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Public Debt - Economic Growth: Evidence of a Non-linear Relationship

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Abstract

The impact of public debt on economic growth has been widely examined in the literature. The discussions shifted towards examining the possibility of a nonlinear relationship after the seminal work of Reinhart and Rogoff (2010) who proposed a threshold of 90 percent debt to GDP ratio beyond which debt is said to have a detrimental effect on economic growth. Many studies came thereafter found a common threshold for a group of countries and a negative impact of debt on growth beyond this threshold. In this context, we examine the presence of a threshold in the debt-growth nexus and the difference in the impact of debt on growth below and above this threshold in case of 39 emerging and developing economies for the period 1980 – 2019. Unlike most of the existing panel studies, we explore the debt growth relationship using country specific threshold regression models. Our findings show that in countries those confirmed a nonlinearity, the thresholds vary drastically, ranging between 24 and 116 percent. The results dismiss the possibility of a common threshold that fit for all countries and highlights the importance of finding country specific thresholds. Further, we could not find an inverted U-shape relationship between debt and growth in our sample. Apart from having different sets of countries with a positive impact below the threshold and a negative impact above, we could also find evidence for debt supporting growth beyond the threshold in case of ten countries. Also, there are countries in which the detrimental impact debt kicking in even below the threshold value of debt. Our result shows that the impact of public debt on economic growth is different across countries both below and above the threshold.

Keywords: Public debt, Economic growth, Nonlinearity, Threshold

JEL Classification: O11, O57, H63, C24

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1. Introduction

The adoption of the idea of a welfare state by countries across the globe has led to the expansion of government expenditures. The government spending has been high particularly in the emerging and developing economies due to the inherently high demand for various welfare and development programmes. Various natural catastrophes and financial crises further enlarges the government spending in these countries. The world is witnessing how various governments have been reacting to the COVID-19 pandemic and how it has put an extra pressure on the fiscal exchequers. Given these, one of the biggest challenges faced by the countries around the world and particularly the emerging and developing economies is how to raise sufficient resources to finance the ever expanding government expenditures. One of the prime sources of funding is the tax revenue. However, many policy makers do not always prefer taxation as a source of funding government expenditure since it generates distortionary effects on economic growth (Barro, 1979). Moreover, many of the countries especially the emerging and developing economies are unable to expand their tax base and hence the tax revenue. The lack of sufficient funds has compelled countries to borrow from the general public and monetary institutions at different levels over time, and public debt has become one of the prime sources of financing government expenditure.

Researchers have competing arguments on the rising dependence on public debt as a source of financing government expenditure. The major focus was on the possible impact of debt accumulation on the economy especially on the borrowing country's growth prospects. The literature provides contradicting views on the impact of public debt on economic growth. The traditional view of public debt argues that public debt can stimulate aggregate demand and output through Keynesian multiplier in the short run (Barro 1990; Elmendorf and Mankiw 1999). J M Keynes argued strongly in favour of a deficit budget, high expenditure from the government and its potential to bring back the economy from a deep recession. Following this view researchers often seem to support raising public debt as it is expected to increase the

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effective demand in the economy given the accumulated debt is rightly spent, via funding various infrastructure and development projects.

On the other hand, the accumulation of public debt was highly condemned by the classical economists including Smith (1776), Mill (1845) and Ricardo (1817). They believed that the effect of public debt on a nation is disruptive. Few other studies such as Modigliani (1961) Diamond (1965) and Blanchard (1984) have also rose their reservation against the accumulation of public debt as it decreases savings and capital accumulation through rise in interest rate and therefore leads to deterioration of economic growth. Later, studies by Barro (1990) and Paul (1992) using endogenous growth models showed that public debt has an adverse effect on long run economic growth. Salotti and Trecroci (2016) explained this negative impact of public debt on economic growth in the following manner - debt accumulation will reduce savings, crowds out capital and thus will lead to lower levels of economic growth. Findings of Kobayashi (2015) supported the argument that fiscal deterioration is the cause for economic stagnation. The debt overhang theory hypothesizes that when debt is higher than the repayment ability of a nation, expected debt service cost will discourage domestic and foreign investment further and becomes detrimental to economic growth. Further, the advocates of rational expectations also questioned the beneficial effects of public debt and the activist role that fiscal policy can have on the economy.

Moving away from these two arguments, the theory of Ricardian Equivalence considered public debt as something equivalent to future taxation and therefore it is not expected to bring in any changes to the aggregate demand in an economy. Thus, Ricardian Equivalence proposed that the impact of public debt on an economy is neutral.

The efforts from researchers in the last decade to resolve the disagreements on the relationship between public debt and economic growth in fact gave birth to the idea of non-linear relationship between the two variables. The idea proposed was that of an inverted U shaped relationship between debt and growth. A positive impact on economic growth till a particular level of debt (threshold) and a negative impact of beyond the threshold. The seminal work on the nonlinear relationship between public debt and economic growth was of Reinhart and Rogoff (2010). Using data that span for 2 centuries and covers 44 countries the study proposed a threshold of 90 percent, and found that median growth rates for countries with public debt over roughly 90 percent of GDP are about one per cent lower than other nations. It argues that

when public debt is below a certain threshold, the crowding-in effect of government spending dominates the crowding-out effect, such that increases in public debt promote economic growth. However, beyond a certain threshold, public debt will have an adverse impact on growth, as the crowding-out effect outweighs the crowding-in effect. This study led to competing arguments surrounding the idea of threshold in the debt growth relationship.

Many studies which came after Reinhart and Rogoff (2010) confirmed a threshold around 90 percent debt to GDP ratio beyond which the impact of public debt on economic growth becomes detrimental. These studies include Cecchetti et al., (2011), Padoan et al., (2012) and Elmeskov and Sutherland (2012) for OECD countries; Westpal and Rother (2012) and Baum et al., (2013) for countries in the Euro area and others including Kumar and Woo (2010), and Karadam (2018) for different panels of advanced and developing economies.

However, Herndon et al, (2014) raised strong reservations against the findings of Reinhart and Rogoff (2010) and refuted the claim that public debt to GDP ratios above 90% consistently reduce a country's GDP growth. Apart from this, studies including that of Minea and Parent (2012); Baglan and Yoldas (2013); Eberhardt and Presbitero (2013) and Pescatori et al (2014) couldn't find a robust inverted U shape between public debt and growth. Presbitero (2012) through the analysis of a panel of 92 low- and middle-income countries during the period 1990 – 2007 concluded that public debt has a negative impact on output growth up to a threshold of 90 percent of GDP and beyond this threshold the impact becomes insignificant. Panizza and Prebistero (2014) finds that the causal link between public debt and economic growth disappears after the endogeneity correction and therefore the study urged not to use the negative debt-growth relationship as an argument in support of fiscal consolidation.

Egert (2015) argued that the negative non-linear relationship between public debt and economic growth cannot be taken for granted considering a variant of Reinhart and Rogoff dataset. The study concluded that the threshold for exhibiting a negative relationship may not be 90%, it can be lower (between 20% and 60% of GDP) and the nonlinearity can change across different samples and specifications. The results according to the study are sensitive to the estimation set up, data coverage, data frequency and the definition of public debt adopted. Thus, similar to the case of arguments favouring and condemning the use of public debt, we can see that there is no consensus yet among researchers regarding the existence of non-linearity in the debt – growth nexus.

Deviating from a threshold value nearing 90 percent of debt to GDP ratio, a few of the recent studies have found a lower threshold in case of developing countries. For example, Law et al. (2021) examined the effect of public debt on economic growth in 71 developing countries from 1984 to 2015. Using a dynamic panel threshold estimation, the paper demonstrated that for developing countries the threshold value of public debt to GDP is 51.65 percent, above this threshold the impact on economic growth is negative and significant, whereas below the threshold the coefficient of debt is insignificant.

In contrast to the previous studies, a few of the recent studies pointed out that the idea of recognising a common threshold for a group of countries is not logical. Puig and Rivero (2017) applied time series analysis for threshold estimation in case of each of the European Union countries under consideration. The study showed that in case of countries under the European Economic and Monetary Union, the impact of debt changes on growth does not occur beyond same threshold or with the same intensity and in almost all countries in the sample a debt increase will have negative impact on growth well before the common Stability and Growth Pact (SGP) debt ceiling of 60% is reached. Bentour (2021) also disregarded the possibility of a common threshold that fit for all, by analysing the case of 20 advanced economies. The study show that some countries are able to grow with high debt to GDP ratios, there are countries that see their growth shrink from even low debt ratios, whereas economic growth in some others is insensitive to public debt.

These studies further emphasise the need for identifying country wise threshold in the debt-growth nexus. Moreover, when countries frame the debt management policies it may not be appropriate to depend on the common threshold value estimated for a group of countries. The existing two studies (Puig and Rivero, 2017; and Bentour, 2021) that estimated country wise thresholds in case of a group of countries considered different sub groups of advanced economies. To the best of our knowledge, none of the studies so far has attempted to estimate individual thresholds for a group of emerging and developing countries. In this context, this paper attempts to investigate the relationship between public debt and economic growth in a sample of emerging and developing economies. Particularly, we try to identify the individual thresholds for each country in our sample and also explores whether there is any difference in the impact of debt on growth below and beyond this identified threshold across these countries.

The experience of many emerging and developing countries with respect to their debt status is also another compelling factor that invites the attention of researchers to the debt growth nexus in these countries. The emerging and developing countries have accumulated huge debt within last few decades. The average debt to GDP ratio of these countries have increased manifold between 1960 and 1990. However, following the financial crisis of 1990s in Latin American and Asian countries and the European debt crisis, governments across the globe have put efforts to reduce the escalating levels of public debt. As a result, the debt has come down in 2000s including in emerging and developing countries. The global financial crisis of 2008 has further put an upward pressure on public debt as the governments were expected to step in with bailout packages and various other proactive policies. Currently, in the emerging market economies and low-income developing countries, the average public debt to GDP ratio is above 60 percent and 45 percent respectively. However, among the emerging and developing countries, Eritrea, Lebanon, Sudan and Venezuela have recorded a public debt to GDP ratio of more than 150 percent in 2019. The rising debt levels creates further worry if they are not being channeled to productive sector. International Monetary Fund (2016) points out that the increasing liabilities of the government is not even partially matched by the increase in public infrastructure in these economies. Further, the governments of many countries end up allocating a huge share of their budget for interest payments. International Monetary Fund (2021) indicated that interest payments as a share of revenue have been rising severely in low income developing countries and to a lesser extent in emerging markets since 2014.

Though there are various risks associated with the building up of public debt, countries especially the emerging and developing countries resort to public debt with the expectation that it can promote economic growth. Therefore, it is important to understand how debt affect economic growth in these countries. Does the relationship between debt and growth depend on the level of threshold? In case of a statistically significant threshold, is there a common threshold for all these countries? And is the dynamics between debt and growth across this estimated threshold consistent among all the emerging and developing countries? Through attempting to answer these questions with our sample of 39 emerging and developing economies our study contributes to the existing literature by estimating country wise thresholds and via quantifying and differentiating the impact of public debt on economic growth below and above the estimated threshold.

The remaining portion of the paper is organised as follows. Section 2 describes the data and methodology used for the empirical analysis in this paper and section 3 comprises of the empirical findings and related discussions and policy implications. Finally, section 4 concludes the paper.

2. Data and Methodology

2.1 Data

The data used in this paper is annual data for the period 1980-2019 collected for 39 emerging and developing economies. The set of countries include, Algeria, Argentina, Bhutan, Brazil, Cameroon, Chile, Comoros, Costa Rica, Ecuador, Egypt, El Salvador, Fiji, Gabon, Gambia, Ghana, Honduras, India, Jamaica, Kenya, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritius, Mexico, Morocco, Nepal, Niger, Pakistan, Senegal, Seychelles, South Africa, Sri Lanka, Saint Vincent and Grenadines, Togo, Tunisia, Turkey and Zimbabwe. We have tried to include all the emerging and developing countries which had recorded a debt to GDP ratio greater than fifty at least once between 1980 and 2019. However, the final list of 39 countries is determined by the availability of data on all the variables. The data on public debt as a ratio of GDP is obtained from the Historical Public Debt Database (HPDD) developed by the International Monetary Fund (IMF) and the World Economic Outlook (WEO). The variables such as growth rate of GDP, and the gross capital formation as a ratio of GDP are collected from the World Development Indicators (WDI). The data on the rate of inflation and trade openness are from the International Financial Statistics (IFS) and finally the proxy for human capital is obtained from the Penn World Tables and WDI.

2.2 Methodology

The study focuses on time series analysis for each country as it will provide an insight to the possible differences in the debt-growth nexus among these countries. We have augmented the Solow growth model to incorporate public debt as one of the determinants of economic growth. According to this specification the growth rate of GDP for any given country (GR_t) can be represented as follows,

$$GR_t = \alpha + \sum_{i=1}^{n} \delta_i X_{it} + \beta_1 debt_t + \epsilon_t \qquad (1)$$

Here, X_{it} represents the set of control variables (i = 1, 2, … n). Our main variable of interest is $debt_{t,}$ which denotes the gross public debt to GDP ratio. We have also included various explanatory variables identified from the literature which are highly influencing economic growth: the ratio of gross capital formation to GDP, the rate of inflation, trade openness and a proxy for human capital as control variables.

Stationarity tests were conducted for all the variables prior to the estimation and all the non-stationary variables were transformed to stationary variables by differencing. Since any change in the growth rate of GDP will have a mechanical effect on the debt to GDP ratio, the study used the lagged value of change in public debt to GDP ratio rather than the contemporaneous public debt to GDP ratio following Egert (2015).

The study aims to find the non-linear relationship between public debt and economic growth. The presence of non-linearity is commonly tested with the help of a quadratic regression model. However, one cannot identify an accurate threshold using quadratic regression, moreover, this technique does not provide any information regarding how the impact of public debt on economic growth will be different in the two regions that are separated by the threshold. Researchers have also argued that quadratic regression models tend to overestimate the threshold level and the use of squared term may result in potential multicollinearity or collinearity problems. Therefore, this study estimated a threshold regression model to understand the underlying dynamics of the nonlinear relationship. Threshold models are observed as better alternatives to identify the sudden breaks or asymmetries in the macroeconomic time series variables.

Under the threshold regression model, developed by Tong (1986, 1990, 2012) and extended by Hansen (2000, 2011), the coefficients are allowed to differ across regions, which are separated based on the threshold value/values. For this reason, threshold models can be viewed as special cases of regime switching models, as different models apply to different intervals of values of some key variables. Each region will be comprised of the set of observations that are above and below the specified threshold. It can be a set of different time spans on a time series or different values of a covariate. The model may have a single threshold or multiple thresholds. If this threshold value is known a priori, it can be used while estimating the model.

A generalised threshold regression model with two regions identified using a threshold variable; h_t can be represented as follows,

$$Y_t = \beta X_t + \gamma_1 Z_t + \epsilon_t \quad if \ -\infty < h_t \leq \delta \qquad (2)$$

$$Y_t = \beta X_t + \gamma_2 Z_t + \epsilon_t \quad if \ \delta < h_t < \infty \qquad (3)$$

In the above representation, Y_t is the dependent variable, X_t is the set of covariates which might include the lagged value of the dependent variable and all the other region invariant explanatory variables. β is the vector that consists of all region invariant parameters. Z_t is the set of control variables which have region specific coefficient vectors of γ_1 and γ_2 respectively. h_t is the threshold variable, which can be a part of either the region independent or region dependent set of independent variables and ϵ_t is an IID error. The parameters are estimated using the conditional least squares. When the threshold is not known, it is identified from the model by minimising the sum of squared residuals (SSR) obtained in case of all the tentative thresholds. The estimated threshold will be one of the values in the threshold variable, h_t.

The least square of the following regression represented in equation (4) with T observations and two regions is minimised to estimate the threshold for a sequence of T_1 values in h_t, where $T_1 < T$. The outlier values of the threshold variable can be eliminated using the trimming procedure and T_1 corresponds to the number of observations left in the threshold variable after trimming the data.

$$Y_t = \beta X_t + \gamma_1 Z_t \, I(-\infty < h_t \leq \delta) + \gamma_2 Z_t I(\delta < h_t < \infty) + \epsilon_t \qquad (4)$$

The estimator for the threshold is,

$$\hat{\delta} = \arg\min_{\delta \in \Gamma} S_{T_1}(\delta) \qquad (5)$$

Where, $\Gamma = (-\infty, \infty)$,

$$S_{T_1}(\delta) = \sum_{t=1}^{T} \{Y_t - \beta X_t - \gamma_1 Z_t I(-\infty < h_t \leq \delta) - \gamma_2 Z_t I(\delta < h_t < \infty)\}^2 \qquad (6)$$

is a $T_1 \times 1$ vector of SSR, and δ is a $T_1 \times 1$ vector of tentative thresholds.

In our context, a threshold regression model with two regions identified using the threshold variable, $debt_t$, which is again the only region specific variable, can be represented as follows,

$$GR_t = \alpha + \gamma_1\, debt_{t-1}(debt_t < \varphi) + \gamma_2\, debt_{t-1}(debt_t > \varphi) + \sum_{i=1}^{n} \delta_i\, X_{it} + \epsilon_t \qquad (7)$$

here, the threshold value of $debt_t$ (φ) is identified from the model, that is to say it is not predetermined. The model captures how the impact of public debt on economic growth changes beyond a threshold value of public debt to GDP ratio in each of the countries in the sample.

3. Empirical Results and Discussion

We attempt to examine the public debt – economic growth nexus in a sample of emerging and developing economies using time series analysis. Through estimating country specific threshold values of public debt to GDP ratio and the magnitude of impact below and above the identified threshold, our objective is to understand the differences in the debt-growth nexus among these countries in comparison to the conclusions drawn by the existing studies under a panel setting.

To begin with, we tried to explore the time series properties of the variables that are under consideration. The unit root tests have been employed on all variables of each country in our sample[3]. From the unit root test results, we observe that growth rates of gross domestic product are stationary in all the countries that are under consideration. Whereas public debt to GDP ratio is nonstationary in most of the economies with the exceptions of Brazil, Costa Rica and Lesotho. For all the other variables the stationarity properties are differing across countries. However, we observe that all the nonstationary variables here are first difference stationary. The threshold regression model requires the variables to be stationary, and therefore, we have used all the nonstationary variables at their first difference in all the estimations.

As mentioned, the threshold regression analysis conducted is time series in nature, considering the 39 emerging and developing economies separately. The threshold regression estimation identified a public debt to GDP threshold beyond which the dynamics between public debt and economic growth may change. The country specific results are reported in Table 1-8. Once we

[3] The unit root test results are presented in the Appendix – Table A1

identify the existence of nonlinearity and the threshold debt to GDP value, the next focus is on the coefficients of debt below and above the identified threshold (φ) in case of each of these countries, captured by γ_1 and γ_2 respectively from equation (7).

As we observe the coefficient of debt to understand the extent of its impact on economic growth, we see that, out of the 39 countries in our sample there are 10 countries where the debt does not affect growth either below or above the identified threshold. This category includes countries such as Bhutan, Ghana, India, Kenya, Lesotho, Malawi, South Africa, St Vincent and the Grenadines, Tunisia and Zimbabwe. Even though these countries have huge accumulation of debt, according to our results, it does not seem to neither boost the economy nor harm their economic growth prospects. These countries provide the evidence of a neutral impact of debt on growth as suggested by Ricardian equivalence.

Further, the results show that debt significantly affects economic growth in 29 countries. Out of these 29 countries, the significance of nonlinearity in the relationship between public debt and economic growth is tested using the Wald test. The Wald test established a significant difference between $\boldsymbol{\gamma}_1$ and $\boldsymbol{\gamma}_2$ in case of 26 countries. The individual thresholds identified for these countries range between 24 percent and 116 percent with the lowest threshold is seen in Algeria and highest in Gambia. This result reaffirms the importance of identifying separate thresholds rather than prescribing a common threshold for a group of countries.

As we observe the threshold debt to GDP values that we obtained in these 26 countries in more detail, we see that, in case of 11 countries the identified threshold value is below 60%. For another 11 countries, the threshold is between 60% and 90%. The threshold crosses 90% only in case of four countries. This result is in contrast with the findings of Reinhart and Rogoff (2010), Caner et al. (2010), Elmeskov and Sutherland (2012) and Karadam (2018) who found a common threshold for a group of countries. Our results on the range of threshold are in line with Puig and Rivero (2017) and Bentour (2021), as they also identified a range for the threshold value of public debt in case of 11 European economies (28 percent – 61 percent) and 20 advanced economies (14.5 percent – 106.9 percent) respectively. The differences in the level of threshold among countries might be the result of factors such as structural characteristics of these countries as suggested by Ghosh et al. (2013) or the institutional characteristics related with fiscal effectiveness and fiscal flexibility suggested by Markus and Rainer (2016).

As we analyse the countries with significant impact of public debt on growth in our sample, we come across different results, particularly in terms of the direction of impact. To summarise our results, the 29 countries that showed a significant relationship between debt and growth are classified further into different categories based on the sign and value of the debt coefficients below and above the threshold. These categories display how the debt-growth nexus differ within the emerging and developing economies.

The following session presents these different categories as distinct cases for understanding the debt growth dynamics in emerging and developing economies.

Case 1: A set of countries from our sample displayed a positive impact of debt on growth below the estimated threshold ($\gamma_1 > 0$). However, the coefficient of debt beyond the threshold is insignificant. This category includes Algeria and Ecuador. In these two countries, debt promotes growth till the threshold. The threshold attains at a very low level of debt to GDP ratio in these countries. Algeria attains the threshold at 24% whereas the threshold is 27% in Ecuador. The impact of debt on growth is 0.12 and 0.28 units respectively in Algeria and Ecuador below the tipping point of public debt to GDP ratio.

Case 2: In the second subset of countries debt is growth retarding even before reaching the threshold ($\gamma_1 < 0$). The impact of debt is insignificant beyond the threshold in these countries. This category constitutes case 2 which includes the countries such as Argentina, Cameroon, Chile, Egypt, El Salvador, Malaysia, Nepal, Pakistan, Senegal and Togo. In these economies, the threshold value of public debt ranges between 32 percent and 95 percent. The coefficient of debt to GDP ratio in these economies range between -0.11 and -0.54 units. The results of these countries are in line with the argument of classical economists that debt is detrimental to growth. Presbitero (2012) also found the similar relationship between debt and growth for 92 low- and middle-income countries with a common threshold value 90%.

Case 3: This category of countries are the ones where debt promotes growth beyond the threshold but the impact is insignificant below the threshold ($\gamma_2 > 0$). This subset includes countries such as Comoros, Gabon, Mauritius, Mexico, Morocco, and Niger with threshold values of 84 percent, 73 percent, 62 percent, 44 percent, 65 percent and 56 percent respectively.

The debt coefficient ranges between 0.10 and 0.40 in this case by Niger showing the lowest impact (0.10) and Morocco showing the highest impact (0.40).

Case 4: Under Case 4, there are 4 countries where debt harm growth beyond the threshold ($\gamma_2 < 0$) while the coefficient of debt below threshold is insignificant. These countries include Honduras, Jamaica, Mali, and Seychelles with a threshold value of 74 percent, 89 percent, 44 percent, and 79 percent respectively. The coefficient of debt ranges between -0.25 and -0.11 in these countries. This case is in line with the findings of Law et al. (2021) who found a negatively relationship beyond the threshold and insignificant impact below the threshold in a sample of 71 developing countries.

Case 5: In case of Brazil and Costa Rica, debt affect growth positively both below and above threshold. The impact is higher below threshold ($\gamma_1 > \gamma_2 > 0$). In Brazil, the coefficient of debt below the threshold is 0.16 and above the threshold the impact on growth is 0.11. The similar coefficients of Costa Rica are 0.19 and 0.09 respectively.

Case 6: Finally, our sample also have countries where debt is detrimental to growth below threshold and promote growth beyond threshold ($\gamma_1 < 0 < \gamma_2$). These countries include Gambia and Madagascar. In these two countries, the threshold is very high. The highest in our sample. 116 percent in case of Gambia and 98 percent in case of Madagascar. This result is partially in line with Minea and Parent (2012) who found that debt negatively affect growth between a threshold of 90% and 115% and promotes growth beyond a debt level of 115% in case of 20 developed economies.

To summarise the impact of public debt on economic growth below and above threshold, our set of economies display a mixed result. We could not observe a particular pattern or theory which is holding true across all the countries under consideration. Various countries of our sample showed varying trends above and below the threshold; and a few of them validate various theories and empirical findings that exist in the literature. We could not find the evidence of a detrimental effect of debt on growth in case of all the countries of our sample once a particular public debt level (threshold) is reached as suggested by a set of studies in the literature that favour the existence of a threshold. Debt affect growth negatively only in case of four countries such as Honduras, Jamaica, Mali, and Seychelles. At the same time, debt

supports growth beyond the threshold in case of 10 countries. This disproves the notion that debt is detrimental beyond the threshold level. The study also found that the impact of debt on growth is not always positive below the threshold. In fact, the impact of debt on growth below threshold is negative in many countries. For example, we found that debt affect growth negatively in case of 12 countries while debt is positively affecting growth only in four countries. We could also observe around ten countries where debt is not impacting economic growth in any manner under our estimation set up.

The differences in the relationships between public debt and growth across countries is possible because of many reasons as suggested by Eberhardt and Presbitero (2015). It might be due to the differences in the country characteristics such as production technology, macro and institutional framework, the differences in debt composition - long-term versus short-term; domestic or external; foreign or domestic currency-denominated and how the borrowed fund is being allocated between the capital expenditure and revenue expenditure.

Table 1: Threshold Regression results (Case 1: $(\gamma_1 > 0)$)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Algeria	24.30	5.61** [0.02]	0.12** (0.05)	-0.09* (0.06)	0.09 (0.09)	-0.003 (0.12)	0.02 (0.07)	0.02 (0.08)	1.87 (5.91)
Ecuador	27.20	6.84*** [0.01]	0.28** (0.12)	-0.04 (0.03)	0.54*** (0.22)	-0.04** (0.02)	0.11* (0.06)	-1.34 (0.96)	5.56*** (1.99)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 2: Threshold Regression results (Case 2: $(\gamma_1 < 0)$)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Argentina	59.74	7.10*** [0.01]	-0.11** (0.05)	0.06 (0.04)	0.89* (0.47)	-0.002** (0.001)	-0.30* (0.18)	-0.25 (0.45)	5.38 (39.08)
Cameroon	61.62	5.10** [0.02]	-0.15*** (0.06)	-0.01 (0.02)	-0.10 (0.54)	0.23 (0.18)	-0.04 (0.09)	-8.15* (4.51)	25.07** (12.11)
Chile	31.90	4.19** [0.04]	-0.27** (0.12)	-0.03 (0.03)	0.80*** (0.26)	-0.13 (0.13)	-0.03 (0.12)	5.58* (3.30)	-2.11 (3.54)
Egypt	91.41	10.96*** [0.00]	-0.13*** (0.02)	-0.02 (0.03)	0.17 (0.12)	-0.02 (0.03)	0.06*** (0.02)	0.06 (0.07)	-2.40 (5.36)
Fiji	38.53	1.25 [0.26]	-0.25** (0.13)	-0.06 (0.11)	-0.17 (0.12)	-0.31 (0.25)	0.01 (0.07)	-1.19 (1.04)	7.69*** (2.65)
El Salvador	50.51	22.71*** [0.00]	-0.36*** (0.07)	-0.03 (0.02)	0.35*** (0.13)	0.04 (0.09)	0.06 (0.04)	1.65 (1.22)	-3.08 (3.42)
Malaysia	64.39	6.10*** [0.01]	-0.19** (0.09)	0.05 (0.06)	0.79 (0.11)	0.51** (0.25)	0.02 (0.05)	-0.11 (0.15)	12.75 (11.36)
Nepal	32.76	5.09** [0.02]	-0.54** (0.28)	0.12 (0.08)	0.14* (0.07)	-0.10 (0.08)	0.18*** (0.07)	-0.06 (0.06)	8.38** (3.85)
Pakistan	76.98	5.16** [0.02]	-0.16*** (0.04)	0.06 (0.08)	0.40** (0.19)	-0.19*** (0.05)	-0.04 (0.09)	0.92* (0.50)	3.52 (0.01)
Senegal	47.59	11.88*** [0.00]	-0.16*** (0.05)	0.08* (0.05)	0.65*** (0.13)	-0.06 (0.05)	-0.28** (0.13)	-0.88 (1.41)	3.88*** (0.69)
Togo	95.90	5.46** [0.02]	-0.17** (0.08)	0.05 (0.07)	0.24 (0.31)	0.18 (0.16)	0.04 (0.15)	0.59 (2.86)	0.32 (8.34)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 3: Threshold Regression results (Case 3: $(\gamma_2 > 0)$)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Comoros	84.06	3.61* [0.06]	0.03 (0.05)	0.14*** (0.03)	0.11 (0.10)	-0.73*** (0.13)	-0.04 (0.10)	-0.92 (1.24)	5.27 (3.82)
Gabon	73.36	10.12*** [0.00]	-0.11 (0.07)	0.23*** (0.09)	-0.06 (0.16)	0.14* (0.09)	-0.11 (0.16)	3.85*** (1.35)	-8.21*** (3.36)
Mauritius	61.53	6.21*** [0.01]	-0.08 (0.07)	0.30** (0.14)	0.11 (0.07)	-0.06 (0.12)	0.02 (0.06)	-0.36* (0.20)	30.24** (14.84)
Mexico	44.09	2.85* [0.09]	-0.17 (0.16)	0.13** (0.06)	0.93*** (0.24)	-0.02 (0.01)	0.03 (0.04)	5.26 (3.74)	-20.88*** (5.82)
Morocco	64.88	4.12** [0.04]	0.10 (0.14)	0.40*** (0.09)	0.50*** (0.17)	-0.50 (0.35)	-0.32*** (0.10)	-0.18 (0.14)	18.34* (10.56)
Niger	56.34	3.89** [0.05]	-0.00 (0.04)	0.10*** (0.04)	0.86*** (0.15)	-0.10** (0.05)	-0.43*** (0.12)	5.98*** (1.24)	-18.44*** (4.58)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 4: Threshold Regression results (Case 4: $(\gamma_2 < 0)$)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Honduras	73.56	2.94* [0.09]	-0.13 (0.05)	-0.11*** (0.04)	0.16 (0.17)	-0.04 (0.05)	0.04 (0.07)	-1.06 (1.84)	4.01*** (0.61)
Jamaica	88.96	3.79** [0.05]	0.05 (0.07)	-0.12*** (0.04)	0.16 (0.20)	0.04 (0.04)	-0.06 (0.05)	1.81 (1.14)	1.07 (4.20)
Mali	44.15	4.91** [0.03]	-0.01 (0.05)	-0.25*** (0.08)	0.34*** (0.10)	-0.11** (0.05)	0.36*** (0.13)	-0.24 (0.19)	-9.96 (7.70)
Seychelles	79.20	4.47** [0.04]	-0.01 (0.06)	-0.16*** (0.04)	0.12 (0.09)	-0.20*** (0.04)	0.02 (0.03)	-1.27*** (0.49)	1.70 (2.97)
Turkey	32.44	1.24 [0.27]	-0.32 (0.20)	-0.09** (0.04)	1.31*** (0.14)	-0.03 (0.02)	0.13*** (0.04)	4.20*** (1.32)	-0.32 (0.20)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 5: Threshold Regression results (Case 5: $(\gamma_1 > \gamma_2 > 0)$)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Brazil	63.74	19.67*** [0.00]	0.16*** (0.05)	0.11*** (0.04)	0.51*** (0.19)	-0.002*** (0.001)	-0.24* (0.14)	31.65*** (8.45)	-15.71*** (4.99)
Costa Ricca	41.64	18.32*** [0.00]	0.19*** (0.04)	0.09*** (0.02)	0.17 (0.15)	-0.14*** (0.03)	0.05 (0.06)	-10.08** (4.85)	-2.42 (2.59)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 6: Threshold Regression results (Case 6: $(\gamma_1 < 0 < \gamma_2)$)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Gambia	115.51	14.36 [0.00]	-0.04*** (0.02)	0.10*** (0.03)	0.09 (0.10)	0.05* (0.03)	0.03 (0.09)	-0.54 (0.67)	4.56* (2.46)
Madagascar	98.10	19.08*** [0.00]	-0.10*** (0.03)	0.08*** (0.03)	-0.04 (0.08)	-0.07 (0.05)	-0.02 (0.14)	0.09 (0.08)	-1.13 (5.78)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 7: Threshold Regression results $(\gamma_1 < \gamma_2 < 0)$

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Srilanka	78.46	2.04 [0.15]	-0.32** (0.14)	-0.11*** (0.04)	0.25*** (0.09)	0.10** (0.05)	0.11** (0.06)	0.43 (0.90)	-2.94 (2.87)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

Table 8: Threshold Regression results (γ_1 and γ_2 are insignificant)

Countries	Threshold (φ)	Wald test stat	γ_1	γ_2	GCF	INF	OP	HC	constant
Bhutan	39.11	3.83** [0.05]	0.77* (0.42)	-0.08 (0.06)	-0.05 (0.10)	-0.15 (0.12)	-0.04 (0.10)	-0.02 (0.15)	11.95 (8.86)
Ghana	48.69	4.05** [0.04]	0.06 (0.05)	-0.06 (0.04)	0.02 (0.08)	-0.05* (0.03)	0.10 (0.11)	-0.37 (1.37)	7.43** (3.56)
India	68.09	1.80 [0.18]	0.17 (0.24)	-0.13 (0.09)	0.51*** (0.11)	0.09 (0.08)	-0.14* (0.08)	-2.08*** (0.77)	8.89*** (1.20)
Kenya	54.43	1.83 [0.18]	0.12 (0.09)	-0.02 (0.06)	0.26* (0.16)	-0.12** (0.05)	0.02 (0.09)	-0.84 (0.65)	7.99*** (1.76)
Lesotho	81.93	2.07 [0.15]	0.02 (0.02)	0.01 (0.02)	0.17** (0.08)	0.06 (0.06)	0.02 (0.01)	-0.06 (0.09)	1.82 (3.21)
Malawi	90.99	4.15** [0.04]	-0.03 (0.02)	0.09 (0.06)	-0.18 (0.14)	0.08 (0.10)	-0.15** (0.07)	0.94* (0.56)	11.08** (5.11)
South Africa	31.32	0.71 [0.40]	0.20 (0.26)	-0.04 (0.09)	0.06 (0.16)	-0.20** (0.10)	0.29*** (0.04)	-0.27*** (4.91)	16.91*** (4.91)
St Vincent & the Grenadines	65.45	2.66 [0.10]	0.07 (0.10)	-0.26 (0.18)	0.09 (0.18)	-0.14 (0.15)	0.21 (0.13)	-1.29*** (0.46)	93.08*** (30.53)
Tunisia	51.56	3.62* [0.06]	0.23 (0.15)	-0.13 (0.18)	0.63*** (0.19)	-0.30 (0.19)	-0.04 (0.04)	-0.10 (0.15)	12.51 (11.49)
Zimbabwe	44.46	3.98** [0.05]	0.19 (0.14)	-0.30 (0.19)	0.34 (0.41)	0.03 (0.11)	-0.23 (0.22)	1.41* (0.81)	0.31 (2.10)

Note: standard errors mentioned in the table within parenthesis are robust. p value from the Wald test is mentioned in square brackets. ***, **, * means significance at 1%,5% and 10% respectively. Dependent variable of this estimation is growth rate.

4. Concluding Remarks

Many countries have adopted the idea of a welfare state and introduced various development programmes for the welfare of its citizens. Following which the governments had expanded their expenditures considerably. However, the inadequate expansion of the tax base compelled these countries especially the emerging and developing countries to raise funds via borrowings. The occurrence of frequent financial crisis as well added fuel to the fire. Evidences shows that there has been a considerable rise in borrowings in recent decades in almost all the countries. One of the prominent concerns in this regard is the possibility of rise in interest rate and consequent reduction in economic growth via fall in private investment. In contrast, there are arguments stressing on the ability of deficit financing to rise aggregate demand and hence economic growth. However, the findings of Reinhart and Rogoff (2010) changed the focus in the debt growth nexus towards identifying a threshold value of public debt to GDP ratio. They explained the case of an inverted U-shape relationship between debt and growth and identified 90 percent as the threshold value of public debt to GDP ratio. The idea was debt will promote growth until attaining this cap of 90 percent and will retard growth beyond the threshold. Some of the studies came after found that the threshold may not be 90% as suggested by Reinhart and Rogoff and established that the threshold is near 60% in case of developing countries. Most of the studies estimated a common threshold for a group developed or developing countries. In this context, this study attempts to identify individual thresholds for a sample of 39 emerging and developing countries using threshold regression model. Further, the paper explores the relationship between debt and growth below and above the identified threshold in each of these countries.

The empirical results show that, individual thresholds identified for the countries ranges between 24 percent and 116 percent with the lowest threshold value of public debt in Algeria and highest in Gambia. Among the 26 countries which showed a significant nonlinearity, we have identified a threshold value below 60% of debt to GDP for 11 countries. For other 11 countries the threshold is between 60% and 90%. The threshold crosses 90% only in case of four countries. This result reaffirms the importance of identifying separate thresholds rather than prescribing a common threshold for a group of countries.

Coming to the impact of public debt on economic growth, the countries under consideration display a mixed result. Out of the 39 countries in our sample 10 countries provide the evidence

of a neutral impact of debt on growth suggested by Ricardian equivalence. The accumulation of debt in these countries does not seems to neither boost nor harm their economic growth. The rest 29 countries show significant impact of debt on growth below and/or beyond the threshold. However, the Wald test established a significant difference between the coefficient of debt below and above threshold only in case of 26 countries. We could not find the evidence of an inverted U-shape relationship between debt and growth as suggested by Reinhart and Rogoff (2010) in any of these countries. However, debt promotes growth below threshold only in case of four countries. In fact, the impact of debt on growth below threshold is negative in 12 countries. Therefore, the paper points out that the notion of debt impacting growth positively below a threshold need not be true for all countries. Rather, it is negative in many cases. Further, debt affect growth negatively only in case of four countries beyond the threshold, in our sample. At the same time, debt supports growth beyond threshold in case of 10 countries. This disproves the notion that debt is detrimental beyond the threshold level always.

To conclude, the study highlights the importance of estimating debt thresholds separately for each country and stresses that framing debt management policies based on a common threshold may not help all countries. Secondly, many countries shows that debt is growth promoting even after reaching the threshold. Therefore, there is a scope for fiscal stimulus in such countries even beyond the threshold level of debt. However, certain countries may have to go for fiscal austerity or other debt management policies to reduce the level of debt even at a very low level of public debt to GDP ratio.

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APPENDIX

Table A1: Augmented Dickey Fuller Unit root test results

	GR		Debt		GCF		INF		OP		HC	
	level	**FD**	**level**	**FD**	**level**	**FD**	**level**	**FD**	**level**	**FD**	**level**	**FD**
Algeria	0.01	-	0.48	0.00	0.72	0.00	0.15	0.00	0.42	0.00	0.00	-
Argentina	0.00	-	0.10	0.00	0.01	-	0.00	-	0.74	0.00	0.00	-
Bhutan	0.00	-	0.65	0.00	0.00	-	0.00	-	0.22	0.00	0.02	-
Brazil	0.00	-	0.01	-	0.06	0.00	0.01	-	0.28	0.00	1.00	0.05
Cameron	0.01	-	0.48	0.00	0.24	0.00	0.00	-	0.54	0.00	0.00	-
Chile	0.00	-	0.25	0.00	0.06	0.00	0.00	-	0.26	0.00	0.02	-
Comoros	0.00	-	0.23	0.00	0.03	-	0.00	-	0.12	0.01	0.01	-
Costa Rica	0.00	-	0.02	-	0.02	-	0.00	-	0.21	0.00	1.00	0.01
Ecuador	0.00	-	0.57	0.00	0.21	0.00	0.10	0.00	0.24	0.00	0.00	-
Egypt	0.04	-	0.08	0.00	0.12	0.00	0.03	-	0.00	-	0.00	-
El Salvador	0.00	-	0.30	0.00	0.14	0.00	0.22	0.00	0.02	-	0.00	-
Fiji	0.00	-	0.13	0.00	0.01	-	0.00	-	0.25	0.00	0.00	-
Gabon	0.00	-	0.56	0.00	0.00	-	0.00	-	0.19	0.00	0.05	-
Gambia	0.00	-	0.09	0.00	0.15	0.00	0.02	-	0.29	0.00	0.00	-
Ghana	0.03	-	0.38	0.00	0.13	0.00	0.00	-	0.89	0.00	0.01	-
Honduras	0.00	-	0.41	0.00	0.23	0.00	0.07	0.00	0.67	0.00	0.28	0.00
India	0.04	-	0.10	0.01	0.77	0.01	0.03	-	0.79	0.00	0.02	-
Jamaica	0.00	-	0.57	0.00	0.01	-	0.03	-	0.00	-	0.00	-
Kenya	0.01	-	0.20	0.00	0.08	0.00	0.02	-	0.38	0.00	0.02	-
Lesotho	0.00	-	0.05	-	0.52	0.00	0.00	-	0.00	-	0.00	-

Note: p values are presented in the table. FD – First difference

Table A1: Augmented Dickey Fuller Unit root test results (Continued)

	GR		Debt		GCF		INF		OP		HC	
	level	FD	level	FD	level	FD	level	FD	level	FD	level	FD
Madagascar	0.00	-	0.14	0.00	0.03	-	0.00	-	0.07	0.00	0.00	-
Malawi	0.00	-	0.19	0.00	0.01	-	0.01	-	0.01	-	0.00	-
Malaysia	0.00	-	0.22	0.04	0.39	0.00	0.00	-	0.74	0.00	0.04	-
Mali	0.00	-	0.24	0.00	0.00	-	0.00	-	0.00	-	0.00	-
Mauritius	0.00	-	0.86	0.00	0.17	0.00	0.01	-	0.54	0.00	0.03	-
Mexico	0.00	-	0.12	0.00	0.02	-	0.00	-	0.02	-	0.24	0.04
Morocco	0.00	-	0.13	0.00	0.23	0.00	0.02	-	0.46	0.00	0.01	-
Nepal	0.00	-	0.26	0.00	0.99	0.00	0.00	-	0.88	0.00	0.02	-
Niger	0.00	-	0.53	0.00	0.49	0.00	0.00	-	0.08	0.00	0.02	-
Pakistan	0.00	-	0.16	0.00	0.12	0.00	0.05	-	0.22	0.00	0.02	-
Senegal	0.00	-	0.63	0.00	0.16	0.00	0.00	-	0.17	0.00	0.33	0.00
Seychelles	0.00	-	0.44	0.00	0.02	-	0.04	-	0.12	0.00	0.94	0.00
South	0.00	-	0.95	0.00	0.04	-	0.20	0.00	0.10	0.00	0.00	-
Sri Lanka	0.00	-	0.21	0.00	0.05	0.00	0.00	-	0.40	0.00	0.05	-
St Vincent &	0.00	-	0.11	0.00	0.03	-	0.00	-	0.33	0.00	0.01	-
Togo	0.00	-	0.31	0.00	0.07	0.00	0.00	-	0.25	0.00	0.01	-
Tunisia	0.00	-	0.15	0.00	0.23	0.00	0.01	-	0.06	0.00	0.00	-
Turkey	0.00	-	0.56	0.00	0.08	0.00	0.06	0.00	0.00	-	0.00	-
Zimbabwe	0.00	-	0.19	0.00	0.28	0.00	0.00	-	0.23	0.00	0.01	-

Note: p values are presented in the table. FD – First difference

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