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Sri Lanka's Sources of Growth

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Abstract

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This paper uses the growth accounting framework to assess Sri Lanka's sources of growth. It finds that while labor was the dominant factor contributing to growth in the 1980s, labor's contribution declined over time and was overtaken, to a large extent, by total factor productivity (TFP) and, to a lower extent, by physical and human capital accumulation. A higher growth path over the medium term will depend on securing a stable political and macroeconomic environment; implementing structural reforms necessary to improve productivity and efficiency of investment; attaining fiscal consolidation; and creating space for the private sector.

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I. INTRODUCTION

Sri Lanka's economic growth has been generally robust even during times of adverse global and domestic macroeconomic conditions. In the 1980s and 90s, Sri Lanka's economic growth averaged about 5 percent, despite a 20 year civil war with various levels of intensity. In 2000-2001, a significant slowdown in growth was associated with a widespread civil conflict. Following a ceasefire in 2002, the economy performed well with real GDP growth averaging 6.2 percent despite a number of external and domestic shocks, including high international oil prices, increased competition for apparel exports following the end of the Multi-Fiber Arrangement (MFA), and the continuing conflict between the Liberation Tigers of Tamil Eelam (LTTE) and the government. The growth pick up in 2006 was supported by a relatively calm political environment and high external support for tsunami reconstruction.

Sustaining the current growth momentum and moving towards a higher economic growth path is possible but will be a challenge. In its Ten Year Horizon Development Framework, the government of Sri Lanka envisages attaining growth of about 8 percent per annum, mainly through investments of about US\$4.5 billion (about 17 percent of GDP) in infrastructure projects in power, roads, water supply, and ports.

This paper uses the growth accounting framework to investigate the main sources of Sri Lanka's growth over the last two decades. This framework helps shed light on what will be required to sustain the recent growth momentum and achieve even higher growth over the medium-term. The paper finds that labor was the most productive factor in the 1980s, contributing the most to real GDP growth. Over time, total factor productivity became the highest contributor to growth while the contribution of labor declined and that of physical capital remained relatively constant.

Growth accounting studies on Sri Lanka are limited and for a few cases available, Sri Lanka is usually included as a case in cross-country and regional assessments of sources of growth (for example Bosworth and Collins (2003); Miller (2004)). These studies tend to assume that the elasticity of factor inputs to growth and the depreciation rates of capital are the same across countries for comparison purposes. These studies tend not to account for country specific factors, particularly elasticities and depreciation rates that can differ for individual countries. This study supplements the work of Fernandez (2005) on Sri Lanka by specifically calculating the elasticities for physical capital from the country's own data instead of using those directly from the general literature. This study also includes human capital as one of the factors and uses slightly higher depreciation rates than in the general literature, given the effects of the extended conflict on the accumulation of capital in the economy.

The paper proceeds as follows. Section II, provides some background to Sri Lanka's economic growth performance through stylized facts and dynamics of growth. Section III describes the growth accounting framework employed in the paper. This framework is a useful tool in decomposing growth into components associated with changes in factor inputs

and total factor productivity (TFP). Section IV applies the growth accounting framework to Sri Lanka's data. Section V assesses Sri Lanka's potential growth. Section VI concludes.

II. STYLIZED FACTS AND DYNAMICS OF GROWTH

Sri Lanka's economic growth performance is highly associated with investor confidence and external conditions. Strong real GDP growth in the 1980s followed a period of economic liberalization that raised private sector investment to 19 percent of GDP between 1980 and 1985 from 10 percent in the 1970s. However, with ethnic tensions developing into a full-scale civil war in 1983 and the government shifting its focus away from economic reforms, private sector confidence declined and average growth fell to 3.7 percent between 1983 and 1989. A pick up in reforms, mainly of a structural adjustment nature, including rationalizing of public spending; liberalizing trade and payments; lowering controls on prices and interest rates; promoting private sector development; promoting foreign investment; reforming the financial sector; and expanding the export sector to garments, helped raise economic growth in the 1990s. However, this was followed by the economy's first recession in 2001 with negative growth of 1.5 percent reflecting a deterioration in the security situation, compounded by a global slowdown, higher oil prices, large imports of military equipment (that nearly resulted in a foreign exchange crisis), and severe drought.

Sri Lanka's strong growth performance has, on average, brought positive benefits to the economy and has benefited from a high quality labor force. Unemployment has been declining (from 17.9 percent in 1981 to 15.9 percent in 1990, and 7.7 percent in 2005) and per capital income has been rising and exceeds that of most other South Asian economies (Figure 1). The quality of the labor force is high relative to other South Asian economies (see the United Nation's estimates of human development in the Human Development Report, 2006, Table 1) in view of high educational standards and literacy rates (at about 93 percent in Sri Lanka compared with about 56 percent in South Asia).

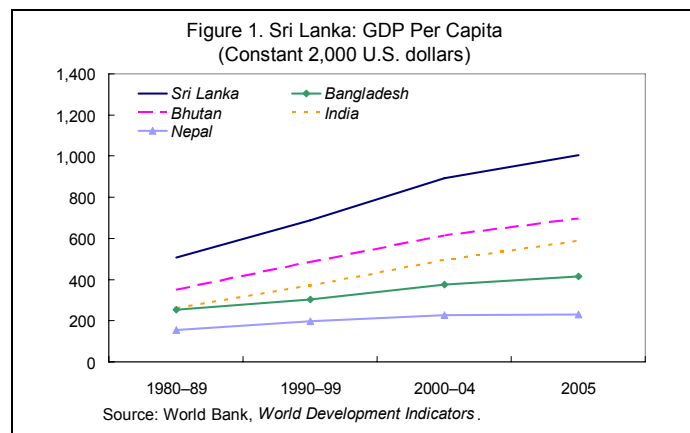
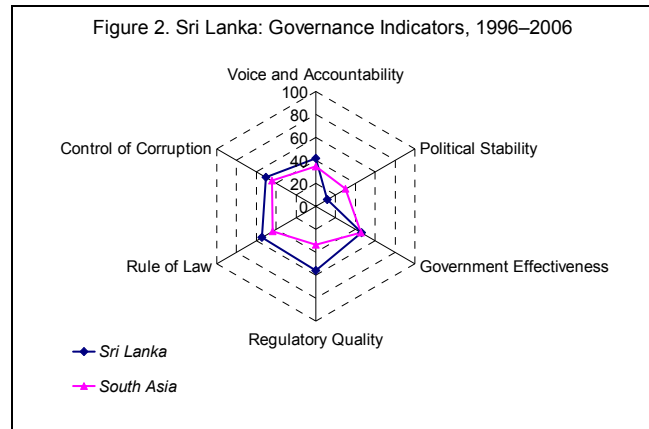


Table 1. Sri Lanka: Human Development Index (HDI)

Country	HDI Rank	Year			
		1980	1990	2000	2004
Bangladesh	137	0.37	0.42	0.51	0.53
Sri Lanka	93	0.65	0.71	0.75	0.76
India	126	0.44	0.52	0.58	0.61
Nepal	138	0.34	0.43	0.50	0.53
Bhutan	135	0.54

Source: United Nations, *Human Development Report (2006)*.

Also, Sri Lanka's governance indicators outpace those in most South Asian economies, except on political stability (Figure 2). World Bank indicators of governance (World Bank, 2007) indicate that Sri Lanka has, over the past 11 years, consistently scored better than other South Asian economies on voice and accountability, control of corruption, rule of law, and regulatory quality. These indicators support strong economic performance. However, Sri Lanka has scored poorly during some periods on government effectiveness and consistently poorly on political stability.



The ethnic conflict that has dominated economics and politics in Sri Lanka over the last quarter century has constrained the economy's growth potential. The conflict has been largely localized to the North and East, though with effects on other areas from time to time. As a result, the contribution of the North and East to economic activity has remained limited, while that of the Western Province has remained the highest in the country. In 2006, the Western Province's contribution to real GDP was about 60 percent (Table 2). The disparity in economic activity across regions has prevented geographically broad-based economic growth and has limited potential output.

Table 2. Sri Lanka: Regional Contributions to Growth, 2007

Province	Percent
West and northwest	59.8
South and central	23.6
North and east	16.6
Total	100

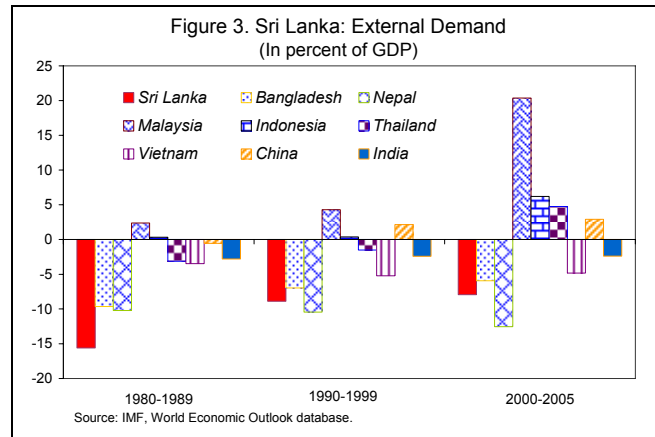
Source: Central Bank of Sri Lanka.

The conflict has contributed to wide disparities in income and poverty levels across the country. In addition, the agricultural sector's contribution to economic activity is falling. Given that the agricultural sector remains the main source of livelihood for rural areas, its declining role in economic activity is contributing to the widening rural-urban income gap and high poverty levels.²

Sri Lanka's overall economic growth performance is on par with other economies in South Asia and its per capita income is moving closer to some East Asian emerging markets. The dynamics of this growth, however, differ to some extent:

² Poverty incidence in Sri Lanka is estimated at 23 percent in 2002. For rural areas, the incidence is even higher at 30 percent compared to 8 percent in urban areas. Though poverty incidence has fallen across areas between 1995/96 and 2002, it still remains high.

- Sri Lanka's growth is largely driven by domestic demand (especially consumption spending), with the ratio of domestic demand to total GDP generally higher than that of other countries in the region. External demand is lower than in most South Asian and some East Asian economies and has remained negative over the past two decades (Figure 3). High growth economies, like India and China, tend to have a much higher contribution of external demand, reflecting a more dynamic and diverse export sector.



- Sri Lanka's gross capital formation is the lowest in the region (Figure 4.1) and current government spending is high. The Sri Lankan government has sustained high fiscal deficits (in the range of 8 percent and 9½ percent of GDP) and a high ratio of government spending to total GDP (estimated around 35 percent) for more than 10 years. Sri Lanka's government debt (averaging 101 percent of GDP over the past five years) far exceeds that of other economies in the region (for example an average of 63 percent of GDP in Nepal, 49 percent in Bangladesh, and 85 percent in India over the last five years).³ High growth economies tend to have a much higher ratio of gross public sector investment to GDP. Also, policies in favor of increased private sector economic participation help in raising economic growth (see for example Rodrik and Subramanian (2004) on India). Therefore, increased public sector investment spending while reducing the size of fiscal deficits (thereby reducing fiscal dominance in economic activity) can positively contribute to economic growth in Sri Lanka.
- On the production side, a clear distinction arises between South Asian economies and some East Asian emerging markets (Figure 4.2). In South Asia, agriculture generally has a higher share to GDP than in East Asia while the opposite applies to manufacturing. This indicates that Sri Lanka is not an outlier in South Asia in terms of the role that the agricultural sector still plays in the economy.

³ These refer to central government debt in Sri Lanka, Nepal, and Bangladesh and general government debt in India.

III. THE GROWTH ACCOUNTING FRAMEWORK

The growth accounting framework is rooted in macroeconomic theory. The initial foundations of this framework were presented in Solow (1957), Kendrick (1961), Denison (1962), and Jorgenson and Griliches (1967). This framework allows for an explicit modeling of growth in terms of contributions from underlying factor inputs. The framework is very useful when the factor inputs that matter for growth are substantially independent from those that determine technological change (Barro, 1998). As such, variants of the basic framework have been used, including additional factor inputs and a disaggregation of capital and labor among types or qualities (Jorgenson and Griliches, 1967) in an attempt to isolate growth effects related to pure technological progress (captured by the residual TFP). The basic neoclassical production function is given by the following equation:

$$Y = F(A, K, L) \quad (1)$$

Where, Y is real output; A is total factor productivity; K is the capital stock; and L is the size of the labor force.

Following from the above framework and its application in a number of developing countries, an economies of scale Cobb-Douglas production function is applied in decomposing sources of growth in Sri Lanka. The production function is of the form that links output to capital, labor, human capital, and total factor productivity:

$$Y_t = A_t K_t^\alpha H_t^\beta L_t^{1-\alpha-\beta} \quad (2)$$

Where, H is a measure of human capital; $\alpha \equiv r_k K/Y$ is the share of capital in output (with r representing the remuneration of capital); $\beta \equiv w_h H/Y$ is the share of human capital in output (with w_h representing the remuneration of skilled labor), and $(1-\beta-\alpha)$ measures the share of labor in output. In the production function presented, capital, human capital, and labor are observable from data, while TFP is not. From the specification in equation (2), TFP is derived in the following manner:

$$A_t = \frac{Y_t}{K_t^\alpha H_t^\beta L_t^{1-\alpha-\beta}} \quad (3)$$

TFP acts as a catch-all variable for anything else that is left unexplained by the other three factors.

Differentiation of equation (2), after taking logs, with respect to time yields:

$$y_t = a_t + \alpha * k_t + \beta * h_t + (1 - \alpha - \beta) l_t \quad (4)$$

This represents the function in terms of growth in output. Following from equation (4), growth in TFP is represented by:

$$a_t = y_t - \alpha * k_t - \beta * h_t - (1 - \alpha - \beta) * l_t \quad (5)$$

The following discusses the data used as representatives of factor inputs in the application of the growth accounting framework in Sri Lanka. The sample period considered in this work is determined by the availability of data necessary for analyzing the sources of growth.

Capital Input

For Sri Lanka, the capital variable is not readily available and is therefore estimated using the perpetual inventory method (PIM) as is generally done in similar studies. The PIM uses gross fixed capital formation (a flow variable) and an assumption on the depreciation rate of capital to derive the capital stock. According to this method, the capital stock is derived as follows (Figure 5):

$$K_t = (1 - \delta) K_{t-1} + I_t \quad (6)$$

In equation (4) above, δ is the depreciation rate, and I is gross fixed capital formation. The formula is applied on a long time series of gross fixed capital formation, starting in 1959 (the earliest data point available for this series). The depreciation rate used for Sri Lanka is 6.7 percent for the period before 1980 and 25 percent thereafter. This is a reasonable depreciation rate for Sri Lanka, taking into consideration the level of development of the economy and the many disruptions in capital formation in recent decades due to an unstable political environment, and the civil conflict. Also, this takes into account the depreciation rates allowed for tax purposes in Sri Lanka, ranging from 6½ percent for buildings to as high as 33½ percent for plant and machinery. Generally, depreciation rates of the capital stock used for developing economies tend to be much higher than those used for developed economies (around 7 percent). In similar studies for countries in East Asia, depreciation rates of 20 percent (Philippines) and even 60 percent (Indonesia) have been used (for example, Bu, 2004). Sensitivity analysis of Sri Lanka's estimates to different depreciation rates is performed and presented in Section IV below.

Labor Input

Labor force data are used as a measure of labor input, as is usually done in similar studies, and some inferences can be drawn from it. Sri Lanka's labor force grew sharply in the 1980s (Figure 6), driven in part by population growth. This contributed to a similarly sharp increase

in unemployment from 12 percent to around 16 percent. From 1987 onwards, high labor migration due to improved opportunities for foreign employment contributed to a slowdown in both the growth of the labor force and unemployment. In the 1990s and 2000s, growth has been relatively constant around 9 percent annually. Employment growth has also tended to follow a similar trend indicating relatively constant absorption of the labor force into the formal sector. Also, labor migration has helped absorb Sri Lanka's labor force and helped reduce the rate of unemployment.

Human Capital Input

Human capital is generally measured through average years of schooling of the working population. In Sri Lanka, this variable was not readily available and had to be estimated by taking the maximum educational attainment of employed people in each level (as a share of total) from the Labor Force Survey of 2005 and multiplying by the number of years of schooling in each grade level.⁴ This is then multiplied by the number of people employed to derive average years of schooling of the working population. The largest percent of those employed have completed middle school (grades 5 to 9) in Sri Lanka.

Total Factor Productivity

As a residual in the growth accounting framework, TFP captures components of real GDP growth that are not explained by capital, labor, and human capital. Also, the measurement of the other factor inputs affects growth in TFP (Musso and Westermann, 2005), and therefore TFP may reflect more than technological progress. When capital inputs are measured using the capital stock, TFP growth will tend to reflect changes in capital utilization. Also, when labor inputs are measured in terms of the labor force, TFP will pick up the absorption and utilization of the labor force. Similarly, when employed persons are used as a labor input, TFP will reflect the effect of changes in average hours worked per employed person. With human capital measured in average years of schooling of the working population, TFP picks up the utilization of this human capital.

Technological progress is also reflected in TFP growth. However, disentangling the effect of pure technological progress from the effects of the measurement of the individual inputs described above is a challenge. Disentangling technological progress has been subject to much debate and some studies have attempted to do it using measures of research and

⁴ These are educational attainments of employed persons as measured in Sri Lanka's Labour Force Survey (Department of Census and Statistics, 2005). These are below grade 5 (representing roughly 25 percent of total employed persons); grades 5–9 (roughly 45 percent of total); GCE (O.L)/NCGE (roughly 16 percent of total); and GCE (A.L)/HNCE (roughly 14 percent of total). For educational attainment at grade 5, the number of years of schooling is six; at grades 5–9, the number of years of schooling is ten; at GCE (O.L)/NCGE, the number of years of schooling is eleven; and at GCE (A.L)/HNCE, the number of years of schooling is sixteen.

development (Griliches, 1973) and the spillover effects of investment in information and communication technologies (ICT). Evidence from these studies has, however, generally not been convincing (Vijsselaar and Albers, 2002).

Consistent with macroeconomic theory, a strong positive correlation between TFP growth and real GDP can be observed for Sri Lanka (Figure 5). Growth accounting theory predicts that countries with high GDP and GDP per capita growth rates have high levels of technological progress. In Sri Lanka, it appears that TFP has positively contributed towards real GDP growth. This is in line with evidence on institutional and human capital aspects of the economy pointed out earlier. Though political instability has, in the past, prevented Sri Lanka from achieving consistently high economic growth, other institutional indicators that are often associated with positive influences on TFP growth have generally been strong relative to those in other South Asian economies.

IV. DECOMPOSITION OF SOURCES OF GROWTH FOR SRI LANKA

This section decomposes Sri Lanka's sources of growth for the past two and a half decades using the growth accounting framework presented above. Estimates of the parameters for capital and human capital are 0.2 and 0.1,⁵ respectively. The estimate for the share of human capital to output uses the growth rate in real wages as a proxy for the remuneration of employees since data on rate of remuneration of skilled employees is not available.⁶

The parameters estimated for Sri Lanka differ slightly from those in similar studies in South Asia and East Asian economies (Appendix I).⁷ Several conclusions can be drawn from the regional empirical work. First, the share of capital in output tends to fall in the range of 0.3 to 0.4. Second, the rate of depreciation of the capital stock can vary from as low as 4 percent to as high as 60 percent given a number of country specific factors including the impact of domestic and external shocks, and stages of economic development. Last, the main contributor to growth varies between countries and can vary over time given, in part, changes in the structure of the economy and implementation of reforms.

⁵ The parameter derived for β was below 0.1, but 0.1 was used since the estimation is highly dependent on less reliable data for human capital and the real wage in Sri Lanka. Also, results do not vary much if β of less than 0.1 is used. Also, results based on a production function using parameters from studies in other economies in the regional provide another good robustness check of the results and the sensitivity of estimates of TFP to different parameters (sensitivity analysis is presented later in this section).

⁶ This assumes that real wages of skilled employees have generally been growing in a similar manner as real wages of the rest of the labor force.

⁷ Appendix I is only meant to be illustrative and not to be conclusive of studies in this area in the region.

In Sri Lanka, factor contributions to growth have evolved over time. In the 1980s, labor was the main contributor to growth and its contribution declined and was overtaken, to a large extent, by TFP in the 1990s and the 2000s and to a lower extent by the accumulation of both physical and human capital (Table 3). The evolution in the contribution of labor to economic activity is consistent with the evolution in the contribution of the most labor intensive sector to economic growth (i.e., agriculture) as discussed earlier. Official data (Ministry of Labour Relations and Manpower, 2006) also indicates that labor productivity (measured as output per employed person) declined from about 12 percent in the early 1980s to about a negative 1 percent in 2003, contributing to a decline in the contribution of labor to output. The contribution of both TFP and physical capital increased substantially in the 1990s, supported by reforms implemented during this period resulting in a slight pickup in investment. In the 1990s and 2000s, growth has been mostly accounted for by TFP growth, with its contribution surpassing that of both human capital and labor.

Improving Sri Lanka's growth potential depends on the country's ability to better utilize its factors of production (i.e., its main sources of growth). Following the current trend of labor and capital contributions, Table 4 shows three scenarios of likely TFP contributions to growth. The table shows that achieving high real GDP growth will require growth in TFP that exceeds its growth in the past. Similarly, achieving high real GDP growth with moderate growth in TFP will require contributions from the other factor inputs at levels higher than in the past.

Table 3. Sri Lanka: Average Annual Contributions to Growth
(Model with human capital)

	1980s	1990s	2000-05	2003-06
Output	4.2	5.1	4.3	6.2
Factor productivity	0.5	2.9	2.7	3.1
Physical capital	0.0	1.2	0.8	1.4
Human capital	0.7	0.3	0.4	0.6
Labor	3.1	0.7	0.3	1.1

Table 4. Sri Lanka: Growth Under Three Scenarios
(Average annual contributions to growth)

	1990s	2000-05	2003-05	2003-06	2007-2011		
					Low TFP	Med. TFP	High TFP
Output	5.1	4.3	5.8	6.2	4.3	5.5	7.0
Factor Productivity	2.9	2.7	4.2	3.1	2.5	3.7	5.2
Physical Capital	1.2	0.8	1.1	1.4	1.0	1.0	1.0
Human Capital	0.3	0.4	0.6	0.6	0.5	0.5	0.5
Labor	0.7	0.3	-0.1	1.1	0.3	0.3	0.3

Sensitivity Analysis

Since estimates of TFP can be sensitive to assumptions made about the depreciation rate of capital and shares of factor inputs, sensitivity analysis was performed. The depreciation rate used prior to the period of the civil conflict starting mainly in the 1980s is 6.7 percent. After 1980, the depreciation rates explored were 15 percent, 20 percent, 25 percent, and 30 percent. Figures 5 and 8 presents growth in the capital stock and TFP given these depreciation rates. It is evident from these figures that applying different depreciation rates does not result in much variation in estimates of growth in the capital stock and TFP. Also, applying the shares mostly used in similar studies in developing countries (0.3 as the share of

capital and 0.35 as the share of human capital) does not result in much variation in TFP growth (Figure 7).

V. POTENTIAL OUTPUT AND THE OUTPUT GAP

Levels of actual factor inputs tend to differ, in practice, from their potential levels, generating a gap between actual and potential real GDP. This gap, called the output gap, is a measure of the difference between the actual output that an economy has achieved and the output that an economy can achieve at full capacity. When the gap is positive, it means that actual output exceeds full capacity and when it is negative, actual output is below full capacity. From equation (2) a country's potential output can be expressed as:

$$Y_t^P = Y_t \left(\frac{\mathcal{E}_{K,t}^P}{\mathcal{E}_{K,t}^C} \right)^\alpha \left(\frac{\mathcal{E}_{H,t}^P}{\mathcal{E}_{H,t}^C} \right)^\beta \left(\frac{\mathcal{E}_{L,t}^P}{\mathcal{E}_{L,t}^C} \right)^{1-\alpha-\beta} \quad (7)$$

The derivation of equation (7) is described in Appendix II. On equation (7), \mathcal{E}_i^P and \mathcal{E}_i^C are potential and actual rates of factor utilization for factor i respectively. In this case, \mathcal{E}_K^C is the actual rate of utilization of capital and \mathcal{E}_K^P is the potential rate of utilization of capital.

Similarly, \mathcal{E}_L^C is the actual rate of employment and \mathcal{E}_L^P is the potential rate of employment (one minus the estimated natural rate of unemployment). For Sri Lanka, data on actual capacity utilization rates is already available from the CEIC database while that of the natural rate on unemployment (NAIRU) is calculated using Okun's law, which provides for a relationship between changes in the rate of unemployment and the difference between actual and potential real GDP. According to Okun's law, unemployment above the inflation-threshold unemployment rate reduces GDP below potential.

Estimates of Sri Lanka's output gap using the production function approach show that the output gap was positive in the late 1990s and also more recently (Figure 9). Figure 9 also plots the output gap estimated through a pure statistical approach (HP-filter) for comparison. Both estimates of the output gap show that actual output was above potential during the late 1990s and more recently. Episodes of positive output gaps correspond with periods during which inflation relatively high and/or increasing, partly as a result of a loose monetary policy stance.

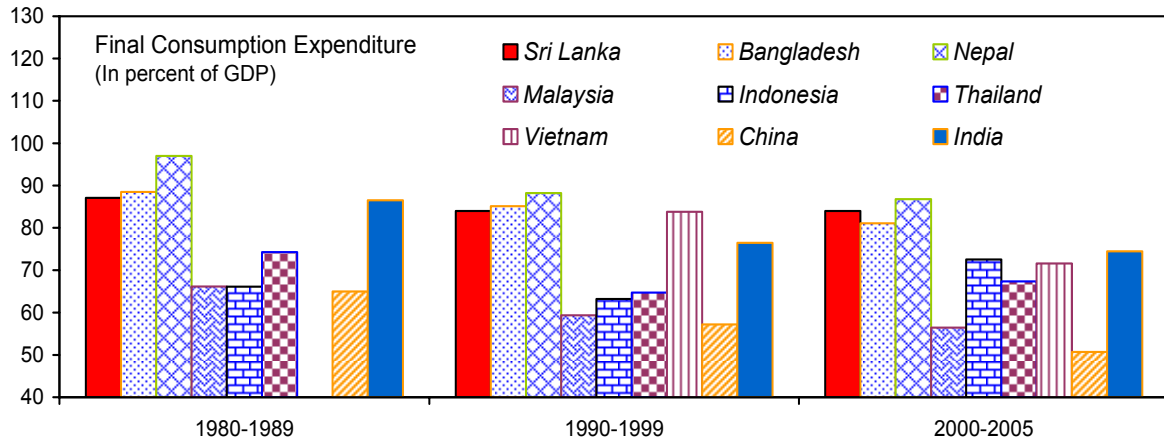
VI. POLICY ISSUES AND CONCLUSION

The growth accounting framework has shown that labor was the major factor contributing to growth through the 1980s and that later, TFP took over as the main contributor. The slowdown in the contribution of sectors that are labor intensive, together with faster growth

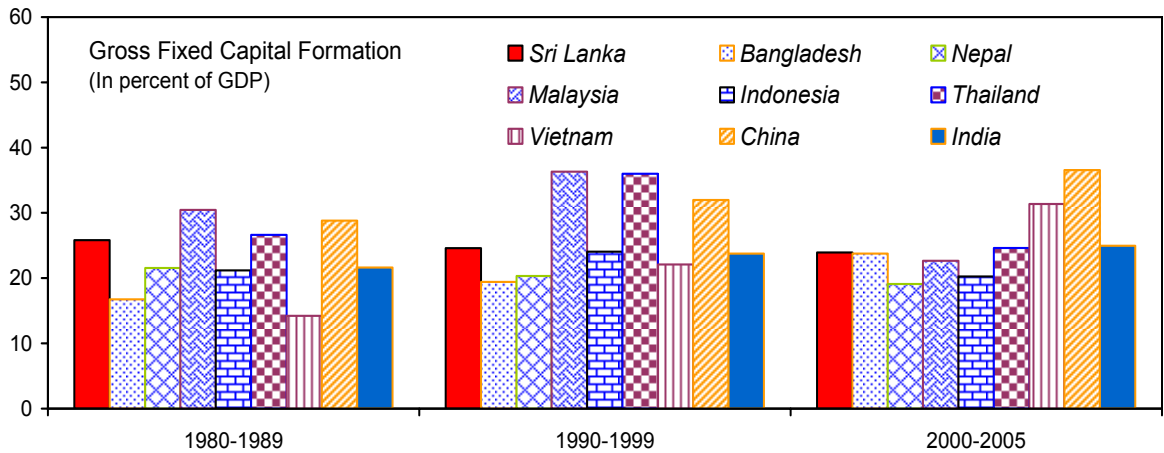
in sectors that are capital intensive and have higher productivity levels, resulted in TFP overtaking other factor inputs as the main contributor to growth. Also, the productivity of physical capital slowed down in recent years, largely due to neglect and fast depreciation as a result of the political conflict and wars.

Unlocking higher growth than in the recent past will require a multifaceted approach. This includes, but is not limited to, a stable political and macroeconomic environment; reforms necessary to improve the productivity of factor inputs through productive investments; and creating space for the private sector partly through a reduction in fiscal dominance. A stable political environment is a necessary but not sufficient condition for growth going forward. Prudent monetary and fiscal policies are necessary to attain stability in the macroeconomic environment. On the structural side, the government's Ten Year Horizon Development Framework, intended at raising the economy's growth potential, envisages a significant scaling up of investment and improving overall productivity in major economic sectors including power, roads, water supply, and ports during 2007-09. This is expected to be supported by both public and private investments (both domestically and foreign), thereby creating some space for private sector involvement in economic development. The modalities of financing for these projects are crucial in ensuring that they do not overload the already high government debt burden (estimated at 87.5 percent of GDP in 2006) and do not undermine the governments fiscal consolidation and debt sustainability efforts, thereby hindering future growth potential.

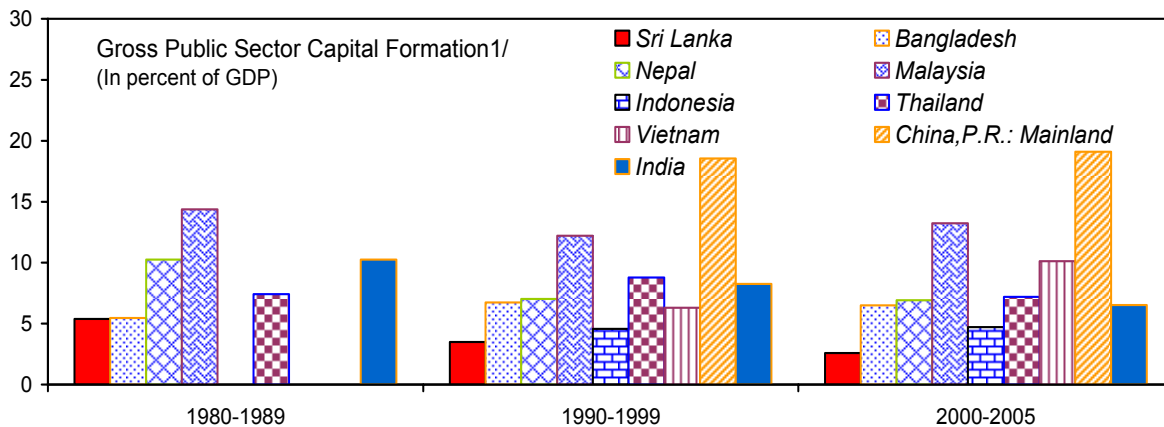
Figure 4.1. Sri Lanka: Regional Comparisons of Expenditure Components



Source: IMF, *World Economic Outlook* database.



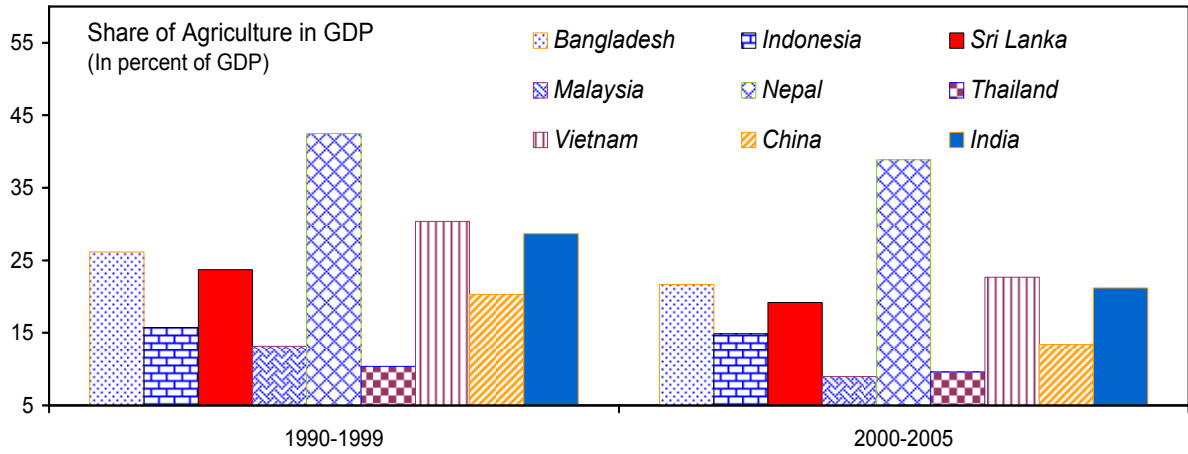
Source: IMF, *World Economic Outlook* database.



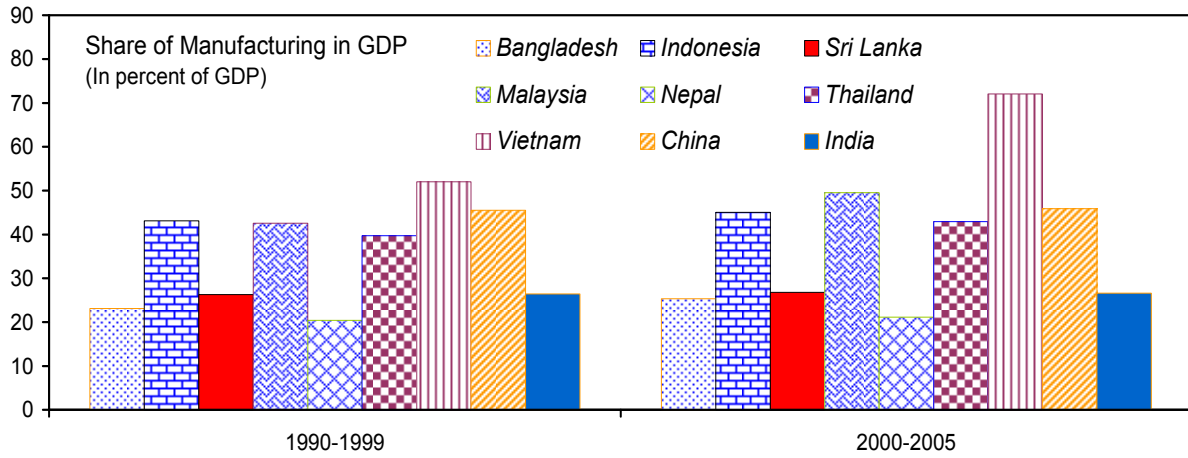
Source: IMF, *World Economic Outlook* database.

^{1/} Bangladesh and Nepal are central governments. Data is not available for some countries in the 1980s.

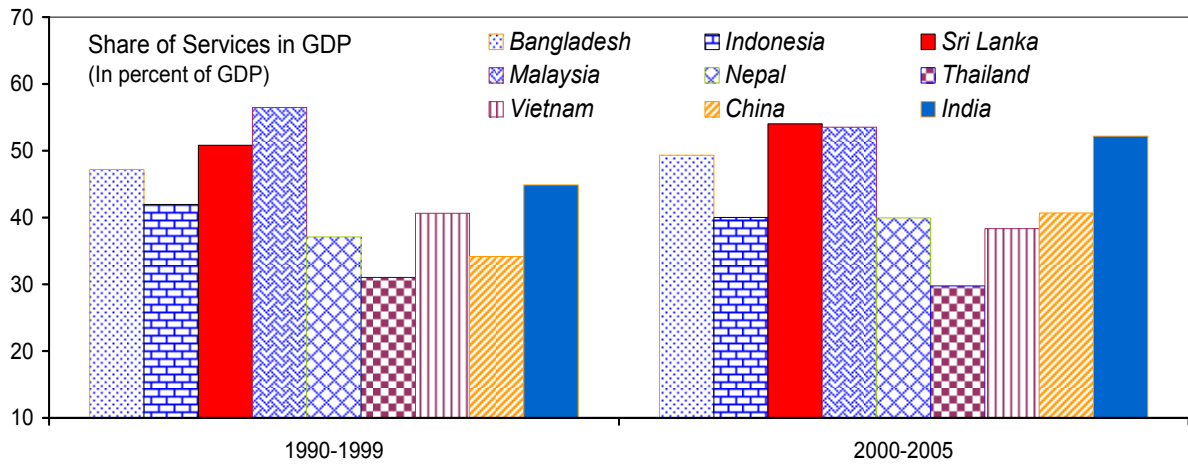
Figure 4.2. Sri Lanka: Regional Comparisons of Production Components



Sources: CEIC Data Co., Ltd.; country authorities; and IMF, *International Financial Statistics*.



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Sources: CEIC Data Co., Ltd.; country authorities; and IMF, *International Financial Statistics*.

Figure 5. Sri Lanka: Capital Stock and Capacity Utilization Rates

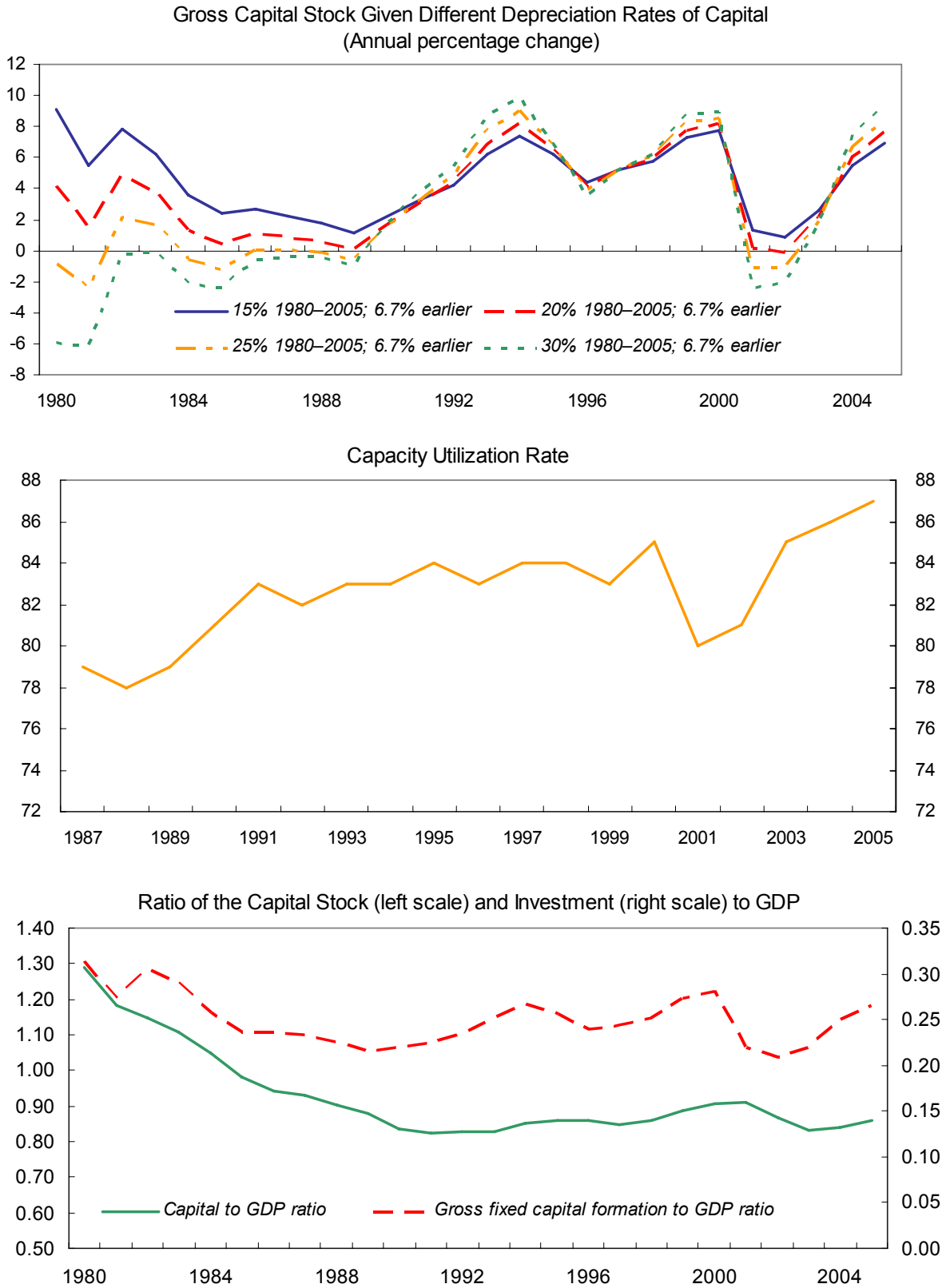
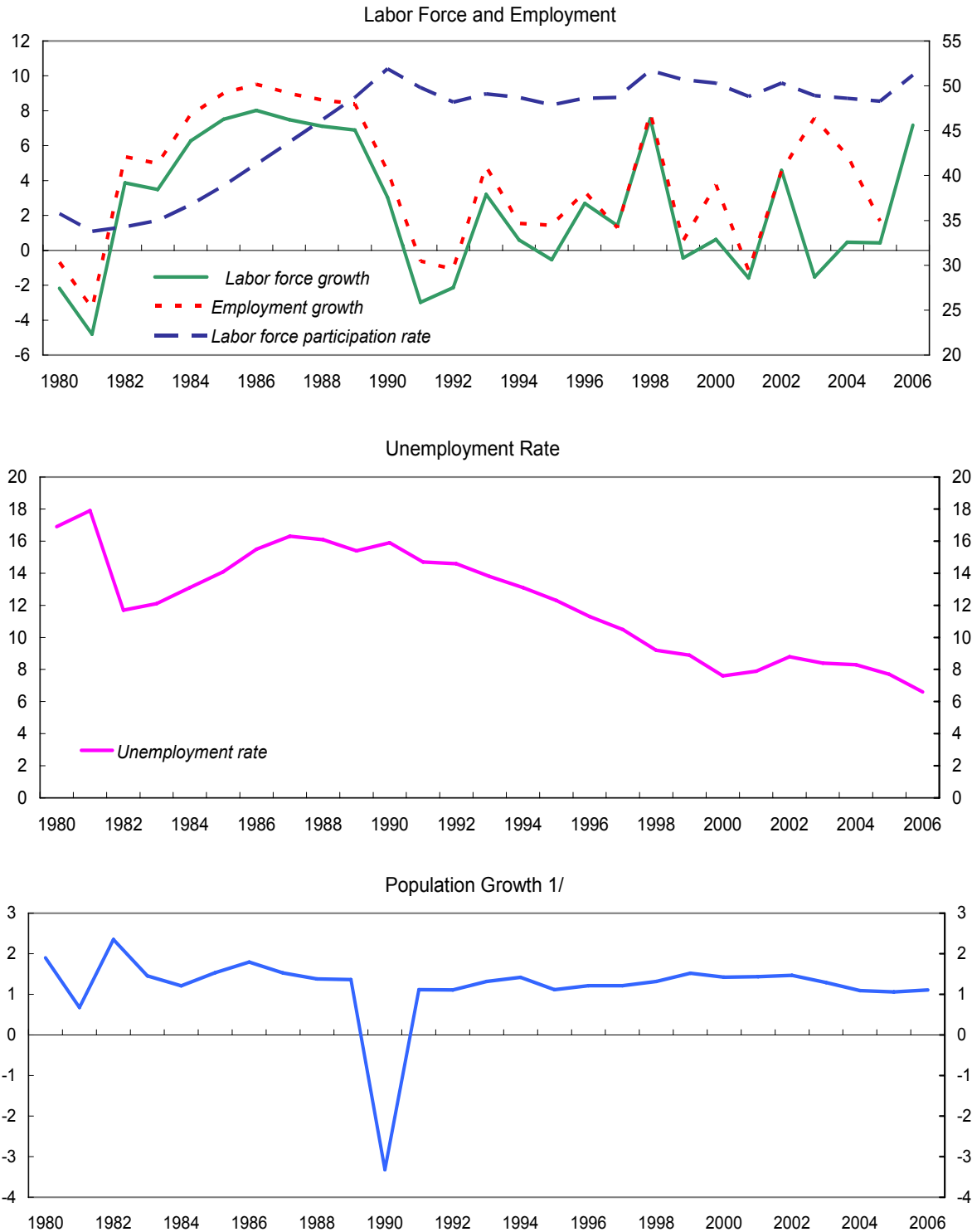


Figure 6. Sri Lanka: Employment, Labor, and Population



1/ The structural break in population growth in 1990 is due to changes in the source of population numbers published by the CBSL from the Registrar General's Department to the 2001 Census.

Figure 7. Sri Lanka: TFP and Real GDP Growth

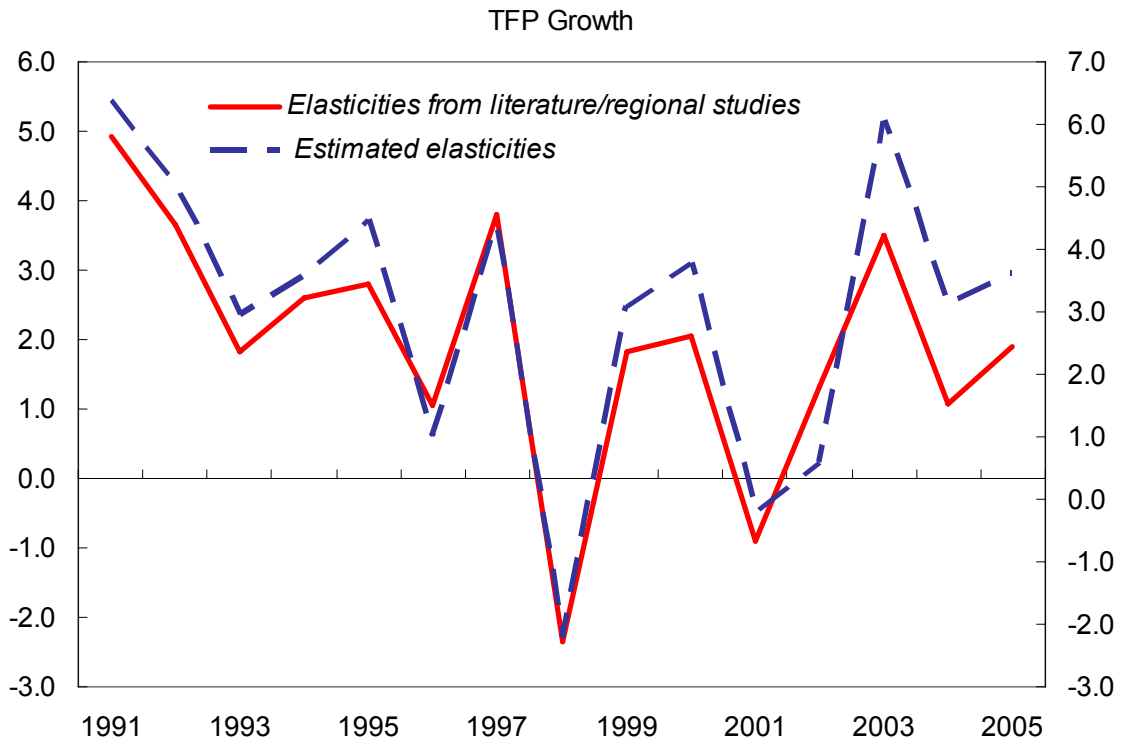
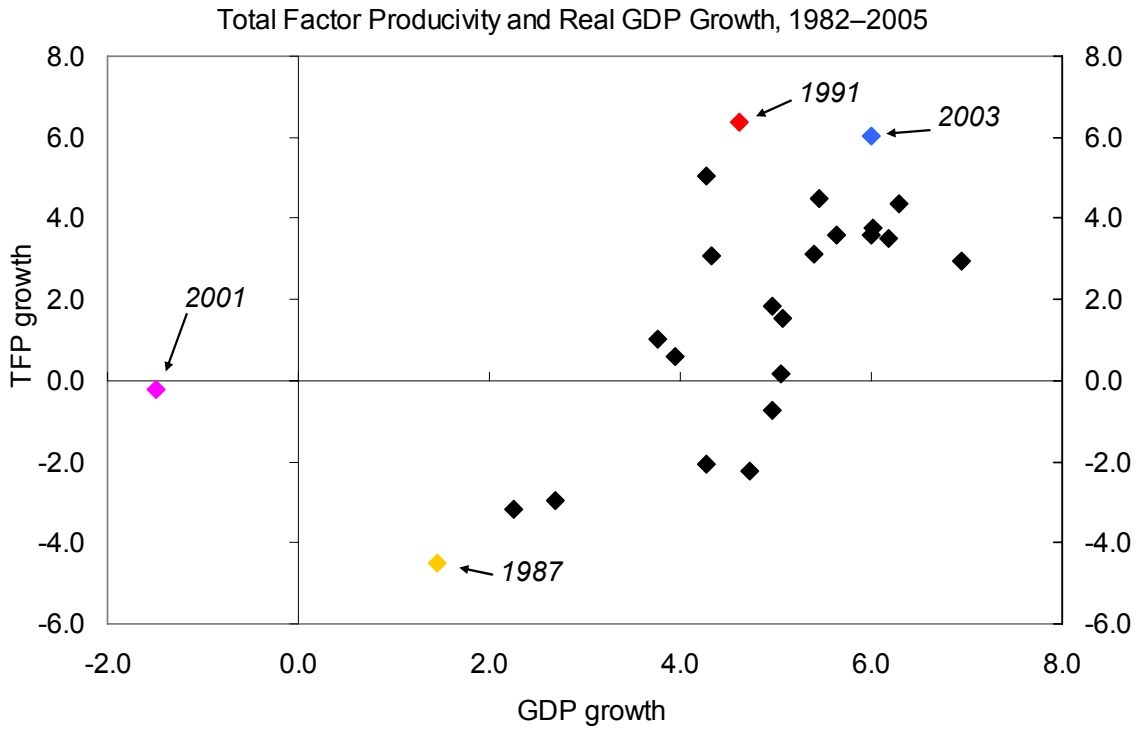


Figure 8. Sri Lanka: TFP Growth with Different Depreciation Rates of Capital Stock

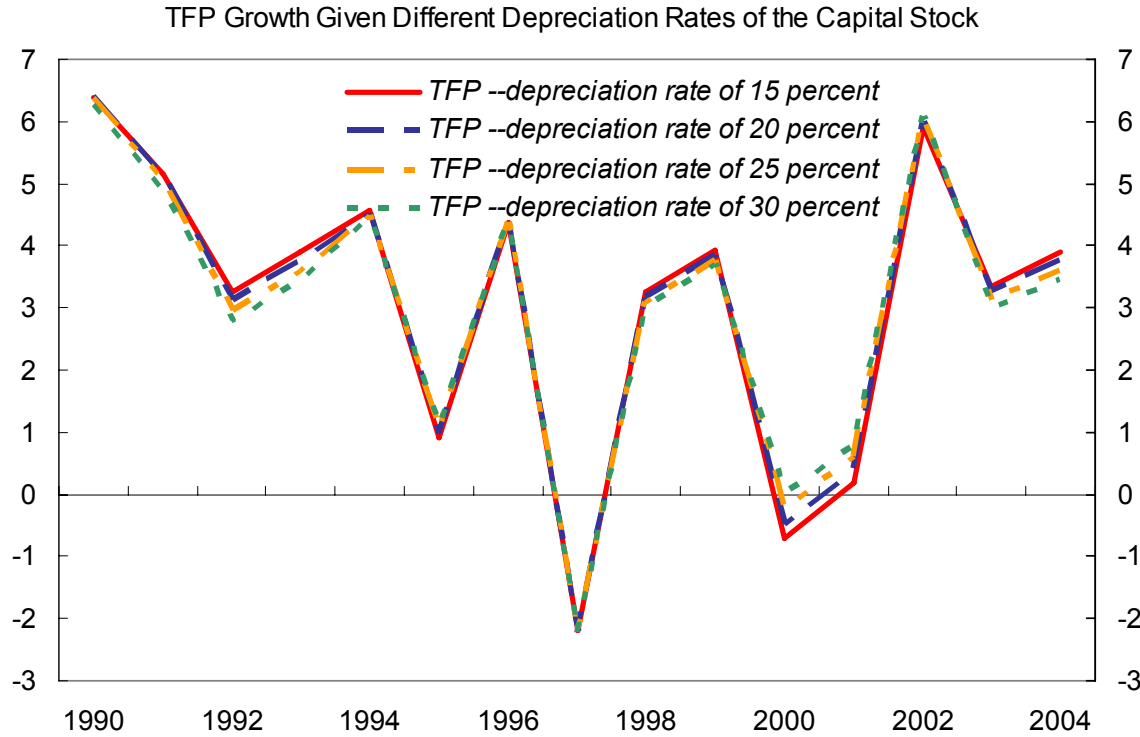
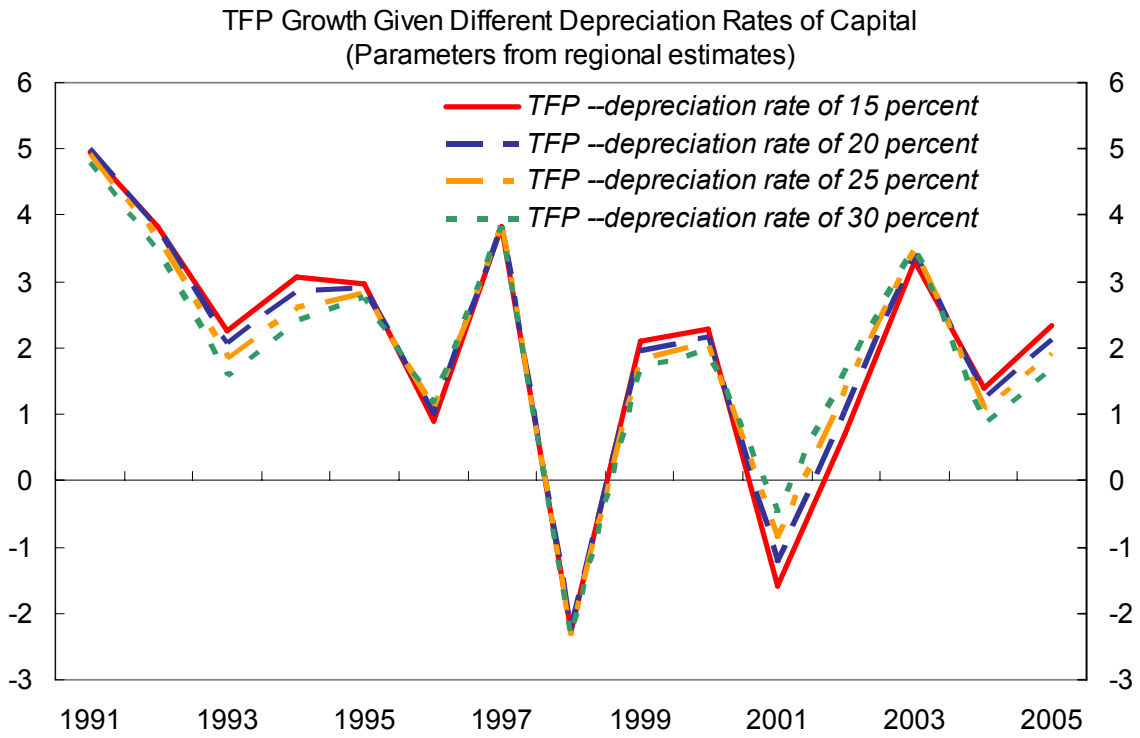
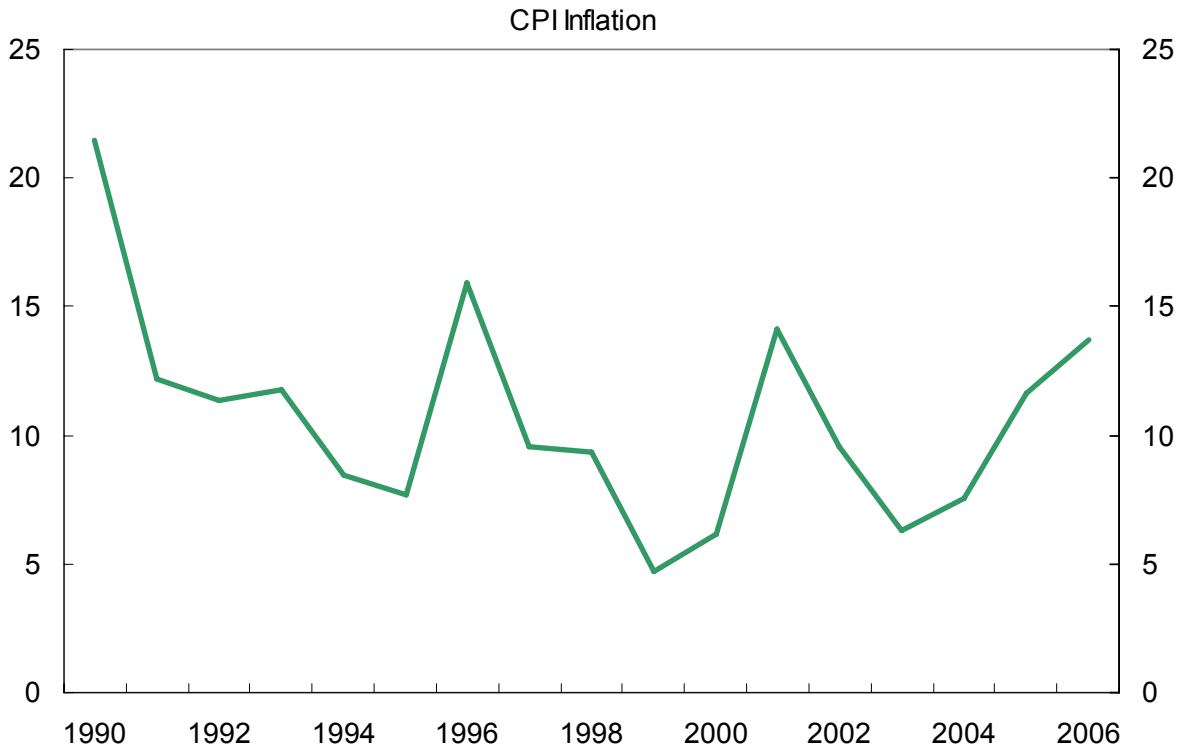
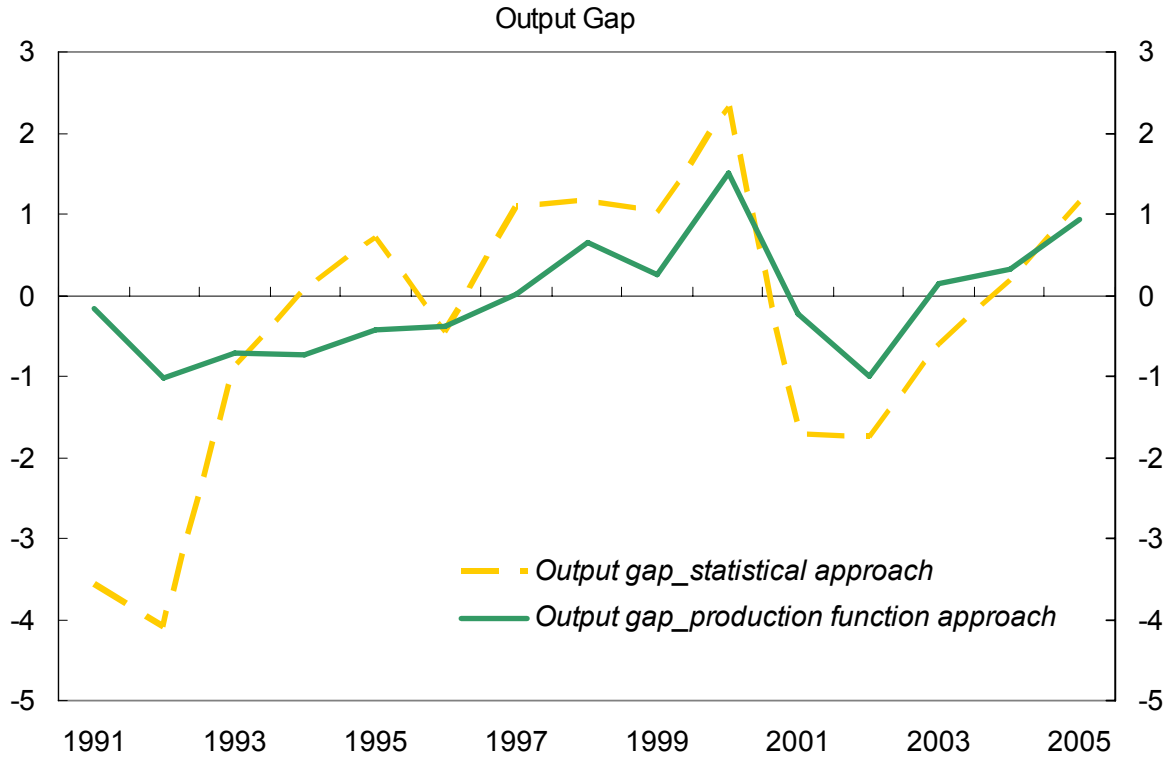


Figure 9. Sri Lanka: The Output Gap and Inflation



APPENDIX I. SOME APPLICATIONS OF THE PRODUCTION FUNCTION APPROACH IN SOUTH AND EAST ASIAN ECONOMIES

Country	Author	Period Covered	Variables and coefficients 1/	Principal Contributor to Growth
India	Rodrik, D. and Subramanian, A. (2004)	1980–2000	K, L; $\alpha=0.35$	Factor productivity (60 percent)
India	Bosworth and Collins (2003)	1960–80	K, L, H; $\alpha=0.35$; $\delta=0.05$	Physical capital (56 percent)
		1980–99		Factor productivity (57 percent)
		1960–99		Factor productivity (44 percent)
East Asia (Indonesia, Malaysia, Philippines, Singapore, and Thailand)	Sarel, M. (1997)	1978–96	K, L, H; α ranges from 0.28 to 0.35;	...
Malaysia	Yap, M. (2001)	1971–97	K, L; $\alpha=0.4$; $\delta=0.04$	Physical capital (50 percent)
	Collins, M. and Bosworth, B. (1996)	1960–94	K, L, H; $\alpha=0.35$, $\delta=0.04$	Physical capital (60 percent)
	Ghani, E. and Suri, V. (2001)	1971–97	K, L, H; $\alpha=0.33$; $\delta=0.075$	Physical capital (47 percent)
	Sarel, M. (1997)	1978–96	K, L, H; $\alpha=0.33$; $\delta=0.075$...
South Asia (Bangladesh, India, Pakistan, and Sri Lanka)	Bosworth and Collins (2003)	1960–2000	K, L, H; $\alpha=0.35$; $\delta=0.05$...
Indonesia, and Philippines	Bu (2004)	1951–90	K, L, H; $\alpha=0.4$; $\beta=0.3$ δ varies with even 0.61 for Indonesia in 1997-98	Physical capital is the largest contributor.

1/ Where α is the output share of physical capital and δ is the annual depreciation rate of the physical capital stock.

APPENDIX II: ESTIMATING POTENTIAL OUTPUT

Given the level of output observed in the economy represented by equation (2), the potential output is:

$$Y_t^P = A_t (K_t^P)^\alpha (H_t^P)^\beta (L_t^P)^{1-\alpha-\beta} \quad (8)$$

Dividing equation (8) by equation (2) yields:

$$Y_t^P = Y_t \frac{A_t (K_t^P)^\alpha (H_t^P)^\beta (L_t^P)^{1-\alpha-\beta}}{A_t (K_t^C)^\alpha (H_t^C)^\beta (L_t^C)^{1-\alpha-\beta}} = Y_t \left(\frac{K_t^P}{K_t^C} \right)^\alpha \left(\frac{H_t^P}{H_t^C} \right)^\beta \left(\frac{L_t^P}{L_t^C} \right)^{1-\alpha-\beta} \quad (9)$$

Where potential employment at time t is:

$$L_t^P = \varepsilon_{L,t}^P L_t \quad (10)$$

Where $\varepsilon_{L,t}^P$ is the potential employment rate (1 minus the NAIRU) and L_t is the labor force. Actual employment is:

$$L_t^C = \varepsilon_{L,t}^C L_t \quad (11)$$

Where $\varepsilon_{L,t}^C$ is the actual employment rate (i.e., 1 minus the actual unemployment rate). Similarly, the potential physical capital stock at time t is:

$$K_t^P = \varepsilon_{K,t}^P K_t \quad (12)$$

Where $\varepsilon_{K,t}^P$ is the potential utilization rate and K_t is the stock of capital at time t. The utilized capital stock is:

$$K_t^C = \varepsilon_{K,t}^C K_t \quad (13)$$

Where $\varepsilon_{K,t}^C$ is the actual utilization rate. A similar set of equations apply to human capital. Plugging the above equations into (9) yields:

$$Y_t^P = Y_t \left(\frac{\varepsilon_{K,t}^P}{\varepsilon_{K,t}^C} \right)^\alpha \left(\frac{\varepsilon_{H,t}^P}{\varepsilon_{H,t}^C} \right)^\beta \left(\frac{\varepsilon_{L,t}^P}{\varepsilon_{L,t}^C} \right)^{1-\alpha-\beta} \quad (14)$$

Assuming the ratio between potential and actual utilization rates of human capital and labor is the same (i.e., $\frac{\mathcal{E}_{L,t}^P}{\mathcal{E}_{L,t}^C} = \frac{\mathcal{E}_{H,t}^P}{\mathcal{E}_{H,t}^C}$), equation (14) reduces to:

$$Y_t^P = Y_t \left(\frac{\mathcal{E}_{K,t}^P}{\mathcal{E}_{K,t}^C} \right)^\alpha \left(\frac{\mathcal{E}_{L,t}^P}{\mathcal{E}_{L,t}^C} \right)^{1-\alpha} \quad (15)$$

The assumption above is reasonable. Since workers with high human capital are less likely to be unemployed than labor in general, the actual rate of unemployment of human capital is likely to be smaller than that of labor. Similarly, given that the natural rate of unemployment for human capital is likely to be lower than that of labor, the assumption that the ratio between potential and actual utilization rates of human capital and labor is the same is reasonable. This assumption is a weaker assumption than that actual and natural rates of unemployment of labor and human capital are identical.

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