JOURNAL OF ECONOMIC DEVELOPMENT
Volume 50, Number 3, September 2025

PUBLIC DEBT, CORRUPTION AND GROWTH: ARE THERE ANY THRESHOLD EFFECTS?

ALI BENABDENNOUR

University of Gabes. Tunisia

Adopting a Panel Threshold Regression (PTR) model, for 96 countries during the period 2010-2019, we propose to verify that the public debt-corruption-growth nexus is non-linear. The stylized facts show that growth starts to increase with debt and then it decreases. Remarkable differences are observed between high-income countries and low and middle-income countries in debt, corruption, and growth. For the whole sample, as well as for the two subsamples of high-income countries and low and middle-income countries, the results estimate thresholds associated to debt and to control of corruption that separate different growth regimes. Debt is a lever only if its level is low and/or control of corruption is high. The latter is estimated to have limited (for entire sample) and retarded (for high-income countries) the negative effects of debt on growth. Thus, for pro-growth debt, it is necessary to control debt and fight corruption. These factors contribute to canalize financial resources towards productive activities, to reduce uncertainty about the future and to stimulate capital accumulation.

Keywords: Public Debt, Corruption, Growth, PTR, Threshold, Non-linearity
JEL Classification: C23, C24, D73, H63, O43

1. INTRODUCTION

Do high levels of public debt reduce economic growth? Panizza and Presbitero (2012) answered "We don't know". This answer is justified by the complexity of the relationship between public debt[1] and growth. The question continues to interest economists, especially with the unprecedented levels of debt in many countries.

The World Bank (2020) shows a remarkable increase in the public debt of low and middle-income countries. It estimates that their debt burden is increasing and

[1] Public debt or debt is the public debt to GDP.

contributing to the vulnerability of their economies. Between 2017 and 2018, the external debt stock of these countries increased by 5.20%. Between 2008 and 2018, the share of low and middle-income countries with external debt, as a percentage of Gross National Income (GNI), below 30% fell from 42% to 25%; the share of them with external debt as a percentage of GNI above 60% and 100% rose to 30% and 9%, respectively.

A similar trend is observed for the most advanced countries, especially after the financial crisis of 2007. This crisis had significant negative consequences on the public finances of many advanced economies. The National Institute of Statistics and Economic Studies (INSEE, 2021) shows that the French debt was 60%-65% over the period 2000-2006; the debt increased to 90% in 2011 and to 115% in 2020. Japan has much higher debt; between 2000 and 2010, the debt of Japan has passed from 100% to 162% and reached 200% in 2016 (World Bank, 2021b).

Many studies have proposed to examine the effects of public debt on growth. The retained conclusions show that there is no unanimity regarding the nature of nexus and the magnitude of the effects. Public debt is assumed to be a complement to national saving and to contribute to capital accumulation and growth (Nurkse, 1953 and Keynes, 1936). It can encourage growth, if the real cost of budgetary stimulus is lower than the cost of debt (Krugman, 2009). It is a source of sustainable and inclusive growth, on condition that it is rigorously managed (World Bank, 2021a). Public debt decreases growth by reducing saving and capital accumulation (Baldacci and Kumar, 2010 and Diamond, 1965), by increasing uncertainty about the future (Kumar and Woo, 2010), and by favoring the shadow economy (Cooray et al., 2017).

A non-linearity in the debt-growth nexus is identified. This non-linearity is associated to the level of debt (Eberhardt and Presbitero, 2015; Reinhart and Rogoff, 2010; Pattillo et al., 2004 and Krugman, 1988), the quality of governance (Law et al., 2021; Ibrahim 2021; Sami et al., 2019; Benfratello et al., 2018; Cooray et al., 2017 and Jalles, 2011) or the level of development (Calderon and Fuentes, 2013). The relationship between debt and growth can be bidirectional (Ferreira, 2009) or from growth to debt (Guex and Guex, 2018 and Pescatori et al., 2014) or, simply, there is no significant relationship (Schclarek, 2004).

Thus, it is difficult to believe that there is a clear trend of the effect of debt on growth. Many factors influence this effect. These are, mainly, the level of public debt, the quality of governance and the specific characteristics of the economy.

The purpose of this paper is to study the relationship between public debt, corruption and economic growth. The study uses annual and cylindered data for a panel of 96 countries over the period 2010-2019. By adopting the Panel Threshold Regression (PTR) model, developed by Hansen (1999), we propose to verify that the relationship between public debt, corruption and growth is non-linear. The aim is to identify endogenously the thresholds associated to public debt and corruption that separate different growth regimes. Section 2 is a literature review. Section 3 presents the data and stylized facts. Section 4 specifies the econometric model. Section 5 presents the estimation results.

Section 6 is a conclusion.

2. LITERATURE REVIEW

The relationship between debt and economic growth has interested economists for a long time. Different visions are advanced. The classical analysis considers that the government must ensure its functions by its own resources; debt should not be encouraged because it leads the government to unnecessary spending (Smith, 1759). The Ricardian equivalence theorem, initiated by Ricardo (1817) and reformulated by Barro (1974), emphasizes the neutrality of public debt. It considers that the interest payments induced by debt will lead to an increase in taxes. Acting rationally, anticipating a tax increase, economic agents decide to reduce their consumption and increase their saving. Thus, the debt has no real effect. This is a reason why Samuelson (1995)[2] thinks that there is some truth in assuming that the budget must be permanently balanced.

Keynesian-inspired analyses argue that it is possible to stimulate economic activity by raising debt. The latter, assumed to be a complement to national saving, helps to promote investment and growth. Debt increases the capital stock, productivity, income and, subsequently, aggregate demand (Nurkse, 1953). However, a positive relationship between debt and growth requires that the productivity of borrowed capital be higher than the cost. This condition can be verified only if the debt is oriented towards productive expenditures. Krugman (2009) proposes that sufficiently large budget deficits today are necessary to promote the welfare of future generations. The author considers that a part of the budgetary stimulus is financed by the increase in income that results from it. The real cost of budgetary stimulus is only 60%.

Overall, the recent studies that have analyzed the effects of public debt on growth can be classified into three categories. The first estimates a negative linear effect. The second assumes that the relationship can be non-linear; in this case, different growth regimes are identified with reference to thresholds associated to one (or more) transition variable(s). The third considers that the effect of public debt on growth is conditioned by institutions and the quality of governance.

2.1. Linear Relationship

Same papers have estimated a negative effect of public debt on growth. Chowdhury (2001) shows that this effect is independent to the level of development; it is verified for rich and poor economies. Sen et al. (2007), for a sample of Latin American countries over the period 1970-2000 and a sample of Asian countries over the period 1982-2002, estimate a negative effect for both samples; the negative effect is higher for Latin

[2] Cited by Nersisyan and Wray (2011).

American countries. Eberhardt and Presbitero (2015), for a panel of 118 countries over the period 1960-2012, detect different negative marginal effects across countries; the negative effect is more important if the country is more indebted. Ferreira (2009), for 20 OECD countries over the period 1988-2001, estimates a negative effect of debt on investment, consumption and growth. The effect is statistically significant and is manifest in both directions: high debt reduces growth and low growth aggravates debt.

Some arguments are advanced to justify the negative effect of public debt on growth. Pattillo et al. (2004) and Elmendrof and Mankiw (1999) consider that high debt discourages capital accumulation and reduces total factor productivity. An increase in debt leads investors to anticipate higher taxes and lower returns on investment (Aguiar et al., 2009 and Krugman, 1988) and contributes to capital flight (Deppler and Williamson, 1987). An increase in debt favors the probability of financial repression (Cochrane, 2011) and the risk of default (Reinhart et al., 2012); in both cases the interest rate rises and private investment decreases.

A high debt increases the probability of default; thus, a question of credibility is posed. We note that performing countries benefit from a virtuous cycle; the absence of default increases confidence, improves the rating and reduces the debt charge. On the contrary, when a country loses the confidence of lenders, it finds itself in a vicious circle of rising interest rates and debt, leading to a restriction of access to capital markets and the appearance of the spectrum of failure.

2.2. Non-linear Relationship

A category of economic literature proposes that the level of debt may influence the structural relationship between debt and growth. This analysis is based on the debt overhang theory developed by Krugman (1988) and Sachs (1989). The debt overhang theory considers that beyond a given threshold, debt discourages consumption and investment and reduces growth.

In this analysis framework, the most cited study is that of Reinhart and Rogoff (2010)[3]. It is a statistical study covers a panel of 44 advanced and emerging countries. The authors observe that growth begins to decline when the debt reaches 60%; growth becomes negative when the debt exceeds 90%. For a sample of 20 OECD countries over the period 1946-2009, the authors show that average growth declined by 4% when debt increases from below 30% to above 90%. For the same sample, over the period 1790-2009, the authors observe that the average growth of economies with debt below 30% is 3.70% against 1.70% for economies with debt above 90%.

The results of Reinhart and Rogoff (2010) had an important impact on policy makers. The vice president of the European Commission referred to these results to justify policies to be adopted[4]: “After the crisis, public debt in the European Union increased

[3] This study has been the subject of critics addressed by Herndon et al. (2013) and Egert (2015b).

[4] An official letter sent on February 13, 2013 to European Union governments (Jensen and Parent, 2014).

from 60% to 90% of GDP. It is widely accepted, based on serious research, that when debt ratio exceed 90%, it tends to have a negative impact on economic dynamics, which leads to low growth for several years".

Many studies confirm the threshold of 90% identified by Reinhart and Rogoff (2010) (Eberhardt and Presbitero, 2015; Herndon et al., 2013 and Padoan et al., 2012). Kumar and Woo (2010), for 38 advanced and emerging countries over the period 1970-2007, estimate that above the threshold of 90% an increase in debt by 10% leads to a decline growth by 0.19%. Cecchetti et al. (2011), for 18 OECD countries over the period 1980-2006, show that, above the threshold of 84%, growth would have declined by 0.13% if debt increased by 10%. For a panel of 155 advanced and emerging economies, over the period 1970-2008, Afonso and Jalles (2013) estimate that growth declines by 0.27% if debt increases by 10%, above the threshold of 90%; the decline in growth is only 0.08% if debt is between 30% and 60%. Pescatori et al. (2014), for 34 advanced countries over the period 1875-2011, show that growth would have decreased by 4% in the year following the crossing the threshold of 90%. The authors note that this effect is in the short term; the effect is lower after 5 years and is even lower after 10 years.

Many arguments are advanced to explain the structural change in debt-growth nexus associated to the debt. Woo (2009) consider that high debt limits countercyclical fiscal policies, leading to high volatility and lower growth. The effect of debt on growth can be influenced by the means of financing the debt burden (Minea and Vilieu, 2008). Indeed, below the threshold, any increase in the public debt charge is financed by a reduction in public consumption expenditure (non-productive expenditure); above the threshold, the debt charge is financed by a reduction in investment expenditure (productive expenditure), which leads to lower growth.

Other studies, while confirming the non-linearity of the relationship between debt and growth, consider that debt thresholds are much lower. Law et al. (2021), for 71 developing countries over the period 1984-2015, estimate a threshold of 51%. Pattillo et al. (2002), for 93 countries over 1969-1998, identify a threshold of 35%; above this threshold, any increase in debt contributes to diverting resources to less productive projects. Lee et al. (2017) and Hansen (2017) estimate thresholds between 30% and 40%. These thresholds are in the 20%-60% range estimated by Egert (2015b). Medina et al. (2020), for Mexico over the period 1994-2016, identify a threshold of 27%. Below this threshold a 10% increase in debt would have increased growth by 0.19%; above this threshold, an equal increase in debt would have decreased growth by 0.35%.

Cordella et al. (2005), for a panel of 79 developing countries over the period 1970-2002, show that the threshold is identified only for low indebted countries. For these countries, the threshold is estimated between 6% and 10%. Above the threshold, debt reduces growth. For high debt countries, the impact of debt on growth is not significant. The authors explain the results by assuming that policies and/or structural factors (institutions, access to capital markets) influence the relationship between public debt and growth.

2.3. Debt, Governance and Growth

The World Bank (2021a) considers that rigorous management of public debt is necessary to stimulate sustainable and inclusive growth. Public debt can be a lever only if it is well managed, transparent, and used in the context of a credible growth policy. The priority is to ensure good debt management and transparency to create a favorable environment for investment and growth.

Many studies share this conclusion. They admit that good governance is necessary to neutralize/reverse the negative effects of debt on growth (Borissov and Kalk, 2020; Calderon and Fuentes, 2013 and Egert, 2013). For Switzerland, over the period 1894-2014, Guex and Guex (2018) show that debt does not disadvantage growth; this result is explained by the high political stability that characterizes the country. A similar conclusion is retained by Tarek and Ahmed (2017), for 17 countries in the MENA region. The authors find that political stability would have reduced debt and contributed to stimulate growth.

The channels through which governance influences the debt-growth nexus are multiple. Bad governance encourages debt (Ibrahim, 2021; Benfratello et al., 2018 and Jalles, 2011), discourages investment and contributes to capital flight (Cooray et al., 2017 and Mauro, 1996), limits access to the capital market and increases the debt charge (Cooray et al., 2017 and Cooray and Schneider, 2013), increases the size of the shadow economy and reduces tax revenues (Schneider et al., 2010) and diverts financial resources from productive activities to less productive and less transparent activities (Pattillo et al., 2002).

Cordella et al. (2005), for a panel of 79 countries over the period 1970-2002, show that in the presence of bad governance, debt reduces growth from a low debt threshold estimated at 10%; the threshold is estimated at 30% for countries characterized by good governance. These results are shared by Jalles (2011), for 72 developing countries over the period 1970-2005; the author estimates that the most corrupt countries are more disposed to have recourse to debt. Debt starts to reduce growth from debt thresholds between 20% and 30% for high corruption countries, and between 30% and 45% for low corruption countries. The results are explained by the fact that low corruption favors good debt management and reduces/retarded the negative effects on growth.

Cooray and Schneider (2013), for a sample of 106 countries over the period 1996-2012, show that the debt would have increased by 0.23% if the corruption index increases by one unit. In addition to the direct effect, the authors estimate an indirect effect of corruption on debt through the shadow economy. Debt would have increased by 0.36 if the shadow economy increases by 1%. Cooray et al. (2017) share these estimates by finding a positive relationship between corruption, shadow economy and public debt. They show that the shadow economy, encouraged by corruption, contributes to increasing debt and reducing growth. It is important, therefore, to take the necessary measures to control corruption. These measures must be sufficiently effective to reduce the size of the shadow economy, reduce public debt and stimulate growth.

Kim et al. (2017), for a panel of 77 countries over the period 1990-2014, estimate a threshold associated to the corruption perception index[5], separates two distinct growth regimes. Depending on the estimation method, the threshold is identified between 4.40 and 8.20. The marginal effect of public debt on growth is negative for countries with high corruption; above the estimated threshold, the marginal effect of public debt on growth changes sign and becomes positive.

3. DATA AND STYLIZED FACTS

The study proposes to examine the relationship between public debt, corruption and growth for a panel of 96 countries[6] over the period 2010-2019. The data are annual and cylindered. The variables are real GDP per capita growth (GGDP. Source: WDI), central government debt to GDP (Debt. Source: IMF), control of corruption (CC. Source: WGI)[7], real GDP per capita in logarithm (Lgdp. Source WDI), government final consumption expenditure to GDP (G. Source WDI), gross fixed capital formation to GDP (Inv. Source WDI), exports plus imports to GDP (Trade. Source WDI) and inflation measured by the GDP deflator (Inf. Source WDI).

We note that the sample is composed of 96 countries, including 35 high-income countries and 61 low and middle-income countries. The entire sample has average growth and debt equal to 1.89% and 52.50%, respectively. 71% of the observations have a debt lower than 60%; 10.50% of the observations have a debt less than 20% and 8.50% of the observations with a debt greater than 100%.

The decomposition of the sample with reference to debt shows that the growth starts to increase with the debt and then it decreases. In fact, the passage from a debt less than 20% to a debt between 20% and 40% is associated with an increase in growth of 0.77%; when the debt exceeds 40%, growth begins to decrease; the decrease of growth is more important if the debt exceeds 80%. The lowest growth corresponds to the highest range of debt. Passing from an average debt equal to 31.34% to an average debt equal to 141.02% corresponds to a decrease of 2.44% in growth (Table 1).

For the entire sample, the control of corruption indicator registers an average equal to 0.08. Remarkable differences are observed between the high-income countries and the low and middle-income countries; the data show a significantly higher control of corruption for high-income countries compared to low and middle-income countries (1.17 vs. -0.54). The differences between these two groups are also remarkable when referring to average growth rate and debt. Indeed, high-income countries are characterized by lower average growth (1.60% vs. 2.05%) and higher average debt

[5] Index that takes value from zero (high corruption) to 10 (low corruption).

[6] For the list of countries, see Table A1-Appendix.

[7] Indicator that takes values between (-2.5) (high corruption) and (2.5) (low corruption).

(66.50% vs. 44.48%).

Table 1. Debt, Corruption and Growth: Descriptive Statistics

	Whole Sample (960 obs.)			Debt<20 (102 obs.)			20<Debt<40 (322 obs.)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
GGDP	1.89	-22.31	23.98	1.88	-5.15	10.10	2.65	-5.27	18.05
Debt	52.50	1.56	201.39	13.16	1.56	19.96	31.34	20.08	39.97
CC	0.08	-1.56	2.40	-0.09	-1.27	2.29	-0.15	-1.38	2.40
	40<Debt<60 (259 obs.)			60<Debt<80 (128 obs.)			80<Debt<100 (67 obs.)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
GGDP	1.83	-22.31	10.16	1.77	-9.44	23.98	0.72	-12.44	4.12
Debt	48.75	40.02	59.97	70.07	60.18	79.96	86.74	80.01	99.26
CC	0.13	-1.56	2.40	0.03	-1.53	1.94	0.78	-1.41	2.08
	Debt>100 (82 obs.)			Low and middle-income (610 obs.)			High-income (350 obs.)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
GGDP	0.21	-8.99	12.51	2.05	-22.31	18.05	1.60	-8.99	23.98
Debt	141.02	101.28	201.39	44.48	4.97	174.48	66.50	1.56	201.39
CC	0.61	-1.16	2.18	-0.54	-1.56	1.03	1.17	-0.30	2.40

Overall, the observations suggest that the relationship between debt and growth may be non-linear. With reference to debt, different growth regimes can be identified. In these regimes the effect of debt on growth and its magnitude may be not the same. Debt could promote growth in the low regime; it would lead to lower growth in the high regime. In this problematic, a probable role for the control of corruption can be identified.

4. MODEL SPECIFICATION

The heterogeneity is an important problem for panel data. Indeed, classical methods (fixed effects and random effects) detect the heterogeneity only in the intercept. However, it is possible that individual heterogeneity influences structural relationships; in this case, a non-linear specification is more plausible (Wang, 2015).

Adopting a PTR model, developed by Hansen (1999), we propose to verify that the relationship between public debt, corruption and growth may be non-linear. Thresholds associated to public debt and corruption, that separate distinct growth regimes, should be identified endogenously. The PTR model proposes the following specification:

$$GGDP_{it} = \alpha_i + \beta\, X_{it}(q_{it}, \gamma) + \varepsilon_{it}, \quad (1)$$

where α_i is the individual fixed effects, X_{it} is the matrix of independent variables, β is the matrix of coefficients; we note that β is a function of the threshold(s) (γ) associated to the transition variable (q_{it}), ε_{it} is the error term. For a single threshold (two regimes), specification (1) is reformulated as follows:

$$GGDP_{it} = \alpha_i + \beta_1 X_{it} I(q_{it} \leq \gamma) + \beta_2 X_{it} I(q > \gamma) + \varepsilon_{it}. \quad (2)$$

In specification (2), $I(\cdot)$ is an indicator function; β_i depends on the threshold (γ) associated to the transition variable q_{it}. The coefficient matrix is β_1 if $q_{it} \leq \gamma$; it is β_2 if $q_{it} > \gamma$. Two distinct growth regimes are, thus, separated by the threshold (γ). A linear growth dynamic characterizes each regime. The PTR model considers that the transition from one regime to another is brutal (in the same period)[8].

To estimate γ, Hansen (1999) considers that we should search on a subset of the transition variable q_{it}. Instead of searching on the entire sample, γ is restricted to the interval $(\underline{\gamma}, \bar{\gamma})$ which are quantiles of q_{it}. The estimator of γ, i.e. $\hat{\gamma}$, is that which minimizes the residual sum of squares. Once $\hat{\gamma}$ is known, the model is estimated by the ordinary least squares method.

Before opting for a non-linear structure, it is important to verify if the model is linear. This returns to testing the H_0 hypothesis against the H_1 hypothesis:

H_0: $\beta_1 = \beta_2$,. Linear model; *H_1: $\beta_1 \neq \beta_2$, Non-linear model.*

The F-statistic is expressed as follows: $F = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$. S_0 and S_1 are the residual sum of squares under, respectively, the null and alternative hypothesis. The null hypothesis is rejected if the F-statistic is higher than the simulated critical values. When non-linearity is verified, we have to estimate the threshold(s) associated to the transition variable. It is possible that the transition variable has more than one threshold level. In the case of two thresholds (three regimes) equation (2) is reformulated as follows:

$$GGDP_{it} = \alpha_i + \beta_1 X_{it} I(q_{it} \leq \gamma_1) + \beta_2 X_{it} I(\gamma_1 < q_{it} \leq \gamma_2) + \beta_3 X_{it} I(q_{it} > \gamma_2) + \varepsilon_{it}. \quad (3)$$

To estimate the number of regimes it is necessary to test the following hypotheses:

H_0: $\beta_3 = 0$, Two regimes model; *H_1: $\beta_3 \neq 0$, Three regimes model.*

The F-statistic is expressed as follows: $F = \frac{S_1(\hat{\gamma}_1) - S_2(\hat{\gamma}_1, \hat{\gamma}_2)}{\hat{\sigma}^2}$. S_2 is the residual sum

[8] Gonzalez (2005) developed a PSTR model proposing a smooth transition.

of squares for the three regimes model. The null hypothesis is rejected if F-statistic is higher than the simulated critical values.

5. ESTIMATION RESULTS

Before proceeding to estimation, it is necessary to test the stationarity of the variables and examine the correlation between them. Stationarity is examined by referring to the unit root test of Levin et al. (2002). The results (Table A2-appendix) indicate that all variables are stationary. The covariance matrix (Table A3-appendix) shows the absence of any correlation between the independent variables.

5.1. Linear Model

We note that the Hsiao test rejects the null hypothesis of a homogeneous model and retains the alternative hypothesis of a panel structure. The Hausman test suggests that the appropriate model is the panel model with fixed effects. The estimation results of the linear model (fixed effects) are reported in Table 2.

The results of the linear model confirm, on the whole, the principal findings of the theory and empirical studies. Indeed, the government final consumption expenditure, non-productive in nature, has a significantly negative effect on growth (Yovo, 2017). Positive and statistically significant effects are identified for domestic and foreign investment (Sarker and Khan, 2020; Khan and Kumar, 1997). The effect of trade openness is, also, positive and significant (Benabdennour, 2013; Berthélemy et al., 1997; Edwards, 1998). For debt, the results estimate a negative and significant direct effect; a 10% increase in debt would have decreased growth by 0.46% (Ferreira, 2009).

Table 2. Estimation of Linear Model

	Coef.	T-Stat.
Lgdp	2.96***	2.62
G	- 0.35***	- 4.83
Inv	0.04*	1.72
Ide	0.05***	3.71
Inf	-0.02	-1.28
Trade	0.05***	5.53
Debt	- 0.04***	- 5.28
CC	0.97	1.39
C	-30.95**	-2.29

Note: ***, ** and * indicate that the coefficient is significant at 1%, 5% and 10%.

However, the stylized facts presented above suggest that the relationship between debt and growth may be non-linear. In this sense, many empirical studies have concluded that debt disadvantages growth only if its level is high. Other studies suggest that the effect of debt on growth may be influenced by the control of corruption.

5.2. Non-linear Model

The estimation results of the non-linear model identify two thresholds associated to the debt. The first is equal to 37.97% and the second is equal to 73.42%. Three growth regimes are thus detected. The first, low regime, is characterized by a debt below 37.97%; the second is characterized by a debt between 37.97% and 73.42%; the third, high regime, corresponds to a debt above 73.42%. For the control of corruption, the results estimate two growth regimes separated by a threshold equal to (-0.79). The estimation results of the non-linear models are reported in table 3.

Model 1 shows a positive and significant effect of debt on growth if its level is low. In the low regime, a 10% increase in debt would have increased growth by 0.41%. If debt exceeds the 37.97% threshold, the effect of debt on growth is positive but not significant. From a debt threshold equal to 73.42%, debt starts to have a significant negative impact on growth. In the high regime, a 10% increase in debt would have reduced growth by 0.10%. Note that the magnitude of the increase in growth in the low regime is greater than that of the decrease in growth in the high regime (250%, approximately).

Table 3. Estimation of Non-Linear Models: Whole Sample

	Model 1: Threshold associated to Debt		Model 2: Threshold associated to CC	
	Coef.	T-Stat.	Coef.	T-Stat.
Lgdp	0.0621	1.45	0.1353***	3.14
G	- 0.1494***	-6.28	- 0.1575***	- 6.75
Inv	0.0195	1.28	0.0264*	1.76
Ide	0.0276**	2.04	0.0266**	2.00
Inf	0.0111	0.79	0.0085	0.61
Trade	0.0074***	3.23	0.0086***	3.81
CC	0.5061***	4.37	0.0944	0.74
Debt				
0	0.0416***	3.24	- 0.0472***	- 9.39
1	0.0084	1.23	- 0.0139***	- 4.82
2	- 0.0100***	- 2.84		
C	1.8700**	2.28	2.3383***	3.04

Note: ***, ** and * indicate that the coefficient is significant at 1%, 5% and 10%.

At the low regime, the positive effect of debt on growth is explained by the fact that a low debt favors its canalization towards the most productive activities. In this range, debt is a complement to saving and helps to stimulate capital accumulation and growth. On the contrary, in the high regime, any increase in debt diverts resources to less profitable projects (Pattillo et al., 2002); the financing of the debt charge by a fall in productive expenditure and uncertainty about the future are factors that can also justify the negative effect of debt on growth in the high regime. In this sense, high debt can have a negative effect on capital accumulation and growth through higher long-term interest rates, higher tax rates and a general constraint on countercyclical fiscal policies (Rugy and Salmon, 2020).

We note that these results explain, in part, the stylized facts presented above of (1) the increase in growth with debt if the latter is below 40% and (2) the considerable decline in growth if debt exceeds 80%. Overall, these results confirm those retained by Caner et al. (2010). Indeed, Caner et al. (2010) estimate a threshold of 77% for debt at which growth falls by 0.17% if debt increases by 10%.

Model 2 estimates a significant role for the control of corruption in the debt-growth nexus. Indeed, although in both identified regimes the effect of debt on growth is negative, this effect is more important in the presence of low control of corruption; in this case, with high corruption (CC below the threshold), the negative magnitude on growth of an increase in debt is 3.40 times more important than in presence of low corruption (CC above the threshold). This result is explained by the positive effects of corruption on debt. Many studies find that if corruption increases, debt increases, leading to lower growth (Benfratello et al., 2017 and Corray et al., 2017). Also, a corrupt environment leads to bad management of debt and contributes to lower growth. In this sense, the World Bank (2021a) considers that debt can only be a lever if it is well managed, transparent and used in the context of a credible growth policy. The priority is therefore to ensure good management and transparency of the debt in order to create an appropriate environment for investment and growth.

The decomposition of the sample into two subsamples, high-income countries (35 countries) and low and middle-income countries (61 countries), shows that the relationship between debt and growth is always nonlinear. For the two groups of countries, a difference in the transition variable is observed. Indeed, the transition variable separating different growth regimes is the control of corruption for low and middle-income countries; it is, rather, debt for high-income countries (Table 4). The absence of a threshold associated to the control of corruption for the high-income countries is explained by the fact that this group has a high control of corruption that is much higher than the average of the entire sample (1.17 vs. 0.08).

For the low and middle-income countries, the debt-growth nexus is significantly influenced by the control of corruption. Two growth regimes are identified and separated by a threshold associated to control of corruption equal to (-1.042). The first regime corresponds to high corruption (CC below -1.042); in this regime a 10% increase in debt led to a significant decrease in growth of 0.653%. The second regime is characterized by

low corruption (CC above -1.042); in this regime the decrease of growth is lower if the debt increases. Indeed, in the high regime, if debt increases by 10%, growth would have decreased by 0.341%.

Table 4. Estimation of Non-Linear Models

	Low and Middle income. Threshold associated to CC		High income. Threshold associated to Debt	
	Coef.	T-Stat	Coef.	T-Stat
Lgdp	0.1013*	1.83	0.1986***	2.99
G	- 0.1878***	-5.52	- 0.1721***	-4.96
Inv	0.0317*	1.78	-0.0249	-0.64
Ide	0.0266	0.98	0.0350***	2.62
Inf	0.0053	0.34	0.0197	0.44
Trade	0.0122**	2.50	0.0070***	3.01
CC	1.0682***	3.45	-0.1735	-0.97
Debt				
0	-0.0653***	-7.73	0.0508***	3.57
1	-0.0341***	-6.81	0.0212***	2.98
2	-	-	-0.0012	-0.30
C	3.9828***	3.96	1.1930	0.85

Note: ***, ** and * indicate that the coefficient is significant at 1%, 5% and 10%.

These results confirm the main findings proposing that less corruption is necessary to reduce the negative effects of debt on growth (World Bank, 2021a and Borissov and Kalk, 2020). High corruption promotes the recourse to debt (Ibrahim, 2021 and Benfratello et al., 2018), contributes to capital flight (Cooray et al., 2017), limits access to the capital market and increases the debt burden (Cooray et al., 2017), increases the size of the shadow economy and reduces tax revenues (Kaufman, 2010) and diverts financial resources to lower productivity and less transparent activities (Pattillo et al., 2002).

For high-income countries two thresholds associated to debt are identified. These thresholds are equal to 46.42% and 102.96%; thus, three growth regimes are detected. Note that the thresholds identified for this group are higher than those estimated for the entire sample. This result is explained by the disposition of these countries of a control of corruption higher than the average of the sample leading to retard the negative effects of debt on growth (Jalles, 2011 and Cordella et al., 2005). The threshold levels identified confirm, on the whole, those estimated by many authors. Indeed, Baum et al. (2013), Ghosh et al. (2013) and Padoan et al. (2012), for samples of rich countries, estimate debt thresholds above 90%.

In the first two regimes the effect of debt is significantly positive with a lower effect in the second regime. Indeed, in the low regime, a 10% increase in debt would have increased growth by 0.50%; the increase of growth is only 0.21% if the debt is between 46.42% and 102.96%. Above the debt threshold of 102.96%, the effect of debt on growth becomes negative and insignificant.

6. CONCLUSION

The public debt-growth relationship has gained new interest because of (1) the unprecedented levels of debt that have been registered in recent years in many countries and (2) the absence of unanimity on the nature of this relationship. The aim of this paper is to propose an attempt to clarify this issue; in this attempt, particular attention is given to the role of corruption.

Our empirical study concerns a heterogeneous sample of 96 countries during the period 2010-2019. The main stylized facts show that growth starts to increase with debt and then it decreases. The decrease of growth is more important if the debt exceeds 80%. Remarkable differences are observed between high-income and low and middle-income countries in debt, corruption and growth.

Adopting a PTR model allows us to identify thresholds associated to debt and control of corruption that separate different growth regimes. The multiplicity of growth regimes is verified for the entire sample, as well as for the two subsamples of high-income and low and middle-income countries. Overall, the results show that debt can be a lever for growth only if its level is low and/or it is associated with high control of corruption. The results suggest that high control of corruption can limit (for whole sample) and retard (for high-income countries) the negative effects of debt.

The results are justified by the fact that the control of debt favors its canalization towards the most productive activities and stimulates capital accumulation and growth. On the contrary, a high debt diverts resources to less profitable projects and increases uncertainty on the future. The negative impact of corruption on the debt-growth nexus is explained by the fact that high corruption favors the accumulation of debt. Debt can be a lever only if it is well managed, transparent, and used in the context of a credible growth policy (World Bank, 2021a).

Thus, a pro-growth debt requires the control of debt and the fight against corruption. Priorities must focus on rigorous and transparent management of debt. This is a necessary condition to create a favorable environment for capital accumulation and growth.

APPENDIX

Table A1. List of Countries

Low and Middle income countries				High income countries		
Albania	Costa Rica	Kyrgyz, Rep.	Russian	Australia	France	Malta
Argentina	Algeria	Lebanon	Rwanda	Austria	United King.	Norway
Armenia	Ecuador	Sri Lanka	Senegal	Belgium	Greece	Oman
Azerbaijan	Gabon	Morocco	Sierra Leone	Bahamas	Croatia	Poland
Benin	Ghana	Moldova	El Salvador	Barbados	Hungary	Portugal
Burkina Faso	Guinea	Madagascar	Chad	Canada	Ireland	Saudi Arabia
Bangladesh	Gambia, The	Mexico	Togo	Chile	Iceland	Singapore
Bulgaria	Guinea-Bissa	Mali	Thailand	Czech R.	Italy	Slovenia
Belarus	Guatemala	Mongolia	Tunisia	Germany	Japan	Sweden
Belize	Honduras	Mauritania	Turkey	Denmark	Korea, Rep.	Uruguay
Bolivia	Haiti	Malaysia	Uganda	Spain	Lithuania	United States
Botswana	Indonesia	Namibia	Ukraine	Finland	Latvia	
Brazil	India	Niger	South Africa			
Cameroon	Jamaica	Nigeria				
Congo, Rep.	Jordan	Nepal				
Colombia	Kenya	Paraguay				

Table A2. Unit Root Test (LLC, 2002)

	Stat.	P-value
Ggdp	- 14.24	0.00
Lgdp	- 7.42	0.00
G	- 10.09	0.00
Inv	- 14.71	0.00
Ide	- 14.53	0.00
Inf	- 19.84	0.00
Trade	- 8.43	0.00
Debt	- 10.72	0.00
CC	- 11.04	0.00

Table A3. Correlation Matrix

	Lgdp	G	Inv	Ide	Inf	Trade	Debt	CC
Lgdp	1.00							
G	- 0.16	1.00						
Inv	0.18	- 0.05	1.00					
Ide	- 0.01	- 0.09	0.14	1.00				
Inf	- 0.08	- 0.19	- 0.01	0.03	1.00			
Trade	- 0.17	0.15	0.11	0.47	- 0.08	1.00		
Debt	- 0.07	0.14	- 0.22	0.11	- 0.14	0.14	1.00	
CC	- 0.08	0.56	- 0.11	0.05	- 0.24	0.27	0.23	1.00

REFERENCES

Afonso, A. and J. Jalles (2013), "Growth and Productivity: The Role of Government Debt," *International Review of Economics and Finance*, 25, 384-407.

Aguiar, M., M. Amador and G. Gopinath (2009), "Investment Cycles and Sovereign Debt Overhang," *Review of Economic Studies*, 76(1), 1-31.

Baldacci, E. and M. Kumar (2010), "Fiscal Deficits, Public Debt, and Sovereign Bond Yields," IMF Working Paper, No.10/184.

Baum, A., C. Checherita and P. Rother (2013), "Debt and Growth: New Evidence for the Euro Area," *Journal of International Money and Finance*, 32, 809-821.

Benabdennour, A. (2013), "Openness, Human Capital and Multiplicity of Equilibrium," *International Journal of Economics and Finance*, 5(11), 124-132.

Benabdennour, A., S. Msakni and W. Bardi (2022), "Financial Development, Economic Development and Poverty: Is There a Threshold Effect," *Review of Economics and Finance*, 20(1), 682-692.

Benfratello, L., A. DelMonte and L. Pennacchio (2018), "Corruption and Public Debt: A Cross-Country Analysis," *Applied Economics Letters*, 25(5), 333-337.

Berthélemy, C., S. Dessus and A. Varoudakis (1997), "Capital Humain et Croissance: Le Rôle du Régime Commercial," *Revue Economique*, 48(4), 897-918.

Borissov, K. and A. Kalk (2020), "Public Debt, Positional Concerns, and Wealth Inequality," *Journal of Economic Behavior and Organization*, 170, 64-80.

Calderón, C. and J. Fuentes (2013), "Government Debt and Economic Growth," IDB Working Paper Series, IDB-WP-424.

Caner, M., T. Grennes and F. Koehler-Geib (2010), "Finding the Tipping Point-When Sovereign Debt Turns Bad," Working Paper No.5391, World Bank.

Cecchetti, S.G., S. Mohanty and F. Zampolli (2011), "The Real Effects of Debt," BIS Working Paper No.352, Bank for International Settlements.

Chowdhury, A. (2001), "External Debt and Growth in Developing Countries: A Sensitivity and Causal Analysis," UNU/WIDER Discussion Paper No.2001/95.

Cochrane, J. (2011), "Understanding Policy in the Great Recession: Some Unpleasant Fiscal Arithmetic," *European Economic Review*, 55(1), 2-30.

Cooray, A. and F. Schneider (2013), "How Does Corruption Affect Public Debt? An Empirical Analysis," Economics Working Papers No.2013-22, Department of Economics, Johannes Kepler University Linz.

Cooray, A., R. Dzhumashev and F. Schneider (2017), "How Does Corruption Affect Public Debt? An Empirical Analysis," *World Development*, 90, 115-127.

Cordella, T., L. Ricci and M. Arranz (2005), "Debt Overhang or Debt Irrelevance? Revisiting the Debt-Growth Link," *IMF Working Paper*, 05/223.

Eberhardt, M. and A. Presbitero (2015), "Public Debt and Growth: Heterogeneity and Non-Linearity," *Journal of International Economics*, 97, 45-58.

Edwards, S. (1998), "Openness, Productivity and Growth: What Do We Really Know?" *Economic Journal*, 108(447), 383-398.

Egert, B. (2015a), "Public Debt, Economic Growth and Non-Linear Effects: Myth or Reality?" *Journal of Macroeconomics*, 43, 229-238.

_____ (2015b), "The 90% Public Debt Threshold: The Rise and Fall of a Stylized Fact," *Applied Economics*, 47, 3757-3771.

Elmendorf, W. and N. Mankiw (1999), "Government Debt," NBER Working Paper No.6470.

Ferreira, C. (2009), "Public Debt and Economic Growth: A Granger Causality Panel Data Approach," Working Papers, ISSN N0874-4548.

Ghosh, A., J.I. Kim, E.G Mendoza, J.D Ostry, M.S. et Qureshi (2013), "Fiscal Fatigue, Fiscal Space and Debt Sustainability in Advanced Economies," *Economic Journal*, 123(566), 4-30.

Guex, G. and S. Guex (2018), "Debt, Economic Growth and Interest Rates: An Empirical Study of the Swiss Case, Presenting a New Long-Term Dataset 1894-2014," *Swiss Journal of Economics and Statistics*, 154(16).

Hansen, E. (2017), "Regression Kink with an Unknown Threshold," *Journal of Business and Economic Statistics*, 35(2), 228-240.

Hansen, E. (1999), "Threshold Effects in Non-Dynamic Panels: Estimation, Testing, and Inference," *Journal of Econometrics*, 93(2), 345-368.

Herndon, T., M. Ash and R. Pollin (2013), "Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff," Political Economy Research Institute, University of Massachusetts Amherst, Working Papers Series.

Ibrahim, C. (2021), "Corruption, Public Debt and Economic Growth: Evidence from Developing Countries," *International Journal of Development Issues*, 20(1), 1-22.

INSEE (2021), "https://www.insee.fr/fr/statistiques/2830301", Consulted on April 11, 2021.

International Monetary Fund (2021), "World Economic Outlook Database."

Jalles, J. (2011), "The Impact of Democracy and Corruption on the Debt-Growth Relationship in Developing Countries," *Journal of Economic Development*, 36(4), 1-26.

Jensen, P. and A. Parent (2014), "Dette Publique et Croissance: Des Erreurs Bien Choisies," *La Recherche*, 487, 62-65.

Khan, M. and M. Kumar (1997), "Public and Private Investment and the Growth Process in Developing Countries," *Oxford Bulletin of Economics and Statistics*, 59(1), 69-88.

Kim, E., Y. Ha and S. Kim (2017), "Public Debt, Corruption and Sustainable Economic Growth," *Sustainability*, 9(433).

Krugman, P. (1988), "Financing vs. Forgiving a Debt Overhang," *Journal of Development Economics*, 29(3), 253-268.

Kumar, M. and J. Woo (2010), "Public Debt and Growth," IMF Working Paper No.10/174.

Law, S., C. Ng, A. Kutan and Z. Law (2021), "Public Debt and Economic Growth in Developing Countries: Non-Linearity and Threshold Analysis," *Economic Modeling*, 98, 57-70.

Lee, S., H. Park, M. Seo and Y. Shin (2017), "Testing for a Debt-Threshold Effect on Output Growth," *Fiscal Studies*, 38(4), 561-590.

Mauro, P. (1996), "The Effects of Corruption on Growth, Investment, and Government Expenditure," IMF Working Paper No.96/98.

Medina, J., G. Medina and P. Pérez (2020), "The Impact of Public Debt on Economic Growth: An Empirical Study of Mexico," CEPAL Review, 130, 7-24.

Minea, A. and P. Villieu (2008), "Un Réexamen de la Relation Non Linéaire Entre Déficits Budgétaires et Croissance Economique," *Revue Economique*, 59(3), 559-584.

Nersisyan, Y. and L. Wray (2011), "Un Excès de Dette Publique Handicape-t-il Réellement la Croissance?" *Revue de l'OFCE*, 116, 27-51.

Nurkse, R. (1953), *Problems of Capital Formation in Underdeveloped Countries*, Oxford: Basil Blackwell.

Padoan, P., U. Sila and P. Noord (2012), "Avoiding Debt Traps: Fiscal Consolidation, Financial Backstops and Structural Reforms," *OECD Journal: Economic Studies*, 2012(1), 1-36.

Panizza, U. and A. Presbitero (2013), "Public Debt and Economic Growth in Advanced Economies: A Survey," *Swiss Society of Economics and Statistics*, 149(2), 175-204.

Panizza, U. and A. Presbitero (2012), "Public Debt and Economic Growth: Is There a Causal Effect?" Money and Finance Research Group, Working Paper No.65.

Pattillo, C., H. Poirson and L. Ricci (2004), "What Are the Channels Through Which External Debt Affects Growth?" IMF Working Paper No. 04/15.

Pattillo, C., H. Poirson and L. Ricci (2002), "External Debt and Growth," IMF Working Paper No.wp/02.

Pescatori, A., D. Sandri and J. Simon (2014), "Pas de Seuil Magique," *Finances and Développement*, 51(2), 39-42.

Reinhart, C., R. Reinhart and K. Rogoff (2012), "Public Debt Overhangs: Advanced-Economy Episodes Since 1800," *Journal of Economic Perspectives*, 26(3), 69-86.

Rogoff, K. and C. Reinhart (2010), "Growth in a Time of Debt," *American Economic Review: Papers & Proceedings*, 100(2), 573-578.

Rugy, V. and J. Salmon (2020), "Debt and Growth: A Decade of Studies," *Mercatus Center*, George Mason University.

Sachs, J. (1989), *Developing Country Debt and Economic Performance*, Chicago: University of Chicago Press.

Sami, A., R. Said, N. Ismail and N. Mazlan (2019), "Public Debt, Institutional Quality and Economic Growth in Sub Saharan Africa," *Institutions and Economies*, 11(3), 1-21.

Sarker, B. and F. Khan (2020), "Nexus Between Foreign Direct Investment and Economic Growth in Bangladesh: an Augmented Autoregressive Distributed Lag Bounds Testing Approach," *Financial Innovation*, 6, 10.

Schneider, F., A. Buehn and C. E. Montenegro (2010), "New Estimates for the Shadow

Economies All Over the World," *International Economic Journal*, 24(4), 443-461.
Tarek, A. and Z. Ahmed (2017), "Governance and Public Debt Accumulation: Quantitative Analysis in MENA Countries," *Economic Analysis and Policy*, 56, 65-75.
Wang, Q. (2015), "Fixed-Effect Panel Threshold Model Using Stata," *Stata Journal*, 15(1), 141-160.
World Bank (2021a), "Dette et Développement," Consulted on January 30, 2023.
_____ (2021b), "World Development Indicators."
_____ (2021c), "Worldwide Governance Indicators."
_____ (2020), "International Debt Statistics."
Yovo, K. (2017), "Public Expenditures, Private Investment and Economic Growth in Togo," *Theoretical Economics Letters*, 7, 865-870.

Mailing Address: Ali Benabdennour, Research Unit 3E. Higher Institute of Management of Gabes. Road Jilani Lahbib, 6002, Gabès. Tunisia, Email: ali_benabdennour@yahoo.fr

Received February 11, 2023, Accepted September 17, 2025.