limited (2003): *Reforms and Productivity Trends in Indian Manufacturing Sector*, Department of Economics and Statistics Tata Services Limited, Mumbai
- Unel, B. (2003): "Productivity Trends in India's Manufacturing Sectors in the last Two Decades", IMF Working Paper No. WP/03/22
- Virmani, A. (2004): "Sources of India's Economic Growth: Trends in Total Factor Productivity", ICRIER Working Paper No. 131
- Xu, Helian, Lai, Mingyong and Qi, Peng (2008): "Openness, Human Capital and Total Factor Productivity: Evidence from China", *Journal of Chinese Economic and Business Studies*, 6(3), 279-289
- Young, A. (1995): "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience." *Quarterly Journal of Economics*, 110(3), 642-680
