Research Paper No. 2004/20

Monetary Policy in the Franc Zone

Estimating Interest Rate Rules for the BCEAO

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February 2004

Abstract

This paper examines to what extent the central bank for the West African Economic and Monetary Union (BCEAO) has used interest rate policy in response to domestic economic developments. We show that while in the long run the BCEAO matches changes in French (Eurozone) interest rates one for one, in the short run it retains freedom to react to domestic economic variables, such as inflation, the output gap, its foreign exchange position and government borrowing.

Keywords: monetary policy, monetary policy rules, CFA zone, credit control

JEL classification: E31, E52, E58

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This study has been prepared within the UNU-WIDER project on 'Long-Term Development in the CFA-zone Countries of Sub-Saharan Africa', directed by David Fielding.

UNU-WIDER gratefully acknowledges the financial contribution to the project by the Finnish Ministry for Foreign Affairs.

UNU-WIDER also acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency – Sida) and the United Kingdom (Department for International Development).

ISSN 1810-2611 ISBN 92-9190-599-2 (internet version)

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Camera-ready typescript prepared by Janis Vehmaan-Kreula at UNU-WIDER
Printed at UNU-WIDER, Helsinki

1 Introduction

This paper asks to what extent the BCEAO, which is the central bank for the West African Economic and Monetary Union, modifies its discount rate in response to changing domestic and international conditions. We focus in particular on the period after the January 1994 devaluation of the CFA franc, considering to what extent the BCEAO reacts to changes in domestic inflation and output, to external constraints involving reserve levels and French interest rates, as well as to other relevant variables. This paper is part of a research project that also involves a companion paper (Shortland and Stasavage 2004). This second paper asks to what extent the BCEAO has used policy tools other than its discount rate to influence credit conditions at the country level within WAEMU. While the BCEAO has been criticized in the past for not using its discount rate as an active policy tool, and while it is true that discount rate changes have been infrequent since 1994, we find evidence that the BCEAO does react to domestic economic variables in a limited fashion, and in particular to inflation. Our estimates are consistent with an interpretation that in the long-run, the BCEAO matches changes in French interest rates one for one, but in the short-run it retains a significant freedom to react to domestic economic variables.

2 Monetary policy in WAEMU: 1995-2000

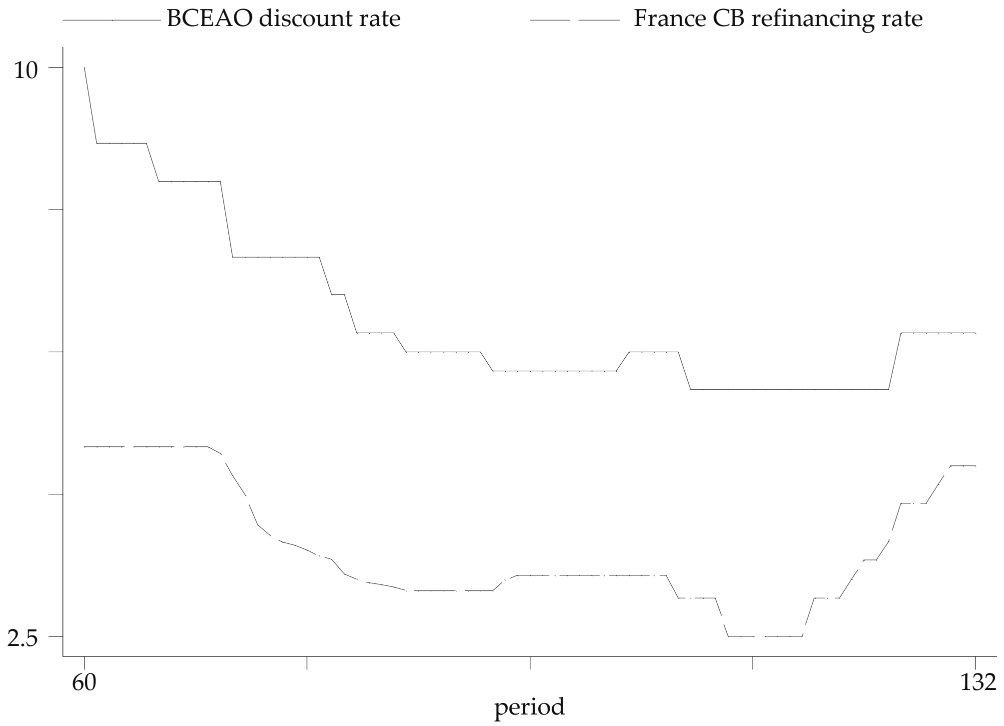
In October 1989 the BCEAO announced its intention to shift towards using indirect instruments of monetary policy, based on modifications of the central bank discount rate as the primary policy tool. Before 1989 monetary policy in WAEMU was carried out using direct instruments to control credit for individual member countries. This occurred as part of an annual programming exercise to determine credit ceilings (Honohan 1990). As a result, earlier studies of monetary policy in WAEMU countries, such as Savvides (1998), have focussed on the extent to which overall domestic credit (as opposed to the BCEAO discount rate) responds to variables like inflation and foreign assets. There has been some question whether the BCEAO has actually begun to actively use its discount rate as a monetary policy tool (see IMF 2001 on this point).

Since 1995 BCEAO interest rates have gone through two distinct periods. During the first period from December 1994 to October 1996 the BCEAO undertook a series of stepwise rate reductions that resulted in the discount rate falling from 10 per cent to 6.5 per cent (see Figure 1). This was also a period of stepwise reductions in French short-term central bank rates. Between October 1996 and December 2000 BCEAO rates remained within a very narrow range (5.75 per cent-6.5 per cent), in keeping with a relative stability in French interest rates, excepting at the end of the period.

3 Estimating an interest rate rule for the BCEAO

As an initial step in our empirical inquiry, we have estimated interest rate rules for the BCEAO central bank. We restrict our attention to the period between January 1995 and December 2000, because in the period immediately preceding and following the January 1994 devaluation of the CFA franc, monetary policy decisions were determined almost

Figure 1
BCEAO interest rates and French interest rates, 1995-2000



exclusively by the goal of maintaining the CFA franc's peg to the French peg.[1] We examine how BCEAO interest rates have responded to domestic inflation rates and to the output gap, as is common practice in estimates of interest rate rules for OECD countries. In addition, we consider to what extent the BCEAO authorities have responded to variables that may play more of a role in monetary policymaking in developing countries, and in particular those countries with fixed exchange rate regimes. These include foreign interest rates, levels of foreign assets, and changes in government claims on the central bank. Extended interest rate rules of this sort have recently been considered by Aron and Muellbauer (2000) for South Africa.

3.1 Specification and data

We begin by considering a basic monetary policy rule of the form adopted by Clarida *et al*. (1998) where the interest rate on the central bank's short-term lending facility r^* depends on the long-run equilibrium nominal rate $\bar{r}$, on the difference between the expectation of the inflation rate for period $t+n$ and the policymaker's preferred rate of inflation π^*, and on the difference between the expectation of output growth for period t and the preferred rate of output growth y^*. This is a generalization of the simple interest rate rule that has been proposed by Taylor (1993).

1 Before January 1994 this involved keeping BCEAO interest rates high in order to offer holders of CFA assets a risk premium. In the months immediately following the devaluation, BCEAO interest rates were raised significantly as part of the provisions of country IMF programmes.

$$r_t^* = \bar{r} + \beta_1(E_{t-1}[\pi_{t+n}] - \pi_t^*) + \beta_2(E_{t-1}[y_t] - y_t^*) \qquad (1)$$

In addition, in our empirical estimates we consider the possibility that the central bank will smooth interest rate changes in order to avoid disruption of financial markets and to avoid making sudden reversals in policy that might damage credibility. While it is accepted that central banks in OECD countries smooth interest rates, these motivations for smoothing are likely to be even stronger in developing country contexts with greater economic volatility and where central banks may have imperfect credibility. Following Clarida *et al*. (1998), rather than attempt to model the reasons for interest rate smoothing directly, we assume that the extent to which the central bank short-term lending rate adjusts to new information depends upon the parameter ρ in the equation below.

$$r_t = \rho(r_{t-1}) + (1-\rho)r_t^* \qquad (2)$$

Empirical estimations of equation 1 often consider both rules where the central bank reacts to forecasts of inflation in the next period (n=1) and rules where it reacts to the forecast for inflation anywhere from 6 to 24 months into the future. The central bank's information set is taken to include data available in period t-1. Based on this assumption, one can then use instrumental variables to incorporate forward-looking expectations into the estimation. Aron and Muellbauer (2000) adopt this technique to estimate an interest rate rule for South Africa. In the case of the West African Economic and Monetary Union, however, there is reason to believe that the appropriate estimation method may be more simple. When using information available at time t-1 to predict inflation at time t (based on monthly data), the only statistically significant predictor is the previous month's inflation rate.[2]

We observe a similar pattern for the output gap. There is no available BCEAO data on inflation expectations in WAEMU, and a recent paper by a member of the BCEAO staff (Tenou 2002) does not include a measure of inflation expectations when estimating an interest rate rule for WAEMU. As a result, in our estimate of the BCEAO interest rate rule we assume that when setting interest rates at time t the BCEAO reacts directly to the inflation rate and the output gap as measured at time t-1. As can be seen from the summary statistics in Table 1, monthly inflation rates in WAEMU are extremely volatile, with a standard deviation of 7.8 percentage points.[3] This volatility has potential implications for BCEAO policymaking; to the extent inflation is volatile and difficult to forecast, the BCEAO may give this variable less weight when considering interest rate decisions.

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2 That is when we instrumented for current inflation with different lags of inflation, only the coefficient on inflation lagged one month was significant (and inflation lagged one quarter in the case of our quarterly dataset).

3 Inflation rates show similar volatility in quarterly data, with a standard deviation of 6.4 percentage points over the 1995-2000 period. There also remains nearly as much volatility in the series of if one considers a six month backward looking moving average for inflation rates. Here the standard deviation is 5.0 percentage points. A six month moving average of this form was a poorer predictor of current inflation than was a one month lag.

Table 1
Summary statistics

	Mean	Standard deviation	Minimum	Maximum
BCEAO discount	6.72	1.09	5.75	10.0
French interest rates	3.64	0.80	2.50	5.00
WAEMU inflation	0.028	0.078	-0.131	0.206
Output gap	0.006	0.052	-0.157	0.100
Foreign assets	0.326	0.045	0.215	0.435
Claims on govt	0.309	0.034	0.261	0.422

These figures are based on monthly data 1995-2001. Summary figures for the quarterly dataset used in the paper are similar.

We estimated the overall output gap for the BCEAO using a Hodrick-Prescott filter and quarterly data for GDP.[4] The recent paper by BCEAO staff that estimates an interest rate rule for WAEMU also uses this approach (Tenou 2002). As was true for inflation rates, the output gap in WAEMU is extremely volatile (see Table 1), and as a consequence, the BCEAO may give less weight to this variable in policymaking than would otherwise be the case. Given that the HP filter is known to have a number of shortcomings, in particularly with accuracy deteriorating towards the end of a series, we also experimented with alternative output gap measures. One option involved calculating trend GDP by using a simple 5-quarter moving average of real GDP growth. The output gap produced using this method turned out to be extremely highly correlated with our existing HP filter measure (correlation coefficient >0.95).

When considering whether the BCEAO alters interest rates in response to changes in WAEMU inflation and the output gap, we constructed each of these variables by weighting individual country inflation rates and output gaps by GDP. However, it is plausible that the decision making process within BCEAO might result in different weightings being applied in practice. In the section below on the robustness of our results we investigated two such possibilities: that BCEAO responds only to Ivoirian economic conditions, which would be based on the interpretation that Côte d'Ivoire plays a predominant role in BCEAO decision making, and that BCEAO responds to an unweighted average of WAEMU inflation rates and output gaps, which would be based on the interpretation that the BCEAO statutes give countries equal weight in decision making, regardless of the size of their population or their economy. As described below, the results did not differ very significantly from those reported here.

In addition to considering the possibility that BCEAO interest rates react to current inflation and the output gap, we follow Aron and Muellbauer (2000) by examining whether interest rates are correlated with several other variables that may logically have an impact on interest rate setting by developing country central banks, and by the

4 In addition, because there was evidence of seasonality of output, we regressed the output gap on a set of seasonal dummies and then used the residual from this regression as our final output gap measure for estimation. There was not strong evidence of seasonality in other variables in our dataset, nor was a set of seasonal dummies statistically significant in any of the regressions we performed.

BCEAO in particular. Most importantly, given capital mobility and the maintenance of the CFA franc's peg to the French franc (and subsequently the euro), the BCEAO can be expected to react to changes in French interest rates. Failure to maintain short-term interest rates at French levels (in addition to compensating for a relative risk premium for holding CFA) will lead to a loss of exchange reserves. To the extent that a reserve outflow is not supported unconditionally by the French Treasury, this will pose a constraint on BCEAO policy. As a result, in our empirical estimates we include French short-term interest rates as an explanatory variable. If interest parity holds in the long-run, then the coefficient $\frac{\beta_4}{1-\beta_1}$ should be equal to 1.

$$r_t = \alpha + \beta_1 r_{t-1} + \beta_2 \pi_{t-1} + \beta_3 (y_{t-1} - \bar{y}_{t-1}) + \beta_4 r_{t-1}^{FR} + \beta_5 a_t + \beta_6 c_t + \varepsilon_t \qquad (3)$$

Given the constraint imposed by the CFA peg, the BCEAO should also logically be more likely to increase short-term interest rates in cases where the central bank's foreign assets are low. The BCEAO statutes contain a policy rule requiring credit restrictions whenever gross foreign assets of the BCEAO fall below 20 per cent of sight liabilities (*engagements à vue*).[5] In our empirical estimates we include the variable a which measures the gross foreign assets of the BCEAO as a share of WAEMU GDP.

Finally, given that the BCEAO has continued to provide a direct credit facility for governments, we also include a variable c which measures total BCEAO claims on governments as a share of WAEMU GDP. This would be justified to the extent that the facility is automatic (BCEAO cannot limit credit to governments unless this exceeds 20 per cent of annual revenues), and that there are fears that an increase in claims will have to be monetized at some point.[6] To the extent that changes in claims provide a good proxy for the overall fiscal deficit, this variable may also capture reaction to direct inflationary effects of expansionary fiscal policy.

Tests for non-stationarity and cointegration produced inconclusive results with regard to the variables we use to estimate equation 3. Based on an augmented-Dickey-Fuller test and the related Phillips-Perron test, the null of non-stationary was strongly rejected for all variables except French short-term central bank rates (based on both quarterly and monthly frequencies). However, results of a Dickey-Fuller generalized least squares test proposed by Elliott *et al*. (1996) suggested that both the BCEAO discount rate and French short-term rates may be non-stationary over the time period we consider.

Given the theoretical relationship between BCEAO rates and French short-term central bank rates, one might expect that if they each have a unit root that they will also be cointegrated. If this were the case, then it would make sense to estimate an error-correction model where BCEAO rates in the long-run depend exclusively on the level of French interest rates (plus a constant reflecting any risk premium), and the other variables in equation 3 then explain short-run deviations from this long-run tend. A likelihood ratio test based on the Johansen procedure for cointegration suggested this is indeed the case. However, the Johansen procedure is known to have poor properties in

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5 This includes notes and coins, sight deposits of banks, financial institutions and the Treasury, and foreign currency liabilities

6 A similar assumption is made in Fielding (2002) chapter 3.

small samples such as we have here. Moreover, tests for cointegration based on the method proposed by Engle and Granger (1987) suggested that the null of no-cointegration of French rates and BCEAO rates could not be rejected.

Based on the above tests, we can conclude that all variables in our estimates are stationary with the potential exception of the BCEAO discount rate and French central bank rates. However, it remains uncertain whether these two series are stationary and whether they are cointegrated (if they are in fact non-stationary). We have chosen to estimate equation (3) in levels, but as discussed in the section below on the 'Robustness of our results', results based on an error-correction model were very similar to the results we actually report here.

3.2 Estimates using quarterly data

Regressions 1 and 2 in Table 2 report estimates of equation 3 using quarterly data for the period 1995-2001. We begin with a simple rule that considers the relationship between BCEAO interest rates, inflation, the output gap, and French interest rates. With the inclusion of the lagged dependent variable, this specification also allows for interest rate smoothing. In this estimate the coefficient on French interest rates is statistically significant, suggesting that a 1 point increase in French interest rates would be associated with a 0.23 point short-run increase in BCEAO rates. Given the confidence interval for this coefficient and for the coefficient on the lagged dependent variable, this result is also consistent with the proposition that in the long-run, a change in French interest rates will have to be matched by a one-for-one change in BCEAO interest rates. In this first regression the coefficient on lagged inflation is of the expected sign and quite large, but it is not statistically significant. The coefficient on the output gap is not statistically significant either.

We next estimate an extended rule where BCEAO interest rates also respond to changes in the level of foreign assets held by the BCEAO and to changes in government claims on the central bank. In this specification there is again evidence that the BCEAO responds to changes in French interest rates, but lagged inflation and the output gap are not statistically significant. However, the coefficients on the foreign assets variable and the government claims variable have the expected sign, and they are statistically significant at the 10 per cent level. Based on these estimates, a one standard deviation decrease in BCEAO foreign assets would be associated with a cut in interest rates by 0.40 percentage points. This is a sizeable reaction. A one-standard deviation increase in claims on government is estimated to be associated with a 0.12 point increase in the BCEAO's discount rate.

Given the results of these regressions using quarterly data, the horizon most frequently used to estimate interest rate rules, it can be suggested that the BCEAO has a tendency to smooth interest rate changes, and it responds to changes in French interest rates, but there is little indication that the BCEAO reacts systematically to either lagged inflation or to the output gap. There is evidence, however, that the BCEAO reacts to changes in its foreign exchange position and to changes in claims in government, but the magnitude of these effects is significantly smaller than is the estimated effect of a change in French central bank rates.

Table 2
Estimating an interest rate rule for BCEAO

	(1)	(2)	(3)	(4)
BCEAO discount (*t*-1)	0.681 (0.076)	0.478 (0.116)	0.829 (0.036)	0.781 (0.058)
French rate (*t*-1)	0.233 (0.082)	0.272 (0.093)	0.142 (0.049)	0.151 (0.060)
WAEMU inflation (*t*-1)	1.234 (0.867)	-0.274 (1.201)	0.891 (0.323)	1.106 (0.410)
Output gap (*t*-1)	-0.036 (0.749)	0.214 (0.805)	0.030 (0.317)	0.052 (0.521)
Claims on government		3.632 (1.917)		0.715 (1.222)
Foreign assets		-8.727 (4.640)		-1.552 (0.793)
Constant	1.154 (0.361)	4.209 (2.196)	0.565 (0.118)	1.135 (0.608)
N=	25	25	73	73
Pr>F	<0.01	<0.01	<0.01	<0.01
Frequency	quarterly	quarterly	monthly	monthly

Estimation by OLS with Newey-West standard errors (in parentheses).

3.3 Estimates using monthly data

While the majority of empirical studies of interest rate rules use quarterly data, several authors have observed that it may make more sense to use monthly data for these estimates, because this is the frequency with which central bank governing boards generally meet to consider interest rate changes.[7] Among the variables used in our estimate of equation 3, the output gap is only available on a quarterly basis, but data for all other variables is available monthly. Regressions 3 and 4 and Table 1 report estimates of an interest rate rule for the BCEAO using monthly data.[8] In these regressions the output gap has been constructed using a simple interpolation where the output gap in each month is estimated to be equal to the measured output gap for that quarter.

In regression 3, as was true for the estimates using quarterly data, there is evidence that the BCEAO smooths interest rates, and that it responds to changes in French short-term interest rates. This result is again consistent with the proposition that the BCEAO partially matches French interest rate changes in the short-run, and that in the long-run it matches these changes one-for-one. In addition, there is now clear evidence that BCEAO responds to increases in inflation with higher interest rates. A one standard

7 This point has been made by Clarida *et al*. (1998) as well as Chevapatrakul *et al*. (2001).

8 Given the significance of a number of variables in our regressions using quarterly data, it may make sense to include three lags of our dependent variable in our monthly regressions. We began with this specification but excluded the second and third lags after we found that they were never statistically significant.

deviation increase in WAEMU inflation (+0.078) is estimated to result in a short-run increase of 0.07 in the BCEAO's discount rate, and a long-run rate increase of 0.41 percentage points. The coefficient on the output gap in regression 3 remains insignificant. The results for regression 4 with regard to inflation are quite similar. In addition, there is evidence that the BCEAO responds to changes in its level of foreign assets, though the coefficient on government claims in this regression is not statistically significant. A one standard deviation decline in BCEAO foreign assets (-0.045) is estimated to result in an increase in the BCEAO's discount rate by 0.07 percentage points in the short-run and by 0.32 percentage points in the long term. This is quite close to the result from the estimates using quarterly data.

In sum, our estimates using monthly data suggest that while changes in French interest rates remain the primary factor to which the BCEAO responds when it sets its discount rate, there is evidence that since 1995 the BCEAO has also reacted to WAEMU inflation, to changes in its foreign exchange position, and to the level of government claims on the central bank.

4 Estimating probabilities of interest rate changes

While standard interest rate rules are used to estimate how the *level* of interest rates responds to changes in macroeconomic variables such as inflation and output, and they implicitly assume that interest rates can be modified by any amount, in practice central banks face choices of whether to respond to changing economic conditions with a discrete change in interest rates, generally of at least 25 basis points. As a consequence, rather than using macroeconomic variables to predict the level of interest rates, it may also be useful to use these same variables to predict the direction of change of the central bank's discount rate (cut, no change, or increase). In this section we follow Chevapatrakul *et al*. (2001) by use of a multinomial logit model to estimate the probability that the BCEAO will cut interest rates, increase rates, or hold them constant in any given month. The multinomial logit model allows us to take account of the fact that central banks are forced to choose between no change in the interest rate, a discrete increase, or a discrete decrease.[9]

Over the period we consider, while the level of the BCEAO's discount rate has varied significantly, changes in the level have tended to occur in large discrete jumps. Over the 73 months in our sample the BCEAO changed rates on only 10 occasions, decreasing rates eight times, and increasing rates in two instances. Seven out of these ten modifications involved changes of at least 50 basis points. This distribution of outcomes suggests that while it may be possible to predict decreases in the discount rate with some confidence, it may be quite difficult to predict rate increases very accurately. Given this distribution, one might prefer to group together cases of interest rate increases with cases where the rate was held steady and then use a standard logit or probit model to estimate the likelihood of a rate decrease. We also considered this possibility and found that the results were very similar to those obtained with the

9 For reasons of tractability we ignore the fact that the BCEAO has made discrete changes of differing magnitudes in recent years.

multinomial logit procedure. As a consequence, we have chosen to report the multinomial logit estimates in Table 3.

Table 3
Estimating probability of a change in BCEAO interest rates: multinomial logit estimates

	Reduced model		Extended model	
	Cut	Increase	Cut	Increase
Difference (*t*-1)	5.04 (1.88)	-2.50 (1.43)	13.0 (3.7)	-2.70 (1.17)
WAEMU inflation (*t*-1)	-13.9 (6.1)	8.1 (12.4)	-31.1 (13.7)	8.9 (10.2)
Output gap (*t*-1)	35.2 (17.5)	5.10 (3.76)	53.0 (18.3)	7.88 (8.63)
Claims on government			-39.2 (18.6)	15.2 (37.6)
Foreign assets			75.7 (31.6)	-4.17 (19.3)
Constant	-19.5 (7.0)	2.91 (3.01)	-59.2 (18.3)	1.135 (0.608)
N=	73		73	
Pr>Chi^2 – H_0: constant only	$p<0.01$		$p<0.01$	
Pr>Chi^2 – H_0: reduced model			$p=0.064$	

Estimation by multinomial logit with heteroskedastic-consistent standard errors (in parentheses).

Table 3 reports the results of our multinomial logit estimates of the following three outcomes where X_t is a vector of variables likely to be correlated with interest rate changes.

$$\Pr(r_t - r_{t-1} < 0 | X_t)$$
$$\Pr(r_t - r_{t-1} = 0 | X_t)$$
$$\Pr(r_t - r_{t-1} > 0 | X_t)$$

For the vector X_t, we use the same set of explanatory variables used to estimate equation 3, with one exception. Instead of using the level of French short-term interest rates, we use the difference between the BCEAO's discount rate and French short-term rates as an explanatory variable $(r_{t-1}^{BCEAO} - r_{t-1}^{FR})$. While the level of French rates is a likely predictor of the level of BCEAO rates, the probability that BCEAO rates will be changed in any given month is more likely to be a function of the difference between the BCEAO rate and the French rate.

Table 3 reports the results of our multinomial logit estimates. In the reduced model, the coefficient on the difference between BCEAO rates and French rates has the expected sign both for predicting cuts in the BCEAO rate and for predicting increases, and it is statistically significant in the former case. In addition, the level of WAEMU inflation has a statistically significant effect on the probability of a rate cut: higher inflation makes a cut less probable. Contrary to intuition, the coefficient on the output gap is actually positive and significant, suggesting that when GDP is above trend the BCEAO will actually be more likely to cut interest rates.

The 'extended model' reported in Table 3 adds claims on government and the level of foreign assets to the central bank's information set. In this extended model the coefficients on WAEMU inflation and on the output gap remain of similar magnitude as in the reduced model. In addition, the level of BCEAO foreign assets and of its claims on government are significant predictors of a cut in the BCEAO's discount rate. A likelihood ratio test shows that these coefficients are jointly significant. As would be expected, when foreign assets are high and claims on government are low, the BCEAO is more likely to cut rates.

A look at the substantive magnitude of the effects from our multnomial logit estimates provides a mixed picture. Changes in French interest rates have large effects on our estimated probabilities of interest rate changes, and changes in other explanatory variables may also have sizeable effects, but only when they are quite far from their mean values. For each of our explanatory variables, Table 4 reports the predicted probability of a cut in BCEAO interest rates when the variable in question is set at one, two and three standard deviations away from its mean. Other variables remain set at their mean values (when all variables are set at their means the estimated probability of an interest rate cut is 0.001). The value for each of the variables listed is shifted in the direction which, according to the extended model in Table 3, would be associated with an increased probability of a cut in the BCEAO discount rate. From the Table it is clear that an increase in the gap between French and BCEAO interest rates by one standard deviation or more has a very large effect on the estimated probability of an interest rate cut. In contrast, the level of WAEMU inflation or the level of foreign assets only has a sizeable impact on the estimated probability of a rate cut when these variables are at least two standard deviations away from their mean. In the sample we consider, this would apply to only 2 per cent of the observations for foreign assets and 5 per cent of the observations for inflation. Finally, even very large changes in levels of claims on government have no effect on the estimated probability of a rate cut.

Table 4
Predicted probability of an interest rate cut

		$\Pr(r_t - r_{t-1} < 0)$		
Variable	variable change	1 Std. Dev.	2 Std. Dev.	3 Std. Dev.
Difference (*t*-1)	above mean	0.78	0.99	0.99
WAEMU infl. (*t*-1)	below mean	0.01	0.13	0.62
Output gap (*t*-1)	above mean	0.02	0.24	0.83
Claims on govt.	below mean	<0.01	0.02	0.06
Foreign assets	above mean	0.03	0.51	0.93

Based on extended model reported in Table 3. Other variables set at their means. Predicted probability when all variables are set at their means is 0.001.

As a final look at the substantive predictions of our multinomial logit estimates, Figure 2 charts the estimated probabilities of a rate cut for each date in our sample (in the shaded columns), and it also indicates the dates on which the BCEAO actually chose to cut interest rates (in the unshaded columns). As can be seen, there is a reasonably close correspondence between a high predicted probability of a cut, and an actual BCEAO decision to cut rates. However, a further look shows that the accuracy of the model is driven above all by the estimated effect of a change in the interest rate differential between WAEMU and France. Figure 3 reports the estimated probabilities from the extended model after we removed the interest rate differential variable from the regression. As can now be seen, there continues to be a correlation between a predicted change in rates and an actual change in rates, but the predicted probability of a change in rates in this model is never greater than 0.5.

Figure 2
Estimated probability of a rate cut – using gap with French rates
(actual cut indicated by unshaded column)

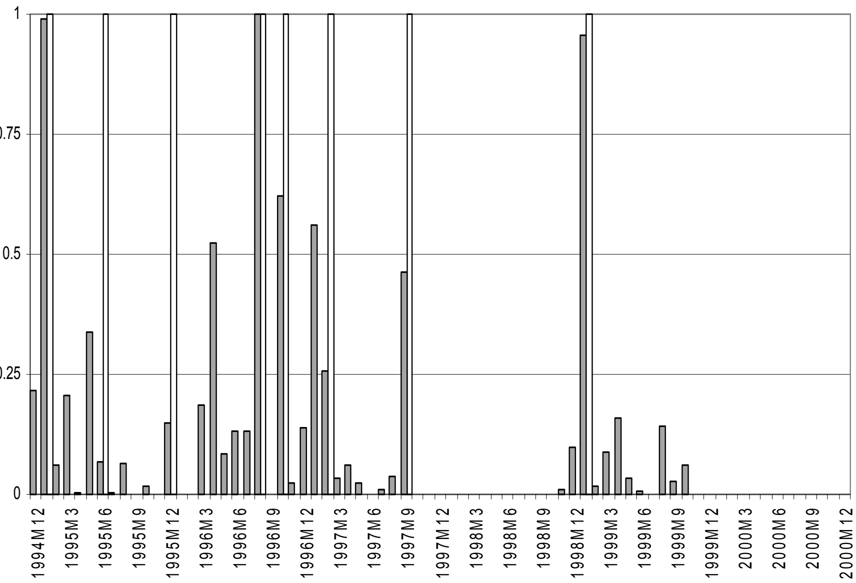
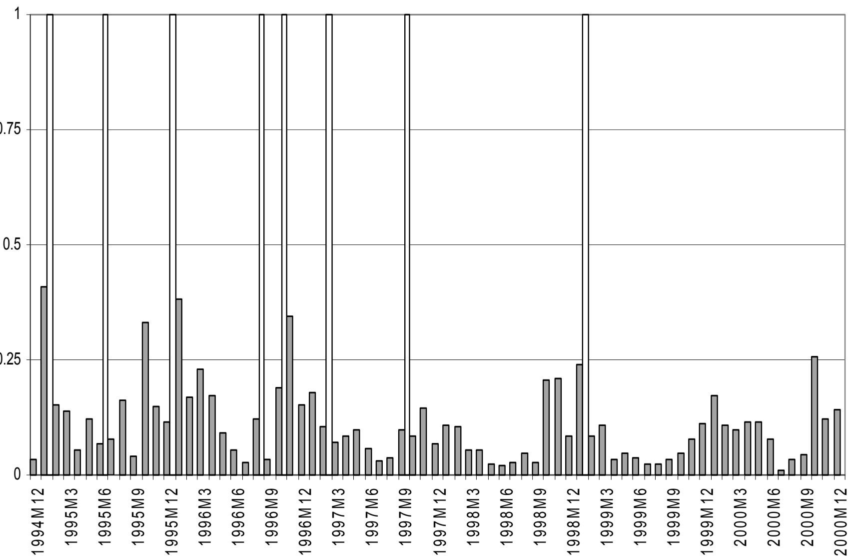


Figure 3
Estimated probability of a rate cut – domestic variables only
(actual cut indicated by unshaded column)



5 Robustness of the results

Before drawing firm conclusions based on our estimates, it is worth considering to what extent these results may be influenced by serial correlation of the errors, by outliers, and by the specification we adopted.

One alternative to the estimation strategy we have adopted for the interest rate rules would be to adopt an error correction model where the trend in the BCEAO discount rate depends upon the trend in French central bank rates, while in the short-run, movements in BCEAO rates also depend upon movements in other variables, such as inflation, the output gap, and changes in foreign assets. We considered a simple error correction model of the following format and found that the results were quite close to those from the OLS estimates.

$$r_t = \alpha + \beta_1 r_t^{FR} + \varepsilon_1$$
$$\Delta r_t = \beta_2 + \beta_3 \Delta\pi_{t-1} + \beta_4 \Delta(y_{t-1} - \bar{y}_{t-1}) + \beta_5 \Delta a_t + \beta_6 \Delta c_t + \beta_7 (r_{t-1} - (\alpha + \beta_1 r_{t-1}^{FR})) + \varepsilon_2$$

In the regression modelling the short-run dynamics of BCEAO rates, the coefficient on the change in the output gap was not significant, while the coefficients on the change in WAEMU inflation, the change in foreign assets, and the change in claims on government were, in fact, statistically significant. The magnitude of these coefficients was also quite similar to that reported in regression 4 of Table 2. The results were also similar when we omitted the constant term from the short-run equation and when we also included a term for the change in French central bank rates.

Standard tests for serial correlation of errors when a lagged dependent variable is present provided mixed conclusions about our Table 2 estimates. Based on a Durbin-H test, the null of no first-order serial correlation could not be rejected for either the estimates using quarterly data or those using monthly data. On the other hand, results of a Breusch-Godfrey test, which can be used to test for both first-order and higher-order autocorrelation, suggested that there is first order autocorrelation in both our quarterly and our monthly estimates, and there is also higher order autocorrelation in the quarterly estimates. These results for the quarterly data should probably be qualified by the fact that the sample size is quite small. We examined whether inclusion of additional lags of our explanatory variables could successfully address any potential serial correlation. However, after inclusion of additional lags, the coefficients on these lag terms were not statistically significant, and tests continued to suggest that both first-order and higher-order autocorrelation might be present. As a consequence, in our Table 2 estimates we have reported the standard errors proposed by Newey and West (1987), which are consistent in the presence of both first order and higher order autocorrelation.

We also considered to what extent our empirical results are influenced by the presence of outliers. For the OLS estimates in Table 2 we identified outliers using Cook's distance and then re-estimated the regressions after excluding those observations where this value was greater than $4/(n\text{-}k\text{-}1)$. After exclusion of several outliers the results of all four regressions remained similar. For our multinomial logit estimates we identified outliers using the Delta-Beta influence statistic developed by Pregibon (1981). After exclusion of two outliers (January 1995 and June 1996) the estimates for predicting a cut in interest rates remained virtually unchanged. In contrast, in both the reduced and the extended model the estimates for an increase in BCEAO rates altered substantially.

The coefficients on lagged inflation, the lagged output gap, and claims on government were each statistically significant with the expected sign.

In addition to examining the effect of serial correlation and outliers on our results, it is also worth considering to what extent our conclusions are dependent on the particular specification adopted in our OLS and multinomial logit estimates. As a first possibility, we considered to what extent our results depend on the restrictive assumption that BCEAO does not use a forecast for inflation and the output gap when setting policy. When we re-estimated our regressions while including a forecast of inflation and output (based on instruments available at time *t*-1), the results were quite close to those reported here. We also considered whether the results with regard to the output gap depended on our use of a de-seasonalized estimate of this quantity. When using an output gap measure that had not been de-seasonalized we found that the coefficient on this variable was not statistically significant in any of our regressions.

As a final step, we also considered whether our empirical results were altered when calculated WAEMU inflation and output using a weighting other than GDP. As mentioned above, one possibility is that because the decision making process in WAEMU gives each country a vote, regardless of its economic size, in practice the BCEAO may tend to react to an unweighted average of inflation and output. When we substituted an unweighted average of WAEMU inflation rates and an unweighted average of country output gaps in our Table 2 and Table 3 regressions we found relatively little change in the results. This was particularly true for the coefficient on lagged inflation, which is not surprising given that the correlation between the weighted average of country inflation rates and the unweighted average was 0.99. In our multinomial logit estimates we continued to observe the same 'perverse' result whereby a positive output gap was associated with an increased estimated likelihood of an interest rate cut.

The polar opposite to suggesting that each country has equal influence on BCEAO decisions would involve the argument that Côte d'Ivoire dominates monetary policy making. In this case we might want to substitute Ivoirian inflation and the Ivoirian output gap for the weighted inflation rate and output gap used in the Table 2 and Table 3 regressions. When we did this we found that there was very little change in our results with regard to the output gap. This is undoubtedly due to the fact that the simple correlation between the Ivoirian output gap and overall WAEMU output gap is 0.92. There was some difference with regard to inflation, as in the Table 2 regressions the BCEAO was estimated to have a somewhat larger reaction to lagged Ivoirian inflation than to overall WAEMU inflation. However, the coefficient on lagged Ivoirian inflation was not significant in the multinomial logit regressions when estimating the probability of an interest rate cut.

6 Conclusion

Our empirical results provide a nuanced picture regarding monetary policy in the West African Economic and Monetary Union. Short-term central bank rates in France (now the euro zone) have continued to be the most important influence on both the level of the BCEAO's discount rate and on decisions to alter the BCEAO discount rate. This is a logical implication of the CFA franc's peg to the French franc (and now the euro). However, while our estimates suggest that in the long-run the BCEAO may have to match changes in the Bank of France (now ECB) lending rate on a one for one basis, it nonetheless appears to retain flexibility in the short-run to use interest rates to react to changes in WAEMU economic conditions. We have provided evidence that the BCEAO takes into account inflation rates and central bank claims on government and its foreign exchange position when making interest rate decisions.

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