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Sacrifice Ratio in West African Economic and Monetary Union (WAEMU)

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Abstract: Several countries use a disinflationary monetary policy to fight inflation. Indeed, inflation results in a decrease in purchasing power, higher imports and lower exports. At the same time, a policy of low inflation is costly for the economy concerned. The sacrifice ratio is the loss in growth of a reduction in inflation. For the West African Economic and Monetary Union, monetary policy implementation by the Central Bank of the States of West Africa's main objective is maintaining price stability (up to 3%) in all member countries. Using a structural VAR model, our study shows that WAEMU countries lose points of growth to meet the desired level of inflation by the BCEAO and WAEMU Commission. The study suggests the implementation of the policy mix to better coordinate the different policies in the area and make economic policy more effective.

JEL Classifications: C22, E31, E52
Keywords: Sacrifice ratio, Structural VAR model, Monetary policy, Fiscal policy, BCEAO, WAEMU, Policy mix

1. Introduction

The Central Bank of the States of West Africa (BCEAO) main objective is maintaining price stability in all countries of the Economic and Monetary Union (WAEMU). The aim is to encourage the promotion of investment and consequently economic growth. Indeed, it is widely accepted that low inflation is likely to stimulate investment decisions, because economic agents will have more visibility in the medium and long term and may make projections realistic results. Similarly, inflation is often considered a nuisance. Because, by increasing the prices of local products, it is likely to encourage imports and restrict exports. Thus, to address this situation, countries often establish a disinflation policy that improves the competitiveness and therefore job creation. Arthus in 2003, shows that disinflation can be done in two ways, by reducing the growth in money supply (deflation through monetary policy) or by reducing the depreciation of parity (disinflation by the exchange). It shows that if inflation expectations adjust rapidly, reducing the growth of money supply seems to be the best option to achieve dis-inflation.

The monetary policy of the BCEAO, which must be compatible with the preservation of a fixed parity between the CFA franc and the euro, is also supposed to support the overall macroeconomic policy. However, the optimal level of inflation is still under discussion and controversy especially when these economies are not yet developed. Indeed, the goal of inflation of 2 to 3% of the BCEAO is not necessarily in step with economic growth potential 7 to 8% of the member countries. Indeed, some economists believe that inflation must keep pace with growth in economic activity. Thus, rates of economic growth must be linked to inflation rates so high. The monetary policy of the

BCEAO can therefore be considered in this light, as a monetary policy of luxury. The various member countries of the union are in a situation of denial of economic growth to maintain the level of inflation threshold. This phenomenon, known under the term sacrifice ratio is the object of the present study. The decline in general price level has a cost that should be measured to help the authorities to better integrate this phenomenon into strategies for monetary and economic convergence. The study is structured as follows. The first section is devoted to the literature review. The second section presents the methodology. The third section presents and interprets the different results. The fourth and final section presents the conclusion and recommendations.

2. Literature Review

There is extensive literature on monetary policy to be implemented by the central bankers particularly when inflation becomes a concern. High inflation is likely to slow the production process; however, a policy of low inflation causes significant economic costs. Thus, if a broad consensus on the absence of long-term real cost of a disinflationary policy (Barro, 1996), it may be true in the short term. From this perspective, the sacrifice ratio, defined as the cumulative loss in growth due to a permanent reduction in inflation to a point, is an extremely useful indicator.

It is common in the literature, both empirical and theoretical, to link the sacrifice ratio rigidities in the labor market (Gordon, 1982 and Mankiw, 1990 a theoretical point of view; Ball, 1994, Jordan, 1997, Durham, 2002, Diana and Sidiropoulos, 2004, Zhang 2005, Coffinet, 2006, an empirical point of view).

However, rigidities in the labor market, via the measurement of nominal wage rigidity, not generally constitute an instrument estimates and not an object of study as such. The analysis of this relationship is hampered by many methodological difficulties. From a theoretical viewpoint, two types of arguments are generally invoked. First, wage rigidities reflecting a less flexible labor market due to wage-setting mechanisms (frequency of changes, degree of indexation) are likely to influence the adjustment of the economy during a phase of disinflation and thereby increase the sacrifice ratio. Gordon (1982) explains that the sacrifice ratios are higher in the United States and Japan during the period 1960-1980. Conversely, the view neo-Keynesian attributed the non-neutrality in the short term money at producer prices more than wages (Mankiw, 1990): assuming that the rigidity of prices affects the cost of fighting against inflation, the wage-setting institutions could play only a secondary role in the level of the sacrifice ratio.

From an empirical point of view, two types of difficulties restrict the scope of diagnosis. First, studies analyzing the link between the sacrifice ratio and indicators of rigidities on the labor market are made exclusively in the context of a partial equilibrium (Ball, 1994; Zhang, 2005; Coffinet, 2006).

Second, the estimation of sacrifice ratios based on two competing methodologies: an approach based on an ad hoc identification of episodes of disinflation (Ball, 1994; Durham, 2002, Daniels and others 2004, Zhang, 2005; Coffinet, 2006) one hand, a structural VAR methodology (Cecchetti and Rich, 2001) on the other. Each of these methodologies has limitations.

The approach developed by Ball (1994) is to identify disinflation episodes ex ante, then calculating the sacrifice ratio on each of them. This literature has several limitations. First, the calculation of sacrifice ratios is very sensitive in identifying start and end of episodes of disinflation.

Second, the many proposed methodologies for estimating potential growth specific to each episode have given rise mixed results. Finally, these methods do not isolate monetary shocks. In other words, the disinflation episode is completely and arbitrarily assigned a monetary shock, without considering other possible supply shocks and demand.

The structural VAR approach has been implemented by Cecchetti and Rich (2001) showing Cecchetti (1994). It serves to distinguish the structural shocks to supply and demand. It also allows a breakdown of monetary policy between systematic component (reaction function of monetary authorities) and stochastic component (monetary policy shocks). However, two main criticisms are usually addressed him. First, the results are generally unstable in the model specification.

The sensitivity of the results is largely due to the difficulty of identification of shocks in such models. Secondly, they do not impose sufficient theoretical constraints to be really structural. They are therefore vulnerable to the Lucas critique and do not analyze the economic mechanisms behind the sacrifice ratio.

This paper fits into this literature and makes an empirical contribution in the countries of WAEMU zone.

Besides the fact that this framework can meet the Lucas critique, this approach also has certain advantages over previous methods. Contrary to the ad hoc approach, we are not forced to calculate the sacrifice ratio over periods of disinflation whose identification can be very robust. The model is estimated on data from the UEMOA zone for the period 1970 to 2007.

In the West African Economic and Monetary Union, Combey and Nubukpo (2008) suggest the existence of a nonlinear relationship between inflation and growth. They tried to highlight the inflation threshold at which a trade-off between inflation and growth is effective. To do so, they use a threshold panel model with individual fixed effects inspired by Drukker et al (2005). With the identification process of endogenous threshold to Hansen, the authors found a level of 8.08%. Monetary policy is conducted by the BCEAO and restrictive in the context of optimal threshold of the inflation / unemployment in the WAEMU zone.

The turn taken by the monetary policies from the eighties for a goal of price stability has been accompanied by periods of sharp disinflation in many countries both developed and developing. A permanent decline in inflation is expected to have no real cost to long term. Instead, it reduces the negative effects of inflation on growth and employment (Fisher, 1996). It is not even in the short term, particularly if monetary policy is wrong early.

2.1 The Sacrifice Ratio

The sacrifice ratio is generally defined as the cumulative loss in growth (resp. employment), expressed as a percentage of real gross domestic product (resp. unemployment), linked to a permanent reduction in inflation rate of a point. It is based in part on a standard relationship between changes in the inflation rate and unemployment rate called Phillips relation (Cahuc and Zylberberg, 2001):

$$\lambda_1\Delta(p_t-p_{t-1}) = \lambda_0 - \lambda_2 u_t - (1-\lambda_3)\Delta a_t \quad (1)$$

In this equation (1), the term $\Delta(p_t-p_{t-1})$ represents the change in the inflation rate between period t and period t-1, u_t the unemployment rate at time t and the variation of Δa_t a parameter measuring the productivity, strictly positive between t and t-1. Δ is the first difference operator.

The introduction of the unemployment rate consistent with a constant inflation rate, called NAIRU (Non Accelerating Inflation Rate of Unemployment) and noted C* at time t, allows to rewrite equation (1) as follows 2:

$$u_t = u^*_t - (\lambda_1/\lambda_2)(\Delta p_t-\Delta p_{t-1}) \quad (2)$$

Equation (2) shows that the reduction in inflation is accompanied by a transient increase in unemployment. λ_1/λ_2 the quotient, which measures the increase in the unemployment rate needed to reduce the inflation rate of one percentage point, is called sacrifice ratio.

This reasoning, explained here in the only part of the job loss, is easily transposable to the loss in production, for example via Okun's law. However, it should be noted that the sacrifice ratio is a measure of the net cost of disinflation because it ignores the benefits associated with reducing inflation, which occur in the medium-long term, including by reducing uncertainty and risk premiums.

2.2 Estimation

It is possible to distinguish three methods for estimating sacrifice ratios:

- A direct estimate of the Phillips curve,
- An approach based on a structural VAR model,
- An ad hoc method based on identifying disinflation episodes.

Initial estimates of sacrifice ratios (Okun, 1978) are based on direct estimation of equation (2), possibly as part of a VAR model (Gordon and King, 1982). Two criticisms are generally directed to these methods:

- First, they assume that the trade-off between growth and inflation is symmetrical between phases of disinflation and higher inflation,
- Second, they rely on the implicit assumption that the fight against inflation has been steady during the study period.

The structural VAR approach, initiated by Cecchetti (1994) and adopted by Cecchetti and Rich (2001), allows accurate identification of monetary policy shocks and the estimated sacrifice ratios vary over time. However, the results depend heavily on model specification. Moreover, the estimate of the sacrifice ratio depends on the time horizon from which we choose to constrain monetary policy to remain neutral. This second method lends itself more to international comparisons. The approach based on an ad hoc identification of disinflationary episodes favoured in this study is largely inspired by the work of Ball (1994) and the improvements made since by Jordan (1997), Zhang (2001) and Durham (2002).

It involves identifying disinflation episodes ex ante, then calculating the sacrifice ratio specific to each of them. The sacrifice ratio for a given episode is defined as the ratio of the total variation of the loss in growth to the change in core inflation over the term of this episode. The determination of potential growth specific to each episode is a first approach to this limit. Furthermore, this method assigns the single monetary policy changes in inflation and output during episodes of disinflation and neglects the supply shocks and other demand shocks. However, this method is well suited to identifying the determinants of sacrifice ratios, conducted as part of an analysis of variance, which is also the subject of this study.

2.3 Structural VAR Representation

Using a structural VAR representation to estimate sacrifice ratios was initiated by Cecchetti (1994) and adopted by Cechetti and Rich (2001).

Limitations of these approaches

The ad hoc method, if it allows a precise study of the relationship between sacrifice ratios and indicators estimated rigidities on the labour market, is no less open to criticism. First, the calculation of sacrifice ratios is very sensitive in identifying start and end of episodes of disinflation. Second, the many proposed methodologies for estimating potential growth specific to each episode has given rise mixed results. Finally, these methods do not isolate monetary shocks. In other words, the disinflation episode is completely and arbitrarily assigned a monetary shock, without considering other possible supply shocks and demand.

If the structural VAR approach facilitates identification of structural shocks and supply and demand allows a breakdown of monetary policy between systematic components (reaction function of monetary authorities) and stochastic (monetary policy shocks), two criticisms can be sent to him. First, the results are unstable in the model specification. The sensitivity of the results is partly due to the difficulty of identifying shocks. Secondly, they do not impose sufficient theoretical constraints to be really structural. They are therefore vulnerable to the Lucas critique and do not analyze the economic mechanisms behind the sacrifice ratio.

3. Methodology

3.1 History, Definitions and Model Philosophy

It is necessary to first differentiate between a VAR and an SVAR. The Cowles Commission distinguished between a reduced form and a structure. The reduced form related endogenous variables to lagged endogenous (predetermined) variables and exogenous variables, while the structure did the same, but also allowed for a contemporaneous interaction between the endogenous variables. Moreover, very few variables entered each structural equation, at least compared with the large number in the reduced form equations. In the literature we are concerned with, the VAR is the equivalent of the reduced form, in that each variable is related to lags of all other variables in the system but there are no contemporaneous interactions. An SVAR allows for some contemporaneous relations.

3.2 SVAR Modelling

In a VAR system *n* endogenous variables are explained from their own past

$$A(L)z_t = e_t \qquad (3)$$

where the matrix polynomial A(L) has degree k and leading matrix in the polynomial A(L) is the identity matrix, reflecting the reduced form nature of the system. Impulse responses are calculated from the vector moving average representation

$$Z_t = A(L)^{-1}e_t = C(L)e_t \qquad (4)$$

where the leading matrix in C(L) is again the identity matrix. The elements of et are correlated, that is, $E(e_t e'_t) = \Omega$ is not diagonal, and Sims (1980) argued that, it is useful to transform them to orthogonal form to be able to see the "distinct patterns of movement" of the system. The triangular factorization $\Omega = T\sum T'$, where T is lower triangular with unit diagonal and $\sum$ is diagonal gives the transformation $e_t=T\varepsilon_t$ such that $E(\varepsilon_t\varepsilon'_t)= \sum$. The orthogonalized impulse responses C(L)T then describe the consequences for z_{t+s}, s= 0,1,…., of unit shocks to the individual, mutually uncorrelated elements of (0,…., 0,1)' . For the last element these are the same as the traditional impulse responses, since the last column of T is (0, . . . , 0, 1); for all other elements the shock has an instantaneous impact, not only on the corresponding z-variable, as in the original system, but also on all variables placed lower in the z-vector. The orthogonalized impulse responses thus depend on the ordering of the variables in the VAR. Often a further scaling of these impulse responses is reported by considering the diagonal matrix $\sum^{1/2}$ of the standard deviations of e_t. Defining $S = T\sum^{1/2}$ gives the Cholesky decomposition $\Omega=SS'$ and associated transformation $\varepsilon_t = S\varepsilon^*_t$, and impulse responses to unit shocks to ε^*_t are then reported. These are $C(L)T\sum^{1/2}$, and describe the dynamic consequences for the *y*-variables of a shock of one standard deviation in the orthogonalized residuals. It is not clear how interpretability is improved by scaling in inverse proportion to the goodness of fit of the equations of the VAR.

Writing the orthogonalized VAR as

$$T^{-1}A(L)z_t = \varepsilon_t \qquad (5)$$

gives the appearance of the Wold causal chain, with contemporaneous coefficient matrix that is lower triangular with unit diagonal, and uncorrelated disturbances. This arises from the orthogonalization procedure rather than the imposition of prior restrictions from relevant economic theory. The recognition that structural analysis in VAR models requires such prior restrictions led to the development of SVAR models. The shocks are often given "structural" names, such as supply, money demand, technology, and so forth. Taking these to be the disturbance terms u_t of the structural model.

$$B(L)z_t = u_t$$

with covariance matrix $\sum$, attention usually focuses on the relation

$$B_0 \Omega B'_0 = \sum$$

and seeks restrictions that identify B_0 and $\sum$ given the reduced form VAR covariances Ω. This approach eschews restrictions on the dynamics, although, in some applications long-run restrictions are used. It is common in the SVAR literature to assume $\sum$ diagonal, but this is not done in the SEM literature, and whether it is a reasonable restriction on an SVAR has been questioned, by Bernanke (1986) himself and Shiller in discussion of Blanchard and Watson (1986), for example, and in more recent reviews such as Pesaran and Smith (1998).

Generalized impulse response analysis (Koop et al., 1996; Pesaran and Shin, 1998; for a precursor see also Evans and Wells, 1983) is an alternative to orthogonalization, whether this is the result of prior restrictions or simple renormalization. Rather than attempting to describe responses to specified shocks, generalized impulse responses (GIRs) describe the effect of "realistic" shocks, meaning shocks of the type that are typically or at least historically observed, as described by the sample estimate of the covariance matrix. If this is not diagonal, a shock to one error is associated historically with changes in the other errors. The GIRs, defined as conditional expectations given the estimated system, describe its dynamic responses to the resulting composite or generalized impulse. They are given as C(L)†, where † denotes the matrix obtained from by dividing the elements of each column by its diagonal element, since $E(e_t/e_{jt}=1) = (\omega_{1j}/\omega_{jj}, \omega_{2j}/\omega_{jj}, \ldots\ldots, \omega_{nj}/\omega_{jj})'$.

The GIRs are invariant to the ordering of the variables in the VAR, and coincide with the orthogonalized impulse responses for shocks to the first variable in the VAR, since when j = 1 the above column vector coincides with the first column of the matrix T defined above.

3.3 The SVAR Model

The study use the structural VAR method (Vector autoregression analysis) and the procedure of decomposition developed by Blanchard and Quah (1989) in order to measure the correlation of the shocks between countries and to examine the speed with which economies fit to these shocks.

3.4 Shocks Identification

The use of the structural "VAR" model allows to pass from some shocks stem from canonical VAR to economically explainable shocks. According to an approach made by Blanchard and Quah (1989), the identification is obtained by imposing a set of restrictions on the long term effect of every disturbance in the three variables included on the VAR model:

- The money variable apprehended by M_2
- The prices apprehended by the GDP deflator
- The production apprehended by the GDP.

The identification of the structural impulses is based on three hypotheses:
1 - A price shock transmits either to M_2 and price;
2 - A money shock has a long term effect only on M_2;
3 - A shock of supply has an effect on all variables of the system (M_2, price, supply).

The model can be expressed in the shape of mobile average as:

$$DX_t = A_0 e_t + A_1 e_{t-1} + \ldots\ldots = \sum_{t=0}^{+?} A_t e_{t-i}$$

$$DX_t = A_0 e_t + A_1 e_{t-1} + \ldots\ldots = \sum A_t e_{t-i}$$

Avec:

$$DX_t = \begin{vmatrix} DM_{2t} \\ DP_t \\ DY_t \end{vmatrix}$$

DP_t, DM_t, DY_t, respectively is the variation of the price, the variation of M_2 and the variation of the output.

$$X_t = \Sigma L_i A_i \varepsilon_t$$

Where L is the lag operator and VAR(t) = I

The choice of the lag number is determined thanks to the criteria of Akaike and Schwarz.

$$e_t = \begin{vmatrix} e_t^{M_{2t}} \\ e_t^{P_t} \\ e_t^{Y_t} \end{vmatrix}$$

e_t^P, e_t^M, e_t^Y respectively represent, the shocks of M_2, of prices and the shocks of supply that affect the economy. When

$$A_i = \begin{pmatrix} a_i^{pp} & a_i^{pm} & a_i^{py} \\ a_i^{mp} & a_i^{mm} & a_i^{my} \\ a_i^{yp} & a_i^{ym} & a_i^{yy} \end{pmatrix}$$

Where a_i^{ys} must be interpreted as the effect of a monetary shock in *t - i* on the real GDP in t.

In summary the vector obeys a mobile average vectorial process of infinite order. Thus, one gets the two traditional tools of the VAR modelling; it is about the answer functions to the shocks and the decompositions of the variance of the forecasting mistake. However, with the difficulty related to the modelling structural VAR, one makes an orthogonalisation as recommended by Shapiro and Watson (1989), Blanchard and Quah (1989), King and Al (1992). The orthogonalisation allows a decomposition of the variance of the forecasting mistake corresponding to the different sets as the contribution of the different structural shock. This method enables us to define for every country the shocks of supply, real demand and of price.

4. Estimation Results of the Structural VAR Model on the Sacrifice Ratio

The sacrifice ratio represents the effects on output and inflation to changes in preference of central banks, or their reaction to events (such as shocks to world interest rates) affecting other variables than those involved in the VAR model used to calculate this ratio. The sacrifice ratio thus indicates a disturbance of the variability of output and inflation following a monetary impulse that cannot be anticipated.

The figure below shows the different results obtained for the case of countries of the West African Economic and Monetary Union.

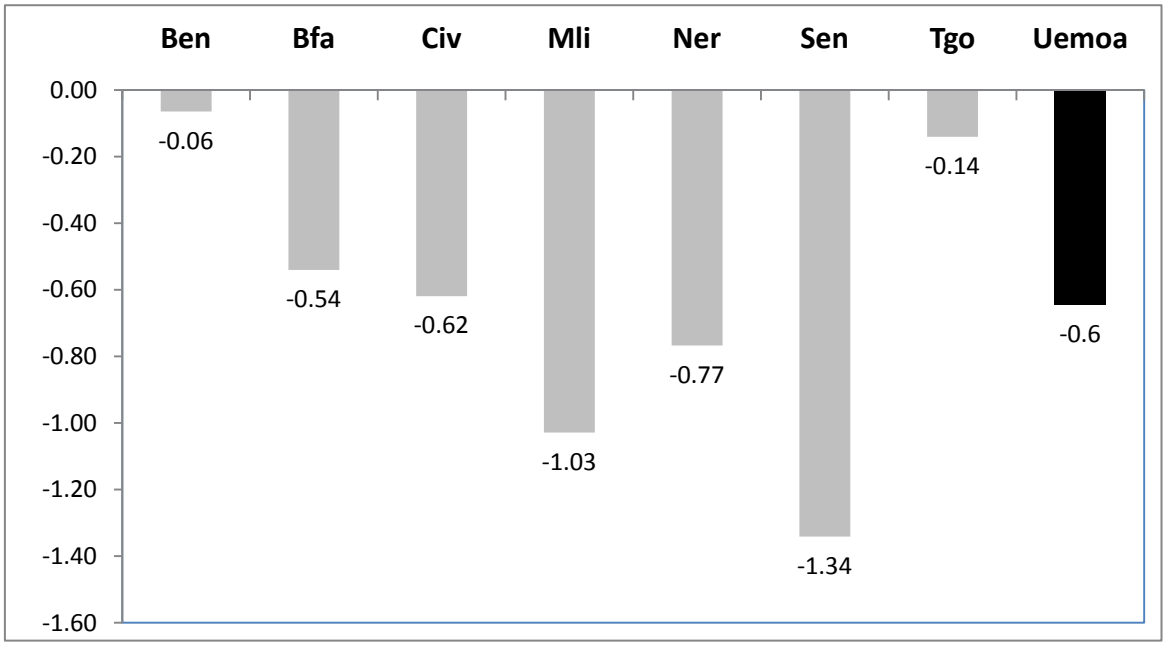

Figure 1. Sacrifice ratio in BCEAO/WAEMU countries

Ben= Benin; Bfa=Burkina Faso; Civ= Côte d'Ivoire; Mli=Mali; Ner= Niger; Sen= Senegal
Tgo= Togo; Uemoa= West African Economic and Monetary Union;

Source: Estimation of the authors from Structural VAR Approach

The different values indicate the price to pay in terms of growth rate for point reduction of inflation. Different countries of the WAEMU zone without exception suffer economic costs associated with keeping inflation at the threshold level set by the central bank. However, the results show that some countries more than others support the reduction of inflation. Thus, we see that Senegal and Mali have the highest ratios. However countries like Benin, Togo and Burkina have economies less sensitive to restrictive monetary policy of the BCEAO. These results seem very useful for coordinating economic policy in the union. Indeed, we find that, despite the similarities of the economies of WAEMU countries do not react the same way to a rate manipulation by the central bank.

Thus, a sustained decline of 1% inflation rate inherent in a monetary shock leads to a cumulative decline of 1.3% growth rate in Senegal, and 0.06% in Benin, for example.

5. Conclusion

The effectiveness of monetary policy depends on the ability of central bankers to specify a set of objectives on the one hand, to understand the effects of policies implemented to achieve the other. As such, the change in monetary policy objectives in favour of disinflation from the eighties in most developed countries and developing countries need to examine their actual cost. These costs, known as the "sacrifice ratio" are tools for measuring costs in production and use of a lower inflation. The analysis of the sacrifice ratio is particularly important for the Central Bank, as the authorities responsible for public policy, insofar as it is expected to bring some answers including the adjustment of labour markets and goods and services the lowest possible cost facing a tightening of monetary policy.

The main potential cost of participation in a monetary union is the loss of control on two domestic equity instruments, the interest rate and exchange rate. However, membership of a single currency area allows the reduction of transaction costs for trade with other countries in the area, the removal of currency risk within the area marked and monetary discipline.

Furthermore, if monetary policy is common to the eight WAEMU member states, it is not the case for fiscal policy that is specific to each country. However, there is a pact of convergence, stability, growth and solidarity, which requires compliance with a number of standards including: a basic fiscal balance of gross domestic product greater than or equal to zero, a rate inflation exceeding 3%, the stock of total public debt to GDP nominal lower or equal to 70%, then the arrears of debt management current zero. The results of our study show that the monetary policy of the BCEAO has a significant cost for the different member countries. However, some countries are more affected than others. The study suggests the implementation of the policy mix in the area to better coordinate monetary policy with fiscal policy in the WAEMU zone.

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