

Development & Sustainability Studies

The Impact of Growing Public Debt on Economic Growth: An Empirical Study on Sri Lankan Economy

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INTRODUCTION

In contemporary economic theory, indebtedness and its implications on the economy is one of the most popular areas of study. The importance of analysing debt level has grown to critical levels during the past half-decade due to the Greek financial crisis and the European crisis driven by less-than-prudent debt management policies of the respective governments. What constitutes a 'prudent' level of debt depends on various factors: Japan, for instance, may be able to smoothly execute economic activities even though its debt amounts to 200% of GDP. In Sri Lanka, debt levels have risen substantially during the past decade: mainly due to the warfare and post-war rehabilitation programs of the government. As a result Sri Lanka is now one of the most highly-indebted nations in South Asia region (International Monetary Fund, 2011). In this context, it becomes critical to analyze the growth implications of public debt in Sri Lanka and the prudent level of debt to be maintained. It is the major purpose of this study to analyse these growth implications of public debt and the prudent debt level to be maintained.

Considering the theoretical argument on debt and growth, two major arguments can be found: the classical theory and the Ricardian equivalence hypothesis. Fisher and Modigliani initially developed classical theory. As per classical theory, debt has a negative relationship with the growth rate: i.e., an increase in the debt level will negatively impact the growth rate of the economy. Ricardian equivalence hypothesis, another subsequently developed theory in relation to debt and growth, indicates that increase in or change in the debt level will not impact growth: i.e., a debt increase or a reduction of government savings will lead to an increase in private savings and not influence aggregate demand and growth. But both the theories appear vague and lack generalisability. In order to overcome this drawback, scholars like Reinhart, Rogoff, Chechtria, and Phillips conducted empirical analyses on debt and economic growth, based on which comprehensive models were developed. Through their findings, it has been possible to establish threshold level of debt, and more importantly, the non-linear relationship between debt and growth. Although such comprehensive analyses conducted in relation to the subject exist, almost all of them concern developed or OECD economies. Therefore, conclusions drawn from those studies become difficult to generalize in the context of developing economies, leading to the need for a comprehensive model which analyses the impact of continuous expansion of debt level on economic development within the context of developing economies. Therefore, this analysis was conducted in order to fill this gap.

In this paper, the relationship between Sri Lanka's economic growth and public debt will be discussed through the development of a comprehensive model, and be further analysed to arrive at the threshold debt limits that the Sri Lankan economy should maintain. This analysis will be conducted based on the model developed by Chechtria and Phillips in 2010, subject to certain modifications introduced in order to comply with statistical requirements and specifications.

LITERATURE REVIEW

Theoretical Literature

Major theoretical arguments developed by Modigliani and Fisher indicates that a marginal increase in the debt level will lead to reduce economic growth. As per the Ricardian equivalence hypothesis, it concludes that an increase in the debt level will not impact economic growth. A number of empirical studies have been conducted based on this theoretical background.

Empirical Literature

There is a lack of empirical literature in relation to the developing economies context, given that most of the studies have conducted based on developed or OECD economies.

A study was conducted to determine the impact of higher growth on economic growth; and entailed a cross-country study within the euro area, based on 40 years' data. The authors argue that public debt and economic growth have a non-linear relationship, where after a certain point the former will have a negative effect on economic growth: observed to occur past the 90% threshold. It concludes that annual changes in the debt level have a negative relationship with the growth. Finally, it concludes that a higher debt level may not be a remedy for higher growth rate (Checherita and Philip, 2010).

Cecchetti et al., 2011: A study conducted to determine the real effect of debt based on a cross-country analysis conducted in 18 OECD economies, this mainly examines the relationship between non-financial debt and economic growth. Through the analysis, it is argued that at ratios beyond 85% Public Debt to GDP, a marginal increase in public debt will reduce economic growth by 0.1%. Such a relationship has only been found in relation to Public Debt: no similar impact on growth was observed due to changes in Corporate and Household Debt. The major conclusion is that an ageing population

has a substantial impact on the debt level as well as the growth, as a remedy for which the study proposes the enhancement of domestic savings.

Another study was conducted to determine whether public debt has a causal effect on economic growth, and its analysis was carried out based on public debt data on OECD economies. Through the analysis, it is argued that the level of debt does not have an impact on the economic growth in advanced economies. That no relationship was found between debt level and growth may not have the same implications for every economy, as those operating beyond the threshold limit may experience adverse effects on economic growth if further increases of public debt take place (Ugo and Presbitero, 2012).

A study conducted on advanced and emerging economies, based on the data available from last four decades in order to determine the relationship between level of public debt and economic growth. The major objectives of this analysis was to determine causality, reverse causation and the prudent debt level. The study was conducted through comprehensive econometric tools and techniques, mainly fixed-effect regression, OLS, SGMM and related robustness techniques, in addition to which the behavior of various channels that determine the growth rate and their relationship with the debt were analyzed. Through the analysis, it was concluded that, *ceteris paribus*, growth in debt level will reduce subsequent growth: more precisely that a 10% increase in the debt level will reduce the long run growth rate by 0.2%. However, this rate of change will be diluted in advanced economies. Through the study it has been concluded that growth has a nonlinear relationship with debt level and beyond the 90 % threshold limit the impact on growth becomes irrelevant. The increasing debt stock was found to pose a growth constraint only on countries that follow prudent macroeconomic policies: effects could not be precisely estimated elsewhere (Kumar and Woo, 2010).

Problem Statement

Government debt is critical for economic growth and in the recent past most relevant data indicate high debt in the Sri Lankan economy. In the current economic and political scenario the most popular theme is continuous expansion of public debt, where many argue that increasing public debt will reduce the economic growth.

“Will public debt lead to enhanced economic growth within the Sri Lankan economic context?”

METHODOLOGY

This study was on macroeconomic variables and its implications, and data required for the study were collected through secondary sources. For the purpose of this study, data was gathered mainly through the database of the Central Bank of Sri Lanka, Human Development Reports, World Bank database and various publications and issues of the relevant authorized institutions. For the purpose of the study, data available from 1964-2012 within various sources are under concern. In order to conduct the analysis the initial variables that were required to address the issue in the research area should first be selected. The study intends to analyze the relationship between public debt, economic growth and development; therefore, major variables under the model are public debt/GDP ratio, economic growth rate. Therefore, the basic model will be based on the relationship between the above variables, in addition to which, based on empirical studies, the National Savings/GDP ratio, Investment/GDP ratio, Trade Openness/GDP ratio, and Budget deficit/GDP ratio were included in order to comply with statistical requirements. These model variables are presented below;

Table 1: Variable Description

Variable	Measurement	Scale
Public Debt	Level of Public Debt	Public Debt to GDP ratio
Economic Growth	Level of Growth	Real economic growth rate
Savings	Level of savings	National savings to GDP ratio
Investment	Gross Domestic Capital Formation	Gross Investment to GDP ratio
Trade Openness	Trade competitiveness	Trade Openness to GDP ratio
Budget Deficit	Government Savings	Budget deficit to GDP ratio

The Debt/GDP ratio was calculated based on values available in the Central Bank of Sri Lanka database. Economic growth indicators were also obtained from the same data source, while the National Savings to GDP ratio was calculated as per information provided under the same, with the savings value including public and private savings alike. Investments or Gross Domestic Capital Formation was also calculated as per the information provided in the Central Bank database, which also includes both public and private investments.

Trade openness has been embedded into the model in light of the fact that expansion of foreign trade and finance may impact both growth and the debt stock. Trade openness was calculated as total absolute value of exports and imports as a percentage of GDP. Export and import values were converted to rupee terms using the year-end US dollar rate.

Model Formulation

Analysis of the problem area of the research was evaluated under a model that explains the relationship between debt and growth. Initially the model was developed on the presumption of a linear relationship between variables, with the following specification:

$$g = \alpha_0 + \beta_0(Debt/GDP) + \varepsilon$$

Subsequently the model was improved by embedding debt/GDP squared into the model. The major reason for introducing debt squared into the model was that, under linear Debt/GDP ratio, the initial model did not provide any significant relationship. Therefore the debt-squared value was introduced to the model, to improve model specification as follows:

$$g = \alpha_0 + \beta_0(Debt/GDP) + \beta_1(Debt/GDP)^2 + \varepsilon$$

Further, the model has tested under various polynomial forms in order to determine the most effective and significant functional form. For this purpose the model was tested under the following polynomial functions:

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^{1.2} + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^{1.4} + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^2 + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^{2.4} + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^3 + \varepsilon$$

Testing for Stationary

Time series econometrics could be treating as a complicated area of study, in spite of which it has a huge value in econometric model formulation. Therefore, a number of studies and models have been developed in relation to this subject area. For the purpose of the study, the Augmented Dickey-Fuller (ADF) test was used to determine and correct the non-stationarity.

The ADF test derives from the Dickey Fuller test, developed on the assumption of an uncorrelated error term. ADF test was developed

based on a simplification or relaxation of the above presumption, and the ADF estimation formula can be derived as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^m \alpha \Delta Y_{t-1} + \varepsilon$$

Where ε was the pure white noise error term, and δ was the $\rho - 1$, represents the non-stationary or unit root coefficient, ΔY_{t-1} represents the first difference operator embedded to the model in order to adjust to the autocorrelation bias.

All the model variables has checked and corrected for stationarity based on the ADF test explained above. Variables checked for stationarity through the following hypothesis,

H_0 : Variable has a unit root (i.e. Non-stationary variable or $\rho = 1$)

H_1 : Variable was not having an unit root (i.e. Stationary process or $\rho < 1$)

Detailed calculations regarding the ADF test are in the annexures.

Estimation of the Model

The analysis was conducted in two stages, where the initial model was developed on a linearity assumption, and the subsequent model was improved to quadratic form. In both cases the model estimation was done using the Generalized Methods of Moment (GMM) method. In estimation, the maximum likelihood estimator is the tool that provides most efficient estimates, but is subject to number of assumptions. On the other hand GMM estimator could be applied under a minimum number of assumptions. Most of the time series empirical analysis were conducted using the GMM technique. The rationale behind GMM estimation was that it estimates the sample moments defined under the model, matching the population

moments. A mathematical representation of the GMM estimation technique adopted on the model is as follows:

$$g = \beta(\text{Debt}/\text{GDP}) + \varepsilon$$

Then as instrumental variable the Debt/GDP (presumed as x_t) ratio was used, and the estimation made on instrumental variables and orthogonality conditions as follows:

$$E[g_t(w_t, \beta)] = E[x_t, \varepsilon_t] = E[x_t (g - \beta(\text{Debt}/\text{GDP}))]$$

Estimation of β will be derived from the following equation,

$$\beta = \Sigma_{xg}^{-1} \Sigma_{xg}$$

Models that were developed under the study based on the GMM estimator followed the above estimation methodology.

ANALYSIS AND RESULTS

Basic Model

Main objective of this study is to determine the relationship between the public debt and the economic growth, in relation to the subject area which indicates that debt has a nonlinear relationship with the growth rate. Therefore, the basic model was developed through nonlinear specification tools. The initial model was estimated on Generalized Methods of Moment (GMM) technique, a tool that can be applied under a minimum number of assumptions. Further, GMM estimates provide an incentive about the long-run behavior between the variables. The initial model estimated under GMM technique is as follows:

$$g = \text{Debt}_{\text{GDP}(x)} + C$$

$$g = -0.073 \left(\frac{\text{Debt}}{\text{GDP}} \right) + 0.0426$$

From the estimated model the following conclusions were made:

Debt/GDP coefficient has become significant at 10% significance level, indicating that a unit change in debt level will change the growth rate by 7% in the long-run.

Model specified R^2 value 16% where model only explains the 16% of the total variance of the dependent variable, though explanatory power is lower in the model, model could be treated as correctly specified under the J statistic.

The model generates very low R^2 values, but this does not indicate model is inadequate in its explanatory power. As explained by Gujarati (2006), “the researcher should be more concerned about the logical or theoretical relevance of the explanatory variables to the dependent variable and their statistical significance. If in this process we obtain high R^2 , well and good; on the other hand, if R^2 is low, it does not mean the model is necessarily bad”. Further even though the model reports very low R^2 value, it could be treated as correctly specified due to the very small J statistic reported on the model.

Model Improvement and Threshold Limits

The initial model that was estimated through the GMM method was based on a linear relationship between debt and growth. Estimation results provided that β or debt/GDP coefficient has become significant at 10% level of significance. However, from an economic perspective 10% is generally treated as insignificant. Further Chechtria and Philips (2010) suggest that a linear combination of debt and growth does not yield significant results. As an option to resolve this issue they suggest to move to a polynomial functional form, i.e., an equation with power of greater than one. They also suggest that increasing this power will reduce the turning point. Following these suggestions, the model was improved to quadratic form as follows:

$$g = \alpha_0 + \beta_1 \left(\frac{Debt}{GDP}\right)^2 + \beta_2 \left(\frac{Debt}{GDP}\right) + \varepsilon$$

This improved model was also estimated through the GMM technique. Estimated results generated by the model can be derived in equation form as follows:

$$g = 0.001 - 0.2561(Debt/GDP)^2 + 0.3121(Debt/GDP)$$

Based on the model it indicates debt and growth follow a nonlinear relationship, and that the curve is globally concave. Further, Debt/GDP squared become significant at 5% level, which is an observed improvement when compared with the linear model. The model is correctly specified as indicated by the very small J statistic. Further, results generated through the improved model were consistent with the findings of Chechtria and Philips (2010), and Roggof and Reinheart, (2010) in that they conclude debt/GDP was globally concave with a relative maxima.

Through the improved model, the maximum or prudent level of debt that the country should maintain has been estimated. As indicated above Chechtria and Philips (2010) explain that enhancement of the power of Debt/GDP ratio will reduce the optimum debt level until the power reaches to 3. They generated the model on the quadratic functional form to interpret the results and determine the effective threshold limit similar approach applied here.

In order to ascertain the optimum threshold level, the generally suggested approach was the Newton Ramphson method (Gujarati, 2004), though in case of certain polynomial functions this test generates accurate results, due to this limitation the first derivative technique was adopted in place of the Newton Ramphson test. The first derivative technique has a functional form derived on the following basis:

$$\frac{dG}{dDebt} = -2\beta \left(\frac{debt}{GDP} \right) + \beta$$

Based on the results obtained through first derivative technique, it is suggested that the debt turning point resides at 61% debt, beyond which point a unit increase in debt level will reduce the growth rate. Results generated through this study on debt turning point marginally contradicts the results of Cooray and Kumara (2013) which indicate the point as 60%, but based on proximity results could be treated as compatible on approximate terms. The reason behind the difference between the two results is the increase in the debt level and the rapid increase in GDP, which may both lead to a higher threshold limit than in previous studies.

Channels for the Impact on Public Debt on Growth

In the first part of the study the relationship between debt and growth was analyzed. In this analysis an important fact that needs to be taken into consideration is the channel by which public debt is likely to impact growth. Based on empirical studies and theoretical implications, the impact of debt on (i) national savings (ii) gross domestic capital formation (iii) trade openness and (iv) budget deficit have been analysed. Through regression, it was observed that each channel had a non-linear relationship between debt stocks. Every variable was checked for the robustness and compatibility with the model and necessary adjustments made.

Impact on national savings due to debt was analyzed based on the following equation:

$$s = \alpha_0 + \beta_1 \left(\frac{Debt}{GDP} \right)^2 + \beta_2 \left(\frac{Debt}{GDP} \right) + \varepsilon$$

Since the savings rate has a non-linear relationship with debt stock, the model was estimated through GMM. As per the estimated results, the savings rate shows a significant relationship between debt stock and growth. Further, savings rate shows an inverted U shaped

relationship with the debt level, debt turning point recorded at 82.14%. These results complied with Checherita and Philip (2010) study on public debt, and beyond the established threshold level, further increases in debt portion will result in dissaving: a result somewhat contradictory to the Ricardian equivalence hypothesis.

Then the impact of gross domestic capital formation over the debt stock was analyzed based on the following equation:

$$\begin{aligned} & \text{Gross_Investments_Rate} \\ & = \alpha_0 + \beta_1 \left(\frac{\text{Debt}}{\text{GDP}} \right)^2 + \beta_2 \left(\frac{\text{Debt}}{\text{GDP}} \right) + \varepsilon \end{aligned}$$

Gross investments rate also having a non-linear with debt stock, the model has been estimated through GMM technique. Gross investment rate also does not provide a significant relationship between debt stock and the derived estimation: compliant with empirical studies (Chechetri and Phillip, 2010), although it is in contradiction with theory.

Thirdly the impact made by debt stock on budget deficit was analysed based on the following equation:

$$\text{Budget_Deficit/GDP} = \alpha_0 + \beta_1 \left(\frac{\text{Debt}}{\text{GDP}} \right)^2 + \beta_2 \left(\frac{\text{Debt}}{\text{GDP}} \right) + \varepsilon$$

Estimations conclude that Budget Deficit/GDP has a significant relationship with debt stocks. The model equation indicates that a percentage point increase in the debt stock ultimately changes debt stock by 61%. Further, the budget deficit having a globally concave U shaped relationship with the debt stock, the model indicates that if debt stock increases more than 79.94% it starts to increase budget deficit, the minimum threshold level of debt. In relation to above, a relationship supporting empirical literature could not be found.

Then the influence made by debt stock over external trade was analyzed, measuring trade openness as the absolute total value of exports as a percentage of GDP. Trade openness also shows a non-linear relationship with the debt stock based on the equation below.

$$to = \alpha_0 + \beta_1 \left(\frac{Debt}{GDP}\right)^2 + \beta_2 \left(\frac{Debt}{GDP}\right) + \varepsilon$$

Since the variables in the equation show a non-linear relationship, the estimation was done through GMM estimation technique. As in the first two estimations, trade openness does not provide any significant relationship with debt stock. Results generated through the model comply with the empirical findings made by Chechtria and Phillips (2010).

Polynomial Functional Form

Initially as per Chechtria and Philips (2010) analysis, it was concluded that under linearity debt will not have significant relationship with the growth rate, which led to the development of an alternative polynomial functional relationship among model variables. As a result, the Debt/GDP ratio rose to various powers and was analyzed in terms of the significance of the relationship between variables. For this purpose, estimations were done through GMM, since they deal with the non-linear relationship among the variables. For the purpose of the study, the following polynomial functions were developed:

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^{1.2} + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^{1.4} + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^2 + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^{2.4} + \varepsilon$$

$$g = \alpha_0 + \beta_1(Debt/GDP) + \beta_2(Debt/GDP)^3 + \varepsilon$$

Results obtained from each model can be summarized as follows:

- when the power is raised to 1.2, Debt/GDP ratio becomes significant at the 5% level. The model indicates a non-linear globally concave relationship with the growth rate and through first differentiation it was ascertained that the debt turning point resides at 60.97%, a relatively higher turning point compared to the basic model of the study.
- in the second model, with a power of 1.4, the Debt/GDP ratio became significant at 5%. This model also shows a globally concave non-linear relationship between the variables, and with a debt turning point at 60.95%.
- when the power was raised to 2.4, it also indicated a globally concave relationship between debt/GDP and growth as in previous models, but the level of significance rose to 12%. As explained earlier, when power continues to rise, after the power of two, significance between variables in the model will reduce. Debt turning point comes to 60.54%, marginally higher than the basic model developed under the study.
- finally, relationship between debt/GDP and the growth rate was tested on cubic form, i.e. power of debt/GDP raised to 3. In this model, debt/GDP becomes insignificant with the growth rate at 10% significance, though in the statistical context it can be accepted as significant at 20% level of significance. As per the model debt/GDP turning point is recorded at 60.17%. It also a relatively higher value compared with the basic model.

From this overall analysis, it can be concluded that the best-fit model to analyze the relationship between debt and growth is in quadratic form, and increasing the power of the debt/GDP ratio will ultimately create a lower threshold limit or debt turning point. Further incrementing the power initially leads to enhance the significance between the variables, but after the power is raised to two, from that point onwards the significance between variables began to decline.

These findings were highly consistent with the previous empirical findings made by Chechtria and Philips, (2010).

CONCLUSION

This study analyzed the impact made by continuous increases in public debt on economic growth and development in Sri Lanka, based on data available over the past 50-year period, i.e., 1963-2012, using econometric estimation and analytical tools.

The initial model on growth and the debt level was developed based on the linearity assumption, but linear relationship between debt and growth does not yield significant results: consistent with previous empirical findings (Chechtria and Phillips, 2010). Therefore, the model was improved and tested for various polynomial functional forms. Through this it was found that increasing the power from linear to quadratic form increases significance. After quadratic form, continuous increases in power will reduce significance; and therefore the basic model was developed based on the quadratic relationship between debt and growth. Increments to the power of debt/GDP ratio will increase the threshold level of debt, but will reduce significance after a certain point.

Based on available data the threshold level of debt was estimated through the first derivative method, and the study found that the optimum threshold of the debt limit resides at 61%: beyond that limit, the marginal increase in the debt level will have an adverse impact on growth. Further, it found that year-on-year changes in debt level, have a negative relationship with economic growth rate. This result shows marginal deviation from the previous study by Cooray and Kumara (2013), which established a threshold level of 60%, mainly due to differences retained in the estimation technique and the continuous improvement recorded in both GDP and debt.

Channels through which public debt impacts growth include the budget deficit and savings rate. Other channels do not indicate any significant relationship with the debt level. Budget deficit indicates a positive relationship with the debt level and the savings rate shows a negative relationship. Debt turning points on savings and budget deficit were recorded at 82.14% and 79.94%, beyond these threshold levels further increases in debt will create negative impacts on each: consistent with the findings of Singh (1999) and Checherita and Philip (2010). Further, it was found that compared with the developed economies' determinants of growth, threshold limits of the determinants lie above the debt threshold limit for the developing countries. Therefore, it can be concluded that increased debt will create an initial impact on growth and it affect growth determinants with a lag.

As these conclusions are drawn purely based on quantitative and statistical grounds, their implications may differ once policy decisions and actions of governments in relation to the public debt are taken into consideration. Therefore, when developing a public debt management policy further qualitative factors also need to be taken into consideration. This will lead to develop more effective policies relating to the growth and development of the economy. Further to reduce the debt/GDP ratio to its 61% threshold, government as well as the central monetary authority should focus on formulating effective strategic plans without compromising on growth prospects. Moving into short term fiscal austerity measures will make adverse impact on the economic performance. Therefore in order to achieve best results, the government must try to formulate prudent and effective mechanisms and debt management policies.

APPENDICES

Appendix 1: Basic Model

Debt_GDP	-0.0739 (0.0736)*
C	0.0426 (0.000)***
R ²	0.1667
J statistic	0.6185

*Note: Dependent variable is the economic growth rate (annual), explanatory variables cited in abbreviations as per the Table xx, estimated variables and their significance (*10%, **5%, ***1%) are shown in the table. Values indicated in parenthesis are significant values of the each estimate. Model has estimated through GMM technique.*

Appendix 2: Model Improvement to Quadratic Form

Debt_GDP	0.3121 (0.0901)*
Debt_GDP ²	-0.2561 (0.0290)**
C	-0.001 (0.0000)***
R ²	0.1215
J statistic	9.43 x 10 ⁻³¹

Appendix 3: Debt Turning Points and Threshold Limits

	Basic Model	Investmen t	Saving s	Trade Opennes s	Budget Deficit
Debt_GDP	0.3121	0.1442	0.4153	-0.0807	-
Debt_GDP ²	-0.2561	-0.1225	-	0.00351	0.9394
			0.4123		0.5973

C	-0.001	0.0032	0.0026	0.0012	-
R ²	12.15%	1.27%		4.813%	0.0037
J statistic		0.5236	3.09%	0.6252	2.49%
	9.43x10 ⁻³¹			3.68x10 ⁻³⁰	0.3208
Debt Turning point	60.93%	58.85%	82.14%	114.95%	78.64%

Note: Debt turning points for the above models ascertained through using first derivative method, following general calculus. In the above table columns represents the dependent variable and rows represents the controllable variable. All the models that mentioned above have estimated by using Generalized Methods of Moments technique.

Appendix 4: Polynomial Functional Form

	Debt_GDP	Debt_GDP ^x	Debt TurningPoint
1.2	1.8349 (0.0443)**	-1.6881 (0.0354)**	60.97%
1.4	0.8844 (0.0525)**	-0.76983 (0.0334)**	60.95%
2	0.31212 (0.0901)*	-0.2561 (0.0290)**	60.93%
2.4	0.20205 (0.1297)	-0.16996 (0.0271)**	60.54%
3	0.11855 (0.2182)	-0.10912 (0.0251)**	60.17%

Note: This table shows the various polynomial functional forms estimated by using the GMM technique. Values in the parenthesis indicates the significant values (10%,5%** ,1%***).*

Appendix 5: Data Set

Year	Debt/ GDP	Invest/ GDP	Savings/ GDP	TO/ GDP	Deficit/ GDP
1963	48%	15.70%	13.00%	48.44%	-4.89%
1964	50%	14.30%	11.30%	47.81%	-5.52%
1965	55%	12.50%	12.50%	47.37%	-5.02%
1966	63%	14.30%	10.10%	44.27%	-6.30%
1967	66%	15.20%	11.10%	40.22%	-6.51%
1968	63%	15.90%	12.30%	40.40%	-6.40%
1969	63%	19.30%	12.10%	39.01%	-6.58%
1970	64%	18.90%	15.00%	31.81%	-6.39%
1971	70%	17.10%	14.70%	29.56%	-7.29%
1972	71%	17.30%	14.80%	26.57%	-6.30%
1973	67%	13.70%	11.50%	27.10%	-5.13%
1974	52%	15.70%	7.50%	33.91%	-3.29%
1975	55%	15.60%	7.40%	35.10%	-6.39%
1976	59%	16.20%	13.10%	33.47%	-8.43%
1977	69%	14.40%	17.70%	36.38%	-4.47%
1978	73%	20.00%	15.50%	68.44%	-12.51%
1979	68%	25.80%	14.80%	72.25%	-11.14%
1980	77%	33.80%	14.00%	77.42%	-19.16%
1981	76%	27.80%	14.30%	66.63%	-12.37%
1982	81%	30.80%	15.40%	63.07%	-14.03%
1983	81%	28.90%	16.40%	57.77%	-10.56%
1984	69%	25.80%	22.20%	56.10%	-6.82%
1985	80%	23.80%	14.20%	56.20%	-9.66%
1986	87%	23.70%	14.50%	49.69%	-10.14%
1987	97%	23.30%	15.30%	51.96%	-8.68%
1988	101%	22.80%	14.20%	53.27%	-12.70%
1989	109%	21.70%	14.60%	54.01%	-8.65%
1990	97%	22.20%	16.80%	58.14%	-7.82%
1991	99%	22.90%	15.20%	56.40%	9.75%

1992	95%	24.30%	17.90%	61.49%	6.06%
1993	97%	25.60%	20.20%	66.40%	7.07%
1994	95%	27.00%	19.10%	68.07%	9.06%
1995	95%	25.70%	19.50%	69.98%	-8.72%
1996	93%	24.20%	19.00%	68.60%	8.42%
1997	86%	24.40%	21.50%	69.59%	7.05%
1998	91%	25.10%	23.40%	67.81%	8.44%
1999	95%	27.30%	23.50%	67.40%	6.92%
2000	97%	28.00%	21.50%	77.38%	-9.49%
2001	103%	22.00%	20.30%	68.52%	10.43%
2002	106%	21.20%	19.50%	65.34%	8.47%
2003	102%	22.00%	21.50%	62.52%	7.31%
2004	102%	25.30%	22.00%	66.58%	7.50%
2005	91%	26.80%	23.80%	62.32%	7.03%
2006	88%	28.00%	22.30%	60.62%	7.00%
2007	85%	28.00%	23.30%	58.53%	6.88%
2008	81%	27.60%	17.80%	54.53%	7.02%
2009	86%	24.40%	23.70%	41.10%	9.85%
2010	82%	27.60%	25.40%	44.54%	-7.96%
2011	79%	29.90%	22.10%	52.10%	-6.88%

(Central Bank of Sri Lanka, 2014)

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