Threshold Effects of Sovereign Debt: Evidence from the Caribbean

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Outline of Presentation

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• The Historical Behavior of Debt in the Caribbean
• Brief Review of the Literature
• Methodology & Data
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Introduction

Public Sector Debt in Selected Countries, end-2010
(In percent of GDP)

Sources: IMF, WEO; 1/ Average of Emerging Markets and Developing Economies.
Introduction

- Debt of Caribbean countries has been increasing over the last decade, and at a particularly faster rate during this crisis period.

**ECCU: Contribution to Changes in Public Debt**
(In percent of GDP)

Sources: Country authorities' and Fund staff calculations.
Introduction

- Allowing debt to grow too large can offset its positive growth effects.

- Past studies have tried to identify the threshold level (w.r.t growth) for the debt-to-GDP, but do not focus specifically on the region.

- This study identifies a threshold level for the Caribbean using the Hansen (1996, 2000) approach, as well as a new approach that is adopted to a growth model specifically designed for CARICOM.
The Historical Behavior of Debt in the Caribbean
Brief Review of the Literature

• Empirical studies on growth usually use the following regression:

\[ y_{i,t} = \gamma X_{i,t} + \varepsilon_{i,t} + \pi Z_{i,t} + \varphi D_{i,t} + \omega (D_{i,t} \cdot ?_{i,t}) \]

• \( Y \) is real GDP per capita. \( X \) are the determinants suggested by the Solow growth model. \( Z \) are those that lie outside the original Solow theory. \( D \) is the indicator for the variable under study.

• There is a wide range of \( Z \) variables used in growth empirics, but few are applicable to the region.

• \( Z \) determinants used in this study are: Fiscal policy; Openness to international trade; Inflation; Investment; and the Population growth rate.
Review of the Literature (cont’d)

• Debt is another variable that could be influencing growth in the region:
  – Borrowed capital can be used to boost investment
  – Debt can have a growth-reducing effect above a certain threshold [see, e.g.: debt overhang theory; liquidity/budget constraint hypothesis]

• There is therefore likely to be a non-linear relationship between debt and growth

• Recent studies now focus on identifying a turning point/threshold.
Review of the Literature (cont’d)

- Varied results for studies that try to estimate the point at which debt begins to negatively affect growth:

<table>
<thead>
<tr>
<th>Study</th>
<th>Estimated Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinhart &amp; Rogoff (2010)</td>
<td>90% central government to GDP</td>
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<tr>
<td></td>
<td>60% external debt to GDP</td>
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<tr>
<td>Caner et al. (2010)</td>
<td>77% public debt to GDP</td>
</tr>
<tr>
<td></td>
<td>64% public debt to GDP for (emerging markets)</td>
</tr>
<tr>
<td>Patillo et al. (2002)</td>
<td>30-40% external debt to GDP</td>
</tr>
<tr>
<td>Clements et al. (2003)</td>
<td>50% external debt to GDP</td>
</tr>
</tbody>
</table>

- Common approaches used: histograms, spline functions, threshold estimations.
- Much of the work on the debt-growth link has been for developed and developing countries.
- Most research for the Caribbean assumed a linear specification, and found that debt is negatively related to economic growth. See for instance: Caldentey (2007); Branch & Adderley (2007)
- Boamah & Moore (2009) assumed nonlinearity and found a threshold of 63% for external public debt to GDP
Methodology

- The following threshold least square regression model is adopted:

\[
y_{it} = \alpha_i (D_{it} \leq \lambda) + \alpha_i (D_{it} \lambda) + \beta_{1i} X_{it} (D_{it} \leq \lambda) + \beta_{2i} X_{it} (D_{it} > \lambda) + \beta_{3i} D_{it} (D_{it} \leq \lambda) + \beta_{4i} D_{it} (D_{it} > \lambda) + \varepsilon_{it}
\]

- We begin at \(\lambda = 22\%\) and increase it by 1 percentage point up to 110\%, each time estimating the above relationship.

- Results are graphed, and we can identify a turning point.

- This approach does not allow for an accurate assessment of the statistical significance of the thresholds by providing confidence intervals. The Hansen (1996, 2000) framework is therefore estimated.
Methodology (cont’d)

• The Hansen (1996, 2000) threshold framework:

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

\[
I_{it}^D = \begin{cases} 
1 & \text{if } D_{it} > D^* \\
0 & \text{if } D_{it} < D^* \\
i = 1, \ldots, N \\
t = 1, \ldots, T
\end{cases}
\]

• The model is again estimated with a threshold search over the range 22 to 112 percent in increments of 0.1% a total of 900 regressions.

• Under the hull hypothesis of no threshold, classical tests have non-standard distributions and are not appropriate for econometric inferences.

• Hansen (1996, 2000) recommended a bootstrap technique to simulate the empirical distribution of the following likelihood ratio test:

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

Impact of Debt on Growth (in percentage points)
at debt thresholds up to and including the indicated debt-to-GDP ratio
Results

Impact of Investment on Growth (in percentage points) at debt thresholds up to and including the indicated debt-to-GDP ratio

Debt Threshold Levels
Results

Impact of Trade on Growth (in percentage points) at debt thresholds up to and including the indicated debt-to-GDP ratio
Impact of Government Expenditure on Growth (in percentage points) at debt thresholds up to and including the indicated debt-to-GDP ratio
**Results**

**Impact of Inflation on Growth** (in percentage points) 
*at debt thresholds up to and including the indicated debt-to-GDP ratio*
Results – the Hansen Approach

• A threshold of 30.6 % is identified.
• The bootstrap estimation for the significance of threshold estimates suggests that the threshold estimate is significant at 1%.
• The model is re-estimated with the corresponding threshold and the results are consistent with the above analysis.
• Specifically, the coefficient on $\gamma_1$ is positive and significant suggesting that debt level lower then 30 percent of GDP is associated with positive economic growth.
• However, the coefficient $\gamma_2$ is negative and significant, which implies that once the debt rises above 30 percent of GDP the relationship between debt and growth becomes negative.
Conclusion

• We contribute to the literature by identifying the effects different levels of debt-to-GDP ratios have on economic growth rates in the Caribbean.

• 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, 2010a) 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% of GDP but becomes a main concern for output beyond 56% of GDP.
Conclusion

• Compared to Reinhart and Rogoff, (2010a) 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.

• Given that most of the countries under investigation 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.
Thanks for your attention.