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Is Debt Always Harmful for Economic Growth? Evidence from Developing Countries

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Abstract

The debate on damage risks of high levels of debt on long run economic performance is not new. Nonetheless, this has achieved increasing interest during the last decades because of several countries and regions have acquired high indebtedness, particularly those with doubtful capacity of repayment. The study of a non-linear relationship between both macroeconomic variables and the value (or values) at which the incidence of debt could change sign at said threshold are relevant issues for the performance of economies, the economic policy and, even, the debt payment. This paper uses a panel threshold regression model, with initial real per capita GDP and debt-to-exports ratio as threshold variables, in order to prove heterogeneous effects of debt on growth in developing countries. The results show that the effect of debt depends on both threshold variables. Higher levels of initial GDP are related to negative effects of debt on growth, the relation between debt and growth tends to be insignificant for medium values and exhibits a positive relation to low values of product. Furthermore, debt-to-exports ratio exhibits a single turning point beyond which debt seems to be harmed for economic growth. The level of those thresholds is also estimated.

Key words: DEBT, ECONOMIC GROWTH, DEVELOPING COUNTRIES, NON-LINIARITIES

JEL: O5, E60

Introduction

How debt affects economic growth seems to have a renewed interest, in particular in those countries of lower and medium income with a bulky and increasing debt level. An important benchmark into this topic is the possible existence of certain thresholds above which the debt could constitute in a hindrance for growth. In this sense, if the ratio debt-GDP surpasses certain level, the former could be harmful for the economic performance. The literature on the non-linear relationship between debt and growth focuses mostly on high-income countries, with some agreement regarding a possible threshold of 90% in the debt-output ratio. However, studies focused on less developed countries are scarcer and the existence of the non-linear relationship and the values of the possible thresholds are a topic under discussion in both empirical and theoretical academic studies (Panizza and Presbitero, 2013). Another aspect that does not find consensus in the literature refers to the debt indicator that should be used when exploring this possible non-linear relationship. In this sense some authors argue that not only is the relationship between debt and product of an economy relevant, but also the capacity to pay that economy has and, therefore, it would be relevant to incorporate the debt-to-exports indicator.

Imbs and Ranciere (2005) find a nonlinear relationship between debt and growth, by applying non-parametric techniques in a sample of 87 developing countries along the 1969-2002. This is significantly negative once the ratios of debt-GDP and debt-to-exports surpass the thresholds of 60% and 200%, respectively. Similarly, Poirson et al. (2004), in panel dataset of 61 developing countries over the 1969-98 periods, show that low debt levels foster both the growth of economic activity and total factor productivity growth, but it has a negative effect at high levels. More recently, for a large panel data set of developing and industrial countries, Karadam (2018) shows that the direction of the effect of public debt on growth changes smoothly from positive to negative, which depends on the level of indebtedness. Interestingly, that threshold of debt is lower for developing countries, so that public debt can reduce growth at lower levels of debt in relation to advanced countries.

Nonetheless, other contributions challenge the consensus about a nonlinear relationship. Into them previously Deshpande (1997) presents evidence for a sample of 13 highly indebted countries during the 1971-1991 period of a consistently negative relation between external debt and investment. Pescatori et al. (2014), in a long run study of an augmented International

Monetary Fund (IMF) database, find no evidence on a threshold above which debt could affect economic growth. Instead, the authors state that the trajectory can be as important as the level of indebtedness in understanding future growth prospects. This claim is based in the fact that countries with high but declining debt present a similar economic performance that those with lower debt. In turn, Eberhardt and Presbitero (2015) analyze the relationship between debt and growth by means of linear and non-linear specifications for a wide sample of countries, and find a negative relationship between public debt and long-run growth across countries.

On the other hand, the High Indebtedness Poor Countries (HIPCs), and in particular the poorer regions of Africa are a special case. In this sense, in a recent study for this region Ndoricimpa (2017) finds that low levels of debt are neutral or even growth-enhancing, but high levels are always prejudicial for growth. However, as his results are sensitive to the choice of the estimation model and control variables, these do not allow establishing an optimal threshold of debt. Therefore, even though some research seems to sustain that only low debt levels are growth-promoting, the issue of the existence of an optimal level is still open. In particular, for less developed and highly indebted countries it seems relevant to determine the relationship profile between the debt and economic growth, as well as if there is a threshold above which the level of debt is harmful for growth. Thus, the objective of this paper is to analyze how different levels of debt-GDP and debt-to-exports ratios affect economic growth in a wide sample of developing countries for the 1970-2019 periods. In order to point out if both the profile and debt threshold changes at different stages of development, threshold regression models are estimated, following the methodology of Hansen (1999). Additionally, to find the debt-product and debt-to-exports thresholds, the dynamic version of the threshold regression models is applied following the commands developed by Seo et al (2019).

The motivation of this paper comes from the renewed importance of increasing indebtedness into several developing countries, which could become a restriction for further growth. The contribution is twofold. First, this study could shed some light on the profile of the debt-economic growth relationship. In second place, and related with the former, this helps in determining the possible existence of thresholds above which indebtedness is harmful for economic growth among countries with different levels of development. In this vein, the contribution of this research is present additional evidence supporting the hypothesis of a non-linear relationship between the level of indebtedness and economic growth. In fact, our evidence indicates the existence of a threshold beyond which debt is harmful for growth, which is lower for developing countries with respect to developed economies.

This paper is structured as follows. The next section presents a survey of the literature. Section 3 presents the data and methodology used in the empirical application and Section 4 presents the results found in the various econometric exercises and finally section 5 presents the conclusions.

2. The debt-economic growth relationship: a brief survey

The debate on damaging effects risks of high levels of debt on long run economic performance is not new. Nonetheless, this has achieved increasing interest during the last decades because of several countries and regions have acquired high indebtedness, and in particular those with doubtful capacity of repayment. Panizza and Presbitero (2013) carry out an exhaustive review of the positions and theoretical and empirical results regarding the sustainability of public debt and its effects on growth.

Historically, the more recent episodes go back to the ´80 and ´90 experiences in Latin America. In fact, high levels of debt and an unfavorable external context gave rise to a very poor performance in the region, in particular in the decade of 1980. Moreover, the problem has been particularly serious in the Heavily Indebted Poor Countries (HIPCs), for which Cordella et al. (2005) present evidence on a negative marginal relationship between intermediate levels of debt and product growth. However, the authors find a non-linear behavior between debt and growth, so the former does not seem to have an effect at high and low levels, but at intermediate levels. Another finding of this paper is that institutional quality and monetary policy behavior affect the level of debt that would be detrimental to economic growth, thus countries with worse policy performance and bad institutions present a lower indebtedness level beyond which the debt constitutes a threat for growth. Similarly, for a large panel data set of 93 developing countries over 1969–98 Poirson et al. (2002) state that external debt negatively affects economic growth from ratios about debt/GDP of 35% and debt-to-exports of 160%, which are clearly lower than those found in developed economies.

More recently, the high levels of debt contracted by several countries since the global crisis of 2008 promoted renewed interest to discuss this issue. In this frame, in a sample of low and middle income countries during the 1990-2007 periods Presbitero (2012) finds that public debt is a drag for output growth up to a threshold of 90%t of GDP. Surprisingly, also for this level of indebtedness Reinhart and Rogoff (2010) and Woo and Kumar (2015) present evidence on a non-linear relationship for both emerging and advanced economies: above such threshold debt has negative effects on economic growth, in particular during prolonged periods of high debt levels. Woo and Kumar (2015) also claim that higher levels of foreign-currency debt are associated with a more harmful effect of the initial debt on economic growth. Similarly,

Cecchetti et al (2011) suggest that such threshold is 96% for the case of public debt, while Baum et al. (2013) also find a non-linear relationship for the case of the Euro Zone and the debt/GDP ratio threshold is 95%. More recently, for a large panel data set which covers both developing and industrial countries and applying a Panel Smooth Transition Regression Karadam (2018) finds that nonlinearity of the relationship between debt and growth depends mostly on debt's structure. The author concludes that the threshold is lower for emerging countries and at short-term external debt and public long-term external debt generates more pronounced and strong negative impact on growth for high levels of indebtedness.

However, even several contributions indicate that there is a threshold of debt/GDP ratio of about 90%, this has not been unanimously accepted (Egert, 2015). Caner et al. (2010), in a large sample of developing countries, states that this is approximately 77%, while Elmeskov and Sutherland (2012) detect a threshold of 66% for developed economies of the OECD. Minea and Parent (2012) employ the panel smooth threshold regression model and find that there is a negative effect of public debt on growth when the level of debt is between 90% and 115% of GDP. Contrary, Herndon et al. (2013) and Herndon et al. (2014), by using the same dataset of Reinhart and Rogoff (2010), find that economic growth does not present an abrupt declination above such threshold. In addition, in a sample of 18 OECD countries for the 1980-2010, Cecchetti et al. (2012) show that government debt over 85% of GDP negatively affects product growth and Greiner (2011) finds that the optimal level of public debt ranges between 43% and 63% of GDP for these countries. In a recent research, for a wide sample of twenty advanced countries during the 1880-2010 period, Bentour (2020) finds a heterogeneous relationship between debt and growth depending on the sample of countries and the time period analyzed. In other words, this relationship is unstable as by country as by group of countries or across different periods. In particular, while for a set of countries economic growth slows starting from low debt levels over the postwar, others show a successful performance from low to medium levels of debt, and some economies verify flat curves in the debt-growth relationship. For African countries, applying panel smooth transition regression approach and dynamics methods, Ndoricimpa (2020) finds a debt threshold in the range of 62–66% and while low public debt is found to be either growth neutral or growth enhancing, high public debt is consistently detrimental to growth.

On the other hand, there are studies that do not find a non-linear relationship between debt and growth. Kourtellos et al (2013) conclude, from the application of the structural threshold regression (STR) model, that the relationship between public debt and growth is crucially mitigated by institutional quality. When a country’s institutions are below a particular quality level, then, more public debt leads to lower growth (ceteris paribus). However, if a country’s

institutions are of sufficiently high quality, then, public debt is growth neutral. In line with this result, for various groups of countries, methodologies and estimation periods are the contributions of Ash et al. (2017), Baglan and Yoldas (2016), Eberhardt and Presbitero (2013), Pescatori et al. (2014), and Deshpande (1997), among others.

In sum, there is bulky evidence that claims the existence of non-linarites in the debt level-economic growth relationship, which is found among countries with different development degrees. Nevertheless several contributions do not support evidence of a nonlinear negative public debt-growth relationship. Furthermore, the correct way to measure and use the debt threshold is under discussion, since the debt/GDP ratio is criticized by some studies in which the importance of incorporating the economies' repayment capacity and thus the possibility of incorporating the debt-to-exports ratio as a threshold variable. And as it was mentioned above, also here the discussion on the existence of an optimal value of this ratio is still open.

3. Methodology and data

3.1. Methodology: Threshold Regression Model

As mentioned, the main purpose of this paper is to analyze the existence of a nonlinear relationship between debt and economic growth and, if this behavior is found, to determine which levels of debt are those that change the effect on the evolution of the product of an economy. To fulfil this purpose the methodology of threshold effect models introduced by Hansen (1999) is applied. Threshold regression models hold that individual estimates can be divided into classes according to the value of an observable variable (Monterubbianesi et al, 2021).

In this paper, following Hansen (1999), a non-dynamic panel model with individual fixed effects is estimated. The technique requires a balanced panel data (Wang, 2015). The dynamic version of this type of models can be seen in Seo et al (2019), this methodology is applied to find the value of the thresholds and to strengthen the results found in the regressions of threshold effects. The general definition of the model for a set of *i* individuals (countries in this study) and *t* time periods is given by equation

$$y_{it} = u_i + \beta_1' x_{it} I(q_{it} \ll \gamma) + \beta_2' x_{it} I(q_{it} > \gamma) + e_{it} \qquad (1)$$

where $I(\cdot)$ is the indicator function (that is, it defines the value of the estimation coefficients according to the value of the threshold variables, u_i is the fixed effect, q_{it} is a scalar of threshold variables, x_{it} is a vector of explanatory variables (it is assumed that there are k

explanatory variables), β represent the coefficients to be estimated that indicate the effect of each endogenous variable on exogenous variable, γ is the threshold parameter and e a random error term (is assumed to be independent and identically distributed (iid) with mean zero and finite variance σ^2). An alternative way of expressing (1) is

$$y_{it} = \{u_i + \beta_1' x_{it} + e_{it}, \qquad q_{it} \ll \gamma \; u_i + \beta_2' x_{it} + e_{it,} \qquad q_{it} > \gamma \quad (2)$$

Another compact representation of (1), with $\beta = \left(\beta_1' \beta_2'\right)'$, is

$$x_{it}(\gamma) = \begin{pmatrix} x_{it} I(q_{it} \ll \gamma) \\ x_{it} I(q_{it} > \gamma) \end{pmatrix} \quad (3)$$

The model can be estimated by non-linear least squares (NLLS) and the equation is equal to

$$y_{it} = u_i + \beta' x_{it} + e_{it} \qquad (4)$$

The observations are divided into two 'regimes' depending on whether the threshold variable q it is smaller or larger than the threshold γ. The regimes are distinguished by β_1 and β_2, as a regression slopes. For the identification of β_1 and β_2, it is required that the elements of x_{it} are not time invariant (Hansen, 1999).

As was mentioned, in this paper fixed effects are applied. In fixed effects models, the individual effects for each unit u_i are not observable, therefore they must be eliminated for the estimation. For this, the within transformation is applied, that is, the variables are redefined as the distance with respect to their mean. Hence, the model is expressed in accordance with equation (5).

$$y_{it}^{*} = \beta' x_{it}^{*} + e_{it}^{*} \qquad (5)$$

The variables indicated with * represent the deviation from their mean. One of the great strengths of the methodology is that it allows estimating the value of the coefficients for each section of the threshold variable and, also, the value of those thresholds endogenously from the minimization of the sum of the squared residuals (Monterubbianesi et al, 2021). In the case of this study, the values that are estimated correspond to the various levels of per capita GDP and debt-to-exports ratio from which the debt-growth relation changes their behavior. Given $\hat{\gamma}$, the value of β can be estimated from (4) as

$$\hat{\beta} = \beta(\hat{\gamma}) = (\beta_1(\hat{\gamma}) \, \beta_2(\hat{\gamma}) \,) \qquad (6)$$

The model can be generalized considering the existence of r thresholds $\gamma_1, \ldots, \gamma_r$ as

$$y_{it} = u_i + \sum_{j=1}^{r} \quad \beta_j^{'} x_{it} \leq (\gamma_{j-1} \leq q_{it} \leq \gamma_j) + e_{it} \quad (7)$$

Hansen (1999) shows that, by means of inference analysis through an F test, it is possible to find the optimal number of regimes. In this case, two alternative numbers of thresholds are considered, starting, in principle, from the hypothesis of non-existence of thresholds versus the existence of a threshold, followed by the existence of a threshold versus two thresholds, and so on. For example, for the first case the null hypothesis will be $H_0 = \beta_1 = \beta_2$ and the value of the statistic will be given by (8).

$$F_1 = \frac{SSR_0 - SSR_1(\hat{\gamma})}{(\widehat{\sigma^2})}$$

If the null hypothesis is rejected, there would be evidence to support that the slopes of the estimated models without thresholds and with thresholds differ and, thus, it is necessary to consider the existence of different regimes. Additionally, we use robust standard errors estimators for fixed effects regression to correct for heteroskedasticity.

3.2. Data

We employ a balanced 5-year period panel dataset covering 47 developing countries in 1970-2019 (Table A.1 in Appendix). The dependent variable is computed as the mean of the growth rate of real per capita GDP over each time interval. The independent variable of main interest is debt-to-GDP ratio (debt from here on), which is obtaining from two different sources in order to strengthen the analysis: the Global Debt Dataset of International Monetary Fund (IMF) and the External Debt and Financial Flows statistics of World Development Indicators, World Bank (WB). Then, the two proxies of debt have dissimilar definitions. The debt variable from IMF refers to the total gross debt of the (private and public) nonfinancial sector as GDP percentage, while the WB indicator is the total external debt stocks to gross national income. Here, external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt.

We also include eight control variables according to growth literature (Levine & Renelt, 1992; Dabús & Laumann, 2006; Rojas el at., 2019). All variables (except human capital) are taken in 5-years non-overlapping averages and are sampled from World Development Indicators (WDI). Control variable are listed below:

- *Investment* is the log of gross capital formation as a percentage of GDP.
- *Initial GDP* is the lagged real per capita GDP (in logs).

- *Openness* is measured as the log of exports plus imports to GDP.
- *Life expectancy* is the log of average life expectancy at birth.
- *Public expenditure* is the log of government consumption to GDP.
- *Inflation* is a semi-log transformation of the average variation of GDP deflactor.
- *Population* is the log of average population growth rates plus 0.05.
- *Human capital* is the index of human capital proposed by the Penn World Table (PWT) 7.0 (variable).

The threshold variables that we consider are the *Initial GDP* (as was defined above) and the *debt-to-exports ratio,* which is taken as *debt* divided by exports-to-GDP obtained from WDI. Table A.2 in Appendix summarizes the descriptive statistics of variables.

4. Empirical Evidence

Table 1 shows the estimations using debt from IMF (columns A and B) and external debt from WB (columns C and D). The threshold variable is initial per capita GDP. Table 2 summarizes the levels of thresholds determined in the four different models.

Table 1. Estimations using *Initial GDP* as threshold variable

Dependent variable: Economic Growth				
	(A)	**(B)**	**(C)**	**(D)**
Investment	0.0274***	0.0279***	0.0261***	0.0264***
	(0.0055)	(0.0051)	(0.0052)	(0.0050)
Initial GDP	-0.0383***	-0.0346***	-0.0355***	-0.0346***
	(0.0074)	(0.0073)	(0.0084)	(0.0076)
Life expectancy	0.0354**	0.0477**	0.0326*	0.0535**
	(0.0170)	(0.0208)	(0.0182)	(0.0202)
Human capital	0.0301**	0.0242***	0.0286**	0.0224***
	(0.0099)	(0.0072)	(0.0107)	(0.0077)
Openness	0.0080		0.0138	
	(0.0086)		(0.0106)	
Population	0.0180		0.0227	

	(0.0182)		(0.0168)	
Inflation	-0.0064***	-0.0044***	-0.0026	
	(0.0018)	(0.0014)	(0.0019)	
Public expenditure	-0.0064		-0.0019	
	(0.0050)		(0.0059)	
Constant	-0.0138	-0.0539	-0.0351	-0.0670
	(0.0725)	(0.0856)	(0.0749)	(0.0842)
Debt				
β_1	0.0351***	0.0401***	0.0373***	0.0462***
	(0.0075)	(0.0097)	(0.0079)	(0.0109)
β_2	-0.0004	0.0002	-0.0007	-0.0019
	(0.0033)	(0.0015)	(0.0018)	(0.0013)
β_3		-0.0127**	-0.0148**	-0.0169***
		(0.0062)	(0.0066)	(0.0050)
Nº	45	45	41	41
F stat.	38.1	49.57	23.89	22.26

Source: Own elaboration. Note: Standard errors are in parentheses. The estimations under robust variance and covariance errors automatically eliminate some countries from the panel. ***,**, and * indicate the 1%, 5% and 10% significance levels, respectively.

Using initial GDP as threshold variable, we can identify if past economic performance conditions debt–growth relationship. If so, originally poorest or richest countries could show heterogeneous behavior with respect to debt.

In first place, there is strong evidence of non-linearities in the debt-economic growth relationship. In this sense, Table A.3 in Annex exhibits nonlinearity tests and the subsequent tests in order to capture the number of significant thresholds[1]. In Table 1, model A includes all control variables and debt from the IMF. In this case, it is shown only one significant threshold

[1] We work at 1% or 5% level of confidence in testing thresholds to ensure strong evidence in favor to non-linearities (or, alternative, in favor to linearity).

below which debt positively affects growth, turning insignificant above. The other three estimations suggest the existence of two thresholds. The outcome means that at low economic levels debt promotes economic growth ($\beta_1$is positive and statistically significant at 1% in A, B, C and D). Then, for medium levels of initial product, there seems to be no evidence to support a relationship between debt and growth ($\beta_2$is not significant for all models in Table 1), whereas for higher levels of initial GDP debt counteracts the economic advance in developing countries. The intuition would be that poorer countries have more scarcity of capital because of their lower levels of savings. Thus, this limitation can be removed with external indebtedness allowed to facilitate higher capital accumulation oriented to productive activities.

Table 2. Threshold levels estimated: Initial GDP

	In logs	Confidence interval (95%)		In levels
(A)				
Threshold 1	5.9208***	5.8923	5.9218	372.71
(B)				
Threshold 1	5.9208***	5.8996	5.9218	372.71
Threshold 2	7.3028**	7.2449	7.3065	1484.5
(C)				
Threshold 1	5.9005***	5.8914	5.9165	365.22
Threshold 2	7.2635**	7.2206	7.2655	1427.24
(D)				
Threshold 1	5.9218***	5.9003	5.9246	373.08
Threshold 2	7.2635***	7.2206	7.2655	1427.24

Source: Own elaboration. Note: ***,**, and * indicate the 1%, 5% and 10% significance levels, respectively.

We can establish, then, three regimes taking into account models B, C and D. From Table 2, for example, the first regime in model B includes those economies whose initial per capita GDP is below $372.71. In the second regime are countries with initial GDP between such value and $1484.5. The third regime, corresponding with a negative sign of the β coefficient, contains

those economies with initial GDP above $1484.5. These values are obtained by calculating the antilog in the threshold values reported in Table 2.

In addition, *investment, initial GDP, human capital* and *life expectancy* have the expected signs. Investment is positively and significantly correlated with growth. The negative sign of initial GDP coefficient is evidence in favor of the conditional convergence hypothesis. Life expectancy and human capital reflect the relevance of human conditions in the process of development. On the other hand, *openness, population and public expenditure* have no significant effect on growth. Finally, *inflation* affects negatively economic growth only in A and B for the IMF data[2].

On the other hand, we analyze if the external restriction can produce different patterns in external debt – growth relation. Since exportations are the genuine source of foreign exchange earnings and developing economies have historically disadvantages in exploiting their balance of payments, a vast literature points the external restriction as a powerful constraint to debt repaid and to growth (Tana et al., 2018; Fischer, 2018; Basu et al., 2020). Moreover, economies with endemic deficits in external balance use to take external debt in order to close the gap between inflows and outflows foreign exchanges.

Table 3 presents estimations using debt-to-exports ratio as threshold variable. In this case, only the indicator of debt from WB is considered, being a better proxy of external debt. When all explicative variables are brought together into the regression, there is little evidence of non-linearities[3] and the robustness of estimation reduces considerably (we have omitted the regression in table 3).

Models A and B in table 3 provide some evidence of the threshold effect of debt-to-exports ratio. In both models, thresholds are statistically significant at 5% (table A.4). The difference between A and B is the consideration of *inflation*. When inflation is embedded as an explicative variable, external debt seems not to be relevant above the threshold (that is, for high levels of debt-to-exports). But once inflation is excluded, external debt becomes strongly significant at 1% with a negative influence on growth. This can suggest a more complex relation between external debt, external restriction, inflation and economic performance in developing economies that should be addressed with greater detail, as well as a possible correlation between debt and inflation. The other significant explanatory variables have, again, the expected effect on dependent variable.

[2] In alternatives estimations for external debt, inflation occasionally shows significance at 10% level of confidence. In those cases, the significance of *beta* is reduced.

[3] The existence of linearity can be rejected only at 10% level and the coefficient beta is not significant.

In model B (Table 3), external debt has a positive relation with economic growth behind the threshold of 152% of external debt as percentage of exports (table 4). When debt is more than 152% of exports, it becomes harmful to growth.

Table 3. Estimations using *debt-to-exports ratio* as threshold variable

Dependent variable: Economic Growth			
		(A)	**(B)**
Investment		0.0318***	0.0317***
		(0.0069)	(0.0069)
Initial GDP		-0.0404***	-0.0416***
		(0.0087)	(0.0089)
Human capital		0.0392***	0.0415***
		(0.0092)	(0.0094)
Population		0.0353**	0.0345**
		(0.0143)	(0.0147)
Inflation		-0.0074**	
		(0.0031)	
Constant		0.068	0.0825
		(0.0592)	(0.0603)
Debt			
	β_1	0.0311***	0.0254***
		(0.009)	(0.0087)
	β_2	0.0003	-0.0035***

	(0.0026)	(0.0011)
Nº	39	39
F stat.	32.22	20.78

Source: Own elaboration. Note: Standard errors are in parentheses. The estimations under robust variance and covariance errors automatically eliminate some countries from the panel. Panel is reduced because of the availability of exports data. ***,**, and * indicate the 1%, 5% and 10% significance levels, respectively.

Table 4. Threshold levels estimated: debt-to-exports ratio

	Ratio	Confidence interval (95%)	
(A)			
Threshold 1	1.5189**	1.4564	1.5374
(B)			
Threshold 1	1.5189**	1.4564	1.5374

Source: Own elaboration. Note: ***,**, and * indicate the 1%, 5% and 10% significance levels, respectively.

In turn, in order to deal with potential endogeneity of the threshold variables and to check the robustness of the results, we apply the dynamic panel threshold model (DPTM) technique developed by Seo and Shin (2016). Unlike Hansen`s methodology, DPTM only detects one threshold (and two regimes), but admits heterogeneous parameters for all explanatory variables. The estimation results reported in Table 5 indicate that the linearity hypothesis is strongly rejected at 1% level, confirming the presence of threshold effects of debt-to-exports on growth.

The debt-to-exports threshold estimated is 286%, and is found to be significant at 5% level. It represents a higher value than the threshold level reported in Table 3. Nevertheless, under DPTM methodology the standard error is 1.14, which means that the true value of debt-to-export threshold could be between 400 and 172%. Below the threshold, the effect of external debt is positive, but beyond the threshold, debt is harmful to growth. On the effect of control variables, the results show that the convergence hypothesis is supported in both regimes; the positive effect of investment and human capital is only corroborated in the upper regime and life expectancy has an effect on growth in the low regime at 10% level.

Debt is also used as a threshold variable in order to obtain an approximation of the level from which external debt is detrimental to economic growth (third and fourth column of Table 5). The estimated debt threshold is 67.11%, with a standard error of 16.05%. Countries with a debt-GDP ratio over 67.11% will face drops in the rate of growth of GDP if they increase their external debt. Nevertheless, developing economies with low levels of debt can even increase the indebtedness with positive effects on growth dynamics.

Table 5. Estimations using DPTM

Dependent variable: Economic Growth

Threshold variable	*Debt-to-exports*		*Debt*	
	Lower regime	Upper regime	Lower regime	Upper regime
Investment	-0.0319	0.0223**	-0.0364***	0.0620***
	(0.0228)	(0.0127)	(0.0065)	(0.0069)
Initial GDP	-0.0321***	-0.0543***	-0.0210***	-0.0798***
	0.0057	0.0121	(0.0061)	(0.0095)
Life expectancy	0.1022*	0.0038	-0.1460***	-0.0636
	0.0557	0.0417	(0.0253)	(0.0390)
Human capital	-0.0374**	0.0691***	0.0708***	0.0708***
	0.0176	0.0119	(0.0149)	(0.0150)
Debt	0.0486***	-0.0456***	0.0753***	-0.0762***
	0.0072	0.0074	(0.0117)	(0.0113)
Threshold level	2.8567**		0.6711***	
	(1.1443)		(0.1605)	

Bootstrap for linearity test	p-value=0.0000	p-value=0.0000

Source: Own elaboration. Note: Standard errors are in parentheses. ***,**, and * indicate the 1%, 5% and 10% significance levels, respectively.

5. Conclusions

The results found in this paper present additional evidence supporting the hypothesis of a nonlinear relationship between the level of indebtedness and economic growth in developing countries. In fact, these indicate that the effect of debt positively affects growth when the initial GDP is low enough, while the effect of debt on growth becomes not significant and negative as the level of initial GDP gets larger. In other words, poorest economies can leverage credits pushing up their growth, whereas countries with higher levels of product can suffer the damages of debt in terms of less economic growth. This can be explained from the scarcity of capital in lower income countries, which could allocate the funds that come from indebtedness to expand their productive capital and then promote economic growth.

According to the literature, the threshold found for debt/GDP in the sample and time period analyzed is lower than those found for developed countries. In this sense, the debt /GDP ratio from which the debt begins to be harmful to growth is approximately of 67%, which is lower than the 90% found previously in the literature for developed countries.

On the other hand, Poison et al. (2002) find that in developing countries the indebtedness is detrimental for growth once this exceeds one and a half times the value of their exports. While for Imbs and Ranciere (2005) this threshold is located at 2. Interestingly, the results found here show a higher threshold of 2.86, which in turn depends on the methodology that is applied.

Hence, the results seem to indicate that the poorest economies can take advantage of indebtedness to promote economic growth for ratios of debt/GDP and debt-to/exports below 0.67 and 2.86, respectively. The idea is that beyond such thresholds the countries face difficulties to reach the payment capacity, and have to allow bulky amounts of resources to meet their debt commitments, which in turn reduces the productive capacity and then economic growth.

Finally, future extensions of this paper can be the study of the effect of external indebtedness in countries of different levels of income and openness. This should determine if, as it is expected; more open economies have a higher threshold beyond which indebtedness is

harmful for growth, because of their higher capacity of payment that comes from their higher levels of exports.

References

Ash, M., Basu, D., & Dube A. (2017). Public debt and growth: An assessment of key findings on causality and thresholds. No. 2017-10. Working Paper, 2017. Available on: https://www.econstor.eu/bitstream/10419/174419/1/2017-10.pdf

Baglan, D., & Yoldas, E. (2016). Public debt and macroeconomic activity: a predictive analysis for advanced economies. Studies in Nonlinear Dynamics & Econometrics, 20(3), 301-324.

Bentour, E.M. (2020). On the public debt and growth threshold: one size does not necessarily fit all. *Applied Economics*, 1-20. Available on: https://creg.univ-grenoble-alpes.fr/sites/creg/files/Mediatheque/Recherche/Cahiers-du-Creg/cahier_de_recherche_du_creg_2018-01.pdf

Cecchetti, S., Mohanty, M., & Zampolli, F. (2012). Achieving Growth Amid Fiscal Imbalances: The real effects of debt in Achieving maximum long-run growth. A symposium sponsored by The Federal Reserve Bank of Kansas City. Federal Reserve Bank of Kansas City.

Cordella, T., Ricci, L., & Ruiz-Arranz, M. (2005). Debt overhang or debt irrelevance? Revisiting the debt growth link. *International Monetary Fund No. 5-223*. Available on: https://www.elibrary.imf.org/view/journals/001/2005/223/article-A001-en.xml

Dabús, C. & Laumann, Y. (2006). Determinantes del Crecimiento: Evidencia Comparada de Países con Diferente Nivel de Desarrollo. Estudios de Economía Aplicada, 24(1), pp. 165-180. https://www.redalyc.org/articulo.oa?id=30113179007.

Deshpande, A. (1997). The debt overhang and the disincentive to invest. *Journal of Development Economics*, 52 (1), 169-187.

Eberhardt, M., & Presbitero, A (2013). This time they are different: heterogeneity and nonlinearity in the relationship between debt and growth. *IMF Working Paper WP/13/248*. Available on: https://www.elibrary.imf.org/view/journals/001/2013/248/article-A001-en.xml

Eberhardt, M., & Presbitero, A. (2015). Public debt and growth: Heterogeneity and non-linearity. *Journal of international Economics,* 97 (1), 45-58.

Égert, B. (2015). Public debt, economic growth and nonlinear effects: Myth or reality?, *Journal of Macroeconomics* 43, 226-238.

Elmeskov, J., & Sutherland, D., (2012). Post-crisis debt overhang: growth and implications across countries. OECD Economics Department: mimeo. Available on: http://www.oecd.org/dataoecd/7/2/49541000.pdf.

Greiner, A., (2011). Economic growth, public debt and welfare: comparing three budgetary rules. *German Economic Review* 12, 205–222.

Hansen, B. E. (1999). Threshold e§ects in non-dynamic panels: estimation, testing, and inference*, Journal of Econometrics*, 93, 334-368

Imbs, J., & Rancièri, R. (2005). The overhang hangover. CEPR Discussion Paper 5210. Available on: https://repositori.upf.edu/bitstream/handle/10230/909/878.pdf?sequence=1&isAllowed=y

Karadam, D.Y. (2018). An investigation of nonlinear effects of debt on growth. *The Journal of Economic Asymmetries*, 18, 1-13.

Kourtellos, A., Stengos, T., & Tan, C. M. (2013). The effect of public debt on growth in multiple regimes. *Journal of Macroeconomics*, 38, 35-43.

Levine R. & Renelt, D. (1992). A Sensitivity Analysis of Cross-Country Growth Regressions. American Economic Review, 82(4), pp. 942-963. https://www.jstor.org/stable/2117352

Minea, A., & Parent, A. (2012). Is High Public Debt Always Harmful to Economic Growth? Reinhart and Rogoff and some complex non-linearities. *CERDI Working Papers 201218*. Available on: https://halshs.archives-ouvertes.fr/halshs-00700471/document

Monterubbianesi, P. D., Rojas, M. L., & Dabús, C. D. (2021). Educación y salud: evidencia de efectos umbral en el crecimiento económico. *Lecturas de Economía*, (94), 195-231.

Ndoricimpa, A. (2020). Threshold effects of public debt on economic growth in Africa: new evidence. *Journal of Economics and Development*, 22 (2),187-207.

Ndoricimpa, Arcade (2017): Threshold Effects of Debt on Economic Growth in Africa, African Development Review, 29 (3), 471-484.

Panizza, U., & Presbitero, (2013). Public debt and economic growth in advanced economies: a survey. *Swiss Journal of Economics and Statistics* 149, 175–204.

Pescatori, A., Sandri, D. & Simon, J. (2014). Debt and growth: is there a magic threshold? *International Monetary Fund*, No. 14-34. Available on: https://www.elibrary.imf.org/view/journals/001/2014/034/article-A001-en.xml

Poirson, H., Ricci L. & Pattillo, C. (2002). External debt and growth. *International Monetary Fund* No. 02/69. Available on: https://www.elibrary.imf.org/view/journals/001/2002/069/article-A001-en.xml

Poirson, H., Ricci, L. & Pattillo, C. (2004). What are the channels through which external debt affects growth? *International Monetary Fund No. 4-15*. Available on: https://www.elibrary.imf.org/view/journals/001/2004/015/article-A001-en.xml

Prebitero, A. (2012). Total public debt and growth in developing countries. *The European Journal of Development Research*, 24(4), 606-626.

Reinhart, C. M., & Rogoff, K. S. (2010). Growth in a Time of Debt. *American economic review*, 100(2), 573-78.

Rojas, M. L., Monterubbianesi, P. D. & Dabús, C. (2019). No linealidades y efectos umbral en la relación capital humano-crecimiento económico. Cuadernos de Economía, 38(77), pp. 425-459. https://doi.org/10.15446/cuad.econ.v38n77.67984

Schneider, B. (2014). Sovereign Debt Restructuring: the Road Ahead, in *Life After Debt: The Origins and Resolutions of Debt Crisis*, Part III, edited by Joseph Stiglitz and Daniel Heymann, Palgrave Macmillan, International Economic Association.

Seo, M. H., Kim, S., & Kim, Y. J. (2019). Estimation of dynamic panel threshold model using Stata. *The Stata Journal*, *19*(3), 685-697.

Wang, Q. (2015). Fixed-effect panel threshold model using Stata. *The Stata Journal*, *15*(1), 121-134.

Woo, J., & Kumar, M. S. (2015). Public debt and growth. *Economica,* 82(328), 705-739.

Fischer, A. M. (2018). Debt and development in historical perspective: The external constraints of late industrialisation revisited through South Korea and Brazil. The World Economy, 41(12), 3359-3378.

Basu, M. S. S., Boz, M. E., Gopinath, M. G., Roch, M. F., & Unsal, M. F. D. (2020). A conceptual model for the integrated policy framework. International Monetary Fund.

Tanna, S., Li, C., & De Vita, G. (2018). The role of external debt in the foreign direct investment–growth relationship. International Journal of Finance & Economics, 23(4), 393-412.

Appendix

Table A.1
List of developing countries

Algeria	Gambia	Niger
Argentina	Ghana	Pakistan
Bangladesh	Guatemala	Panama
Benin	Guyana	Paraguay

Bolivia	Haiti	Peru
Botswana	Honduras	Philippines
Cameroon	India	Rwanda
Central African Republic	Jamaica	Senegal
Chad	Kenya	Sierra Leone
Colombia	Madagascar	South Africa
Costa Rica	Malaysia	Sri Lanka
Dominican Republic	Mali	Thailand
Ecuador	Mexico	Tunisia
El Salvador	Morocco	Turkey
Fiji	Nepal	Zimbabwe
Gabon	Nicaragua	

Source: own elaboration.

Table A. 2
Descriptive statistics of variables

Variable	Mean	Std. Dev.	Min	Max
Growth	0.0157442	0.0280841	-0.0790594	0.161995
Real per capita GDP	7.495984	1.004617	5.376585	9.624901
Investment	3.007066	0.3795998	1.273971	3.959564
Debt-to-GDP ratio (IMF)	0.5809699	0.6591415	0.0440265	7.535326
Debt-to-GDP ratio (WB)	0.5302023	0.655414	0.0140161	8.393853
Debt-to-exports ratio	2.768541	3.196205	0.1986801	38.60731
Human capital	1.826967	0.5145243	1.011596	3.012178
Population	1.951434	0.1545669	-0.0755246	2.270037
Life expectancy	4.102121	0.1770507	3.355237	4.381003
Inflation	-0.8285561	0.4661888	-1.062155	3.652969
Openness	0.6228872	0.341343	0.0857035	2.215171

Public expenditure	2.519173	0.3616642	1.354068	3.633751

Source: own elaboration.

Table A.3
Tests for linearity and remaining nonlinearity. Threshold variable: initial GDP

Model	*F.stat*	*Test*	*Critical value*		*Conclusion*
			5%	*1%*	
(A)					
Single	24.61	H0=0 vs H1=1	12.54	16.36	Rejected (1%)
Double	11.43	H0=1 vs H1=2	12.43	15.88	No rejected
(B)					
Single	30.56	H0=0 vs H1=1	13.01	15.99	Rejected (1%)
Double	12.18	H0=1 vs H1=2	12.08	17.13	Rejected (5%)
Triple	20.55	H0=2 vs H1=3	26.52	37.00	No rejected
(C)					
Single	21.73	H0=0 vs H1=1	12.1	14.62	Rejected (1%)
Double	13.95	H0=1 vs H1=2	11.32	16.19	Rejected (5%)
Triple	16.61	H0=2 vs H1=3	19.79	30.75	No rejected
(D)					
Single	27.29	H0=0 vs H1=1	11.94	15.86	Rejected (1%)
Double	16.22	H0=1 vs H1=2	11.32	15.78	Rejected (1%)
Triple	9.57	H0=2 vs H1=3	15.54	23.94	No rejected

Source: own elaboration.

Table A.4
Tests for linearity and remaining nonlinearity. Threshold variable: debt-to-export ratio

Model	*F.stat*	*Test*	*Critical value*		*Conclusion*
			5%	*1%*	
(A)					
Single	16.31	H0=0 vs H1=1	13.76	19.43	Rejected (5%)
Double	6.68	H0=1 vs H1=2	12.35	15.44	No rejected
(B)					
Single	14.5	H0=0 vs H1=1	14.68	18.34	Rejected (5%)*
Double	7.22	H0=1 vs H1=2	12.77	19.33	Rejected

Source: own elaboration. Note: *the F statistic is in the line of critical value with a p-value of 0.051. So, we reject the null hypothesis and accept the existence of a single threshold.