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An Aggregate View of Macroeconomic Shocks in Sub-Saharan Africa

A Comparative Study Using Innovation Accounting

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Abstract

This paper investigates the impacts and responses of macroeconomic shocks in some domestic economies in Sub-Saharan Africa over the period 1961-99; more specifically, it seeks to answer the question of whether there are any systematic differences in the responses of the CFA franc zones and the non-CFA franc zone countries to macroeconomic shocks. Based on the Blanchard-Quah methodology, we identify shocks to the changes in real exchange rate and output using a structural VAR (SVAR) model for these small open economies. Our finding that the real exchange rate innovations in the CFA franc zones are largely independent of domestic variables suggests that external influence is more important in the CFA zones. There is also some evidence that money demand shocks are more significant in the non-CFA franc zone countries.

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Keywords: structural VAR models, innovations, Sub-Saharan Africa

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Finally the analyses suggest that shocks tend to persist in the non-CFA countries and less so in the CFA franc zone. A comparison of both the short-run and long-run responses of each franc zone and the non-CFA countries suggests that being in the monetary union ensures that the CFA franc zone respond differently to macroeconomic shocks, and have more stable macroeconomies.

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1 Introduction

Most countries in Sub-Saharan Africa (SSA) are generally considered to be small economies, and are often the price-takers on the world market. However, since the 1980s, most African countries have increasingly been implementing policy reforms aimed at boosting economic growth and promoting their integration into the world economy. To the extent that they are open, the quest comes with the added responsibility of having greater external influences being exerted on the domestic economy, in addition to the domestic disturbances that may occur. Aside from the geographical and political heterogeneity that exists within African countries, marked differences in economic performance, especially over the 1980s, have led to the question of whether being in a monetary union in this part of the world has caused the CFA franc zones to respond differently to macroeconomic shocks, relative to the non-CFA franc countries. Also there is a question whether such economies have fared better or worse than their neighbours who are not part of the monetary union (see Devarajan and De Melo 1991; Devarajan and Rodrik 1991; Clement 1994; Elbadawi and Majd 1996; Ghura and Hadjimichail 1996).

Particularly, over the last two to three decades there generally has been a relatively poor growth in almost all of Africa, and there is a large quantity of literature that has sought to investigate the factors affecting long-run growth in this part of the world (Ghura and Hadjimichael 1995; World Bank 1994). In fact, there is growing literature suggesting that these dismal performances are best explained by understanding their unstable macroeconomies (see Ramey and Ramey 1995; Collier and Gunning 1999; Sachs and Warner 1996), and to do this, a thorough understanding of the sources of macroeconomic shocks in these economies and the responses is of vital importance. Although there was generally poor growth in the region, there were also some significant differences in economic performance among the countries and economic blocks in SSA. Notable among these differences are those observed between the countries within the CFA franc zone, having a fixed exchange rate regime *vis-à-vis* the French franc (Euro, since 1999) and the non-CFA franc countries in SSA. While there are some important comparative studies on the topic (e.g. Kose and Reizman 2001[1]; Elbadawi and Majd 1996), more direct relevance to this paper is provided by the studies that have specifically sought to include the CFA franc zone in comparisons regarding macroeconomic shocks (e.g. Fielding and Shields 2001; Hoffmaister *et al*. 1998). While Fielding and Shields (2001) consider macroeconomic shocks to identify impacts to output and prices in the economies of 12 countries that make up the CFA franc zone of SSA over the period 1962-97, Hoffmaister *et al*. (1998) investigate the sources of macroeconomic fluctuations in SSA by comparing—as a two sub-groups—eight CFA countries and 15 non-CFA countries by measuring the relative importance of domestic versus external shocks for the period 1971-93. The CFA franc zones and the non-CFA franc zone countries of SSA provide a good test case of how the macroeconomies of countries in SSA respond to macroeconomic shocks, both domestic and external. This paper, however, focuses on domestic disturbances. Our work, which differs in emphasis from either of the above, takes an aggregate view of the macroeconomies of the CFA

1 The authors examine the role of external shocks in explaining macroeconomic fluctuations in African countries by using a quantitative, stochastic, dynamic multi-sector equilibrium model calibrated for a 'typical' African country. The external shocks examined include trade shocks (fluctuations in price) and financial shocks (fluctuations in world interest rate).

franc zones, and also assesses the behaviour of a representative group of individual non-CFA franc zone countries to similar shocks. Specifically, we look at two CFA franc zones of SSA: West African Economic and Monetary Union (WAMU) or *Union Économique et Monétaire Ouest Africaine* (UEMOA) and the Union of Central African States (UDEAC) or *Communauté Économique et Monétaire de l'Afrique Centrale* (CEMAC)—and Ghana, Kenya and Nigeria. The WAMU or UEMOA consists of eight countries (Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo), the UDEAC or CEMAC consists of six countries (Cameroon, the Central African Republic, Chad, the Republic of Congo, Equatorial Guinea, and Gabon), Ghana is bordered on all sides by UEMOA countries and the Atlantic ocean, Nigeria separates the UEMOA and the CEMAC zones and is one of the most important oil producing countries in the world. Kenya, in central to eastern part of Africa, is an important and relatively well developed manufacturing economy. One important feature of our work is that it allows to examine the differences (or similarities) between the two areas that make up the CFA franc zone (UEMOA and CEMAC) and a representative group of three individual non-CFA countries (Ghana, Kenya and Nigeria) regarding their response to shocks (Appendix 1).

In relating our work with Fielding and Shields (2001) and Hoffmaister *et al.* (1998), we note that while there are some important similarities as both studies focus on macroeconomic shocks in countries in SSA, there are also some important differences we need to highlight on. While Fielding and Shields (2001) consider inflation, output growth and growth in nominal money stock and condition on foreign price inflation, our model considers real exchange rate appreciation, real output growth, and the growth in real money balances for each region. Our focus on the real exchange rate growth is in line with the questions this paper seeks to address, which include the role of the exchange rate regime in influencing the other determinants associated with macroeconomic stability. Second, we condition our domestic variables on a wider scope of variables in the foreign economy. Third, our decision to consider the two CFA franc zones as averages is influenced by the fact that we believe the money supply for each country within a zone hardly stays within its borders over time. This is because each of the two monetary unions has a common currency within a zone, but different across the zones (both called the CFAF, *franc de la Communauté Financière d'Afrique* for the UEMOA and *franc de la Coopération Financière en Afrique Centrale* for the CEMAC zone). Using annual data we find it prudent to consider the zonal effect rather than country level effect. Hoffmaister *et al*. (1998), on the other hand, use a CFA group that comprises both countries in UEMOA and CEMAC, and also combines the non-CFA countries from all across the sub region. Because our objectives vary from both Fielding and Shields (2001) and Hoffmaister *et al.* (1998) in that we wish to draw a comparison between the responses to macroeconomic shocks under managed and floating exchange rate regimes for the each CFA franc zone as a unit and for individual non-CFA countries, and which therefore influences our adjustments to the model, we consider our studies as complementary rather than competing.

We find, in agreement with Hoffmaister *et al.* (1998), that there are distinct differences between the responses of the CFA and the non-CFA franc zone countries to real exchange rate shocks, we also find some evidence of the tendency for shocks to persist in the non-CFA franc group, in the long run. In the next section, we present the theoretical and empirical considerations motivating our model including the identifying methods. Section three describes the sources of the data used, and in section four we present and discuss the results and the final section summarizes and concludes.

2 Model estimation and identification

There is growing literature, which hypothesizes that in order to promote long-term economic growth, there is a need for a thorough understanding of how the macroeconomy functions. In this paper, we extend the traditional atheoretic** VAR analysis and use economic theory and time-series analysis to determine the dynamic responses of disturbances to economic variables. In the next section, we present the theoretical basis that motivates the model we use, and also provide some insight into the empirical basis for the analysis we perform.

2.1 Theoretical considerations

Reform by SSA countries aimed at improving integration into the world market has been designed to increase growth through more efficient allocation of economic resources, which has rendered the sub-region more susceptible to both domestic shocks and the after-effects of economic shocks of their trading partners. With economic growth and macroeconomic stability a prime policy objective in the developing world, the need to increase output and to attract foreign direct investment (FDI) is paramount. Any improvement in this regard will be highly influenced by the capability of the macroeconomy to withstand shocks, as this bears hugely on how successful this quest will be. This idea is vital to why the macroeconomies of developing countries are represented as small, open economies and this we consider appropriate for the regions of SSA we use.

In a small open-economy framework, domestic variables are likely to be affected by the world but not *vice versa*, and we consider the macroeconomy at a steady state. For this reason, our model allows to examine the influence of selected variables in the economies of the most important trading partner,[2] and to use these as conditioning variables. In the long run, when no further variation in the endogenous variables is considered to exist, we make use of the aggregate demand (AD) equation, the aggregate supply (AS) equation, the money demand (MD), and a relative price equation which makes use of the concept of purchasing power parity (PPP).

In the rather complex economies of SSA, where financial sectors are in various stages of development, political institutions are usually major players in the economy, prices and wages are sticky, and there is considerable private sector activity with strong dependence on international institutions and trade, the concept of aggregate demand—which in theory is used to measure the ability and the willingness of individuals and institutions to purchase goods and services—may be influenced by more factors outside national control than the norm. In equation (a), we present an inverted version of an AD equation where the growth in aggregate demand (Δy) is a function of the interest rate growth (Δr) and the growth in real exchange rate.

$$\Delta r = a_0 + a_1\Delta y + a_2\Delta(p - p^*); \qquad \text{typically} \qquad a_1 \leq 0, a_2 \leq 0 \qquad \text{(a)}$$

[2] The most important trading partner is based on trade volumes and value as recorded in the IMF's *Direction of Trade Statistics* (DOTS) Yearbooks. Data collected show that France is the most important trading partner for the CFA zones, the United Kingdom for Ghana and Kenya and the USA for Nigeria.

In principle, the willingness to investment and/or consume domestically will be influenced partly by changes in the real interest rates Δr. Central to the investment decision is, in fact, the rate of return, which hinges directly on the growth in interest rate Δr; and on the foreign front, through the trade (hence growth in net export), the AD will be influenced by the real exchange rate growth $\Delta(p - p^*)$.

Equation (b) presents a simplified AS equation, where the growth in aggregate supply is expressed as a function of the growth in the real interest rate Δr. The AS in the economy is influenced by the amount of productive resources in the economy that can meet the demand.

$$\Delta y = b_0 + b_1 \Delta r; \qquad \text{typically} \qquad b_1 \leq 0 \tag{b}$$

In equation (b) however, we allow variables that are not easily quantified such as improvements and new developments in production (i.e. technology) to be captured as a part of the innovations. In short, we allow for the long-run growth in the aggregate supply to be influenced by the growth in real interest rates, since a firm that produces must consider the real effects of changes in interest rates on the capital stock.

Money serves many functions as a medium of exchange—a store of value, a unit of account, and a means of deferred payment—and the need to hold money is immediately apparent. Early theories about money demand, such as the quantity theory of money, back this idea. Over time, theories such as Keynes' *liquidity preference theory* highlighted the importance of interest rates in the desire (or decision) to hold money—the opportunity cost for holding money increases with an increase in the returns on other investments, say bonds. In an increasingly interdependent world, where there are expanding trade and economic ties between countries, the need to hold domestic currency may be influenced by increased demand for foreign goods (hence currency) or an anticipated change in the real value of domestic currency. In small, open economies, even under fixed exchange rate regime (e.g. CFA franc zones), there is sometimes the tendency for informal exchange rate markets to emerge, thus causing some divergence. In 1988, the official exchange rate for the CFAF was 285.25 to 1 US dollar, but in parallel markets, the Ivorian franc was being sold as high as 360 francs to the US dollar. Any hint of a change in the guaranteed convertibility by the French treasury, or an expected devaluation is likely to lead to some degree of divergence in the markets through the assumed risk of holding CFA francs, and also indicate the return on foreign money, and acknowledge the concept of currency substitution.

$$\Delta(m - p) = c_0 + c_1 \Delta y + c_2 \Delta r + c_3 \Delta(p - p^*); \quad \text{typically} \quad c_1 \geq 0 \geq c_2,\ c_3 \geq 0 \tag{c}$$

In equation (c), for reasons given above, our long-run money demand is presented as a function of growth in real income [Δy], the real interest rates [Δr], and the real exchange rate [$\Delta(p - p^*)$].

A key theorem akin to the important issue of real exchange rate deviations is purchasing power parity (PPP),[3] and even though the assumption of PPP has come under some

[3] According to the PPP theorem, exchange rate equals the ratio of the two countries' price level of the same good or service. When domestic price level increase (i.e. inflation), that country's exchange rate must be depreciated so that they can return to PPP.

criticism particularly in the late 1980s, recent studies have given the theorem some support by pointing to behaviour close to equilibrium behaviour (see Johnson 1993; Lohian and Taylor 1996). Though some evidence is available that behaviour close to PPP holds in many cases, deviations do occur and these are not very rare.

$$\Delta(p - p^*) = f_0; \quad \text{typically} \quad f_0 \geq 0 \tag{d}$$

In equation (d) we present a form of relative PPP, which allows for a steady long-run growth in the real exchange rate (and measures deviations from PPP), and also the possibility of an equilibrium long-run real exchange rate (when $f_0 = 0$). Real exchange rate fluctuations have important consequences for competitiveness, fiscal sustainability and monetary policy. A prolonged real appreciation may have an adverse effect on a country's competitiveness, as it induces a switch from home goods to foreign goods, which could possibly lead to a recession. Another consequence of changes in real exchange rate affects debt repayment, a very important factor for countries in SSA, as most are rather highly indebted. As for monetary policy, many open economy models often refer to real exchange rate defined as deviations from equilibrium levels (Ball 2000; Svensson 2000; Taylor 1999).

Given that the interest rate data available are relatively inadequate,[4] we adopt the method by Fielding and Shields (2001) to construct a reduced form for the equations (a)-(c) by substituting equation (a) into (b) and (c). Any shock to the resulting equation will, therefore, not be branded as either a strict demand shock or a supply shock, but rather broadly as a real output shock.

In an open economy, individuals and firms may choose to hold their wealth (or assets) in either the domestic or foreign economy. The countries in question being relatively small participants in an increasingly interdependent world, we allow for external influence on the domestic economy; the variable often included in literature is the foreign real interest rate (see e.g. Khalid 1999; Leventakis 1993) and there is some evidence to show that when trade and economic links exist among countries or regions, changes in national income (GDP) may influence the domestic income (see Desruelle *et al*. 1998: Table 1.2). For completeness, we condition the resulting equations above on some selected foreign variables—real output growth (Δy^*) and real interest rate (Δr^*) of the largest trading partner. Therefore, in an open economy framework, our long-run economic model is represented as:[5]

$$\Delta(p - p^*) = f_0 + \beta_0 \Delta y^* + \alpha_0 \Delta r^* \tag{d′}$$

$$\Delta y = \{(b_0 + b_1 a_0) + b_1 a_2 \Delta(p - p^*) + \beta_1 \Delta y^* + \alpha_1 \Delta r^*\} / \{1 - b_1 a_1\} \tag{e′}$$

$$\Delta(m - p) = (c_0 + c_2 a_0) + (c_1 + c_2 a_1) \Delta y + (c_3 + c_2 a_2) \Delta(p - p^*) + \beta_2 \Delta y^* + \alpha_2 \Delta r^* \tag{f′}$$

In equation (e′), given the typical interrelationships between the variables in the VAR, the expected sign of $b_1 a_2 \geq 0$, but $(1 - b_1 a_1)$ may be positive or negative and this possibility allows for the impact of a shock to the real exchange rate on Δy to be

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4 The discount rate is the most consistent available for the CFA franc zones, but this is inappropriate as a viable measure of the cost of borrowing.

5 All variables except Δr^* are in expressed as changes in the natural logarithm of these measures.

ambiguous. Typically, the expected outcome of a real exchange rate appreciation is that the effect on output is negative. This, however, from the model, may be either positive or negative depending on whether the product of b_1 (the elasticity of AS with respect to the real interest rate) and a_1 (the slope of the AD curve in equation (b)) is less or greater than 1. As predicted by economic theory, the elasticity of the real money demand growth with respect to the real exchange rate growth, ($b_3 + b_2a_2$) will be positive. Also from the initial equations, we would expect the slope of equation (f′) with respect to the real output growth ($b_1 + b_2a_1$) to be positive, which is also consistent with economic theory.

The long-run equations (d′), (e′) and (f′) above compose a VAR, and thus we estimate the dynamics of the three variables: the real exchange rate growth ($\Delta(p - p^*)$), the growth in real income (Δy) and the growth in real money balances ($\Delta(m - p)$). The variables Δy^* and Δr^* (external variables) are considered to be purely exogenous to the domestic economy. This triangular structure of (d′)-(f′) applies only in the long run, but the variables are simultaneously determined in the short run; as an example, in the short run, when PPP does not have to hold, the model allows the real exchange rate to be influenced by all the other variables in the VAR. According to the model, the demand for real money balances, even in the long run, is influenced by real exchange rate (via domestic and foreign price inflation, for domestic purchases and for transaction purposes), interest rate changes (through both transaction requirements and portfolio allocation decisions, which could cause reallocation of money holdings), income (due to the increased level of activity and demand for liquid assets that accompany increases in income); and allowance is made for the influence of the external exogenous variables, Δr^* and Δy^*, which are likely to be more significant with stronger trade linkages.

In the short run, therefore, the model without any restrictions can be expressed in matrix form as:

$$\begin{bmatrix} B_{11}(L) & B_{12}(L) & B_{13}(L) \\ B_{21}(L) & B_{22}(L) & B_{23}(L) \\ B_{31}(L) & B_{32}(L) & B_{33}(L) \end{bmatrix} \begin{bmatrix} \Delta(p - p^*)_t \\ \Delta y_t \\ \Delta(m - p)_t \end{bmatrix} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \\ F_{31} & F_{32} \end{bmatrix} \begin{bmatrix} \Delta r_t^* \\ \Delta y_t^* \end{bmatrix} + \begin{bmatrix} \Phi_{1t} \\ \Phi_{2t} \\ \Phi_{3t} \end{bmatrix} \qquad (1)$$

Where $B_{i,j}(L)$ are the lag polynomials, which will be used to ensure the long-run restrictions are possible, $F_{i,j}$ are the coefficients which depict the contemporaneous effects of the exogenous variables on our endogenous ones. Finally, the vectors containing the pure structural innovations $\Phi_{i,t}$ are the pure structural shocks to the real exchange rate appreciation, the growth in real output (as earlier defined), and the growth in real money demand.

Innovation accounting will allow assessment of mainly the variance decomposition and the long-run impulse responses. While variance decompositions of the forecast error variance will provide information of the proportion of the variance due to each of the pure innovations, $\Phi_{i,t}$ and 'a variable that is optimally forecast from its own lagged values will have all its forecast error variance accounted for by its own disturbances' (Sims 1982: 131-2). In theory, the long-run impulse responses provide the time path for a given variable in response to a shock; and the other variables' response to similar shocks therefore provides information on the behaviour of the variables in the VAR. Given the extent of the explanation provided by the exogenous variables in each sequence, the $\Phi_{i,t}$ will provide the measure of the pure shock in the domestic economy. Hence, among the regions considered the extent of correlation of each shock will provide some information about the similarity of shocks experienced in each country/zone. A positive and high correlation between the pure shocks to the $\Phi_{1,t}$ will be indicative of similar real exchange rate shocks to their domestic economies. In the case of the CFA franc zones, a high positive correlation can be interpreted as these regions facing similar real exchange rate shocks, which could thus warrant a common policy response, especially since they are being affected by similar external influences. For the non-CFA countries considered, similarities in the $\Phi_{1,t}$ shocks may be interpreted as experiences of similar deviations from the relative PPP state. In fact, regions facing similar domestic pressures on the real exchange rate will show higher correlation in $\Phi_{1,t}$. Similarly, significantly high and positive correlations between the $\Phi_{2,t}$ will be indicative of similar real output shocks (as earlier explained, the model does not disaggregate this shock into aggregate demand or aggregate supply shocks). Finally, significantly positive and high correlation in $\Phi_{3,t}$ in the model will suggest similar shocks to the demand for real money balances in the domestic economy.

2.2 Empirical methodology

SVAR models use the long-run properties of the variables to identify and recover the economic shocks. In our SVAR model, we use the approach of Blanchard and Quah (1989) to achieve this where the long-run restrictions together with the independence of shocks (orthogonality conditions) are used to recover the structural shocks. The restrictions are used to distinguish and isolate the short-run effects of any shocks. The long-run restrictions, though based on the methodology used in the Blanchard and Quah (1989) framework, are imposed on a macroeconomic structure that is different in terms of both variables used and size. One advantage of this methodology is that, it is based on long-run restrictions that are derived from economic theory. Although there is criticism of some 'incredible identifying restrictions'[6] being used at times to identify SVARs, this methodology is widely used and is somewhat less controversial, at least in comparison to empirical evidence that uses short-run or impact restrictions. We note that in using the Blanchard and Quah methodology, variations of this approach have been used by many researchers and in many different contexts as in Bayoumi and Eichengreen (1994); Bergmann (1996); Funke and Hall (1998); Keating and Nye (1999) for OECD countries; Enders and Lee (1997), Bergmann *et al.* (2000) in investigating the dynamics of real exchange rates, Fielding and Shields (2001) in evaluating shocks within the CFA franc zone.

In our model, the vector of endogenous variables X_t is given as:

$$X_t = \big(\Delta(p - p^*)_t, \Delta y_t, \Delta(m - p)_t\big) \tag{2}$$

and our vector of external conditioning variables is also given as $M_t = (\Delta y^*_t, \Delta r^*_t)$. The SVAR in matrix form will be written as:

6 See Sims 1980: 1-48.

$$BX_t = \alpha_0 + \sum_{i=0}^{p} \Gamma_i X_{t-i} + \sum_{m=0}^{q} \Psi_1 M_{t-m} + \Phi_t \qquad (3)$$

Where $\text{cov}(\Phi_t \Phi_t') = I_3$ (a 3 × 3 identity matrix), p and q are the number of lags for the endogenous and exogenous variables, respectively.

The reduced form of equation (3) will be expressed as:

$$X_t = a_0 + \sum_{i=0}^{p} \text{A}_i X_{t-i} + \sum_{m=0}^{q} \text{R}_m M_{t-m} + u_t \qquad (4)$$

Alternatively equation (4), using the lagged polynomials, may be expressed as:

$$X_t = (I_3 - \text{A}(L))^{-1} a_0 + (I_3 - \text{A}(L))^{-1} \text{R}_1 M_t + \ldots + (I_3 - \text{A}(L))^{-1} \text{R}_q M_{t-q} + (I_3 - \text{A}(L))^{-1} u_t (5)$$

This in a more compact form is presented as:

$$X_t = \mu + \varphi_1 M_t + \Xi_t u_t \qquad (6)$$

Where $\mu = (I_3 - \text{A}(L))^{-1} a_0$, $\varphi_t = \sum_{m=0}^{q} (I_3 - \text{A(L)})^{-1} \text{R}_{t-k}$ and $\Xi_t = (I_3 - \text{A}(L))^{-1}$

Estimation of this reduced form VAR (equation 6) will provide us with the information required to identify and recover the structural shocks using the Blanchard and Quah (1989) methodology. Since the reduced form residuals, u_t, are not uncorrelated across variables ($\text{cov}(u_t u_t') = \Omega$), we cannot make any explicit inferences from these, hence the need for identification and isolation of the pure structural shocks.

Our impulse response equation, with the structural shocks, in matrix form may be written as:

$$X_t = \mu + \varphi_1 M_t + \Lambda_t \Phi_t \qquad (7)$$

Where Φ_t is the vector of pure structural shocks, Λ_t is described as the impulse response functions (IRF) and shows the time path that X_t will follow as a result of a structural shock. Given that the structural shocks are not correlated, and have a unit variance $\text{cov}(\Phi_t \Phi_t') = I_3$ (a 3 × 3 identity matrix), we can then isolate the effects of each shock, as described. Hence we can re-write equation 7 (leaving out the constant for the sake of simplicity) as:

$$X_{i,t} = \begin{bmatrix} \Delta(p - p^*)_t \\ \Delta y_t \\ \Delta(m - p)_t \end{bmatrix} = \begin{bmatrix} \varphi_{11}(\text{L}) & \varphi_{12}(\text{L}) \\ \varphi_{21}(\text{L}) & \varphi_{22}(\text{L}) \\ \varphi_{31}(\text{L}) & \varphi_{32}(\text{L}) \end{bmatrix} \begin{bmatrix} \Delta y^*_t \\ \Delta r^*_t \end{bmatrix} + \begin{bmatrix} \Lambda_{11}(\text{L}) & \Lambda_{12}(\text{L}) & \Lambda_{13}(\text{L}) \\ \Lambda_{21}(\text{L}) & \Lambda_{22}(\text{L}) & \Lambda_{23}(\text{L}) \\ \Lambda_{31}(\text{L}) & \Lambda_{32}(\text{L}) & \Lambda_{33}(\text{L}) \end{bmatrix} \begin{bmatrix} \Phi_{1t} \\ \Phi_{2t} \\ \Phi_{3t} \end{bmatrix} (8)$$

For each region considered, the use of the first differences is justified by the results from ADF tests for unit roots that support our use of the first differences.

In equation 8, n^2 restrictions are needed to identify exactly the structural shocks in the n variable system. The identification of our 3-variable system will require nine restrictions: six ($n(n + 1) / 2$) of which are achieved through the orthogonality condition of the variance of the structural shocks (i.e. $\text{cov}(\Phi_t\Phi_t') = I_3$) and three being from the long-run restrictions. In line with the Blanchard and Quah (1989) methodology, the imposition of the long-run restrictions, resulting long-run structure of equations (d′)-(f′), provides the remaining three restrictions needed to identify the model exactly. $\Lambda(L)$ being a 3×3 matrix for our 3 equation model, our three zero restrictions would make $\Lambda(L)$ lower triangular and hence, $\Lambda_{12} = \Lambda_{13} = \Lambda_{23} = 0$. Intuitively, the long-run behaviour of the real exchange rate appreciation will identify the Φ_{1t} shock in (d′), this known, the long-run behaviour of growth in real output will be used to identify Φ_{2t} in (e′), and then finally Φ_{3t} in (f′).

3 Data sources

In estimating the coefficients of the reduced form VAR, we make use of the variables in equations (d′)-(f′). The variables for each monetary union—UEMOA and CEMAC—are constructed by averaging over the members within the union (see Appendix 2); for Ghana, Kenya and Nigeria, no such averages are necessary. In effect, each of the two franc-zones is assessed as a single unit, however due to insufficient data for Equatorial Guinea of CEMAC and Guinea Bissau of UEMOA these could not be included in the averages.

The variables of the reduced form VAR include both endogenous variables (the real exchange rate growth, real output growth, and growth in the real money demand) and exogenous variables (growth in foreign real income and the foreign real interest rate). The period of interest is 1961-99, and the real exchange rate growth sequence is computed by taking the logarithm of the ratio of the change in the domestic and foreign price indices (Δp and Δp^*). The foreign price index is measured in terms of domestic currency by multiplying by the nominal exchange rate (e), which is determined through a common mapping to the US dollar using data from the International Monetary Fund's (IMF) *International Financial Statistics* (CD-Rom 2001). Hence $\Delta rer_t = \Delta p_t - e_t \Delta p_t^*$. The price index used for all the regions considered, is the GDP deflator; this index is used in preference to the consumer price index (CPI) because aside of the lack of complete CPI data for some countries within the study, this index is based on a broader class of goods in the economy and encompasses prices of investment goods, and goods bought by the public as well as consumer good prices. The source of this price index is the 2001 World Bank Development Indicator (WBDI) series and the 2002 World Bank Africa Database CD-Rom and data for the real income for all the countries/zones, including that for the foreign economy, are taken from the same sources as the price indices above, and are measured as the annual change in the logarithm of the real GDP (in local currency units).

The growth in the real money demand, $\Delta(m - p)$, is calculated using data on nominal money series and the price index. Using a broad definition of money (M2), the money series is measured as the sum of currency outside banks, demand deposits other than those of the central government; and information on the time savings, and foreign currency deposits of resident sectors other than the central government is taken from the same sources as the price indices and corresponds to lines 34 and 35 in the *IMF IFS* *database*. The $\Delta(m-p)$ series is, therefore, taken as the annual change in the logarithm of the real money balances. Finally, the foreign interest rate data used in computing the change in foreign interest rate measure (Δr^*_t) is taken from the IMF's *International Financial Statistics* (CD-Rom 2001). The real value of the deposit rates is used, except in the US series where the treasury bill rates were used as a proxy. Δr_t^* is measured as the annual change in this measure.

4 Estimation and results

E Views is used to estimate the VAR coefficients and, through preliminary tests, select a lag order of two (supported by the Aikaike Information Criteria (AIC)) of the unrestricted VAR. In each equation of the unrestricted VAR, a two-period lag of the endogenous variables is included, which is allowed to influence the current values. To contain the effects of significant structural breaks, we use dummy variables (D94 for the CFA franc zones, D86 and D99 for Nigeria, and D66 for Kenya—these are primarily due to major devaluations and money supply shocks in these regions). The inclusion of the dummy variables is intended to help smoothen out such breaks.

In presenting our results, we make use of:

i) Forecast error variance decompositions of the structural shocks in each zone/country.

ii) Long-run impulse responses as a way of tracing how the economy reacts to a shock in the long run, and especially the direction of the reaction.

iii) Finally, as a measure of the similarity of shocks, we use the correlations of the structural innovations in each area.

The dynamic effects of the shocks will be captured by the variance decompositions and the impulse responses (together called *innovation accounting*), and the degree of homogeneity or otherwise, based on the data and conditioning variables used, will be indicated through the sign and magnitude of the innovation correlations. One importance of using this approach is that it allows both short-run and long-run interactions to be analysed. In an under-identified system, it will not be possible to trace the pure shocks in the model, even when all the coefficients of the primitive model are known. In the case where the system is exactly identified (as we have), the accumulated Impulse responses indicate the direction of the response to an innovation and also give the long-run accumulated effect of each shock on each variable.

4.1 Stability and stationarity

As a property, shocks to stationary time-series data will necessarily be dissipated over time, which allows for stationary time series to revert to a long-run mean level. The variance of such a series is also finite and does not vary over time. In contrast, non-stationary time-series data do not show any tendency to revert to a mean value and the variance also shows some tendency to go to infinity with time. In order to be able to make use of OLS efficiently and in the classical regression models we use stationary variables, a requirement of the Blanchard and Quah (1989) methodology employed in our estimation. The stability of the VAR is a necessary condition to make appropriate deductions and inferences from the estimated values

Our variables, which are all *I*(1) in levels are initially tested for the presence of unit roots and ADF unit root tests justify the use of first differences,[7] which are *I*(0) and stationary (Appendix 1A). Second, the VAR as a whole is found to be stable (stationary) since the inverse roots of the characteristic autoregressive (AR) polynomial (see Lütkepohl 1991) are found to have a modulus less than one and lie within the unit circle (Appendix 1B). When we attempt to estimate a VAR that is not stable, the solution is said to be explosive and the impulse responses, variance decompositions and standard errors will not all be valid. Our results show that the VAR as used for each of the five regions is stable.

In Table 1, we present a summary of some regression diagnostic statistics from the unrestricted VAR. As a brief summary, we present the R^2 values for each equation in the VAR, the standard error and the Durbin-Watson Statistic.

Table 1
Summary of unrestricted VAR regression diagnostics

(a). $\Delta(p - p^*)$ equation

	R^2	Std error	Durbin Watson
UEMOA	0.87	0.033	1.35
CEMAC	0.72	0.059	1.92
Ghana	0.42	0.327	2.41
Kenya	0.21	0.200	2.04
Nigeria	0.85	0.159	1.58

(b). $\Delta(y)$ equation

	R^2	Std error	Durbin Watson
UEMOA	0.82	0.038	1.83
CEMAC	0.51	0.064	1.77
Ghana	0.62	0.13	2.20
Kenya	0.30	0.18	2.37
Nigeria	0.31	0.17	1.97

(c). $\Delta(m - p)$ equation

	R^2	Std error	Durbin Watson
UEMOA	0.20	0.068	1.38
CEMAC	0.53	0.066	2.15
Ghana	0.49	0.11	2.11
Kenya	0.80	0.15	2.74
Nigeria	0.24	0.16	1.93

7 Although some criticism has been levelled against differencing (see Sims 1980; Doan 1992) in that it 'throws away' information containing co-movements in the data, it remains a popular approach.

In these tables, the R^2 values for all the regions considered, show some significant variations, but are typically above 0.2. In the real exchange rate appreciation sequence, the two monetary unions and Nigeria show a goodness of fit value above 0.7. This is indicative of the chosen explanatory variables explaining a high percentage of the variation in the sequence; however Ghana and Kenya show relatively lower values.

Given the tendency of VARs to be over-parameterized, we note that the goal or aim of the VAR model is not to make short-term forecasts, but rather to find the important inter-relationships that exist among the variables in the VAR. In fact, the VAR estimation output shows that some of the coefficient estimates can be properly excluded from the model. However, in order not to waste important information and also to maintain the structure of the VAR, we risk compromising the efficiency of our model, but note that the VAR is nonetheless consistent as steady state values are not compromised, and the use of OLS is appropriate. The Durbin-Watson values from above show that there is no significant evidence of autocorrelation within the observed residuals (the reduced-form residuals), and the null hypothesis of no autocorrelation can be immediately accepted in most of the cases.

4.2 Variance decomposition

In principle, VARs are very useful in determining how the variables used in the VAR interact with each other in the economy. If, say, $\Phi_{1,t}$ shocks explain none of the forecast error variance of the real exchange rate, then the sequence evolves independently of its own shocks, and $\Delta(p - p^*)$ will be a purely endogenous variable. If, at the other extreme, it explains all of its forecast error variance, then the change in the real exchange rate is said to be entirely exogenous of other variables in the model. Our analyses of the variance decompositions show the relative importance of each innovation and will form a basis for our short-run analyses. Although the variance decompositions contain some inherent problems because the identifying restrictions we impose on the **B** matrix place some restrictions on which variables can influence any one sequence, especially over short-time spans, this tendency is reduced over time and the variance decompositions will converge. In spite of this inherent problem, innovation accounting provides a useful tool in the assessment of the interplay of the variables in a model. Since we employ the Blanchard and Quah (1989) methodology where there is no correlation between the structural shocks ($\Phi_{i,t}$), there is little cause for concern. We present below a summary of our variance decomposition results for each of the structural shocks ($\Phi_{i,t}$) for each region considered. The structural innovations derived from equations (d′), (e′) and (f′) are represented by $\Phi_{i,t}^{rer}$, $\Phi_{i,t}^{y}$, and $\Phi_{i,t}^{rmd}$, respectively.

Table 2(a)
Percentages of forecast error variance decomposition of the $\Phi_{i,t}^{rer}$ (periods 1-5) due to each shock in UEMOA region

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.033	99.873	0.008	0.117
2	0.033	99.695	0.148	0.156
3	0.034	99.498	0.301	0.200
4	0.034	99.495	0.300	0.204
5	0.034	99.459	0.333	0.206

Table 2(b)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rer}$ (periods 1-5)
due to each shock in CEMAC region

Period	S.E.	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.059	99.981	0.0116	0.007
2	0.059	99.332	0.0167	0.652
3	0.061	98.918	0.0256	1.055
4	0.062	98.829	0.053	1.117
5	0.062	98.821	0.058	1.120

Table 2(c)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rer}$ (periods 1-5)
due to each shock in GHANA

Period	S.E.	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.327	60.916	38.779	0.304
2	0.344	63.409	36.062	0.528
3	0.375	54.137	43.939	1.923
4	0.379	53.655	44.174	2.170
5	0.381	53.073	44.596	2.329

Table 2(d)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rer}$ (periods 1-5)
due to each shock in KENYA

Period	S.E.	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
§ 1	0.203	70.748	28.848	0.4029
2	0.218	63.498	35.610	0.8911
3	0.224	64.722	34.420	0.8573
4	0.224	64.637	34.479	0.8838
5	0.224	64.234	34.885	0.881

Table 2(e)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rer}$ (periods 1-5)
due to each shock in NIGERIA

Period	S.E.	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.159	76.968	12.754	10.276
2	0.160	76.395	13.143	10.460
3	0.168	75.503	12.819	11.676
4	0.169	75.013	13.036	11.950
5	0.169	74.758	13.312	11.929

Tables 2a-e show the percentage forecast error variance decomposition for a one-standard deviation $\mathbf{\Phi_{i,t}^{rer}}$ shock in each of the five regions considered. The CFA franc zones show that innovations in the real exchange rate are largely ‘self-driven’ (above 98 per cent), in other words, the real exchange rate movement is largely due to its own shocks, and the sequence can broadly be said to evolve nearly independently of the other structural shocks ($\mathbf{\Phi_{i,t}^{y}}$ and $\mathbf{\Phi_{i,t}^{rmd}}$) in the model. The long-run form of the growth in real exchange rate is therefore given some support, even in the short run in these economies.

In contrast, the non-CFA franc zone countries show a more varied response where shocks in the real output growth and real money demand sequences are shown to be fairly significant in explaining movements in the real exchange rate. The results are largely consistent with the findings by Hoffmaister *et al*. (1998), that movements in the real exchange rate are more important for the CFA subgroup and largely independent of domestic variables.

Two plausible explanations for these differences may be variations in the exchange rate regimes between the CFA franc zones and the non-CFA franc countries or differences in the economic structure in the regions. Next we attempt to shed some light on the case where the former is true and how this may explain the observed difference, since the preliminary study by Hoffmaister *et al*. (1998) does not find grounds to justify the latter. The CEMAC and the UEMOA have fixed exchange rate regimes, in which their currency, the CFA franc, has been pegged to the French franc since 1948 (1948-93: 50 CFAF = 1 FF and 100CFAF = 1 FF since 1994; 655.957 CFAF = 1 Euro since January 1999).[8] Guaranteed by a special operations account opened with the French treasury, full convertibility of the CFA franc to the French franc is assured. At least, this was the case until 1992. However, some restrictions have been put in place since 1993, and this has tended to create some informal markets within the zones. The non-CFA group has largely had a floating exchange rate regime over the period of the study. Due to administrative and institutional rules, the countries within the monetary union cannot use nominal exchange rate as policy without the agreement of France and member countries. With the commitment to the fixed exchange rate regime, and the central banks (*BCEAO* of UEMOA and *BEAC* of CEMAC) and France ensuring that monetary and exchange rate policies hold, there is less pressure on macroeconomic policies. Consequently, there is more stability in price, interest rates, and the quantity of money. The remaining tool left for adjustment at the country level is fiscal policy and that is where the pressure builds, albeit there are some institutional rules that also control governments in this regard (e.g. the 20 per cent limit on government domestic borrowing of the previous year's tax revenues). Although governments are less restricted regarding their borrowing abroad, this is more dependent on the government's creditworthiness.

In response to a real exchange rate shock, the variance decomposition Table 2c shows that for Ghana about 38-45 per cent of the movement in the sequence is attributable to the output shocks; the proportion attributable to output growth shocks for Kenya and Nigeria is roughly 30 per cent and 13 per cent, respectively. In Nigeria, the growth in real money demand shocks is almost as important as the output shocks in explaining real exchange rate appreciation shocks. Unlike the countries within the CFA franc zone, which have pegged/fixed exchange rates, the non-CFA countries' floating exchange rate systems afford them the option of using nominal exchange rate changes to support adjustment processes. Given that during the latter part of the 1980s, most of the sub-region was hit by terms of trade shocks, results of Tables 2a and 2b give some explanation why attempts in the CFA regions at adjustment, which was highly reliant on fiscal policy, were largely ineffective in achieving real depreciation during the 1980s. The 1994 devaluation of the CFA franc relative to the French franc was the last resort in

8 From 1948, the rate of convertibility was 0.5 CFAF to 1FF. In 1968, however, the introduction of the new French franc implied 50CFAF was now converted for 1FF, although the parity had not changed. This parity remained in place until the 50 per cent devaluation in January 1994.

the attempt to restore some level of competitiveness for the zone. In fact, the brunt of any adjustment to the real exchange rates falls on prices under the fixed exchange rate regime, whereas under the floating exchange rate regime, the nominal exchange rate is often used in the adjustment process and Tables 2c-e show how the other components of the domestic macroeconomy can be important in propping it up.

In Tables 3a-e, in response to a one-standard deviation shock in $\mathbf{\Phi_{i,t}^{y}}$, the results show that the proportion of the shock that is explained by the real exchange rate sequence is significantly high for all the five regions: 55-64 per cent for UEMOA and 71-74 per cent for the CEMAC region and similarly so for the Anglophone countries (although slightly lower). In the non-CFA franc zone countries, there is a tendency for the real money demand sequence to explain significantly the movements in the real output. This is significantly so in two of the non-CFA franc countries—Ghana and Nigeria, but not in Kenya. This being the case, distinct systematic differences and/or similarities are not as clearly observed as for the $\mathbf{\Phi_{i,t}^{rer}}$ shock. The fact that monetary policy is not an available option as a means of adjustment for the individual CFA franc countries could be a reason for this observation. However this cannot be explicitly established with the data on hand and without having precise policy equations.

Table 3(a)
Percentages of forecast error variance decomposition of the $\Phi_{i,t}^{y}$
(periods 1-5) due to each shock in UEMOA region

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.038	55.173	44.518	0.308
2	0.041	59.545	40.019	0.435
3	0.043	61.883	37.611	0.504
4	0.044	63.212	36.248	0.539
5	0.044	63.302	36.155	0.542

Table 3(b)
Percentages of forecast error variance decomposition of the $\Phi_{i,t}^{y}$ (periods 1-5)
due to each shock in CEMAC region

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.064	71.706	26.119	2.173
2	0.067	74.607	23.436	1.956
3	0.068	74.400	23.441	2.158
4	0.068	74.650	23.131	2.217
5	0.068	74.575	23.086	2.337

Table 3(c)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{y}$ (periods 1-5)
due to each shock in GHANA

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.133	50.458	27.770	21.770
2	0.137	47.147	30.852	22.000
3	0.159	36.528	47.027	16.444
4	0.163	38.965	45.023	16.011
5	0.165	38.727	44.880	16.392

Table 3(d)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{y}$ (periods 1-5) due to each shock in KENYA

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.185	96.762	3.209	0.028
2	0.194	93.434	6.534	0.031
3	0.207	81.891	18.027	0.080
4	0.208	82.009	17.821	0.168
5	0.210	81.392	18.439	0.168

Table 3(e)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{y}$ (periods 1-5) due to each shock in NIGERIA

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.175	41.012	38.333	20.654
2	0.188	36.259	41.205	22.535
3	0.195	35.769	40.525	23.705
4	0.195	35.536	40.824	23.639
5	0.195	35.448	40.970	23.581

Table 4(a)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rmd}$ (periods 1- 5) due to each shock in UEMOA region

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.068	3.342	21.88	74.775
2	0.069	6.018	21.708	72.273
3	0.069	6.624	21.847	71.527
4	0.069	6.718	21.841	71.439
5	0.070	6.929	21.807	71.263

Table 4(b)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rmd}$ (periods 1-5) due to each shock in CEMAC region

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.066	0.004	9.303	90.691
2	0.087	35.335	5.636	59.028
3	0.088	34.363	6.202	59.434
4	0.089	34.351	6.197	59.451
5	0.089	34.344	6.220	59.435

Table 4(c)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rmd}$ (periods 1-5) due to each shock in GHANA

Period	**S.E.**	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.116	5.251	3.226	91.523
2	0.121	7.767	5.389	86.843
3	0.133	7.972	18.93	73.092
4	0.135	9.936	19.47	70.591
5	0.136	10.18	19.38	70.431

Table 4(d)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rmd}$ (periods 1-5)
due to each shock in KENYA

Period	S.E.	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.151	66.137	8.161	25.701
2	0.158	61.649	14.887	23.462
3	0.169	55.555	23.677	20.766
4	0.169	55.717	23.540	20.741
5	0.170	55.838	23.613	20.548

Table 4(e)
Percentages of forecast error variance decomposition of $\Phi_{i,t}^{rmd}$ (periods 1-5)
due to each shock in NIGERIA

Period	S.E.	$\Phi_{i,t}^{rer}$	$\Phi_{i,t}^{y}$	$\Phi_{i,t}^{rmd}$
1	0.157	0.503	10.876	88.620
2	0.160	0.832	13.858	85.308
3	0.162	1.515	13.480	85.004
4	0.162	1.526	13.482	84.991
5	0.163	1.526	13.506	84.967

When we consider the variance decompositions for shocks to the real money demand growth sequence, a substantial level of explanation is offered by both the real output shocks ($\Phi_{i,t}^{y}$) and the real exchange rate shocks ($\Phi_{i,t}^{rer}$) in all the regions considered. However, the extent of importance varies widely and there is no clear pattern. While real output shocks offer better explanation in the UEMOA zone, the real exchange rate shocks are more important in the CEMAC region—this difference could be due to the nature of the economies: CEMAC region is predominantly agricultural, while the CEMAC region is almost made up entirely of oil exporters. In the non-CFA countries the real output shocks seem instrumental in explaining the sequence, the real exchange rate shocks seem to feature prominently, particularly for the Kenyan economy.

4.3 Impulse responses

So far we have focussed on what can be used to explain the movements in the economy in each variable after a shock in one part of the economy. This has shed some light on what can be considered important in explaining movements over the short run, but there is an aspect of the economy's response after a shock that is better captured by the time path of the variables. As a practical way of illustrating the behaviour of the endogenous series in the longer run, impulse response functions (IRFs) provide a good visual representation of the path followed by each variable. In a situation where there are prompt policy responses to shocks within the economy, there is little need to dwell on these long-run effects; alternatively in situations where there is some appreciable delay in responding to shocks, impulse response functions can be very useful. The IRFs are most important when there is the tendency for adjustment decisions to be taken well after the occurrence of a shock, and based only on an assumption of the effects of the shock in question. Using equation (7) and based on knowledge of the coefficients of the structural VAR estimated earlier, we can chart the IRFs. Since the data for this

Table 5
Long-run impulse responses (standard errors in parenthesis)

	$\Phi_{i,t}^{rer}$ on $\Delta(p - p^*)$	$\Phi_{i,t}^{rer}$ on Δy	$\Phi_{i,t}^{y}$ on Δy
UEMOA	0.75 (0.003)	-0.32 (0.003)	0.71 (0.002)
CEMAC	0.69 (0.005)	-0.65 (0.006)	0.91 (0.003)
Ghana	1.04 (0.031)	0.85 (0.049)	3.65 (0.029)
Kenya	1.06 (0.021)	-1.36 (0.038)	5.02 (0.019)
Nigeria	1.46 (0.023)	-1.09 (0.040)	2.02 (0.025)

work are available annually, for all practical purposes it is not very likely that the asymptotic effect will be realized, or that only the given shock will pertain; however, for the sake of completeness, we provide the results below. In Table 5, we give a summary of the accumulated responses to the various structural shocks (see Appendix 3 for complete graphical representation).

In all the cases presented in Table 5, the responses have been standardized by dividing the innovations of that variable by the corresponding element of the leading diagonal of the B^{-1} matrix, thereby simulating a unit shock, given that the IRF on impact is $B^{-1}(\Lambda_0 = B^{-1})$. This allows for easy comparability across all the regions.

With the model structured so that there is the long-run restriction on the $\Delta(p - p^*)$ equation, Table 5 shows the long-run impact of a real exchange rate growth shock ($\mathbf{\Phi_{i,t}^{rer}}$) on its own sequence $\Delta(p - p^*)$ and also on the Δy sequence. In the third column we also show the long-run impact of a real output shock ($\mathbf{\Phi_{i,t}^{y}}$) on its own evolution (Δy). Observations in Table 5 show an interesting pattern: the observed response to a real exchange rate growth shock ($\mathbf{\Phi_{i,t}^{rer}}$) shows that the CFA franc zones each settle at a long-run level which is positive and smaller than the initial impact (75 per cent and 69 per cent for UEMOA and CEMAC, respectively). In the non-CFA countries, however, the opposite seems to pertain, there is a general proclivity for a shock in the $\Delta(p - p^*)$ sequence to have an incremental effect and show some persistence over time.

Next we offer some suggestions as to why this may be the case:

i) In the CFA franc zone, the maintenance of an exchange rate peg against the French franc (now to the Euro) provides a commitment to an inflation rate, which, on average, is lower than that of many African countries. Anyadike-Danes (1995) presents some findings through an empirical study, which suggest that inflation is usually less under the fixed exchange rate regime than in the floating exchange rate regime and Fielding (2002: 162-82), presents some evidence to support the view that the CFA monetary union provides a greater degree of credibility of low-inflation compared to other managed exchange rate regimes. This commitment to low inflation is absent in the non-CFA franc zone countries, where inflation is more pervasive and monetary policy is likely to be used to respond to a real exchange rate shock caused by the less-than-stable domestic inflation. Given that high and variable domestic inflation is likely to affect output adversely, even in the long run, results from Tables 2a-e show $\mathbf{\Phi_{i,t}^{y}}$ shocks to be significantly important in the non-CFA zones but less so in the CFA franc zones. High and variable inflation will therefore be more likely to cause more variation in the $\Delta(p - p^*)$ sequence, compared with the CFA franc zones.

ii) While it is true that the fixed nominal exchange rate does not necessarily mean fixed relative prices, the commitment to keeping the peg has proven to be useful in keeping the real exchange rate for CFA zone countries fairly stable (Fielding 2002; Hadjimichael *et al.* 1995). On the other hand, variability in the nominal exchange rate is somewhat linked with relative price variability of some domestic goods (e.g. tradables). When there is a shock in the nominal exchange rate, stickiness in the prices of certain goods may cause increased variation in the real exchange rate. Hence, after a shock in the real exchange rate growth sequence, there is a tendency for the observed persistence to be higher in the non-CFA franc zone countries; and this is compounded by the presence of domestic price instability.

iii) Fielding (2002: 180) suggests that in countries outside of the CFA franc zone, some trade restrictions shield the capital goods markets from the rest of the world, and the domestic investment deflator is determined by government fiscal policy and domestic market conditions. This being the case, there is a greater tendency for variability in the domestic investment deflator through the variability in the proportion of non-traded capital goods. Given the role of the nominal exchange rate and the fact that it is influenced not only by the domestic investment deflator but also by other prices (and sometimes by government), the stability of relative prices is more in doubt.

iv) Finally, there is a higher tendency in the non-CFA countries for expansion in the money supply, which is more likely to lead to higher price inflation, and currency devaluations. Relative costs associated with the expansion of the money supply base are less than in the CFA countries; and there is no threat of reneging on a commitment, unlike the possibility in the CFA franc zones. As is observed in many countries in SSA where seigniorage is high, under a fixed exchange rate regime, the costs of a rapid money supply are more likely to lead to significant balance-of-payments deficits, because the exchange rate cannot be depreciated while the money supply has expanded and this is a situation they would rather avoid. Fielding (2002: 34) finds that the extra benefit for the CFA, compared to other managed exchange rate regimes, is as much as 4.9 percentage points.

As noted earlier, the long-run response of the real output growth, Δy, to a real exchange rate growth shock, $\mathbf{\Phi_{i,t}^{rer}}$ (column 2, Table 5) may be either positively or negatively signed (see discussion of the effect of $b_1a_2 \,/\, (1 - b_1a_1)$). There are some obvious differences between countries in the CFA and the non-CFA groups, while the output growth is mostly negatively affected by a $\mathbf{\Phi_{i,t}^{rer}}$ shock. Here too there is the tendency for some persistence in the macroeconomies of the non-CFA franc zone countries. As is evident from Tables 2a-e, the variance decompositions in the CFA zones do not show $\mathbf{\Phi_{i,t}^{y}}$ shocks explaining much of the movements in $\Delta(p - p^*)$. In comparison, the variance decompositions for the non-CFA countries show the $\mathbf{\Phi_{i,t}^{y}}$ shocks responsible for explaining quite substantial proportions of the real exchange rate growth sequence (i.e. between approx. 13 per cent and 45 per cent). As explained above, there is more likely to be an interplay between the real output growth and the real exchange rate growth, which could be the cause of the observed tendency of persistence.

The option available for the non-CFA franc zone countries to make use of monetary policy (unlike the CFA zone countries which can only use fiscal policy in managing their individual economies) may also be a key issue in explaining the tendency of persistence. From equation (e′), when the elasticity of the real exchange rate growth with respect to the real output, $b_1a_2 / (1 - b_1a_1)$ increases over time, we would expect the sort of response we observe in Kenya and Nigeria. Assuming a fixed or minimally varying value of $(1 - b_1a_1)$, the option to use monetary policy under the flexible exchange rate regime will likely allow more variability (through changes in interest rates) in the elasticity of the real exchange rate with respect to the aggregate demand (i.e. a_2 in equation (a)), hence some tendency of persistence. In the CFA zone where individual countries are not in a position to take advantage of monetary policy for adjustment, there is less likelihood for this elasticity to vary significantly, hence dampening the effect over time. Ghana seems to conform to the other case, where the long-run response is positive. One explanation might be that the nominal exchange rate data in Ghana show a more frequent and varied sequence than in other non-CFA countries. If the nominal exchange rate is often varied for adjustment purposes, then there will be less pressure to cause high variations in a_2, hence the lower magnitude of the b_1a_2 coefficient in equation (e).

In column 3 of Table 5, we present the standardized long-run accumulated impulse responses of real output growth shocks on real output growth. As can be observed, these are all positive as expected from economic theory (and from model). In CFA zone countries, there is a dissipating effect over time. But here too as in the previous cases described above, the non-CFA countries generally experience a persisting effect after a shock; the reasons detailed earlier will also suffice here. In the variance decomposition tables, a real output growth shock is explained rather significantly by both $\mathbf{\Phi_{i,t}^{rer}}$ and $\mathbf{\Phi_{i,t}^{rmd}}$ shocks, but more so in the non-CFA regions, and the feedback received in these is likely to be the major reason for such behaviour. In broad terms we draw this analogy: in relating this to the theoretical model of Kydland and Prescott (1997), since zero rate of inflation is not an equilibrium, it can then be inferred that in regions where inflation persists, there is likely to be persistence on the other indicators influenced by inflation.

4.4 Innovation correlations

For purposes of completeness in our innovation accounting, as conducted so far, it is instructive to determine also the correlation between the structural innovations, the non-forecastable part of each variable. In the Blanchard and Quah (1989) methodology, the pure structural residuals ($\Phi_{i,t}$) that are independent of each other are not correlated, hence the time path charted by the impulse responses is attributable to a particular innovation. The same cannot be said of the reduced form residuals ($u_{i,t}$), which may be correlated with each other. Since the structural innovations are independent of each other, we can examine the extent of similarity between the shocks observed in each region to determine if a common approach to tackling the particular innovation is in order. If there are significantly high correlations, say, between shocks to the real exchange rate appreciation across the two CFA franc zones, then it might be worthwhile to consider a common approach to deal with these occurrences. Fielding and Shields (2001), using a similar approach for inflation and output innovations, find that if 'inflation stabilization was an overriding policy goal', then borders between the two CFA franc zones are not needed, since inflation correlation between the zones was high and on average the same as within the zones, with one exception—Niger—which showed less correlation with the other members of the zones.

Table 6
Innovation correlation matrix for the real exchange rate appreciation sequence

Structural ($\Phi_{1,t}$) innovation correlations below diagonal;
Reduced form innovations ($u_{1,t}$), in italics, above diagonal

	CEMAC	UEMOA	Ghana	Kenya	Nigeria
CEMAC	1	*0.46*	*-0.06*	*0.08*	*-0.02*
UEMOA	0.45	1	*0.28*	*0.21*	*0.20*
Ghana	0.13	0.33	1	*-0.03*	*-0.22*
Kenya	0.04	0.09	-0.11	1	*0.46*
Nigeria	0.03	0.30	-0.16	0.55	1

Table 7
Innovation correlation matrix for the real output growth sequence

Structural ($\Phi_{2,t}$) innovation correlations below diagonal;
reduced form innovations ($u_{2,t}$), in italics, above diagonal

	CEMAC	UEMOA	Ghana	Kenya	Nigeria
CEMAC	1	*0.39*	*-0.17*	*-0.01*	*-0.05*
UEMOA	0.20	1	*-0.14*	*-0.10*	*-0.03*
Ghana	-0.14	-0.22	1	*-0.04*	*0.16*
Kenya	0.05	-0.20	-0.11	1	*0.61*
Nigeria	-0.06	-0.01	0.31	0.09	1

Table 8
Innovation correlation matrix for the real money demand growth sequence

Structural ($\Phi_{3,t}$) innovation correlations below diagonal;
Reduced form innovations ($u_{3,t}$), in italics, above diagonal

	CEMAC	UEMOA	Ghana	Kenya	Nigeria
CEMAC	1	*0.37*	*-0.23*	*-0.13*	*0.16*
UEMOA	0.27	1	*0.16*	*0.07*	*0.13*
Ghana	-0.37	-0.01	1	*-0.02*	*0.09*
Kenya	-0.36	0.02	0.26	1	*0.43*
Nigeria	-0.03	-0.10	0.22	0.26	1

Since the correlation matrices are perfectly symmetrical with ones on the main diagonal, and for the sake of brevity, we present the reduced form innovation correlations above the main diagonal and the structural innovations correlations below the diagonal. We do not address country-level correlation within the CFA franc zones, but do so between the two CFA franc zones. Since central bank policies are, as with all monetary unions, taken for 'the collective good' of the countries within the zone rather than for individual countries, a high correlation between the zones can represent some justification for a common policy approach. Significantly high correlations between the innovations of any two regions will suggest an incentive to adopt some common policies thereof. Tables 6-8 present the correlation matrices for each type of innovation (both structural and reduced form innovations), as a basis for determining any similarity in innovations. As is expected, the structural and reduced form innovations presented in Tables 6-8 generally show positive correlations between the two CFA franc zones for all the types of innovation; the highest being in terms of the real exchange rate innovations, which is not unusual and the lowest being in real output, which is also not usual given that most of the CEMAC countries are oil-exporting countries (although diversified), whereas that UEMOA countries are mainly exporters of agricultural raw materials. The non-CFA countries, on the other hand, show less correlation among themselves and also with the CFA franc zones. Overall, the five regions do not show any clear and consistent pattern, nor is there any observation of correlations that stand out, be they positive or negative. Although we observe positive correlations between the two CFA franc zones for all the three types of innovation, the correlations in all cases fall below 0.5. There is also no distinct correlation between any of the Anglophone countries and the two zones. On the basis of these results, we cannot conclude this section to support or reject the common policy approach, since the tables do not reveal robust and significantly high correlations.

5 Conclusions

Using the Blanchard and Quah (1989) decomposition, this paper identifies structural shocks to three important variables in the macroeconomy (real exchange rate appreciation, real output growth and the growth in real money demand) for a representative group of SSA countries/regions. The results, through innovation accounting, show some important differences between the macroeconomies of the CFA franc zones (UEMOA and CEMAC) and the non-CFA countries (Ghana, Kenya and Nigeria).

Forecast error variance decomposition results show that the real exchange rate appreciation sequence in the CFA franc zones evolves almost independently of the other domestic variables whereas in the non-CFA franc zone countries, both the growth in real money demand and the real output innovations are shown to be significant in driving the real exchange rate sequence. External influences are therefore more important in the CFA franc zones and may explain why the domestic policies which were aimed at adjustment during the early 1980s in response to terms of trade shocks, were largely unsuccessful in the CFA franc zones, but less so in the non-CFA countries. In addition, while the real exchange rate appreciation is seen to explain a significant proportion of the variations in real output growth sequence across all the countries for the other types of shock, growth in real money demand is more important in the non-CFA franc zone group. These results are largely consistent with evidence provided by Hoffmaister *et al*. (1998) for aggregate groups of CFA and non-CFA countries.

In the event of failure to respond to the short-term effects of a shock to the macroeconomy, the accumulated impulse responses show that while the long-run effects of a shock are somewhat dissipated in the CFA franc zones, there is a tendency for shocks in the non-CFA franc countries to persist. This is observed both in shocks to the real exchange rate appreciation sequence and the real output growth sequence, which buttresses the results of the variance decompositions that the CFA franc zones present a more stable macroeconomy. The increasing standard error bands around the real money demand growth in both groups do not allow a meaningful and significant analysis to be made. However in the short run, these display greater importance in the non-CFA countries.

Correlations in the shocks to the real exchange rate appreciation, the real output growth and the real money demand sequences between the zones and the non-franc zone countries do not show any significant pattern. Although we find positive correlations between the innovations observed in the two CFA franc zones, these are below 0.5 and cannot be used to make robust statements concerning common policy approaches. We also do not find any consistent or robust pattern of correlation between the non-CFA franc zone countries, and even though the Kenyan and Nigerian economies exhibit some positive correlations, there is again no clear-cut pattern to warrant a suggestion for a common policy approach.

Hoffmaister *et al.* (1998) do not find the differences in economic structure to be a significantly important source of the observed macroeconomic differences. This implies that the institutional and administrative differences accompanying the two kinds of exchange rate regime are important determinants. Therefore the individual use of monetary policy and the ability of the nominal exchange rate to adjust in the non-CFA franc zone countries are suggested to be highly probable causes for such observations, and the significant interplay between the real exchange rate and the real output in the non-CFA countries explains to some extent this observed persistence.

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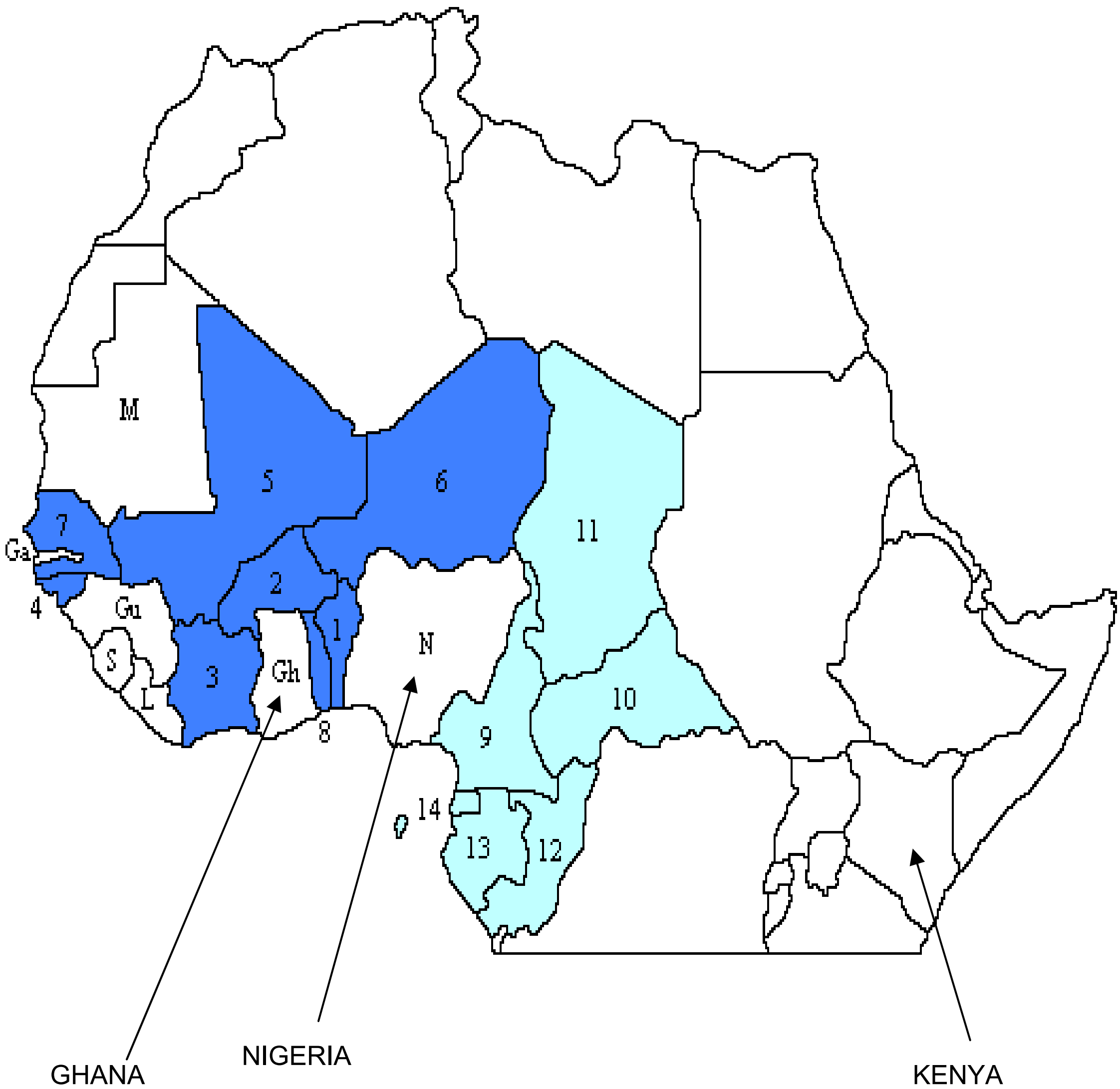
APPENDIX 1

Legend: Dark shaded area = UEMOA (8 countries)
Lighter shaded area = CEMAC (6 countries)
Ghana, Nigeria, Kenya



1	= Benin	2	= Burkina Faso
3	= Côte d'Ivoire	4	= Guinea-Bissau
5	= Mali	6	= Niger
7	= Senegal	8	= Togo
9	= Cameroon	10	= C.A.R.
11	= Chad	12	= Congo Republic
13	= Gabon	14	= Equatorial Guinea
Ga	= Gambia	Gh	= Ghana
Gu	= Guinea-Conakry	L	= Liberia
M	= Mauritania	N	= Nigeria
S	= Sierra Leone		

Appendix 1A—Unit root tests

Series	UEMOA	CEMAC	Ghana	Kenya	Nigeria
Δy	-4.516	-5.479	-3.340	-4.422	-4.645
$\Delta(p - ep^*)$	-6.745	-6.686	-6.422	-7.475	-3.632
$\Delta(m - p)$	-7.163	-4.574	-5.911	-5.110	-5.367
Δr^*	-5.485	-5.485	-5.980	-5.980	-5.111
Δy^*	-6.034	-6.034	-2.616	-2.616	-2.866

Note: Series are all in first differences. The ADF is the Augmented Dickey Fuller unit root test with the appropriate number of lagged differences determined by the Aikaike Information Criterion (AIC). The critical values for the 0.01, 0.05 and 0.10 significance levels are -3.61, -2.94 and –2.609 respectively.

UEMOA

Roots of characteristic polynomial
Endogenous variables: RER DY RMD
Exogenous variables: C D94 DRIRFR DRIRFRL DYFR DYFRL
Lag specification: 1 2
Date: 07/29/03 Time: 14:44

Root	Modulus
-0.096827 – 0.596846i	0.604649
-0.096827 + 0.596846i	0.604649
-0.075599 – 0.266348i	0.276869
-0.075599 + 0.266348i	0.276869
-0.174352	0.174352
0.174122	0.174122

No root lies outside the unit circle.
VAR satisfies the stability condition.

CEMAC

Roots of Characteristic Polynomial
Endogenous variables: RER DY RMD
Exogenous variables: C D94 DRIRFR DRIRFRL DYFR DYFRL
Lag specification: 1 2
Date: 07/29/03 Time: 14:43

Root	Modulus
-0.033861 – 0.519308i	0.520411
-0.033861 + 0.519308i	0.520411
0.427754 – 0.197351i	0.471085
0.427754 + 0.197351i	0.471085
-0.318203 – 0.234683i	0.395385
-0.318203 + 0.234683i	0.395385

Ghana

Roots of Characteristic Polynomial
Endogenous variables: RER DY RMD
Exogenous variables: C DRIRUK DRIRUKL DYUK DYUKL
Lag specification: 1 2
Date: 07/29/03 Time: 14:41

Root	Modulus
0.763629	0.763629
-0.416099 - 0.445538i	0.609625
-0.416099 + 0.445538i	0.609625
-0.548294	0.548294
0.214724 - 0.367103i	0.425290
0.214724 + 0.367103i	0.425290

No root lies outside the unit circle.
VAR satisfies the stability condition.

Kenya

Roots of Characteristic Polynomial
Endogenous variables: RER DY RMD
Exogenous variables: C DRIRUK DRIRUKL DYUK DYUKL
Lag specification: 1 2
Date: 07/29/03 Time: 14:36

Root	Modulus
-0.469847 - 0.331108i	0.574795
-0.469847 + 0.331108i	0.574795
0.478786 - 0.159248i	0.504575
0.478786 + 0.159248i	0.504575
-0.058281 - 0.308902i	0.314352
-0.058281 + 0.308902i	0.314352

No root lies outside the unit circle.
VAR satisfies the stability condition.

Nigeria

Roots of Characteristic Polynomial
Endogenous variables: RER DY RMD
Exogenous variables: C D86 D99 DYUS DYUSL DRIRUS DRIRUSL
Lag specification: 1 2
Date: 07/29/03 Time: 14:42

Root	Modulus
0.491364 - 0.175360i	0.521718
0.491364 + 0.175360i	0.521718
-0.010307 - 0.355498i	0.355647
-0.010307 + 0.355498i	0.355647
-0.269074 - 0.043575i	0.272580
-0.269074 + 0.043575i	0.272580

No root lies outside the unit circle.
VAR satisfies the stability condition.

Appendix 2—CFA franc zones average variable computations

The basic data used in this paper spans the period 1960-99, for all the five regions considered:

M The money stock (broad money, M2 – Money plus quasi money).
Source: IMF's International Financial Statistics (IFS)

P The price index used – the GDP deflator.
Sources: 2001 World Bank Development Indicator (WBDI) series
and the 2002 World Bank Africa Database CD-Rom

e The exchange rate (domestic currencies per unit of foreign currency).
Source: IMF's International Financial Statistics (IFS) CD-Rom 2001

Y The gross domestic product in local currency units (LCU).
Source: 2001World Bank Development Indicator (WBDI) series
and the 2002 World Bank Africa Database CD- Rom.

*r** The 90 day deposit rate for the foreign country (largest trading partner).
Source: IMF's International Financial Statistics (IFS) CD-Rom 2001

*Y** The Gross Domestic Product in Local Currency Units (LCU) for the foreign country (largest trading partner).
Source: 2001World Bank Development Indicator (WBDI) series
and the 2002 World Bank Africa Database CD-Rom

1) The real income for UEMOA and CEMAC, is calculated as:

$$\boldsymbol{y} = \ln \sum_{i=1}^{n} y_i$$

where n is the number of countries in the zone, y_i is the real GDP for country i in the appropriate CFA franc zone.

2) Average price index in each zone (UEMOA and CEMAC) is :

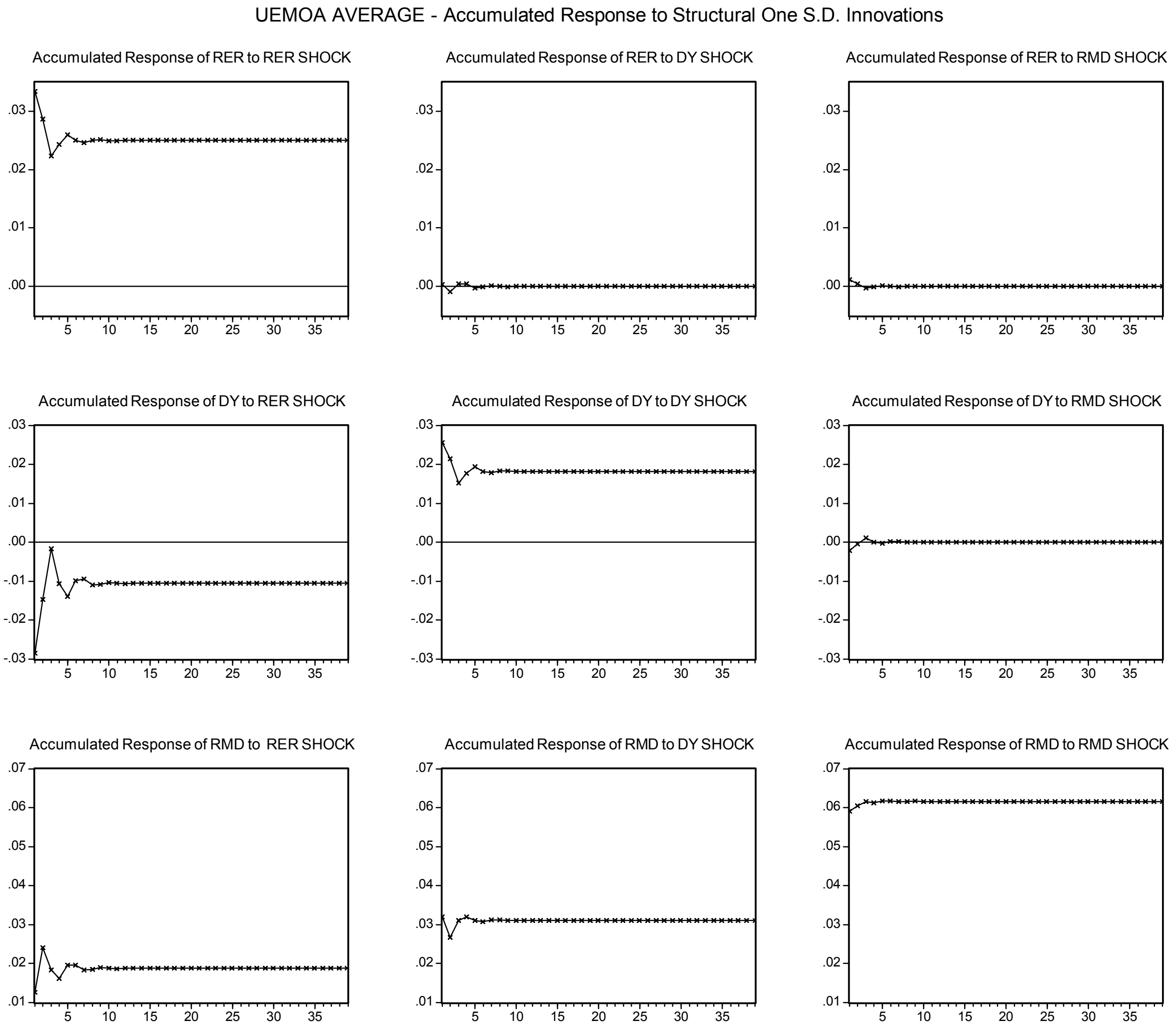
$$\boldsymbol{p} = \ln \left(\sum_{i=1}^{n} y_i P_i \Big/ \sum_{i=1}^{n} y_i \right),$$

where P_i is the domestic price index and y_i is the real income for country i in CFA franc zone.

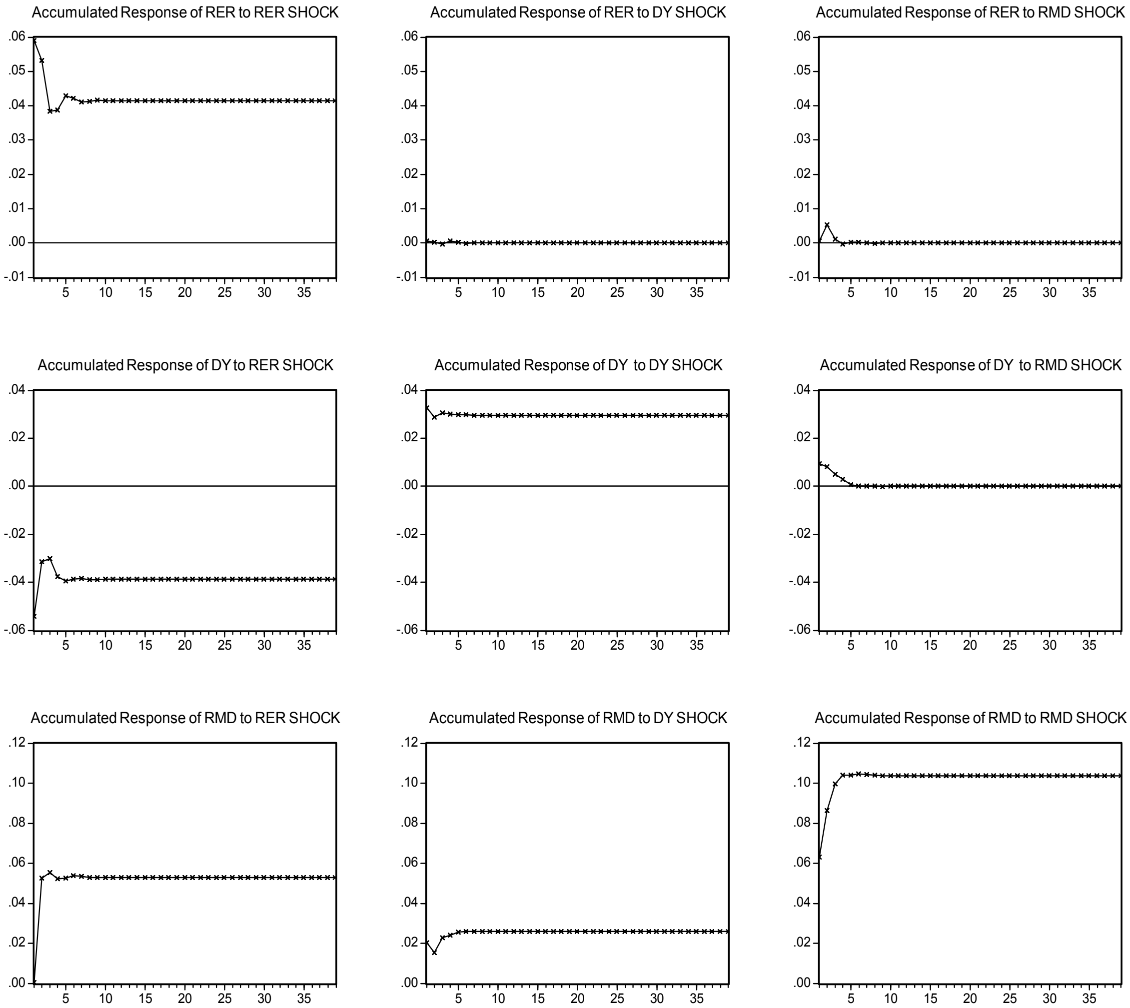
3) Real exchange rate (RER) The ratio of the domestic GDP deflator (p) to the GDP deflator for the largest trading partner's economy (p^*) multiplied by the nominal exchange rate (e): RER = $\boldsymbol{p} - \boldsymbol{ep^*}$, where e is the nominal exchange rate.

4) The real money demand (RMD) is calculated as $\left(\ln \sum_{i=1}^{n} M_i \right) - p$; where M_i is the money stock (broad money) for country i in CFA franc zone and $\boldsymbol{p}$ is defined as in 2 above.

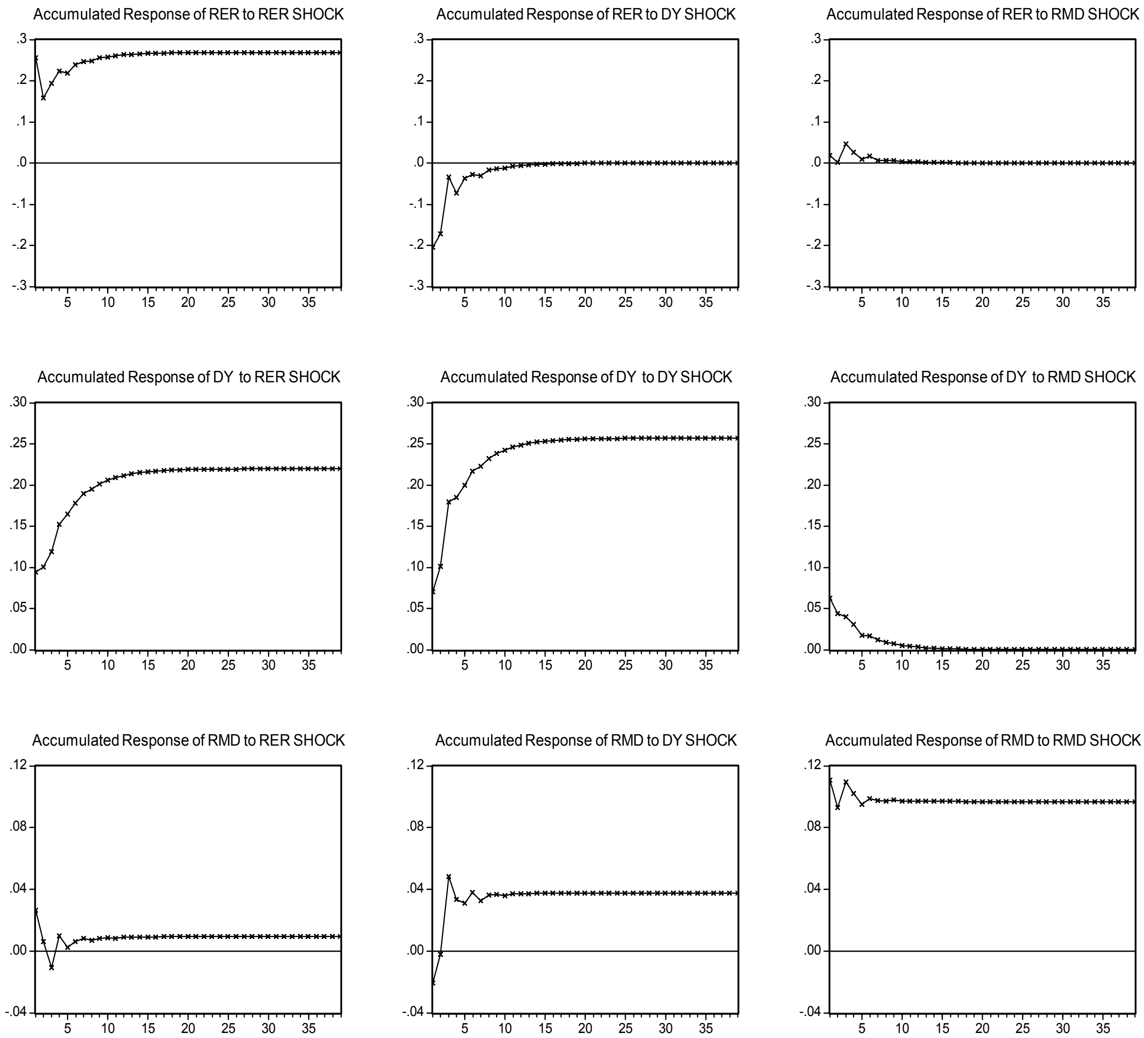
Appendix 3—Accumulated long-run impulse responses



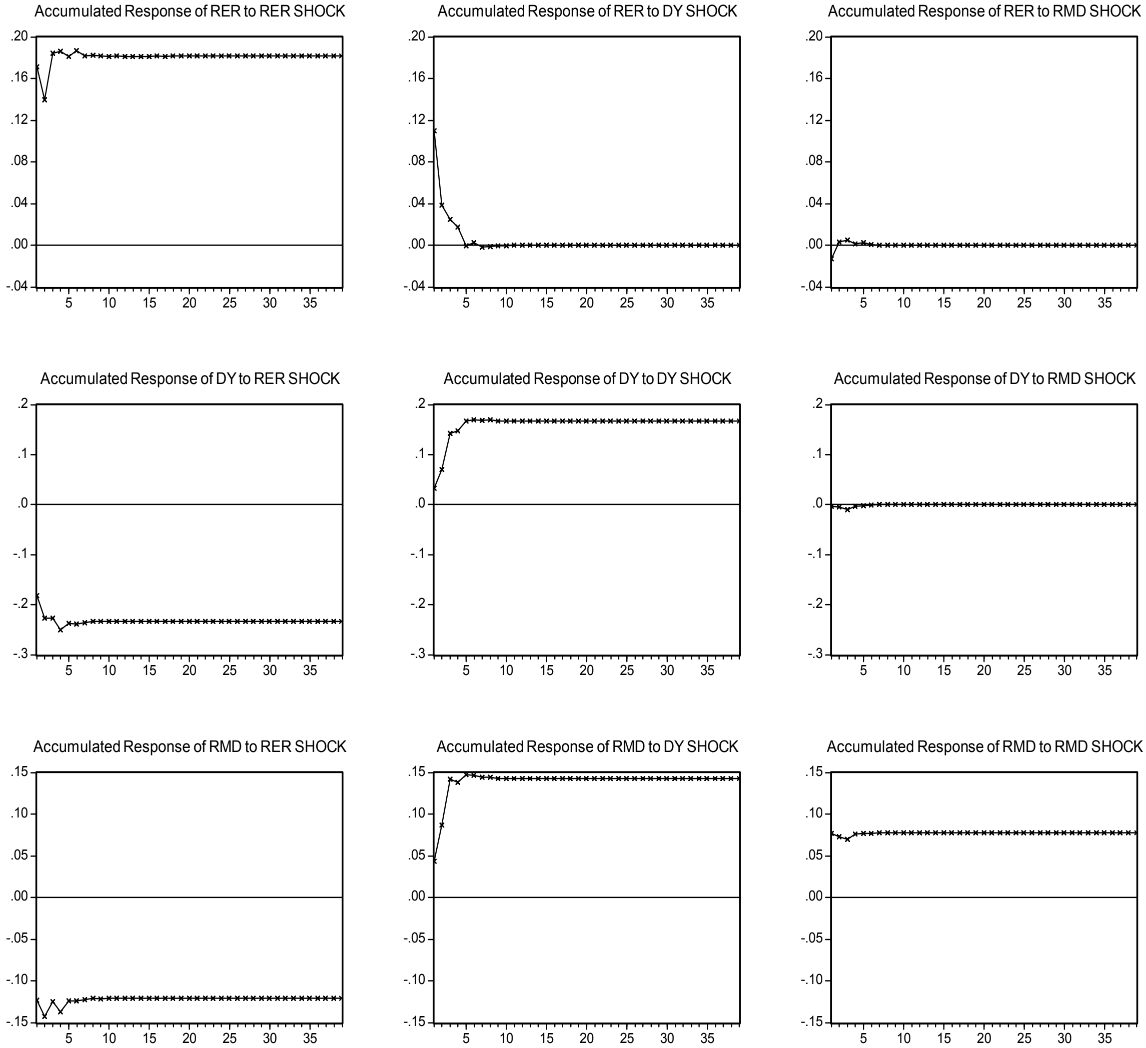
CEMAC AVERAGE - Accumulated Response to Structural One S.D. Innovations



GHANA - Accumulated Response to Structural One S.D. Innovations



KENYA - Accumulated Response to Structural One S.D. Innovations



NIGERIA - Accumulated Response to Structural One S.D. Innovations