A Reaction Function for the Bank of the Central African States in a Context of Fiscal Dominance

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Abstract

The aim of this study is to estimate the reaction function of the BEAC and to assess the extent to which the monetary policy is influenced by the evolution of the financial situation of the States members of the CEMAC. We estimated two reaction functions of the Central Bank according to its two main monetary policy instruments: the monetary base and the policy rate, by taking into account the potential role of fiscal dominance. Estimates of quarterly data for *Mc Callum* rule for the monetary base and *Taylor rule* for the key interest rate in the CEMAC countries, over the period 1996 to 2013, revealed four major results. Firstly, we find that in the event of economic overheating, BEAC contracts the monetary base and releases it to support activity in the slowdown phases, revealing the sensitivity of the Central Bank to the evolution of the economic situation in the CEMAC when manipulating its monetary base. Secondly, the BEAC policy rate does not respond to the output gap or the inflation, due in part to the weakness of the transmission mechanisms and the inoperability of the interest rate channel. Thirdly, our results indicate that BEAC carries out a very high rate smoothing and the associated coefficient is of the order of 0.98, reflecting the uncertainties on the effects of its action. As for the fourth result, he indicates that the conduct of monetary policy is influenced by the financial situation of the States thus validating the hypothesis of fiscal dominance. We find, however, that fiscal dominance is more pronounced in the policy of managing the monetary base than in the policy rate setting strategy.

Keywords : monetary policy, prices stability, central bank.

JEL Codes : E43, E52, E58.

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Non-technical summary

The present study focuses on the Central Bank's reaction to its main objectives (inflation gap and support to activity) and to the financial situation of the States of the Economic and Monetary Community of Central Africa (CEMAC). The BEAC's reaction function is captured in this study through the two main instruments available to the BEAC: the monetary base and the interest rate. This study seeks is to account for the behaviour of the BEAC in the conduct of monetary policy. To do this, two types of monetary policy rules are estimated: a rule to evaluate the monetary base's fixing behavior, and a rule to evaluate the rate-setting behavior. However, in both forms of rules, we take into account the potential role of fiscal dominance by introducing into each of the rules, the Government's Net Position (PNG), which represents the difference between the liabilities and the assets of the State.

The estimates based on quarterly data of the Mc Callum type rules for the monetary base and the Taylor type for the key rate in the CEMAC countries over the period 1996Q1 to 2013Q4, revealed four major results:

(i)The first result indicates that the Central Bank is sensitive to the evolution of the economic situation in the CEMAC when it manipulates its monetary base. In other words, in the event of economic overheating, it contracts the monetary base and releases it to support activity in the slowdown phases.

(ii) The second result indicates that the BEAC policy rate does not respond to the output gap or the inflation gap due to weak transmission mechanisms and the ineffectiveness of the interest rate channel;

(iii) The third major result indicates that the BEAC proceeds to a very high interest rate smoothing and the corresponding coefficient is about 0.98, reflecting the uncertainties on the effects of its action.

(iv) The fourth result indicates that the conduct of monetary policy is influenced by the financial situation of States, thus validating the hypothesis of fiscal dominance in the subregion. However, fiscal dominance is more pronounced with regard to the policy of managing the monetary base compared to the strategy of policy rate setting.

As a recommendation, the low sensitivity of the BEAC policy rate to the inflation and output gaps identified in this study calls for appropriate measures to make monetary policy transmission mechanisms work, as actions on policy rates have virtually no significant effect on the output and prices. To this end, it is recommended to accelerate the completion of the actions undertaken in the context of the ongoing monetary policy reform, in particular for the development and deepening of the financial system of the Zone. The establishment of a market in negotiable debt securities and the repo market is expected to contribute significantly to the broadening of the range of exchangeable financial instruments in the banking market and to the dynamization of the interbank component of the money market of the CEMAC. The sensitivity of the BEAC to the financial situation of States underlines the need to strengthen the framework for the coordination

of monetary and fiscal policies in order to limit the perverse effects of fiscal dominance in the sub-region, and reinforce the independence of the Central Bank.

Introduction

Taking into account the expectations of economic agents and information asymmetries in assessing the effectiveness of economic policy decisions is at the origin of the adoption of the rules. Indeed, the economic debate around the rules of economic policy dates back to Kydland and Prescott (1977) in their seminal article entitled "rules rather than discretion", where they show the primacy of rules over discretion in monetary policy. According to these authors, the strategies of rule-based decision-makers increase their credibility and are more optimal than those based on discretion.

These theoretical developments have considerably influenced the profound changes observed in the conduct of monetary policy since the 1990s, both in developed and developing countries, notably through the setting of price stability as the main objective of monetary policy. Indeed, the priority given to price stability at the central bank level stems from the theoretical consensus around the crucial role of a central bank's credibility in the effectiveness of its monetary policy decisions. Far from being an asset, this credibility is itself conditioned by the transparency and the adoption of rules in the conduct of monetary policy (Barro and Gordon, 1983).

The literature distinguishes two categories of monetary policy rules: (i) "passive" rules, which are, independent of the state of the economy, such as Friedman's k% rule according to which the central bank should target a constant growth rate of the money supply, and (ii) the "actives", which provide that the direction of monetary policy may be modified according to events affecting the economy (Drumetz and Verdelhan , 1997).

Despite their operational simplicity, the "passive" rules have been gradually abandoned by central banks, in particular because of the limited scope for active monetary policy management. To this end, we will focus on active rules, which are mainly concerned with rules for the modification of monetary aggregates and rules for fixing interest rates.

The active rules for modifying monetary aggregates, initially theorized by Mc Callum (1988), emphasize the consistency between monetary changes, price stability and nominal GDP growth in the medium term in the economy. Most of the central banks that have adopted them have simultaneously pursued a monetary aggregate control strategy, relying mainly on the stability of the link between money supply and inflation and the demand for money. However, the erosion of the link between the money supply and inflation related to the increasing instability of the demand for money, due to the development and deepening of the financial sector, justified the gradual abandonment of monetary aggregate control in favour of the management of interest rates in the early 1990s.

In terms of interest rate setting, Taylor (1993, 1999) is the first author to propose a descriptive rule for the Federal Reserve's (Fed) rate policy. The rule that bears its name is a reference both normative and explanatory of the monetary policy of the Fed (Bricongne and Fournier, 2008). Indeed, according to Orphanides (2007), the Taylor rule is a simple rule of monetary policy that prescribes how a central bank should adjust its interest

rate instruments systematically in response to changes in inflation and economic activity. Since then, much work has contributed to improving the specification of this rule, including many other macroeconomic variables followed by central banks in the development and implementation of their monetary policy.

Monetary reforms in the Central African Monetary Union (UMAC) in the mid-1990s led to the inclusion of monetary stability as a primary objective for the BEAC. This objective has two dimensions: internal, linked to price stability through a weak increase in inflation and, externally, linked to an adequate external money coverage rate, with a minimum threshold of 20%. Nevertheless, in accordance with Article 1 of its Statutes, without prejudice to the objective of monetary stability, the BEAC supports the economic policies elaborated in the subregion. In addition, the current configuration of the UMAC gives the central bank the possibility of providing direct and supervised support to the States, which may justify the sensitivity of the BEAC to the budgetary situation of the States and thus compromise the objectives.

To achieve these objectives, the BEAC uses a set of indirect instruments, which are organized around two main pillars: the refinancing policy on the money market through manipulation of the monetary base (action on quantities through the monetary programming) and the setting of its key rate (action by rates). In the context of the monetary programming exercise, the BEAC determines a reference level for the growth of the money supply and, ultimately, the monetary base, consistent with monetary stability over the medium term. Regarding its interest rate policy, the BEAC has a discount rate, the tender rate (TIAO), which is its main policy rate.

After more than two decades of action, this policy should be assessed. Does the central bank really take into account activity and prices in the manipulation of its instruments or is it more influenced by the financial situation of the states?

The purpose of this study is to take into account the behaviour of the BEAC in the conduct of monetary policy. Given the "two-pillar" strategy pursued by the BEAC, including actions on quantities (materialized here by the Mc Callum rule) and rates (materialized in the study by the Taylor type rule).

This study has a dual interest for the conduct of BEAC monetary policy. It seeks to identify the behavior of the Central Bank vis-à-vis its main objectives and its sensitivity to the financial situation of States, but it also makes it possible, by comparing the two types of rules used (Mc Callum and Taylor) to select the rule that better describes the behavior of the Central Bank. Moreover, by characterizing the systematic element of the behavior of the Central Bank, and by adopting the rule that best fits the realities of CEMAC economies, this study offers an important input to the construction of DSGE simulation models of the effects of economic policies[3] for the BEAC, which are under construction as part of the monetary policy reform.

[3] The construction of structural models for the BEAC to evaluate the effects of monetary policy can thus be inspired by this work.

The rest of the paper is structured around three sections. The first presents a review of the economic literature on active monetary policy rules with an emphasis on fiscal dominance. The second approach addresses the methodological aspects of estimating a BEAC reaction function. The third focuses on the analysis of results and the resulting recommendations.

I. The literature on the active monetary policy rules of central banks

1. Rules based on the control of monetary aggregates: the McCallum type rules

One of the most famous monetary policy rules based on the control of monetary aggregates is undoubtedly the one developed in 1988 by Bennett McCallum. Simply described, this rule stipulates a rate of growth of the monetary base anchored to the growth of real output with adjustments to account for changes in money velocity and deviations from nominal expenditure in relation to a previously established target (Racette et al., 1992).

Indeed, McCallum builds his argument on two main consensus raised in the literature: the superiority of rule-based policies in relation to discretionary actions, as established by the work of Kydland and Prescott (1977), and the independence of the long-run movement of the real variables in relation to the average growth rate of the nominal variables. This last point, coupled with the absence of a dominant macroeconomic model that explains the short-run evolution of large aggregates and, more specifically, the division of nominal output into real and monetary components, prompted it to choose nominal income as a target of the monetary authorities.

According to McCallum (1988), the monetary base directly controlled by central banks is more appropriate to control changes in activity and prices. Practically, the McCallum rule implies that the central bank influences the rate of growth of the monetary base so that nominal GDP grows steadily at a non-inflationary rate corresponding to the long-run real growth rate. The central bank is therefore asked to modulate monetary policy according to the gap between the potential GDP ($\bar{y}$) and the actual GDP (y_t), that is :

$$\Delta bm_t = \Delta\bar{y} - \Delta v_t + \varphi(\Delta\bar{y} - \Delta y_t) \qquad (1)$$

In this equation, Δbm_t represents the growth rate of the monetary policy instrument, which is here the monetary base; $\Delta\bar{y}$ is the target of the nominal GDP growth rate; Δv_t is the average velocity rate of the money defined as the ratio of nominal GDP to the monetary base; and $(\Delta\bar{y} - \Delta y_t)$ is the growth gap, thus representing the central bank's reaction function. The parameter φ ($\varphi > 0$) thus represents the reaction factor of the central bank to the growth gap. In this expression, a low value of φ implies a weak central bank reaction to the output gap, a high value indicating exactly the inverse, with risks of dynamic instability. Mc Callum (1988) assumed that the value of φ can be set to 0.5

The control of Monetary aggregate was in fact adopted in the 1970s by several countries, including Switzerland and Germany, which were promoted better partisans of the monetarist school of thought for their control of inflation. Other countries have used this strategy in the same way as the United States (under the era of Paul Volker[4]), Canada, the United Kingdom or Japan.

Following Mc Callum, several studies empirically assessed the performance of such a rule for developed countries (Hall 1990, Judd and Montley 1991, 1993, Dueker 1993, Todd 1994, Stark and Croushore 1996, Razzak 2003) or emerging (Liu and Zhang 2007; Kong 2008).

In the 1980s, financial liberalization and financial development led to a considerable change in the money velocity in some countries and made monetary policies based on the control of monetary aggregates insufficient to ensure price stability. Indeed, financial development and the introduction of sophisticated financial instruments that substitute for money have challenged the ability of central banks to control the supply of money and induce instability in the demand for money.

These changes have led many central banks in the early 1990s to focus more on indirect monetary policy instruments, based on the interest rate management. This shift in the conduct of monetary policy also coincided with the evolution of the objectives assigned to central banks, namely the stability of prices, with the adoption by many of them, of inflation targets and / or inflation targeting strategy.

2. *Rules for setting interest rates : Taylor rules*

Most central banks use the Taylor rule either to construct more sophisticated models (the DSGEs), or as an indicator in the optimal conduct of monetary policy. However, beyond interpretations often assigned to the Taylor rule, it should be emphasized that several specifications of this rule have been proposed. Indeed, its initial formulation dates back to Taylor (1993) for the American case and had the following form:

$$r = p + 0{,}5y + 0{,}5(p - 2) + 2 \qquad (2)$$

Where r is the central bank interest rate (or federal funds rate), p is the rate of inflation over the past four quarters, y is the output gap [5]. Finally, $p - 2$ represents the difference between observed inflation and the Central Bank inflation target, which is 2%. According to Taylor, the central bank's short-term interest rate must rise when expected inflation exceeds the central bank's inflation target or when the real GDP is above its long-term trend (potential GDP). And when inflation is equal to the 2% target, and GDP reaches its trend value, the real interest rate $(r - p)$ will be 2%.

This rule therefore provides guidance on the weight that the central bank attaches to price stability and output in the conduct of its monetary policy. Taylor (1993) chooses 0.5 as the weight for both objectives in the US

[4] He was Director of the Federal Reserve of the United States from 1979 to 1987.

[5] It is a measure of the degree of overheating in the economy and is obtained by differentiating between real GDP and potential GDP relative to potential GDP.

case, but recognizes that this weight may change from one country to another. Thus, by comparing the interest rates derived from this rule with the observed rates, one can judge the adequacy of monetary policy to the fundamental economic variables. And Taylor has shown that this rule reproduces well the evolution of the interest rate of the United States during the period 1987-1992. However, as originally formulated, the Taylor rule is generally subject to several criticisms.

First of all, with respect to its variables, the uncertainty associated with their construction can lead to divergent results. Indeed, with respect to the real interest rate, for example, Taylor sets it at 2%, which also represents the trend growth rate of the US economy over the period under review. However, this choice, which is underpinned by the neutrality[6] of monetary policy with respect to long-term activity, is not shared by all authors. Sachs (1996), Drumetz and Verdelhan (1997) retain a rate of 3.5%, while Smets (1998) and Kozicki (1999) considered a real interest rate which is equal to the average of the gap between the nominal interest rate and the inflation rate over the period under review. Verdelhan (1998) subsequently advocated the possibility of setting the inflation target a priori and then deducting the real interest rate. The calculation of the output gap depends on the method of determining the potential GDP and the choice of the smoothing parameter of the data.

In addition to the limitations associated with the determination of variables, the initial specification of the Taylor rule is criticized because it assumes that the monetary policy stance of the central bank is mainly determined based on information of the current period, thus reducing the ability of central banks to use all available information both in terms of the past and upcoming events.

Taking into account these last limits allowed the introduction of lagged and / or anticipated variables in the initial Taylor rule. Sachs (1996), for example, introduced inflation expectations instead of current inflation and obtained the following more general formulation:

$$r = r_{réel} + p_{anticipé} + \alpha y + \beta(p - p_{cible}) \qquad (3)$$

In this specification, the expected inflation rate (pa) is sometimes approximated by the inflation of the previous period; $r_{réel}$ is the neutral real interest rate that allows long-term equilibrium and by reference to neoclassical theory, it is often considered that this neutral rate is equal to the potential growth of the economy; α et β are positive parameters that measure respectively the weight that the central bank gives to the stabilization of activity and prices.

However, the introduction of the anticipated variables exposes the Taylor rule to an additional limit related to the fact that its determination requires information that is sometimes unavailable (Mc Callum, 1993). Taking

[6] Indeed, in the long run, the inflation target is reached and the output gap is zero, so the nominal interest rate is such that the real interest rate is equal to the real neutral rate, ie to the potential growth rate , reflecting the neutrality of the long-term interest rate on economic activity

account of adaptive and then rational expectations has thus led to two other specifications of the Taylor rule: a specification giving rise to "backward-looking" behaviours (equation 4), and another giving rise to "forward-looking" behaviours (equation 5).

$$r_t = r_{réel} + p_t + \alpha y_{t-1} + \beta(p_{t-1} - p_{cible}) + \varepsilon_t \qquad (4)$$

$$r_t = r_{réel} + p_t + \alpha E_t(y_{t+i}|\omega_t) + \beta E_t([p_{t+i} - p_{cible}]|\omega_t) + \varepsilon_t \qquad (5)$$

In the equation (5) $E_t(.|\omega_t)$ denotes the expectation conditional to the information available to the central bank at time *t*, that is, at the moment when it makes its decision, while ω_t materializes all of this information and i is the anticipation horizon.

Subsequently, several studies have investigated the smoothing effect of the interest rate on the basis that the Taylor rule as defined does not capture the central bank's tendency to smooth the fluctuations of the interest rate to avoid its volatility. Indeed, in the event of uncertainties about the effects of interest rate control on economic dynamics, central banks tend to smooth out the changes in their key interest rates (Sack, 2000). The central bank's assumption of smoothing of key rates is a reflection of an adaptation of their function of reaction to the constraints of the functioning of the economy in order to take account of the behavior of the agents and especially the mechanism of formation of their expectations. Finally, the smoothing of the interest rate is justified by the fact that the central bank wants to avoid rate instability and preserve its credibility among economic agents. Hence, smoothing interest rate fluctuations is a kind of response to the uncertainty of any monetary policy decision.

Among the authors who proposed a smoothing of the interest rate are Rudebusch (1995), Sack (1998), Clarida and Gertler (1996), Orphanides (1997), Verdelhan (1998) and Gertler (2000). The specification of the Taylor rule integrating the smoothing of the policy interest rate is generally as follows:

$$r_t = (1-\rho)r_t^* + \rho r_{t-1} + \varepsilon_t \qquad (5)$$

Where r_t^* represents one of the rules specified above (3) or (4) so that we have :

$$r_t = (1-\rho)[r_{réel} + p_t + \alpha y_{t-1} + \beta(p_{t-1} - p_{cible})] + \rho r_{t-1} + \varepsilon_t \qquad (6)$$

Or

$$r_t = (1-\rho)[r_{réel} + p_t + \alpha E_t(y_{t+i}|\omega_t) + \beta E_t([p_{t+i} - p_{cible}]|\omega_t)] + \rho r_{t-1} + \varepsilon_t \qquad (7)$$

In these specifications, ρ represents the interest rate smoothing parameter and its value is between 0 and 1 Clarida, Gali, and Gertler (2000) estimated the value of ρ to be 0.8 for the case of the United States.

It should be noted, however, that in view of the wide range of indicators and variables used regularly by central banks for the conduct of their monetary policy, many studies have attempted to introduce additional variables into the Taylor rule , including: the exchange rate, the lagged interest rate, the money supply, the prices of raw materials, etc. Regarding the Franc Zone, Tenou (2002) estimated the reaction function of the Central Bank of West African States (BCEAO) by adding as an additional variable the interest rate differential between the zone and France which is the main partner country of this area. However, several authors have focused more on adding the exchange rate in the Taylor rule, such as Ball (1999), Svensson (2000), Taylor (2001). And the generally accepted specification (where e_t represents the exchange rate at period t) is as follows:

$$r_t = (1-\rho)[r_{réel} + p_t + \alpha E_t(y_{t+i}|\omega_t) + \beta E_t([p_{t+i} - p_{cible}]|\omega_t) + \varphi \Delta e_t] + \rho r_{t-1} + \varepsilon_t (8)$$

3. Taking into account the fiscal dominance in the conduct of monetary policy

Through works on the fiscal theory of the general level of prices, recent developments in the literature on the rules led to the consideration of the implications of fiscal dominance on the conduct of monetary policy by the Central Banks. The fiscal theory of the price level runs counter to the monetarist thesis that inflation is always and everywhere a monetary phenomenon (monetary domination) and argues that the rise in uncontrolled budget deficits can accelerate inflation in a context of limited independence of the central bank. Thus, high inflation induced by expansionary fiscal policy may hamper the conduct of monetary policy.

Fiscal dominance refers to contexts where monetary policy orientations are strongly dictated by those of fiscal policy (Cochrane, 2001, Bergin 2000, Benhabib, et al 2001, Woodford, 2001, Afonso, 2002, Zoli, 2005) . In other words, the central bank sets and modifies its instruments according to the stakes related to the management of the public debt, either for the sake of coordination with fiscal policy in the context of a *policy mix*, or simply because of the pressures that the fiscal authorities directly exert on it. Fiscal dominance assumes that the central bank also has a goal of maintaining the country's fiscal solvency. This implies that in certain crisis situations where intertemporal fiscal solvency is no longer assured, the central bank restores it by increasing the money supply or by reducing its key interest rates.

Empirically, fiscal dominance can be captured by integrating a budgetary variable into the central bank's reaction function, such as the government spending gap relative to its target value (Kumhof et al., 2007) or the primary deficit Ekpo et al., 2015):

$$r_t = (1-\rho)[r_{réel} + p_t + \alpha E_t(y_{t+i}|\omega_t) + \beta E_t([p_{t+i} - p_{cible}]|\omega_t) + \varphi \Delta e_t] + \rho r_{t-1} + \theta(g_t - g^*) + \varepsilon_t \quad (9)$$

$$r_t = (1-\rho)[r_{réel} + p_t + \alpha E_t(y_{t+i}|\omega_t) + \beta E_t([p_{t+i} - p_{cible}]|\omega_t) + \varphi \Delta e_t] + \rho r_{t-1} + \theta(PB_{t-1}) + \varepsilon_t \quad (10)$$

II. Estimation of a BEAC reaction function

1. Methodological approach

As mentioned above, the monetary policy strategy currently pursued by the BEAC is revolves around "two pillars", with actions aimed at controlling money aggregates, in particular through monetary programming, and actions aimed at managing interest rate on the money market through the setting of its key interest rate (the interest rate on tenders - TIAO).

To take account of this specificity noted in the conduct of the monetary policy of the Issuing Institute, we will retain the two categories of rule (Mc Callum and Taylor) for the specification of the reaction function of the BEAC. For the formulation of the Taylor-type rule for the BEAC, like Tenou (2010) for the case of the BCEAO, and drawing on the work of Sachs (1996), Orphanides (1997) , Kozicki (1999) and Clarida, Gali and Gertler (2000), we will adopt a forward looking rule specification. The values of the expected variables (inflation and output) are described by partial adjustment mechanisms of their current levels to the target. With respect to the Mc Callum rule, we will retain the formulation of Racette et al. (1992).

For each of these rules, the main innovation brought to the baseline theoretical formulations is the introduction of new variables to take account of the specific characteristics of BEAC's monetary policy framework and context. Indeed, the net external position of the governments (PNG) vis-à-vis the financial system was introduced in order to assess the hypothesis of fiscal dominance in BEAC's monetary policy orientations. The choice of PNG to take account of fiscal dominance, instead of the primary deficit (Ekpo et al., 2015) or the gap in public spending relative to their target (Kumhof et al., 2007) observed in the literature, is simply justified by the unavailability of these variables at a quarterly frequency in the Zone.

McCallum rule to be estimated for the BEAC is as follows:

$$\Delta BM_t = \partial(y_t - y^*) - \mu\Delta v_t + \tau(PNG_t - PNG^*) + \theta(AEN_t - AEN^*) + \delta(\pi - \pi^*) \qquad (11)$$

With :

ΔBM_t : percentage change of the monetary base;

$y_t - y^*$ is the output gap or the gap between production and its potential level in percentage;

Δv_t: variation in the money velocity;

PNG_t: the net position of the Governments vis-à-vis the financial sector as a whole;

$PNG_t - PNG^*$: PNG deviation from its target level as a percentage;

AEN_t : Net foreign assets;

$AEN_t - AEN^*$: the NEA deviation from its target level in percentage; $\pi_t - \pi^*$ the inflation deviation with respect to its target value;

$\pi - \pi^*$ est l'écart d'inflation par rapport à sa valeur cible ;

∂ , μ, δ and τ : parameters to be estimated.

For the interest rate rule, we will estimate an 'augmented Taylor rule' that also includes net foreign assets (NEA) to take account of the nature of the fixed exchange rate regime in effect in the CEMAC. In a fixed exchange rate regime, the central bank should be concerned, in addition to the internal variables (production and inflation), of a variable related to the rate of coverage of the money, in particular external assets, which, in practice could be seen as an objective in its own. Indeed, the guarantee of a fixed parity requires the monetary authorities to pay particular attention to the variables of external balance (Ertugrul et al., 2005).

Thus, for the Taylor rule, the model is then written

$$r_t = (1-\rho)[r_{réel} + E_t(p_{t+i}/\omega_t) + \alpha[E_t(y_{t+i}/\omega_t) - y^*] + \beta[E_t(p_{t+i}/\omega_t) - p^*] + \varphi[E_t(V_{t+i}/\omega_t) - V^*]\,] + \rho r_{t-1} + \varepsilon_t \qquad (12)$$

E : mathematical expectation operator;

r_t : the BEAC steering interest rates, TIAO;

$r_{réel}$: real equilibrium interest rate;

p_t : inflation rate;

$E_t(y_{t+i}/\omega_t) - y^*$: output gap or gap between expected output and its potential level;

$[E_t(p_{t+i}/\omega_t) - p^*]$: gap between the expected inflation rate and the target inflation rate;

ρ : smoothing parameter to be estimated. Its value is between 0 and 1 ;

ω_t : set of information available at time *t* ;

α,β, φ and μ parameters to be estimated;

V_t : all variables taken into account in the conduct of the BEAC monetary policy. They include net foreign assets (AEN_t) and the net position of Governments vis-à-vis the financial sector as a whole (PNG_t).

Assuming a partial adjustment of the expected variables, using the following equation:

$E(X_{t+i}/\omega_t) = \gamma_X E(X_{t+i-1}/\omega_t) + (1-\gamma_X)X^*$, where γ_X is a parameter between 0 and 1 measuring the credibility of the target, the Taylor reaction function is then as follows:

$$r_t = \rho r_{t-1} + (1-\rho)\left[r_{réel} + \gamma_p p_t + \left(1-\gamma_p\right)p^* + \beta\gamma_p(p_t - p^*) + \alpha\gamma_y(y_t - y^*) + \varphi\gamma_\varphi(V_t - V^*)_t\right] + \varepsilon_t \quad (13)$$

By rearranging equation (13), we obtain the final model of the reaction function to be estimated:

$$r_t = \rho r_{t-1} + (1-\rho)(r_{réel} + p^*) + \partial(p_t - p^*) + \emptyset(y_t - y^*) + \vartheta(V_t - V^*) + \varepsilon_t \quad (14)$$

With $\partial = \beta\gamma_p(1-\rho)$; $\emptyset = \alpha\gamma_y(1-\rho)$ et $\vartheta = \varphi\gamma_\varphi(1-\rho)$.

2. Data and variables of the study

Estimates of the reaction functions of the BEAC monetary policy were made over the period 1996-2013 from the following quarterly data sets available to the BEAC: *i*) the BEAC TIAO, its main policy rate; (*ii*) the net position of the Governments vis-à-vis the CEMAC financial system; (*iii*) CEMAC quarter-on-quarter inflation rate, calculated from household consumer price indices, (*iv*) CEMAC GDP, interpolated to quarterly frequency by the Goldstein and Khan method (1976), (*v*) the output gap in the CEMAC, calculated using the Hodrick Prescott filter with a parameter $\boldsymbol{\lambda = 1600}$, (vi) the net external assets at a quarterly frequency, (*vii*) the quarterly monetary base in the CEMAC, and (*viii*) the velocity of money at a quarterly frequency.

3. Estimation methods

The specification of the Mc Callum rule does not really pose a problem of estimation, compared to that of the Taylor rule, whose estimation requires more adapted methods to control the endogeneity bias associated with the existence of the lagged endogenous variable among the explanatory variables and the non-observability of the anticipated variables.

Three estimation methods are generally used for this purpose: the generalized method of momments (GMM), the instrumental variables approach and the cointegration approach of Johansen (1991).

The development of the GMM method was due to the growing interest in the early 1980s for rational expectations models. Indeed, the problem of endogeneity observed sometimes arises from the fact that authors who cannot dispose of the expected inflation, generally use the output GAP instead (Svenson, 1997):

$$p_{t+1/t} = p_t + \tau GAP_t \quad (15)$$

Thus, the expected inflation obtained becomes endogenous and the most appropriate estimation method then becomes that of the generalized moments. This method allows, among other things, to check the potential endogeneity of all the explanatory variables.

Nevertheless, other authors use the instrumental variables method, and take as instruments the output GAP, lagged inflation, and interest rates (Mayes, 2000).

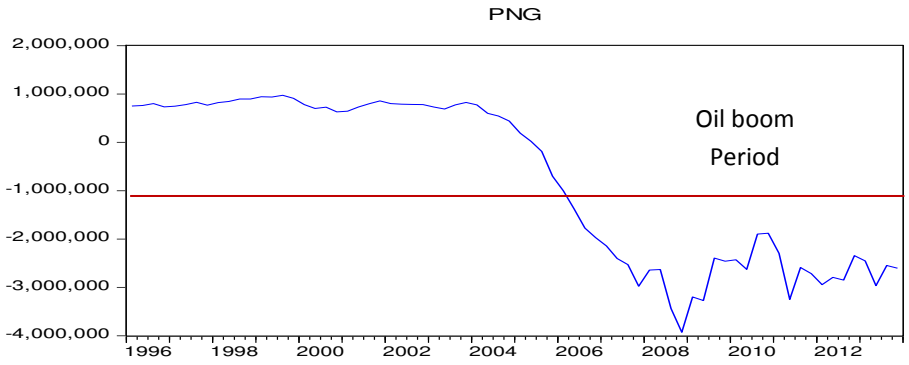
As for the cointegration approach of Johansen (1991), besides controlling the endogenous bias of some variables, it allows to estimate a robust relation in the presence of non-stationary variables.

This latter method is preferred for the estimation of the Taylor type reaction function for BEAC.

III. Results of the BEAC monetary policy reaction function

Equations (11) and (14) are estimated over three periods: the overall period of the study (1996Q-2013Q4) and two subperiods (1996Q-2005Q3 and 2005Q3-2013Q4). The subdivision of the estimation period into two subperiods is dictated by the change of regime observed in the evolution of PNG in the CEMAC.

Figure 1 : Evolution of PNG in the CEMAC



Source: Authors based on data from BEAC and national administrations.

Indeed, as the PNG is the difference between government liabilities and assets, the oil boom in the early 2000s, due to the good performance of oil prices, resulted in an increase in revenues (negative PNG) of most CEMAC member countries due to the influx of large oil revenues. In this context, the surplus of income generated by the States has resulted in an improvement in their net position vis-à-vis the financial sector. The results of our estimates are shown in Tables 1 and 2 below.

For *the Mc Callum-type rule,* the results generally show that the central bank's adjustments of the monetary base were mainly influenced by the inflation gap, the economic situation reflected in the output gap, and finally the financial situation of States, through the fluctuations of PNGs around their long-term trend. The negative sign associated with the output gap reflects the fact that in the event of economic overheating, the BEAC contracts the monetary base and releases it to support activity in phases of insufficient growth. Similarly, in the context of the regulation of bank liquidity, the acceleration of inflation has, on average, led the Central Bank to limit the growth of the supply of central money to credit institutions. Although relatively small in magnitude, the influence of the financial position of states on the monetary base adjustments made by the BEAC appears to be significant over the study period as a whole. The positive sign associated with PNG fluctuations around its long-term trend corroborates the fiscal dominance hypothesis. The deterioration of the

net financial positions of the States vis-à-vis the financial system has, on average, been associated with an increase in the supply of central money to the economy, in particular through direct advances from the Central Bank to National treasures.

The results also highlight a structural change in the behavior of the Central Bank in line with the state's financial situation. Indeed, the period before the oil boom (1996Q1-2005Q3)) shows a higher sensitivity of the monetary base to the financial situation of the states[7] , compared to the period 2005Q3-2013Q4 (0,13068> 0.00159). In other words, during good times, the management policies of the monetary base adopted by the Central Bank are less sensitive to the evolution of the overall fiscal situation of the States in the sub-region. On the other hand, in a context of less favorable fiscal conditions, the Emission Institute has been more sensitive to the overall fiscal situation of the Member States of the Union. A Chow test carried out on the parameter associated with the variable $(PNG_t - PNG^*)$ leads to a structural change in the value of this parameter between the 2nd and 3rd quarters of 2005, the period beginning the reversal of the net financial position of States on the financial sector (see table 1 in the appendices).

We also observe that the increase in the monetary base translates into a significant decrease in the velocity of money, thus reflecting a progressive financial development, illustrated in particular by the increasing use of electronic money.

Table 1: Results of the estimation of a McCallum rule for BEAC

Variables	Total sample	Before the oil boom	After the oil boom
	1996Q1-2013Q4	1996Q1-2005Q3	2005Q3-2013Q4
Δv_t	-0.85729***	-0.92200***	-0.796354***
	(-5.905505)	(-5.357095)	(-3.828447)
$p_t - p^*$	-0.48965***	-0.52064***	-0.78614*
	(-3.312281)	(-3.799254)	(-1.761093)
$y_t - y^*$	-0.138839*	-0.166144*	-0.274881
	(-1.705641)	(-1.938926)	(-0.488064)
$PNG_t - PNG^*$	0.00247*	0.13068*	0.00159**
	(1.825579)	(1.838911)	(2.293354)
$AEN_t - AEN^*$	0.01709	0.02188	0.38257

[7] Materialized here by the PNG deviation from its trend

	(1.415072)	(1.610979)	(1.505815)
Observations	71	68	68
R-squared	0.40	0.66	0.019

The Student T-Statistics are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' estimates

As for the Taylor rule, the coefficients associated with inflation and activity are not significant, despite the fact that their signs are consistent with the prediction of the theory, thus reflecting a low sensitivity of the Central Bank policy rate to these variables. This result is consistent with previous studies notably that of Bikai and Kenkouo (2015), which showed the weakness and inefficiency of the interest rate channel in the CEMAC.

On the other hand, the coefficient of the lagged interest rate is 0.98, reflecting BEAC smoothing behaviour in the setting of its key policy rate. This coefficient is close to that obtained by Tenou (2013) on quarterly data from the BCEAO that is 0.9. The very high effect of the interest rate smoothing is explained by the existence of uncertainties about the effects of steering the central bank's interest rate on economic activity and inflation in the CEMAC. Indeed, in the face of uncertainty about the transmission channels of monetary policy, high and rapid changes in the key rate can lead to uncontrolled and unanticipated effects on the real sphere. In such a context, it seems useful for Central Banks to adopt an optimal behavior consisting in limiting the amplitude of variation of their key interest rate (Clarida et al., 2000).

Moreover, the negative and significant coefficients associated with the PNG evolution suggests that the central bank is also sensitive to the evolution of the public finance situation in fixing its rate. The hypothesis of fiscal dominance observed in the case of the adjustment of the monetary base also seems to be valid for the fixing of the Central Bank's key rate. However, the sensitivity of the policy rate to changes in PNG is more pronounced during periods of unfavourable fiscal conditions. Indeed, estimates obtained on the sub-period before the oil boom give a significant coefficient associated with the PNG and being almost the double of the one obtained on the global sample (0.000155 <0.000277). The hypothesis of structural change of the parameter associated with PNG fluctuations between the 2nd and 3rd quarters of 2005 is also corroborated by a Chow test, the results of which are recorded in Table 2 in the appendix.

However, the degree of fiscal dominance seems limited when considering the manipulation of interest rates relative to the monetary base (0.000155 <0.130791). This may be related to the variable chosen to capture the influence of the fiscal policy of the states on the conduct of the monetary policy of the BEAC. Indeed, through direct advances from the Central Bank to National Treasuries, PNG opens a direct channel through which the dynamics of state fiscal policies affect the BEAC's monetary policy stance.

Moreover, the results of the estimates for the two sub-periods before and after the oil boom highlight a more systematic response by the issuance Institute to inflation and net external assets. However, the sensitivity of the Central Bank's key rate to the inflation differential is higher in the oil boom period. This underlines the tendency for the central bank to take more account of the risks of accelerating inflation in setting its policy rate during this period. In contrast, the policy rate of the issuance Institute seems less sensitive to the evolution of net external assets during the good times. This intuitive result is explained by the fact that the significant expansion of net external assets during the period contributed to loosening the constraint on external balance, thereby providing more room for action for the monetary policy of the Central Bank to pursue internal objectives of price stability and support for economic growth.

Tableau 2: Results of Estimates of an augmented Taylor Rule for the BEAC

Dependent Variable:TIAO= r_t			
	Total sample	Before the oil boom	After the oil boom
	1996Q1-2013Q4	1996Q1-2005Q3	2005Q3-2013Q4
r_{t-1}	0.982688***	0.980009**	0.96022***
	(12.04650)	(2.333785)	(3.413989)
$r_{reel}+ p^*$	0.015643**	0.306923***	0.120597*
	(2.606538)	(3.933795)	(2.046938)
$p_t - p^*$	0.001174	0.016668*	0.036929*
	(0.127992)	(1.760534)	(1.860276)
$y_t - y^*$	0.005228	0.004793	0.037260
	(1.189621)	(1.476093)	(1.403129)
$PNG_t - PNG^*$	-0.000155***	-0.000277***	-0.004834
	(-2.271801)	(-2.784397)	(-1.236738)
$AEN_t - AEN^*$	2.87E-05	-0.001249***	0.023603*
	(0.054747)	(-2.893446)	(1.774821)
Observations	68	35	34
R-squared	0.98	0.96	0.95

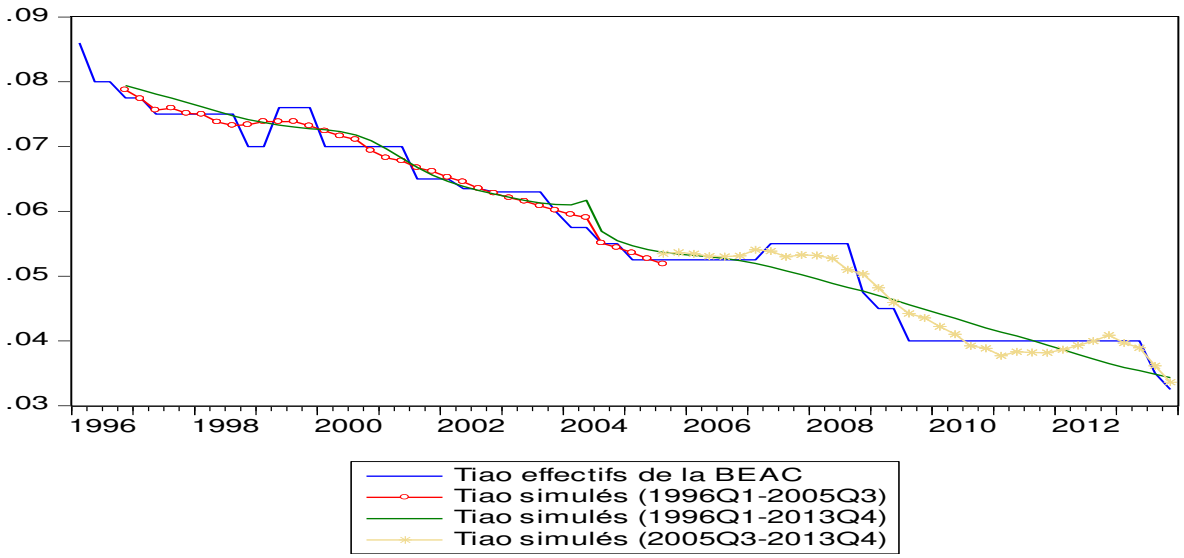
The student T-statistics are in parentheses

*** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' estimates

Figure 2 below shows, on the same level, the rates simulated from the estimated Taylor rule and the rates actually set by the BEAC. Overall, it is clear that the monetary policy of the BEAC is well represented by the estimated monetary policy rule.

Figure 2 : *Comparative trends in TIAO and policy rates calculated on the basis of the Taylor Rule*



Source: Authors Based on Estimates of the Taylor Rule « added ».

Conclusion

This article examined the behaviour of the central bank and the influence of the state's financial position on the central bank. To this end, we estimated a BEAC reaction function according to two main instruments: the policy rate and the monetary base, while taking into account the potential role of fiscal dominance over the period 1996Q1 to 2013Q4.

Estimates of two types of rules have yielded a number of results. First, the Central Bank is sensitive to the evolution of the economic situation in the CEMAC through its policy of manipulation of the monetary base. In other words, in the event of economic overheating, it limits the increase in the supply of central money and releases it to support activity in the phases of weak growth. Second, the estimate of the augmented Taylor rule over the entire period under scrutiny shows that the BEAC policy rate does not respond to the output gap and to inflation, due in particular to the weakness of the transmission mechanisms and the inoperability of the interest rate channel. The uncertainty of the effects of the interest rate is confirmed by a very large smoothing effect of the order of 0.98. Third, for the two types of instruments used by the BEAC, the results obtained underline the relative influence of the financial position of the states on the monetary policy impulses carried out by the central bank, thus corroborating the hypothesis of fiscal dominance in the monetary policy implemented in the sub-region. We find, however, that fiscal dominance is more pronounced as regard with the management policy of the monetary base than in the strategy of setting the policy rate. Similarly, for each type of instrument, the influence of the financial position of states on monetary policy is more pronounced in the period before the oil boom.

These results give rise to economic policy recommendations related to the implications of fiscal dominance in the conduct of monetary policy and the inoperability of the interest rate channel reflecting the low sensitivity of the policy rate to the inflation gap and the output gap.

On fiscal dominance, by highlighting the biases that can be introduced by taking into account the financial situation of States in the conduct of the BEAC monetary policy, such a study stresses the need to strengthen the framework for the coordination of monetary policies in order to limit the perverse effects of fiscal dominance in the sub-region and thus strengthen the independence of the Central Bank. More specifically, the elimination of direct advances from the Central Bank to national treasuries would considerably limit the influence of the state's financial situation on the strategy of adjusting the Central

Bank's monetary base. For this purpose, it will be appropriate to lead to its end the process of eliminating direct advances from the Central Bank to national treasuries in the CEMAC, suspended in 2014 following the effects of the double oil and security shock that affected the economies of the sub-region. Similarly, the billing of direct advances, currently backed by the interest rate on tenders, should be disconnected from the BEAC policy rate.

The low sensitivity of the BEAC policy rate to the inflation and output gap identified in this study calls for appropriate measures to make monetary policy transmission mechanisms work, as the actions on key policy rates have virtually no significant influence on activity and prices. To this end, it is recommended to accelerate the completion of the actions undertaken in the context of the ongoing monetary policy reform, in particular for the development and deepening of the financial system of the Zone. The establishment of a market in negotiable debt securities and the repo market is expected to contribute significantly to the broadening of the range of exchangeable financial instruments in the banking market and to the dynamization of the interbank component of the money market of the CEMAC.

Finally, by providing specifications of the monetary policy rules taking into account the current context of the BEAC, the results of such a study represent a necessary input in the design of general equilibrium models dedicated to economic policy simulations.

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Appendices

1. Results of the Chow test on the structural break of the PNG coefficient in the Mc Callum rule for the BEAC

Chow Breakpoint Test: 2005Q3

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: PNG_GAP

Equation Sample: 1997Q1 2013Q4

F-statistic	7.945267	Prob. F(1,62)	0.0065
Log likelihood ratio	8.199349	Prob. Chi-Square(1)	0.0042
Wald Statistic	7.945267	Prob. Chi-Square(1)	0.0048

2. Results of the Chow test on the structural failure of the PNG coefficient in the Taylor rule for the BEAC

Breakpoint Test: 2005Q3

Equation Sample: 1997Q1 2013Q4

Andrews-Fair Wald Stat.	9.225115	Prob. Chi-Square(6)	0.0613
Andrews-Fair LR-type D Stat.	21.21360	Prob. Chi-Square(6)	0.0017
Hall and Sen O Stat.	0.000000		