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Real Interest Rate Differentials and the Real Exchange Rate: Evidence from Four African Countries [1]

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Abstract

During the early 1990s much has been written about the return of foreign private capital to many of the larger Asian and Latin American countries. However, until 1992 there was little evidence that countries in sub-Saharan Africa were participating in this phenomenon. In this paper we use variance decompositions and impulse responses from vector autoregressions to shed light on the possible causes and consequences of capital inflows to four countries: Ghana, Kenya, Uganda, and Zimbabwe. We use trend-cycle decompositions to provide evidence linking the appreciation of the real exchange rate to periods of heavy capital inflows. We show that domestic real interest rates have played an important role in explaining the recent behavior of the real exchange rate. In particular, we trace the rise in domestic nominal and real interest rates to policies designed to liberalize the domestic financial sector and attempts to curb the monetary expansion associated with the capital inflows through sterilized intervention.

1/ This paper was prepared for the African Economic Research Consortium workshop held on May 27-June 2, 1995 in Nairobi. Parts of this research was carried out while Patrick K. Asea was a visiting scholar in the Research departments of the Bank of Uganda and the International Monetary Fund. The views presented in this paper are those of the authors and do not necessarily represent those of the Fund. We thank John Cuddington, Ibrahim Elbadawi, Mohsin Khan, Vincent Reinhart, Ulrich Von Allmen and seminar participants at the African Economic Research Consortium workshop for helpful discussion and suggestions.

I. Introduction

During the early 1990s much has been written about the return of foreign private capital to many of the larger Asian and Latin American countries. 1/ However, until 1992 there was little evidence that countries in sub-Saharan Africa and other low-income countries, such as Bangladesh, Bolivia, India, Pakistan, and Sri Lanka, were participating in this phenomenon. Throughout most of the 1980s and early 1990s, capital flows to these countries were dominated by official transfers, as foreign private capital was funnelled elsewhere. However, by 1992 even several of these smaller countries began to share in the marked rise in private capital inflows to the developing world.

However, as these inflows persisted, many of the less desirable side-effects of capital inflows also became manifest. Nominal and real exchange rate pressures emerged, and countries such as Kenya and Uganda experienced a pronounced appreciation in the real exchange rate (Chart 1). As the monetary authorities attempted to stem the appreciation by intervening in the market for foreign exchange, reserve accumulation accelerated (Chart 2) and monetary control became more difficult, let alone meeting pre-announced monetary targets. Attempts to sterilize the foreign exchange transaction through either open market operations or increases in reserve requirements often drove domestic nominal and real interest rates higher, acting as a further stimulus to inflows and increasing debt-servicing costs for the government and the central bank. 2/

Recurring questions that emerged were: To what extent are the capital inflows an exogenous phenomenon driven by external fundamentals? Or conversely, what role have domestic macroeconomic and structural policies played in attracting the flows? What is the appropriate policy response? What factors determine the extent of the real exchange rate

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1/ See Calvo, Leiderman, and Reinhart (1995) for a discussion of this literature.

2/ These effects of the sterilization policies are not limited to the African countries, as several Asian and Latin American countries had similar experiences (see Reinhart and Dunaway (1995)).

appreciation? Are the high domestic real interest rates a byproduct of financial liberalization or of monetary policy?

The purpose of this paper is to answer some of these questions for four African countries that have recently experienced a rise in capital inflows. The paper analyzes the recent economic developments and the relevant stylized facts in Ghana, Kenya, Uganda, and Zimbabwe. Developments in the current and capital accounts, international reserves, real and nominal exchange rates, real and nominal interest rates, investment, inflation and growth are examined. The role played by financial liberalization is discussed and monetary, exchange rate, and fiscal policy responses to the inflows are reviewed. The experiences of these countries are compared to those of countries facing similar circumstances outside the region. A more detailed empirical analysis of the relationship among domestic and foreign real interest rates and the real exchange rate is provided for Ghana and Kenya.

All told, six key empirical regularities emerge from the analysis:

First, trend-cycle decompositions of the real exchange rate reveal that for the countries considered, the real exchange rate tends to appreciate relative to its steady-state equilibrium values during the period of rising capital inflows and heavy reserve accumulation.

Second, domestic real interest rates tended to be higher and domestic-foreign rate spreads were wider during the early phases of the capital inflow episode.

Third, the rise in domestic nominal and real interest rates can be traced to structural polices (i.e. liberalization of the domestic financial sector) and to the policy response to the rise inflows (Le. sterilized intervention).

Fourth, foreign real interest rates are found to be a significant determinant of domestic real interest rates and real exchange rates at standard confidence levels.

Fifth, while the foreign real interest rate accounts for about half of the monthly forecast error variance of the real interest rates, this external factor accounts for less than 20 percent of the monthly forecast error variance of the real exchange rate. Domestic interest rates have

played a more important role in explaining the behavior of real exchange rates, as these account for 15-50 percent of the monthly forecast error variance of the real exchange rate.

Sixth, as predicted by theory, impulse responses show that increases in foreign real interest rates (these would be associated with a capital outflow) tend to depreciate the real exchange rate. On the other hand, increases in domestic real interest rates (which would be associated with a capital inflow) lead to a real exchange rate appreciation. An increase in real short-term U.S. interest rates translates to a higher domestic real interest rate. Thus, the impulse responses also indicate that domestic and foreign rates move in a common direction, indicating a high degree of capital mobility.

The following section presents the stylized facts, reviews the role of recent structural, monetary, and exchange rate policies in influencing the behavior of nominal and real interest rates and presents a trend-cycle decomposition of the real exchange rate, so as to assess the relationship between shifts in capital flows and over/under valuation. Section III summarizes a theoretical model that motivates the subsequent empirical analysis. Section IV examines the interaction between domestic and foreign real rates of return and the deviations of the real exchange rate from its steady state value. This section analyzes whether external interest rate shocks have played a systematic role in influencing the behavior of the domestic interest rate and the real exchange rate. In addition, since liberalization of financial markets in several African countries in recent years has had a profound influence on the behavior of nominal and real interest rates (as have the efforts to sterilize capital inflows), this section examines how fluctuations in domestic real interest rates may influence the real exchange rate. Policy implications and areas for further research are discussed in the final section.

II. Real Interest Rates, Capital Flows and the Real Exchange Rate

This section reviews the basic stylized facts and developments in the current and capital accounts, international reserves, real and nominal exchange rates, real and nominal interest rates,

investment, inflation and growth. The role played by financial liberalization is discussed and monetary, exchange rate, and fiscal policy responses to the inflows are reviewed. The experiences of these countries are compared to those of countries facing similar circumstances outside the region.

1. *Recent trends*

Table 1 summarizes the recent developments in the external accounts of the four countries of interest. The increased inflows show up as larger surpluses in the capital account balance, which consists of public and private flows and includes errors and omissions. However, for these countries an important component of the inflows is not recorded in the capital account. Private transfers and workers' remittances in the current account have also picked up in 1993 for all these countries. 1/ A large proportion of the rising inflows are short-term and funnelled through the domestic banking system, as marked increases in foreign direct investment have not yet materialized. In addition, because of the relatively small size of domestic capital markets, portfolio investment, which has played a key role in the larger Asian and Latin American has been very limited. In the case of Uganda, the return of flight capital of formerly resident Asians has also been a factor.

The universal feature of the these capital inflows episodes has been that some portion of the inflows has a counterpart in reserve accumulation (see Chart 2 and Calvo, Leiderman, and Reinhart (1994)). Central banks have tended to resist, in varying degrees, a nominal appreciation. Besides an accumulation in reserves, the macroeconomic effects of the inflows have been more ambiguous. As Chart 1 illustrates, the behavior of the real exchange rate varies considerably; this is also the case for countries outside the region (see Calvo, Leiderman, and Reinhart (1994 and 1995)). The evolution of the current account also shows considerable cross-

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1/ This has also been the case for other countries outside the region, such as El Salvador and Pakistan.

country variation, although in the majority of countries, including Ghana, Uganda, and Zimbabwe, the capital inflows have financed larger current account deficits.

In most instances, the inflows have been associated with higher economic growth (Table 1), although the composition of aggregate demand has also varied considerably across countries and time. In some countries, such as Argentina, Brazil, and Mexico the inflows have been accompanied by a boom in consumption. 1/ In many of the fast-growing Asian economies the increase in absorption has been primarily in investment. As Table 1 shows, there is considerable cross-country variation, in both Kenya and Uganda private investment (as a percent of GDP) has risen, in the case of the latter there has also been a marked rise in public investment. For Ghana and Zimbabwe, the increases in aggregate demand have come from either the public sector of private consumption, which has risen as a share of GDP.

As to causes of the inflows, an inspection of Chart 3 suggests that the sharp rise in domestic real interest rates may have been a key factor behind the rising capital inflows. After remaining negative through much of the 1980s and early 1990s, the combination of financial market liberalization and efforts to fully or partially sterilize the large scale foreign exchange operations of the central bank drove real interest rates higher. On a risk-adjusted basis the increases in real rates may be even more pronounced. During recent years, countries such as Kenya and Uganda have also liberalized remaining exchange restrictions on current account transactions as well trade and the capital account. In addition, some of these countries have also had successful inflation stabilization programs and somewhat better growth performance. Taken together, it could be argued that the risk premia for these countries may have declined. 2/ In addition, by 1993 short-term international interest rates had levelled off (albeit, at very low levels) and by February 1994, these were on the rise, making it unlikely that foreign financial

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1/ In the case of Argentina, investment picks up at a later stage.

2) Indeed, the model outlined in the next section highlights the links among macroeconomic variables and the risk premia.

sector developments were the dominant factor behind the rise in inflows. These issues will be examined in Section IV.

However, a positive external shock in the form of a boom in coffee prices may also be an important contributor to the recent inflows, as past booms have also had similar effects in these countries and elsewhere (see Cuddington (1989) and Hadjimichael et. al. (1995)). As Table 1 shows, coffee accounts for almost all of Uganda's exports and about one-third of Kenya's exports. During 1992-93 coffee prices stood at $0.80 a kilo; by mid-1994, on the wake of a frost in Brazil, coffee prices more than trebled to $3.20 a kilo (see Sharer, De Zoysa, and Donald (1995)).

2. Equilibrium real exchange rate: trend-cycle decompositions

As shown in a variety of models of real exchange rate determination (see for instance, Edwards (1989),, Lizondo (1991 and 1993), Montiel and Ostry (1991 and 1992), and Calvo, Reinhart, and Veigh (1995)), the determinants of the equilibrium real exchange rate usually include, among other variables, the terms-of-trade, government spending on nontraded goods, and the ratio of consumption of traded goods to nontraded goods. Some models stress the role of wealth effects (see Lizondo (1991 and 1993) and Montiel and Ostry (1991 and 1992)),, while others focus on the structure of capital flows (see Elbadawi and Soto (1994)). In any case, these models suggest that the equilibrium real exchange rate is anchored by a number of macroeconomic variables that are often hard to measure, particularly at monthly or quarterly frequencies; some, as the capital mobility measures used by Edwards (1989),, are hard to quantify at all.

In the steady state, these models assume that real interest rate parity holds; in models that allow for imperfect asset substitutability, such as the one outlined in the next session, the parity condition holds on a risk-adjusted basis. However, if prices adjust slowly to their equilibrium values in response to shocks, temporary deviations from real interest rate parity can occur and

these deviations should be correlated with the cyclical component of the real exchange rate--as the real exchange rate will also temporarily deviate from its long-run value (see, for example, Baxter (1994)).

In this paper, we do not attempt to model the steady-state behavior of the real exchange rate, but instead focus on the relationship between the cyclical component of the real exchange rate and the domestic and foreign real interest rate. Theory predicts that, other things equal, higher domestic real interest rates will attract capital from abroad. The capital inflow, in turn, will finance an increase in aggregate demand. To the extent that part of the increased absorption falls on the non-traded good, the real exchange rate will appreciate, relative to its steady-state level. In addition, if the increased inflow of foreign exchange results in a nominal appreciation of the exchange rate and prices are slow to adjust, then the nominal appreciation will also translate into a real appreciation. Conversely, a rise in real international interest rates induces a capital outflow, as foreign assets become more attractive, and a real depreciation ensues.

Of course, the extent to which the real exchange rate responds to changes in rates of return will depend importantly on the exchange rate regime, the openness of the economy, and the structure of aggregate demand. The greater the degree of exchange rate flexibility, the more rapid the response of the nominal and real exchange rate to changes in interest rate differentials and international capital movements. The higher the degree of international capital mobility, the greater the sensitivity of capital flows to changes in international interest rates. In addition, the extent of the real exchange rate appreciation will be greater the more that the expansion in absorption is biased toward the nontraded good (see Diaz-Alejandro (1984) and Calvo, Leiderman and Reinhart (1994)).

Hence we proceed in two steps, we first decompose the real exchange rate into its permanent "trend" component and its cyclical "temporary" component. The aim of this section is to first provide an idea to what extent the recent real exchange rate movements are associated with cyclical forces, possibly related to rising capital inflows, or in what measure it reflects a

change in the underlying trend. In the second step, the linkages between the cyclical component and domestic and foreign interest rates; those issues are examined in the following section. Alternative methodologies to address this issue are available: some are univariate, such as the one used here, while others focus on a systems approach (see for instance, Baxter (1994) and Reinhart and Wickham (1994)).

The appropriate technique for extracting the permanent component of a time series depends on the underlying properties of that series. If a unit root is present, then admissible ways of disentangling trend from cycle include the methodology proposed by Beveridge and Nelson (1981). 1/ In testing for the real exchange rate for the presence of a unit root using the standard tests (including the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) test), we found that the null hypothesis of a unit root in the real exchange rate could not be rejected for any of the four countries under consideration, irrespective of whether or not a structural break was included. 2/

First, employing the Beveridge-Nelson (B-N) technique (Beveridge and Nelson (1981)) as modified by Cuddington and Winters (1987) and Miller (1988), we decompose the real commodity price into its "permanent" (or steady-state) component and "temporary" (or cyclical component), denoted by z and c, respectively. As discussed above, the identifying criteria for this technique is that the former captures the nonstationary component of the variable, while the latter captures its stationary element. Hence,

$$y_t = z_t + c_t \qquad (1)$$

1/ An alternative methodology for the univariate case would be the structural time series approach associated with Harvey (1985), as this approach also allows for the presence of a stochastic trend.

2,/ These results are not reported in the paper but are available upon request. The break point for each country was determined by selecting the month in which the largest devaluation took place during the sample. Since, indeed, the nominal devaluation translated into a real devaluation as well.,

The evolution of the permanent component is given by

$$\Delta z_t = \mu + \frac{(1-\theta_1-\theta_2-\ldots-\theta_q)}{(1-\phi_1-\phi_2-\ldots-\phi_p)}\epsilon_t \qquad (2)$$

where θ and ϕ are the parameters describing the ARMA process. Using the estimates of θ, ϕ, and ϵ the path of the permanent component is constructed. The cyclical component is calculated residually, as the difference between the estimated permanent component, z, and the actual values of y. 1/

The real exchange rate index used is trade weighted, and the data is monthly for the period January 1979-December 1994. Given that several of the countries under consideration had large discrete nominal devaluations during the period covered, we allowed for multiple breaks in the drift when fitting the data to an ARMA process. Table A.1 in the Appendix reports these dates. Using the Box-Ljung Q statistic as a guideline, the ARMA processes were selected so as to whiten the error. In general the longer ARMA processes provided the best fit. 2/ At the quarterly frequency, an ARMA(20,4) process was fitted to the all-commodity and beverages groupings, while food and metals were characterized by ARMA(16,4) processes. Table A.1 in the Appendix reports the full estimation results for the annual frequency and the main diagnostics of the quarterly estimation.

Chart 4 plots the ratio of the actual series to the estimated "permanent" or steady-state component, that is the cycle or temporary component. Since an increase in the real exchange rate index denotes an appreciation, then a ratio greater than unity indicates that the real exchange rate is "overvalued" relative to its steady-state level. For example, a ratio of 1.05 indicates that the actual real exchange rate is five percent above its steady state value. Several

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1/ For additional details see Beveridge and Nelson (1981) and Miller (1988).

2/ For a discussion of the problems associated with fitting low ARMA processes to macroeconomic data see Cochrane (1988).

observations emerge from examining the behavior of reserves, real interest rates, and the cyclical component of the real exchange rate (Charts 2-4). During periods of heavy reserve accumulation and rising capital inflows, Ghana (1991),, (mid-1993-1994), Kenya (mid-1993-1994), , Uganda (1993-1994), and Zimbabwe (1993-1994), , domestic real interest rates are rising and, in some instances remaining at levels which are well above 10 percent. Hence, based on an inspection of Charts 2-3, it could be noted that high domestic real interest rates are pulling in foreign capital.. During these periods, as shown in Chart 4, the real exchange rate tends to appreciate relative to its permanent, steady-state component and the ratio tends to exceed unity. Indeed, Chart 4 is an interesting contrast to Chart 1, which plots the actual real exchange rate. A perusal of Charts 1-3 would lead one to conclude that there are no apparent patterns in the behavior of the real exchange rate during periods of high real interest rates and rising capital inflows, since the real exchange rate appreciates in only two out of the four cases. However, it is interesting to note, that in all four cases (as in Chart 4) the real exchange rate appreciates, relative to its steady-state value during these episodes. Hence, real interest rates and fluctuations in capital flows would appear to be linked to cycle of the real exchange rate rather than its underlying trend.

3. Interest rates, financial liberalization, and sterilized intervention

During the late 1980s, the process of liberalizing and reforming domestic financial markets got underway in a number of African countries (see, for instance, Galbis (1993) and Montiel (1994)). In Ghana ceilings on interest rates were removed in 1987, while quantitative credit controls were removed in 1992. In Kenya, interest-rate ceilings were removed in July 1991. In Uganda, the process of financial liberalization began in July 1988 when an increase of 10 percentage points was announced on most interest rates. However, interest rates continued to be administratively set by the Bank of Uganda until April 1992. 1/

1/ See Sharer, De Zoysa, McDonald (1995).

In most instances, the financial liberalization was accompanied by a rise in real interest rates, often from very negative levels (Chart 3). However, financial liberalization has not been the only factor behind the high interest rates. As discussed earlier, the initial policy reaction to the rising capital inflows has been to intervene in the market for foreign exchange and sterilize the effects of the intervention through either open market operations, increases in reserve requirements, or both. In the case of Kenya, large-scale sterilization efforts began around October of 1993 and persisted through most of the first half of 1994. For Uganda sterilization efforts were particularly intensive in 1993.

As in several Asian and Latin American countries, sterilization in Kenya took several forms. The Central Bank of Kenya increased its sales of treasury bills during late 1993 and early 1994. In addition, during the October 1993-March 1994 period the statutory cash ratio was raised in three steps from 12 percent to 20 percent. As Table 2 highlights, the increased sales of treasury bills and higher reserve requirements drove domestic interest rates higher. 1/ Since the Kenya shilling was appreciating during this period the rise dollar returns is even more dramatic. By mid-1994 the high level of interest rates was increasing debt-servicing costs, generating quasi-fiscal losses and stimulating additional inflows. 2/ Indeed, domestic interest payments in the 1993/94 budget were 1.5 percent of GDP over program. At that time, it was decided that intervention efforts would be scaled back considerably and the shilling was allowed to appreciate further.

In the case of Uganda, sterilization took place primarily through the sales of treasury bills. During 1993 and early 1994 there was considerable intervention and sterilization efforts continued until April 1994. Domestic interest rates did not rise, as inflation was falling markedly during this period (Table 2). However, given the appreciation in the Uganda shilling during this

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1/ This pattern of response prevails in numerous sterilization episodes in Chile, Colombia, Indonesia, Malaysia, and the Philippines, among others (see Reinhart and Dunaway (1995).

2:/ For a discussion of the quasi-fiscal effects of sterilization policies see Rodriguez (1991),, and Kiguell and Leiderman (1994).

period, returns in dollars rose markedly (Table 2). Due to the lack of a well-developed secondary market and an insufficient volume of new issues, it became increasingly difficult for the central bank to pursue sterilization policies for an extended period of time. The marked decline in interest rates in the post-May 1994 reflects, in part, the inability of the central bank to conduct open market operations (Table 2).

III. Modelling Imperfect Asset Substitutability

When capital flows into a country it signals an increase in the demand for that country's assets. From a theoretical perspective this observation suggests that an international asset pricing model is the appropriate framework to investigate the causes, possible consequences, and policy responses to capital inflows. In addition, asset pricing models are desirable because they explicitly characterize the uncertainty governing asset returns. The existing literature on capital inflows to developing countries is based on deterministic intertemporal macroeconomic models that abstract from uncertainty and have little to say about the asset pricing nature of capital inflows.

Asea and Reinhart (1995) develop a stochastic general equilibrium asset-pricing model in a two-country world that addresses the limitations of existing cash-in-advance models. The model is novel in a number of respects. First, it synthesizes important aspects of both the monetary and portfolio-balance models of exchange rates. Second, it allows for imperfect asset substitutability. The model contributes to the literature by emphasizing the critical role played by the degree of relative risk aversion in determining the level and volatility of the exchange rate.

In the present paper we provide a brief discussion of some of the findings in Asea and Reinhart (1995). We focus on the risk premium and the effects of various macroeconomic variables on the premium. The model is a two-country, two-currency, two-bonds, two-commodity world economy. There are no constraints on international capital

flows. The two bonds, $B(B^*)$ are interest-bearing assets denominated in domestic(foreign) currency, are traded on international financial markets and have nonstochastic instantaneous nominal rates of interest, $i(i^*)$. 1/

The nominal value of domestic money is denoted by $M(M^*)$. Money is used only in the country in which it is issued and is a non-interest-bearing asset. In each country an investor maximizes the intertemporal expected utility of her lifetime consumption and the stock of real balances subject to her wealth $W(W^*)$ constraint,

$$\max E0 \{ \int_0^{+\infty} U[C(r), M(r), r] dr \} \tag{3}$$

where E_0 is the conditional expectation operator, conditional on her current wealth and the state of the economy, C is the consumption of domestic residents which is a constant elasticity of substitution (CES) aggregator of tradable and nontradable consumption. 2/ U is a time-dependent utility function which is monotonically increasing and strictly concave in real consumption and the stock of real balances.

We solve the investor's optimization problem by stochastic dynamic programing and show that the optimal portfolio share of assets (x_1) in this two-country world economy is

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1/ i and i^* are functions of the vector of state variables and time. They are known with certainty at each instant of time. However, the future values of i and i^* are not known with certainty, as such, they are endogenous in this model.

2/ See Asea and Mendoza (1994) for a similar treatment in a deterministic growth model.

$$x_1 = \frac{1}{\vartheta\sigma_\delta^2}(-i + i^* + \delta - \sigma_\pi^2 + \sigma_{\pi\pi^*} - \beta\sigma_R^2) + \frac{(\sigma_\pi^2 - \sigma_{\pi\pi^*} + \beta\sigma_R^2)}{\sigma_\delta^2} + \sum_1^m \varphi_i \frac{\sigma_\delta H_i \rho_{i\delta}}{\sigma_\delta^2} \quad (4)$$

where

$$\vartheta = \frac{-Jw_W}{Jr_{;,}}$$

is the coefficient of relative risk aversion;

$$\varphi_i = \frac{-J_{\tilde{w}\tilde{w}}}{J_{\tilde{w}}} \frac{1}{\tilde{W}} \qquad i=1,\ldots,n;$$

and

$$\sigma_{\delta\pi} = \sigma_\pi^2 - \sigma_{\pi\pi^*} + \beta\sigma_R^2$$

$\sigma_{\pi\pi^*}$ is the instantaneous covariance of the change in domestic inflation rate with the change in foreign inflation rate; $\sigma_{\pi R}$ is the instantaneous covariance of the change of domestic (foreign) inflation rate with the change in the exchange rate, 0 denotes the expected instantaneous rate of change of the exchange rate and $a0^2$ denotes the instantaneous variance of the rate of change of the exchange rate. S is a vector of state variables that are assumed to follow Itó Processes. and asterisks denote foreign variables. The optimal portfolio share (4) consists of three terms: a speculative component, a minimum variance component, and a hedge component. The first term on the right-hand side in (4) represents the speculative

portfolio share which depends on the expected real yield differential

$$r - r^* = -\mathbf{i} + \mathbf{i}^* + 0 - a_{11}2 + a_{11"11"}^* - fJaR2$$

the risk aversion parameter (/J, and exchange rate risk $a0^2$.

The second term is a minimum-variance component which is independent of risk aversion. Its composition depends only on the relative riskiness of the domestic and foreign bonds,

$$a_{u}^{2} - a_{r}^{2} + a_{r}^{2} * - 2a_{rr} *$$

$$\sigma_{r}^{2} - \sigma_{rr} * \sigma_{\pi}^{2} - \sigma_{\pi\pi} * + \beta\sigma_{R}^{2} ,$$

Finally, the last term is a hedge component against possible unfavorable shifts in the consumption opportunity set.

One of the merits of this asset pricing approach is that we are now able to derive an explicit representation of the risk premium as a function of macroeconomic variables. The risk premium is

$$rA = \text{'IJ}(a",,2 \quad a_{11"11"*} + (3aR^2) - \text{'IJao2} \frac{E(M^* \pm B^*)}{M + B + E(M^* + B^*)} + \quad (5)$$

$$(\text{'IJ} - 1)a/ \quad (\{3 - (3^*)\frac{W^*}{W + W^*} + \text{'IJ}\, frpiroHiPiO$$

where r_A is the portfolio risk premium on domestic assets in the international financial market. An interesting feature of the risk premium in (5) is that it is a function of the relative supply of outside assets but not a function of net foreign assets. Contrary to claims made in some policy and academic circles, there is in general no direct link between the current account and related changes in net foreign assets and the risk premium. However, Asea and Reinhart (1995) are able to establish a link between the current account and the risk premium through the redistribution of wealth in the global economy.

Having derived the risk premium in general equilibrium, we will now use it to illustrate how the model can be used to provide specific answers to a number of interesting questions. First,

how does the risk premium respond to an increase in domestic money supply or domestic bonds? To answer this question note that an increase (decrease) in domestic money supply or in the supply of domestic bonds raises (reduces) the risk premium on domestic assets. On the contrary, an increase (decrease) in foreign money supply or in the supply of foreign bonds leads to a decrease (increase) in the risk premium on domestic assets.

Second, how does the variability of the inflation rate affect the risk premium? To answer this question, note that the larger (smaller) is the variability of the domestic rate of inflation, the larger (smaller) is the variability of real returns on domestic assets. This causes domestic assets to be riskier (less risky) and raises (lowers) the risk premium on domestic assets. On the contrary, the larger the is covariance between the domestic inflation rate and the foreign inflation rate, the smaller is the risk premium. Since the larger covariance reduces the relative riskiness of domestic assets compared with foreign assets, this decreases the risk premium on domestic assets.

Third, how does nominal exchange rate variability affect the risk premium? To answer this question, note that the larger is the variance of the rate of depreciation, the smaller is the risk premium. The larger the exchange rate variability, the larger is the variability of real return on foreign assets in domestic real terms. This makes foreign assets riskier and decreases the risk premium on domestic assets. In summary, the higher is the exchange rate risk, the riskier are foreign-currency-denominated assets and, on the contrary, the safer are the domestic-currency-denominated assets. Note that the variance of the foreign inflation rate has no impact on the risk premium on domestic assets since it is fully offset by exchange depreciation.

The merits of adopting an equilibrium asset pricing approach should be apparent from the above discussion. The valued-added is that one is able to ask very specific questions regarding the relationship between macroeconomic variables and risk premia. We conclude this section with a few comments on how the model outlined here differs from the familiar portfolio-balance

model. In the portfolio-balance model, investors wish to allocate their wealth in portfolio shares that are well-defined functions of expected rates of return on domestic and foreign assets because they are imperfect substitutes. In the portfolio-balance model, perfect substitutability between domestic and foreign assets means that investors are indifferent as to the composition of their portfolios as long as the expected rates of return on two countries' assets are the same when expressed in any common numeraire.

In the present analysis, however, asset demand function depend on the second moments of stochastic variables as well as on expected real rates of return. Even though the expected real rates of return on domestic and foreign assets are the same, there will always exist an optimal portfolio share of assets such that investors minimize the variance of portfolio returns and thus. Therefore investors cannot be indifferent between holding domestic assets and foreign assets that pay the same expected rate of return.

IV. Empirical Evidence

Here we examine the interaction between domestic and foreign real rates of return and the deviations of the real exchange rate from its steady state value. The aim of the analysis is twofold. First, we gauge whether external interest rate shocks have played a systematic role in influencing the behavior of the domestic interest rate and the real exchange rate. Second, liberalization of financial markets in several African countries in recent years has had a profound influence on the behavior of nominal and real interest rates. 1/ In addition, efforts to sterilize capital inflows through either open market operations or increases in reserve requirements have also been a key element in driving domestic interest rates higher in several African countries and

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1/ For a chronology of the reforms in a number of African countries, see Montiel (1994). For broad cross-country evidence of the significant impact that financial market liberalization has on real interest rates, see Galbis (1993). For the experience of Uganda in particular, see Sharer, De Zoysa, and Mc Donald (1995).

elsewhere in recent years. 1/ Hence, it is useful to examine how fluctuations in domestic real interest rates may influence the real exchange rate. 2/

1. *Do external factors play a significant role?*

In this subsection, the analysis proceeds in two stages. We first estimate a structural VAR that includes domestic and foreign variables: the real domestic interest rate on a 3-month Treasury bill, the comparable U.S. interest rate, and the cyclical component of the exchange rate, as derived in Section II. 3/ Since all the variables in question are stationary, statistical inference can proceed as usual. 4/

The foreign and domestic real interest rates are included separately (rather than as a spread) because we wish to distinguish between the influences of the exogenous foreign factor and the endogenous domestic one. Besides, the theoretical model reviewed in the previous section suggests that the relative risk premium on domestic and foreign assets drives a wedge between the two national interest rates. In addition, the-noise-to-signal ratio in domestic and foreign real rates of return are markedly different, as the variance in domestic real rates is several times that of US real interest rates. Hence, imposing that their coefficients be equal, but oppositely signed, may be too restrictive an assumption.

In the second step, we estimate a restricted system, which excludes the foreign interest rate, and perform tests of these exclusion restrictions to determine the statistical significance of the foreign variable. Variance decompositions are used to quantify the relative importance of domestic and foreign factors in accounting for forecast error variance of the domestic real

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1/ For a review of the experience of a number of Asian and Latin American countries with these policies see Reinhart and Dunaway (1995).

2) To examine how deviations in the real exchange rate from its equilibrium level affect, growth, exports, and saving and investment, see Ghura and Grennes (1993).

';i/ All data is monthly and the period of estimation is given in the tables that follow.

1/ However, because one of the variables is constructed for a preliminary round of estimation--the cyclical component of the real exchange rate, standard errors should be interpreted with caution.

interest rate and the real exchange rate cycle, while impulse response functions show how these variables react to a variety of shocks.

Defining r_t and $r^{***}t$ as the domestic and foreign real interest rate, respectively, and $REXC_t$ as the log of the cyclical component of the real exchange rate (plotted in Chart 4), the reduced form of the system is given by:

$$
\begin{aligned}
r^{*}_{t} &= Q1 + \sum_{i=1}^{n} f31ir^{*}_{t-i} + U_t^{r^{*}} \\
rt &= Q2 + \sum_{i=1}^{n} f32ir^{*}_{t-i} + \sum_{i=1}^{n} 02irt\text{-}i + \sum_{i=1}^{n} ol2iREXCt\_i + U_t^{r} \qquad (6) \\
REXCt &= Q3 + \sum_{i=1}^{n} f33ir^{*}_{t-i} + \sum_{i=1}^{n} 03irt\text{-}i + \sum_{i=1}^{n} ol3iREXCt\_i + U_t^{REXC}
\end{aligned}
$$

As equation (6) illustrates, we allow for an autoregressive dynamic specification of the foreign interest rate but impose its temporal exogeneity by not including lagged values of the endogenous variables, domestic real interest rates and the real exchange rate, in its equation (i.e. $\delta_{1i}=\delta'_{1i}=0$);hence, we impose structure on the temporal relationships between these variables. Each equation in the system includes a constant. Since the tests could be affected by the number of lags included in the right hand side of each equation, and given that we had no strong priors on this issue, we used the Schwarz criteria to select among one-, three-, six-, nine-, and 12-month lag profiles. 1/ The lag length selected by this criteria varied across countries and is reported in Tables 3A and 3B.

The reduced-form residuals, the u_t's, depend on the structural errors, e_t, and the contemporaneous relationships between the endogenous variables, specifically, $u_t = e_tA$. So next, we consider the structure of the matrix A, which describes the contemporaneous relationships between the variables. In the general case, a causal ordering amounts to assuming

---

1/ For simulation evidence on the efficacy of these criteria, see Lutkepohl (1985).

that the endogenous variables enter the system in a triangular form, with the first equation containing one endogenous variable, the second two variables, and so on, giving a specific form to the A matrix. Since our priors suggested a just-identified system, we do not follow the methodology of Bernanke (1986) and Blanchard (1989), and simply opt for the triangular ordering associated with the Choleski factorization described below. Specifically, since there is a presumption that the foreign factors are exogenous, we do not allow for feedback from shocks to the domestic variables to the reduced form error of the foreign variable.

$$r^*_t = e^{r^*}_t ,$$

while the domestic real interest rate is affected by the structural shocks to the foreign variable and by its own shock,

$$r_t = a_{21} r^*_t + e^{r}_t .$$

$$REXC_t = a_{31} r^*_t + a_{32} r_t + e^{REXC}_t .$$

The real exchange rate is allowed to respond to all of the shocks. 1/

After the system was estimated using monthly data from around 1980 to December 1994, we tested for the significance of the foreign interest rate. 2/ Tables 3A and 3B summarize the results of the tests for exclusion restrictions, tests that involve the temporal relationships. The null hypothesis being tested is that the foreign variable does not affect the domestic real interest rate and the real exchange rate. The high X^2-statistics and low probability values indicate that in

---

1/ Alternative orderings are explored. One alternative imposes that there be no contemporaneous relationship between reserves and the real exchange rate, while another treats reserves as the most "endogenous" variable in the system. The results do not differ appreciably from those presented here.

2) Exact dates are given in the Tables 3A and 38.

the two countries examined, one can reject the null hypothesis at the 95 percent level of confidence or higher. 1/

To examine the interaction among the domestic variables, we conducted Granger causality tests. Specifically, we were interested in assessing whether deviations of the real exchange rate from its steady-state level were systematically influenced by the domestic real rate of return. The results, which are reported in Table 4, show that in the case of Ghana the causality runs in both directions--past domestic real interest rates influence the cyclical component of the real exchange rate and vice versa. For Kenya the domestic real interest rate Granger-causes the real exchange rate, but the lagged cyclical component of the real exchange rate is only significant at the ten percent level. Hence, in both countries domestic interest rates have a systematic causal influence on the deviations of the real exchange rate from its steady-state level.

While Tables 3A, 3B, and 4 provide evidence only on the statistical significance of the relationships between the variables, it is also useful to assess the relative importance of the foreign impulses. For this purpose, we examined variance decompositions and the impulse responses of the real exchange rate and domestic real interest rates. Two observations are worth noting from the results of the variance decompositions of real exchange rate forecast errors presented in Table 4 and the impulse responses plotted in Chart 5.

First, the share of the monthly forecast error variance of the real exchange rate explained by the foreign real interest rate is considerably smaller, and in the 8-to-13 percent range. This is well below the 30-50 percent share that Calvo, Leiderman, and Reinhart (1993) find for Latin American countries. There are, at least, three possible explanations for this difference. Calvo, Leiderman, and Reinhart (1993) focus on monthly data for a large number of countries over a smaller sample 1988-91. For a smaller sample, country-idyosincratic shocks are likely to be fewer. An example of a "country-specific" shock is financial liberalization, which takes place

---

1/ Tables 3A and 38 also summarize the usual diagnostic statistics for the equations of the two endogenous variables.

during the period covered in our sample for both Ghana and Kenya; financial sector reforms predated 1988 for most of the Latin American countries. 1/ Temporary terms-of-trade shocks may be relatively more important in explaining cycles in the real exchange rate for Ghana and Kenya vís-a-vís the more diversified Latin American countries. 2/ Lastly, the United States may play a more important role in Latin America, given its geographical proximity and the high degree of integration in capital and goods markets.

Second, these decompositions highlight that domestic financial sector developments, to the extent that these are reflected in real interest rates, play an important role in explaining the behavior of the real exchange rate.in the case of Kenya, the domestic real interest rate accounts for an important (about 50 percent) share of the monthly forecast error variance of the real exchange rate, while for Ghana the share is lower, at around 17 percent.

Last, we turn to impulse response functions. Chart 5 depicts for Ghana and Kenya the response of the real exchange rate to a one-standard-deviation shock to the domestic and external real interest rate. Chart 5 shows that, as predicted by theory, increases in foreign real interest rates (which would be associated with a capital outflow) tend to depreciate the real exchange rate for a period of about a year, before the real exchange rate converges to its initial level. On the other hand, increases in domestic real interest rates (which would be associated with a capital inflow) lead to a real exchange rate appreciation. One key difference, however, to how the real exchange rate responds to these interest rate shocks is that for both countries the effects of a domestic shock tend to be much more persistent. Indeed, there are substantial effects lasting up to two years--even after 60 months the real exchange rate does not return to its initial level.

1/ Galbis (1993) presents considerable cross-country evidence suggesting financial sector liberalization leads to higher real interest rates and increased capital inflows.

2/ Since the terms-of-trade is excluded from this system, its influence would, most likely, show up in idiosyncratic shocks to the real exchange rate.

2. *Interest rate links and capital mobility*

We now turn to the response of the domestic real interest rate to foreign interest rate shocks and examine this interaction so as to make inferences about the degree of capital mobility. With regard to the quantitative importance of foreign real rates of return, we find that for both countries a sizable fraction (about 30-50 percent) of the monthly forecast error variance in the domestic real interest rate is accounted for by the foreign interest rate (Table 4). These magnitudes are in line with the results of Glick and Moreno (1994), who used similar approach and focused on nominal interest rates for a sample of Asian countries. Indeed, Glick and Moreno estimate these relationships over two sample periods and associate the increased importance of foreign interest rates during the more recent sample period with the removal of capital account barriers in the countries they examine.

The results of the impulse responses also attest to the importance of foreign interest rate shocks. As shown in Chart 6, an increase in real short-term U.S. interest rates translates to a higher domestic real interest rate for a period of about a year; afterwards the domestic real rate tends to converge to its initial level. Thus, these impulse responses also indicate that domestic and foreign rates move in a common direction, indicating a high degree of capital mobility. 1/ The fact that these two rates do not move in tandem is perfectly consistent with our theoretical model of imperfect asset substitutability.

V. Concluding Remarks

Reviewing the recent experience of several African countries with rising capital inflows highlights many similarities and a few differences with countries facing similar experiences in other regions. Inflows to the African countries have tended to be more skewed toward the short

---

1/ If real interest rate parity held exactly, the comovement would be one-to-one; if capital markets were completely closed there need be no relationship between domestic and foreign rates.

end of the maturity spectrum, since foreign direct investment and portfolio flows have not played an important role. This could potentially make capital flows more interest sensitive. Indeed, as shown in the previous section, the evolution of domestic real interest rates have played a key role in explaining the behavior of the real exchange rate.

As to the macroeconomic effects of these inflows, there does not appear to be any particular case that deviates from the experiences of countries outside the region. In the area of policy response, the experience of Kenya and Uganda, in particular, also resembles that of several Asian and Latin American countries, particularly countries such as Peru and the Philippines, which have more flexible exchange rate arrangements. However, there does appear to be a difference in these countries' ability to sterilize foreign exchange operations, as small or nonexistent secondary markets for short-term paper appear to be more of a constraint. While other countries, such as Chile and Malaysia, eventually scaled-back or abandoned sterilization policies, they were able to conduct these policies for extended period of time.

Lastly, it appears that much of the behavior of the real exchange rate can be accounted for by the evolution domestic real interest and, hence, it could be inferred that the same would apply to capital flows. The previous statement would suggest that the recent capital inflows may have been a byproduct of financial sector liberalization. However, it is worth noting that an important difference between the recent experiences of Uganda, and to a lesser extent, Kenya, with other developing countries experiencing capital inflows is that the former have enjoyed a more pronounced terms-of-trade improvement that has been experienced elsewhere. Hence, to the extent that some of this improvement is temporary, then so may be the capital inflows.

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Table 1. Selected Economic Indicators

	Ghana	Kenya	Uganda	Zimbabwe
Current account as a percent of GDP				
1983-92	-2.4	-3.3	-4.5	-3.3
1993-94	-7.5	2.3	-6.3	-5.0
Capital account as a percent of GDP				
1983-92	2.5	2.9	3.5	2.4
1993-94	9.3	4.4	6.1	3.7
Private transfers in the current account as a percent of GDP				
1983-92	2.4	1.3	2.5	-0.4
1993-94	4.8	2.2	3.6	0.6
Real GDP growth				
1983-92	4.2	3.5	3.7	2.0
1993-94	5.0	2.1	5.0	3.3
Private investment as a percent of GDP				
1983-92	5.4	11.7	2.8	16.6
1993-94	3.3	12.9	5.0	15.1
Public investment as a percent of GDP				
1983-92	6.2	7.4	3.2	2.9
1993-94	10.9	5.9	7.6	4.5
Coffee exports as a percent of total exports				
1985-87 average	0.1	31.7	95.8	0.0

Sources: Hadjimichael, et. al. (1995) and World Economic Outlook, International Monetary Fund.

Table 2. Interest Rates and Sterilized Intervention

	Interest rate 3-month Treasury bill	Interest rate Converted into dollars [11]	Change in Reserves (millions of dollars)	Change in the nominal exchange rate [21] (percent)
Kenya				
Pre-inflow:				
August 1992-July 1993	33.8	-14.3	35.0	99.3
Capital inflows and heavy sterilization				
August 1993-June 1994	39.8	84.27	591.9	-14.6
Capital inflows and moderate intervention				
July 1994-December 1994	19.7	177.1	-126.9	-19.9
Uganda				
Pre-inflow:				
November 1991-November 1992	39,4	13.8	-10.5	32.3
Capital inflows and heavy sterilization				
December 1992-Apri11994	21.7	47.7	115.8	-17.7
Capital inflows and moderate intervention				
May 1994-December 1994	9.3	17.9	70,4	-2.7

liThe following fa-mula is used to convert the domestic interest rate into U.S. dollars: $(1+i_t)e_t/e_{t+_3}$ where e_t is the spot exchange rate and it is the nominal interest rate.

[21] A decline in the nominal exchange rate denotes an appreciation.

Table 3A. Ghana: Vector Autoregressions
1981 :6-1994: 12

Dependent Variable	Domestic Real Interest Rate	Cyclical Component of the Real Exchange Rate
R^2	0.84	0.97
R-BAR^2	0.80	0.96
SEE	15.20	0.04
Q	24.61 (0.92)	22.18 (0.97)
Observations	163	
Number of lags	9	
Test for exclusion Restrictions		
χ^2	19.04 (0.01)	

Source: The authors.
Notes: Probability values are in parentheses.
The optimal lag length of the VAR was selected using the Schwarz criteria.

Table 3B. Kenya: Vector Autoregressions
1981:6-1994:12

Dependent Variable	Domestic Real Interest Rate	Cyclical Component of the Real Exchange Rate
R^2	0.85	0.92
R-BAR^2	0.83	0.91
SEE	8.91	0.02
Q	41.55 (0.24)	32.45 (0.64)
Observations	163	
Number of lags	6	
Test for exclusion Restrictions		
χ^2	13.69 (0.03)	

Source: The authors.
Notes: Probability values are in parentheses.
The optimal lag length of the VAR was selected using the Schwarz criteria.

Table 4. Causality Tests
1981:6-1994:12

	Domestic Real Interest Rate Equation	Real Exchange Rate Equation
Ghana		
Domestic Real Interest Rate:		
F-statistic	57.454	2.789
Probability value	0.000	0.008
Cyclical Component of the Real Exchange Rate:		
F-statistic	2.834	234.124
Probability value	0.004	0.000
Kenya		
Domestic Real Interest Rate:		
F-statistic	85.531	3.049
Probability value	0.000	0.008
Cyclical Component of the Real Exchange Rate:		
F-statistic	2.016	176.573
Probability value	0.067	0.000

Source: The authors.
Notes: Probability values are in parentheses.
The optimal lag length of the VAR was selected using the Schwarz criteria.

Table 5a. Decomposition of Variance: Real Exchange Rate

Country	Number of months	Standard error	U.S. real interest rate	Domestic real interest rate	Cyclical componer of the real exchange rate
Ghana	12	0.199	10,475	9.718	79.806
	24	0.255	12.914	14.146	72.939
	36	0.276	12,467	15.787	71.745
	48	0.284	12.109	16,414	71,476
	60	0.287	12.052	16.631	71.315
Kenya	12	0.039	7.994	30.334	61.671
	24	0.054	9.241	42.552	48.206
	36	0.062	8.735	46.633	44.625
	48	0.066	8.437	48,466	43.096
	60	0.069	8.287	49,415	42.297

Table 5b. Decomposition of Variance: Domestic Real Interest Rate

Country	Number of months	Standard error	U.S. real interest rate	Domestic real interest rate	Cyclical componer of the real exchange rate
Ghana	12	4.710	45.448	52.617	1.934
	24	4.976	47.789	49.068	3.142
	36	5.049	48.211	47.910	3.877
	48	5.081	48.353	47.440	4.206
	60	5.089	48.309	47.350	4.339
Kenya	12	2.826	38.856	56.696	4.446
	24	2.978	36.421	56.889	6.694
	36	3.049	35.065	57.047	7.889
	48	3.095	34.245	57.128	8.626
	60	3.124	33.731	57.183	9.084

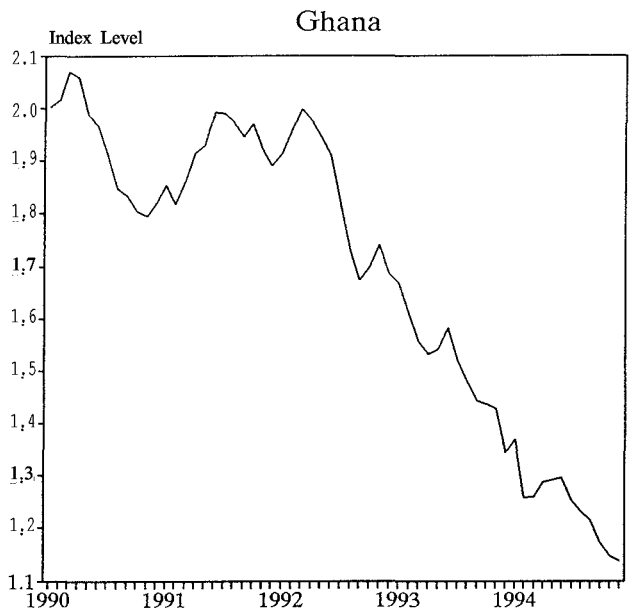
Table A.1. ARMA Process Used in Modelling the Change in the Permanent Component of the Real Exchange Rate 1/

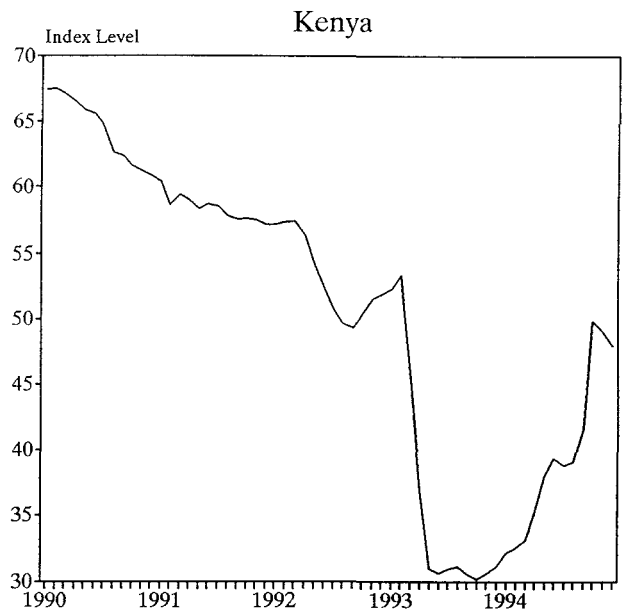
Country:	Ghana	Kenya	Uganda	Zimbabwe
	Monthly: 1978:1 - 1994:12			
ARMA(p,q)	ARMA(8,1)	ARMA(12,1)	ARMA(12,1)	ARMA(12,1)
R^2	0.185	0.206	0.221	0.209
Q statistic	10.852	27.091	14.934	27.167
Significance level	(0.999)	(0.925)	(0.997)	(0.923)
Break dates	1983:5	1981 :9	1985:12	1986:5
	1986:1	1993:4	1987:5	1987:7

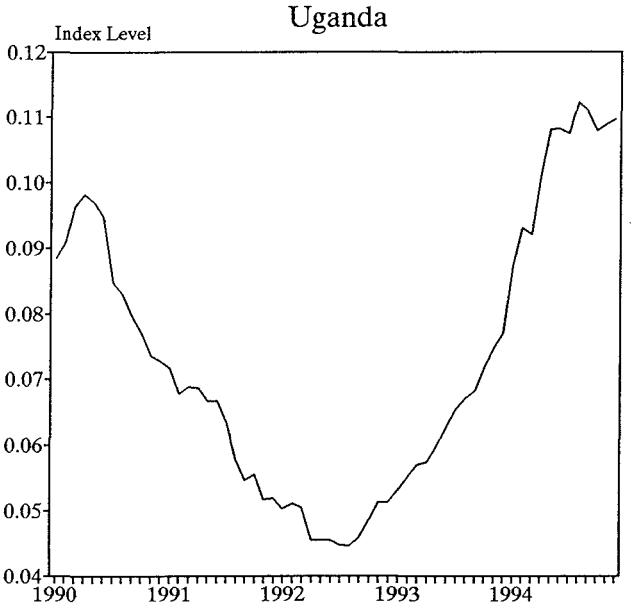
Source: The authors.

1/ The models were estimated using log-differences. All series were allowed to have a break in their rates of change. The Q-statistic tests whether the regression residuals are white noise. The significance level is the probability that the actual Q-statistic value will be observed under the null hypothesis that the residuals are white noise.

Chart 1. Real Exchange Rates



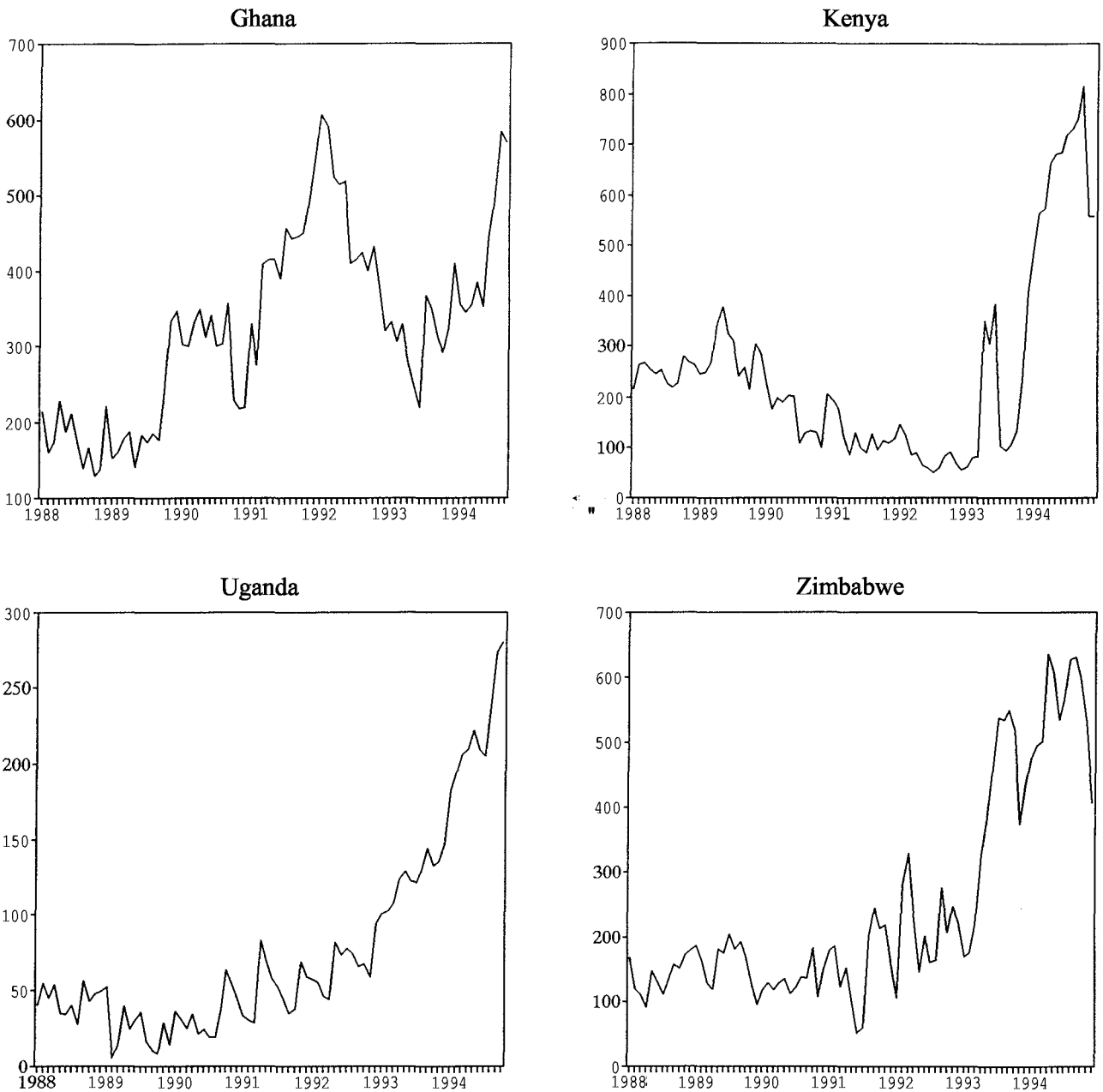




Source: Information Notice System, International Monetary Fund.
Note: An increase in the index level denotes a real appreciation.

Chart 2. Total Reserves

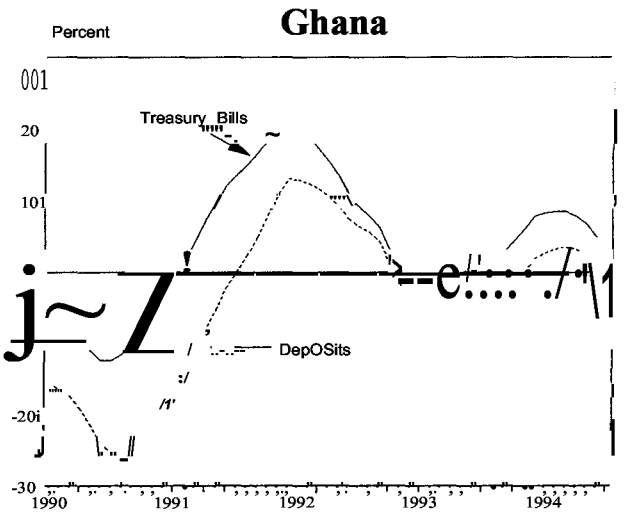
(In millions of U.S. dollars)

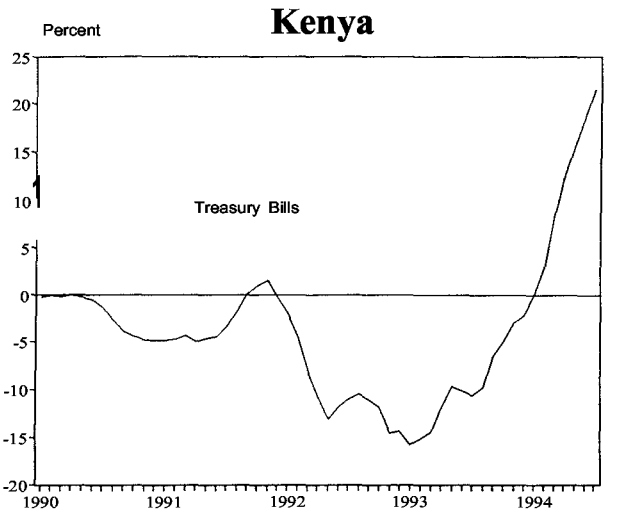


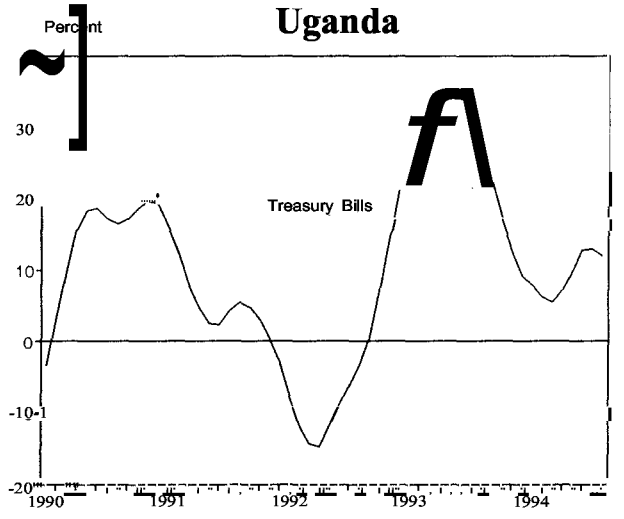
Source: International Monetary Fund, International Financial Statistics.

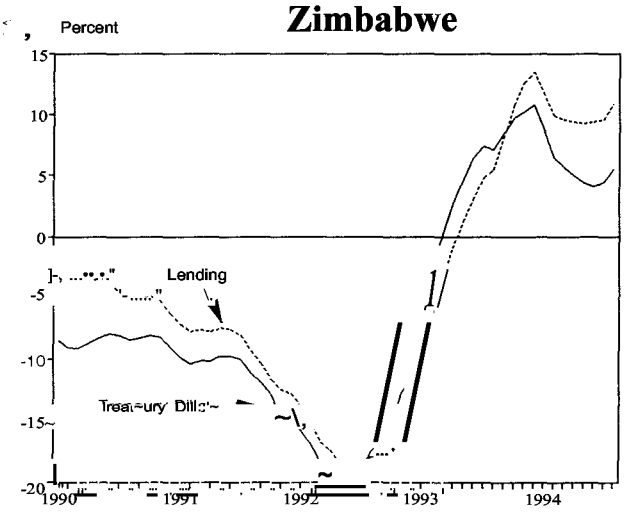
Chart 3. Real Interest Rate

(12-Month Average)





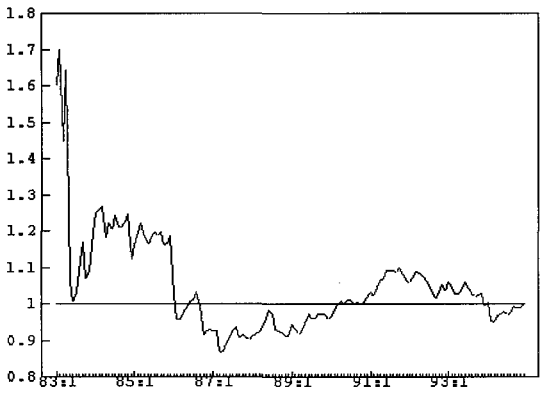




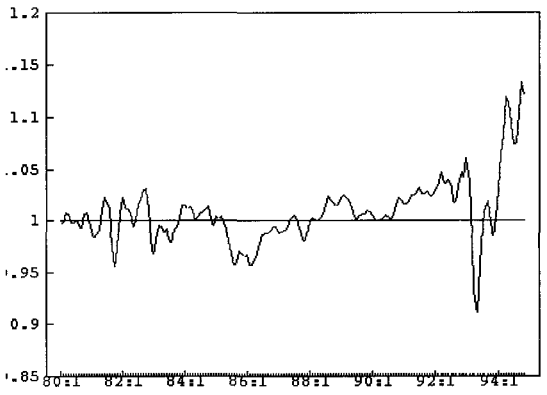
Source: International Financial Statistics, IMF

Chart 4. Real Exchange Rates: Cyclical Component

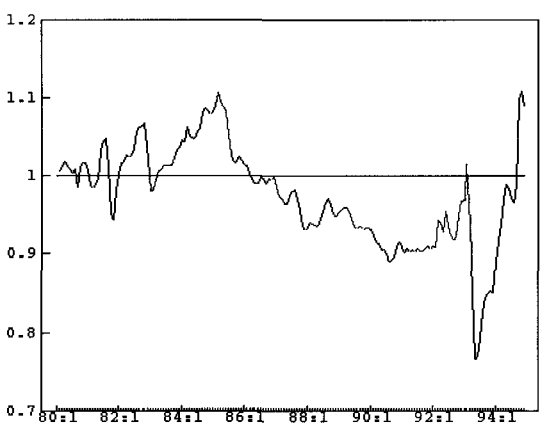
GHANA



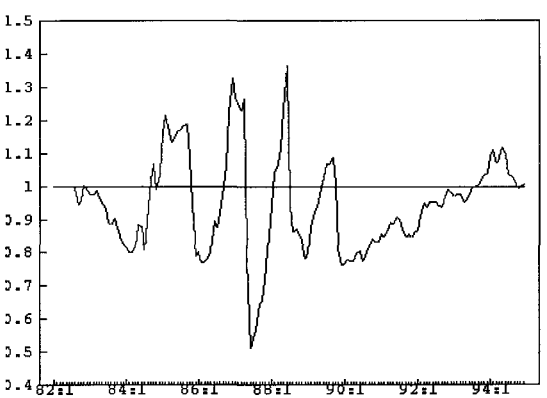
KENYA



ZIMBABWE



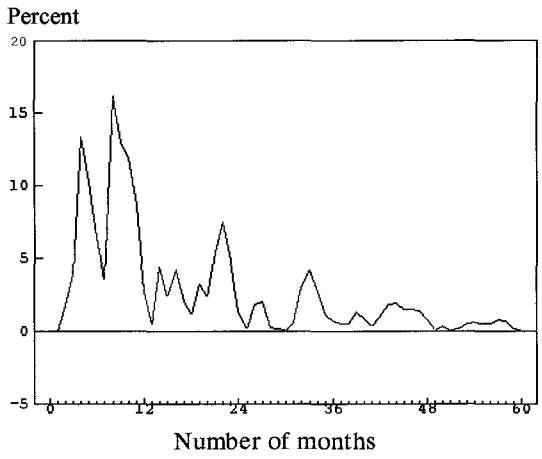
UGANDA



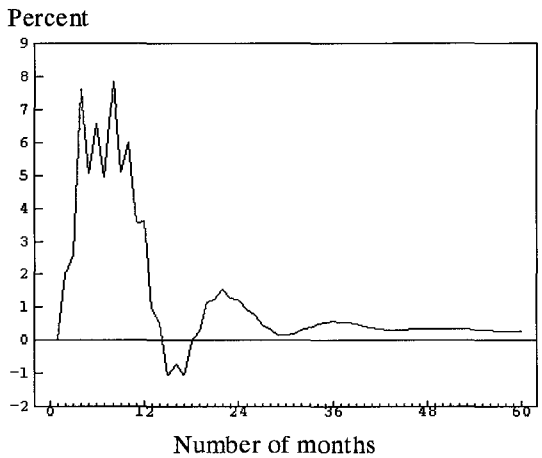
Source: Information Notice System, INS, and the authors.
Notes: An increase in the index denotes an appreciation. The cyclical component is shown as the ratio of the actual to the estimated permanent component.. Hence, a ratio greater than unity denotes an "overvalued" real exchange rate.

Chart 6. Response of the Domestic Real Interest Rate to a One-Standard- Deviation Shock in the Foreign Real Interest Rates

GHAI A



KENYA



Notes: The interest rates used are those on 3-month Treasury bills. The real interest rate is computed as $((1+i_t)pt/pt+3 -1)$.