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Estimation of the equilibrium interest rate in CFA countries in Africa

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This paper treats determination of neutral or natural interest rate in CFA zone and under zone UEMOA and CEMAC. Methodology used is based on a generalized Taylor rule derived from the goals of monetary policies and budgetary attaches with a quadratic function of reaction which takes into account a target of inflation, public expenditure and interest rate. The estimates highlight a neutral interest rate between 1.4 - 1.6%. In addition, it is observed that overall the level of natural interest rate in zone UEMOA (1.51) is lower than in zone CEMAC (1.65). It notices a larger homogeneity in CEMAC zone than UEMOA zone.

Key words: Taylor rule, Kalman filter, natural interest rate, monetary policy, panel data, central bank reaction function.

INTRODUCTION

The creation of the integration institutions as UEMOA and CEMAC marks a decisive turning point and a major stage on the way of the economic integration already started since the independences in the countries of the franc zone. They were the fruit of several years of adjustment efforts showed by the states members in order to arrive to the high degree of convergence required for the participation to the economic and monetary union. The nominal convergence thus strengthened these last years. It is necessary to see the anti-inflationary policy effects led, on the one hand, by the states members as part of the discipline imposed in general by the multilateral (inflation, budgetary spending, change and interest rate) follow up closely in the UEMOA and in the CEMAC.

The limitation of the monetary policy role in the reduction of the production variability and the inflation brings to wonder about the relevance of the Kydland-Prescott (1977) and Barro and Gordon (1983b) analysis that dominated the analysis of the monetary policy from the beginning of the eigthies until the publication of the works of Taylor (1993). The debate on the need to establish a rule in the conduct of monetary policy has reappeared in the early 70 s in a context characterized by a distrust of economic agents with respect to monetary authorities. The thought of supporters of a policy based on transparent rules, as opposed to a discretionary policy, articulated on how to steer monetary policy. Moreover, the debate was extended to the problem consisting in the application of a passive rule as proposed by Milton Friedman ("k% rule") on the nominal growth in money supply or the adoption of an active rule to value more indicative than prescriptive.

The theoretical support brought about the drawbacks of purely discretionary monetary policies (inflationary bias and lack of transparency) gave central banks the opportunity to apply rules of conduct consistent with their objective of price stability, without eliminating their field of discretionary actions. Among these rules, those of Taylor and McCallum are mostly cited in publications in academic and monetary agencies.

Taylor rule fits now consistently in discussions of the appropriateness of monetary policy to fundamentals of the real economy. The ambition through this rule is to define a course of action facing the authorities

JEL: E4, E43, E52, C32, C33, C51.

Acronym: BCEAO, Central bank of West African countries; **BEAC**, central bank of central African countries; **UEMOA,** West African economic and monetary union; **CEMAC,** central African economic and monetary union; **CFA,** African financial community; **HP,** hodrick and prescott filter.

responsible for the conduct of monetary policy. It is based on the calculation of an interest rate of short-term, supposedly compatible with both the inflation target announced by the concerned central bank and with stabilizing output at its potential level. From a descriptive point of view, the Taylor rule is often used to study the behavior of a central bank in conducting monetary policy. The modeling of the reaction function of central banks allows economic agents, on one hand to understand the actions of monetary authorities and the other to anticipate temporal changes in interest rates of short-term. In addition, the estimated Taylor rule gives an early indication of the weight allocated to the stabilization of inflation and the elimination of the gap between the level of production and its potential level (the "output gap"). From a normative point of view of the Taylor rule - comparing the interest rate from the short-term Taylor rule interest rate observed on the market - can judge the appropriateness of monetary policy. It represents, moreover, a comparison tool of monetary policies for different times and / or conducted by different central banks. This contribution is devoted to the estimation of a Taylor-type rule for the CFA economies and estimation of an equilibrium interest rate both for BCEAO and BEAC countries.

CONTEXT OF THE IMPLEMENTATION OF THE MONETARY POLICY IN THE FRANC ZONE

In the West African Union Monetary, the central bank opted since 1989 for an indirect regulation of the banking liquidity. In order to reach the main objective of the monetary policy, namely; the stability of the prices, the states members instituted in 1994, a multilateral surveillance procedure permitting to assure the convergence of the performances and the economic policies. The central bank gives up the credit restrictions making the interest rate the main monetary policy instrument. Generally, the innovations are about the revise of the scale of the BCEAO leading rates, with the introduction of a repurchase rate, whose evolution is adapted to the one of the rate of the money market that it influences and for which it can serve as a signal. There has been a deep change in the money market, in order to constitute a privileged instrument of management of the banking finances and the interventions of the institute issue.

The volume and the nature of its interventions are determined according to orientations that it intends of impulse in the market and to the behaviour of the banks, from the legal view point of its objectives concerning the currency and the credit policy and the current fluctuations of the liquidity. The liberalization of the bank conditions, results notably in debit rate applicable to the credits, and to the free and fixed custom, in agreement, under the reserve that they do not pass, all expenses, commissions and remunerations of all nature, the debasement legal rate, definite as the double of the rate of discount of the BCEAO. The efficiency of the new money management device in the UMOA rests notably below on the conditions (BCEAO 2000):

(i) A big sensitivity of the cost of bank refinancing to the leading interest rates of the BCEAO,
(ii) A strong elasticity of the demand of primary credits and investments in relation to the interest rates.

From 1986, following the deterioration of the monetary situation of the Zone CEMAC, and to the inefficiency of the strategy of monetary policy, the mechanisms and the complementary instruments founded on the principles and the rules of the market were elaborated. Before October 1990, The Bank of States of the Central Africa had like final objective the economic development; the public authorities of the CEMAC countries had opted for the financing of the development by the money creation. Some weak and steady interest rates were applied, with however some rare readjustments to take account of the pressure of the international environment. The qualitative control of the credit was the dominant feature of the monetary policy and the credit of the BEAC during this period. It used three instruments mainly: the interest rate and banking margins, the selectivity of the rediscount maximum limits and the individual limits.

As the BCEAO, the BEAC uses from now and exclusively the indirect instruments of monetary policy, and this, since the establishment of the money market in July 1994. The BEAC proceeds regularly, in the context of the money market, to the injections of liquidities and/or to levies of liquidities. The monetary stability is established like final objective of the monetary policy, it means, the external coverage of the currency and a weak inflation. The credits to the economy and the money supply M2 has been kept like intermediate objectives. The conduct of the only monetary policy appears in the continuity: It is the outcome of a long monetary integration process.

On the world plan, the eighties mark a turn point in the conduct of the monetary policy with the financial market development, the liberation of the capital movements. The interest moved to anti-inflationary policy. For this, the central banks turned progressively toward the control of the short-term nominal interest rate.

Problem

The debate on the necessity to establish a rule in the conduct of the monetary policies is reappeared in the beginning of the years 70 in a context characterized by economic agent distrust to the monetary authority consideration. The thought of the adepts of a policy based on transparent rules, by opposition to a discretionary policy, articulate on the manner to pilot the monetary policies. Besides, the debate was spread to the problematic solid

in the application of a passive rule as the one proposed by Milton Friedman (" k% rule ") relative to the nominal growth of the monetary mass or in the adoption of an active rule to value more indicative than normative that means compatible with necessary discretionary actions to a macroeconomic stability.

The theoretical support brought as for the merely discretionary so-called monetary policy inconveniences (inflationary slant and absence of transparency) gave the central banks the opportunity to apply some coherent conduct rules with their objective of price stability, without eliminating their field of discretionary actions. Among these rules those of Taylor and McCallum are more evoked in the monetary and academic organism publications. The rule of Taylor appears henceforth in a systematic manner in proceedings of the adequacy of the monetary politics to the variables fundamental of the real sphere. The ambition displayed through this rule is to define a line of conduct that imposes itself to the authorities responsible for the conduct of the monetary politics. It takes the calculation of a short term interest rate as a basis, supposed compatible at a time with the objective of inflation displayed by the concerned central bank and with the stabilization of the production to its potential level.

From a descriptive view point the rule of Taylor is used often to fear the behaviour of a central bank concerning conduct of the monetary policies. The modelling of the function of central bank reaction allows the economic agents, on the one hand to fear the actions of the monetary authorities and on the other hand to anticipate better the temporal evolutions of the short term interest rates. Besides, the evaluation of the rule of Taylor gives a first indication of the weight allocated to the stabilization of the inflation and to the elimination of the gap between the level of production and its potential level "output gap". From a normative view point the adjusts Taylor - while comparing the interest rate derivate from the Taylor rule to the short-term interest rate observed on the market - permits to judge the adequacy of the monetary policies to the fundamental economic variables (Judd and Rudebusch, 1998). It represents according to Tchaidze (2001), a tool of relative monetary policy comparison at times different and /or driven by banks distinct power stations.

The analysis of the monetary policy in countries of the CFA zone is essential in order to better specify the central bank behaviour and to wonder about the links that exist between the instruments of the monetary policy and its final and intermediate objectives. The “function of reaction” of the monetary authority gives a synthetic vision of these links. The strategy of the monetary policy of the authorities aims thus to identify the disruptive economic that constitute a threat for the stability of the prices and to cause, in reaction, of the monetary policy measures likely to separate this risk. This paper is dedicated, in a first time, to the evaluation of a Taylor rule type for the CFA zone. In a second time, we will wonder about the adequacy of the interest rate determined with the economic fundamental data of the economy of the CFA zone countries.

SELECTIVE LITERATURE REVIEW

Identification of the reaction functions

In 1993, John Taylor proposes a simple rule of determination of the interest rate from a linear relation between this last and the variables of inflation and activity as the gap between the current inflation and the objective inflation of the monetary authority. The Taylor rule permits to choose an interest rate of short term compatible with the objective of inflation of the central bank and the evolution of the output gap (gap between the observed production and the potential production). The rate so calculated can be compared to the interest rate of short term.

The function of reaction describes the strategy followed by the central Bank. It represents the solution of the problem of minimization of a loss function in relation to the instruments of economic policy:

$$L = \left[\sum_{i=1}^{n} a_i \left(y_i - y_i^* \right)^2 \right] + b\left(x - x^* \right)^2$$

Under the constraint: $y_i = c_i x \quad i = 1, ..., n$

Where, L is the measure of the loss registered by the monetary authorities, y_i is the variable representative of the objective at the date t, n objective exists, y^*i is the targets value of this variable for the objective i, x is the instrument controlled by the monetary authorities, x^* is the targets value for this instrument. The analytic solution of this approach produces a function of reaction in which the monetary policy instrument depends on all state variables in the economy:

$$x = c_0 + \sum_{i=1}^{n} e_i y_i$$

The Taylor rule reminds, of a brief way, the essential of the monetary policy, that means the adjustment of an instrument (the interest rate) when the targets variables (the inflation and/or the production) stray from their long term level. According to the Taylor rule, the adjustment of the interest rates is impose by both considerations of long term relative to the stability of the prices (the gap of inflation) and the short term, in relation with variations economic fluctuations of the output gap. This monetary rule applied and adapted for the case of the United

States is presented as follows:

$$r = 2 + p + 0.5y + 0.5\,(p - 2) \quad (1)$$

where, r indicate the federal fund rate, p the rate of last four quarter inflation and y the gap between the real effective GDP and the trend GDP. When the inflation is equal to its target value of 2% and that the GDP reaches its trend value, the real interest rate or neutral rate (2%) is equivalent to the trend growth rate of the economy (2/2% on the period 1984 - 1992).

Later users (Gali, 1999; Taylor, 1999; Orphanides and Williams, 2003) confirmed the exploit of the Taylor rule and its strengtheness in the analysis and the description of the ex-post behaviour of the monetary authorities. However, it seems that the adoption of such a rule is problematic in the context of the conduct of a monetary policy based on the imperfect information availability (Orphanides, 2001).

The generalized Taylor rule

Different arrangements have been brought to the initial formulation. They led to the development of the models of the kind: "Taylor - Type rules ". These arrangements are organize themselves around three elements.

(a) The interest rates, calculated according to the Taylor rule, depend on the "output gap" actual and of the gap of inflation observed during the four previous quarters. However, the central bank, at the time of its relative decision holds to the interest rates, often ignores the values of the real GDP and the inflation of the current quarter. The problem of data availability can be gotten round very well by the lagged variable substitution to the unknown contemporary values, either by the forecast values.

(b) The weighting adopted by Taylor in his initial specification doesn't lie on theoretical justification. The coefficients allowed to inflation gap and to the "output gap" reflect the degree of reactivity with which a central bank answers the gaps of the inflation and the production in relation to their values of reference. Thus, they can vary in the time, but also to diverge of a central bank to another. That is why; the upholding of an absolute fixity of these coefficients is not at all necessary. According to the suggestions of Taylor the weighting proposed in his initial rule are besides only valid for the United States.

(c) In order to ensure a certain stability the partisans of the "Taylor-type rules" suggest to introduce in the equation lagged interest rate. The main argument, on which this arrangement is founded, is dictated by a worry of financial stability that incites the central banks to privilege a smoothing smoothly rather than of the abrupt movements of the leading rates. Gertler (1999) consider that the smoothing of interest rate allows a bigger stability of the prices and the output at a time. The resumption of this idea in empiric applications is only partially conclusive. Indeed For a multitude of models the lagged interest rate introduction drove, to instability of the Equation (1).

In spite of arrangements brought to the Taylor rule, some difficulties persist as for the weightening of the differential of the inflation and the gap of the production. The transposition of this rule to study the central bank behaviour concerning monetary policy raises the question of the inclusion of the output gap.

SPECIFICATIONS OF THE FUNCTIONS OF REACTIONS OF THE BCEAO AND THE BEAC

The monetary policy of the states of the CFA zone has like main objective the stability of the prices. The central banks try to consolidate the inflation to a targets level and to limit the major fluctuations of the production and the employment while acting on the interest rate. According to Taylor (1998) and Clarida et al. (1998), the orientation of the monetary policy is assured by the short-term interest rate that is controlled by the central bank (Table 1).

The models

The structure and the coefficients of the function of reaction depend on the structure of the economy, of the authority preferences, of the structure of information. Their empiric analysis is inspired by the theoretical equation of the Taylor rule. Their model includes 4 observable variables: the rate of inflation, the gap of production and the money supply and the exchange rate. We keep the yearly objective of inflation of 3% clearly announced by the BCEAO and the BEAC and already in force, in most countries of the zone. Otherwise, we choose to introduce only the past inflation. Consensus does not exist on this question. Clarida et al. (1998) think that a "forward" formulation represents better the data than a backward formulation on an application to the European central banks. On their side, Rudebusch and Svensson (1998) estimate that the two formulations are appropriated for the functions of preference of a big majority of banks power stations. Finally, Angeloni and Dedola (1999) showed that it is very difficult to make a choice between the two formulations but that, on the more recent period, a "backward" approach would be more effective.

Otherwise, the output gap appears in a lot of research like an explanatory variable. Debrun and Wyplosz (1999) concluded that the central banks are attentive to the inflation but that they do not ignore the cyclic variations of the activity level. The functions of reaction estimated by Clarida and al. (1998) suggest that the central banks in USA, in Germany and in Japan answer to the output gap

Table 1. Availability and source of variables.

Abbreviation	Description	Period	Source
i	Interest rate	1970-2003	World Bank Data Base
Inflation 1	Deflator of GDP (index)	1970-2003	World Bank Data Base
Aidtete	Aid per capita	1970-2003	World Bank Data Base
Debt /GDP	Debt/GDP	1970-2003	World Bank Data Base
GDP	Gross Domestic Product	1970-2003	World Bank Data Base
G/PIB	Public expenditure/GDP	1970-2003	World Bank Data Base
Txcrois	Economic growth Rate	1970-2003	World Bank Data Base
M2/GDP	Aggregate Money/GDP	1970-2003	World Bank Data Base

partially. This variable does not clearly appear like an objective of the ECB but it is mentioned however in the second pillar of the monetary policy. We can think indeed that, even though the monetary authorities clearly privilege the objective of inflation, they also have the worry to encourage the growth from the moment the stability of the prices is assured.

In theory the growth and the employment represent a second rank objective of only in the conduct of the monetary policy of the CFA zone. However, the hold in account of the output gap is justified theoretically, even though the objective function of the central bank takes account mainly only of the inflation, because of its influence on the evolution of the prices to long term. To reach its objectives, the central bank manipulates the short-term nominal interest rate according to the state of the economy. Indeed, following Taylor (1998); Clarida and al. (1998), the orientation of the monetary policy is assured by the short-term interest rate which is controlled by the central bank. Besides, we generally recognize the tendency of the central banks to smooth the variations of interest rate, usual practice justified by the fear of the disorganization of the capital markets, by the potential loss of credibility that could result from sudden political change.

We suppose therefore, as make it Dornbusch et al. (1998) as well as Debrun and Wyplosz (1999), a partial adjustment: every period, the present interest rates fit to reduce a fraction of the gap between the wanted interest rate and the rate inherited of the previous period. The nominal interest rate lagged of one period is introduced therefore like explanatory variable in the function of reaction.

Next to the final objective of price stability, the Central Bank watches over the aggregate monetary M2, element of the second pillar of its monetary policy. Most of the National Central Bank also looked after the growth of M2 during the eighty and ninety decades. In the modern financial system, the banks and the financial institutions propose to the economic agents a range of remunerate varied assets (life insurance, right to loans, fiscal advantages).

The currency is not detained anymore in liquidity. The economic agents do their transactions by credit card or electronic wallet. In the countries of CFA zone, the economic agents use intensely the paper money in the transactions. M2 is again the money aggregate that is followed by the central banks of the zone, whereas in the European or American financial systems a larger aggregate is controlled by the central banks. Strong of this statement, we added the monetary supply in our model.

These internal factors presented, it remains to wonder about the possible external factors taking in account that would be likely to influence the central bank reactions. Indeed, Svensson (2000) showed notably that, under some conditions, the optimal reaction function drifted of a strategy of inflation objective can be expressed like an augmented rule of Taylor and that such a rule can include the monetary objectives or exchange rates. The exchange rates have indeed a determining role in the definition of the monetary policy. Following the devaluetion intervened in 1994; the CFA is anchored to the euro according to parity. Countries of the CFA zone are therefore in a fixed change system in relation to the euro. On the basis of the criterion mentioned above we consider the following reaction function supposed to represent the best monetary authority behaviour: It is about a model of dynamic coefficient:

$$i_t = a_t + \alpha_t\left(\pi_t - \pi^*\right) + \beta x_{t-1} + \gamma_t\left(\Delta M_2 - \Delta M_2^*\right)_{t-1} + \lambda_t i_{t-1} + \varphi Z_t + \varepsilon \quad (2)$$

$$\begin{cases} eq\,2 \rightarrow \alpha_{it} = a_0 \alpha_{t-1} + \varepsilon_{\alpha t} \\ eq\,3 \rightarrow \beta_t = b_0 \beta_{t-1} + \varepsilon_{\beta t} \\ eq\,4 \rightarrow \gamma_t = c_0 \gamma_{t-1} + \varepsilon_{\gamma t} \\ eq\,5 \rightarrow \lambda_t = d_0 \lambda_{t-1} + \varepsilon_{\lambda t} \\ eq\,6 \rightarrow a_t = e_0 a_{t-1} + \varepsilon_{at} \end{cases} \quad (3)$$

It is unavoidable that a phenomenon of interactions exists between the zone euro and the CFA zone founded on the European economic policy transmission. These external factors are taken in account in the Z variable.

$$x_t = \frac{PIB - PIB^*}{PIB}$$

Zt represents the external constraint. It is about a change variable that is to say the exchange rate of the euro in relation to the dollar.

π_t represents the inflation,

π^* is fixed to 3% correspondent to the rate of inflation targeted by the monetary authorities assuring the convergence of the performances and economic policies of the countries of the CFA zone,

x_t is the ratio of the output gap (the gap between the GDP and the potential GDP) to the GDP,

ΔM2 is the gap of the monetary supply, and ΔM_2^* is the monetary supply targets of the central bank. The monetary supply target is calculated by the HP filter for every country.

The functions of reaction of the BCEAO and the BEAC have been estimated while using several econometrics approaches. Our model is a model of dynamic coefficient estimated by the filter of Kalman, the GMM (Generalized Methods of Moments), the panel's data and the iterative least squares. Our approach is innovating much as we estimated a neutral interest rate for every country and for every zone with the Kalman filter. Otherwise we consider that the output gap follows an AR (1) process. The equation is:

$$gdp = pot + gap \quad (4)$$

Where, gdp represents the GDP, pot is the potential GDP and gap is the gap of the potential GDP in relation to its target. The potential GDP is defined in the literature as the realize macroeconomic production without an acceleration of the inflation beyond its current level. It is estimated by the method of Hodrick and Prescott filter.

The constraints

The usually retained approach in works consists in considering that the real interest rate of balance is equal to the average of the gap between the nominal interest rate and the rate of inflation during the studied period (Kozicki, 1999; Smets, 1998). It is possible to fix the target of inflation and to deduct the real interest rate of balance of it (Verdelhan, 1998).

The problem of determination of the neutral real interest rate

The evaluation of the level of the neutral real interest rate is spoilt of uncertainty, what justifies having recourse to multiple methods for its assessment. In the initial Taylor rule, the neutral real interest rate is a constant. Roughly, it is equal to the trend growth rate of the real GDP on the studied period. However, it is well possible that the neutral real interest rate departs, at least short-term and appreciably, of the trend growth rate of the real GDP.

The neutral real interest rate is commonly approximate by the difference between the average of the interest rates short-term and the average of the inflation rates observed on the same period, either by the potential growth rate of the GDP. The neutral real interest rate is often considered like being a variable which permit to unified the set of the elements permitting a better control of the inflation. So, all gap of the inflation or the output in relation to their values targets requires an adjustment of the nominal interest rate in order to maintain the real interest rate to its level balance. It is more realistic to estimate the rule of Taylor while opting for a variability of the neutral real interest rate instead of its constancy in the time. Objectively, the hold in account of the interest rate variability real neutral would drive to a bigger precision in the evaluation of the level-headedness of the components of the Taylor rule, in this case the output gap and the gap of inflation. However, this last affirmation is conditioned by the presence of technological shocks or modifications of the preferences that represents, in theory, the unique source of the variability of the neutral real interest rate. In the absence of such shocks and/or of relative centennial component to the evolution of the prices, Laubach and Williams (2001) recommend the approximation of this rate by the efficient real interest rate average. That means by the average of the gaps between the nominal interest rate and the inflation observed relatively on one long period.

The empiric results for the presence of a unit root in the sets of real interest rate are mitigated. Indeed, the works of Walsh (1987) confirmed the presence of a unit root. While, the battery of tests employee by Garcia and Stairway (1996) in the setting of an autoregressive process with regimes change invalidated it. They conclude that some shocks affecting the real interest rate are temporary, what explains the convergence of the rates toward their middle level.

The method of evaluation of the output gap is a source of result divergence

The potential growth rate can calculate itself by modelling or by a simple evaluation of the trend. According to the sources and methods, the results differ appreciably. Thus, the uncertainty that affects the determination of the level of the output gap can drive, from a retrospective view point, to divergent appreciations of the adequacy of the monetary policy to the fundamental data of the economy. In this contribution, the relative output gap to the CFA zone is extracted of the yearly set of the real

GDP by the application of the Hodrick-Prescott filter.

RESULTS

Iterative least squares

Table 1 shows functions of reactions in the franc zone; evaluation by the iterative least squares (on appendix).

Panels estimation

Table 2 highlights estimation on the panel data (Table 2 on appendix)

Estimation by the Kalman filter

Table 3 shows estimation by the Kalman filter in UEMOA zone (Table 3 on appendix).

Table 4 shows estimation by the Kalman filter in CEMAC zone (Table 4 on appendix).

Interpretation of the results

According to the stationary tests, most of the series are not stationary. We choose therefore to use the first differences on the non stationary series: the output gap, the differential of the inflation rate in relation of its target (3%). The economic foundations lead us to choose the logarithm of the interest rate at level; it comes from the monitoring of the inflation rate by the monetary authorities while manipulating the interest rate. This specification is confirmed by Clarida et al. (1998), Angeloni and Dedola (1999) and Clausen and Hayo (2002). The estimations of the reaction functions have been done on two under periods: the period of 1960 - 1988 and the one of 1989 - 2001 where there are some main changes in the monetary system in countries of CFA zone.

The interest rate

The observation of the results gotten on panel data with the Table 2, emphasize a high coefficient for the lagged interest rate. The fact that the monetary authorities in the CFA zone have a preference for a smoothing of the interest rate is an example. Indeed, the gotten coefficients vary between 0.77 (UEMOA), 0.91 (CEMAC) and 0.89 in the CFA zone. These results are reinforced by studies carry out on quarterly American data. Williams (1999) finds a coefficient of partial adjustment of 0.83 (period 1980 - 1997), Levin et al. (1998) observe a value of 0.80 (period 1980 - 1996). Kozicki (1999) gets a value of 0.80 also (period 1983 - 1997). However, these results contradict the simple rule of Taylor (1993) that makes the implicit hypothesis that the fixing of the short term interest rate is independent of the passed value of this one.

Otherwise, in theory, the works of Woodford (1999) emphasize in the case of a simple model that certain inertia of the interest rate of the central bank could be optimal. In practice, the smoothing of the rates by the central Bank is explained for the sake of preserving its credibility while avoiding a strong volatility of the leading rate or to limit the impact on the long rates. However, while observing the results gotten on the face function of reaction of every central bank showed in the Table 1 and calculated according to the iterative GLS and the Kalman filter, we realize that Burkina constitutes an atypical case, insofar as the coefficient linked to the interest rate is negative and non significant. This watches that Burkina doesn't exercise the rule of the smoothing function of the interest rate as the other countries of the franc zone.

On average, we calculate that an increase of the gap of inflation of 10% has an almost nil effect on the interest rate of the CFA zone, as well as on the two under zone; however the effect observed in CEMAC zone is twice the one observed in UEMOA zone. We observe a sensitivity a few more marked of the interest rate to a variation of the money supply gap. Indeed an increase of the money supply gap of 10 points dragged a rising of the interest rate of 1% in the CFA zone and UEMOA and of 4% in the CEMAC zone. At the money supply, the sensitivity of the interest rate is nearly nil in CFA zone, very weak in UEMOA zone and non significant in CEMAC zone.

The inflation gap

On the whole, the coefficients gotten with the panel data estimation are statistically significant. The gap of inflation is significant and has the waited sign while using the panel data estimation. The coefficients associated to the objective of control of the inflation are weak. At the global level, a gap of inflation of 1% over the objective results in a raising of the interest rate of 1% what expresses an exactly proportional reaction. However, the Kalman filter estimation and the iterative least squares bring out again heterogeneousness in the fictitious National Central Bank reaction (BCN) of each country. We note mainly that two clubs of country exist: those in which the monetary authorities choose an exactly proportional reaction: Benin, Ivory Coast, Mali, Niger, Senegal, Togo, Cameroon and the other where the monetary authorities choose a reaction less than proportional: Central African Republic, Gabon, Congo, Chad.

The estimations done in the under zones confirm that the results gotten to the global level are strong. So, the reaction of the BEAC and the BCEAO in relation to a variability of the inflation gap is almost identical. We note that the gap of inflation contributes to the explanation of the interest rate variability considering its weight which is

estimated less than 1%. The field of research indicates that the coefficients associated to the gap of production and the gaps of growth are statistically significant at the level of 10%. As for the values of the gap of inflation coefficients, they are significant at the level of 1% in the two regressions.

The output gap

The gap of production is calculated here by the ratio (Y-Y*)/Y. where Y* is the potential GDP estimated by the Hodrick Prescott filters (HP). The estimation by the panels data emphasize that the weight attach to the objective of gap production is relatively weak. The coefficients gotten vary between 0.01 and 0.04 in the different zones, according to the methods used in countries of the CFA zone. The effects under zones taken into account emphasize a difference of reaction in the implementation of the monetary policy. Indeed, we observe with the estimations done with the panel data that the reaction in the CEMAC zone is stronger than those in the UEMOA zone. An increase of the gap of production of 1% in the countries of CEMAC zone appears by an upwards effect of the interest rate of 1.04% while in the UEMOA countries the effect is least (1.01%). However while taking in account the estimation done in each country (every country being represented by its fictitious national central bank) by the Kalman filter and the GLS, we realize a certain disparity in the results: On one hand, only the coefficients of three countries are significant for this objective: Benin and Niger and Gabon. On the other hand we observe that the waited sign is not in line with the economic theory.

According to the Taylor (1993) estimations, the weight coefficient of the output gap is 0.5 for the United States. In the case of the zone euro countries, Verdelhan (1998) finds a coefficient of 0.6. We can emphasize however that in the case of the United States, the various simulations done by Kozicki (1999) combining different measures of the output gap and the inflation, with partial adjustment of the interest rate, reveals that in the majority, the coefficient of the output gap is statistically equal to 0.5 (period 1983-1997). Our results emphasize a non conformity of the output gap in relation to the empiric results gotten in other studies.

The bad quality of the results gotten from this variable can be link to the measure of the variable herself that is not always very reliable. The results also show that the monetary authorities in the countries of the CFA zone base their decision of interest rate fixings more on the smoothing interest rate than on pressure that could provide for the production gap. This hypothesis justifies itself in the context of the CFA zone, where the private agent decisions are on the limit of the rationality, especially in a context of the pressure of the informal and the dwindling of the formal sector. On the other hand it is necessary to take account the lack of an adequate financial market and generally under dimensioning in the economic sphere, the monetary policy come up against serious problems, in the modelling of the economic agent behaviours. Of this fact, the economic agents could be different from the waiting of the economic policy decision-makers, simply for reasons of ruptures or inconsistency in the transmission mechanism of the implement policies.

The money supply gap

The estimations realised on panel data emphasize that the objective of control of the money supply growth is statistically significant in the countries of the CFA zone, although the values found for this parameter remained weak. We can conceive that this result coming from the money supply growth does not constitute in itself a dominant objective on the point to encourage the monetary authorities to react to all gaps.

However, we observe while analyzing the results on the fictitious reactions functions of the National Central Banks that the coefficients associated to this objective are significant in none of CFA countries zone. These results confirm the fact that the objective of the money supply growth would be an objective of second rank for the CFA zone countries.

The neutral interest rate

Table 5 shows the estimation of the neutral interest rate (on Appendix).

INTERPRETATION

The estimations done on panel data emphasize a natural interest rate (neutral) in the margin of 1.4 - 1.6%. Thus, we note that the estimation done on panel data are compatible with those done while using a Kalman filter. On the other hand, we observe that globally the level of the natural interest rate in the UEMOA zone is weaker than in the CEMAC zone. The highest neutral rate is observed in the Malian economy and lowest in Burkina.

But, in fact, we notice bigger homogeneity in the CEMAC zone that in the UEMOA zone. This rises some questioning as for the impact of the policy economic of the BCEAO in these two countries that are yet similar.

The phenomenon could explain itself by several economic arguments: The implement of the monetary policies in the countries of the UEMOA zone, could not be optimal because of the existence of the bottlenecks in the mechanism of adoption of the BCEAO rules by the economic agents. So, an asymmetric bias in the implementation of the common monetary policy in the zone UEMOA countries can exist.

The existence of inertias in the Malian economy coming from the change of the financial scheme (Mali left the CFA zone during some years) brought economic agent

distrust and especially lead the secondary banks to pass on the rates enact by the central bank. The estimations of the neutral interest rate by the approach (Average of interest rate - Average of inflation rate) permits to note that the neutral rate in the UEMOA zone (1.31%) is higher than the one of the CEMAC zone (0.9%). This shows a disparity in the approaches. While always considering the objective of inflation equal to 3%, the balance real interest rate deducted is 1.31% in UEMOA zone and 0.90 in CEMAC zone. Knowing that the calculated balance interest rate is respectively 1.51 and 1.64% in UEMOA zone and CEMAC, the result is gaps of 0.2% in UEMOA zone and 0.75% in CEMAC zone. The real interest balance rates deduct and calculated are extensively lower to those gotten in the study of Tenou (2002) on the UEMOA zone (2.66% deducted and 2.18% calculated). However, these two results although different are comparable if the objective of inflation in the study of Tenou (2002) is considering fixed to 2% whereas in the present paper this objective is fixed to 3%.

CONCLUSION

In the present study, the fundamental questions were the estimation of a neutral interest rate as well as the weighting attached to the fundamental variables of the economy in the case of the use of a generalized Taylor rule in the countries of the CFA zone that putt together two central banks, the BCEAO and the BEAC. At the empirical level, it is known that the Taylor rule is the main reference for the central banks, in particular those having chosen for a stability scheme of price. In the case of the CFA zone countries, another generation of the family of the Taylor rule has been used: it is about the generation of the generalized Taylor rules that incorporate in the fictitious central bank's function of reaction, other variables of interests as the money supply, the public deficit etc, in addition to the original variables coming from the Taylor rule.

The results of the estimations make on the period 1970 - 1999, permit to conclude that the BCEAO and the BEAC have a preference for a rule of a smoothing interest rate. In spite of the fact that the bias coming from the calculation of the gaps of production variables and money supply exist, the results present a certain general consistency. Although the define reaction function for countries of the CFA zone, can constitute an automatic application rule by the monetary authorities, it stays however an important reference in the economic policy decision making. However, the results gotten on the real balance interest rates emphasize a very strong mechanism of inflation control in the zone franc countries. The proof is given by the weakness of the gaps observed between the calculated neutral interest rates and those deducted in the two under zones; respectively. 0.2 and 0.75% in UEMOA and CEMAC zone. At another level, we note that the follow-up of the money supply is really a second rank objective in the CEMAC zone while in the UEMOA zone assume a certain importance although very weak. The impact of the inflation is more marked on the interest rate in the CEMAC zone than in the UEMOA zone. This result is interesting insofar as it confirms empirically the link between the interest rate and the inflation.

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APPENDIX

Table 1. Functions of reactions in the franc zone; evaluation by the iterative least squares.

Franc zone	α	β	γ	δ	C0
Benin					
	0.93	-0.01	1.35	0	0.14
	0	0	0.07	0.39	0.13
Burkina					
	-0.11	0	0.27	0	0.02
	0.49	0.94	0.76	0.73	0.56
Ivory Coast					
	0.9	0	-0.52	0	0.2
	0	0.04	0.44	0.91	0.08
Mali					
	0.87	-0.01	-0.2	0	0.28
	0	0	0.71	0.91	0.04
Niger					
	0.92	-0.01	0.84	0	0.17
	0	0	0.03	0.25	0.09
Senegal					
	0.92	-0.01	0.35	0	0.17
	0	0	0.55	0.76	0.1
Togo					
	0.91	0	0.11	0	0.18
	0	0.69	0.81	0.35	0.09
Central Africa					
	0.88	0	-0.24	0	0.25
	0	0.87	0.69	0.81	0.05
Congo Brazza					
	0.9	-0.01	0.24	0	0.22
	0	0.05	0.51	0.84	0.08
Cameroon					
	0.89	0	0.09	0	0.24
	0	0.2	0.81	0.75	0.06
Gabon					
	0.91	0	-0.56	0	0.2
	0	0.56	0.08	0.2	0.11
Chad					
	0.9	0	0.15	0	0.22
	0	0.69	0.81	0.35	0.09

Table 2. Estimation on the panel data of central bank reaction function.

	Parameter	Coef	Prob	R2
		S.U.R Method		
CFA	α	0.896	0.00	
	β	0.000	0.00	
	γ	0.005	0.03	0.86
	δ	0.197	0.00	
	C0	_	_	
		S.U.R Method		
	α	0.92	0.00	
	β	0.00	0.08	
	γ	0.01	0.08	0.85
	δ	0.00	0.01	
	C0	0.15	0.00	
UEMOA	α	0.76899	0.0000	
	β	0.000061	0.0225	
	γ	0.01000	0.1061	0.97
	δ	-0.00005	0.0001	
	C0	0.470817	0.0105	
CEMAC	α	086	0.0000	0.99
	β	0.000101	0.2468	
	γ	0.042200	0.0001	
	δ	-1.70E-06	0.9841	
	C0	0.188587	0.0000	

Table 3. Kalman filter estimation of central bank reaction function in UEMOA.

ZONE UEMOA			
Likelihood method (BHHH)			
	Coefficient	**Prob**	
α	0.94	0.00	
β	-0.01	0.00	
γ	1.32	0.09	
δ	0.00	0.40	BEN
C0	0.13	0.16	
Log likelihood	-30.72		
Akaike info criterion	1.59		
α	-0.343	0.285	
β	0.003	0.717	
γ	0.111	0.923	
δ	0.003	0.575	BFA
C0	0.035	0.385	
Log likelihood	-41.616		
Akaike info criterion	2.841		

Table 3. Continued.

α	0.902	0.000	CIV
β	-0.004	0.050	
γ	-0.517	0.470	
δ	0.000	0.918	
C0	0.200	0.098	
Log likelihood	-37.601		
Akaike info criterion	2.087		
α	0.851	0.000	MLI
β	-0.011	0.008	
γ	-0.204	0.729	
δ	-0.001	0.805	
C0	0.316	0.049	
Log likelihood	-38.366		
Akaike info criterion	2.540		
α	0.92	0.00	NER
β	-0.01	0.00	
γ	0.84	0.04	
δ	0.00	0.28	
C0	0.17	0.12	
Log likelihood	-34.03		
Akaike info criterion	1.89		
α	0.915	0.000	SEN
β	-0.012	0.002	
γ	0.353	0.575	
δ	0.001	0.774	
C0	0.174	0.123	
Log likelihood	-34.568		
Akaike info criterion	1.923		
α	0.910	0.000	TGO
β	-0.001	0.714	
γ	0.114	0.821	
δ	0.002	0.379	
C0	0.181	0.118	
Log likelihood	-38.504		

Table 4. Kalman filter estimation of central bank reaction function in UEMOA.

CEMAC ZONE			
Likelihood method (BHHH)			
	Coefficient	**Prob**	
α	0.88	0.00	CAF
β	0.00	0.88	
δ	-0.24	0.71	
γ	0.00	0.82	
C0	0.25	0.08	
Log likelihood	-28.55		
Akaike info criterion	1.85		

Table 4. Continued.

α	0.90	0.00	
β	-0.01	0.08	
δ	0.24	0.55	
γ	0.00	0.85	CMR
C0	0.22	0.10	
Log likelihood	-25.94		
Akaike info criterion	1.68		
α	0.91	0.00	
β	0.00	0.60	
δ	-0.56	0.11	GAB
γ	0.00	0.24	
C0	0.20	0.14	
Log likelihood	-28.59		
Akaike info criterion	1.85		
α	0.887	0.000	
β	0.001	0.242	
δ	0.091	0.823	
γ	0.000	0.768	COG
C0	0.239	0.080	
Log likelihood	-28.667		
Akaike info criterion	1.854		
α	0.90	0.00	
β	0.00	0.14	
δ	0.15	0.57	TCD
γ	0.00	0.38	
C0	0.22	0.09	
Log likelihood	-27.71		
Akaike info criterion	1.79		

Table 5. Estimation of the neutral interest rate.

(Interest rate average – Inflation rate average)			
Country	**TXINT average**	**Inflation average**	**Neutral rate (%)**
UEMOA zone			
BEN	6.83	5.38	1.45
BFA	6.83	4.54	2.29
CIV	6.83	6.29	0.54
MLI	7.17	7.53	-0.37
NER	6.80	5.12	1.69
SEN	6.83	4.98	1.85
TGO	6.83	5.07	1.76
Average	6.87	5.56	1.31

Table 5. Continued.

	CEMAC zone		
CAF	7.55	6.93	0.62
CMR	7.54	6.13	1.41
COG	7.55	6.96	0.59
GAB	7.55	7.86	-0.31
TCD	7.58	5.38	2.20
Average	**7.55**	**6.65**	**0.90**