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The Size of the Government and Economic
Growth: An Empirical Study of Sri Lanka

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Regional- und Umweltwirtschaft

The Size of the Government and Economic Growth: An Empirical Study of Sri Lanka[*]

Shanaka Herath[†]

Abstract - *The new growth theory establishes, among other things, that government expenditure can manipulate 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 applying an analytical framework based on time series and second degree polynomial regressions are generally consistent with previous findings: government expenditure and economic growth are positively correlated; excessive government expenditure is negatively correlated with economic growth; and an open economy promotes growth. In a separate section, the paper examines Armey's (1995) idea of a quadratic curve that explains the level of government expenditure in an economy and the corresponding level of economic growth. 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 per cent. This paper adds to the literature indicating that the Armey curve is a reality not only for developed economies, but also for developing economies.*

Keywords: government expenditure, economic growth, time series regression, polynomial regression, Armey curve

JEL-Classification: C32, F43, H50

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 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.

On the other hand, the new growth theory 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 non-linear 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 plays a role in navigating economic growth.

This paper 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. The study attempts to address this issue by

explaining the significance of total government spending and the impact that government spending has on the growth of the economy. The second issue deals with the possibility of empirically verifying the existence of the Armey curve in the context of Sri Lanka. The phenomenon of the Armey curve has been empirically established for the United States and many Western countries over the last decade, but it was hardly investigated in the context of developing countries. This study provides an analytical framework based on time series regression and second degree polynomial regression methodologies to analyse the relationship between government expenditure and economic growth and attempts to construct the Armey curve for Sri Lanka.

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. If government spending in developing countries 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 real gross domestic product (RGDP).

The remaining paper is organised as follows: Section 2 provides a brief overview of the theoretical background to government spending and economic growth, and to the concept of the Armey curve. Section 3 specifies the methodology used in the study and data sources. Section 4 discusses the empirical results. Sections 5 & 6 conclude the paper by providing a policy perspective to these results.

2. Theoretical background

Government spending and economic growth

The literature regarding government expenditure (or government size) and economic growth is comprised of studies that assume a linear as well as a non-linear relationship between government expenditure and economic growth. Most of these studies are based on linear models, although Sheehey (1993), Armey (1995), Tanzi & Zee (1997), Vedder & Gallaway (1998), Giavazzi, Jappelli & Pagano (2000), among others, subscribe to forms of non-linear relationship.

A review of this literature provides inconclusive evidence as to whether government expenditure is detrimental to economic growth. On the one hand, Landau (1983), Landau (1986), Grier & Tullock (1987), Barro (1989, 1990, 1991), Alexander (1990), Engen & Skinner (1992), Hansson & Henrekson (1994), Devarajan, Swaroop & Zou (1996), Gwartney, Holcombe & Lawson (1998), Folster & Henrekson (1999), Folster & Henrekson (2001), Dar & Amirkhalkhali (2002), and Chen & Lee (2005) support a negative relationship between government expenditure and economic growth. On the other hand, Rubinson (1977), Ram (1986), Kormendi & Meguire (1986), Grossman (1988), Diamond (1989), and Carr (1989) establish arguments of a positive relationship between the two variables. The studies by Devarajan, Swaroop & Zou (1993), Sheehey (1993), Hsieh & Kon (1994), Hsieh & Lai (1994), Lin (1994), Cashin (1995), and Kneller, Bleaney & Gemmell (1998) put forward mixed results, while Kormendi & Meguire (1985) question whether there is a significant relationship between government expenditure and economic growth.

The relationship between economic growth and government size in the context of Indonesia has been reviewed by Ramayandi (2003). His paper claims that government size tends to have a negative impact on growth. In a separate study by Higgins, Young & Levy (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) reassessed the work of Gwartney, Holcombe & Lawson (1998) with respect to 22 OECD countries and found that the size of government has only a minor effect on long-term growth outcomes. The study completed by Bagdigen & 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, Bleaney & Gemmell (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 & 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. They also found evidence, on the other hand, 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, how much government involvement is needed? One can use the notion of optimal size of government to answer this question. The idea of optimal size of government was refined and popularised by Armey (1995) through his so-called 'Armey Curve', which explains the optimal government size that ensures positive incremental economic growth for a particular country.

The concept of the Armey curve

Armey (1995) borrows a graphical technique similar to that popularized by Kuznets (1955, 1963)[i] and Laffer (1980s)[ii] to explain the phenomenon of the Armey curve. Armey maintains that low government expenditures can increase economic growth until it reaches a critical level; nevertheless, excessive government expenditures can harm economic growth. He suggests a relationship similar to that of Kuznets' curve between government expenditure and economic growth, and indicates that the size of the government and the growth of the economy can also be modelled as a quadratic function, i.e. an inverted U-shaped curve. The expected model, therefore, assumes a role for both the linear term and the squared term of government expenditure in the economic growth process.

Vedder & Gallaway (1998), borrowing from Armey (1995), have argued that the non-existence of government causes a state of anarchy and low levels of output per capita, because there is neither the rule of law nor the protection of property rights. Consequently, there is little incentive to save and invest. Only a minimal amount of wealth was accumulated by productive economic activity when governments did not exist and anarchy reigned. The rule of law and the establishment of private property

rights contributed significantly to economic development when a government is in place. No economy has ever obtained high levels of economic development without a government. On the other hand, there is a general consensus that excessively large governments have also reduced economic growth. Output per capita is low when all input and output decisions are made by the government. However, output should be large where 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.

Figure I Government spending and the economy (Armey curve)
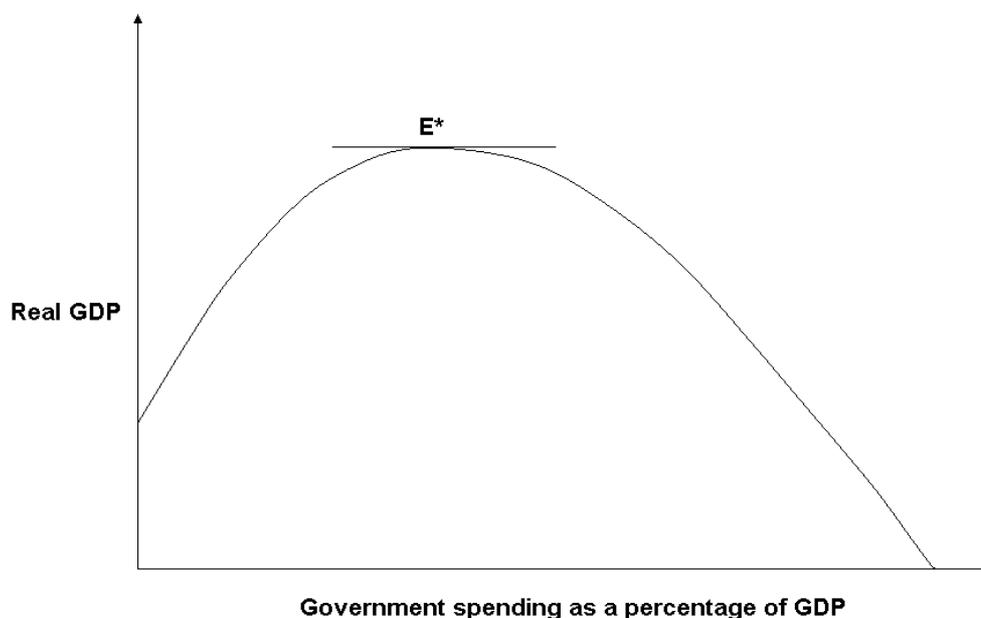
This phenomenon can be put into a graphical perspective. The output-enhancing features of government should dominate when government is very small, and expansions in governmental size should be associated with expansions in output. The presence of a government or a collective action creates improved transportation and a reliable medium of exchange, which lowers trading costs. Nevertheless, growth-

enhancing features of government should diminish at some point and further expansion of government should no longer lead to output expansion. For instance, as spending rises, additional projects financed by government become increasingly less productive and the taxes and borrowing levied to finance government impose increasing burdens, thus creating disincentives to workers. At some point, the marginal benefits from increased government spending reach zero (point E* in Figure I). The growth-enhancing features of government begin to diminish when the adverse effects of big government result in a reduction of output growth. Excess infrastructure lowers benefits per dollar spent while higher tariffs de-motivate imports and exports. Further expansions of government contribute to a further decline in output.

It may be noted that relatively few studies in recent literature empirically test the occurrence of the Armey curve. One notable study, Vedder & Gallaway (1998), however, does statistically test the validity of the Armey curve phenomenon in the context of United States, Canada, Denmark, Italy, Sweden and Britain. The results of this study not only suggest the occurrence of the Armey curve in the US over the time period from 1947 to 1997 but also provide empirical evidence supporting the incidence of the Armey curve for all these countries. Vedder & Gallaway further provide an approximate principle that explains the validity of the Armey curve: the 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 Armey Curve, where reduction in the relative size of government generates positive effects on economic opportunities for the citizens.

The study of Pevcin (2004) investigates the relationship between government spending and economic growth using a sample of European countries. Based on panel

data regression analysis using five-year arithmetic averages, Pevcin states that there is a clearly observable negative relationship between the size of government and economic growth. This study empirically claims that arguments in support of the Armey curve are affirmative.

Handoussa & 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 Armey curve. They not only observe the presence of the Armey curve but also empirically argue that 35 per cent 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.

Obtaining relevant data for calculating the optimum proportion of public spending is one of the difficulties that can arise in these studies. As Radwan & Reiffers (2004) demonstrate, data on different types of public spending in Israel is very difficult to obtain because military and defence spending is mostly unavailable. Radwan & Reiffers, considering only public consumption, estimate that a 44 per cent of public consumption to gross domestic product (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.

3. Methodology and data sources

The present paper adopts a methodology similar to that of Vedder & Gallaway (1998). It, however, introduces several adjustments to examine the relationship between government expenditure and economic growth with relation to a developing country,

i.e. Sri Lanka. The approach used by Vedder and Gallaway (1998) relates government size (G) to economic growth (O). Government size is represented by government expenditure as a percentage of output (GDP), and the growth of the economy is represented by total output (RGDP). This provides the following quadratic function:

$$O = \beta_0 + \beta_1 G - \beta_2 G^2 + \varepsilon$$

The positive coefficient of the linear G term is related to the constructive effects of government spending on output, and the negative coefficient of the squared G term is designed to demonstrate the negative effects of increased government size. In addition to government size, human and physical capital resources of a country also grow over time. This is taken into account by adding in a time variable T. The effect of business cycles on output is captured by the variable unemployment (U). The coefficient of U is expected to be negative, because increased unemployment will result in reduced growth. The resulting expanded equation is as follows:

$$O = \beta_0 + \beta_1 G - \beta_2 G^2 + \beta_3 T - \beta_4 U + \varepsilon$$

The present study diverges from the work of Vedder & Gallaway (1998) in several ways. The dependent variable of the present study is real gross domestic product (*RGDP*)[iii] 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[iv] and Baumol's cost disease[v]; next, *RGDP* without government expenditure is calculated using the GDP deflator. Since the plotted data series suggests that it is not affected by business cycles, the study avoids using the Hodrick & Prescott filter (1997)[vi], which is classically used by macroeconomists to control for business cycle effects.

This analysis, rather than relying on a simple dummy variable to enumerate human and physical capital, employs more macroeconomic indicators that may have an impact on economic growth. These independent variables include the investment share of RGDP (*ki*), the consumption share of RGDP (*kc*) and openness in constant prices (*openk*), in addition to the government share of RGDP (*kg*) and the square term of government share of RGDP (*kg²*). The inclusion of the variable kg^2 assists in empirically verifying or invalidating the phenomenon of the Armey curve within this framework. The random error term is referred to as ε.

The resultant multiple regression equation is given as follows:

$$RGDP = \beta_0 + \beta_1\ kg + \beta_2\ kg^2 + \beta_3\ ki + \beta_4\ kc + \beta_5\ openk + \varepsilon$$

The macroeconomic variables applicable in the analysis are comprised of national data series that are annually collected. This study, therefore, estimates a time series regression rather than a cross-sectional regression, given that the variables concerned are data series with a time dimension.

This study includes both the linear term and the squared term of *kg* in the estimation equation. This regression equation, 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 *kg*'s highly correlated since they are both powers of *kg*? The terms like kg^2 and kg^3 are all nonlinear functions of *kg* and, therefore, they do not violate the assumption of 'no multicollinearity'.

This study is based on country-level data 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 2003 inclusive (45 years).

All data comes from two different sources. The dependent variable is calculated from GDP at current market prices (Sri Lankan rupees million), the gross domestic product deflator (GDPD) (1996=100), and government expenditure data obtained from the annual reports of the Central Bank of Sri Lanka from 1959 to 2003. This study also uses data from the Penn world tables available at the website of the Centre for International Comparisons at the University of Pennsylvania. Data for the following variables taken from these tables is presented as percentages: the government share of RGDP (*kg*), the investment share of RGDP (*ki*), the consumption share of RGDP (*kc*), and the openness in constant prices (*openk*).

4. Empirical results and discussion

This section reports on the study's empirical findings. It discusses the descriptive statistics, results of the stationarity tests, and the empirical estimation of the time series regression equation.

Descriptive statistics

Table I contains definitions of the variables in the dataset and descriptive statistics. From two candidates for the dependent variable, *RGDP* is shown only for illustrative purposes and is not used in any further analysis. The *RGDP* variable used in the analysis does not include the government expenditure component as it represents adjusted values in order to use them appropriately in the analysis. The explanatory -

**Table I Variable definitions and descriptive statistics**

Variable	Definition	N	Mean	Median	Maximum	Minimum	S.D.
Economic growth							
Real GDP	Real gross domestic production in SL Rupees Mn.	45	449122.50	372828.90	1083512.00	128320.00	277585.90
Real GDP without government expenditure	Real gross domestic production without government expenditure (in SL Rupees Mn.)	45	318111.90	249960.50	835194.40	93440.00	206211.40
Government size							
Government share of real GDP	Government share of real GDP (base year = 1996)	45	37,56	32,54	58,91	29,04	8,90
Square term of the government share of real GDP	Square term of the government share of real GDP (base year = 1996)	45	1.488,61	1.058,85	3.470,39	843,32	749,64
Investment							
Investment share of real GDP	Investment share of real GDP (base year = 1996)	45	14,82	14,12	26,96	10,49	3,41
Consumption							
Consumption share of real GDP	Consumption share of real GDP (base year = 1996)	45	72,15	69,40	101,79	62,93	8,29
Openness							
Openness in constant prices	Total trade (exports plus imports) as a percentage of real GDP	45	98,76	81,47	221,60	62,93	40,03

- variables that are of interest in the analysis consist of the government share of RGDP (kg) and the square term of that variable (kg^2). Other explanatory variables are included in the model as control variables.

When compared with its developing counterparts and south Asian neighbours, Sri Lanka has a higher percentage of RGDP spent on government expenses with a mean of 37.56 per cent. The median spending percentage also reaches as high at 32.54 per cent. Sri Lanka has spent at least 29.04 per cent of its RGDP annually as government expenses. In the extreme case, government spending was as high as almost 59 per cent. This is justified by the fact that Sri Lanka is considered to be a welfare nation with high public spending, especially on health and education programmes. Osmani (1994) once wrote that despite the prevailing world pattern of economic liberalization in the 1970s and 1980s, Sri Lanka managed to maintain a high level of welfare.

Figure II depicts a decreasing trend in government expenditure as a percentage of RGDP until Sri Lanka opened up its economy in 1977. Since 1977, the Sri Lankan economy, once dominated by agriculture, has experienced strong growth in its industrial and service sectors. 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 RGDP began to fluctuate afterwards, but it has more or less stagnated ever since. High level of economic liberalization means less government involvement in the economy. Nevertheless, in Sri Lanka's case, 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.

**Figure II Government expenditure as a per cent of real GDP**
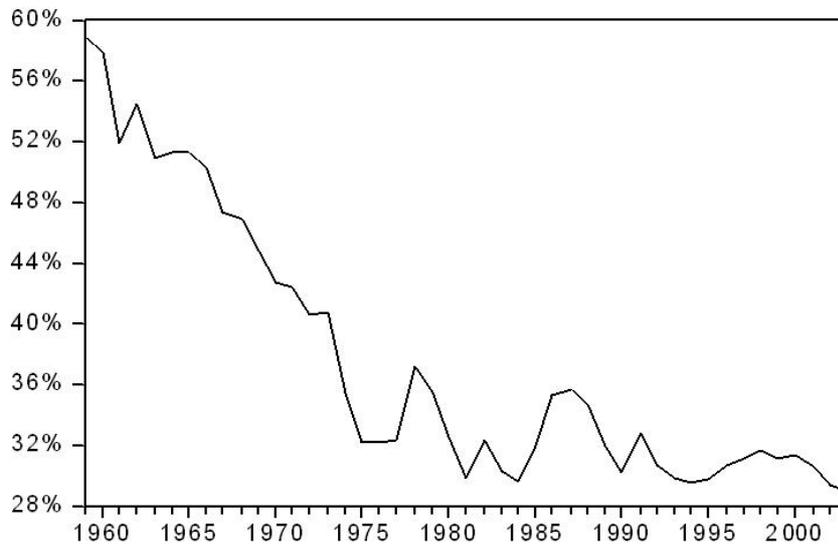
Data source: Alan Heston, Robert Summers and Bettina Aten, Penn World
Table Version 6.2, Center for International Comparisons of Production, Income
and Prices at the University of Pennsylvania, September 2006.

Figure III plots the trends of two selected economic growth indicators. The indicator employed in the statistical analysis is comprised of government expenditure adjusted values. Both plotted variables show a similar movement over the 45 years with similar fluctuations and minor shocks. These minor shocks in national output and economic growth 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 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 2000 with the victory of the Sri Lanka Freedom Party-led coalition in the presidential election. The most significant of these shocks is the one which occurred after the 1977 parliamentary election. The anti-Tamil riots and the establishment of a new

14

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.

Figure III Indicators of economic growth (government expenditure adjusted)
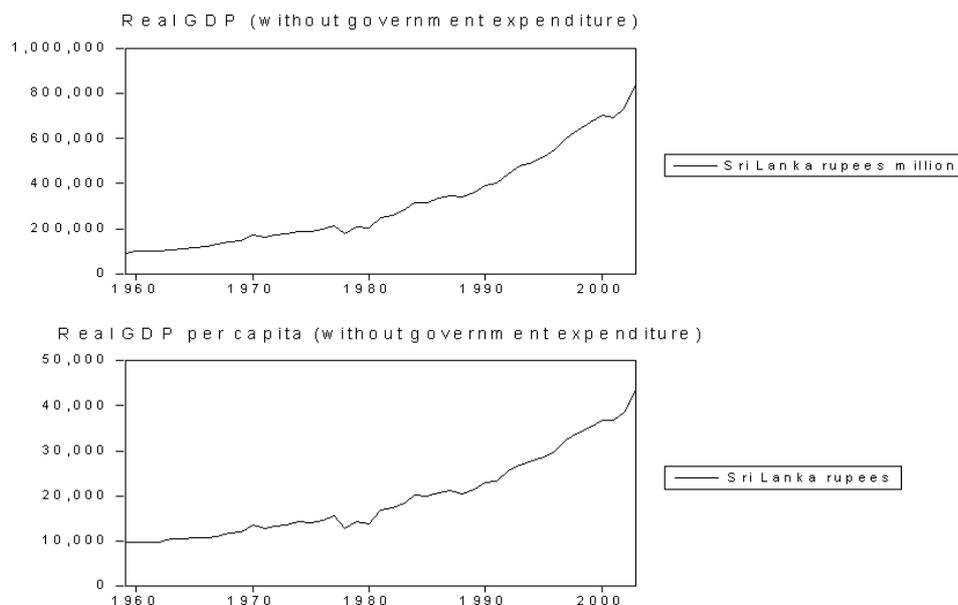
Data source: Central Bank of Sri Lanka (various years), Annual report, various issues.
Note: The graphs are based on authors own calculations.

Stationarity[vii] of the variables

Stationarity of the data series becomes important when dealing with time series data.

Much past empirical work based on time series data assumes that the underlying time

series are stationary. On the one hand, stationary time series avoid autocorrelation[viii]

and spurious regression[ix]. On the other hand, they allow for forecasting and

performing causality tests of Granger and Sims[x].

The usual way of dealing with nonstationarity is to obtain the first differences of a

variable. Since in this study there is one variable with time dependence, i.e. real GDP

without government expenditure, first differences of this data series are employed in

15

the time series regression estimation. The study does not merely employ first differenced data in the analysis, but confirms stationarity of the data series using the unit root tests. This study uses one of several types of unit root tests available, namely the Augmented Dickey-Fuller (ADF) test[xi] for this purpose. The results of the Augmented Dickey-Fuller unit root tests and the stationarity level of the data series based on these results are shown below:

Table II Results of the Augmented Dickey-Fuller unit root test

Variable	ADF test statistic		
	Constant	Constant, Linear trend	None
Real GDP (without government expenditure)			
Level	4.55	1.06	7.86
First difference	-4.04***		

Where "*" indicates the t-value is significant at 10% level and the series is stationary, "**" indicates the t-value is significant at 5% level and the series is stationary, and "***" indicates the t-value is significant at 1% level and the series is stationary.

These findings suggest that level data series of the variable *RGDP* (without government expenditure) is not stationary. The problem is not solved even after adding-in a linear trend to the test equation. Nevertheless, the first differenced data series of this variable is stationary and indicates the t-value is significant at 1% level. Therefore, it is appropriate to use the first differenced *RGDP* (without government expenditure) data series instead of level data in the time series regression estimation. Other variables, i.e., government share of RGDP, square term of government share of RGDP, consumption share of RGDP, investment share of RGDP and openness in constant prices are expressed as ratios and hence need not be tested for stationarity.

Results of the time series regression estimation

In order to examine the effect of each factor influencing real GPD without government expenditure (hereafter, RGDP) and economic growth, a series of time

series regression analyses using the OLS estimation technique were carried out. Table III lists the main results of the time series regression analysis, which has been rectified using the residual tests. This time series regression is an analysis using all five explained variables. An autoregressive AR (5) term was introduced to control problems of serial correlation: it also significantly improves the predictive capacity of the model. All the coefficients are significant at 5 per cent level or better in the estimated time series regression.

Table III Economic growth and countrywide economic indicators (The results of the time series regression using OLS)

Dependent variable: Change of real GDP	
Government size	
Government share of real GDP	8988.64** (3521.19)
Square term of the government share of real GDP	-169.15*** (48.88)
Investment	
Investment share of real GDP	-2075.06*** (303.16)
Consumption	
Consumption share of real GDP	1717.79*** (485.46)
Openness	
Openness in constant prices	849.74*** (129.28)
R-squared	0.71
Adjusted R-squared	0.61
F-statistic	6.93
Prob(F-statistic)	0.00
Number of observations	45

Notes: AR (5) term introduced to control problems of serial correlation is not listed here. Standard errors are shown in parentheses.
* Statistical significance at the 10-percent level
** Statistical significance at the 5-percent level.
*** Statistical significance at the 1-percent level.

When considering the time series regression results, the equation's overall F tests are significant at a level above 1 per cent, and the coefficient of determination R^2 is above 0.71. Accordingly, more than 71 per cent of the variation of *RGDP* is explained by government expenditure, consumption, investment and the openness of the economy.

This means that the equation has results that fit well, and that a very strong corresponding relation exists between the explanation variables and economic growth in Sri Lanka.

The estimated model is shown below:

$$RGDP = -245338.6 + 8988.64 \, kg - 169.15 \, kg^2 - 2075.06 \, ki + 1717.79 \, kc + 849.74 \, openk$$

As one would expect, the coefficient of the linear term of government expenditure kg has a positive sign to account for the positive beneficial effects of government spending on output, while the negative sign of the coefficient of squared term kg^2 explains any adverse effects associated with increased governmental size. This model also suggests that openness is beneficial for Sri Lanka: it increases $RGDP$ and economic growth. The negative sign of the coefficient of investment share of RGDP is associated with the negative effects of investment on $RGDP$ and economic growth. This is contradictory to the economic theory and needs further examination since economic theory would suggest that investment is pro-growth. The estimation results further suggest that the difference of $RGDP$ is predicted to increase by 8988.64 million Sri Lankan rupees when the government share of RGDP goes up by one per cent; to decrease by 169.15 million Sri Lankan rupees when the square term of the government share of RGDP goes up by one unit; to decrease by 2075.06 million Sri Lankan rupees when the investment share of RGDP goes up by one per cent; to increase by 1717.79 million Sri Lankan rupees when the consumption share of RGDP goes up by one per cent; and to increase by 849.74 million Sri Lankan rupees when openness in constant prices goes up by one unit. The difference of $RGDP$ is predicted to decrease by 245338.6 million Sri Lankan rupees when the government share of

18

RGDP, the investment share of RGDP, the consumption share of RGDP, and openness in constant prices are zero.

5. Policy perspective

There is a policy perspective to this exercise. The properties of the estimated parameters provide extra information about the potential policy directions: these coefficients of the estimated quadratic equation provide evidence to prove or not to prove the existence of the Armey curve. The geometric presentation of the quadratic function and its properties are illustrated in Figure IV. In order to establish this inverted U-shaped curve, the coefficient of the square term of government share of RGDP (kg^2) needs to be negative. The illustration below exhibits this negative c[xii].

Figure IV The properties of the quadratic function
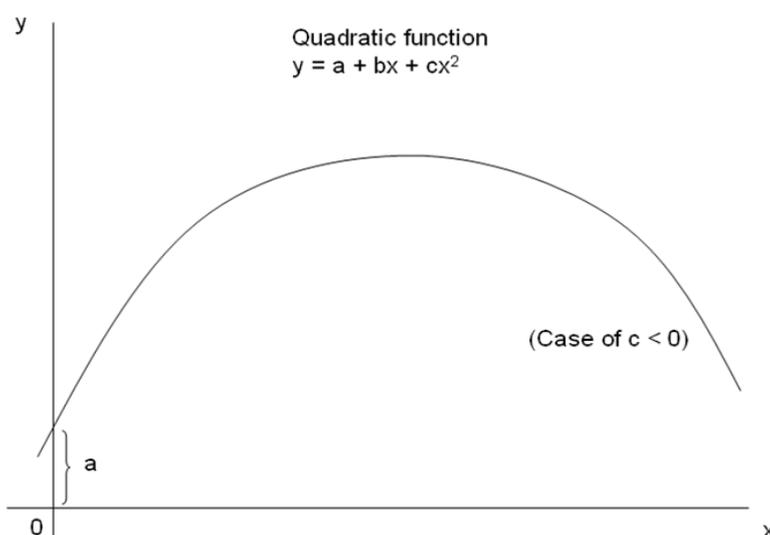
The quadratic function specified above plots as a parabola, a curve with a single built-in bump or wiggle. The positive sign of the linear term kg is designed to show the positive beneficial effects of government spending on output, while the negative sign

of the squared term kg^2 means that the variable measures any adverse effects associated with increased governmental size. Since the squared term increases in value faster than the linear term, the presence of negative effects from government spending eventually will outweigh the positive effect, producing a downward-sloping portion. The values that were obtained in the case of Sri Lanka are consistent with this principle.

The graphical solution of the optimum value is the peak of the quadratic curve. The mechanism specified below can be used to calculate the optimal level of government expenditure using first partial differentiation. This study calculates the partial derivative of RGDP with respect to *kg,* to indicate that all the other independent variables in the function are held constant when taking this particular derivative through partial differentiation. Also it should be noted that this is a local and conditional maximum that depends on the coefficients of other independent variables, but by taking partial derivatives this study assumes other variables are held constant:

$$RGDP = -245338.6 + 8988.64\,kg - 169.15\,kg^2 - 2075.06\,ki + 1717.79\,kc + 849.74\,openk$$

Calculate the first partial derivative; $\dfrac{\partial(RGDP)}{\partial(kg)} = 8988.64 - 2(169.15)\,kg$

Equalise these values to zero to calculate the optimal government size;

$$0 = 8988.64 - 2(169.15)\,kg$$

$$kg = 26.57$$

These results support the statistical estimation of the Armey curve, and they provide a framework to approximately compute the specific point where output is maximised. The curve peaks where government spending is equal to 26.57 per cent of RGDP

(approximately 27 per cent). Sri Lanka spent an average of 30 per cent of RGDP as government expenditure from 2000-2003, but the share of government spending shows a downwards trend. For instance, government expenditure in Sri Lanka in 2003 was exactly 29 per cent. Since the 1960s, the average government share of RGDP continued to drop from 50.74 per cent in the 1960s to 37.18 per cent in the 1970s to 32.43 per cent in the 1980s to 30.75 per cent in the 1990s. The results indicate that Sri Lanka has had excessive government expenditure, but, nonetheless, is reaching an ideal amount of government expenditure from the standpoint of growth optimization.

If these results are accurate, the country, since 1959, has been in the negatively sloped portion of the Armey Curve: i.e., higher government spending as a percentage of total output is associated with lower levels of real output. These results are consistent with the idea that welfare states do not necessarily promote economic growth.

6. Conclusions

One of the arguments put forward by the architects of the endogenous growth theory is that governments can manipulate growth. Following in these footsteps, Armey (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) can government expenditure increase or decrease economic growth? (b) is it possible to empirically verify the existence of the Armey curve in the case of Sri Lanka?

In answering the first question as to whether government expenditure can increase or decrease economic growth, the findings of the investigation validate the non-linear 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; a positive relationship exists between consumption and economic growth; and, an open economy promotes growth. One exception is that these results suggest there is a negative relationship between investment activities and economic growth.

In answering the second question as to whether it is possible to empirically verify the existence of the Armey curve in the case of Sri Lanka, this study performs an empirical test of the popular phenomenon of the Armey curve using a data set of 45 observations (1959-2003) for Sri Lanka. The signs of the coefficients of the government share of real gross domestic product and its square term confirm the possibility of constructing the inverted U-shaped Armey curve for Sri Lanka. This paper adds to the literature 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 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 per cent for Sri Lanka. In comparison to the lowest government expenditure percentage in recent times (29 per cent in 2003), the Sri Lankan government is spending at least 2 per cent more money than the required amount of spending from an optimization point of

22

view. In other words, the size of the government is about 7 per cent too large from a growth-enhancing point of view. These findings have important implications for the appraisal of government spending and policy design.

Notes:

[i] 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 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.

[ii] Richard Armey borrows the graphical technique from Arthur Laffer to develop what he termed the Armey Curve. 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 per cent and 100 per cent tax rates.

[iii] Real GDP is considered a proxy for the steady growth in the productive capacity of the economy (and so a growth of domestic income). It is sensible to use real GDP to represent economic growth. A simple way to calculate real GDP is to divide gross domestic product by the GDP deflator.

[iv] 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 paper, 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 paper 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.

[v] 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 will be generated and be spent as public expenditure.

[vi] The Hodrick and Prescott (HP) filter (1997) is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series. The HP filter is a two-sided linear filter that calculates the smoothed series s of y by minimizing the variance of y around s, subject to a penalty that constrains the second difference of s. In other words, the HP filter chooses s to minimize:
$$\sum_{t=1}^{T}(y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1}((s_{t+1} - s_t) - (s_t - s_{t-1}))^2,$$
Where λ is the penalty parameter that controls the smoothness of the series σ. The larger the λ, the smoother the σ. As $\lambda=\infty$, s approaches a linear trend. Annual data is used in this analysis; therefore, a penalty parameter of 100 is recommended to smooth the series.
The interest of this study is only in the trend component of the *RGDP* data series; thereby it should eliminate the cyclical component. But, a careful look at the graph suggests that the data series is not prone to cyclical shocks, therefore, no need arises to adjust the data series.

[vii] A time series is weak stationary if its mean and variance do not vary systematically over time, or if first and second moments of a series do not depend on t. If a series is weakly stationary and normally distributed, then it is stationary in the strict sense.

[viii] Autocorrelation is the correlation between members of series of observations ordered in time. In other words, autocorrelation occurs when error terms of the observations are correlated. This can be shown econometrically as follows:

$$E(u_i u_j) \neq 0 \qquad i \neq j$$

[ix] When regressing a time series variable on another time series variable, it tends to produce very high R^2 values even though there is no meaningful relationship between the two variables. This is the case especially when both time series variables are subject to a deterministic trend. This situation is referred to as the spurious (nonsense) regression.

[x] Time series forecasting as well as causality tests of Granger and Sims assume that the time series involved in analyses are stationary. Therefore, usually stationary tests precede tests of causality.

[xi] The testing procedure for the ADF test is applied to the model

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + ... + \delta_p \Delta y_{t-p} + \varepsilon_t,$$

Where α is a constant, β is the coefficient of a time trend and p is the lag order of the autoregressive process. If the model is a random walk, both the constraints $\alpha = 0$ and $\beta = 0$ apply. When modelling a random walk with a drift, only the constraint $\beta = 0$ applies.

The test statistic of the unit root test is calculated as follows. The relevant null hypothesis is $\gamma = 0$ against the alternative hypothesis $\gamma < 0$:

$$DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$$

The test statistic is then compared to the relevant critical value for the DF test. If the test statistic is greater than the critical value, the null hypothesis $\gamma = 0$ is rejected (data series is stationary).

[xii] In the case of c>0, the curve will "open" the other way, displaying a valley rather than a hill.

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