

*Shanaka Herath**

SIZE OF GOVERNMENT AND ECONOMIC GROWTH: A NONLINEAR ANALYSIS

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ABSTRACT: *The new growth theory establishes, among other things, that government expenditure can manipulate the economic growth of a country. This study attempts to explain whether government expenditure increases or decreases economic growth in the context of Sri Lanka. Results obtained employing a productive output series and applying an analytical framework based on second degree polynomial regression are generally consistent with previous findings: government expenditure and economic growth are positively correlated; excessive government expenditure is negatively correlated with economic growth; and investment promotes growth. In a separate section, the article examines Armey's idea*

of a quadratic curve that explains the level of government expenditure in an economy and the corresponding level of economic growth [Armey, D. (1995). The Freedom Revolution. Washington, D.C.: Regnery Publishing Co.]. The findings confirm the possibility of constructing the Armey curve for Sri Lanka, and it estimates the optimal level of government expenditure to be approximately 27%. This article adds to the literature indicating that the Armey curve is a reality not only for developed economies, but also for developing economies.

KEY WORDS: *government expenditure, economic growth, Sri Lanka, polynomial regression, Armey curve*

JEL CLASSIFICATION: E62, F43, H10

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1. INTRODUCTION

There are two basic types of growth model: the neoclassical growth model, also known as the exogenous growth model, developed primarily by Solow (1956), and the new growth theory, also known as the endogenous growth model, pioneered by Romer (1986), Lucas (1988), Barro (1990), and Rebelo (1991). The analysis of growth has long been based on Solow's neoclassical growth theory, which takes into account the linear relationship between a range of variables and economic growth in the long run. Solow's neoclassical theory predicts that economies grow with exogenous technology change, and that income per capita of countries converges over time. Based on this theory, economic growth is an effect of an external cause and therefore government policy cannot affect growth except during the transition to a steady state. The new growth theory, on the other hand, postulates that transition and steady state growth rates are endogenous, implying that long-run economic growth rates are also endogenous. The introduction of the new growth theory, which also permits a nonlinear relationship between government expenditure and economic growth, sees the role of government in the growth process in a new light. It maintains, contrary to the neoclassical growth theory, that endogenous factors, including government, can influence economic growth. As a result, government policy can play a role in navigating economic growth.

This article examines two main issues related to government expenditure and economic growth in Sri Lanka. The first issue is whether government expenditure increases or decreases economic growth. If government spending in Sri Lanka has a significant positive impact on economic growth at a macro level, it may explain the long, more or less steady, rise in government spending as a fraction of Gross Domestic Product (GDP). The second issue deals with the possibility of empirically verifying the existence of the so-called 'Armey curve' in the context of Sri Lanka. The Armey curve, as defined in the literature, claims an inverted U-shaped relationship between government size, i.e., government expenditure as a percentage of GDP, and economic growth. Over the last decade the phenomenon of the Armey curve has been empirically established for the United States and many Western countries, but it has hardly been investigated in the context of developing countries; a gap this study aims to address. The strategy of this study involves first employing an analytical framework based on second-degree polynomial regression to construct the Armey curve, and then, based on the geometric properties of the Armey curve, to derive policy implications by analysing the relationship between government expenditure and economic growth in the context of Sri Lanka.

Sri Lanka is considered a welfare nation with exceptionally high government spending levels, and thus provides an apposite case study for the analysis of growth outcomes of government expenditure. To establish this point, the article begins by describing trends of government expenditure and economic growth from 1959 to 2009. This exploratory analysis shows that government spending levels varied between 23% and 43% during the study period. Consistent with these statistics, Osmani (1994), among others, has documented that Sri Lanka maintained high public spending, especially on health and education programmes. The initial analysis also suggests that changes in the political environment and government policy have an influence on economic growth. Detailed analysis in the latter part of the study attempts to confirm these initial results.

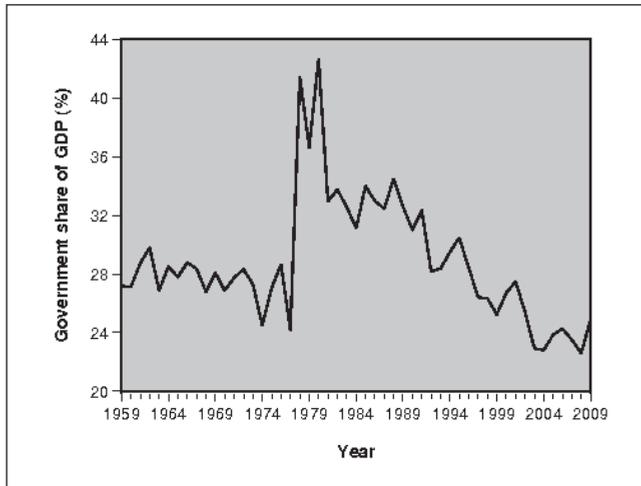
The study of optimal government spending level is particularly important at a time when governments are considering whether to actively participate in their economies to deal with the implications of the financial crisis. An understanding of the optimal government intervention level is also important in the context of developing countries that have managed to secure donor funding for development, since these countries are under enormous pressure to implement policies that are in line with free market principles. Interestingly, political motivations, poverty, and the deprived conditions that prevail in these developing countries encourage governments to get involved in the economy by spending a substantial amount of money through welfare expenditure. In that sense this analysis shows how the governments make this trade-off. It is expected that the results obtained in the context of Sri Lanka could be of relevance to other developing countries, or at least to those with similar economic structures or size. Other countries at the same level of development, therefore, may gain insights from the results.

The remaining article is organized as follows: Section 2 provides a brief overview of trends in government spending patterns and economic growth indicators in Sri Lanka. The theoretical background to government spending and economic growth and to the concept of the Armey curve is briefly reviewed in Sections 3 and 4. Section 5 specifies the methodology used in the study and data sources. The empirical results are discussed in Section 6. Section 7 provides a policy perspective to these results, and Section 8 concludes the article.

2. GOVERNMENT EXPENDITURE AND ECONOMIC GROWTH TRENDS IN SRI LANKA

The government size of Sri Lanka averaged 29% of GDP from 1959 to 2009 (Central Bank of Sri Lanka, various years). Sri Lanka spent at least 23% of its GDP annually on government expenditure. In the extreme case, government spending was as high as almost 43%. This demonstrates the fact that Sri Lanka is considered to be a welfare nation with high public spending, especially on health and education programmes. Osmani (1994) supports this view when he published that, despite the prevailing world pattern of economic liberalisation in the 1970s and 1980s, Sri Lanka managed to maintain a high level of welfare.

Figure 1. Government size, Sri Lanka (1959-2009)



Data source: Central Bank of Sri Lanka, (various years) Annual Report, Central Bank of Sri Lanka, Colombo

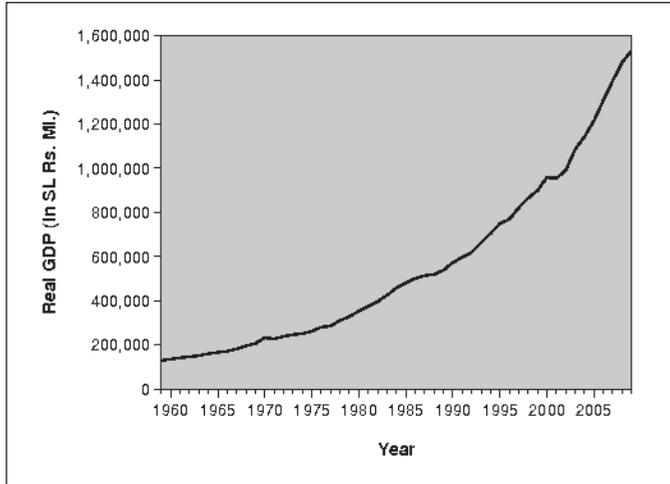
There was stagnation in government expenditure as a percentage of GDP from 1959 until Sri Lanka opened up its economy in 1977 (see Fig. 1). Sri Lanka was the first country in the South Asian region to liberalize its trade, payment, and investment policy regimes in 1977. The fundamental policy reform was to replace the import-substitution industrialisation strategy with an outward-oriented industrialisation strategy. The decomposition of total government expenditure into current and capital public spending revealed that the immediate increase in government share after 1977 was primarily generated by an inflow of capital resources, mainly motivated by favourable aid terms and investment conditions.

The unprecedented rise in government spending went on for a few years until it started to fall again in the early 1980s.

On the political front, Sri Lanka began to shift away from a socialist orientation in 1977. Since then the government has been deregulating, privatizing, and opening the economy to international competition. The share of government in GDP began to fluctuate afterwards, but it has generally shown a downward trend ever since. This trend is consistent with the theory that a high level of economic liberalisation means less government involvement in the economy. The high fluctuations in Sri Lanka's case are probably because left and right aligned political parties won general elections one after the other, and came into power interchangeably. This resulted in very frequent changes in government policies and spending decisions.

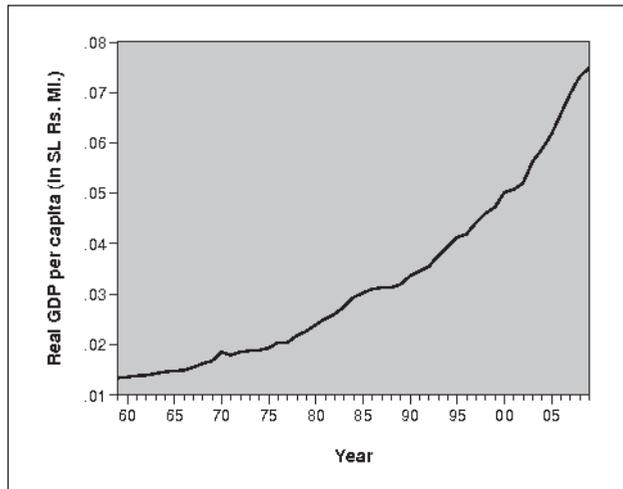
The trends of two selected economic growth indicators, real GDP and real GDP per capita, are plotted in Figures 2 and 3. Both variables show a similar movement over the 51 years with similar fluctuations and minor shocks. These minor shocks in the output of the economy and per capita income are closely related to the political developments in the country. For example, the minor shock after 1970 is possibly associated with the Sri Lanka Freedom Party-led coalition's victory in the 1970 parliamentary election; the one in 1977 with the anti-Tamil riots and the United National Party's win in the 1977 parliamentary election; the one in 1988-1989 with the insurrection in which around 50,000 lives were lost; and the one soon after the year 2000 with the victory of the Sri Lanka Freedom Party-led coalition in the presidential election.

Figure 2. Real GDP, Sri Lanka (1959-2009)



Data source: Central Bank of Sri Lanka, (various years) Annual Report, Central Bank of Sri Lanka, Colombo

Figure 3. Real GDP per capita, Sri Lanka (1959-2009)



Data source: Central Bank of Sri Lanka, (various years) Annual Report, Central Bank of Sri Lanka, Colombo

The impact of some of these landmark changes were immense; for instance, the establishment of a new government with a different political orientation in 1977 saw Sri Lanka's economy change noticeably in its structure and dimension due

to pro-right policies. Since 1977 the Sri Lankan economy, once dominated by agriculture, has experienced strong growth in its industrial and service sectors. These events and corresponding changes in economic growth (proxied by real GDP) provide some provisional support for the argument that changes in the political environment and government policy have an influence on economic growth.

3. THEORETICAL BACKGROUND TO GOVERNMENT SPENDING AND ECONOMIC GROWTH

The literature regarding government expenditure and economic growth includes studies that assume a linear as well as a nonlinear relationship between government expenditure and economic growth. Most of the studies are based on linear models, although Sheehey (1993), Armev (1995), Tanzi and Zee (1997), Vedder and Gallaway (1998), Giavazzi et al. (2000), among others, subscribe to forms of nonlinear relationships.

A review of this literature provides inconclusive evidence as to whether government expenditure is detrimental to economic growth. On the one hand, Landau (1983, 1986), Barro (1989, 1990, 1991), Alexander (1990), Engen and Skinner (1992), Hansson and Henrekson (1994), Devarajan et al. (1996), Gwartney et al. (1998), Folster and Henrekson (1999, 2001), Dar and Amirkhalkhali (2002), and Chen and Lee (2005) support a negative relationship between government expenditure and economic growth. On the other hand, Rubinson (1977), Ram (1986), Kormendi and Meguire (1986), Grossman (1988), Diamond (1989), and Carr (1989) establish arguments of a positive relationship between the two variables. The studies by Devarajan et al. (1993), Sheehey (1993), Hsieh and Lai (1994), Lin (1994), and Cashin (1995) put forward mixed results, while Kormendi and Meguire (1985) raise the concern of whether there is a significant relationship between government expenditure and economic growth.

In a study by Higgins et al. (2006), the relationship between US economic growth and the size of government is explored at three levels: federal, state, and local. They conclude that all federal, state, and local governments are either negatively correlated with economic growth or are uncorrelated with economic growth. Grimes (2003) found that the size of government has only a minor effect on long-term growth outcomes with respect to 22 OECD countries. The study completed by Bagdigen and Hakan (2008), which examines the validity of Wagner's Law

using data for Turkey, concluded that public expenditure has no effect on economic growth.

There are studies that test whether the evidence is consistent with the predictions of the endogenous growth model that the structure of taxation and public expenditure can affect the steady-state growth rate. For instance, Kneller et al. (1999) use data for 22 OECD countries to demonstrate that productive government expenditure enhances growth, whilst non-productive expenditure does not. The study by Miller and Russek (1997) examines the effects of fiscal structure on economic growth. They found evidence to support the view that debt-financed increases in government expenditure retard growth and tax-financed increases stimulate growth for developing countries. On the other hand they also found evidence that debt-financed increases in government expenditure do not affect growth and tax-financed increases reduce growth for developed countries.

If governments could interfere in the economic growth process by becoming actively involved in the economy, as some of the literature suggests, the question that is of interest to the policy maker is how much government involvement is required from an optimal growth point of view. To address this issue, the notion of optimal size of government was refined and popularised by Armev (1995) using a quadratic curve which explains the optimal government size that ensures positive incremental economic growth for a particular country.

4. THE CONCEPT OF THE ARMEV CURVE

Armev (1995) maintains that low government expenditure increases economic growth until it reaches a certain level; nevertheless, excessive government expenditure reduces economic growth. The presence of a government and the provision of improved infrastructure and public goods create a growth-enhancing environment in the economy. Government contributions for regulation and up-keep of law and order further contribute to the growth of the economy by creating a safe economic atmosphere. Any expansion of government spending in the economy initially is associated with an expansion in output. Nevertheless, as spending rises, additional projects financed by the government become increasingly less productive. The excess infrastructure lowers benefits per dollar spent while higher tariffs de-motivate imports and exports. In addition, the taxes and borrowings levied to finance these disproportionate ventures impose increasing burdens, thus creating disincentives to workers. At some point, the marginal benefits from increased government spending reach zero. The

constructive features of government begin to diminish when the adverse effects of big government result in a reduction of output growth. Further expansions of government contribute to a decline in output.

Armev (1995) puts this phenomenon into a graphical perspective when he makes use of a graphical technique similar to that popularised by Kuznets (1955, 1963)¹ and Laffer (1980s)² to explain the relationship between government spending and economic growth. Armev consequently indicates that the size of the government and the growth of the economy can be modelled as a quadratic function, i.e., an inverted U-shaped curve, which assumes a role for both the linear term and the squared term of government expenditure in the economic growth process. The upward-sloping portion of the curve demonstrates the productive effects of small government, while the downward-sloping portion of the curve exhibits those unproductive consequences of large government. The highest point (mathematically, 'maxima') illustrates the point where the marginal benefits from increased government spending reach zero.

The Armev curve thus implies the following: no economy can obtain a high level of economic growth without a government; excessively large governments have reduced economic growth; and output should be high when there is a mix of private and government decisions regarding the allocation of resources. In this context, government involvement in the economy is a necessary but not a sufficient condition for growth.

There are several studies in the literature that empirically test the occurrence of the Armev curve. One notable study, Vedder and Gallaway (1998), statistically tests the validity of the Armev curve in the context of the United States, Canada, Denmark, Italy, Sweden, and Britain. The results of this study provide empirical evidence supporting the incidence of the Armev curve for all these countries. Vedder and Gallaway further suggest that growth of government in emerging economies tends to increase output despite the fact that many modern Western economies are in the downward-sloping portion of the Armev Curve, where a

- 1 Kuznets' hypothesis made the proposition that, during the course of secular economic growth of a country, income inequality first increases, but begins to decline after reaching a critical point. The model that demonstrates an inverted U-shaped curve includes the variables inequality, average income (GDP per capita) and its square term. The horizontal axis of the graph demonstrating the 'Kuznets curve' is a measure of increased economic development, and the vertical axis is a measure of income inequality.
- 2 The Laffer curve is a concept used to illustrate that increases in the rate of taxation do not necessarily increase tax revenue. The Laffer curve is an inverted U-shaped curve in which an optimal tax rate is assumed to lie somewhere in between 0 % and 100 % tax rates.

reduction in the relative size of government generates positive effects on economic opportunities for citizens.

The study of Pevcin (2004) investigates the relationship between government spending and economic growth using a sample of 12 European countries. Based on panel data regression analysis using five-year arithmetic averages, Pevcin empirically claims that arguments in support of the Armeij curve are confirmed. This study suggests that the Armeij curve peaks when government spending is between 37% and 42% of GDP.

In a recent study, De Witte and Moesen (2010) investigate the Armeij curve using nonparametric Data Envelopment Analysis (DEA). The results show that among 23 OECD countries the long-run optimal government size varies between 29% and 54%. The optimal average government involvement amounts to 41% of GDP. This analysis also suggests that a large decrease in government involvement should occur in Italy compared to an increase in government involvement in New Zealand.

Obtaining relevant data for calculating the optimum proportion of public spending is one of the difficulties that can arise in these studies. As Radwan and Reiffers (2004) demonstrate, data on different types of public spending in Israel is very difficult to obtain because information on military and defence spending is mostly unavailable. Radwan and Reiffers, considering only public consumption, estimate that a 44% of public consumption to GDP ratio is optimal. However, they maintain that this high figure is realistic in a country where the state has been an all-pervading presence for a long time.

The study by Chen and Lee (2005) indicates that a nonlinear relationship of the Armeij curve exists in Taiwan. Using the threshold regression methodology, it also demonstrates that all the three classifications of government size have threshold effects. The analysis produces a threshold regime of 22.84% for 'total government expenditure divided by GDP', a threshold regime of 7.30% for 'government investment expenditure divided by GDP' and a threshold regime of 14.97% for 'government consumption expenditure divided by GDP'.

Relatively few concerns have been expressed as to the validity of the Armeij curve with regard to developing countries. However, Handoussa and Reiffers (2003) study the relationship between size of government and economic growth in the case of Tunisia. Using data for the three decades from 1968 to 1997, the authors attempt to establish the validity of the Armeij curve. They not only observe the

presence of the Arme y curve but also empirically argue that 35% of government expenditure is the ideal threshold required in the context of Tunisia. The study asserts this government size as credible due to the significant role played by the Tunisian state in economic activity.

5. METHODOLOGY AND DATA SOURCES

The approach used in this study relates government size (g) to economic growth (y). Government size is represented by total government expenditure as a percentage of output (GDP), and the growth of the economy is represented by growth of total output (real GDP).³ This analysis employs more expenditure-side indicators that may have an impact on economic growth as control variables. These explanatory variables include the investment share of GDP (i), the consumption share of GDP (c), and the openness of the economy (o), in addition to the government share of GDP (g) and the square term of government share of GDP (g^2). The inclusion of the variable g^2 assists in empirically verifying or invalidating the phenomenon of the Arme y curve within this framework. The random error term is referred to as ε .

$$y_t - y_{t-1} = \beta_0 + \beta_1 g_t - \beta_2 g_t^2 + \beta_3 i_t + \beta_4 c_t + \beta_5 o_t + \varepsilon_t \quad (1)$$

The positive coefficient of the linear g term is related to the constructive effects of government spending on output, and the expected negative coefficient of the squared g term is related to the negative effects of increased government size. This regression equation includes both the linear term and the squared term of g in the estimation equation, and therefore is a quadratic function or, in other words, a second-degree polynomial function. Since the second-degree polynomial function is linear in the parameters, i.e., β s, it does not present any special estimation problems and can be estimated using the Ordinary Least Squares (OLS) estimation technique. A second concern is whether there is a collinearity problem: are these two g s highly correlated since they are both powers of g ? The terms such as g^2 and g^3 are all nonlinear functions of g and, therefore, they do not violate the assumption of ‘no multicollinearity’. Consistent with the literature detailed in section 4, only the linear and quadratic terms of g are employed, assuming that the relation between government spending and

³ Real GDP is considered a proxy for the steady growth in the productive capacity of the economy (and so a growth of domestic income). Real GDP is commonly used to represent economic growth. The simple way to calculate real GDP is to divide nominal GDP by the GDP deflator.

growth is uncomplicated and the curve depicting this relationship has no more than one maxima/minima.

As indicated before, this study is based on expenditure-side determinants of growth. Other expenditure-side variables are included as control variables, since the prime variable of interest is government expenditure. If production-side variables such as education and human capital are employed alongside expenditure-side variables, this results in double counting. Since national production, national expenditure, and national output are equal by definition, inclusion of expenditures other than government, i.e., consumption and investment expenditures, ensures that the productive effects of education and human capital etc. that were incurred by the private sector are indirectly captured. On the other hand, government contribution to education and human capital are taken into account within government expenditure.

During the estimation phase, the dependent variable(s) are slightly adjusted in order to use them appropriately in the analysis. The purpose of this adjustment is to incorporate important theoretical contributions into the analysis, namely Wagner's law⁴ and Baumol's cost disease⁵. The applied dependent variable of the regression equation is real GDP without the government expenditure component. This data series is calculated as follows: first, only nominal GDP without any government component is considered, to avoid the effect of Wagner's Law and Baumol's cost disease; next, real GDP without government expenditure is calculated using the GDP deflator. This treatment is an original contribution of this study and it offers two distinctive advantages: first, it confirms that any causality present between government expenditure and real GDP is in the direction from government expenditure to real GDP; second, the new real GDP series employed

4 Wagner's Law effect is the idea that the development of economies is accompanied by an increased share of government spending. With the development process, state expenditure needs to be increased in order to achieve expanded social, administrative, protective, and welfare objectives. The present article, however, examines the relationship in the opposite direction, i.e., from government expenditure to economic growth. Studies with both these objectives perform the Granger causality test to identify the direction of causality. The present article diverges from the conventional way of dealing with this issue by removing the actual government expenditure component from real GDP to eliminate causality in the direction from increased GDP to government spending.

5 The term 'Baumol's cost disease' is used to explain a lack of growth in productivity in the public sector. On the one hand, public administration activities are labour-intensive and there is little growth in productivity over time. On the other hand, public services like public hospitals and universities hardly grow in productivity. As a result, only a little more resources are generated and spent as public expenditure in these sectors.

here is the productive output flow since the less productive government sector is eliminated. From the model estimation point of view, the former ensures that the concern of endogeneity is addressed. Since the plotted data series suggests that it is not affected by business cycles, the study avoids using the Hodrick and Prescott (1997) filter, which is classically used by macroeconomists to control for business cycle effects.

In order to compare an alternative way of examining the relation between government size and economic growth, the present study also specifies an alternative indicator of economic growth, i.e., real GDP per capita, as the dependent variable in a second regression. This coincides with the intuition that real GDP is an aggregate figure that does not account for differing sizes of nations, and the better measurement of actual economic growth is per capita income. Those who advocate in support of GDP per capita as a superior indicator of economic growth usually resort to the fact that it captures the population size, and therefore is an indicator of the average standard of living of individual members of the population.

This study is based on annual Sri Lankan country-level data obtained from the annual reports of the Central Bank of Sri Lanka. Although government expenditure data is available from 1950 onwards, reliable data on the national income of Sri Lanka is only available for the period after 1959. Therefore the study period runs from 1959 to 2009 inclusive (51 years). Data problems, including short time series, plague all macroeconomic studies, preventing definitive conclusions and, to avoid these issues as far as possible, this study worked with an annual data series spanning the longest possible historical sample in the context of Sri Lanka.

The dependent variable is calculated from GDP and government expenditure data (both at current market prices in Sri Lankan rupees million), and the GDP deflator (1996=100). Data for the following variables is presented in the annual reports of the Central Bank of Sri Lanka as percentages: the investment share of GDP (i), and the consumption share of GDP (c). The government share of GDP (g) is total government expenditure divided by GDP, and the openness indicator (o) is total exports plus imports divided by GDP (total trade as a percentage of GDP). Note that values of g and o are the same when expressed in real terms because the price level conversion factor for government expenditure, exports, imports, and GDP is the same.

6. ESTIMATION RESULTS AND DISCUSSION

In line with the methodological framework, growth of real GDP is first specified as a function of government share of GDP, investment share of GDP, consumption share of GDP, and openness of the economy. In order to examine the effect of each cause influencing economic growth, a series of regression analyses using the OLS estimation technique were carried out. Table 1 lists the results of the regression equation estimated on the log of growth of real GDP without government component.

The full model, Model 1, uses all the explanatory variables. Since Model 1 yields two coefficients that are not significant, the explanatory variables of the model are left out step by step, always eliminating the least significant variable, until all the included variables are significant at the 5% level or better. This procedure leads to the reduced models, Model 2 and Model 3. Note that Model 2 leaves out consumption share of GDP (c) while Model 3 leaves out consumption share of GDP (c) and the openness (o) indicator from the regression equation.

Turning to the parameter estimates, all the coefficients in Model 1 are statistically significant at the 5% level or better, with two exceptions. The positive coefficients of the variables consumption share of GDP and openness are also consistent with the theoretical view that consumption and openness are pro-growth, but these coefficients are not significant. More importantly, government share of GDP has the expected positive coefficient, which is significant at the 5% level, and the square term of government share of GDP has the expected negative coefficient with a significance level of 1%. Additionally, the coefficient of the investment share of GDP is positive and significant, in line with the expectation that investment is beneficial for the Sri Lankan economy.

Table 1. Regression results on the impact of government size on economic growth, Sri Lanka, 1959-2009

<i>Dependent variable: the log of growth of real GDP (without government component)</i>			
<i>Explanatory variables</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Constant	-0.8319** (0.3434)	-0.6280** (0.2485)	-0.5658** (0.2490)
Government share of GDP	0.0390** (0.0155)	0.0404** (0.0154)	0.0401** (0.0156)
Square term of government share of GDP	-0.0007*** (0.0002)	-0.0008*** (0.0002)	-0.0007*** (0.0003)
Investment share of GDP	0.0065*** (0.0021)	0.0061*** (0.0021)	0.0036** (0.0014)
Consumption share of GDP	0.0027 (0.0031)		
Openness	0.4480 (0.3140)	0.4826 (0.3105)	
R-squared	0.35	0.34	0.30
Adjusted R-squared	0.28	0.28	0.26
F-statistic	4.76	5.80	6.72
p (F-statistic)	0.0015	0.0008	0.0007
DW statistic	2.44	2.35	2.29
Number of observations	51	51	51

Notes: Coefficient SEs are given in parentheses.

*, ** and *** denote significance at the 10%, 5% and 1% level.

Source: Author's calculation.

Indicators of model quality illustrate that the equation's overall F tests are significant at a level above 1% in all three models, and notably the F-statistic has improved from the full model to the reduced models, indicating that overall model significance has improved. The explanatory power of the models remains moderate, although highly significant parameter estimates demonstrate that a considerable part of the variation of real GDP is explained by government share of GDP, square term of government share of GDP, and investment share of GDP. The reduced form regression equation derived from the first regression estimation is given as follows:

$$y_t - y_{t-1} = -0.5658 + 0.0401 g_t - 0.0007 g_t^2 + 0.0036 i_t \quad (2)$$

In the second regression estimation, the log of growth of real GDP per capita is specified as a function of government share of GDP, investment share of GDP, consumption share of GDP, and openness of the economy.

Table 2. Regression results on the impact of government size on economic growth, Sri Lanka, 1959-2009

Dependent variable: the log of growth of real GDP per capita (without government component)			
<i>Explanatory variables</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Constant	-0.8235** (0.3419)	-0.6332** (0.2472)	-0.5919** (0.2441)
Government share of GDP	0.0391** (0.0154)	0.0404** (0.0153)	0.0402** (0.0153)
Square term of government share of GDP	-0.0007*** (0.0002)	-0.0008*** (0.0002)	-0.0007*** (0.0002)
Investment share of GDP	0.0064*** (0.0021)	0.0060*** (0.0020)	0.0044*** (0.0013)
Consumption share of GDP	0.0025 (0.0031)		
Openness	0.2883 (0.3126)	0.3206 (0.3088)	
R-squared	0.38	0.37	0.35
Adjusted R-squared	0.31	0.31	0.31
F-statistic	5.36	6.59	8.41
<i>p</i> (F-statistic)	0.0006	0.0003	0.0001
DW statistic	2.48	2.40	2.37
Number of observations	51	51	51

Notes: Coefficient SEs are given in parentheses.

*, ** and *** denote significance at the 10%, 5% and 1% level.

Source: Author's calculation.

The same procedure was followed in estimating the full model, Model 1, and the reduced models, Model 2 and Model 3. Table 2 reports that the results produced by all three models are very similar to those of the first regression, confirming the findings of the first estimation. The estimation of the second regression provides the following reduced form equation:

$$y_t - y_{t-1} = -0.5919 + 0.0402 g_t - 0.0007 g_t^2 + 0.0044 i_t \quad (3)$$

The second regression estimation is preferred, due to the fact that it provides three minor advantages over the first estimation. First, the investment share of GDP in the second reduced model is significant at a 1% level compared to 5% significance in the first reduced model. Second, the parameter estimations of the second regression explain approximately 3%-5% more variation of the dependent variable in comparison to the estimations of the first regression. Third, the F-statistics of the second regression estimation are even more significant.

Table 3. Chow’s breakpoint test

<i>Regression on growth of real GDP</i>			
F-statistic	0.499298	Probability	0.7363
Log likelihood ration	2.322811	Probability	0.6766
Wald statistic	1.997193	Probability	0.7363
<i>Regression on growth of real GDP per capita</i>			
F-statistic	0.559128	Probability	0.6935
Log likelihood ration	2.594043	Probability	0.6279
Wald statistic	2.236510	Probability	0.6924

Source: Author’s calculation.

Before deriving policy implications, it is useful to examine whether the parameters of the estimated models are stable across various subsamples of the dataset. As mentioned in Section 2, the year in which the open trade policies were adopted in Sri Lanka was a possible breakpoint. Therefore, using 1977 as the breakpoint year, Chow’s breakpoint test⁶ was performed. The results are shown in Table 3. The test statistics suggest that the variances of the residuals are not significantly different for the periods 1959-1976 and 1978-2009. The test statistics for both regression estimates, therefore, accept the null hypothesis of the absence of a structural break in the year 1977. This confirms that the parameters estimated are stable throughout the sample.

6 The breakpoint Chow test fits the regression equation separately for each subsample and observes whether there are significant differences in the estimated equations. In other words, the test compares the sum of squared residuals obtained by fitting a single equation to the entire sample with the sum of squared residuals obtained when separate equations are fit to each subsample of the data. A significant difference indicates a structural change in the relationship.

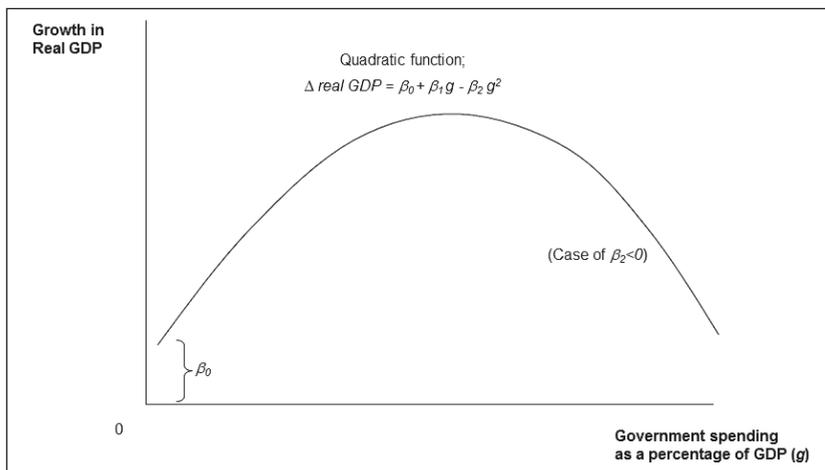
7. POLICY PERSPECTIVE

There is a policy perspective to these findings. The properties of the estimated parameters of the quadratic equation not only provide evidence to prove the existence of the Armey curve but also provide extra information about the potential policy directions. The geometric presentation of the quadratic function and its properties are illustrated in Fig. 4. In order to establish this inverted U-shaped curve, the coefficient of the linear term of government share of GDP (g) needs to be positive and the coefficient of the square term of government share of GDP (g^2) needs to be negative.

The positive sign of the linear term g exhibits the positive beneficial effects of government spending on output (upward-sloping segment of the curve), while the negative sign of the squared term g^2 displays any adverse effects associated with increased governmental size (downward-sloping segment of the curve). Since the squared term increases in value faster than the linear term, the presence of negative effects from government spending eventually outweighs the positive effect, producing a downward-sloping portion.

The values that were obtained for Sri Lanka are consistent with this principle, and each of the estimated quadratic equations specified in Section 6 plots as a parabola. These results, therefore, support the statistical estimation of the Armey curve, and they provide a framework to approximately compute the specific point where output is maximised.

Figure 4. The properties of the quadratic function



The graphical solution of the optimum amount of government spending is the peak of the quadratic curve. Alternatively, the mechanism specified below can be used to calculate the optimal level of government size using partial differentiation. This study calculates the first partial derivative of growth of real GDP and real GDP per capita with respect to g , assuming that the other independent variable in the function, i.e., investment share of GDP, is held constant. Therefore, it should be noted that this is a local and conditional maximum that depends on the coefficient of the investment indicator. Also, the fact that this maximum is local and conditional makes this mechanism more appropriate for the *ex post* analysis:

$$y_t - y_{t-1} = \beta_0 + \beta_1 g_t - \beta_2 g_t^2 + \beta_3 i_t \quad (4)$$

$$\frac{\partial(y_t - y_{t-1})}{\partial(g_t)} = \beta_1 - 2(\beta_2) g_t \quad (5)$$

$$0 = \beta_1 - 2(\beta_2) g_t \quad (6)$$

The procedure that equalizes the values of the first partial differentiation to zero calculates the optimal government size (\hat{g}) with regard to the first regression as 27.51% and with regard to the second regression as 27.19%. These results, therefore, suggest that the curve peaks where government spending is approximately equal to 27% of GDP. The average government share of GDP in Sri Lanka continued to drop from 34% in the 1980s to 28.5% in the 1990s. This downward trend in the share of government spending meant that Sri Lanka spent an average of 24.5% of GDP as government expenditure between 2000 and 2009. The results indicate that Sri Lanka had excessive government expenditure in the past, but nonetheless is reaching an ideal amount of government expenditure from the standpoint of growth optimisation.

8. CONCLUSIONS

One of the arguments put forward by the architects of the endogenous growth theory is that governments can manipulate economic growth. Following in these footsteps, Armeý (1995) argued that low levels of government expenditure can increase economic growth until it reaches a critical level; nevertheless excessive increments of government expenditure can harm economic growth. This study attempts to answer two research questions related to government expenditure and economic growth in the context of Sri Lanka: (a) whether government

expenditure increases or decreases economic growth, and (b) whether it is possible to empirically verify the existence of the Armey curve.

In answering the first question as to whether government expenditure increases or decreases economic growth, the first regression analysis that uses real GDP values as an indicator of economic growth validates a nonlinear relationship between government expenditure and economic growth. The results are generally consistent with the previous findings: government expenditure and economic growth are positively correlated; excessive government expenditure is negatively correlated with economic growth; and investment promotes economic growth. The results of the second regression analysis, which employs real GDP per capita as a proxy for economic growth, are very similar, confirming the findings of the first regression analysis. The novelty of this study is that real GDP and real GDP per capita series are adjusted in order to incorporate theoretical contributions, namely Wagner's Law and Baumol's cost disease, into the analysis. This treatment also ensures that economic growth is represented by a productive output series.

The estimation results of the regression analyses is then used, in the latter part of the study, to answer the second question as to whether it is possible to empirically verify the existence of the Armey curve for Sri Lanka. The signs of the coefficients of the government share of GDP and its square term confirm the possibility of constructing the inverted U-shaped Armey curve for Sri Lanka. This article adds to the literature indicating that the Armey curve is a reality not only for developed economies, but also for developing economies.

The Armey curve provides the possibility of calculating optimal government expenditure percentages, and therefore may well be used as a policy tool in determining the efficient levels of government expenditure. The results of the study suggest an optimal government expenditure percentage of approximately 27% for Sri Lanka. When comparing this to the actual government expenditure percentage in recent years, i.e., 25% in 2009, Sri Lanka is more or less in the safe zone; yet the government is spending approximately 2% less money than the required amount of spending from an optimum growth point of view. It is safe to assume that current government size is still better, taking into account the fact that governments in Sri Lanka have reduced in size drastically since the 1980s to reach this relatively safe range. Historically, downsizing of government in Sri Lanka over the study period brought positive growth effects based on its consumption, investment, and openness patterns; nevertheless, going below the current levels is not envisaged. Both the government-growth relationship shown

in these findings and the instruments employed in the study are useful in the appraisal of government spending and policy design.

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