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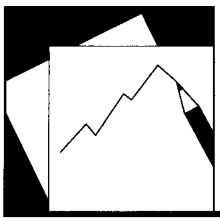

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Threshold Effects of Sovereign Debt: Evidence from the Caribbean

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Abstract

This paper addresses the issue of threshold effects between public debt and economic growth in the Caribbean. The main finding is that there exists a threshold debt to gross domestic product (GDP) ratio of 55–56 percent. Moreover, the debt dynamics begin changing well before this threshold is reached. Specifically, at debt levels lower than 30 percent of GDP, increases in the debt-to-GDP ratio are associated with faster economic growth. However, as debt rises beyond 30 percent, the effects on economic growth diminishes rapidly and at debt levels reaching 55–56 percent of GDP, the growth impacts switch from positive to negative. Thus, beyond this threshold, debt becomes a drag on growth.

JEL Classification Numbers:F34, C23, C24

Keywords: Debt Problems, Debt Threshold, Panel Data, Threshold Regressions

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I. INTRODUCTION

During economic crises, developing countries tend to accumulate debt as the growth in expenditure levels exceeds that of revenues while capital inflows decline. The mid-2007 global economic crisis had an immense impact on economies throughout the world. With mounting debt service payments due to the inability to raise sufficient capital, the global financial crisis has resulted in serious debt management problems. The current Euro-crisis provides great evidence of the effect high debt levels can have on an economy. In the Caribbean, economic recovery has been sluggish because of strong linkages with the United States and Europe. High levels of public debt are also an issue facing the region, which have implications for fiscal sustainability and economic growth. The Caribbean, which has some of the world's most indebted nations (as a share of GDP) accumulated debt from continuous periods of fiscal deficits since the mid-1990s.

Allowing debt to grow too large can offset the positive impacts[1] and lead to problems in the macro-economy, in particular depressing real GDP growth. With a debt-overhang, investors lower their expectations of returns in anticipation of higher taxes needed to repay the debt and may also refrain from investing given the uncertainties about what portion of the debt will actually be serviced with the countries' own resources. Therefore, new domestic and foreign investment is discouraged, which slows down capital-stock accumulation. Output may also be constrained through lower growth in total factor productivity. Governments may be less willing to undertake difficult and costly policy reforms as this may incur future debt and subsequently hinder technological improvement or the efficient use of resources given the lack of available finances. In periods of high debt, policymakers tend to rely on robust economic growth to ensure debt sustainability. However, when GDP falls, it becomes difficult for governments to raise sufficient revenues to repay debt service obligations.

Over the years, researchers showed great interest in the relationship between debt and growth by using predominantly causality approaches (Scott, 1995; Amoateng and Amoako-Adu, 1996; Karagol, 2002). More recently, studies have sought to investigate the threshold level for the debt-to-GDP ratio, which identifies the initial point of debt that causes output to fall. Reinhart and Rogoff (2010), whose work has captivated much attention, alluded to debt ratios beyond 90 percent as detrimental to economic improvement while Caner et al. (2010) proposed a much lower 77 percent. These studies focused on a combination of developed and developing countries from various regions but failed to concentrate on a particular geographical area.

In this article, countries from only the Caribbean community (CARICOM) are investigated since empirical findings tend to vary among nations with structural and economic differences. Therefore, the results from this paper should provide a more centered analysis of the community. Unlike previous research, the study also gives a complete view of public debt over various ratios to GDP and its impact on economic growth. In light of the recent global financial crisis, the paper is very timely as CARICOM governments have made public debt one of its top priorities as they aim to reduce the debt levels and improve productivity. Therefore, policy-makers such as central bankers, regulators and supervisors can better understand the role of debt in the economy and identify when debt begins to get too excessive.

[1] Positive growth can be achieved when countries with low stocks of capital use the borrowed funds for productive investment.

In this paper, along with the threshold estimation technique outlined by Hansen (1996, 2000), a new approach is utilised and adopted to a growth model specifically designed for the Caribbean community. The new method is a regression approach that allows one to see the impact of public debt on economic growth as the debt to GDP ratios vary over a pre specified range. This approach gives a relatively complete view of public debt ratios dynamics on economic growth and the other determinants of economic growth. The findings suggested a debt threshold of about 56 percent of GDP and showed that debt under 30 percent of GDP is beneficial for the economies.

This paper is organized as follows. The next section presents an overview of the historical behavior of public debt in the Caribbean. Section 3 examines the theoretical and empirical literature, with a focus on economic growth theory. Section 4 outlines the methodological approach and the data employed in the study, while section 5 discusses the estimated results. Section 6 summarizes the main findings of the paper as well as provides the key policy implications of the threshold analysis for decision-makers.

II. THE HISTORICAL BEHAVIOR OF PUBLIC DEBT

Increasing trends exist in the nominal debts of all the 12 selected CARICOM countries during the review period of 1990 to 2010. Most of these economies witnessed sustained expansions in debt over the entire two decades with exceptions being Suriname, whose debt level plateau after 1994 and Guyana where significant fluctuations are noticeable (see Table 1 and Figure 1).

Nominal debt levels ranged from U.S$130 million to US$15,055 million recorded for Dominica and Jamaica, respectively. The average debt levels of the Eastern Caribbean Currency Union (ECCU)[2] states and Suriname are remarkably less than those of the other nations. The combined averages of the aforementioned countries equate to about 28 percent of the average debt of Jamaica.

Specifically for Grenada, St. Lucia, Jamaica and Trinidad and Tobago, during the early and mid 2000s the increases in debt slowed. However, decreases were noticed in the cases of Antigua and Barbuda and Dominica. Markedly, it is very clear that during the recessionary years of 2008–2010 nominal debt in these CARICOM territories continued on an upward trajectory with the only exception being Antigua and Barbuda that have engaged in debt restructuring. The volatility, measured by the standard deviation, of nominal debt levels of the fixed exchange rate countries to the U.S. dollar (Barbados, Bahamas, and the ECCU states) range from US$42 to US$534 while that of the managed floating exchange rate countries are much greater (Jamaica US$2900 and Trinidad US$2400).

Similarly, rising trends also exist for the real debt levels of these nations excluding Jamaica (Table 2 and Figure 2). The Jamaican data suggested that their price level increased much faster than their debt. The average levels of debt to nominal gross domestic product for the countries

[2] The ECCU states include: Antigua and Barbuda, Grenada, Dominica, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines.

Table 1. Summary Statistics for Nominal Public Debt

	ANTIGUA	BAHAMAS	BARBADOS	DOMINICA	GRENADA	GUYANA	JAMAICA	ST KITTS	ST LUCIA	ST VINCENT	SURINAME	TRINIDAD
Mean	679.3	1311.2	1489.7	145.8	235.0	1500.9	7663.0	349.9	252.6	192.3	1174.4	4371.1
Median	726.6	1152.6	1254.5	123.0	137.8	1467.9	5528.6	258.3	172.6	135.8	569.8	3055.2
Maximum	1224.9	3520.3	4134.2	272.0	674.3	2120.0	15055.4	817.4	608.4	377.7	9390.9	11057.0
Minimum	355.6	243.1	246.6	10.7	23.8	835.0	3178.9	85.9	24.8	49.5	145.3	1187.0
Std. Dev.	248.3	863.8	998.2	88.1	207.2	338.4	3866.3	259.4	208.2	113.6	1937.4	2773.6
Skewness	0.2	0.8	1.0	0.2	1.0	0.0	0.8	0.5	0.6	0.3	3.5	1.0
Kurtosis	2.1	2.9	3.3	1.6	2.5	2.3	1.9	1.8	1.8	1.6	14.8	2.9
Jarque-Bera	1.0	3.5	5.3	2.9	5.9	0.6	4.4	2.4	3.4	2.5	187.4	5.1
Probability	0.6	0.2	0.1	0.2	0.1	0.7	0.1	0.3	0.2	0.3	0.0	0.1
Observations	22	31	31	31	31	31	31	21	30	25	24	31

Figure 1. Nominal Public Debt levels of selected CARICOM States

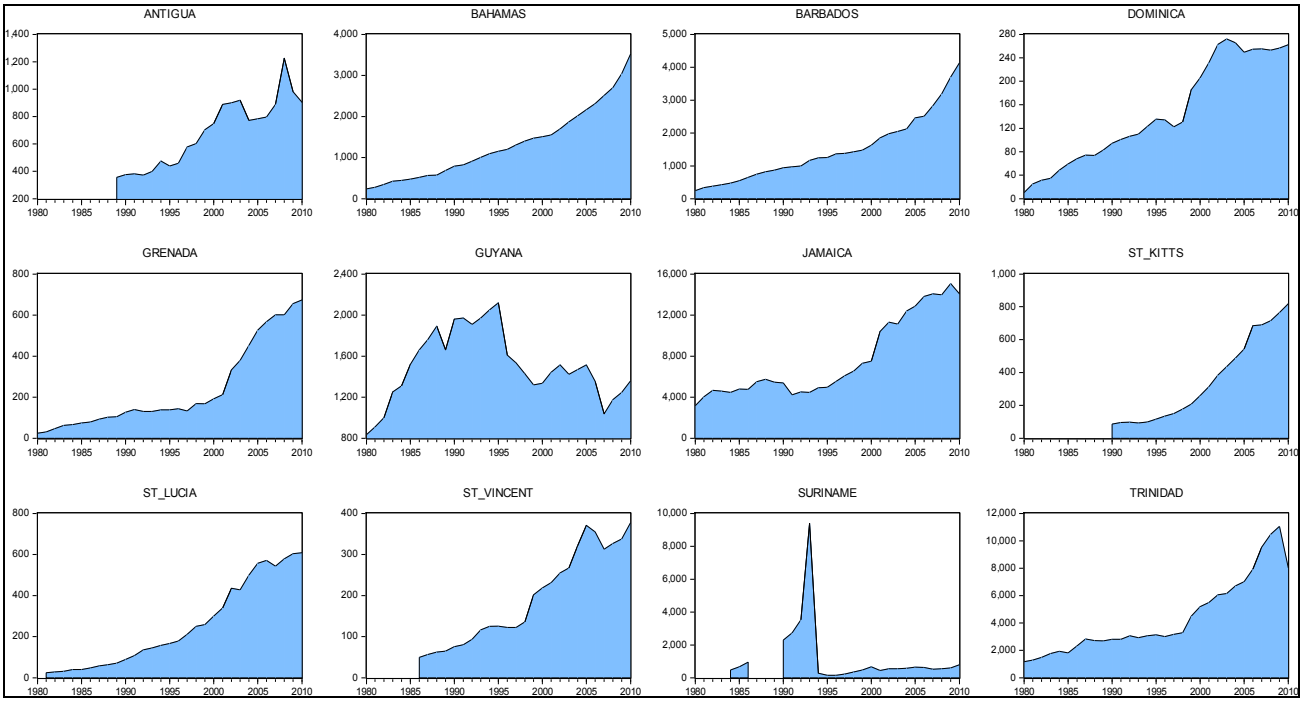
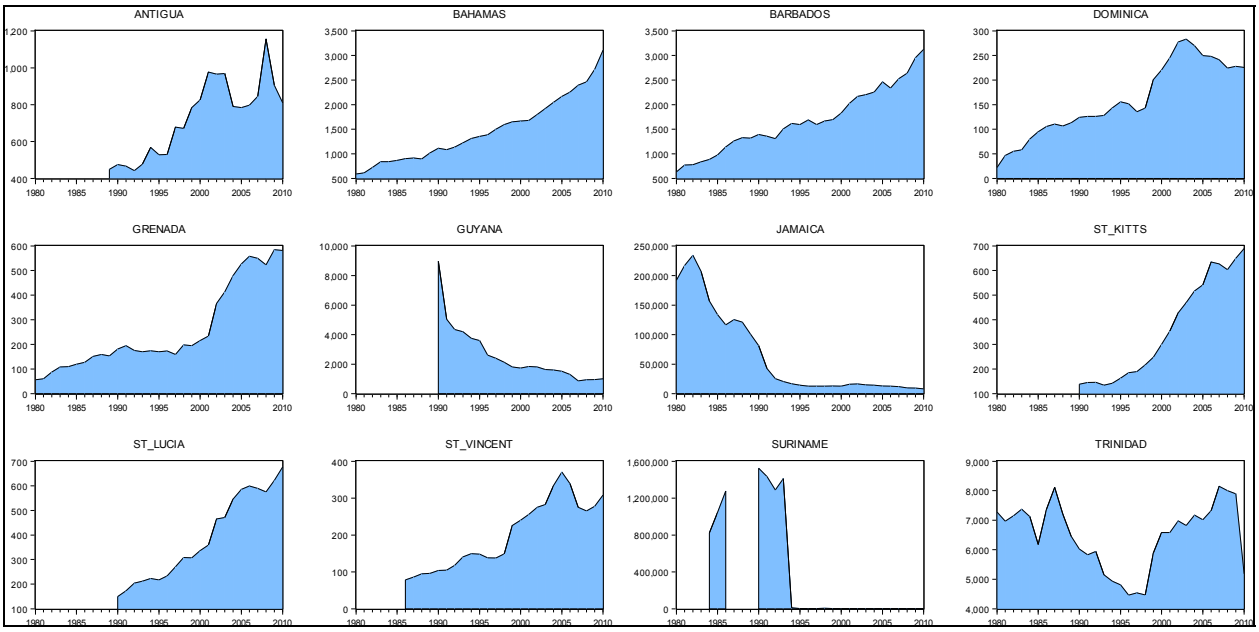


Table 1. Summary Statistics for Real Public Debt

	ANTIGUA	BAHAMAS	BARBADOS	DOMINICA	GRENADA	GUYANA	JAMAICA	ST KITTS	ST LUCIA	ST VINCENT	SURINAME	TRINIDAD
Mean	721.9	1475.6	1673.0	159.3	256.5	2567.1	64290.0	358.2	386.6	199.6	367832.3	6483.1
Median	783.2	1349.8	1595.2	142.9	175.1	1815.9	16305.7	299.7	336.3	149.3	1482.9	6815.6
Maximum	1155.6	3103.8	3123.2	283.2	584.5	8956.6	234115.6	689.3	676.9	370.6	1525501.0	8152.3
Minimum	441.2	586.5	633.6	22.3	56.5	873.9	7864.3	134.2	148.7	77.8	406.9	4459.2
Std. Dev.	207.2	654.5	659.9	75.1	173.3	1909.3	73523.0	205.9	175.2	92.7	596442.8	1116.3
Skewness	0.2	0.7	0.4	0.1	0.9	1.9	1.1	0.3	0.2	0.3	1.0	-0.4
Kurtosis	2.0	2.7	2.4	1.9	2.2	6.9	2.7	1.5	1.5	1.6	2.2	2.1
Jarque-Bera	1.0	2.6	1.4	1.7	4.9	26.8	6.1	2.4	2.1	2.2	5.0	2.0
Probability	0.6	0.3	0.5	0.4	0.1	0.0	0.0	0.3	0.3	0.3	0.1	0.4
Observations	22	31	31	31	31	21	31	21	21	25	24	31

Figure 2. Real Public Debt for selected CARICOM States

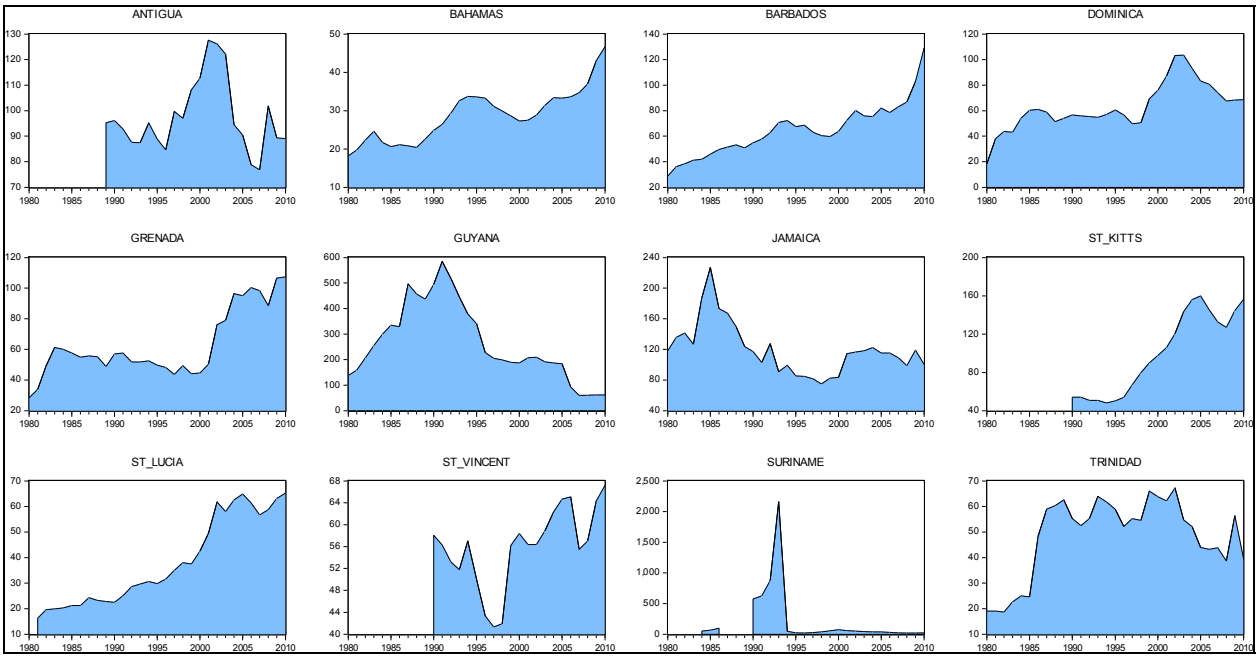


under analysis present themselves in two distinct bands (Table 3 and Figure 3). The debt bands average around 48 percent and 98 percent of nominal gross domestic product. St. Kitts and Nevis has the largest debt ratio of 140 percent in 2006, 2007 and 2009 while Suriname holds the minimum of 18 percent in 2008. The data trends downward throughout the latter 1900s and early 2000s, followed by a general upward movement toward the end of the sample period. Interestingly, all the countries except Suriname showcase a shock to this ratio during the recessionary period of 2008 to 2010 irrespective of the trends observed previously. Notably, there is not a high level of volatility for this ratio over this period.

Table 3. Summary Statistics for Public Debt to Gross Domestic Product Ratios of Selected CARICOM States

	ANTIGUA	BAHAMAS	BARBADOS	DOMINICA	GRENADA	GUYANA	JAMAICA	ST KITTS	ST LUCIA	ST VINCENT	SURINAME	TRINIDAD
Mean	97.4	28.8	64.7	63.0	63.0	264.6	119.7	99.4	38.0	56.0	210.5	48.4
Median	94.9	28.8	63.0	58.7	55.2	207.3	116.6	97.6	31.1	56.4	44.5	54.6
Maximum	127.5	46.7	129.1	103.5	107.4	585.1	227.2	159.9	65.3	67.2	2157.8	67.3
Minimum	76.9	18.2	28.7	18.2	28.4	59.6	75.0	47.9	16.3	41.3	16.9	18.6
Std. Dev.	14.0	6.9	20.6	18.5	22.1	149.8	33.7	42.4	17.2	7.3	471.7	15.3
Skewness	0.9	0.5	0.9	0.3	0.8	0.5	1.3	0.1	0.5	-0.6	3.3	-0.8
Kurtosis	3.0	3.0	4.5	3.4	2.4	2.2	4.9	1.4	1.6	2.8	13.4	2.4
Jarque-Bera	2.9	1.5	6.9	0.8	3.7	2.1	13.2	2.3	3.5	1.3	150.9	4.1
Probability	0.2	0.5	0.0	0.7	0.2	0.4	0.0	0.3	0.2	0.5	0.0	0.1
Observations	22	31	31	31	31	31	31	21	30	21	24	31

Figure 3. Public Debt to GDP Ratios of Selected CARICOM States

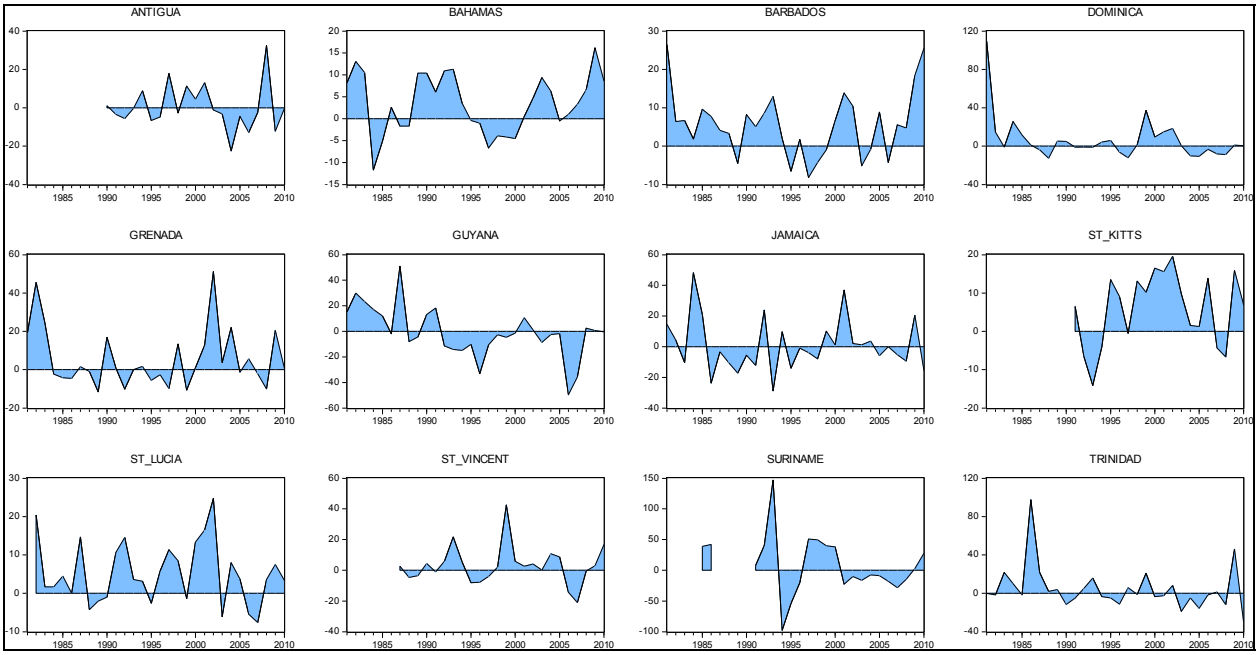


The average growth in the debt to gross domestic product ratio of the CARICOM states studied was 6.3 percent (Table 4 and Figure 4). The fastest increase was observed in St. Kitts (12 percent) while the lowest was Guyana (-2 percent). The growth rate of this ratio appears to be highly volatile and fluctuated between a minimum of -39 percent and 54 percent in Suriname and Grenada, respectively. In general, the debt variables and ratios exhibit no serious non-normality problems, which allows for the interpretation of the standard errors using the central limit theorem.

Table 4. Summary Statistics for the Growth in the Public Debt to GDP Ratio

	ANTIGUA	BAHAMAS	BARBADOS	DOMINICA	GRENADA	GUYANA	JAMAICA	ST KITTS	ST LUCIA	ST VINCENT	SURINAME	TRINIDAD
Mean	0.3	3.4	5.5	6.2	5.5	-0.7	0.7	5.9	5.2	3.0	8.5	4.4
Median	-2.5	3.4	5.3	0.8	0.8	-1.8	-2.2	8.0	3.6	2.7	-2.4	-1.4
Maximum	32.5	16.2	26.4	109.4	51.2	50.9	48.1	19.6	24.7	42.5	147.2	97.5
Minimum	-22.5	-11.7	-8.2	-12.6	-11.5	-49.5	-28.8	-14.1	-7.6	-21.0	-97.9	-30.1
Std. Dev.	11.7	6.8	8.5	22.5	15.5	19.6	16.9	9.5	8.1	12.4	48.4	22.7
Skewness	0.8	-0.2	0.7	3.4	1.4	0.0	0.9	-0.4	0.5	1.1	0.6	2.5
Kurtosis	4.3	2.3	3.4	16.0	4.7	4.2	3.8	2.1	2.7	5.9	4.8	10.8
Jarque-Bera	3.8	0.8	2.6	270.8	14.0	1.7	5.0	1.3	1.5	13.8	4.3	106.7
Probability	0.1	0.7	0.3	0.0	0.0	0.4	0.1	0.5	0.5	0.0	0.1	0.0
Observations	21	30	30	30	30	30	30	20	29	24	22	30

Figure 4. Growth of the Public Debt to GDP Ratio



III. LITERATURE REVIEW

The theoretical literature suggests that there is a nonlinear relationship between debt and growth through various channels such as private savings, public investment, total factor productivity, interest rates, inflation, and capital accumulation. One of the most important factors is investment. It is generally accepted that smaller and/or less developed economies are likely to be resource-constrained, and if borrowed capital is used for productive investment, higher growth rates can be attained (Burnside and Dollar, 2000). However, several theories attest to the growth-reducing effect debt can have above a certain threshold (Cordella et al., 2005; Caner et al., 2010). The economy can suffer from debt overhang: after a certain point the debt level serves as a disincentive for investors, who believe their profits will be heavily taxed so that the government is able to service its relatively large and growing stock of debt. This has negative implications for economic growth. There is also the liquidity/budget constraint hypothesis, which proposes that debt service limits the amount of funds at government's disposal that can be used for investment purposes that could increase economic activity. In addition, some of the literature suggests that rising debt levels simply increase investors' uncertainty about government policies and actions and therefore discourages investment (Clements et al., 2003).

In terms of the empirical literature, it appears that for the estimation of a prudential debt limit with regards to growth, the more common approaches include the use of histograms, spline functions and threshold estimations. Reinhart and Rogoff (2010), utilizing histograms formed from two centuries of data for 44 countries, discovered a weak link between growth and debt up until a 'tipping point' of 90 percent of central government debt to GDP, beyond which debt restricts growth. A lower threshold of 60 percent was found for external debt (government plus private) to GDP of emerging market economies. Using the perhaps more rigorous threshold estimation techniques developed by Hansen (1996, 2000), Caner et al. (2010) estimated a much lower threshold– an average of 77 percent for public debt to GDP for both developed and developing countries, and an even lower threshold (64 percent) when the estimations are conducted for emerging markets alone. Cordella et al. (2005), employing spline functions and the threshold estimation techniques of Hansen (1996, 2000), also identified debt tipping points of between 15–30 percent for countries with good policies and institutions (non-Heavily Indebted Poor Countries (HIPCs), and 0-20 percent for economies without HIPCs).

Some studies estimate a threshold for external debt alone. For example, Pattillo et al. (2002) applying spline functions found that the average impact of external debt on per capita growth becomes negative above 35–40 percent of GDP, and that the marginal effect is negative at about half these levels. Similarly, Clements et al. (2003) located a threshold at approximately 50 percent of nominal external debt to GDP, and 20–25 percent for the net present value of external debt to GDP.

Much of the work on the debt-growth link has been for developed and developing countries. There has been comparatively less focus on the Caribbean region where there are 5 of the world's 13 most indebted nations. Most of the older Caribbean studies (for example, Blackman, 1988 and Boamah, 1989) tended to be more descriptive when assessing the debt-growth link in the Caribbean. One of the more dated research which performed some empirical testing is that by Holder and Prescod (1991), who followed the neoclassical approach and linearly specify income growth as dependent on the savings rate, export growth (a proxy for technological change), debt growth, and wages corrected for productivity. They found that debt had a negative effect on income growth in Barbados.

Also assuming a linear relationship is Caldentey (2007) who examined the consequences of debt for growth in CARICOM, using a scatter plot and regression analysis. A negative relationship is said to exist between these two variables, possibly through increasing uncertainty, crowding out of investment and the effects of debt overhang on rates of return. The author also suggested that with the accumulation of debt, the focus of economic policy and institutions shifts from the development of the real sector to debt management. In another recent study by Schclarek and Ramon-Ballester (2005), there is both a linear and nonlinear estimation of the relationship between external debt and economic growth in Latin America and the Caribbean, using a dynamic system GMM panel estimator. They also find an inverse relationship, but no evidence of nonlinearity. Branch and Adderley (2007) came to the same conclusion in their study of national debt and economic growth of The Bahamas, which also postulated a linear specification. Most of the research for the Caribbean which assumed a linear specification has therefore found that debt is negatively related to economic growth.

One of the studies that found non-linearity was that by Boamah and Moore (2009) who used a standard neo-classical growth model to examine the relationship between external debt and growth in the Caribbean. They added to the external debt to GDP variable, an interaction term between debt and policy, where the debt variable enters the term in quadratic form. The study utilised the two-stage least squares estimator, augmented with country specific and time dummies to correct for endogeneity of the debt variable. It is found that external debt is positively related to economic growth in a good policy environment (low inflation, manageable fiscal positions and open trade policies). However, above a threshold of 63 percent debt is growth-reducing, regardless of the type of the policy environment.

A strand of research, closely related to the issue of threshold effects and economic growth, is that of debt sustainability and identifying a maximum sustainable debt ratio. In fact it can be argued that the existence of a debt threshold as it pertains to growth would imply that this is the point beyond which debt become unsustainable. IMF (2003) addressed this issue using a number of interesting approaches. First they estimated fiscal policy reaction functions, where a positive response of the primary balance to debt indicates that the policy stance will allow for long-run solvency. They found that for emerging economies the response of the primary balance stops when debt surpasses 50 percent of GDP, compared to a threshold of 80 percent for industrial countries. The paper also employed a methodology that seeks to determine whether a government is “over borrowing”, that is, if the existing debt stock is more than the present discounted value of future primary balances. Assuming that the past is the best indicator of future policy action, the average of historical primary balances was used as an estimate of expected primary balances, so that a benchmark debt-to-GDP ratio could be calculated. This benchmark level was found to be 25 percent for emerging markets and 75 percent for industrial economies. Finally, the paper considers uncertainties governments may face, in particular with respect to revenues earned; variability in revenues – especially when revenues are low for a long period – can impact debt sustainability. IMF (2003) conducted simulations for ‘typical” emerging market and industrial countries and found that countries with a lower and more volatile revenue base, less ability to adjust expenditures, as well as greater disparity between the real interest and growth rates, are able to sustain lower debt levels. As with the other approaches used, it was found that emerging economies are able to sustain a lower ratio than more advanced countries.

Apart from considering the point at which debt starts to negatively affect economic growth, and the formal debt sustainability methods, there are other various approaches to identifying a debt threshold, as noted by Bannister and Barrot (2011). There are those that consider the impact on the external balances, while some examine the efficacy of fiscal policy at various debt levels. In addition there is the debt intolerance approach by Reinhart, Rogoff and Savastano (2003) and Reinhart and Rogoff (2009), where the Institutional Investor Rating (the measure of intolerance) is regressed on the debt ratio, default history and inflation. Bannister and Barrot (2011) revised this procedure by addressing some of the methodological issues. In particular, they employed a dynamic panel approach, accounted for endogeneity in the regressors, and based the calculation of debt thresholds on credit ratings of major rating agencies, which are more objective criteria. They are then able to rank Central America, Panama, and Dominican Republic countries by level of debt intolerance.

IV. Methodology and Data

The following threshold least square regression model is adopted:

$$y_{it} = \alpha_t(D_{it} \leq D^*) + \alpha_t(D_{it} > D^*) + \beta_{1t}X_{it}(D_{it} \leq D^*) + \beta_{2t}X_{it}(D_{it} > D^*) + \beta_{3t}D_{it}(D_{it} \leq D^*) + \beta_{4t}D_{it}(D_{it} > D^*) + \varepsilon_{it} \quad (1)$$

where y_{it} is real GDP growth, X_{it} is a matrix of controls as discussed in the previous section, D_{it} is public debt as a percent of GDP, and D^* is the debt-to-GDP threshold, thus $(D_{it} \leq D^*)$ is an indicator function. On the choice of control variables, it is noted that quite a wide range of variables have been used in growth empirics; however a number of these, such as ethno-linguistic fractionalization (from Sala-i-Martin, 1997a, 1997b; Easterly and Levine, 1997) and assassinations (Burnside and Dollar, 2000), are not applicable to the Caribbean. The choice of variables used here is arrived at by a survey of the literature as it relates to developing countries, in particular work done on the Caribbean[3] region. There are fiscal policy, openness to international trade, inflation, government expenditure, investment and the population growth rate. To account for omitted variable bias and reverse causality the initial level of GDP per capita is included in the set of control variables.[4] In addition, the model is estimated with fixed effects using cross-section weights to take care of country heterogeneity. The time-fixed effects are not incorporated due to the low level of degrees of freedom. The White cross-section method is employed to account for cross-equation correlation.

Given the small size of the panel employed here, where there are only 12 countries with annual data of 20 years, and the need to derive the threshold levels in a non arbitrary way, the study commence at 22 percent and increase it by 1 percent up to 110 percent. This range covers

[3] Specifically, works by Williams and Daniel (1991), the World Bank**Error! Bookmark not defined.** (1994), Boamah (1997), Lewis and Craigwell (1998), Peters (2001), and Downes (2003). Note that a wider review of the literature on these variables is contained in Greenidge (2006).

[4] This is a common approach in the literature; see for example Caner et al. (2010).

approximately 85 percent of the distribution. Next the estimated relationships are graphed and conclusion derived. This approach gives a relatively complete view of the debt ratios dynamics on growth and the other determinants of growth and is quite informative. However, it does not allow for an accurate assessment of the statistical significance of the thresholds by providing confidence intervals.

To overcome such a problem, Hansen (1996, 2000) threshold framework is estimated as follows:

$$y_{it} = \gamma_1\left(1 - I_{it}^{D^*}\right)(D_{it} - D^*) + \gamma_2 I_{it}^{D^*}(D_{it} - D^*) + \theta' X_{it} + e_{it}$$

$$I_{it}^{D^*} = \begin{cases} 1 \; if \; D_{it} \geq D^* \\ 0 \; if \; D_{it} < D^* \end{cases} \quad i = 1, \ldots, N \quad t = 1, \ldots, T \qquad (2)$$

where D^* is the threshold level of debt as a percent of GDP and I is a dummy variable that takes the value of one for debt level greater than D^* and zero otherwise. Depending on the actual level of debt one of the first two terms in the model specification will drop out of the regression thus allowing for thresholds effects. When the debt is below the threshold, γ_1 is estimated. When it is above the threshold, γ_2 is estimated. Since D^* is unknown, the model is again estimated with a threshold search over the range 22 to 112 percent in increments of 0.1 percent. Thus, debt threshold among the following values of D^*: {22%, 22.1%, 22.2% … 112%} is searched for; a total of 900 regressions. The optimal level of threshold is chosen based on the standard errors of each individual parameter.

However, as noted by Hansen (2000), under the hull hypothesis of no threshold $(\gamma_1 = \gamma_2)$ classical tests have non-standard distributions and therefore are not appropriate for econometric inferences. Hansen (1996, 2000) recommended a bootstrap technique to simulate the empirical distribution of the following likelihood ratio test statistic:

$$LR_0 = \frac{S_0 - S_1(D^*)}{\sigma^2}$$

where S_0 and $S_1(D^*)$ are the sums of squared residuals (SSR) under H_0: $D^* = 0$, and H_1: $D^* \neq 0$ respectively; and σ^2 is the residual variance under H_1. Thus, S_0 is SSR without a threshold effect and $S_1(D^*)$ is SSR with a threshold effect of Equation (2).

The study used annual data ranging from 1980 to 2010 for 12 CARICOM countries: Antigua and Barbuda, The Bahamas, Barbados, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago. The variables public debt, gross domestic product, exports, imports, investment and government expenditure were converted to millions of U.S. dollars and expressed as a ratio of nominal gross domestic product. The variables employed were obtained from various sources and are statistically summarized in Table 4. Openness proxied by imports and exports is utilised in this study to account for the strong trade linkages between the Caribbean countries, and the U.S. and the U.K.

V. RESULTS

The results from Equation (1), illustrated in Figures 5 to 9, suggest that there are threshold effects in the relationship between public debt and economic growth. The threshold impacts appear at 30 percent and 56 percent of debt to GDP levels (see Table 5 and Figure 5). When debt as a share of

GDP is lower than the threshold value of 30 percent, increases in the debt-to-GDP ratio up to the threshold value are associated with faster economic growth of roughly 0.41 percentage points.[5] Small or less developed economies, such as those in CARICOM, tend to be resource-constrained, and so capital accessed through borrowing can be used to boost investment and allow higher growth rates to be achieved.

As the debt-to-GDP ratio rises above the 30 percent threshold value, the effect on growth is still positive but is now much less and also statistically insignificant. As the debt levels continue to rise, another threshold appears at 56 percent of GDP, where the growth effects switch from positive to negative as debt becomes a drag on growth. This threshold exists for one or more reasons. At this point the economy may begin to suffer from debt overhang; this level of debt discourages investment as investors believe that their profits will be taxed away in order to service the debt, and this hinders economic expansion. Alternatively, or at the same time, higher debt-servicing costs associated with higher debt levels, constrain the amount of funds available for public investment that can boost growth. In addition, the possibility exists that increasing debt levels heighten investors' uncertainty about government policies and therefore acts as a disincentive to investment.

The lower debt threshold value of 30 percent also appears to be important for the impact of investment on economic growth (see Table 6 and Figure 6). At debt levels below 30 percent of GDP, investment has a positive and significant impact on growth. As the debt levels increase about this threshold value, the positive investment effect on growth diminishes and becomes statistically insignificant. A similar pattern exists for trade openness, except that the tipping point is a debt level of 34 percent of GDP (see Figure 7). At debt levels below this threshold, greater openness to trade has a positive impact of growth, while the effects are insignificant once debt levels exceed the threshold.

Table 5. Threshold Debt Regression using the Modified Hansen Model

	Least Square		Two-Stage LS	
Variable	Coefficient	p-value	Coefficient	p-value
γ_1	0.127	0.051	0.123	0.072
γ_2	-0.082	0.015	-0.080	0.000
Initial GDP per capita	-0.159	0.052	-0.176	0.008
Openness	0.004	0.139	0.004	0.139
Inflation	-0.003	0.071	-0.003	0.070
Investment to GDP(%)	0.06	0.017	0.053	0.002
Government Expenditure to GDP (%)	-0.126	0.036	-0.146	0.001
D*	54.7		55.8	
R-squared	0.457		0.448	

[5] This is the average of the debt coefficients between 22 and 29 percent levels of debt to GDP.

Figure 5. Public Debt and Growth

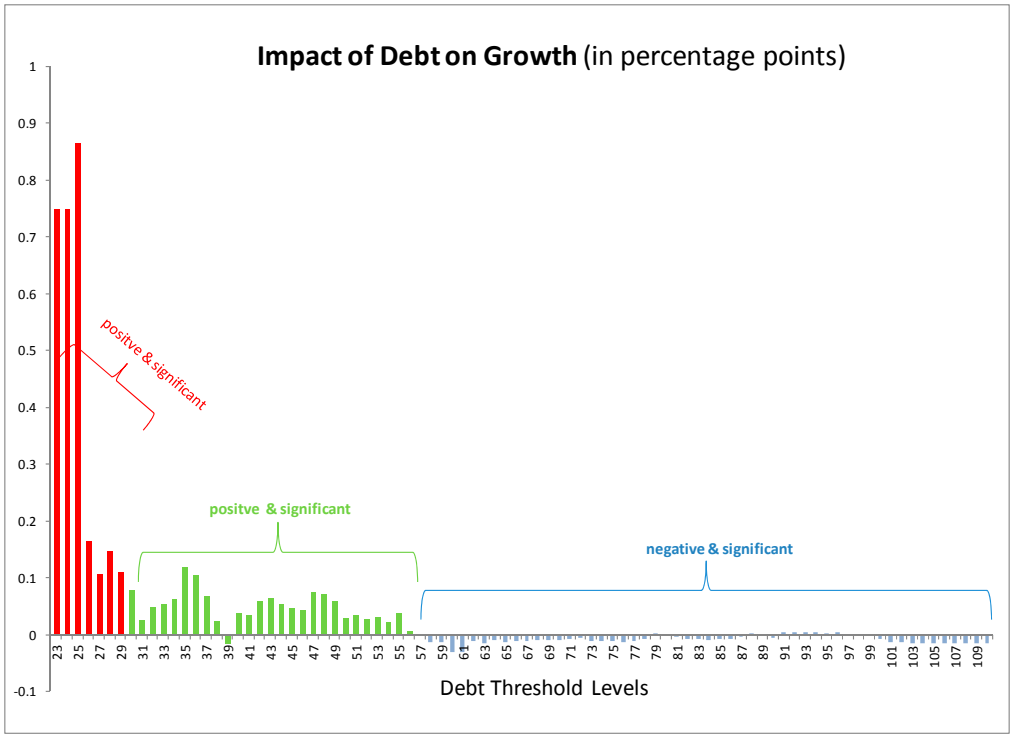


Table 6. Estimated Loss in Real GDP Growth
(In Percentage Points)

	Annual percentage point loss in real GDP growth	Cumulated loss since 1980 in percentage points of real GDP growth
Antigua and Barbuda	3.31	102.59
The Bahamas	n/a	n/a
Barbados	1.65	32.98
Dominica	1.12	23.38
Grenada	1.59	25.37
Guyana	16.76	519.70
Jamaica	5.22	161.97
St. Kitts and Nevis	5.46	76.46
St. Lucia	0.51	4.62
St. Vincent	0.37	5.50
Suriname	53.74	322.43
Trinidad and Tobago	0.42	6.26

Figure 6. Investment and Growth

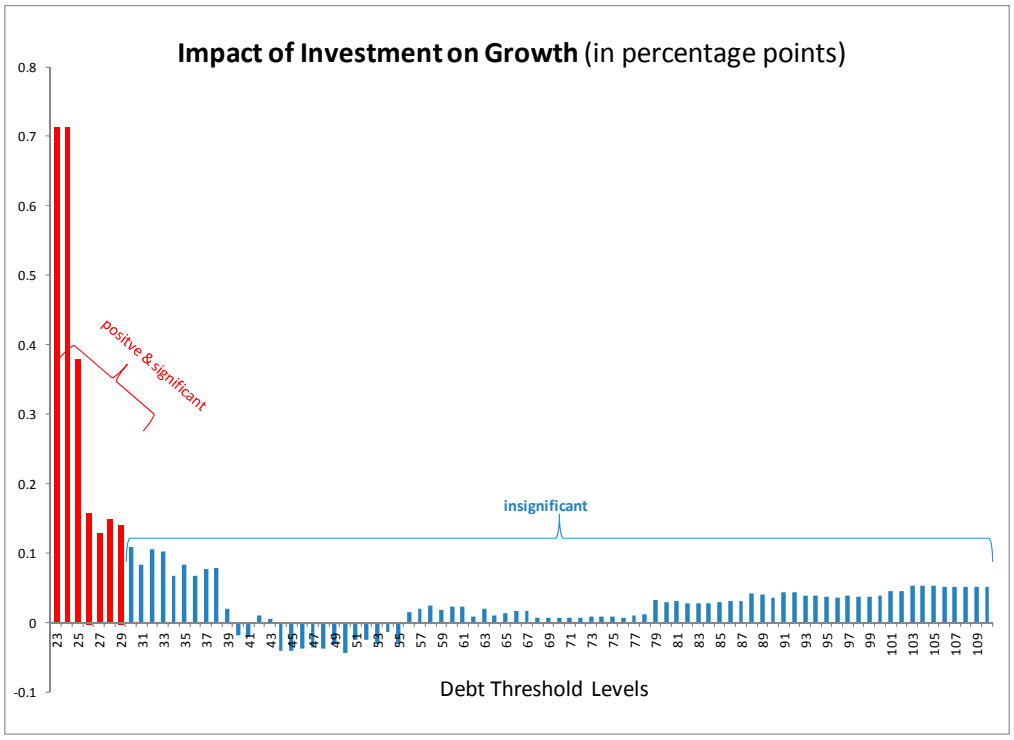
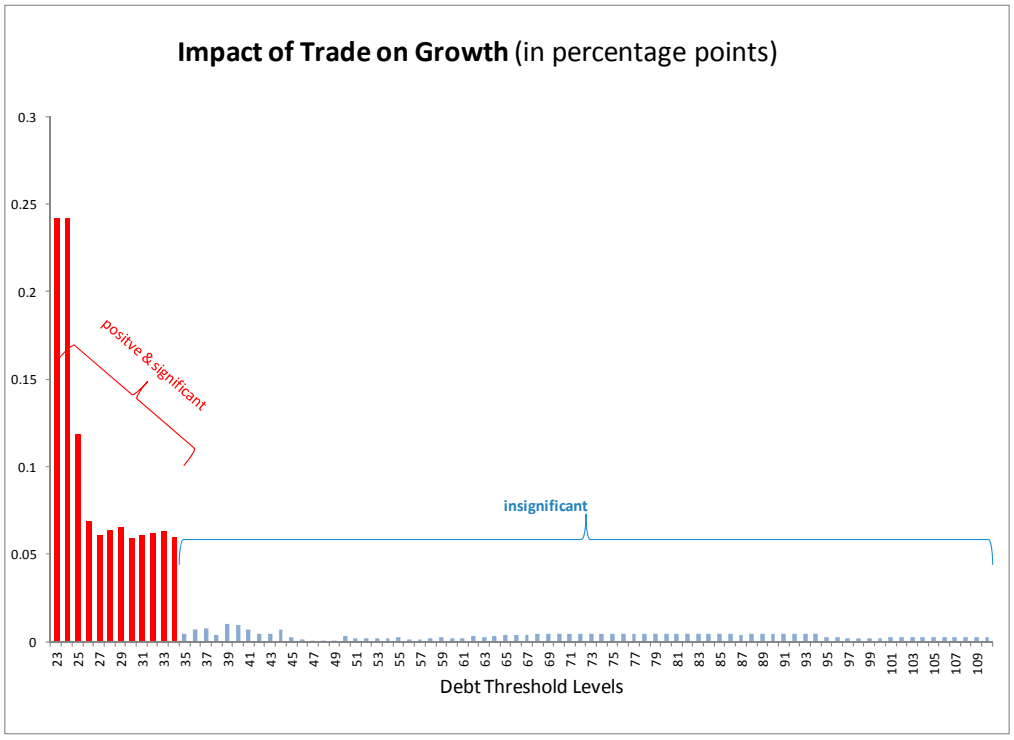


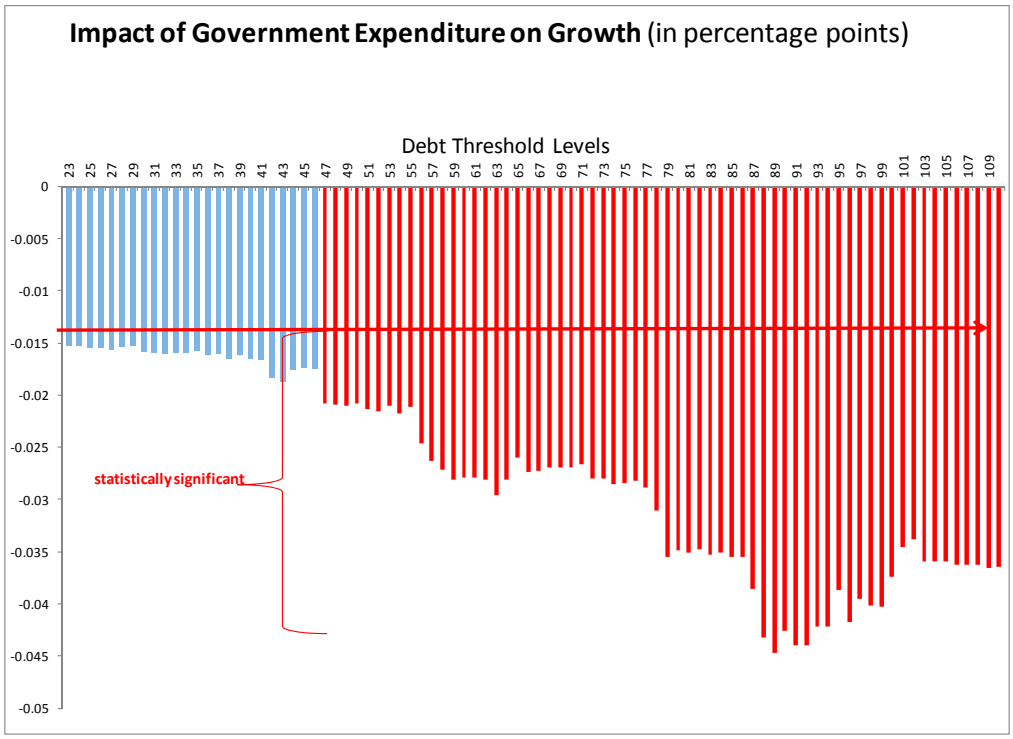
Figure 7. Trade and Growth



Government expenditure has a negative impact on growth, however its effects only becomes significant once debt exceeds 47 percent of GDP (see Figure 8). Beyond this threshold, every 10 percentage points increase in the debt ratio slows growth, via the government spending channel, by an average of 0.4 percentage points. As debt builds up, the associated interest expense increases government expenditure and therefore limits the amount of government resources that can be spent on productive projects. The inflation-growth effect is also dependent on the 47 percent threshold (see Figure 9). At debt levels below this threshold, inflation has a negative impact on growth, while above the threshold the effects are insignificant.

Threshold estimation from Equation (2) yields a threshold value of 54.7 percent. The corresponding sums of squared residuals as a function of the debt threshold are depicted in Figure 10. The bootstrap estimation for the significance of threshold estimates suggests that the threshold estimate is highly significant (p-value 0.002)[6]. The model is re-estimated with the corresponding threshold and the results are shown in Table 5 and are consistent with the above analysis. The coefficient on γ_1 is positive and significant suggesting that debt level lower than 54.7 percent of GDP is associated with positive economic growth. However, the coefficient γ_2 is negative and significant, which implies that once the debt rises above this threshold the relationship between debt and growth becomes negative. Moreover, if debt exceeds this level, each additional percentage point in the ratio of public debt to GDP costs approximately 0.08 percentage points in annual average economic growth.

Figure 8. Government Spending and Growth



[6] The Eviews programs for the threshold estimation and bootstrapping can be obtained from the authors.

Figure 9. Inflation and Growth

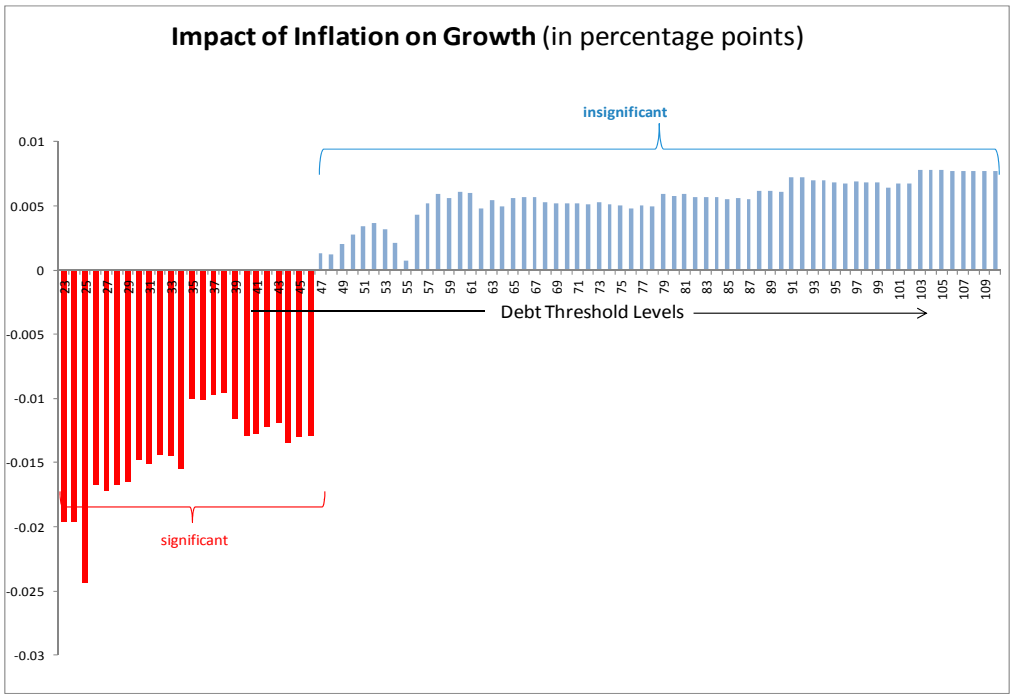
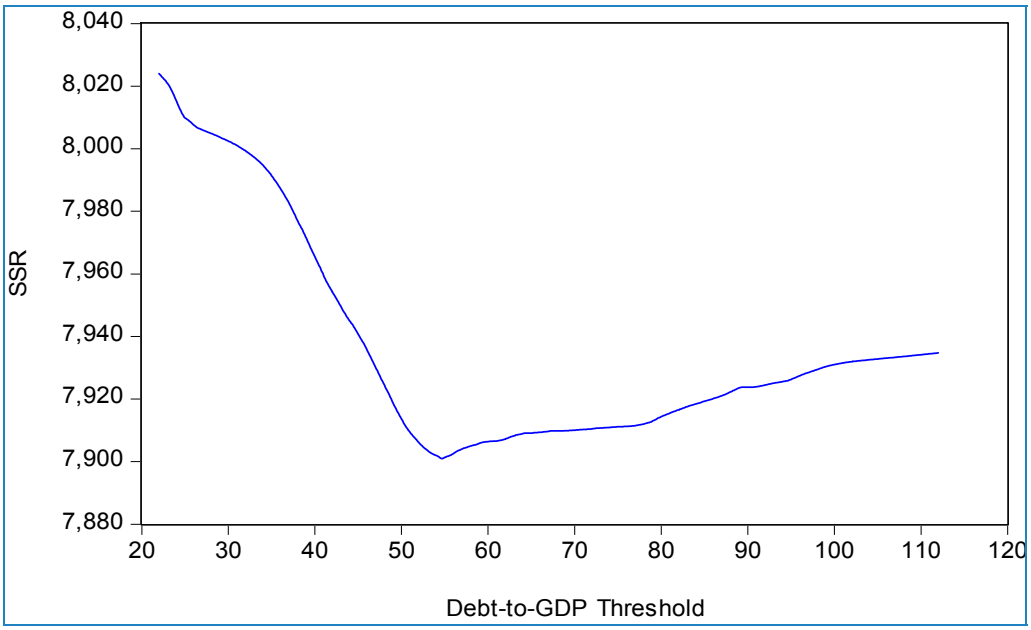


Figure 10. Sum of Squared Residuals as a Function of Debt Threshold

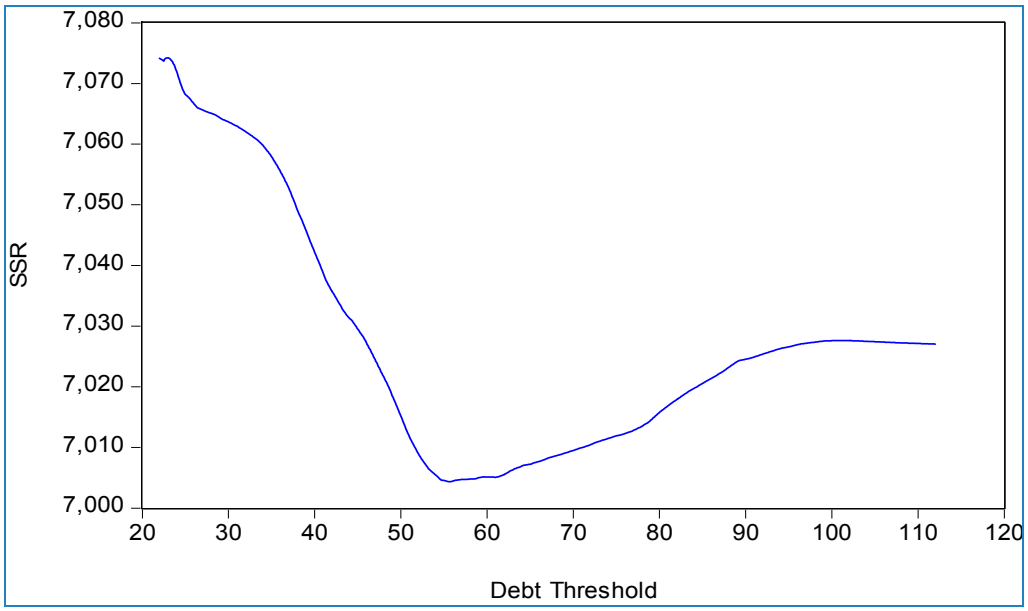


To put the 54.7 percent threshold in to perspective, consider Table 6 which shows the annual average percentage point loss in real GDP growth as a result of exceeding the threshold. It also depicts the cumulative loss over the period 1980 to 2010 for exceeding and staying above the threshold for extended periods. The calculations suggest that it is very costly for countries to exceed the threshold for an extended period of time. For example, Barbados' public debt level rose

above this threshold in 1991 and continued to increase since then to reach roughly 129 percent of GDP in 2010. The evidence suggest that this cost the country approximately 1.65 percentage points in real GDP growth per annum, equivalent to 32.98 percentage points loss over the 1991 to 2010 period.

Finally, as part of the robustness check of the results, we revisited the issue of causality. Although the initial level of GDP per capita is included to control for omitted variable bias and reverse causality, it may be argued that such an approach does not fully correct for endogeneity. Thus, equation 2 is also estimated using two stage least squares and employing the first lags as instruments (see Table 5, column 2; the sum of squares residuals are in Figure 11). The resulting threshold is slightly higher, at 55.8 percent of GDP and the remaining estimates are similar to the least square ones.

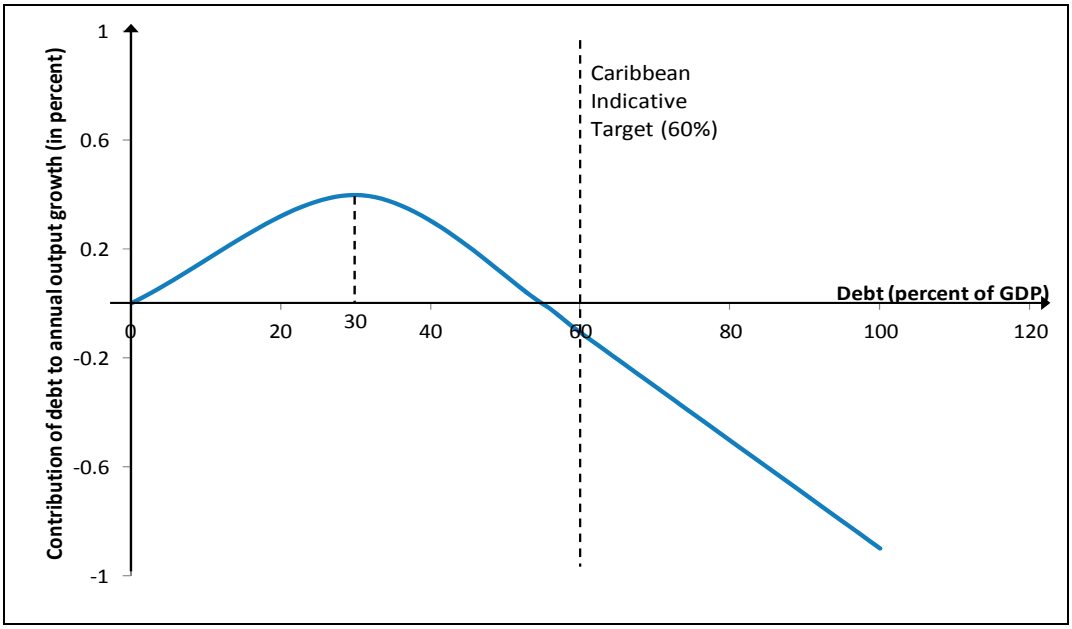
Figure 11: Sum of Squared Residuals with Instruments



VI. CONCLUSION

This paper contributes to the debt literature by identifying the effects different levels of debt-to-GDP ratios have on economic growth rates. The study adopted the threshold estimation approach as described by Hansen (1996, 2000) and a variant thereof. The findings validated the notions that emerging markets face lower thresholds of debt-to-GDP (Reinhart and Rogoff, 2010) and that high levels of debt, especially for low income or developing countries, can have adverse effects on growth levels. The results indicated that debt contributes positively to growth when it is below 30 percent of GDP but becomes a main concern for output beyond 55 percent of GDP. Moreover, between 30 and 55 percent of GDP the marginal impact of debt diminishes, where the contribution to growth from each additional increase in the debt-to-GDP ratio decreases up to the 55 percent threshold, and then turns negative (Figure 12).

Figure 12. Stylized Shape of the Threshold Effects of Public Debt on Growth



The logical conclusion is that countries with debt ratios above 55 percent should aim to achieve debt- to-GDP levels that do not impede growth by adopting polices that put debt on a trajectory towards the 55 percent threshold. Governments should also target debt levels that are well below the estimated thresholds to cater for recessionary periods of the business cycle or events such as natural disasters that affect capital stock. Compared to Reinhart and Rogoff, (2010) and Caner et al. (2010), a much lower threshold was found for the Caribbean region because of its small size and lack of physical resources (excludes Jamaica and Trinidad and Tobago). Most of the countries in the community rely significantly on tourism and have underdeveloped capital markets, which makes the economies much more vulnerable to external shocks.

Since emerging/developing markets have been identified to have a much more binding debt threshold than developed countries, and given that most of the countries under investigations currently have high debt-to-GDP ratios that are above the suggested turning point threshold, it is critical for governments to engage in fiscal consolidation. However, with lingering effects from the current recession, including higher unemployment levels due to a long, slow recovery, consolidation of the fiscal balances would become more difficult. Therefore, in order to achieve faster and sustained growth paths, government, in conjunction with the private sector, need to present more innovative ideas and rehash some of the current policies for the region.

One suggestion would be to focus on improving trade through CARICOM or the Caribbean Single Market and Economy (CSME). The economic union can be used for cost savings through scale economies, for example, integrating the activities of financial supervision and regulation. Additionally, greater progress is needed in the areas of information technology and renewable energy production. Since Caribbean countries are net importers of oil products, with the exception of Trinidad and Tobago, the region is likely to benefit from lower import bills if swift action is taken to provide better incentives for the usage of renewable energy.

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