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Non-Linear Response of Fiscal Policy to the Business Cycle: Empirical Evidence in Sub-Saharan Africa

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Abstract

This article examines the cyclicality of tax policy on a sample of 12 Sub-Saharan African countries for the period 2004-2018. Based on the threshold effect model (PTR), the results show that there are thresholds for mining rent, credit, public debt and corruption, which condition the passage from the pro-cyclical fiscal reaction to the counter-cyclical fiscal reaction in sub-Saharan Africa.

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1. Introduction

The tax theory developed by Keynes (1936) advocates the use of the discretionary counter-cyclical budget tool to compensate for demand shocks and stabilize employment. This Keynesian position is called into question by the new classical macroeconomics which pleads for an acyclical tax policy. Indeed, Barro (1979) limits fiscal policy to the action of automatic stabilizers and prohibits any additional discretionary action. Although the question of the direction of fiscal policy is controversial, no theory legitimizes the use of pro-cyclical fiscal policy. According to policymakers, a pro-cyclical fiscal reaction should be avoided for at least two reasons. First, it contributes to unsustainable cyclical expansion, exacerbating periods of economic booms and reinforcing general business cycle volatility as well as macroeconomic instability (Llorca, 2016). Second, it contributes to the lack of fiscal discipline during boom times, by allocating new tax revenues to pressure groups, rather than keeping those revenues in reserve for future counter-cyclical public spending (Kumar and Ter-Minassian, 2007). In other words, it feeds the accumulation of debt in periods of expansion since the deficits incurred in periods of recession are not offset by surpluses during periods of expansion. However, despite this unanimous view of economists and policymakers against pro-cyclical fiscal policy, it is still far from the norm in some developed and many developing countries (Talvi & Végh, 2000; Kaminsky, Reinhart & Végh, 2004; Ilzetzki & Végh, 2008; Konuki & Villafuerte, 2016).

However, like other developing regions, the degree of cyclicality in sub-Saharan Africa has changed for some time, as fiscal policies tend to be acyclical or more counter-cyclical (Frankel et al., 2013; Calderón, 2017 and Jalles, 2019). From this perspective, the literature on the determinants of fiscal cyclicality shows to what extent fiscal policy can be counter-cyclical. For example, institutional (Calderón and Nguyen, 2016) and financial (Konuki & Villafuerte, 2016; Bobbo, 2016) factors are considered to be important determinants of the cyclical orientation of tax policy in Africa. In developed, emerging and developing countries, certain studies condition fiscal cyclicality in terms of debt in developed, emerging and developing countries (Égert, 2014; Combes et al., 2017). Although several works have helped to nourish reflection on the determinants of fiscal cyclicality, to our knowledge, there is no research applied to Africa on the role of mining rent, despite the heavy dependence of African economies in the primary sector. Moreover, the debt threshold that conditions the government's response to the economic cycle is less well known in Africa. Furthermore, existing work has not explored the role of the components of public debt namely : external public debt and domestic public debt. Likewise, the role of bank credit in guiding tax policy has not yet been the subject of robust study in Africa, whereas according to Gavin and Perotti (1997) and Kaminsky et al. (2004), the lack of credit in times of crisis may be the cause of pro-cyclical tax policies. Finally, the level of corruption ensuring the transition from pro-cyclical tax policies to counter-cyclical tax policies has not yet been the subject of a robust study, despite the determining role of good (poor) institutional quality in the tax cyclicality (Calderón et al. 2016).

This study seeks to examine, through the lens of threshold effects, the mediating role of mining rent, corruption, bank credit and public debt in the reaction of tax policy to the economic cycle. To achieve this, we apply the threshold effect method (PTR), put forward by Baum et al. (2013), on a sample of 12 sub-Saharan African countries exporting raw materials, over the period 2004-2018[1]. This article contributes to the literature in several ways. First, we produce a first empirical evidence of the idea that mining rent is the source of pro-cyclical policies in Africa.

[1] Statistics from the World Trade Organization (WTO) indicate that 24 of the 54 countries of the African continent export mining products (Maréchal, 2013). However, mining rent as a percentage of GDP is only reported for 12 countries in sub-Saharan Africa over the period 2004-2018 (see the WDI database).

Thus, this article produces a mining rent target necessary to establish a counter-cyclical tax rule in sub-Saharan African countries, like Chile's counter-cyclical fiscal mechanism, which is based on a structural tax rule (Gutiérrez & Revilla, 2010). Then, this study provides a first empirical proof of the role of credit as a determinant of the cyclicality of tax policy. Similarly, this study produces a first empirical proof on the determining role of debt in the cyclicality of tax policy in Africa. From this perspective, we conduct a more detailed analysis, examining not only the role of total debt, but also that of external and domestic debt in the cyclical response of fiscal policy. No study to our knowledge has explored the role of debt components on the government's response to fluctuations in economic activity, despite the fact that international and domestic creditors contribute to the pro-cyclicality of lending in commodity exporting countries (Stigltz, 2005). Finally, the PTR approach adopted in this study makes it possible to condition the fiscal reaction to cyclical fluctuations according to the thresholds of mining rent, credit, public debt and corruption. In other words, this approach provides the target values of mining rent, credit, public debt and corruption, necessary for the implementation of a counter-cyclical tax rule in Africa. This is not the case with most of the work to our knowledge, which has been limited to interacting the output gap with certain institutional and financial variables. In doing so, our study reconciles the various studies which have, on the one hand, proven that tax policy is counter-cyclical, and on the other hand, the studies that have concluded that there is a pro-cyclical or acyclical tax reaction.

The remainder of the article is organized as follows: Section 2 provides a brief review of the literature. Section 3 deals with the methodology. Section 4 presents and discusses the results. Finally, section 5 serves as a conclusion and implications of economic policy.

2. Brief review of the literature

Empirically, the literature on the determinants of fiscal cyclicality can be organized into two axes: studies relating to developed countries and those relating to African countries.

When it comes to developed countries first, public debt is identified as an important determinant of the cyclical orientation of tax policy (Égert, 2014; Vdovychenko, 2017; Combes et al., 2017). Using the GMM estimation technique in OECD countries over the period 1970-2008, Égert (2014) concludes that fiscal policy is counter-cyclical when the level of debt is below 30%. However, it is neutral or pro-cyclical, when the level of debt is between 30% and 89%; pro-cyclical if public debt is greater than 90% of GDP. Applying a smooth transition logistic regression (LSTR) over the period 1998-2015, Vdovychenko (2017) suggests that tax policy is counter-cyclical in Ukraine, when the debt threshold exceeds 50% of GDP. Following this logic, Combes et al. (2017) reveal that there is a debt threshold of 87% of GDP, below which tax policy is counter-cyclical, and beyond which tax policy becomes pro-cyclical. The author applied the PTR method on a panel of 56 developed, emerging and developing countries, for the period covering 1990-2011.

With regard to African countries, the literature highlights the determining role of institutional factors (Diallo, 2009; Lledo et al., 2009; Calderón & Nguyen, 2016), financial factors (Combes & Ouedrago, 2014; Bobbo, 2016; Calderón et al., 2017), factors linked to trade openness (Mpatswe et al., 2012; Ouedraogo & Sourouema, 2018) and a set of factors (Thornton, 2008; Konuki & Villafuerte, 2016) on the cyclical stance of fiscal policy.

Regarding institutional factors, Diallo (2009) looked at the specific role of democracy in fiscal cyclicality on a panel of 47 countries in sub-Saharan Africa for the period 1989-2002. Using the OLS model, he concludes that democratic institutions are associated with counter-cyclical

fiscal policies. In contrast, by studying the cyclical orientation of public spending in a sample of 174 countries (including 44 SSA countries) for the period 1970-2008, Lledo et al. (2009) have shown, based on the GMM model, that changes in political institutions have no impact on the behaviour of tax policy. Calderón and Nguyen (2016) examine the role of institutional quality on fiscal cyclicality in a sample of 128 countries for the period 1970-2013. The results obtained by the author, based on OLS, 2SLS and GMM techniques, indicate that a good quality of institutions (measured by an aggregated index of the investment profile, corruption, the rule of law and the quality of Bureaucracy) contributes to reducing the degree of pro-cyclicality of public spending for the majority of African countries. Regarding financial factors, Combes and Ouedrago (2014) study the role of public aid on fiscal cyclicality on a panel of 39 countries in sub-Saharan Africa for the period 1985-2012. Using the panel data technique, he concludes that pro-cyclical bilateral aid is the source of pro-cyclical fiscal policy, while the pro-cyclicality of multilateral ODA intensifies the pro-cyclical fiscal reaction. Likewise, Calderón et al. (2017) studied the influence of official development assistance in the fiscal reaction, based on a sample of 99 countries (made up of 37 from Sub-Saharan Africa, 20 from Latin America, 20 from Asia in development and 22 industrial economies) for the period 1970-2014. Using the least squares technique, they come to the conclusion that official development assistance exacerbates the pro-cyclicality of fiscal policy in Africa. Bobbo (2016) for his part, studies the relationship between the exchange rate regime and fiscal cyclicality based on a sample of 34 African countries over the period 1980-2012. The estimation of the reaction function of public consumption expenditure by the method of generalized moments in difference (DIFF-GMM) allowed the author to conclude that in fixed and intermediate exchange rate regimes, tax pro-cyclicality is more intense; however, in a flexible regime, tax pro-cyclicality decreases.

Regarding factors related to trade openness, the impact of the terms of trade and the concentration of exports on fiscal cyclicality has been examined in some studies (Mpatswe et al., 2012; Ouedraogo & Sourouema, 2018). Indeed, using GMM system and difference techniques, on a panel of 44 SSA countries over the period 1980-2008, Mpatswe et al. (2012) found that tax policies in SSA are highly pro-cyclical. In addition, they emphasized that public consumption is less pro-cyclical than public investment. They further showed that terms of trade shocks lead to pro-cyclical tax policies in CEMAC countries. For their part, Ouedraogo and Sourouema (2018) examined the impact of the concentration of exports on tax pro-cyclicality based on a sample of 40 countries in sub-Saharan Africa over the period 1995-2015. Using the GMM method, they come to the conclusion that, the concentration of exports is positively associated with the pro-cyclicality of public expenditure, and this result is mainly due to the pro-cyclical reaction of public investment, since the reaction of consumption public is not significant.

Finally, the fiscal reaction to the economic cycle in faction on the one hand, aid, corruption, income distribution and democracy (Thornton, 2008), on the other hand, the degree of financial depth of the level of currency holdings and institutional quality (Konuki & Villafuerte, 2016) was studied. Drawing on the OLS technique on a sample of 37 low-income African countries for the period 1960-2004, Thornton (2008) suggested that public consumption is highly pro-cyclical. In addition, he showed that public consumption is more pro-cyclical in African countries which are more dependent on foreign aid inflows and which are less corrupt, and less pro-cyclical in countries with unequal income distribution and which are more democratic. Based on the countries of sub-Saharan Africa for the period from 2000 to 2014, Konuki and Villafuerte (2016) find that greater financial depth made it possible to considerably reduce the degree of pro-cyclicality of tax policies in the countries from sub-Saharan Africa. In addition, they show that large foreign currency holdings significantly reduce the degree of pro-cyclicality of tax policy. In the same study, they argued that the difference in institutional quality does not

play a significant role in the differentiated response of the budget to the business cycle in sub-Saharan Africa.

From the above, it emerges that the literature on the impact of mining rent on the pro-cyclicality of tax policy is non-existent. In addition, the role of the level of debt in the cyclicality of tax policy is less well known in Africa. Similarly, the literature treating of the role of corruption on the cyclical orientation of fiscal policy has not explored the influence of the public debt components namely : external public debt and domestic public debt. Likewise, the impact of bank lending in the cyclical orientation of fiscal policy is not yet fully understood. Finally, the method used in the aforementioned works, consisting of interacting institutional quality with the economic cycle, gives a limited overview of the role of institutions in fiscal cyclicality. Indeed, this method does not make it possible to define the targets necessary for the construction of a counter-cyclical tax rule.

3. Methodology

3.1. Model and empirical strategy

Studies on the cyclicality of tax policy estimate a reaction function of tax policy to cyclical fluctuations (Bobbo, 2016 and Calderón et al., 2017). To this end, the equation suitable for the analysis of the reaction of tax policy to cyclical fluctuations is written as follows:

$$B_{i,t} = \alpha_0 + \alpha_1 * B_{i,t-1} + \beta * EPIB_{i,t} + \theta_j X_{i,t} + \varepsilon_{i,t} \quad (1)$$

$B_{i,t}$ represents the tax variable (expenditure, revenue or balance) of country i in year t. EPIB can be the output gap or real GDP growth. X represents the vector composed of control variables. To establish the cyclicality of the fiscal policy conditioned on the thresholds of mining rent, public debt, bank credit and corruption, we start from the threshold effect model (PTR) of Hansen (1999). The process $y_{it}, t \in Z\ et\ i \in Z)$ satisfies a two-state PTR representation, if and only if:

$$y_{it} = \mu_i + \beta_1 x_{it} I(q_{it} \leq \gamma) + \beta_2 x_{it} I(q_{it} > \gamma) + \theta_j X_{i,t} + u_{it} \quad (2)$$

Where y_{it} represents the dependent variable, q_{it} is the threshold variable, γ refers to the threshold, $I(.)$ Is an indicator function of the transition regimes, x_{it} the dependent variable of the different regimes, μ_t is the vector of the individual fixed effects and ε_{it} is a white noise iid with zero mean and constant variance. The index $i = 1, \dots, N$ refers to the individual dimension and the index $t = 1, \dots, T$ to the time dimension. Adapting equation (2) to the context of this article involves the substitution of y_{it} by the structural primary fiscal balance, x_{it} by the output gap (EPIBR). The mining rent, public debt, bank credit and corruption variables will replace q_{it} in an alternative way. However, to address the problem of endogeneity, Hansen and Caner (2004), and Kremer and al. (2013) extended Hansen's model (1999) by developing a dynamic panel threshold model. Their approach is applied in three steps. Firstly, they estimate the parameter of the reduced form by OLS. Secondly, they estimate the threshold, using the predicted values of the endogenous variable. Thirdly, the coefficients are estimated by the 2SLS method or the GMM method. In the same way, Cimadomo (2007) and Baun et al. (2013) extend Hansen's model (1999) by including the lagged dependant variable, and by considering all the explicative variables with a lag of one period. We adopt the latter approach because it seems more improved. Indeed, it estimates the threshold and solves the problem of endogeneity in a

single step (Sinicakova, 2017 ; Šuliková and Tykhonenko, 2017). Thus, the cyclicality of tax policy can be assessed on the basis of the following equation:

$$SBPS_{i,t} = \mu_i + \beta_1 EPIBR_{i,t-1} I(q_{it-1} \leq \gamma) + \beta_2 EPIBR_{i,t-1} I(q_{it-1} > \gamma) + SBPS_{i,t-1} + \theta_j X_{i,t-1} + e_{i,t} \quad (3)$$

From this specification emerge two types of coefficients. On the one hand, the coefficients which depend on the regimes of mining rent, public debt, bank credit and corruption. More precisely, the coefficients of the output gap (β_1 and β_2). On the other hand, the coefficient θ_j (j=1,…,5) relates to that of the control variables. It should be noted that the latter is identical in each of the regimes of the above-mentioned threshold variables.

3.2. Variables and data

In order to determine the fiscal reaction to cyclical fluctuations, conditional on the thresholds of mining rent, credit, public debt and corruption, we use a dataset of a balanced panel, which covers 12 countries of Sub-Saharan Africa (listed in appendix 1), over the period from 2004 to 2018. It should be noted that there is no consensus in the literature on how the explanatory variable and the variable of interest should enter into the regression analysis (Calderón & Nguyen, 2016). Regarding the tax variable, some studies have used the growth of the tax variable (Thornton, 2008; Halland & Bleaney, 2011), we use the level tax variable which is a widely used approach (Cimadomo, 2005; Fatás & Mihov 2012). Regarding the variable of interest, some studies have used the growth of real output (Thornton, 2008; Lledó et al., 2011; Dessus et al., 2014), we use the cyclical component of real GDP, approximated the output gap, which is a measure widely used in the literature (Frankel et al., 2013; Calderón & Nguyen, 2016). For this purpose, the potential GDP, which is part of the calculation of the production gap (EPIBR) is obtained based on the Hodrick-Prescott filter with the HP filter (λ = 100). The dependent variable, primary structural fiscal balance ($SBPS_{i,t}$) is approximated to the residuals of the cyclical primary fiscal balance ($SBP_{i,t}$) estimated on the basis of the equation:

$$SBP_{i,t} = \alpha EPIBR_{i,t} + \mu_{i,t} \quad (4)$$

GDP at constant price, approximated to real GDP is taken from the World Bank database (WDI). Data on the primary fiscal balance come from the IMF database. The first threshold variable is the mining rent. This variable, which captures the effect of changes in commodity prices and production, is integrated, to the extent that budget pro-cyclicality seems to be acute in countries that are highly dependent on commodities (Céspedes & Velasco, 2011). Profit from minerals expressed as a percentage of GDP (BENMIN), is considered as a proxy for the rent derived from mining. The related dataset comes from the World Bank database (WDI). Credit to the economy is retained as a threshold variable, because access to credit facilitates government counter-cyclical intervention (Gavin and Perotti, 1997). However, too much credit can be the source of a pro-cyclical tax reaction (Kaminsky et al., 2004). Credit to the economy expressed as a percentage of GDP (CRE) is taken from the World Bank database. Public debt is included because the literature indicates that the response of fiscal policy to cyclical fluctuations is conditioned by the level of debt (Egert, 2014; Vdovychenko, 2017). In this paper, we consider the total debt (DEBT). In addition, we consider the components of public debt, namely: external public debt (DEBTEX) and internal public debt (DEBTIN). The data series on total public debt, external public debt and internal public debt are taken from the IMF database. The measure of institutional quality is the V-Dem corruption index (COR). The directionality of the V-Dem corruption index ranges from least corrupt to most corrupt.

Therefore, low values of this index imply low corruption, while high values correspond to a high degree of corruption. Regarding the control variables, they are not necessarily the same in all the studies. Apart from the lagged tax variable, included in most regressions, control variables such as debt in GDP (which measures borrowing constraints) and terms of trade are commonly used (Halland & Bleaney, 2011). Our first control variable is the previous primary structural fiscal balance, which normally exerts a positive effect on the primary structural fiscal balance (Gali & Perotti, 2003; Cimadomo, 2005, 2007). Based on Ott and Ott (1965), we secondly control investment, in that it takes into account the endogenous effects of the state of the fiscal balance. A public deficit increases the net assets of the private sector, which is equated with an accumulation of claims on the government, in the form of monetary or interest-bearing public debt. In this context, an increase in investment corresponds to an increase in the fiscal deficit. The investment control variable expressed as a percentage of GDP (INV) is extracted from the IMF database. We also monitor terms of trade fluctuations (VTERME), which is the main source of exogenous shocks to government revenue and expenditure (Jaimovich, 2007; Frankel, Vegh & Vuletin, 2013). Fluctuations in the terms of trade are equated with the relative deviation of the level of the terms of trade, observed from their trend level. This specification assumes that only an unanticipated change in the terms of trade, that is, a deviation from its trend, affects tax policy. As with the output gap, we measure changes in the terms of trade by the relative deviation of the terms of trade index (at constant price) from its trend level. The trend level of the terms of trade is obtained with the filter of Hodrick and Prescott (1997) with 100 as the smoothing parameter. The value of the terms of exchange is taken from the IMF database. The fourth control variable is population growth, as it involves the development of urbanization, which creates needs in public infrastructure, and hence, an increase in public expenditure. The urban population growth data series (POPURB) comes from the World Bank (World Development Indicators). We integrate external aid (Thornton, 2008), normalized by the product, because it helps finance public spending, which has a negative effect on the fiscal balance. We have also included inflation. The expected effect of inflation on the fiscal balance is negative. Indeed, inflation decreases the real value of tax-based government revenue between the time of taxation and the time of collection (Oliveira-Keynes-Tanzi effect, see Tanzi, 1992). The data series on net official assistance received (ODA) expressed as a percentage of GNI and inflation (INFL) measured as the percentage of annual increase in the consumer price index come from the database of the World Bank (WDI).

4. Results and Discussions

In this section, we present and discuss the results of the estimations of the different versions of the reaction functions of tax policies conditioned by the rent derived from minerals, credit to the private sector, public debt and corruption.

4.1. Mining rent and fiscal cyclicality

The dependence on mining rents is considered to be at the root of pro-cyclical fiscal policies. In this context, to reduce pro-cyclicality and make fiscal policy counter-cyclical, a better knowledge of the level of the rent favorable to a counter-cyclical fiscal reaction is necessary. Indeed, the less a country depends on its mining rent, the less it is inclined to implement a pro-cyclical tax policy. On the other hand, the more he depends on his pension, the more he is predisposed to implement a pro-cyclical tax policy. Before estimating the threshold effect model, we performed the linearity test. The related results indicate the presence of a non-linear relationship between the output gap and the structural fiscal balance (see Appendix 3). The results of the estimates according to Equation 3, reported in Table 1, reveal that fiscal policy

reacts counter-cyclically, when the mining rent is less than 1% of GDP. In contrast, when the mining rent exceeds 1% of GDP, the fiscal stance is pro-cyclical.

Table 1: Role of mining rent in fiscal cyclicality

Dependent variable: structural primary fiscal balance ($SBPS_t$)					
Explanatory variables		Model 1	Model 2	Model 3	Model 4
$SBPS_{it-1}$	θ_0	0.247*** (0.081)	0.174** (0.085)	0.166* (0.086)	0.167* (0.086)
INV_{it-1}	θ_1	-0.396*** (0.097)	-0.403*** (0.095)	-0.394*** (0.097)	-0.394*** (0.097)
$VTERME_{it-1}$	θ_2	-0.067*** (0.024)	-0.055** (0.024)	-0.052** (0.025)	-0.053** (0.025)
$POPURB_{it-1}$	θ_3		-0.584** (0.226)	-0.546** (0.235)	-0.545** (0.236)
APD_{it-1}	θ_4			-0.234* (0.135)	-0.234* (0.136)
$INFL_{it-1}$	θ_5				-0.054 (0.067)
$EPIBR_{it-1}(\mathbf{BENMIN_{i,t-1}} \leq \gamma)$	β_1	0.018*** (0.009)	0.020*** (0.004)	0.020*** (0.005)	0.020*** (0.005)
$EPIBR_{it-1}(\mathbf{BENMIN_{i,t-1}} > \gamma)$	β_2	-0.03*** (0.013)	-0.02** (0.050)	-0.02* (0.057)	-0.019* (0.057)
R^2		0.61	0.60	0.56	0.55
Threshold	γ	1	1	1	1
F test		F(11, 151) = 2.37 Prob > F = 0.0098	F(11, 150) = 2.40 Prob > F = 0.0090	F(29, 355) = 2.58 Prob> F = 0.0000	F(11, 148) = 2.20 Prob > F = 0.0174

Note: All these single-threshold models are estimated using the STATA software using a PTR estimator, according to the method developed by Baum et al. (2013). Standard errors are shown in parentheses. *** significant at 1%, ** significant at the 5% level, * significant at 10%.

Regarding fiscal rigidities, our results reveal that the initial structural primary fiscal balance ($SBPS_{t-1}$) acts positively on the structural primary fiscal balance. This result can be explained by the fact that the initial deficit generates an increase in expenditure in the form of interest on the debt. African countries often resort to debt to finance their deficits, which forces them to release each year in the form of current expenditure, interest on the debt. This hysterical effect is also present in the study by Bobbo (2016). The variable measuring the endogenous effects of the state of the fiscal balance (INV_{t-1}) acts negatively on the primary structural fiscal balance. This result is revealing, as suggested by Ott and Ott (1965), of an accumulation of claims on the government in the form of interest-bearing public debt. Changes in the terms of exchange have a negative effect on the primary structural balance. In other words, this result suggests that unanticipated changes in the terms of trade, that is, a deviation from its trend, affects fiscal policy. Likewise, the increase in the population translates into a deterioration of the fiscal balance. Such a result can be explained by the fact that the corollary of population growth is the development of urbanization, implying an increase in public expenditure. Official development assistance has a negative effect on the primary structural fiscal balance. Our

results confirm those of Thornton (2008), who suggest that tax policy is pro-cyclical in African countries dependent on foreign aid.

4.2. Bank credit and fiscal cyclicality

We estimate the cyclical reaction of tax policy conditional on the level of credit of credit to the economy. The aim is to show that access to domestic credit is favourable to the implementation of counter-cyclical tax policies, provided that credit does not cross a certain level. In Table 2, the results of the estimates suggest that credit to the economy conditions tax cyclicality.

Table 2: Role of credit in fiscal cyclicality

Dependent variable: structural primary fiscal balance ($SBPS_t$)					
Explanatory variables		Model 1	Model 2	Model 3	Model 4
$SBPS_{it-1}$	θ_0	0.239*** (0.081)	0.174** (0.085)	0.164* (0.086)	0.164* (0.086)
INV_{it-1}	θ_1	-0.417*** (0.097)	-0.420*** (0.096)	-0.408*** (0.097)	-0.408*** (0.098)
$VTERME_{it-1}$	θ_2	-0.069*** (0.024)	-0.058** (0.024)	-0.055** (0.025)	-0.055** (0.025)
$POPURB_{it-1}$	θ_3		-0.510** (0.231)	-0.458* (0.240)	-0.458* (0.241)
APD_{it-1}	θ_4			-0.246 * (0.134)	-0.244* (0.135)
$INFL_{it-1}$	θ_5				-0.058 (0.067)
$EPIBR_{it-1}(\mathbf{CRE_{i,t-1}} \leq \boldsymbol{\gamma})$	β_1	0.017*** (0.006)	0.018*** (0.006)	0.018*** (0.006)	0.018*** (0.006)
$EPIBR_{it-1}(\mathbf{CRE_{i,t-1}} > \boldsymbol{\gamma})$	β_2	-0.026*** (0.010)	-0.019* (0.010)	-0.019* (0.010)	-0.019* (0.010)
R^2		0.61	0.59	0.55	0.54
Threshold	γ	13.54	13.54	13.54	13.54
F test		F(11, 151) = 2.73 Prob > F = 0.0030	F(11, 150) = 2.23 Prob > F = 0.0154	F(11, 149) = 2.18 Prob > F = 0.0185	F(11, 148) = 2.14 Prob > F = 0.0206

Note: All these single-threshold models are estimated using the STATA software using a PTR estimator, according to the method developed by Baum et al. (2013). Standard errors are shown in parentheses. *** significant at 1%, ** significant at the 5% level, * significant at 10%.

The results of the estimates reveal the presence of a bank credit threshold of 13.54%, below which fiscal policy acts in a counter-cyclical manner. However, our results indicate that any level of credit exceeding this threshold can lead to a pro-cyclical fiscal reaction. This result supports the argument that credit is essential for the implementation of a counter-cyclical fiscal policy (Gavin & Perotti, 1997). However, as Kaminsky et al. (2004), excess credit can lead governments to pursue pro-cyclical tax policies. The effects of the control variables on the structural primary fiscal balance remain identical to those obtained in Table 1.

4.3 Public debt and fiscal cyclicality

In this part, we highlight the determining role of public debt on the direction of fiscal policy. The results in Tables 3,4 and 5 summarize the role of public debt and its components in the cyclical direction of fiscal policy.

Table 3: Role of total public debt in fiscal cyclicality

Dependent variable: structural primary fiscal balance ($SBPS_t$)					
Explanatory variables		Model 1	Model 2	Model 3	Model 4
$SBPS_{it-1}$	θ_0	0.177** (0.081)	0.164* (0.086)	0.154* (0.087)	0.154* (0.087)
INV_{it-1}	θ_1	-0.353*** (0.098)	-0.388*** (0.096)	-0.376*** (0.098)	-0.376*** (0.098)
$VTERME_{it-1}$	θ_2	-0.063*** (0.024)	-0.058** (0.025)	-0.055** (0.025)	-0.054** (0.025)
$POPURB_{it-1}$	θ_3		-0.666*** (0.227)	-0.607** (0.237)	-0.607** (0.238)
APD_{it-1}	θ_4			-0.124* (0.069)	-0.124*** (0.043)
$INFL_{it-1}$	θ_5				-0.075 (0.056)
$EPIBR_{it-1}(\mathbf{DEBT}_{i,t-1} \leq \gamma)$	β_1	0.013** (0.005)	0.015** (0.007)	0.015*** (0.005)	0.015*** (0.004)
$EPIBR_{it-1}(\mathbf{DEBT}_{i,t-1} > \gamma)$	β_2	-0.013*** (0.004)	-0.017** (0.006)	-0.017* (0.006)	-0.017** (0.007)
R^2		0.59	0.58	0.56	0.57
Threshold	γ	39.96	39.95	39.57	39.86
F test		F(11, 151) = 2.09 Prob > F = 0.0241	F(11, 150) = 2.29 Prob > F = 0.0128	F(11, 149) = 2.18 Prob > F = 0.0184	F(11, 148) = 2.15 Prob > F = 0.0201

Note: All these single-threshold models are estimated using the STATA software using a PTR estimator, according to the method developed by Baum et al. (2013). Standard errors are shown in parentheses. *** significant at 1%, ** significant at the 5% level, * significant at 10%.

The results of the estimates suggest that external public debt conditions the reaction of fiscal policy to cyclical fluctuations. Indeed, when the total public debt is less than 39.86% of the GDP, the fiscal reaction is counter-cyclical. The Keynesian hypothesis, supporting the counter-cyclicality of fiscal policy is therefore proven for a low level of debt in Africa. Conversely, fiscal policy turns out to be pro-cyclical in a high debt regime, more precisely when the debt threshold is higher than 39.86% of GDP. In this case, fiscal policy is suboptimal and contrasts with both Keynesian and neoclassical norms. Such a result can be justified by the fact that high debt ratios generate high interest payments (Egert, 2012), which deprive the government of part of the resources necessary for counter-cyclical operations of tax policies. Also, Frankel, Vegh and Vuletin (2013) point out that a low debt-to-GDP ratio can help reduce a country's risk of default and provide leeway for the implementation of a counter-cyclical fiscal policy. Our

results corroborate those of Combes et al. (2017), who conclude that the cyclical response of the budget is conditional on the level of debt in advanced, emerging and developing countries. Nevertheless, the optimal debt threshold of 87% of GDP obtained in their study seems to be higher than that obtained in our study. Such a gap can be explained by the difference in the size of states. It should be noted, however, that the influence of the control variables on the structural primary fiscal balance remains identical to those of previous estimates.

Table 4 : Role of external public debt in fiscal cyclicality

Dependent variable: structural primary fiscal balance ($SBPS_t$)					
Explanatory variables		Model 1	Model 2	Model 3	Model 4
$SBPS_{it-1}$	θ_0	0.244*** (0.082)	0.165* (0.085)	0.154* (0.086)	0.154* (0.086)
INV_{it-1}	θ_1	-0.383*** (0.098)	-0.393*** (0.096)	-0.380*** (0.097)	-0.380*** (0.097)
$VTERME_{it-1}$	θ_2	-0.073*** (0.025)	-0.059** (0.025)	-0.056** (0.025)	-0.056** (0.025)
$POPURB_{it-1}$	θ_3		-0.657*** (0.226)	-0.595** (0.236)	-0.595** (0.237)
APD_{it-1}	θ_4			-0.131** (0.051)	-0.131** (0.056)
$INFL_{it-1}$	θ_5				-0.069 (0.065)
$EPIBR_{it-1}(\mathbf{DEBTEX_{i,t-1}} \leq \boldsymbol{\gamma})$	β_1	0.021** (0.010)	0.017* (0.010)	0.017* (0.010)	0.017* (0.010)
$EPIBR_{it-1}(\mathbf{DEBTEX_{i,t-1}} > \boldsymbol{\gamma})$	β_2	-0.015** (0.007)	-0.018*** (0.006)	-0.018*** (0.006)	-0.018*** (0.006)
R^2		0.59	0.57	0.57	0.55
Threshold	γ	28.79	28.85	28.90	28.69
F test		F(11, 151) = 2.19 Prob > F = 0.0174	F(11, 150) = 2.32 Prob > F = 0.0118	F(11, 149) = 2.22 Prob > F = 0.0159	F(11, 148) = 2.19 Prob > F = 0.0176

Note: All these single-threshold models are estimated using the STATA software using a PTR estimator, according to the method developed by Baum et al. (2013). Standard errors are shown in parentheses. *** significant at 1%, ** significant at the 5% level, * significant at 10%.

Table 5: Role of domestic public debt in fiscal cyclicality

Dependent variable: structural primary fiscal balance ($SBPS_t$)					
Explanatory variables		Model 1	Model 2	Model 3	Model 4
$SBPS_{it-1}$	θ_0	0.174** (0.083)	0.101** (0.041)	0.088* (0.050)	0.087** (0.038)
INV_{it-1}	θ_1	-0.369*** (0.100)	-0.374*** (0.097)	-0.359*** (0.098)	-0.360*** (0.098)
$VTERME_{it-1}$	θ_2	-0.064** (0.025)	-0.046* (0.025)	-0.043* (0.025)	-0.042* (0.025)

$POPURB_{it-1}$	θ_3		-0.765*** (0.229)	-0.698*** (0.238)	-0.700*** (0.239)
APD_{it-1}	θ_4			-0.144** (0.057)	-0.140* (0.076)
$INFL_{it-1}$	θ_5				-0.068 (0.043)
$EPIBR_{it-1}(\mathbf{DEBTIN}_{i,t-1} \leq \gamma)$	β_1	0.035*** (0.012)	0.049*** (0.015)	0.050*** (0.015)	0.051*** (0.015)
$EPIBR_{it-1}(\mathbf{DEBTIN}_{i,t-1} > \gamma)$	β_2	-0.095** (0.043)	-0.075** (0.033)	-0.075** (0.031)	-0.075** (0.032)
R^2		0.58	0.58	0.59	0.56
Threshold	γ	10.91	10.75	10.81	10.93
F test		F(11,151) = 2.18 Prob > F = 0.0182	F(11, 150) = 2.57 Prob > F = 0.0052	F(11, 149) = 2.45 Prob > F = 0.0076	F(11, 148) = 2.44 Prob > F = 0.0078

Note: All these single-threshold models are estimated using the STATA software using a PTR estimator, according to the method developed by Baum et al. (2013). Standard errors are shown in parentheses. *** significant at 1%, ** significant at the 5% level, * significant at 10%.

The results are robust, as by replacing total debt with external and domestic debt in turn, the signs and signification of the estimated coefficients β_1 and β_2 (the business cycle coefficients) did not change. The same is true for the debt regime independent coefficients ($\theta 0$, $\theta 1$, $\theta 2$, $\theta 3$, $\theta 4$, $\theta 5$), which are consistent. Furthermore, it turns out that the levels of external and external public debt above which the fiscal policy response is counter-cyclical are 28.69% and 10.93% of GDP, respectively. Otherwise, the threshold of external debt that ensures the transition from counter-cyclical to pro-cyclical fiscal policies is higher than that of domestic debt. This result implies that external debt is the appropriate financing modality for counter-cyclical intervention in Africa, given the limited level of domestic savings in these countries (African Capacity-Building Foundation, 2015). This low level of domestic savings limits the ability to finance a counter-cyclical fiscal intervention through domestic debt.

4.4. Corruption and fiscal cyclicality

This is to show that corruption is a transmission channel in fiscal cyclicality. The results of the estimates of the threshold-effect model, reported in Table 6 indicate that the orientation of fiscal policy is conditioned by the level of corruption.

Table 6: Role of corruption in fiscal cyclicality

Dependent variable: structural primary fiscal balance ($SBPS_t$)					
Explanatory variables		Modèle 1	Model 2	Model 3	Modèle 4
$SBPS_{it-1}$	θ_0	0.230*** (0.082)	0.159* (0.085)	0.151* (0.087)	0.151* (0.087)
INV_{it-1}	θ_1	-0.437*** (0.100)	-0.437*** (0.098)	-0.428*** (0.099)	-0.428*** (0.100)
$VTERME_{it-1}$	θ_2	-0.071*** (0.025)	-0.058** (0.025)	-0.056** (0.025)	-0.056** (0.025)

$POPURB_{it-1}$	θ_3		-0.578** (0.230)	-0.542** (0.239)	-0.543** (0.240)
APD_{it-1}	θ_4			-0.272** (0.126)	-0.271* (0.113)
$INFL_{it-1}$					-0.054 (0.362)
$EPIBR_{it-1}(\mathbf{COR}_{i,t-1} \leq \gamma)$	β_1	0.021** (0.010)	0.015*** (0.005)	0.014** (0.010)	0.014*** (0.005)
$EPIBR_{it-1}(\mathbf{COR}_{i,t-1} > \gamma)$	β_2	-0.016** (0.007)	-0.017*** (0.006)	-0.017** (0.006)	-0.017** (0.007)
R^2		0.59	0.58	0.57	0.55
Threshold	γ	0.14	0.14	0.14	0.14
F test		F(11, 151) = 2.71 Prob > F = 0.0032	F(11, 150) = 2.42 Prob > F = 0.0084	F(11, 149) = 2.34 Prob > F = 0.0110	F(11, 148) = 2.32 Prob > F = 0.0119

Note: All these single-threshold models are estimated using the STATA software using a PTR estimator, according to the method developed by Baum et al. (2013). Standard errors are shown in parentheses. *** significant at 1%, ** significant at the 5% level, * significant at 10%.

The results of our estimates support the hypothesis that tax policy is more pro-cyclical when corruption is more prevalent. Indeed, it appears that when the corruption index is below 0.14, the fiscal reaction is counter-cyclical. In contrast, when the corruption index is above 0.14, fiscal policy is pro-cyclical. The fiscal reaction to cyclical fluctuations is more optimal when corruption decreases. Such a result can be explained by the fact that good governance translates into improved tax revenues, making it possible to finance a counter-cyclical government intervention. Our results corroborate those of Alesina and Tabellini (2005), who argue that low corruption leads to counter-cyclical tax policy in democratic countries. Although the role of corruption on tax cyclicality in our study is not conditioned on democracy as in the study of Alesina and Tabellini (2005), our results call into question those of Thornton (2008), who concludes that 'lower corruption leads to greater pro-cyclicality in the sample of 37 African countries he studies.

5. Conclusion and economic policy

The aim of this article was to show that mining rent, credit, debt and corruption affect the response of fiscal policy to cyclical fluctuations in Africa. To achieve this, we used a threshold-effect panel model (PTR), applied to a panel of 12 countries in sub-Saharan Africa for the period 2004 to 2018. Consistent with the assumption that the pro-cyclical stance of developing country tax policies migrates to counter-cyclical policies, this article produces a first robust empirical evidence on the conditions for shifting from pro-cyclical to counter-cyclical tax policies. Lessons from this study provide the mining rent, credit, debt and corruption targets needed for tax rule-making in African countries.

First, we have found that there is a dynamic in the fiscal reaction conditional on the level of mining rent. Our results suggest that there is a mining rent threshold of 1% of GDP, below which fiscal policy reacts counter-cyclically, and beyond which fiscal reaction becomes pro-cyclical. Next, our results show that credit and borrowing influence the fiscal response to cyclical fluctuations. Indeed, below a credit threshold of 13.54% of GDP, the stance of tax

policy is counter-cyclical. However, when credit to the economy exceeds this threshold, tax policy reacts with pro-cyclicality. Likewise, when the level of total public debt is below 39.86% of GDP, fiscal policy is counter-cyclical, but beyond this level of debt, the cyclical reaction of fiscal policy is pro-cyclical. In addition, the thresholds of external debt and domestic debt that condition the cyclical reaction of fiscal policy are respectively 28.69% and 10.93% of GDP. Finally, our results show that corruption plays a decisive role in the cyclical orientation of tax policy. Indeed, when corruption is below 0.14, the orientation of fiscal policy is counter-cyclical, but above this threshold, fiscal policy turns out to be pro-cyclical. Furthermore, our results suggest that investment, terms of exchange, population growth and official development assistance are important determinants of fiscal cyclicality in Africa.

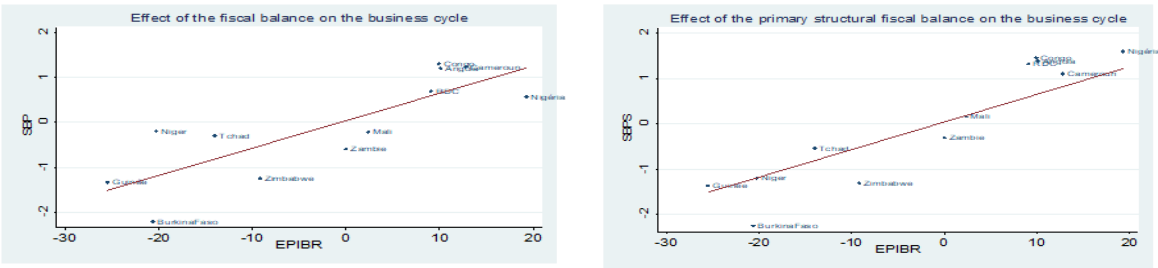
In view of the results obtained, two major implications of economic policy can be formulated for the establishment of tax rules in Africa. First, the results of the estimates show that mining rent conditions the government's cyclical response. Within this framework, the countries of sub-Saharan Africa should not use more than 1% of the GDP of the rents drawn from the raw materials to revive the economic activity. A significant part of the rent drawn in times of a commodity boom should be saved, in order to guarantee a counter-cyclical fiscal reaction, in downturns. Likewise, the implementation of a tax rule in sub-Saharan African countries seems necessary. In fact, this rule should be sensitive to fluctuations in the mining rent, since the latter influences the structural fiscal balance. Thus, when the GDP and mining rent deviate from their potential values, the cyclical fiscal balance may adjust. Afterwards, in order to finance a counter-cyclical boost, external debt should be privileged, since the external debt threshold ensuring the transition from a counter-cyclical to a pro-cyclical fiscal reaction is higher than the domestic debt threshold. However, to make domestic debt an effective financing modality for counter-cyclical intervention, policies to promote domestic savings need to be implemented. Finally, the governments of African countries should make the fight against corruption a priority in order to promote an increase in the taxes collected, necessary to finance a counter-cyclical intervention.

Appendices

Appendix 1: List of countries

Angola, Burkina Faso, Cameroon, Democratic Republic of Congo, Republic of Congo, Chad, Guinea, Mali, Niger, Nigeria, Zambia and Zimbabwe.

Graph: Relationship between fiscal balance and economic cycle



Source: author.

Appendix 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
SBPS	-1.59e-08	7.259734	-23.61499	31.82972
INV	22.83001	10.0479	5.461671	57.33511
VTERME	-.5074135	18.86632	-48.25626	63.93692
POPURB	39.0587	14.17253	16.208	66.916
EPIBR	-17.64067	88.5435	-827.2889	139.716
DEBT	42.40056	28.67212	7.2	129.7353
DEBTEX	28.0086	20.03834	3.027072	111.7204
DEBTIN	14.39196	15.61902	-8.176949	85.9581
CRE	12.42063	6.783171	1.095236	31.29515
COR	.4674468	.1891105	.2565658	.9816402
BENMIN	4.423904	5.545584	0	19.50502

Source: author

Appendix 3: Linearity Tests

H0: Linear Model H1: PTR model with at least one Threshold Variable (r=1)		
Wald Tests (LM)	W = 5.7083**	pvalue = 0.0476
Fisher Tests (LMF)	F = 10.8624*	pvalue = 0.0357
LRT Tests (LRT)	LRT = 5.6196***	pvalue = 0.0602

Source: author

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