

# Threshold Effect of Public Debt on Economic Growth: An Empirical Investigation for Selected North African Countries

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## Abstract

In this paper, we examine the non-linear relationship between public debt and economic growth, using panel data for 4 North African countries (Tunisia, Algeria, Morocco and Egypt) from 2003 to 2012. Applying a Panel Threshold Regression (PTR) model proposed by Hansen (1999), we got empirical results indicating that public debt lower than 42,8% of GDP is positively effected by economic growth. However, beyond this threshold of public debt, this relationship becomes negative, which implies that public debt seems to reduce economic growth. Therefore, the policy implication is to address fiscal consolidation and reduce public debt so as to stimulate the economic growth of the 4 North African countries.

**Keywords:** Public debt, Economic growth, PTR model

**JEL:** H63, O4, C24

## 1. Introduction

The sharp increase of the sovereign debt, as a result of the 2008-2009

global financial crisis, has a dramatic repercussion on the public finance of the developed countries. Different countries of the euro zone suffered from the increase of the levels of deficits and public debt. In many industrial countries, Cecchetti et al. (2010) showed that the public debt trajectories have become unsustainable. In fact, public debt is considered to act as a drag on economic growth. Consequently, it is necessary to take rigorous measures to avoid adverse effects of public debt on the long-term growth and monetary stability. Therefore, the government must reduce public debt, as a burden on future generations in order to boost economic growth.

This crisis led to a debate among economists and policy makers about the effect of public debt on several macroeconomic variables such as inflation, monetary policy<sup>1</sup> and investment<sup>2</sup>. In recent years, the impact of public debt on economic growth has been the major issue in the economic debate. In this regard, the major question that should be raised is whether a large public debt contributes to economic growth, or on the contrary, it is harmful to it.

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<sup>1</sup> Abdelkafi (2018) examined the relationship between public debt, economic growth and monetary policy in Tunisia over the 2002-2013 period.

<sup>2</sup> Benayed et al. (2015) indicated that public debt is negatively associated with domestic investment when its threshold exceeds 47,31% of GDP for 10 African countries during the 1981-2010 period.

In fact, several empirical studies, which have been interested in the possibility of the existence of a non-linear effect of public debt on economic growth, were conducted by Reinhart and Rogoff (2010), Kumar and Woo (2010) and Checheritta and Rother (2010). Generally, these studies showed that economic growth decreases if public debt threshold exceeds 90% of the GDP.

The question of indebtedness, which is a widely debated subject mainly where fiscal imbalances are important, is not limited to the developed countries. This problem is also addressed to the developing countries. However, only a few studies have been conducted in the African countries.

The aim of this paper is then to add to the existing literature on public debt and economic growth by using a Panel Threshold Regression (PTR) model. We apply annual data for 4 North African countries (Tunisia, Algeria, Morocco and Egypt) over the 2003-2012 period.

The rest of the paper is organized as follows: the second section is devoted to presentation of the theoretical and empirical literature review. The third section presents the Panel Threshold Regression (PTR) model, the data and the empirical results.

## 2. Literature review

The impact of public debt on economic growth has been the subject of several theoretical and empirical analysis, but the conclusions are different. In the literature, some studies found that public debt has a negative effect on economic growth, while others found a non-linear impact.

Moreover, the theoretical literature indicated a negative relationship between public debt and economic growth. For instance, Meade (1958), Modigliani (1961), Diamond (1965) and Saint-Paul (1992) used a neoclassical growth model and showed that

national debt is a burden for next generations. They found that an increase of public debt decreases economic growth.

In fact, some of the empirical literature appears to support this theoretical consideration by focusing on the role of external debt mainly in the developing countries. For his part, Schclarek (2005) empirically studied the relationship between debt and economic growth in both developing and industrial countries over the 1970-2002 period. He found that, in the developing countries, the growth rate is high when the level of external debt is low. This confirms the existence of a negative effect of external debt on economic growth.

After examining the impact of domestic debt and external debt on economic growth in Pakistan during the 1980-2010 period, Atique and Malik (2012) showed an inverse relationship between domestic debt and economic growth as well as between external debt and economic growth. They also found that the decrease of economic growth is remarkable following the increase of the external debt rather than after the increase of the domestic debt. The authors concluded that external debt has an important negative effect on economic growth.

Using a panel of fixed effects model rate for the East African Community from 1970 to 2010, Babu et al. (2014) also found that external debt has a negative and significant effect on economic growth.

Likewise, Mousa and Shawawreh (2017) investigated the same relationship for the case of Jordan over the 2000-2015 period and found that the impact of external debt is negative, as an increase of external debt will lead to a decrease of economic growth.

Using a sample of six Central African Economic and Monetary Community (CEMAC) countries between 2000 and 2016, Njangang (2018) confirmed that public debt has an

adverse effect on economic growth. In fact, he asserted that the higher the debt is, the lower economic growth will be.

However, several empirical studies showed that the relationship between public debt and economic growth may be non-linear and characterized by a threshold of indebtedness from which the effect of public debt becomes negative.

This problem was firstly addressed by Reinhart and Rogoff (2010). In their paper, they examined the evolution of public debt and economic growth in 44 advanced countries and emerging markets during a 200-year period. They found that economic growth slows down when the ratio of public debt to GDP rises above 90%.

For 12 euro zone countries during the 1970-2011 period, Checherita and Rother (2010) stressed the non-linear effect of government debt on the per capita GDP growth. These authors showed that if the public debt-to-GDP ratio exceeds 90-100%, an increase of debt reduces long-term growth.

In the same vein, and on a sample of 101 developing and developed economies from 1980 to 2008, Caner et al. (2010) argued that the effect of debt on economic growth depends on a threshold of public debt. Their empirical results showed a threshold of debt equal to 77% of GDP. Above this threshold, the effect of public debt becomes negative.

Similarly, the results obtained by Kumar and Woo (2010) for 38 advanced and emerging countries during the 1970-2007 period, indicated an inverse relationship between the initial debt and the subsequent growth. It is beyond a debt threshold that debt has negative effect on growth.

Furthermore, Chang and Chiang (2011) focused on 21 developing Latin American and Caribbean countries between 1962 and 2006

and found two debt thresholds of 32,88% and 55,89% of GDP. Between 32,88% and 55,89% of GDP, the impact of public debt on economic growth is positive, while when the threshold is below 32,88% and above 55,89%, the relationship becomes negative.

On a sample of 18 OECD<sup>3</sup> countries over the 1980-2010 period, Cecchetti et al. (2011) found that when government debt goes beyond 85% of GDP, it has a negative effect on economic growth.

For their part, Afonso and Jalles (2013) focused on the debt-growth nexus on a sample of 155 developed and developing countries during the 1970-2008 period and confirmed the existence of nonlinearity and the relevance of the debt threshold. The empirical analysis showed a debt threshold equal to 59% of GDP for the euro zone and a value higher than 79% for the emerging ones. The authors also concluded that an increase of public debt by 10% causes a decrease of economic growth by 0.2%, for countries with debt above 90% and below 30% of GDP.

Using a panel dynamic ordinary least squares for 13 Caribbean countries over the 1990-2012 period, Wright and Grenade (2014) found evidence of a non-linear relationship between public debt and economic growth. The authors's estimation results suggested a threshold of debt of 61% of GDP, beyond which public debt hampers economic growth.

In a paper investigating 29 OECD countries during the 1960-2010 period, Egert (2015) confirmed the existence of a negative nonlinear relationship between public debt and economic growth. He also showed that this nonlinearity is established when public debt is very low (between 20% and 60% of GDP).

Using a Panel Threshold Regression (PTR) model for 252 countries (advanced, emerging,

<sup>3</sup> Organisation for Economic Co-operation and Development

BRICS<sup>4</sup>, OECD and developing countries) from 1960 to 2009, Swamy (2015) showed the existence of a debt threshold characterizing the non-linear relationship between public debt and economic growth. The author's results are comparable to those of Reinhart and Rogoff (2010), namely a debt threshold equal to 90% of the GDP.

For South Africa's economy, Baaziz et al. (2015) also confirmed a non-linear relationship between public debt and economic growth, between 1980 and 2014. The estimation results of an LSTR<sup>5</sup> model showed a public debt threshold of 31,37%, above which the impact of public debt on economic growth becomes negative.

Focusing on the advanced economies, Serrão (2016) also indicated an inverse relationship between public debt and economic growth over the 1960-2010 period. The author found that the real GDP growth decreases if the ratio of public debt to GDP is above 220%.

Recently, on a panel composed of 4 MENA<sup>6</sup> countries, Omrane et al. (2017) have used a PSTR<sup>7</sup> model over the 1970-210 period and showed that beyond a public debt threshold of 39,5% of GDP, an increase of public debt causes a reduction of economic growth.

While the empirical literature has been interested on the indebtedness threshold across countries, Lechtenberg (2017) determined the public debt ratio to GDP threshold for individual countries using a threshold regression. On the one hand, the empirical results showed that countries with a high level of public debt have a statistically significant debt ratio to GDP threshold. On

the other hand, economic growth is adversely affected by public debt, namely the case of France, Greece, Italy, the United Kingdom and the United States.

### 3. Data, empirical methodology and estimation

#### 3.1. Data

In this paper, we used annual data for a panel of 4 North African countries, including Tunisia, Algeria, Morocco and Egypt<sup>8</sup> over the 2003-2012 period. The source of the data on the public debt ratio to GDP was given by Abbas et al. (2010). Other sources of the data are the World Development Indicators (WDI) and the International Monetary Fund (IMF) (table 1).

**Table 1.** Variables: description and data sources

Variables	Description	Sources
Government Consumption	General government final consumption to GDP	WDI
GDPt-1	GDP per capita	WDI
Economic Growth	GDP per capita growth	WDI
Investment	The ratio of gross fixed capital formation to GDP	WDI
Population Growth	Population growth	WDI
Trade openness	Trade to GDP	WDI
Public Debt	The ratio of total public debt stocks to GDP	Abbas et al. (2010)
Deficit	General government net lending/ borrowing to GDP	IMF

#### 3.2. Panel Threshold Regression model

The relationship between public debt and economic growth is estimated through a Panel Threshold Regression (PTR) model proposed by Hansen (1999). This methodology enabled

<sup>4</sup> Brazil, Russia, India, China and South Africa

<sup>5</sup> Logistic Smooth Transition Regression

<sup>6</sup> Middle East and North Africa

<sup>7</sup> Panel Smooth Transition Model

<sup>8</sup> The choice of these 4 countries is made depending, on the one hand, on the data availability, and on the other hand, on our objective which consists in having a homogeneous panel.

us to estimate the endogenous threshold. Then, the Panel Threshold Regression model is defined by:

$$EG_{i,t} = \alpha_i + \beta X + \text{debt} \cdot I(q_{it} \leq \gamma) + \text{debt} \cdot I(q_{it} > \gamma) + \varepsilon_{it}$$

The dependent variable,  $EG_{i,t}$ , designates the economic growth<sup>9</sup>. The threshold variable ( $q_{it}$ ) is the public debt ratio to GDP.  $\gamma$  is the threshold parameter.  $I(\cdot)$  is the indicator function.  $\alpha_i$  represents the country-fixed effects.  $X$  contains the control variables (the

$$\begin{aligned} EG_{i,t} &= \alpha_i + \beta X + \text{debt} \cdot I(q_{it} \leq \gamma) + \varepsilon_{it} && \text{if } q_{it} \leq \gamma \\ EG_{i,t} &= \alpha_i + \beta X + \text{debt} \cdot I(q_{it} > \gamma) + \varepsilon_{it} && \text{if } q_{it} > \gamma \end{aligned}$$

The estimation of this model requires several steps. In the first step, we estimate the equation using the ordinary least squares procedure to identify the threshold. Afterwards, we compute the sum of squares residuals for all possible values of the threshold  $\gamma$ . The sum of squared residuals is:

$$S_1(\gamma) = [\hat{\varepsilon}(\gamma)]' [\hat{\varepsilon}(\gamma)]$$

In the second step, and following Hansen (1999), the threshold parameter is estimated by minimizing the sum of squared residuals,  $S_1(\gamma)$ , such as:

$$\hat{\gamma} = \underset{\gamma}{\text{Argmin}} S_1(\hat{\gamma})$$

In the third step, after estimating the threshold parameter, it is necessary to test the significance of the threshold level. Following Hansen (1999), the null hypothesis of linearity is written as:

$$H_0: \beta_1 = \beta_2$$

Like Hansen (1999), we use the following likelihood ratio test of  $H_0$ :

$$F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$$

general government final consumption to GDP, the growth domestic product per capita, the ratio of gross fixed capital formation to GDP, the population growth, the trade openness and general government net lending/ borrowing to GDP).

The index  $i$  ( $i=1...N$ ) refers to individual dimension (in our case, 4 North African countries) and  $t$  ( $t=1...T$ ) refers to the time dimension (2003-2012).

This equation can also be written as:

where  $S_0$  is the sum of squared residuals under  $H_0$ , i.e of the linear model.  $S_1(\hat{\gamma})$  indicates the sum of squared residuals under the alternative hypothesis, i.e of the threshold model.

However, Hansen (1999) showed that the asymptotic distribution of  $F_1$  is non-standard. To resolve this problem, he used a bootstrap procedure to simulate the asymptotic distribution of statistics  $F_1$ .

### 3.3. Empirical results

Table 2 reports the results of the Panel Threshold Regression (PTR) model estimation. For a panel of 4 North African countries over the 2003-2012 period, the relationship between public debt and economic growth is non-linear. The estimated public debt threshold is established at a level of 42,8% of GDP.

<sup>9</sup> The economic growth is obtained through the following equation:  $EG_t = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}} * 100$

**Table 2.** Estimation of the non-linear effect of public debt on economic growth

Dependent variable: Economic Growth		
Explanatory variables	Regime 1: Public debt<42.8%	Regime 2: Public debt> 42.8%
Deficit	-0.0903 (-1.4969)	-0.2543 (-1.3542)
GDP <sub>t-1</sub>	-0.0268 (-7.7269***)	-0.169 (-3.3483***)
Population Growth	29.9824 (5.5999***)	12.5398 (1.8882*)
Investment	-0.1719 (-3.0154**)	0.2710 (1.3090)
Trade openness	0.3931 (5.3927***)	0.1080 (3.2059***)
Government Consumption	-0.5888 (-2.7064**)	0.1841 (0.3175)
Public Debt	0.1373 (2.6392*)	-0.2621 (-2.8808***)
Threshold estimate	42.8 %	
F1 statistic bootstrap p-value	0.0200	
95% confidence intervals for the threshold	[28.6, 59.8]	

\*, \*\* and \*\*\* denote the levels of the coefficient significance at 10%, 5% and 1%, respectively.

The empirical results suggest that, when public debt ratio to GDP is lower than the level of 42,8% of the GDP, the impact of public debt on economic growth is positive and statistically significant. In other words, an increase of public debt raises the economic growth. Beyond this threshold level, the relationship will be reversed and becomes negative. Thereby, additional public debt slows down economic growth.

The control variables selected in our model are similar to those used in the growth models. According to the estimation results, the control variables are statistically significant and conform to the theory.

## Conclusion

The objective of this paper is to study the impact of public debt on economic growth for 4 North African countries (Tunisia, Algeria, Morocco and Egypt) applying the Panel Threshold Regression model.

The results of the empirical analysis confirmed that the relationship between public debt and economic growth is non-linear. The threshold of the public debt ratio to GDP estimated at 42,8% is low compared to that of the developed countries.

However, the impact of public debt on economic growth varies considerably depending on the selected countries, the studied period and the econometric model used. Thus, the threshold differs substantially from one study to another. In particular, compared to Omrane et al.'s (2017) study, we found a public debt threshold different from that of Omrane et al. (2017) (42,9% against 39,5% of GDP). Our results are particular to the PTR model applied and the selected sample. Consequently, the threshold values should be interpreted with caution.

Moreover, our empirical results have some important implications for fiscal policymakers in North Africa to stimulate economic growth when public debt is low. In fact, governments must pursue a restrictive fiscal policy that helps reduce both the fiscal deficit and the public debt in order to foster economic growth. Therefore, a restrictive fiscal policy is not harmful to economic growth and may have expansionary effects on economic growth.

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