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Threshold effects of fiscal policy on economic growth in developing countries

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ABSTRACT

We examine the relation between fiscal policy and economic growth for a panel of 40 developing countries over the period of 1990 to 2012 using eight macroeconomic variables: real GDP, budget deficit, current government spending, national saving, inflation rate, total investment, public debt, and current account balance. The study documents a double threshold effect of the fiscal balance. The first one is at a level of the deficit around 4.8% of GDP; the second one is at the fiscal surplus level of 3.2% of GDP meaning that economic growth would be negatively affected when exceeding these two different levels. The result also show that the sign of the relation between budget deficit and economic growth is conditioned by the level of total investment i.e. only for total investment higher than 23%, there exists a positive relation. However, it becomes negative, when investment falls below this threshold.

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1.0 Introduction

In both theory and evidence, there are controversial thoughts and debates that focus on the impact of the fiscal deficit on economic growth. Since the nineties, this subject becomes highly debated in the literature. Barro (1990) is considered as one of the most important pioneers in the field. He suggested a simple endogenous growth model and showed that the share of government spending in GDP might have a significant effect on economic growth. Nevertheless, a few empirical and theoretical studies have taken into account the non-linearity that can prevail on the relationship between growth and budget deficit [Minea and Villieu (2005), Adam and Bevan (2005), Tanimoune, Combes and Plane (2008) and Minea and Villieu (2008)]. These authors try to identify anti-Keynesian effects, which would be related to the persistence of high fiscal contractions.

Euro convergence criteria in the Maastricht Treaty (1993) outlined that the ratio of the annual general government deficit about gross domestic product (GDP) at market prices, must not exceed 3% at the end of the preceding fiscal year. Even though it is hardly justified[1]. The European debt crisis in 2010 shook the global economy when some indebted countries in Euro area, which had been maintaining high levels of debt and fiscal deficit, faced the default on payment of the public debt and its interest. Although the crisis mainly pertained to European countries, the concern of a similar public debt crisis is also shared by other countries in the world. This paper provides an empirical analysis to identify the nature of the relationship between budget deficit and

[1] It has been argued by many economists that the threshold of 3% was set arbitrarily and has no basis but the circumstances as European fiscal deficits in the early 90s were less than 3%. See Buiter, Corsetti and Roubini (1993, and Buiter (2006) for more details.

economic growth for a panel of 40 developing countries using annual data over the period spanning from 1990 to 2012.

This paper is organized as follows: The next section explores the theoretical literature. Section 3 will briefly return to the empirical studies around this topic. Section 4 outlines the methodological approach, data employed in the study and the finding of the econometric analysis of both linear and non-linear model by considering sequentially, the overall fiscal deficit and total investment as threshold variables. The estimation of the linear model will allow us first to identify the economic variables that affect real GDP growth. For the threshold analysis, we used the threshold estimation technique outlined by Hansen (1999). Section 5 concludes the paper and summarizes its main findings.

2.0 Theoretical studies

Before the advent of the Keynesian theory, governments tried to implement every effort to reach the fiscal balance. But with the Keynesian theory, this dogma was questioned. Keynes argued that there is a positive relationship between budget deficit and economic growth. Governments are encouraged to run deficits during the recession as it will help to stabilize the economy. On the other hand, there is the liberal theory that argued the opposite. Their main argument is related to the crowding out phenomenon. More recently, Barro[2] (1990) presented an endogenous growth model which is considered now as a fundamental reference. The model highlights an explicit link between government spending and long-run economic growth in the context of endogenous growth and shows that we can determine an optimal public spending. At this point, any additional expenditure may affect economic growth negatively. Therefore, if public expenditures exceed their optimal level, there will be a negative correlation, and conversely, if public expenditures fall below their optimal level, there will be a positive correlation. However, there are, to our knowledge, only a few theoretical studies that deal with non-linear effects of fiscal deficits in growth models. We cite by way of example reference Perotti's model (1999) where non-linear effects of fiscal policy are identified, but not in a growth context. Their model shows that government expenditure may have positive "Keynesian" effects or reversed effects depending on the initial level of public debt[3]. So, in high-debt contexts, a fiscal consolidation may reduce the risk of defaulting on sovereign debt, thus improving confidence and increasing private consumption. By using Barro's (1990) model, Greiner and Semmler (2000) removed the balanced budget assumption and analyzed different budgetary regimes. They claimed that the impact of deficit-financed increase on growth depends on the budgetary regime the government operates within. Thus, governments can generate positive growth effects of a public deficit on the growth rate only for a given debt/capital ratio and if the deficit is used primarily for public investment. Ghosh & Mourmouras (2004) extended the Greiner and Semmler framework to include welfare analysis. Their main objective is to analyze the growth and welfare implications of the golden rule of public finance. They showed that optimal fiscal policy depends on the particular budgetary regime considered.

In Barro's (1990) model, neither public debt nor public deficits are allowed. Thus, all public expenditures are productive and growth-enhancing. Minea and Villieu (2005) tried to examine the nature of fiscal deficit effects on growth by extending the Barro (1990) endogenous growth model. They introduced productive public spending, public deficit and debt in the model to study the non-linear effect of fiscal policy in the short and long run, and showed in their model how the effect of public deficit shifts from one condition to another depending on the multiplicity of balanced growth paths. In the long run, if public deficits are devoted to public investment, we will be in the presence of a lower balanced growth path. On the other hand, in the short run, the effect of public deficit depends on both the level of growth's steady states and the initial level of public debt.

3.0 Empirical studies

Beyond the theoretical debates, the study of the relationship between fiscal policy and economic growth received much attention in the empirical literature. However, it is difficult to provide an unclouded characterization of what the appropriate behavior of fiscal policy should be. Empirical results are quite often inconsistent and sometimes contradictory. This discordance regarding evaluation and finding are mainly due to multifarious factors such as time dimension, types of governments, methods of analysis as well as econometric methods that are used. By not taking into account the non-linear hypothesis, a large body of empirical literature on fiscal policy falls under the Keynesian theory, while other studies claim that having a balanced budget is more desirable as it will help the

[2] In Barro's model (1990), all public expenditures are productive and goes for public investment increasing marginal productivity of private capital, as for example infrastructure, schools, sanitation, property rights, etc. Investment public spending is financed through income taxes, complement private investments. Thus, since public investments raise the productivity of private investments, higher taxes can be associated with an increase or a decrease in overall growth.

[3] In contrast with Perotti (1999), Giavazzi, Jappelli & Pagano (2000) found no evidence of a small impact of high or rapidly growing public on non-linear effects of fiscal policy, but found instead that during periods of rapidly growing public debt the impact of taxes and government spending on national savings is significantly different.

economy to grow faster over time. To explain the "productivity slowdown" in the 1970s for the United States, Aschauer (1989) indicates, by using time series, a positive relationship between government expenditure and economic growth: a 1% increase in the ratio of public to private capital stocks raises productivity by 0.39%. However, the study points out the importance of how the public capital is composed. The core infrastructure (streets, highways, airports, mass transit, sewers, water systems, etc.) is the most important component in determining productivity. The almost same conclusion is derived from the research made by Easterly and Rebelo (1993) for the period going from 1970 to 1988. By using panel data for 28 countries and cross-sectional data for 100 countries, they found that the share of public investment in transport and communication is robustly and positively correlated with growth. Public outlays on infrastructure investment raise growth. Contrariwise, agriculture investment is consistently negatively correlated with growth, while Public enterprise investment has no effect on growth. Based on the research made by Benos (2009), the previous result related to infrastructure spending was again proven to be accurate. The author used panel data on 14 EU countries during 1990-2006 and also found that public expenditures on property rights protection enhance growth, while government expenditures on human capital have no effect on growth.

On the opposite side, other studies agreed with the liberal theory thought, in which fiscal deficits have a negative effect on economic growth. A theory that gives support to the budgetary rule assuming that obtaining a balanced budget is considered as the only way to maintain a sustainable growth over time. Within the same framework, Gupta, Clements, Baldacci, Mulas-Granados (2005) found for a panel of 39 low-income countries during the period 1990 - 2000 that a balanced budget stance generally leads to an increase in economic growth in both short and long terms. The study pointed out also the significant importance that holds the composition of public spending: when wages accounts for a big share of public expenditure, growth falls dramatically, while governments which concentrate their spending on capital and nonwage goods and services are more likely to experience a significant increase in growth. With an emphasis on the causal relationship lying between budget deficit and economic growth, keho's study (2010) focused on the member countries of the West African Economic and Monetary Union during the period 1980 - 2005. The results suggest that for three countries there is no causality link between budget deficit and growth, whereas for the remaining four countries deficits exert a negative impact on growth.

Consistent with the Ricardian equivalence hypothesis[4], other studies claimed that there is a neutral relationship between fiscal deficit and growth[5]. From Malaysia's perspective, Abd Rahman's study (2012) gives support to the previous hypothesis. By using an Autoregressive Distributed Lag Modeling, it was found that there is no long-run relationship between fiscal deficit and growth and that only the GDP and productive spending can bring the economy to its equilibrium state in a case where the Malaysian economy undergoes a shock.

Differences regarding results may be due to default in taking into account the non –linearity hypothesis as fiscal deficits may have either traditional Keynesian effects or reversed effects. Nevertheless, more recently, a major importance was given to this hypothesis. For instance, we can find Adam and Bevan's research paper (2005) where the authors try to identify thresholds effects of fiscal deficit on growth for a panel of 45 developing countries for the period 1979 - 1999. The study indicates that fiscal deficits are associated with robust non-linear effects on growth and finds evidence of a threshold effect at a level of the deficit around 1.5% of GDP. When reducing deficits to this level, there appears that governments enjoy faster growth expansion; this effect reverses itself when exceeding the determined threshold. Nearly, the same conclusion was made by Tanimoune, Combes and Plane (2008) on the pattern of public debt with a focus on the member countries of the West African Economic and Monetary Union during the period 1986 - 2002. The study indicates a threshold effect at a debt level of 83%. There appears to be a growth shrinking to exceeding debt at this level. As regards for OECD countries, Minea and Villieu (2008) carried out research to determine if there can be a non-linear effect of fiscal deficit on growth, depending on the public debt to GDP ratio. Results confirm that budget deficits are growth-increasing only for low-indebted economies as long as the debt burden may be absorbed by a cut in government consumption. In contrast, for further high debt values, raising deficits are growth-decreasing since the government can no longer reduce public consumption and the budget adjustment will inevitably rely on decreasing productive spending. Hence above a certain level of public debt, raising deficits becomes growth-reducing. The study indicates a threshold for a debt level standing at around 90%. This is consistent with the Rogoff and Reinhart's (2010) analysis. It was also claimed that exceeding 90% of public debts will result in impeding the process of economic growth. On the basis of a database covering forty-four countries spanning about two hundred years, the study finds evidence that growth for countries above 90% of public debt is -0.1% on average. A result which has been rectified in Herndon, Ash and Pollin's review study (2013) reporting only a 1% drop in growth.

[4] See Barro (1974) for more details on Ricardian equivalence.
[5] There is, however, an extensive empirical literature that has found evidence against this hypothesis [Feldstein (1986), Kotlikoff, Razin and Rosenthal (1988), Modigliani and Sterling (1990), Dalamagas (1992), Graham (1995), Evans (1993), Cardia (1997) and Banzhaf and Oates (2012)].

These last studies indicate that fiscal deficits are in general associated with strong non-linear effects on growth. In high debt contexts, growth drops off sharply. And inversely, for low debt values, growth remains high. Hence, we will investigate in this paper fiscal policy from the perspective of a non-linearity by using the panel threshold regression technique proposed by Hansen (1999).

4.0 Methodology, data, and econometric estimation

This section empirically evaluates the fiscal policy initially by considering that the relationship between fiscal policy and economic growth is a linear one and then trying to determine the economic variables that affect growth. Secondly, we will consider that this relationship may be non-linear and then conduct a threshold effects analysis by considering sequentially the overall fiscal deficit and total investment as threshold variables.

The study covers a panel of forty[6] developing countries. The sample selection was made a priori depending on data availability. Indeed, Hansen's method (1999) is valid only for a balanced panel. We use annual data for the period 1990 to 2012, the choice of the period being determined by their availability since 1990 and the lack of monthly and quarterly data.

4.1 Linear model estimation

Appendix B provides a summary of the statistics of the data and defines the variable mnemonics used later in the paper. We estimate the following empirical growth model:

$$GDP_{it} = \mu_i + \alpha_1 GE_{it} + \alpha_2 NS_{it} + \alpha_3 FD_{it} + \alpha_4 INV_{it} + \alpha_5 INF_{it} + \varepsilon_{it}$$

Where (i,t) captures the cross-sectional and temporal dimensions of the panel, μ_i represents the country-fixed effects and ε_{it} is a stochastic error term. Our econometric model is a fixed effects model where the relationship between the dependent variable and the explanatory variables are supposed to be identical for the countries in question. Using a fixed effects model will enable us to take into consideration differences regarding economic structure and history for each country. Choosing this specification is backed by the Hausman[7] and the Breusch & Pagan[8] test. As a matter of fact, it was concluded that the choice of "Within" estimator is required. To eliminate the individual effect, we will proceed by removing the individual-specific means.

The expected sign for α_5 is negative, while for α_2 and α_4 it is positive:

$$GDP_{it} = f(GE_{it}, NS_{it}, FD_{it}, INV_{it}, INF_{it})$$
$$\quad ? \quad + \quad ? \quad + \quad -$$

As regards, the domestic saving, classical and neoclassical theories show their importance for economic activity. When allowing for investment financing, savings enable for maintaining productivity growth. Aghion, Comin, and Howitt (2006) found that for poor countries, national saving plays an important role in attracting foreign investment and therefore to promote innovations. Thus, local savings matter for economic growth. Hence, we expect a positive sign for this variable. Regarding the fiscal deficit and the government current expenditure, it seems a little equivocal to predict a priori, under the linearity assumption, their impact on economic growth. While Keynesian economies showed their beneficial effect, liberal economies indicated the opposite. Similarly, for empirical literature, findings are mitigated and contradictory. Concerning investment, it is, as is well known, a determining factor of growth and productivity, for both the neoclassical and the Keynesian economies. Furthermore, it may generate, in accordance with the endogenous growth theory, positive externalities. As for inflation, Liberals consider it as highly injurious for economic growth. Besides, a wide range of empirical studies indicates a negative relationship between inflation and growth. Khan and Senhadji (2001) claimed the presence of a threshold effect of inflation on growth. Both industrialized and developing countries caught their interest. For the industrialized ones, when inflation exceeds 1-3% it has a negative impact on growth. Whereas for developing countries, inflation has constantly a negative impact on productivity, and it does widen even more when inflation surpasses 11-12%. Therefore, we expect a negative sign for inflation.

Appendix C reports the estimation results. On the basis of the information criterion[9], the best model would be (3). The p-value of the first Fisher test is below 5% (0.000), which attests to the significance of the explanatory

[6] Details of country coverage, data source and descriptions are provided in Appendix (A and B).
[7] The Hausman test probability is less than 10% (P-value = 0.0002% <10%), implying that the fixed effects model is preferred over random effects model.
[8] This test allows examining the significance of the individual specific effects. It is based on the residues obtained by the OLS. The probability of the Breusch & Pagan statistic showed that fixed effects are significant at the 5% level (P-value <0, 05). And therefore, a fixed effects model is preferred.
[9] The AIC (Akaike Information Criterion) outputs for model selection are shown in Appendix C.
The BIC (Bayesian Information Criterion) outputs for model selection are shown in Appendix C.

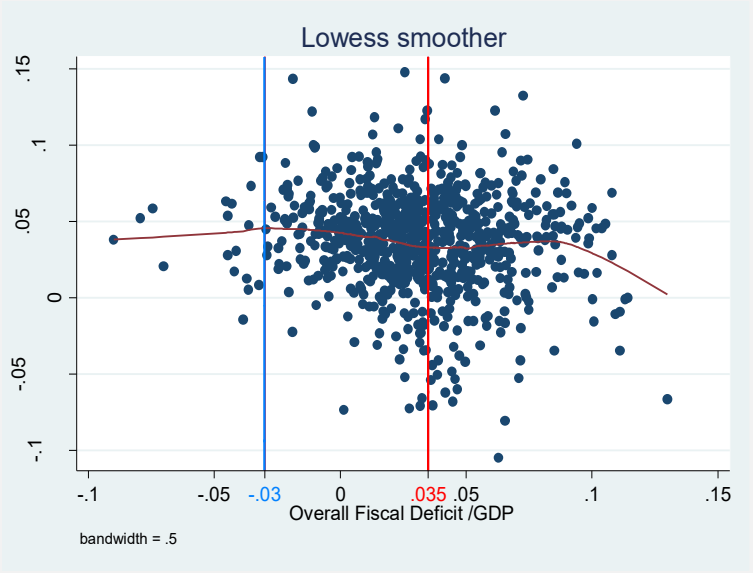
variables. The second Fisher test shows the wide heterogeneity of individuals in the form of fixed effect, as the p-value is lower than 5% (0.000). All the variables have the signs that were previously anticipated. The variables FD, INV and INF, are significant at a 1% level. GE variable is significant at the 5% level. And finally, the variable NS is significant at the 10% level. Current government expenditure is negatively correlated with growth, and thus its increase can hinder the process of growth. A high ratio of national savings to GDP should have a favorable impact on economic activity. The fiscal deficit has a negative sign, which means that raising deficit is growth reducing. As for total investment, it has a positive sign and hence a positive effect on GDP growth. And finally, inflation has a negative sign, and thus having high inflation rates would have an adverse economic impact, with harmful consequences for growth.

4.2 Threshold effects analysis

We propose, before moving to the more systematic analysis, to explore a simple scatter plot visualizing the relationship between budget deficit and GDP growth. The existence of threshold effects assumes implicitly that this relationship is non-linear. Figure 1 illustrates this relation in the form of a cloud diagram. The non-linear function is plotted, as a locally weighted smoothing[10] (lowess smoother) with a "bandwidth" setting of 0.5, to identify graphically the existence of non-linearities.

It can be drawn from figure 1 that a linear representation may hide important and relevant nonlinearities at many budget deficits' levels. Moreover, it is clear that high budget deficit is associated with a very low GDP growth. However, growth payoffs start as the deficit falls from around 3.5%. The existence of a threshold effect implies not only a variation in the slope of the regression line but also a sign switch in the relationship. For a budget deficit value below a given threshold, there appears to be a favorable effect on economic activity, this effect inverse itself for higher fiscal deficit values.

Figure 1: Fiscal Deficit and GDP Growth in 40 Developing Countries, 1990-2012



Given the high degree of dispersion, as observed in the scatter plot, we should note that this attempt to view the data is just preliminary and that we will submit hereafter the findings to a more systematic analysis using econometric methods.

4.3 A brief description of the econometric approach: Hansen (1999)

The panel threshold regression model with individual-specific effects proposed by Hansen (1999) will be used below to characterize the relationship between growth and fiscal policy. Estimating the PTR requires the minimization of the sum of squared errors according to the following equation:

$$y_{it} = \mu_i + \alpha_1 x_{it} I(q_{it} \leq \gamma) + \alpha_2 x_{it} I(q_{it} > \gamma) + \varepsilon_{it}$$

[10] It is a smoothing method that tends to follow the data. Basically, the main idea is to create a new variable, so that each observation in the data may correspond to a smoothed value. The smoothed values are obtained from a regression, growth of GDP in the fiscal deficit. This regression is weighted so that each point receives the highest weight.

Where q_{it} is the threshold variable[11], γ refers to the threshold, I(.) is an indicator function of the "regimes" transition which equals 1 when the condition in parenthesis is satisfied and 0 otherwise. Although, in this model, we have a single threshold where the observations are divided into two regimes depending on whether the threshold variable q_{it} is smaller or larger than the threshold parameter γ, we can generalize our model to a more larger specification with r thresholds (i.e. r + 1 regimes) as illustrated below:

$$y_{it} = \mu_i + \alpha_1 x_{it} I(q_{it} \leq \gamma_1) + \alpha_2 x_{it} I(\gamma_1 < q_{it} \leq \gamma_2) + \dots \alpha_r x_{it} I(\gamma_{r-1} < q_{it}) + \varepsilon_{it}$$

Estimating this model is carried out by stages. First, the individual fixed effects μ_i should be removed by eliminating individual specific means, and then we apply the ordinary least squares procedure. Afterwards, we can compute the sum of squared residuals referred to as $S_1(\gamma)$:

$$S_1(\gamma) = \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{\varepsilon}_{it}^2$$

The threshold parameter γ is then estimated by minimizing $S_1(\gamma)$.

$$\hat{\gamma} = Arg\,Min_{\gamma}\, S_1(\hat{\gamma})$$

As Hansen (1999) stresses, the sum of squared error function is a step function with at most nT steps. Thus, the minimization problem can be reduced to a search over values of γ equal to the distinct values of q_{it} in the sample. The next step consists of testing whether the identified threshold is statistically significant or not. The null hypothesis describes a linear specification and can be writen as: $H_0 : \alpha_1 = \alpha_2$. We use the likelihood ratio test verify this hypothesis:

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

Where S_0 indicates the sum of the squared residuals of the linear model, $S_1(\gamma)$ is the sum of the squared residuals of the model with a single threshold, and $\sigma^2 = S_1(\gamma)/n(T-1)$. However, Hansen emphasizes that the distribution of this statistic F_1 has a non-standard character since that the PTR model contains unidentified nuisance parameters under H_0, and propose, in order to resolve this problem, to simulate by Bootstrap the asymptotic distribution of the statistic F_1. When a single threshold effect is attested to be significant, the same procedure can be applied to the general model in order to determine the number of regimes. In this case, the new null hypothesis consists of testing a specification with r regimes versus a specification with r+1 regimes. For determining the number of thresholds, Hansen advocates to start by testing one threshold versus two, then two versus three, and so forth. The procedure stops when the null hypothesis is not rejected.

4.4 Fiscal deficit as a threshold variable

Our threshold least square regression model is specified as follows:

$$GDP_{it} = \mu_i + \alpha_1 GE_{it-1} + \alpha_2 FD_{it-1} + \alpha_3 INV_{it-1} + \alpha_4 INF_{it-1} + \beta_1 NS_{it-1} I(FD_{it-1} \leq \gamma_1) + \beta_2 NS_{it-1} I(\gamma_1 < FD_{it-1} \leq \gamma_2) + \beta_3 NS_{it-1} I(\gamma_2 < FD_{it-1}) + \varepsilon_{it}$$

Where μ_i represents the country-fixed effects, (i,t) captures the cross-sectional and time dimensions of the panel, and ε_{it} is a stochastic error term.

Table 1: Threshold effects tests for the fiscal deficit

Test for a single threshold effect	
F_1	16.001
P-Value	0.016
(10%, 5%, 1% critical values)	(11.714 ; 13.745 ; 18.262)
Test for a double threshold effect	
F_2	18.382
P-Value	0.006
(10%, 5%, 1% critical values)	(11.599 ; 13.175 ; 17.322)
Test for a triple-threshold effect	
F_1	14.160
P-Value	0.050
(10%, 5%, 1% critical values)	(11.850 ; 14.124 ; 18.805)

In order to determine the number of threshold effects, the model above has been estimated by the least squares method, sequentially, for one, two and three threshold effects. The test statistics F1, F2 and F3, set out together with their bootstrap p-values[12] are presented in the table 1. The statistic F1 which made a reference to the test for

[11] The threshold variable is assumed to be time independent, and it cannot be contemporaneous endogenous variable.
[12] 500 bootstrap replications were used for each test.

a single threshold effect is significant at a 5% level with a bootstrap p-value of 0.016. The test for a double threshold effect F2 is even more significant at a 1% level with a bootstrap p-value of 0.006. Finally, the test for a triple threshold effect F3 may be considered as not statistically significant at the 5% level as the bootstrap p-value is equal to 0.050. These tests allow us to conclude that there are two thresholds effect of fiscal deficit on economic productivity according to our empirical growth regression model. The two thresholds estimated values and their asymptotic confidence intervals 95% are reported in table 2. The point estimates are -0.032 and 0.048. Appendix D, E and F present the likelihood ratio function $LR_1(\gamma)$, $LR_2^r(\gamma)$ and $LR_1^r(\gamma)$, respectively, corresponding to estimates for γ_1, γ_1^r and γ_2^r. The point estimates are the value of γ at which the likelihood ratio reached the zero axis.

Table 2: Threshold estimates for the fiscal deficit

	Estimate	95% Confidence Interval
γ_1^r	-0.032	[-0.032 ; 0.055]
γ_2^r	0.048	[0.017 ; 0.055]

The point estimates are -0.032 and 0.048. Figures (5, 6 and 7) present the likelihood ratio function $LR_1(\gamma)$, $LR_2^r(\gamma)$ and $LR_1^r(\gamma)$, respectively, corresponding to estimates for γ_1, γ_1^r and γ_2^r. The point estimates are the value of γ at which the likelihood ratio reached the zero axis. In what remains, we will consider a double threshold effect. The regression coefficient estimates and their standard deviations are shown in the table 3.

Table 3: Regression Estimates for a double threshold effect of the fiscal deficit

Explanatory Variables	Coefficient estimate	OLS Standard-errors	White-corrected Standard-errors
INV_{it-1}	0.003	0.028	0.028
GE_{it-1}	-0.023	0.027	0.028
FD_{it-1}	**-0.237*** **	**0.054**	**0.053**
INF_{it-1}	-0.00084	0.00078	0.00061
NS_{it-1} I ($FD_{it-1} \leq -0.032$)	**-0.115*** **	**0.047**	**0.056**
NS_{it-1} I ($-0.032 < FD_{it-1} \leq 0.048$)	**0.056****	**0.030**	**0.033**
NS_{it-1} I ($0.048 < FD_{it-1}$)	**0.148*** **	**0.035**	**0.037**

*** Significant coefficient at the 1% level, ** 5% and * 10%.

To test the significance of the non-linear regression slope estimates, we used the Student's t-test[13]. We can see that the variables FD and NS are the only significant ones. The ratio of the budget deficit / GDP lagged by one period (FD_{it-1}) has a negative impact on GDP growth. Results also indicate that when the ratio of budget deficit / GDP approaches 0.048 starting from the highest deficit value of 0.13, domestic savings NS_{it-1} should then have a positive effect on growth with the coefficient estimate of 0.148. And conversely, domestic saving should have a positive impact on growth, but with a smaller coefficient equal to 0.056, only for countries being close from a balanced budget with a deficit lower than 0,048 and a surplus not exceeding 0.032. And finally, if the surplus exceeds the value of 0.032, then domestic savings should have a negative impact on growth. The percentages of countries belonging to each of the three defined regimes in each year are reported in table 4. This distribution will allow us to see the countries division per year according to the pension deficit.

Table 4: Percentage of Countries per year in Each Regime of the Fiscal Deficit

Regime (Year)		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1st	$FD_{it-1} \leq -0.032$	0	3	0	3	0	0	0	3	3	3	0
2nd	$-0.032 < FD_{it-1} \leq 0.048$	90	75	80	78	73	80	70	78	60	75	80
3rd	$0.048 < FD_{it-1}$	10	23	20	20	28	20	30	20	38	23	20
Regime (Year)		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1st	$FD_{it-1} \leq -0.032$	0	0	0	0	3	10	5	5	0	3	3
2nd	$-0.032 < FD_{it-1} \leq 0.048$	78	68	73	88	83	80	80	80	68	68	70
3rd	$0.048 < FD_{it-1}$	23	33	28	13	15	10	15	15	33	30	28

We can see that the percentage of countries which fall into the first regime varies from 0% to 10% over the years. The percentage of countries, in the second regime, ranges from 60% to 90%, and finally, in the third regime, it varies from 10% to 33%. We can also observe that most countries fall into the second regime, and this is valid for all years. It is interesting to note that in 2010, we can perceive the highest number of countries with a budget deficit exceeding the level of 4.8%.

[13] When Student's t-test statistic is greater than the value read in the student's table (1.96 at the 5% level and 1.64 at the 10% level), we reject the null hypothesis of the non-significance of the parameters.

4.5 Investment as a threshold variable

The following threshold least square regression model will be estimated:

$$GDP_{it} = \mu_i + \alpha_1 GE_{it-1} + \alpha_2 NS_{it-1} + \alpha_3 INV_{it-1} + \alpha_4 INF_{it-1} + \beta_1 FD_{it-1} I(INV_{it-1} \leq \gamma_1) + \beta_2 FD_{it-1} I(\gamma_1 < INV_{it-1}) + \varepsilon_{it}$$

Where μ_i represents the country-fixed effects, (i,t) captures the cross-sectional and time dimensions of the panel, and ε_{it} is a stochastic error term.

The same procedure will be adopted. The test statistics F1, F2 and F3, set out together with their bootstrap p-values[14], are presented in table 5. The statistic F_1 which refers to the test for a single threshold effect is the only significant statistic at a 1% level with a bootstrap p-value of 0.002. Both tests for a double threshold effect F_2 and for a triple-threshold effect F_3 are not significant at the 5% level. These Tests allow us to conclude that there is a single threshold effect for investment. The threshold estimates with its asymptotic confidence interval 95% is reported in Table 6.

Table 5: Threshold effects tests for investment

Test for a single threshold effect	
F_1	18.687
P-Value	0.002
(10%, 5%, 1% critical values)	(11.148 ; 12.421 ; 15.649)
Test for a double threshold effect	
F_2	3.271
P-Value	0.876
(10%, 5%, 1% critical values)	(10.446 ; 12.295 ; 16.357)
Test for a triple-threshold effect	
F_1	2.086
P-Value	0.968
(10%, 5%, 1% critical values)	(9.062 ; 10.348 ; 12.884)

Table 6: Threshold estimates for investment

	Estimate	95% Confidence Interval
γ_1	0.236	[0.212 ; 0.250]

The point estimate is 0.236. Appendix G presents the likelihood ratio function $LR_1(\gamma)$ corresponding to the estimate for γ_1. The regression coefficient estimates and their standard deviations are shown in the table 7.

Table 7: Regression Estimates for a Single Threshold Effect of Investment

Explanatory Variables	Coefficient estimate	OLS Standard-errors	White-corrected Standard-errors
NS_{it-1}	**0.062*** **	**0.030**	**0.032**
GE_{it-1}	-0.032	0.027	0.027
INV_{it-1}	-0.024	0.029	0.034
INF_{it-1}	-0.0008	0.0008	0.0006
$FD_{it-1} I(INV_{it-1} \leq 0.236)$	**-0.137*** **	**0.047**	**0.042**
$FD_{it-1} I(0.236 < INV_{it-1})$	**0.167*** **	**0.069**	**0.076**

*** Significant coefficient at the 1% level, ** 5% and * 10%.

Similar to the previous analysis, we will use the Student's t-test[15] to test the significance of the non-linear regression slope estimates. We can see that only the coefficient estimates for the following variables NS, FD and INV are significant and that investment is significant just in the case of regimes switching. Gross national savings lagged by one period NS_{it-1} has a significant positive impact on growth. We can also note that when investment in the previous year is less than or equal to the threshold of 23.6%, then the budget deficit FD_{it-1} should have a negative effect on growth with a coefficient estimate of -0.137. And conversely, it should have a positive impact on growth with a coefficient estimate of 0.167 as the investment exceeds the defined threshold.

[14] 500 bootstrap replications were used for each test.

[15] When Student's t-test statistic is greater than the value read in the student's table (1.96 at the 5% level and 1.64 at the 10% level), we reject the null hypothesis of the non-significance of the parameters.

Table 8: Percentage of Countries per Year in Each Regime of Investment

		Year										
Regime		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1er	$INV_{it-1} \leq 0.236$	55	75	75	70	65	63	63	65	60	73	70
2ème	$0.236 < INV_{it-1}$	45	25	25	30	35	38	38	35	40	28	30
		Year										
Regime		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1er	$INV_{it-1} \leq 0.236$	78	75	80	70	65	65	60	55	73	70	63
2ème	$0.236 < INV_{it-1}$	23	25	20	30	35	35	40	45	28	30	38

Table 8 reports that the percentage of countries belonging to the first regime - where the ratio of total investment / GDP is below the threshold of 23% - varies from 55% to 80%. Whereas the second regime - where investment exceeds the threshold of 23% - the percentage ranges from 20% to 45%. Hence, we can say that most countries fall into the first regime.

5.0 Summary and conclusion

This paper contributes to the fiscal policy literature by re-examining the relationship between the fiscal deficit and economic growth. Initially, the study identifies, under a linear hypothesis, the impact of five economic variables, namely the fiscal deficit, government current expenditure, national savings, inflation rate and total investment. In a second step, examining the scatter plot in Figure 1 urged us to call into question the nature of the relation between growth and the fiscal deficit as it shows an apparent non- linearity, hence we consider the existence of threshold effects in the relationship between fiscal policy and growth by using the threshold estimation approach as proposed by Hansen (1999) for non-dynamic panels. The data cover a sample of 40 developing countries for the period 1990 – 2012.

We present, in our analysis, an empirical growth model in which two types of non- linearity emerged, one related to the impact of the fiscal deficit on growth, and the other involving the effects of investment. The empirical results strongly suggest the existence anti-Keynesian effects that would be associated with high budget deficits levels. We find an evidence of a double threshold effect of the fiscal balance which is robust to their inclusion. A fiscal deficit exceeding 4.8% of GDP would exert a negative effect on growth, but also a fiscal surplus exceeding the threshold of 3.2% of GDP would negatively impact economic growth. Results also shows that the sign of the relationship between the budget deficit and growth is conditioned by the level of total investment: when total investment exceeds the threshold of 23% of GDP, then the budget deficit is positively correlated to economic growth with a coefficient estimates of 0.167, whereas it is negatively correlated to growth with a coefficient estimates of -0.137 when total investment falls below this threshold. Our findings also suggest the 4.8% threshold is a deficit level beyond which Domestic savings exert a positive effect on growth with coefficient estimates of 0.148, and with a lower coefficient of 0.056 for countries being close from a balanced budget with a deficit lower than 4.8% and a surplus not exceeding 3.2%. When the surplus exceeds 3.2%, then Domestic savings are negatively related to economic growth. As for inflation, results indicate that increases in inflation rates may have an adverse effect on growth in developing economies. Current government expenditure is also negatively correlated to GDP growth. Within this framework, countries are expected to set priorities for reducing government final consumption expenditure for productive investment. Therefore, a rational public spending management is required.

While the results are instructive, some caveats are important to bear in mind when interpreting these results. First, the asymptotic distribution of the statistic F_1 on the threshold variable has a non-standard character and requires bootstrap methods to compute its significance level. Second, the estimated model does not provide the precise channels through which fiscal policy affects growth. There are also some particular issues related to data which may skew the results. Inflation rate and the current account balance show a high degree of dispersion and heterogeneity within the sample of countries. Strong asymmetry in the inflation distribution was detected as it reveals the presence of a few high values.

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Appendices

Appendix A: Sample Countries

Bahamas, Bangladesh, Barbados, Benin, Bolivia, Brazil, Central African Republic, Chile, Colombia, Comoros, Costa Rica, Djibouti, Dominica, Dominican Republic, Ecuador, El Salvador, Fiji, Ghana , Honduras, Hungary, India, Jamaica, Jordan, Kenya, Malaysia, Mexico, Morocco, Mozambique, Namibia, Pakistan, Poland, South Africa, Sri Lanka, Suriname, Saint Vincent and the Grenadines, Syria, Thailand, Tunisia , Uruguay, Vanuatu.

Appendix B: Summary Statistics, Data for 40 Developing Countries

Variables	Mnemonic	Obs.	Mean	Standard Deviation	Median	Min.	Max.	Total Variance	Within Variance	Between Variance
Real GDP growth	GDP	915	0.036	0.034	0.040	-0.119	0.148	0.001	0.001	0.000
Ratio of current government expenditure to GDP	GE	854	0.153	0.058	0.143	0.032	0.402	0.003	0.000	0.003
Ratio of gross national savings to GDP	NS	849	0.178	0.077	0.175	-0.061	0.399	0.006	0.002	0.004
Ratio of the overall budget deficit to GDP	FD	824	0.031	0.030	0.030	-0.090	0.130	0.001	0.001	0.000
Ratio of total investment to GDP	INV	872	0.215	0.063	0.211	0.047	0.466	0.004	0.002	0.002
Inflation rate	INF	911	0.113	0.311	0.056	-0.074	5.858	0.097	0.085	0.012
Ratio of the general government debt to GDP	GD	670	0.547	0.304	0.482	0.039	2.197	0.092	0.031	0.061
Ratio of current account balance to GDP	CCB	917	-0.039	0.065	-0.032	-0.331	0.171	0.004	0.002	0.002

Sources:

Data on real GDP growth, gross national savings, overall budget deficit, investment, Inflation, general government debt are taken from the IMF's World Economic Outlook database April 2013.

Data on current government expenditure are taken from the World Bank database.

Definitions:

Data on current government expenditure, overall fiscal balance, gross national savings, total investment, current account balance and government's total debt are expressed in current local currency as ratios to nominal GDP. Data on inflation are expressed as annual percentages of the average consumer prices. Data on GDP growth are expressed on constant prices.

General government final consumption expenditure includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes national defense and security outlays, but excludes government military spending.

Overall fiscal balance expresses a net lending (+) or borrowing (–) and measures the extent to which the government is either putting, in the event of a surplus, financial resources at the disposal of the other economic sectors and the rest of the world, or, in the case of a deficit, utilizing the financial resources generated by the other sectors and the rest of the world.

Gross national saving is calculated as gross disposable income minus final consumption expenditure after taking account of an adjustment for pension funds.

Total investment or gross capital formation is measured by the total value of the gross fixed capital formation – Gross fixed capital formation include land improvements (fences, ditches, drains, and so on), plant, machinery, and equipment purchases; and the construction of roads, railways, etc. including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings – plus net changes in the level of inventories and acquisitions of valuables.

Current account balance is the sum of net exports of goods and services, net primary income, and net secondary income.

General government debt consists of all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans.

Inflation rate and real GDP growth are measured on the basis of year-on-year changes; the base year is country-specific.

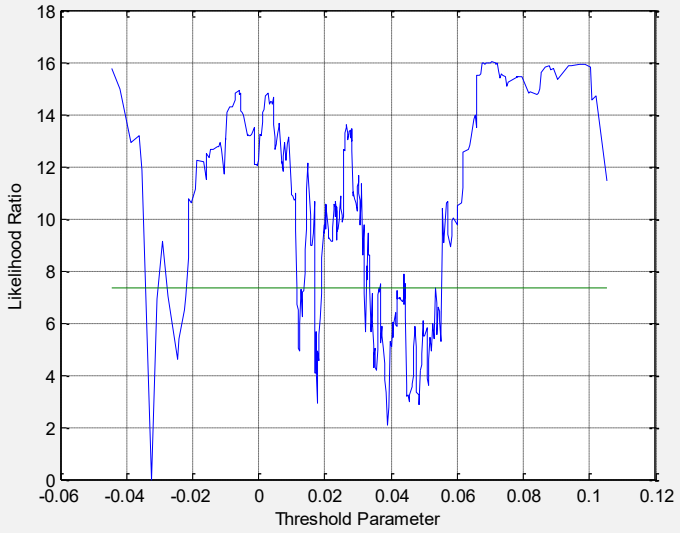
Appendix C: Linear Model Estimation

Dependent Variable: Real GDP Growth

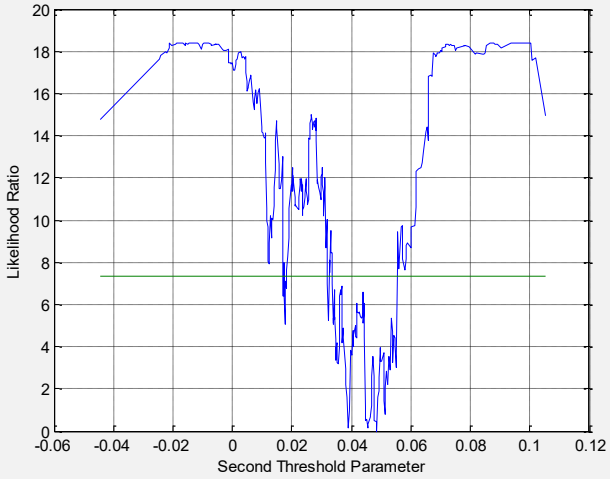
	The linear models		
Explanatory Variables	(1)	(2)	(3)
GE	-0.159**	-0.159**	-0.119**
	(2.29)	(2.30)	(2.23)
NS	0.099	0.080**	0.053*
	(0.84)	(2.41)	1.88
FD	-0.121**	-0.120**	-0.201***
	(2.14)	(2.13)	4.18
INV	0.167	0.186***	0.164***
	(1.36)	(5.68)	5.75
INF	-0.034	-0.034	-0.042***
	(1.42)	(1.43)	3.01
GD	-0.006	-0.006	
	(0.95)	(0.95)	
CCB	-0.020		
	(0.17)		
Constant	0.017	0.016	0.020**
	(1.20)	(1.20)	2.06
Fisher Test (1)	F (7.517) = 11.76	F(6.518) = 13.74	F(5.666) = 21.62
Fisher Test (2)	F (34.517) = 4.11	F(34.518) = 4.23	F(36.666) = 5.23
AIC	-2453.441	-2455.412	-3092.999
BIC	-2418.832	-2425.129	-3065.624
R^2	0.14	0.14	0.14
Number of observations	559	559	708

*** Significant coefficient at the 1% level, ** 5% and * 10%.
Student's t-values are put between brackets.
Fisher Test (1) checks the significance of the explanatory variables.
Fisher Test (2) is used to examine the significance of the fixed effects.

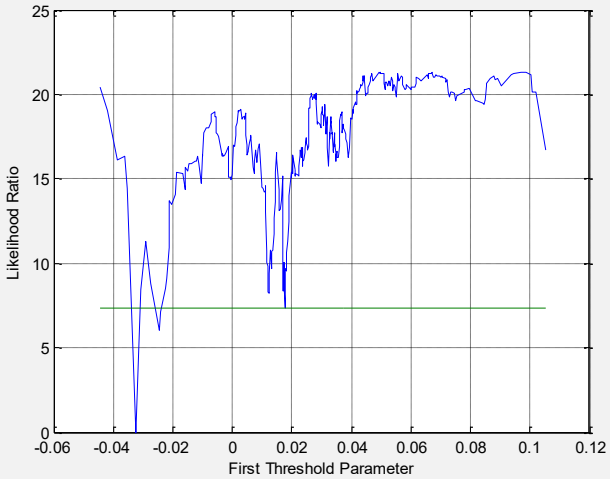
Appendix D: Likelihood Ratio Function $\mathbf{LR_1}(\gamma)$ for a Single Threshold Effect of the Fiscal Deficit



Appendix E: Likelihood Ratio Function 〖LR〗_2^r (γ) for a Double Threshold Effect of the Fiscal Deficit



Appendix F: Likelihood Ratio Function $LR_1^{\tau}(\gamma)$ for a Double Threshold Effect of the Fiscal Deficit



Appendix G: Likelihood Ratio Function $LR_1(\gamma)$ for a Single Threshold Effect of Investment