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Chantal Dupasquier, Patrick N. Osakwe and Shandre M. Thangavelu

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Choice of Monetary and Exchange Regimes in ECOWAS: An Optimum Currency Area Analysis*

Chantal Dupasquier and Patrick N. Osakwe**
UN Economic Commission for Africa
P. O. Box 3005, Addis Ababa
Ethiopia

Shandre M. Thangavelu
Department of Economics
National University of Singapore
Singapore

Abstract: There are plans by five West African countries to establish a second monetary zone in the sub-region by December 2009. In this paper we ask whether a monetary union is the appropriate exchange rate regime for the sub-region based on economic criteria. We address the issue using a rigorous theoretical framework that captures the crucial trade-off between the savings in transaction costs, resulting from a common currency, and the macroeconomic stabilization benefits of a flexible exchange rate regime. The main result is that a flexible exchange rate regime dominates a monetary union in the ECOWAS sub-region.

Keywords: Exchange rates; Regimes; Welfare; Transaction costs; West Africa
JEL classification: E52; F33; F41.

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**Corresponding author: Patrick N. Osakwe, Tel: (251-1) 443409; E-mail: posakwe@uneca.org.

Introduction

The successful launching of the euro in 1999 has generated and rekindled interest in the economics of common currencies in different parts of the world. In North America, there is an ongoing debate on whether Canada should form a monetary union with the United States and, possibly, Mexico (Macklem et al. 2001, Crow 1999, and Grubel 1999). Similar issues have also been raised in Asia and Africa, although the African debate has been taken one step further with the recent decision by five West African countries---Gambia, Ghana, Guinea, Nigeria, and Sierra Leone---to form a monetary union by December 2009.[1] If established, this would be the second monetary zone in West Africa. The first monetary zone in the subregion, the West African CFA franc zone, has eight members: Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo.[2] It is expected that the new monetary zone will be merged with the existing West African CFA franc zone a few years after its inception, resulting in a single currency in the Economic Community of West African States (ECOWAS).[3]

Since the establishment of the European Economic and Monetary Union (EMU), discussions on exchange rate regimes in Africa have generally focused on the implications and challenges African policy-makers have to confront in an attempt to set up monetary unions in Regional Economic Communities (RECs) on the continent. Implicit in these discussions is the assumption that there are either no other feasible alternative exchange rate regimes for

1. The initial plan was to introduce the common currency in 2003. However, the commencement date was extended to July 2005 and then December 2009 to enable member States meet the convergence criteria and increase the degree of preparedness for monetary unification (WAMI, 2005). Members of the Common Market for Eastern and Southern Africa (COMESA) are also entertaining the idea of forming a monetary union. COMESA was formed in December 1994 and has the following members: Angola, Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Namibia, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia, and Zimbabwe. There are also plans by members of the East African Community --- Kenya, Tanzania, and Uganda --- to set up a common currency although the commencement date has not been made public. It is not yet clear how these different plans for monetary integration will be reconciled with the issue of overlapping membership.

2. The CFA (Communaute Financiere Africaine) franc zone was created in 1948 for French-speaking countries in West and Central Africa. The value of the currency was originally fixed to the French franc and its convertibility was guaranteed by the French treasury. After the formation of the European Monetary Union (EMU) it was linked to the euro. The CFA franc zone is composed of two parts: the West African Economic and Monetary Union (WAEMU); and the Central African Economic and Monetary Community (CAEMC). CAEMC has the following members: Cameroon, Chad, Central African Republic, Congo, Equatorial Guinea, and Gabon.

3. ECOWAS was formed in 1975 and has fifteen members. Its main objective is the regional integration of the West African sub-region. The members of ECOWAS are: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

African countries or that, although other regimes are feasible, a monetary union is the optimal regime. Given the strong interest in this issue on the continent, it is necessary to examine and quantify the net benefits of alternative exchange rate regimes in African RECs to determine whether a case can be made for the establishment of monetary unions in the subregion.[4]

In general, there are various types of exchange rate regimes that countries can choose from: flexible, crawling pegs, dollarization, currency boards, and monetary unions, to name a few. However, the European Monetary System (EMS) currency crises of 1992, the Mexican financial turmoil of 1994, the East Asian currency crises of 1997-1998, and the move towards capital account liberalization in developing countries suggest that there are only two viable alternative exchange rate regimes open to these countries (Obstfeld and Rogoff 1995; Osakwe and Schembri 2002).[5] Countries either have to float their currency and rely on fluctuations in the nominal exchange rate to achieve domestic macroeconomic objectives or adopt a credibly-fixed exchange rate regime and loose the nominal exchange rate as an instrument of adjustment to shocks. Currency boards, dollarization, and currency unions are often described as examples of credibly-fixed exchange rate regimes. However, the speculative attacks on the Hong Kong currency during the East Asian currency crises of 1997-1998 and the recent experience of Argentina suggest that currency boards are not truly credibly-fixed exchange rate regimes.[6] Dollarization is technically feasible but would be difficult to implement in West Africa because of political sensitivities to the adoption of currencies deemed to represent foreign cultures and interests. Consequently, the choice of exchange rate regime in Africa is really one between a monetary union and a flexible exchange rate regime.

4. See Honohan and O'Connell (1997) for an analysis of the historical evolution of monetary policy regimes in Africa.

5. Some economists have questioned this bi-polar view of exchange rate regimes (see Williamson 2000).

6. Although the speculative attack on the Hong Kong currency was unsuccessful, due in part to the interest rate increases and the intervention in the equity market by the monetary authority, the associated credibility and financial costs to the economy cannot be underestimated. Argentina introduced a currency board system in 1991. On 11 February 2002, intense exchange market pressure on the peso forced the government to abandon the currency board system in favour of a floating exchange rate regime, thereby confirming the view that currency boards are not immune to exchange rate crises.

A flexible exchange rate regime allows national governments to pursue independent monetary policies and to rely on the exchange rate as an instrument for adjusting to shocks. However, it increases transaction costs. These costs can arise from two sources: (a) the need to exchange or convert currencies in international transactions; and (b) the direct costs of hedging exchange rate uncertainty as well as the indirect costs to society from possible reductions in trade and investment resulting from exchange rate uncertainty.

There are also costs and benefits associated with a monetary union. The most obvious benefit is that it reduces transaction costs as well as exchange rate uncertainty. In addition, it increases price transparency and could, potentially, enhance policy discipline and credibility.[7] The main cost is the inability to pursue an independent monetary policy and to rely on the exchange rate as an instrument of macroeconomic adjustment.

This paper compares a flexible exchange rate regime to a monetary union using a structural model of monetary policy in the spirit of Canzoneri and Henderson (1985), Buiter et. al. (1995), and Lane (2000). Although these papers examined the economic consequences of exchange rate regimes, they did not incorporate transaction costs into their analyses, thereby making it difficult to get a realistic assessment of the relative benefits of alternative exchange rate regimes.[8] The focus on transaction costs is appropriate because, as emphasised in Mundell (1961), the choice between a flexible exchange rate regime and a monetary union involves a crucial trade-off between the transaction costs savings of a common currency and the stabilization benefits resulting from the ability to use the nominal exchange rate for adjustment to asymmetric shocks. The first contribution of our paper is, therefore, to extend a version of the aforementioned structural monetary models to incorporate endogenous transaction costs associated with currency conversion and hedging of exchange rate risk. The

7. Guillaume and Stasavage (2000) argue that the formation of monetary unions in Africa can improve policy credibility only if exit from a union is made costly and institutions are designed to guarantee enforcement of monetary rules.

8. Using a different framework, Devarajan and Rodrik (1991) provide an interesting analysis of the trade-off involved in the choice between a fixed and a flexible exchange rate regime in the CFA franc zone in Africa. Their paper, however, does not consider transaction costs. Furthermore, no distinction is made between correlated and idiosyncratic shocks. Note that there is a difference between a monetary union and a fixed exchange rate regime. The former enhances price transparency and eliminates transaction costs, associated with currency conversion and hedging, while the latter does not.

second contribution is to apply the model empirically to the ECOWAS subregion with a view to providing quantitative estimates of the welfare consequences of monetary union and flexible exchange rate regimes in the community.

The theory of Optimum Currency Areas (OCA) developed by Mundell (1961), and extended by Mckinnon (1963) and Kenen (1969), provides criteria for determining countries or groups of countries that are best suited for a monetary union. Our model incorporates two features emphasized in the OCA literature as critical factors in the choice of exchange rate regimes in open economies: transaction costs and asymmetric shocks. Features such as the degree of labour mobility and the existence of a fiscal transfer system have also been identified in the literature as criteria for the determination of OCA.[9] However, because of language and institutional barriers to employment in West African communities, there is very low labour mobility in the subregion and it will take very serious commitments, and political will, on the part of West African leaders for this trend to change when, and if, the adoption of a common currency in the ECOWAS subregion becomes a reality.[10] As for a fiscal transfer system, we believe that the high level of poverty among the countries in the subregion, coupled with the political challenges and conflicts that may arise from any distribution system that will be adopted, calls into question the ability of members of the proposed union to effectively put into place a workable and efficient fiscal transfer system.[11] Consequently, the model developed here does not incorporate labour mobility and fiscal transfers.

An issue that is not addressed in this paper is the lack of credibility of monetary policy. It has

9. The idea is that under a monetary union, a country cannot rely on movements in the nominal exchange rate to cushion the effects of asymmetric shocks. If, however, there is either free mobility of labour or a fiscal mechanism to transfer resources between the domestic economy and other economies in the union, the cost of adjustment to asymmetric shocks will be less.

10. Although there are no visa requirements in the ECOWAS subregion for citizens of member States, it is difficult for a citizen of one member State to obtain residency status in another. Furthermore, although most West African leaders support the idea of free movement of people across national boundaries in the subregion, they are ready to compromise this principle to achieve domestic political objectives. The expulsion of Nigerians from Ghana in the early 1970s and the retaliation by the Nigerian Government in 1982 attests to the fact that there are serious constraints to the employment and integration of foreign nationals into domestic labour markets in the subregion.

11. The five ECOWAS countries contemplating establishing a second monetary zone in the subregion intend to set up a Compensation Fund to make transfers to member States. There is no guarantee, however, that members will make their contributions when necessary (or needed) because some ECOWAS member States have a reputation for not paying their dues.

been emphasized in the literature that a monetary union can act as an "external agency of restraint" on government fiscal and financial policy, thereby improving policy discipline and credibility (Honohan and Lane 2000).[12] However, the incorporation of this effect will unduly bias the results against a flexible exchange rate regime because there is no guarantee that the expected credibility gain from this channel will be realized in the ECOWAS subregion, given the fact that the formation of a similar union in West and Central Africa---the CFA franc zone---has not eliminated the tendency toward excessive fiscal deficits in the union (see Stasavage 1997). Besides, there are counter arguments in the literature that will offset any potential welfare gains arising from this channel.[13] For example, it has been stressed that the possibility of bail-outs in a monetary union could increase fiscal indiscipline and lower policy credibility in the union (Masson and Pattillo 2001).

The plan of the paper is as follows. The basic structure of the model is presented in section 2. In section 3 we solve the model under a flexible exchange rate regime. Section 4 considers the case of a monetary union. In section 5, we simulate the model using West African data and perform a welfare comparison of alternative regimes. An analysis of the results is the subject matter of section 6. The last section is devoted to the implications of the results for the formation of a monetary union in ECOWAS.

2. The model

The framework presented here is a version of the structural monetary model of Lane (2000), modified to incorporate endogenous transaction costs. The economy consists of two countries: domestic and foreign. It is assumed that each country specializes in the production of one good and that output exhibits decreasing returns to scale with respect to labour.[14] All structural parameters in the model are positive and are assumed to be the same across

12. The potential improvement in policy discipline and credibility is likely to reduce country risk premium and hence increase investment and welfare.

13. As we argue later, credibility issues are also ignored in order to focus more clearly on the trade-off between the transaction costs savings resulting from a monetary union and the macroeconomic stabilization benefits of a flexible exchange rate regime.

14. There is, implicitly, a second factor of production in the model: capital. However, it is assumed to be constant and its value is, without loss of generality, normalized to 1 so that the analysis can be conducted as if there were a single factor of production.

countries.

At this stage, it is necessary to justify our use of a two-country model in which the structural parameters are the same across countries to analyse what is in essence a multi-country monetary arrangement.[15] The two-country framework is adopted for analytical tractability. The structural parameters are assumed to be the same across countries because, from an empirical point of view, using a model that permits structural parameters to differ across countries is problematic given the fact that most of the countries in West Africa do not have long and consistent time series on the relevant variables that would permit any meaningful econometric estimates to be obtained from country-specific regressions.[16]

To give a formal description of other features of the model, variables for the foreign country are distinguished from those of the domestic country by an asterisk. Furthermore, all variables other than interest rates are in natural logarithms and are expressed as deviations from a no-shock equilibrium. If y_t and y_t^* represent domestic and foreign output levels respectively, supply schedules in the domestic and foreign countries are given by

$$y_t = (1-\alpha)n_t; \qquad y_t^* = (1-\alpha)n_t^* \tag{1}$$

where n_t and n_t^* are domestic and foreign employment levels respectively, $(1-\alpha)$ is the share of labour in output, and $(0<\alpha<1)$. Profit maximizing competitive firms hire labour up to the point at which real wages are equal to the marginal product of labour. Assuming that employment decisions are made after the shocks are realized, the profit-maximizing conditions are[17]

15. The use of a model in which the structural parameters are the same across countries implies that differences in results across exchange rate regimes are due to the nature and magnitude of underlying shocks rather than differences in structural coefficients between countries.

16. Because of the poor quality of West African data, some of the coefficients we obtained from country-specific regressions were highly unstable. To obtain more precise and reliable estimates, we had to resort to a pooled-sample regression. It was therefore necessary to assume that the parameters in the model are the same across countries to be consistent with the use of pooled-sample estimates.

17. The exact expression for the marginal product of labour is $(-\alpha n_t + \log(1-\alpha))$. For notational simplicity, we have omitted the constant term.

$$w_t - p_t = -\alpha n_t; \qquad w_t^* - p_t^* = -\alpha n_t^* \tag{2}$$

where w_t is the domestic wage rate, p_t is the price of domestic output, w_t^* is the foreign wage rate, and p_t^* is the price of foreign output. To capture all the deadweight and efficiency losses associated with the use of multiple currencies, we assume that a percentage θ_R of output is lost by the economy in the form of transaction costs. The transaction costs parameter has a subscript to indicate that it depends on the exchange rate regime. With positive transaction costs, output demand in the domestic and foreign country is given by

$$(1-\theta_R)y_t = \delta z_t - \lambda r_t + \varepsilon_t; \quad (1-\theta_R)y_t^* = -\delta z_t - \lambda r_t^* + \varepsilon_t^* \tag{3}$$

where z_t is the real exchange rate, r_t is the domestic real interest rate, ε_t is the shock to domestic demand, r_t^* is the foreign real interest rate, and ε_t^* is the shock to foreign demand. Equation (3) states that output demand in each country, less transaction costs, depends on the real exchange rate, the real interest rate, and a demand shock. All shocks in the model are assumed to have zero mean and finite variance. If s_t is the nominal exchange rate, defined as the number of units of domestic currency required to buy one unit of foreign currency, then the real exchange rate is

$$z_t \equiv p_t^* + s_t - p_t \tag{4}$$

The real interest rate in each country is equal to the nominal interest rate minus the expected rate of inflation.

$$r_t = i_t - (E_t q_{t+1} - q_t); \quad r_t^* = i_t^* - (E_t q_{t+1}^* - q_t^*) \tag{5}$$

where i_t is the domestic nominal interest rate, i_t^* is the foreign nominal interest rate, q_t is the domestic price level, q_t^* is the foreign price level, and E_t is an expectation operator conditional on information available at time t. Capital mobility is introduced into the model through the uncovered interest rate parity condition

$$i_t = i^*_t + E_t s_{t+1} - s_t \tag{6}$$

Equation (6) simply states that if the capital market is in equilibrium, the domestic nominal interest rate must be equal to the foreign nominal interest rate plus the expected rate of depreciation of the domestic currency.

Assuming that β is the share of imports in domestic consumption (or the exchange rate pass-through coefficient), the consumer price levels in the domestic and foreign countries are defined as

$$q_t \equiv (1-\beta)p_t + \beta(p^*_t + s_t) = p_t + \beta z_t; \quad q^*_t \equiv (1-\beta)p^*_t + \beta(p_t - s_t) = p^*_t - \beta z_t \tag{7}$$

where it is assumed that the share of imports in domestic consumption β lies in the interval $(0 < \beta < 1/2)$. This assumption ensures that the real interest rate differential and the expected rate of depreciation of the real exchange rate between the domestic and foreign countries move in the same direction (see Buiter et al. 1995). More importantly, it is consistent with the empirical evidence of home bias in consumption.

Money market equilibrium in each country is realised when the money supply satisfies a Cambridge-type equation

$$m_t = p_t + y_t + \upsilon_t = w_t + n_t + \upsilon_t; \quad m^*_t = p^*_t + y^*_t + \upsilon^*_t = w^*_t + n^*_t + \upsilon^*_t \tag{8}$$

where m_t and m^*_t are money supplies and υ_t and υ^*_t are velocity shocks in the domestic and foreign countries respectively.[18] It is well known in the literature that nominal wage or price rigidity is needed in an economy for the choice of an exchange rate regime to matter. To capture this feature in the model, it is assumed that wages are set one period in advance. In particular, wages are determined before the realization of shocks. Because the shocks are unanticipated, it must be the case that $w_t = w^*_t = 0$ in equilibrium.[19] Using this result in

18. It is assumed that domestic residents in each country do not hold foreign money.

equation (8) implies that employment is a function of monetary surprises. That is:

$$n_t = m_t - \upsilon_t; \quad n_t^* = m_t^* - \upsilon_t^* \tag{9}$$

Before finding a solution for the model, it is useful to express the real exchange rate and the consumer price levels as functions exclusively of exogenous, predetermined or control variables. From equations (4), (5), (6) and (7), we can write the real interest rate differential between the domestic and foreign countries as a function of the expected rate of depreciation of the real exchange rate. That is, $(r_t - r_t^*) = (1-2\beta)(E_t z_{t+1} - z_t)$. Equations (1) and (3) together with the expression for the real interest rate differential between the domestic and foreign countries can be used to derive a first order stochastic expectational difference equation in z_t. Solving this difference equation and imposing a no-bubble terminal condition yields the following expression for the real exchange rate:

$$z_t = \rho[(1-\theta_R)(1-\alpha)(n_t - n_t^*) - (\varepsilon_t - \varepsilon_t^*)] \tag{10}$$

$$\rho \equiv \frac{1}{2\delta + \lambda(1-2\beta)}$$

Using equations (2) and (10) in (7) the consumer price levels in the domestic and foreign countries could be expressed as:

$$q_t = \alpha n_t + \beta\rho[(1-\theta_R)(1-\alpha)(n_t - n_t^*) - (\varepsilon_t - \varepsilon_t^*)]; \tag{11}$$

$$q_t^* = \alpha n_t^* - \beta\rho[(1-\theta_R)(1-\alpha)(n_t - n_t^*) - (\varepsilon_t - \varepsilon_t^*)]$$

Using equations (2), (4) and (10), it is straightforward to show that the nominal exchange rate between the domestic and foreign countries is:

19. To derive this result, note that all variables are expressed as deviations from a no-shock equilibrium, and that the objective of wage setters is to minimize the variance of employment. Given that all shocks have zero mean, the optimal wage rate is equal to the expected money supply. Because the shocks are unanticipated, the expected deviation of the money supply from equilibrium is zero. Consequently, the deviation of wages from equilibrium must be zero.

$$s_t = [\alpha + (1 - \theta_R)(1 - \alpha)\rho](n_t - n_t^*) - \rho(\varepsilon_t - \varepsilon_t^*) \tag{12}$$

Policy-makers preferences

The preferences of the domestic and foreign monetary authorities are represented by the loss functions L_t and L_t^* defined as follows:[20]

$$L_t = \frac{1}{2}[n_t^2 + \sigma q_t^2 + TC_R]; \quad L_t^* = \frac{1}{2}[n_t^{*2} + \sigma q_t^{*2} + TC_R] \tag{13}$$

where: σ is the relative weight on price stability; and TC_R represents transaction costs. More specifically, it captures the direct welfare costs of currency conversion and hedging exchange rate risk and the indirect costs to society resulting from the potential negative effects of exchange rate volatility on trade and investment.[21] The transaction costs in the loss function are expressed as a percentage of labour and so have the same weight as employment. Expressing transaction costs as a percentage of labour involves dividing the ratio of transaction costs to output θ_R by the share of labour in output $(1 - \alpha)$. That is,

$$TC_R = \frac{\theta_R}{(1 - \alpha)} \tag{14}$$

Four points should be noted here. First, the loss functions imply that the monetary authorities care about transaction costs and instabilities in employment and prices. Second, we have simplified the analysis by using a loss function that does not contain an inflation bias in order to focus on the trade-off between the transaction costs savings of a common currency and the stabilization benefits resulting from the use of the nominal exchange rate to respond to asymmetric shocks. Therefore, we do not address credibility issues. Third, there is an externality in this model in the sense that the domestic consumer price level depends on the

20. Given that the wage contracts last one period, the use of a static loss function is appropriate because the monetary authorities would have to reoptimize each period even if they have long horizons.

21. Although there are well known theoretical channels through which exchange rate instability reduces trade and investment, the empirical evidence is inconclusive due largely to measurement problems.

real exchange rate and hence on both domestic and foreign employment. This implies that there are potential gains to monetary policy coordination because the domestic monetary authority does not have perfect control over the domestic price level. Finally, the structure of the model is such that, in both exchange rate regimes considered, optimal monetary policy fully accommodates velocity shocks.[22] Consequently, velocity shocks do not pose a stabilization problem in this framework.

3. Flexible exchange rate regime

In this section, we obtain a solution for the model on the assumption that each country has a flexible exchange rate regime. In such a regime, each country runs an independent monetary policy and, therefore, movements in the nominal exchange rate can help the economy to achieve domestic macroeconomic policy objectives. Furthermore, because transaction costs are incurred in a flexible exchange rate regime, the parameter θ_R is positive.

Each monetary authority chooses its money supply to minimize the relevant loss function in equation (13) subject to the constraints in equations (9), (11), and (14). The optimal solutions to the optimization problems are characterized by the following equations:

$$n_t = \psi_0 n_t^* + \psi_1(\varepsilon_t - \varepsilon_t^*); \quad n_t^* = \psi_0 n_t - \psi_1(\varepsilon_t - \varepsilon_t^*) \tag{15}$$

$$\psi_0 \equiv \frac{\sigma\beta\rho(1-\theta_R)(1-\alpha)[\alpha + \beta(1-\theta_R)(1-\alpha)\rho]}{1 + \sigma[\alpha + \beta(1-\theta_R)(1-\alpha)\rho]^2}$$

$$\psi_1 \equiv \frac{\sigma\beta\rho[\alpha + \beta(1-\theta_R)(1-\alpha)\rho]}{1 + \sigma[\alpha + \beta(1-\theta_R)(1-\alpha)\rho]^2}$$

To obtain the reduced-form equations for n_t and n_t^*, we use equation (15) to find the global shift in employment $(n_t + n_t^*)$ and the asymmetric shift in employment $(n_t - n_t^*)$. We then solve the resulting expressions for n_t and n_t^*. Following this procedure, the expressions for

22. By accommodating velocity shocks, the monetary authority is able to stabilize employment without sacrificing either price or exchange rate stability.

domestic and foreign employment levels in a flexible exchange rate regime are:

$$n_t\big|_{flex} = \frac{\psi_1}{1+\psi_0}(\varepsilon_t - \varepsilon_t^*) \tag{16}$$

$$n_t^*\big|_{flex} = -\frac{\psi_1}{1+\psi_0}(\varepsilon_t - \varepsilon_t^*) \tag{17}$$

Equations (16) and (17) imply that when the domestic demand shock is larger than the foreign demand shock, the domestic employment level increases and the foreign employment level decreases. Using the solutions for n_t and n_t^* above in equations (11) and (12), we obtain solutions for the nominal exchange rate and domestic and foreign consumer price levels in a flexible exchange rate regime. The exact expressions are:

$$s_t\big|_{flex} = \left[\frac{2[\alpha + (1-\theta_R)(1-\alpha)\rho]\psi_1 - \rho(1+\psi_0)}{1+\psi_0}\right](\varepsilon_t - \varepsilon_t^*) \tag{18}$$

$$q_t\big|_{flex} = \left[\frac{\alpha\psi_1 + \beta\rho[2(1-\theta_R)(1-\alpha)\psi_1 - (1+\psi_0)]}{1+\psi_0}\right](\varepsilon_t - \varepsilon_t^*) \tag{19}$$

$$q_t^*\big|_{flex} = -\left[\frac{\alpha\psi_1 + \beta\rho[2(1-\theta_R)(1-\alpha)\psi_1 - (1+\psi_0)]}{1+\psi_0}\right](\varepsilon_t - \varepsilon_t^*) \tag{20}$$

Equation (18) shows that part of the burden of adjustment to asymmetric demand shocks is borne by the nominal exchange rate. Having derived the equilibrium values for the nominal exchange rate, employment, and consumer price levels, we compute expected welfare in the domestic and foreign countries under a flexible exchange rate regime as follows :

$$W_t\big|_{flex} = \frac{1}{2}E_{t-1}\left[(n_t\big|_{flex})^2 + \sigma(q_t\big|_{flex})^2 + TC_R\right] \tag{21}$$

$$W_t^*\big|_{flex} = \frac{1}{2}E_{t-1}\left[(n_t^*\big|_{flex})^2 + \sigma(q_t^*\big|_{flex})^2 + TC_R\right] \quad (22)$$

The precise expression for expected welfare in both countries under a flexible exchange rate regime can be obtained using equations (16), (17), (19), and (20) in equations (21) and (22).

4. Monetary union

In this section, we examine the macroeconomic and welfare consequences of the formation of a monetary union. In a monetary union the two countries would have the same currency and a single monetary policy. Because there is neither exchange rate risk nor the need to convert currencies, transaction costs are zero. Therefore, $\theta_R = 0$. The monetary authority chooses the union-wide money supply m_t^u to minimize the loss function:

$$L_t^u = \frac{1}{2}(n_t^2 + n_t^{*2} + \sigma[q_t^2 + q_t^{*2}]) \quad (23)$$

The use of the same currency in a monetary union implies that the logarithm of the nominal exchange rate is zero. That is, $s_t = 0$. Therefore, from equation (12), it must be the case that:

$$n_t - n_t^* = \frac{\rho}{[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \quad (24)$$

In equilibrium money demand must be equal to money supply. Assuming that the union-wide money demand is an equally weighted average of money demand in the two countries, the money market equilibrium is given by:

$$m_t^u = \frac{1}{2}(n_t + n_t^*) + \frac{1}{2}(\upsilon_t + \upsilon_t^*) \quad (25)$$

where, m_t^u is the union-wide money supply. Equations (24) and (25) can be used to express n_t and n_t^* as functions of the union-wide money supply. The exact expressions are:

$$n_t = m_t^u - \frac{1}{2}(\upsilon_t + \upsilon_t^*) + \frac{\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{26}$$

$$n_t^* = m_t^u - \frac{1}{2}(\upsilon_t + \upsilon_t^*) - \frac{\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{27}$$

The next step is to use equations (11), (26) and (27) to express q_t and q_t^* as functions of the union-wide money supply noting that, given the structure of the model, the monetary authority of the union cannot affect the real exchange rate between the two countries. That is:

$$q_t = \alpha m_t^u - \frac{\alpha}{2}(\upsilon_t + \upsilon^*_t) + \frac{\alpha\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) + \beta z_t \tag{28}$$

$$q_t^* = \alpha m_t^u - \frac{\alpha}{2}(\upsilon_t + \upsilon^*_t) - \frac{\alpha\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) - \beta z_t \tag{29}$$

Using equations (26)-(29) in (23) and minimizing the resulting expression with respect to m_t^u, it is straightforward to show that the solution to the monetary authority's problem is:

$$m_t^u = \frac{1}{2}(\upsilon_t + \upsilon_t^*) \tag{30}$$

Equation (30) suggests that optimal monetary policy in a monetary union fully accommodates union-wide velocity shocks $(\upsilon_t + \upsilon_t^*)$ but does not respond to union-wide demand shocks $(\varepsilon_t + \varepsilon_t^*)$. Union-wide demand shocks are fully absorbed by adjustments in the real interest rate. Also, in a monetary union regime, optimal monetary policy does not respond to asymmetric demand shocks.[23] Consequently, the burden of adjustment to these shocks falls on domestic and foreign employment levels. This is in contrast to a flexible exchange rate regime where the nominal exchange rate adjusts to cushion the effects of asymmetric shocks, thereby reducing the volatility of employment and hence output.

23. Note that this policy reduces the volatility of union-wide employment but increases the volatilities of employment in domestic and foreign countries.

Substituting for m_t^u in equations (26) and (27) the optimal employment levels in the two countries are:

$$n_t\big|_{union} = \frac{\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{31}$$

$$n_t^*\big|_{union} = -\frac{\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{32}$$

The real exchange rate in a monetary union is:

$$z_t\big|_{union} = -\frac{\alpha\rho}{[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{33}$$

Using the solutions for m_t^u and z_t in equations (28) and (29), the consumer price levels in the domestic and foreign economies under a monetary union are:

$$q_t\big|_{union} = \frac{\alpha(1-2\beta)\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{34}$$

$$q_t^*\big|_{union} = -\frac{\alpha(1-2\beta)\rho}{2[\alpha + (1-\alpha)\rho]}(\varepsilon_t - \varepsilon_t^*) \tag{35}$$

Expected welfare in the domestic and foreign countries under a monetary union is therefore given by:

$$W_t\big|_{union} = \frac{1}{2}E_{t-1}\left[(n_t\big|_{union})^2 + \sigma(q_t\big|_{union})^2\right] \tag{36}$$

$$W_t^*\big|_{union} = \frac{1}{2}E_{t-1}\left[(n_t^*\big|_{union})^2 + \sigma(q_t^*\big|_{union})^2\right] \tag{37}$$

5. Simulation and estimation procedure

The simulation experiments require picking values for the key structural parameters of the

model. The approach adopted in choosing values for these parameters is as follows. The share of labour in output is set at 0.66, which is consistent with the estimates used by Kose and Riezman (2001) to calibrate a general equilibrium model to African data. In their paper, they used a three factor production function for the final goods sector and the share of labour and capital were 0.45 and 0.23 respectively. Adjusting for the fact that our production function has only two factors gives a relative share of labour in output of 0.66.

There are no readily available estimates of the relative weight central banks in West Africa place on price stability. However, in the literature on inflation targeting, it is typically assumed that central banks in advanced countries put more weight on price relative to output stability. Since central banks in ECOWAS countries are less aggressive than their developed country counterparts in the fight against inflation, it is reasonable to assume that they put equal weight on price and output stability. We, therefore, set the relative weight on price stability at 1 and recognise the fact that there is uncertainty surrounding its true value by doing a sensitivity analysis on the chosen figure.

To obtain values for the real exchange rate and the semi-real interest rate elasticities of output (or demand), we estimated an error correction equation for output. This is based on the usual assumption that actual output is cointegrated with potential output and that the output gap is an error in the cointegrating vector (see Kamin and Klau, 1997). The growth rate of real output in eight ECOWAS countries for which we had data was regressed on one-period lags of the growth rate of output, the change in the real interest rate, the change in the real exchange rate, and the output gap. The estimation was done using an unbalanced data set for the period 1976 to 1999. A fixed-effects panel approach, which allows the intercept terms in the equation to differ across countries, was adopted in the estimation. In addition, we accounted for heteroskedasticity by computing the standard errors and covariances using the methodology in White (1980).

Results of the estimation are presented in Table 1. The adjusted R-squared of the equation is 0.29, which is quite reasonable. The real output growth rate and the output gap are significant at the 1 percent level. The real exchange rate is of the expected sign and the coefficient (0.02)

is significant at the 10 percent level.

Table 1: Fixed Effects Output Regression Results[a]

Variable	Coefficient[b]	Standard Error
Real output growth rate (-1)	0.37*	0.08
Change in real interest rate (-1)	-0.01	0.02
Change in real exchange rate (-1)	0.02***	0.01
Output gap (-1)	-0.66*	0.09
Standard Error of Regression = 3.90 $\bar{R}$ = 0.29 F-Statistic = 7.14 (p-value = 0.00) Sample Size = 166		

a. Country-specific intercept terms not reported.
b. * and *** indicate significance at the 1 and 10 per cent levels respectively.

Turning to the real interest rate, it has a coefficient of 0.01 and has the expected sign. However, it is insignificant at conventional levels. This may be a reflection of the fact that West African financial markets are underdeveloped and interest rates are not really market determined. Based on our regression results, we set the coefficients on the real exchange rate and the real interest rate at 0.02 and 0.01 respectively in the calibration experiments. The standard deviation of the real demand or output shock was set at 3.90 to match the standard error of the output regression.[24]

The share of imports in GDP was used as a proxy for the share of imports in domestic consumption (that is, the exchange rate pass-through coefficient). We set this parameter at 0.38, which is the average ratio of imports to GDP from 1976 to 1999 for the eight ECOWAS countries used in our regression equation. This figure is also consistent with the exchange

24. Because our sample includes both CFA and non-CFA countries with different exchange rate regimes, the robustness of the results can be questioned. To address this issue, we also estimated the equation excluding the CFA countries. Relative to the benchmark regression, however, there was no significant difference in the coefficients of the real exchange rate and the real interest rate.

rate pass-through coefficient reported by Klau (1998) for non-CFA African countries. To account for the possibility that the actual pass-through coefficient for ECOWAS countries may be lower than the figure used in our benchmark simulation, we also simulated the model using a pass-through coefficient of 0.30. A summary of the key benchmark parameter values is presented in Table 2.

Table 2: Benchmark Simulation Parameters

Parameter	Value	Description
$(1-\alpha)$	0.66	Share of labour in domestic output
δ	0.02	Real exchange rate elasticity of demand
λ	0.01	Interest rate semi-elasticity of demand
β	0.38	Share of imports in domestic consumption (or the exchange rate pass-through coefficient)
σ	1.00	Relative weight on price stability in loss function
θ	0.00	Transaction costs parameter
σ_ε	3.90	Standard deviation of domestic demand shock

Empirically, it is difficult to pin down the transaction costs parameter so instead of using a specific figure, we assumed that it is an unknown parameter and then used a grid search to find the critical value that would make an agent indifferent between the two exchange rate regimes.

6. Analyses of results

In comparing alternative exchange rate regimes, we focus on three types of real demand shocks: a perfect negatively correlated shock ($\varepsilon_t^* = -\varepsilon_t$); a common or symmetric shock ($\varepsilon_t^* = \varepsilon_t$); and an idiosyncratic or uncorrelated shock ($\varepsilon_t \neq 0;\ \varepsilon_t^* = 0$).[25] For ease of exposition and comparison, the following procedure will be adopted in the presentation of the results. First, we assume that there are no transaction costs and compare welfare in the domestic country under each exchange rate regime. Second, we conduct sensitivity analyses

25. Note that correlated and idiosyncratic shocks are different types of asymmetric shocks.

on some of the structural parameters of the model. Finally, we introduce transaction costs to determine whether it changes the ranking of regimes relative to the benchmark model.

Welfare loss under each exchange rate regime in a version of the model without transaction costs is presented in Table 3. In the version with perfect negatively correlated shocks and no transaction costs, a flexible exchange rate regime has slightly lower welfare loss than a monetary union regime. The ratio of the welfare loss in a monetary union to the welfare loss in a flexible exchange rate regime is 1.021. This suggests that the relative welfare gain resulting from the ability to cushion the effects of asymmetric real shocks through movements in the nominal exchange rate is positive but small.

Table 3: Welfare Loss (No Transaction Costs)

Case	Regime	Negatively Correlated Shocks	Common (Symmetric) Shocks	Idiosyncratic (Uncorrelated) Shocks
Benchmark	Monetary Union	16.83	0.000	4.208
	Flexible Rate	16.48	0.000	4.121
	Ratio[a]	**1.021**	0.000	**1.021**
$\beta = 0.30$	Monetary Union	17.00	0.000	4.251
	Flexible Rate	16.18	0.000	4.045
	Ratio	**1.051**	0.000	**1.051**
$\sigma = 1.50$	Monetary Union	16.89	0.000	4.222
	Flexible Rate	16.49	0.000	4.122
	Ratio	**1.024**	0.000	**1.024**

a. Ratio is equal to welfare loss in a monetary union divided by welfare loss in a flexible exchange rate regime.

The results also suggest that the nature of the shocks is important. As should be expected, there is no welfare loss under both regimes when the two countries face a common or symmetric real demand shock. Such shocks are fully absorbed (or offset) by changes in the real interest rate and so do not have any welfare effects.[26] In each exchange rate regime,

26. See Appendix II for a derivation of this result.

welfare loss under perfect negatively correlated shocks is about four times larger than under idiosyncratic shocks. However, the relative loss across regimes is the same regardless of whether the shocks are correlated or idiosyncratic. This has to do with the fact that both shocks are asymmetric shocks and what matters for the relative performance of the two exchange rate regimes is the asymmetric component of the demand shocks.

We conducted sensitivity analyses on some parameters of the model. The results are also presented in Table 3. Reducing the value of β from 0.38 to 0.30 increases the relative attractiveness of a flexible exchange rate regime. The intuition for this result is as follows. A reduction in the value of β implies less exchange rate pass-through. With sticky nominal prices and wages, this suggests that changes in the nominal exchange rate would have more impact on the real exchange rate thereby enhancing the effectiveness of the exchange rate as a tool for macroeconomic stabilization. Our result is consistent with the idea in the literature that more open economies are better candidates for a monetary union. The idea being that more open economies are likely to have higher exchange rate pass-through and hence less ability to affect the real exchange rate through changes in the nominal exchange rate.

In general, increasing the relative weight on price stability in the loss function results in a marginal increase in the relative attractiveness of a flexible exchange rate regime. The ratio of welfare loss in a monetary union to the loss under a flexible exchange rate regime increases from 1.021 to 1.024 when the relative weight on price stability is increased from 1 to 1.5.

Turning to the model with transactions costs, as indicated earlier it is difficult to pin down the actual value of the transactions costs parameter. Therefore, rather than set it to a specific value, we solved the model to find out the critical value of this parameter that would be required for welfare to be the same across the two exchange rate regimes. Based on the results of the simulations, it turns out that welfare will be higher under a monetary union if transaction costs are greater than 1 percent of output in the ECOWAS subregion. The question then is whether or not the actual value of transactions costs in the ECOWAS region is likely to be more or less than this critical value. Although we do not know the actual value

of the transactions parameter, we can use our knowledge of the value of intra-ECOWAS trade as well as the estimated value for the European Union (EU) to infer what the upper bound for transactions costs in the ECOWAS region might be. In the literature the gains in transactions costs from the formation of the European Monetary Union is estimated to be around 0.5 percent of GDP (European Commission, 1990). Since intra-EU trade is large (61 percent of total trade in 1999) and intra-ECOWAS trade is low (less than 10 percent of total trade), the transactions costs savings from the formation of a monetary union in ECOWAS must be less than the 0.5 percent figure for the EU. Consequently, the results provide some evidence that a flexible exchange rate regime dominates a monetary union in the ECOWAS region.

Policy Implications

The welfare results from the simulations indicate that based on economic criteria a flexible exchange rate regime dominates a monetary union in the ECOWAS sub-region.[27] The results imply that from an economic perspective, the five West African countries planning to establish a second monetary zone in the sub-region would be better-off with a flexible exchange rate regime because it would enable them to use the nominal exchange rate to adjust to asymmetric shocks. The fact that the commencement date for the formation of the proposed monetary union has been postponed twice due in part to difficulties in meeting the convergence criteria, lends credence to the results in this paper that a monetary union is not the best exchange rate regime given the current structure of the economies in the sub-region (WAMI, 2005).

The results also suggest that although the choice of exchange rate regime can help to ease the burden of adjustment to shocks, it cannot be a panacea for poor macroeconomic performance of countries. Sound macroeconomic policies coupled with good governance are needed to improve macroeconomic performance in the sub-region.

27. It should be noted that the results obtained here are based on ex-ante analyses and that a monetary union that is not feasible ex-ante may well be ex-post due to the well known endogeniety conditions for an optimum currency area (see Frankel and Rose, 1998).

Appendix I: Data

Data used in the study were obtained from the 2002 World Bank Africa database. Because of data limitations, the ECOWAS countries used in the analysis are: Cote d'Ivoire, Gambia, Ghana, Guinea, Nigeria, Senegal, Sierra Leone, and Togo. Other useful pieces of information regarding the estimations are as follows:

1. Real output growth rate was computed using real GDP at 1995 constant prices (in local currency).

2. Real exchange rate was computed using bilateral nominal exchange rates, adjusted for inflation differentials between the domestic and foreign economies. Inflation rates were computed using consumer price indices (1995=100).

3. The output gap was computed as the difference between real GDP and potential output, with the later computed using the Hodrick-Prescott filter.

4. The real interest rate was computed as the nominal discount rate minus the current rate of inflation.

Appendix II: Proofs

Response of real interest rates to demand shocks

From equation (1), the global shift in output is:

$$(y_t + y_t^*) = (1-\alpha)(n_t + n_t^*) \tag{38}$$

From equation (3), the global shift in output is:

$$(y_t + y_t^*) = -\frac{\lambda(r_t + r_t^*)}{(1-\theta_R)} + \frac{(\varepsilon_t + \varepsilon_t^*)}{(1-\theta_R)} \tag{39}$$

Equations (38) and (39) imply that:

$$(1-\alpha)(n_t + n_t^*) = -\frac{\lambda(r_t + r_t^*)}{(1-\theta_R)} + \frac{(\varepsilon_t + \varepsilon_t^*)}{(1-\theta_R)} \tag{40}$$

Under each exchange rate regime, $(n_t + n_t^*) = 0$. Therefore:

$$(r_t + r_t^*) = \frac{(\varepsilon_t + \varepsilon_t^*)}{\lambda} \tag{41}$$

If the two shocks are perfectly negatively correlated (perfect asymmetric shock), there is no change in real interest rates. However, if demand shocks are common, equation (41) becomes:

$$(r_t + r_t^*) = \frac{2\varepsilon_t}{\lambda} \tag{42}$$

Consequently, the real interest rate fully absorbs or offsets common or symmetric real demand shocks.

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