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REAL EXCHANGE RATES AND MACROECONOMIC ADJUSTMENT IN SUB-SAHARAN AFRICA AND OTHER DEVELOPING COUNTRIES

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Economists like to talk about currency misalignments, and exchange rates being under- or over-valued. But this presumes that they know what a currency's long term equilibrium rate is. The truth is that there is wide disagreement about how to define an equilibrium, let alone measure it.

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1.INTRODUCTION

As an economy-wide relative price signalling for inter-sectoral resource transfers, the concept of the real exchange rate (RER) has assumed a central position in the past and current debates on economic development and growth strategies, and in the more recent literature on structural adjustment and economic stabilization. In particular, it has been argued that avoiding serious RER overvaluation (with respect to its level of equilibrium) is a pre-requisite for efficient and relatively less costly stabilization and structural adjustment reforms in the short-to-medium runs, and for sustained export-oriented growth in the future (see World Bank, 1993). Even those who tend to be skeptical about the role of across-the-board trade liberalization have always recognized the importance of maintaining the economy-wide RER sufficiently close to its equilibrium level (Helleiner, 1994; Rodrik, 1992).

It is not an overstatement to suggest that the issues related to the determinants of the RER, its evolution over time and its position relative to equilibrium now occupy a central role in the academic and policy debates on economic adjustment and, increasingly, in the discussions on long-term growth and development strategies. However, in spite of its importance, the research on the empirical determination of RER, the calculation of its equilibrium path and the assessment of the misalignment of the RER can, at best, be described as inadequate. And this applies to both developed and developing countries alike. Even more lacking is a sufficient understanding of the normative and

positive underpinnings of the notions of the equilibrium RER, the sustainability of fundamentals, and the implications of the different approaches for RER modelling and the calculation of equilibrium path(s).

Following Elbadawi (1994) and Elbadawi and Soto (1994), this paper contributes to this discussion by estimating the long-run cointegrated equilibrium of the RER and a set of fundamentals consistent with "internal" and "external" balances. The cointegrated equilibrium is obtained from a model of the real exchange rate that characterizes the equilibrium as "the relative price of non-tradable to tradable goods which, for given sustainable values of other relevant variables such as taxes, international terms of trade, commercial policy, capital and aid flows and technology, results in the simultaneous attainment of internal and external equilibrium", (Edwards (1989), pp. 16). Internal equilibrium is achieved when the market for non-tradable goods clears in the present and is expected to clear in the future; external equilibrium holds when present and future current account balances are compatible with long-run sustainable capital flows.

The model will be applied to the cases of 7 developing countries, including 4 countries from Sub-Saharan Africa (SSA), for the period 1960-1993. In addition to expanding the evidence of our previous work to a wider an interestingly diverse sample of developing countries, an important contribution of this paper is to propose a new approach to the problem of scaling that arises in the computation of the equilibrium RER (see for example Edwards, 1989; Elbadawi, 1994). Section 2 of the paper attempts to put the concept of equilibrium and its modelling implications in perspective, by providing a selective review of the main approaches to the concepts of RER equilibrium and sustainability of the fundamentals. Section 3 contains a formal statement of the model and the methodology to determine the equilibrium level of the RER. Section 4 discusses and compares the estimates of the long-run cointegrated specifications for the ERER as well as the corresponding short-run error-correction specification. In addition, the estimated long-run relationships are used to derive indexes of equilibrium RER and the corresponding RER misalignment for the 7 developing countries. In order to compare the misalignment index arising from our approach to that proposed in Williamson (1994), section 5 estimates and simulates a standard simultaneous equations model of the RER in Chile. Finally, conclusions and some policy implications are collected in section 6.

2. APPROACHES AND CONCEPTS OF EQUILIBRIUM RER

In this section we address three issues regarding approaches and concepts in RER modelling. First, the interpretation and the implications for the modelling of the concept of sustainable RER discussed in the introduction, which will be used in subsequent analysis of this paper. Second, the relationship of this concept with others in the RER literature. Third, the review of some positive issues related to the characteristics of econometric RER models.

2.1 The Purchasing Power Parity Approach to the RER

Given the available empirical evidence (associated with both the traditional and more recent cointegration econometrics), this concept is not an option to modelling the RER, despite its intuitive appeal and simplicity.[1] In particular for the Casselian form of strict PPP (Cassel, 1922), which holds that the equilibrium RER for a given country should remain constant throughout, as nominal exchange rates will adjust instantaneously to any price differential between the country and a trading partner. The more recent unit-root econometrics research posits a weaker version of PPP -which allows the presence of non-traded goods in price indices-, essentially seeking to establish that the nominal exchange rate is linked to domestic and foreign prices only in the long run (cointegrates), in the context of a linear equation with a constant term.[2] Therefore, these models do not test for the proportionality and symmetry restrictions that could deliver the stronger version of PPP (Breuer, 1994) and, consequently, do not even imply that the RER is stationary, let alone be constant or unity, as claimed by relative and absolute versions of PPP.

For broad economy-wide indices, the weak form of PPP could only be corroborated empirically for the very long run (70 years or more) and for developed countries only. Moreover, the evidence show that cointegration is achieved usually in the case of bilateral exchange rates, but not in the case of multilateral exchange rates.[3] An interpretation for these findings is that price indices are

[1]A survey of empirical tests of the PPP is presented in Froot and Rogoff (1994).

[2]See, for example, Apte et al. (1994).

[3]Cointegration is more easily obtained if transportation costs are included (Michael et al., 1994).

sufficient statistics for fundamentals only in the 'ultra-long run', when the influences from other independent fundamentals are assumed to balance themselves out.

Clearly, the cointegration version of PPP has little relevance for understanding the equilibrium RER and, indeed, it is very close to the 'path dependent' concepts of the RER discussed below. In addition, the fact that such equilibrium holds only in the ultra-long run limits substantially its use for policy analysis. Furthermore, given the change over time in trade regimes and capital flows in developing countries, the above PPP equilibrium may not be adequate for those countries even in the long run.

A second line of analysis under the PPP hypothesis suggests that the RER should be unpredictable or, using time-series jargon it should follow a random-walk process, if the former holds. As noted by Froot and Rogoff (1994), the theoretical foundations for the RER as following a random-walk process can be found in the Balassa-Samuelson model -in which the RER is determined by unpredictable productivity differentials between countries-, and not in portfolio or asset-price models, as is usually claimed in the literature,[4] since the latter require, in addition to PPP, asset markets efficiency, an additional hypothesis that has hardly received any empirical support (Shiller, 1989). Initial tests of this type of models have been unable to reject the null hypothesis of a dominant unit-root in the RER for the countries with floating exchange rates (Meese and Rogoff, 1988). For fixed exchange rates, however, tests are not conclusive, in particular for European countries, as discussed in Chowdhury and Sdogati (1993). Nevertheless, results have been hampered by the low power of tests, in particular when shocks dissipate slowly. Being the RER a relative price affecting productive and investment decisions, it should be expected that shocks have persistent effects, invalidating random-walk tests. As in the cointegrating approach of the PPP, policy implications and RER predictability are unattainable in this type of modelling.

Considering these issues, the following position stated in Williamson (1994) seems to represent the overwhelming opinion of the profession: "PPP comparisons are indispensable for comparing living standards, but they are the wrong basis on which to calculate equilibrium exchange

[4]For example, Roll (1979) suggests the random-walk hypothesis is a consequence of perfect arbitrage in currency markets.

rates. They are wrong conceptually, and they provide seriously misleading advice. For that purpose they should be abandoned, once and for all" (page 191).

2.2 The Equilibrium RER Concept (Edwards, 1989; Elbadawi, 1994; Elbadawi and Soto, 1994).

The notion of equilibrium in this methodology is essentially intertemporal as the path of the equilibrium RER is affected not only by the current value of fundamentals, but also by anticipations regarding the future evolution of these variables.[5] Unlike under the PPP approach, the equilibrium RER experiences movements in response to exogenous and policy-induced shifts in its real fundamentals. In addition to such movements, the observed RER is also influenced in the short-to-medium run by shocks --such as macroeconomic and exchange rate policies-- which are not part of the fundamentals. RER misalignments can occur (as in the standard PPP theory) when those policies are inconsistent with the fundamentals. For example, in a system of pegged nominal exchange rates, expansionary fiscal and monetary policies can be a cause of persistent real overvaluation; Edwards (1989) and Elbadawi (1992a) provide strong evidence of this effect.

The empirical modelling of the equilibrium RER, and therefore the derivation of the RER misalignment, consistent with the above definition may not be trivial. However, Elbadawi (1994) shows that, given cointegration,[6] the basic equilibrium RER model is adequate in this framework since it accounts for the following desirable properties: (1) it is consistent with a behavioral model specifying the equilibrium RER as a forward looking function of the fundamentals, (2) it allows for flexible dynamic adjustments of the RER toward the equilibrium, (3) it allows for the influence in the short-to-medium run of macroeconomic and exchange rate policies on the RER, and (4) the

[5]Edwards (1986) and chapter 2 in Edwards (1989) formalize this concept of equilibrium RER in the context of an optimizing model. See also Lizondo (1989).

[6]The idea of cointegration states that even though individual series may be non-stationary, there may exist a linear combination of them which is stationary. More formally, let the n-vector y_t be composed of n-non stationary variables (y_{it}, ... y_{nt}), then y_t is said to be cointegrated if there exists at least one n-element vector β such that $\beta' y_t$ is trend stationary. This is a mild definition of cointegration (Campbell and Perron, 1991), which is more suited to the empirical analysis of economic date since it allows the inclusion of deterministic components (such as trends and structural break dummies) in the cointegration model.

stochastic nature of fundamentals allows their time-series decomposition into permanent (sustainable) and transitory components and a relatively straightforward computation of the equilibrium RER.

2.3 The Fundamental Equilibrium Exchange Rate (Williamson, 1994)

Williamson (1994) recommends an **ex-ante** approach for "estimating the set of real effective exchange rate paths needed to achieve simultaneous internal and external balance by some date in the medium run future and maintain balance thereafter" (page 185). The so-called fundamental equilibrium exchange rate (FEER), therefore, calls for specifying (or assuming) behavioral specifications for the fundamentals and using the RER equations in the context of a bigger model to derive the trajectory of the equilibrium RER given the assumed path of the fundamentals.

The equilibrium RER index specified in Section 3 is consistent with the **ex-post** version of the FEER concept, where equilibrium RER paths are based on the permanent historical time-series components of the fundamentals. The difference between the equilúbrium RER and the FEER essentially relates to the normative concept of what is a "sustainable equilibrium". For example, Williamson's view is that the time series-based approach to the determination of the sustainable components of the fundamentals[7] may lead to the identification of lengthy episodes of excessive government expenditure or capital flows as sustainable. However, to the extent that the time horizon is long enough, one should expect fundamentals to eventually revert to their sustainable levels and be picked up by time series-based methods. On the other hand, assuming and simulating paths for the fundamentals, as recommended in the FEER approach, does not necessarily produce a prediction of the equilibrium RER which is free of transient phenomena, unless a full stochastic simulation of the model is undertaken.

An empirical test of whether or not the time series approach significantly diverges from a notional ex-ante sustainable equilibrium is conducted for the case of Chile for which, in addition to being studied using the time-series based approach of this paper, a small structural model that endogenizes key fundamentals is estimated as well.

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[7]Based on moving averages of the data (Edwards, 1989), time-series decomposition (Elbadawi, 1994) or a combination of both (Elbadawi and Soto, 1994).

2.4 Desired Equilibrium Exchange Rate (Bayoumi et al, 1994)

This research is an offspring of the "underlying balance" approach developed by the IMF during the 1970s (see IMF, 1970). The view of the authors of the desired equilibrium RER (DEER) is that the FEER concept is more applicable in the long-run, when some fundamentals reldted to the asset-market equilibrium have worked themselves and reached their stationary levels. This view appears legitimate, given the lack of dynamic considerations in the FEER model. In addition, the DEER approach stresses the point that the concept of equilibrium RER consistent with underlying macroeconomic balances is based on a set of "desired" macroeconomic objectives. The emphasis on "desired" objectives underlines the important role of normative considerations in differentiating this approach from the above theoretical models. However, the static version of the DEER in Bayoumi et al. (1994) does not bring this out to any deeper level beyond the original contribution of Williamson in the FEER approach.

One contribution of this approach is provided by the "dynamic DEER", which accounts for an important characteristic of equilibrium RER behavior: that different equilibrium values may not be independent of the dynamic adjustment towards them, i.e., there is an *hysteresis* effect.[8] They use the 'sustainable' current account (CA) concept to illustrate the point. Suppose that the initial period is one of internal and external equilibria and that the RER is equal to the DEER. Next, assume that the currency appreciates in the second period leading to a CA deficit, but internal balance remains at equilibrium (for simplicity). The CA deterioration due to the RER appreciation will lead to higher indebtedness; then, the obligation to serve the extra debt -let alone attempting to reduce it to initial levels- requires the currency to overdepreciate for a period of time before the equilibrium DEER reaches its initial level once the extra debt service is paid off. Even though the desired current account target remains the same, its composition changes with a higher trade surplus required to meet the

[8]In a recent paper, Baldwin and Lyons (1994) present a variation of the sticky-prices model of Dornbusch (1976) allowing for sunk costs to trade at the industry level, in which sufficiently large policy misalignments induce hysteresis in the behavior of the RER and path dependence to those policies.

extra debt service, and the DEER has to undergo an overdepreciation relative to its initial level leading to a hysteresis loop.[9]

2.5 The Structure of RER Models in Developing Countries

The above selective review has focused mainly on normative issues, i.e., preferences regarding "ideal" or "sustainable" equilibrium. In addition to these, there are also differences on positive issues when modelling the RER, related to our view about the most relevant aspects of the economy to RER modelling. These issues range from the basic concern of the appropriate RER definition to the number of goods and agents, characteristics of markets and expectations regimes.

The definition of the RER adopted in this paper is the ratio of prices of non-tradable to tradable goods, which is consistent with the Salter-Swan model of the dependent economy (Dornbusch, 1980). Due to data limitations, however, an approximation of this measure frequently used in the empirical literature is the ratio of the (trade weighted) multiple of nominal exchange rates and WPIs to the domestic CPI. In support of the use of this proxy, Edwards(1989) and Harberger (1986) have noted that, given the practical difficulties in computing the above definition of the RER, the proxy is appropriate since the WPIs are dominated by tradable goods, while the CPI corresponds mostly to non-tradable goods. Hinkle and Nsengiyumva (1995), however, criticize the measure on the grounds that WPIs may misrepresent the price of tradables that consumers or producers face for economic decisions due to large differences in commodity composition.

Regarding the structure of models, although the framework employed in this paper is intertemporal and extends on similar models in the literature (e.g., Rodríguez, 1989; Edwards, 1989) in two important directions (see section 3 for details), the model is based on the equilibrium condition of just the home-goods market and the current account balance, with the labor market and productivity growth exogenously given. This, in turn, suggests two possible extensions.

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[9]The story can be made more complicated should other fundamentals also change with increase indebtedness (e.g., productivity levels or public investment). For example, with increased productivity, debt ratios may not increase to the extent of producing a major hysteresis trap relative to the initial DEER level.

First, the inclusion of asset markets. Equilibrium in asset markets allows the inclusion of the free (or parallel) market premium in the long-run cointegrating specification (as in Edwards, 1994). Alternatively, the asset market may be linked to the stock of official reserves relative to the stock of foreign assets held by the private sector (e.g., Edwards, 1985; Elbadawi, 1992a). If, in the latter case, equilibrium in asset markets is not assumed, the ultimate reduced-form solution of the equilibrium RER requires the inclusion of the ratio of official reserves to private-sector foreign-assets in the set of fundamentals. Such extension, which is not attempted in this paper due to the lack of appropriate data, could be of some interest when asset market disequilibria are likely to have significant effects on official reserves (as in the cases of several SSA countries in the 1980s (see Kiguel and O'Connell, 1995)), or when exchange rate unification is under consideration (e.g., the possible unification of financial and commercial Rands in South Africa).

A second aspect of the model are the implicit assumptions regarding full employment, exogenous labor force growth, and full price and wage flexibility. As argued in Baffes et al. (1996), these assumptions may not be as restrictive as they seem. For example, a sector specific real-wage floor or a constant wage differential between two sectors (e.g., exports and imports) will not prevent full employment in the long run.[10] Even when considering an economy-wide real-wage floor that could lead to less than full employment equilibrium, the implications on the ultimate solution of the model will not be that consequential. Basically, the internal balance conditions have to be combined with the real-wage target, which suggests that those fundamentals that influence the former but not the latter -such as the government's demand for domestic goods- will be excluded (Dornbusch, 1980).

Agenor and Montiel (1995), however, developed a macroeconomic model with segmented labor markets, which separates the labor market equilibrium from that of the non-traded goods market. Their model leads to an equilibrium RER solution that depends, among other fundamentals, on the labor supply in the traded goods sector and predicts that a rise in labor supply in the traded goods sector could raise the real wage in the non-traded goods sector, dampening production and requiring a real appreciation to eliminate the excess demand for non-traded goods. This model could be useful for economies dominated by a tradable goods sector, where employment and real wages in

[10]The economy will operate along an inferior production possibilities curve, but only the elasticities of the RER with respect to fundamentals will change (Baffes et al, 1996).

the traded goods sector are essentially determined by conditions related to the sector and not to the interaction of supply and demand in the domestic economy or in the non-traded sector, and also where labor substitutability between sectors is less than perfect.

2.6 Empirical Models of the Real Exchange Rate

For analytical purposes it is useful to separate econometric models of the RER in three broad groups: (a) studies which focus on the implications of a particular theory for the evolution of the exchange rate, (b) models which attempt to parameterize either structural or reduced-form specifications of theoretical relationships, and (c) models which use calibrated parameters and proposed structural relationships to replicate some of the observed characteristics of the RER (in terms of trend and cycle, variance of shocks, covariance with other variables, etc.) as is typical in the real business-cycles literature.

In general, tests of theory implications have concentrated on monetary models -as opposed to real models discussed below-, such as the flexible-price model cum PPP hypothesis. The standard flex-price specification, which assumes that the exchange rate is determined in a two-country framework by relative money supplies, relative income levels and interest rates, has been rejected in a variety of countries and time periods. In a comprehensive study, McDonald and Taylor (1992) show that estimated models frequently present wrong signs, low in-sample fit, and poor out-of-sample forecasts.[11] On the other hand, the PPP component of monetary models has been rejected in the majority of cases, as discussed in section 2.1, for both the strict and weak versions of the hypothesis. The main drawbacks of indirect tests of RER models are, first, that the evidence is marred by the weakness of statistical methods and, second and more important, that the methodology of the analysis does not necessarily allow the researcher to reach meaningful conclusions from the tests, since competing theories are not being tested and the determinants of the RER -in particular, policy variables- are not explicitly modelled.

[11]McDonald and Taylor (1994), however, present evidence for the sterling-dollar case that the model is consistent with the data in the long-run, though short-run deviations are important and highly persistent.

Undoubtedly, parameterized models are the most frequently tool used to analyze the evolution of the RER. Nevertheless, the structure of models have changed markedly during the last decade as a result of dynamic time-series analysis. Large multiequational models, which were the base of the analysis in the 1960s and 1970s (e.g., Corbo, 1985), have been replaced by smaller time-series models (from vector autoregressions to error-correction models), as their statistical and theoretical superiority became apparent.

The ability of vector autoregressive models (VAR) to replicate the data and provide good forecast of the RER has led researchers to rely on these a-theoretical models when the analysis of the RER does not require a full description of the channels through which policies or shocks affect the RER and/or structural forms parameters are not the main concern. A recent application of this framework to RER problems is presented in Calvo et al. (1993), in which the effects of capital inflows on appreciating the RER are analyzed for a group of developing countries. Conclusions to be derived from VARs usual

y relate to the short and long run response of the RER to permanent or transitory shocks given to fundamentals, the causality between variables, and the importance of each fundamental's uncertainty in the prediction of the RER. A second use of VAR techniques is to separate predictable from unpredictable shocks to the RER and relates either of them to changes in fundamentals or policies. Asea and Reinhart (1995) apply this methodology to discuss the effects on the RER of the return of private capital inflows and interest rate differentials in a group of African countries.

Although powerful, unrestricted VAR models are inadequate to discuss issues concerning the equilibrium RER, as this requires both a parameterization of the effects of fundamentals on the RER and determining the sustainable level of the latter. Cointegration-error correction models[12] have increasingly captured the attention of researchers, as they provide a framework in which the virtues of time-series models to track the dynamics of exchange rates are preserved within the context of a structural model (Elbadawi, 1994; Edwards, 1994). In this setup, a structural or theoretical model provides a reduced-form linear long-run relationship between the RER and its fundamentals, while an error-correction mechanism is used to describe the short-run dynamics of the RER around its long

[12]Cointegration-error correction models have been developed along the work of Engle and Granger (1987), Hendry (1995) and Johansen (1988), among others.

value.[13] In addition to separating short-run from long-run effects of fundamentals on the RER, error-correction models allow to test the effects of shocks to non-fundamental variables -which have only transitory effects on RER- in such a way that it does not affect the estimation of the parameters of the cointegrating vector.[14] Moreover, provided the sustainable level of fundamentals, the cointegrating vector allow a straightforward computation of the equilibrium RER.

In addition to parametric models, simulated models have been used to address the response of the RER to changes in policies or exogenous variables in the context of general equilibrium frameworks. The main difference between these and parametric models is that in simulated models parameters, when required, are supplied by the researcher and not estimated with the available data. The latter is used only to validate th model. Also, a simulated model allows for a complete description about the channels by which fundamentals act upon the RER. There are, basically, two types of models: computable general equilibrium (CGE) and stochastic simulation models. Being short-run in nature, CGEs are not well suited for analyzing long-run equilibrium RER issues; on the contrary, stochastic simulation models are an important tool for the analysis of the dynamics of the RER, in particular when the interest lies in discussing non-normal or non-linear phenomena (e.g., the asymmetric response of the RER to nominal devaluations -which have important effects to correct disequilibria but very little impact when the RER is not misaligned- or capital inflows -which for developing countries are frequently difficult to obtain and easy to lose).[15] An example of the latter is provided in Quiroz and Chumacero (1993), in which a rational-expectations general equilibrium model is developed to estimate the effect of trade liberalization on the equilibrium RER in Chile;

[13]An extension of this type of model consists in exploring the presence of non-linear determinants in the long-run model -which could arise for example from structural changes- using non-linear time-series techniques (Soto, 1995).

[14]Edwards (1989) presents a comprehensive survey of standard econometric models of the RER, in which reduced form models -either single or multiequational- are estimated in a static framework and, frequently, mixing fundamentals and non-fundamental variables. Despite being misspecified, these initial estimates have provided a wealth of evidence on RER determinants which have become very helpful when setting up more modern econometric models.

[15]In a stochastic simulation model exogenous variables (such as technological shocks) which, in turn, determine the evolution of the RER, are repeatedly simulated so as to obtain a probabilistic response of the endogenous variables for a given set of parameters. If that simulated response matches-in-probability the observed path of the RER, then the structural parametric model is accepted; otherwise, a new set of parameters and laws of motion for fundamentals is tried.

allowing for technical progress and risk-averse agents, the model aptly replicate the evolution of the RER during a period generally difficult to model, the major economic reforms of 1975-85.

3. THE MODEL

In this paper, we extend the intertemporal model of the determinants of the RER of Rodríguez (1989) and Edwards (1989), to include two elements that might have an important effect on the equilibrium real exchange rate: (a) the effects of financial flows and (b) the role of the country (sovereign) risk. The specification of the theoretical model is consistent, at the econometric level, with a cointegration-error correction structure, which enables us to separate the short and long run determinants of the RER and provides us a simple framework for computing its equilibrium level.

Consider a small open economy with three productive sectors (importables, exportables and non-tradable goods), for which the international price of traded goods is assumed to be exogenous. The domestic price of tradables, then, is determined by the level of tariffs to importables and exportables and the nominal exchange rate. Let P_x^* and P_m^* be the dollar-denominated international prices of exportables and importables, *E* the nominal exchange rate, and t_x and t_m the net export and import tax rates, respectively. The domestic price index of tradable goods is defined as:

$$P_T = E[(1 - t_x)P_x^*]^{\alpha}.[(1 + t_m)P_m^*]^{1-\alpha} \qquad \textbf{(1)}$$

The price of non-tradables, on the other hand, is endogenously determined as the result of the interaction of supply and demand forces in the domestic market. Since there is casual evidence that consumers and the government may have a different propensities to spend in traded and non-traded goods, the demand for the latter is disaggregated in two components. We assume that the proportion of private expenditure allocated to non-tradable goods -denoted by E_{PN}- depends on the prices of exports, imports and non-traded goods (P_x, P_m, and P_n, respectively), while that of the government (E_{GN}) is a fraction (g_N) of total government expenditure. Hence, the latter is a policy or control variable for the government. The total demand for non-traded goods is expressed as:

$$E_N \equiv E_{PN} + E_{GN} = \underset{+\ +\ -}{d_n(P_x, P_m, P_n)}.[A - g.Y] + g_N.g.Y \qquad \textbf{(2)}$$

where $d_n(.)$ is the proportion of private expenditure (absorption less total government expenditure) devoted to non-traded goods, A is absorption, Y is income, and *g* is the ratio of government expenditures to income. The signs of the price elasticities appear below the $d_n(.)$ function.

The supply of nontraded goods, which is also specified as a fraction of total income, depends on the prices of tradable and non-tradable goods as shown by the sign of the elasticities below the $s_n(.)$ function:

$$S_N = \underset{-\ -\ +}{s_n(P_x, P_m, P_n)}\ Y \qquad \textbf{(3)}$$

Equation (4) sets the equilibrium condition in the non-traded goods market ($S_N = E_N$), which in turn determines P_n:

$$s_n(P_x,\ P_m,\ P_n) = d_n(P_x,\ P_m,\ P_n).\left[\frac{A}{Y} - g\right] + g_n.g \qquad \textbf{(4)}$$

Using as the definition of the real exchange rate, *e*, the relative price of non-traded to tradable goods we have:

$$e \equiv \frac{P_n}{E P_x^{\alpha} P_m^{1-\alpha}} = \frac{P_n}{E P_x^{*\alpha} P_m^{*\,1-\alpha} (1-t_x)^{\alpha} (1+t_m)^{1-\alpha}} \qquad \textbf{(5)}$$

Equations (4) and (5) can be solved for the level of the RER that ensures instantaneous equilibrium in the nontraded goods market, for given levels of foreign and domestic "fundamentals":

$$e = \underset{(+)\ \ (?)\ \ (+)\ \ (+)\ \ (+)\ \ (?)}{e\left(\frac{A}{Y},\ \ TOT,\ \ t_x,\ \ t_m,\ \ g_N,\ \ g\right)} \qquad \textbf{(6)}$$

where TOT represents the terms of trade (P_x^*/P_m^*). Equation (6) implies that higher levels of absorption, trade taxes, and public expenditures on non-traded goods are consistent with a more appreciated RER. The effects of TOT and total government expenditures on the RER cannot be determined *a priori*; the empirical evidence, however, shows that improved TOT and higher government expenditure usually lead to a RER appreciation.[16] Ambiguity regarding the effects of the former variable arises because the presence of a wealth effect of an improvement in the TOT -which tends to expand the demand for non-traded goods and thus raises P_n appreciating the RER- and a substitution effect, which works in the opposite direction by lowering the cost of imported inputs in the production of non-traded goods. On the other hand, the evidence suggests that government expenditure tends to appreciate the real exchange rate, due to the tendency of governments to spend more on non-traded goods than the private sector. Nevertheless, the size of this latter effect has been found empirically small.[17]

Following Elbadawi (1994) and Elbadawi and Soto (1994) we extend the basic model of equation (6) by endogenizing private absorption as a function of net capital inflows (i.e., the sustainable level of current account deficit) and the real consumption rate of interest:

$$\frac{A}{Y} = \frac{A}{Y}\left(\underset{(+)}{\frac{NKI}{Y}}, \underset{(+)}{(r_t^* + r_A)} - \underset{(-)}{\phi [{}_t e_{t+1} - e_t]} \right) \qquad \textbf{(7)}$$

where NKI is a measure of sustainable net capital inflows, ϕ is a parameter, r* is the international real interest rate, r_A is a measure of the country-risk premium, and ${}_te_{t+1}$ is the expected real exchange rate at t+1 (based on the information set available at time t), so that ${}_te_{t+1} - e_t$ is the expected change in the real exchange rate. Equation (7) implies that a rise in sustainable capital inflows allows a higher sustainable level of absorption, while an increase in foreign interest rates, the country risk or the expected depreciation of the RER reduces current absorption through an intertemporal relocation of consumption towards the future (i.e., wealth effects are not dominant).

16See, for example, Edwards (1989) and the papers collected in Williamson (1994).

[17]See Edwards (1994), Elbadawi and Soto (1994) and Soto (1995) for empirical evidence.

The sovereign risk premium, r_A, is given by the following expression:

$$r_A = (\hat{\sigma}_{\pi}^2 - \hat{\sigma}_{\pi\pi^*} + \beta\hat{\sigma}_{e}^2) - \hat{\sigma}_{E}^2 \frac{E(m^* + b^*)}{m + b + E(m^* + b^*)} \quad \textbf{(8)}$$

where σ^2_{π} is the instantaneous variance of domestic inflation (π), σ^2_e is the instantaneous variance of the RER, $\sigma_{\pi\pi^*}$ is the covariance between domestic and foreign inflation, σ^2_E is the variance of the nominal exchange rate, *m* and *b* are the domestic stocks of money and bonds, while *m** and *b** are their international counterparts.[18]

The presence of the expected value of the RER ($_te_{t+1}$) in equation (7) yields a forward-looking expression for the equilibrium RER as a function of the expected path of its fundamentals. Linearizing equations (7) and (8), solving for e_t and rearranging, we obtain the following reduced-form dynamic equation for the RER:

$$\log e_t - \lambda_t \log e_{t+1} = \delta' F_t \quad \textbf{(9)}$$

where F_t represents the vector of fundamentals, δ is a vector of coefficients and λ corresponds to a combination of ϕ and some coefficients in δ.

$$F_t = \left[1, Log(TOT_t), Log(g_t), r_t^* + r_{A_t}, Log(Open_t), \frac{NKI_t}{GDP_t}, Log\left(\frac{Pub.Inv_t}{GDP_t}\right)\right] \quad \textbf{(10)}$$

$$\delta = [\delta_1, \delta_2, \delta_3, \delta_4, \delta_5, \delta_6, \delta_7]'$$

Two variables have been included as proxies for fundamentals: OPEN, which is defined as the sum of exports and imports as ratio to the GDP, is used as a proxy for commercial policy (t_x, t_m) because of the difficulty of obtaining good time-series data on t_x and t_m, and also because it may account not only for explicit commercial policy but also for implicit, though very important, factors

[18]This representation of the country risk as determined from macroeconomic fundamentals is adapted from a paper by Asea and Reinhart (1995), which develop a general stochastic equilibrium asset-pricing model in a two country world framework. In addition to deriving explicitly an expression for country risk, the model allows imperfect asset substitutability.

such as quotas and exchange controls. Public Investment (as percentage of GDP) is used as a proxy for g_N, the public sector propensity to spend in non tradable goods, because of the lack of appropriate data.[19] Note, also, that being the specification relevant for the determination of the long run RER, the short-run capital flow and portfolio investment components of capital flows are expected to have non-significant effects. Elbadawi and Soto(1994) present empirical support for such conjecture for the case of Chile.

The model in equation (9) can be solved recursively to yield:

$$log\tilde{e}_t = \sum_{j=0}^{\infty} \lambda^j \delta'_t \tilde{F}_{t+j} \qquad \textbf{(11)}$$

Equation (11) shows that in this framework the equilibrium real exchange rate ($\tilde{e}$), in addition to clearing the non-traded market in every instant, is consistent with the expected long-run evolution of the fundamentals. As discussed in section 2, however, in order to have an empirical measure of the ERER it is necessary to estimate the sustainable path of the fundamentals. In this paper, we follow the methodology proposed by Elbadawi (1994), which exploits the time-series properties of the variables to get the long-run trajectory of the RER fundamentals, by using a cointegration approach and decomposing the series into cyclical and permanent (sustainable) components. Hence, the latter corresponds to the ex-post version of the FEER concept.

3.1 Cointegration, error-correction mechanisms and the equilibrium RER

The standard prescription for solving rational-expectations forward-looking models is to exploit the recursive nature of the model, as that in equation (11), to obtain an expression for e_t as dependant on observed variables. In our specification, this becomes usually intractable. Nevertheless, when fundamentals are characterized by nonstationary processes, as is frequent in macroeconomic

[19]Equation (9) appears in several forms in the empirical tradition of the RER literature: e.g. Edwards (1986 and 1994), Elbadawi (1994), and Mundlak et al (1989).

data, the model can be consistent with the following long-run cointegrated equilibrium (Kaminsky, 1988)[20]:

$$log\tilde{e}_t = \frac{1}{1-\lambda}\,\delta'\tilde{F}_t + \eta_t \qquad \textbf{(12)}$$

where $1/(1-\lambda)\delta'$ is the cointegrating vector and η is an uncorrelated random disturbance. This is an important advantage of cointegration, as it allows the derivation of a simple empirical framework from a much more complicated theoretical model. The parameters of the cointegrating vector can, in principle, be estimated using simple linear regression methods.

This specification is also consistent with a dynamic error-correction model[21], which describes the short-run movements of the RER as arising from the presence of transitory shocks to fundamentals and non-fundamental variables (such as the nominal exchange rate and monetary policies), as well as a result of the self-correcting mechanism that adjusts the previous period disequilibrium:

$$\Delta log e_{t+1} = b_0\left(\frac{1}{1-\lambda}\delta' F_t - log e_t\right) + b_1'\Delta F_{t+1} + b_2'\,\Delta logZ_{t+1} + \epsilon_{t+1} \qquad \textbf{(13)}$$

where *Z* is a vector of stationary variables (including, for example, the rate of change in domestic credit to GDP, short term capital inflows and the rate of nominal exchange rate devaluation), and the disturbance ϵ_{t+1} is a stationary random variable composed of the one-step-ahead forecast error in the RER (i.e. $\Delta\log e_{t+1} - {}_t\Delta\log e_{t+1}$). The error-correction term $\left(\frac{1}{1-\lambda}\delta' F_t - \log e_t\right)$ in equation (13) clearly incorporates the forward-looking sources of RER dynamics. Suppose, for example, that we start from an initial condition of real overvaluation (i.e. the error-correction term is negative); then, the self-correcting mechanism immediately calls for a future depreciation in the actual RER. This effect is captured by the negative error-correction term and its positive coefficient in the $\Delta\log e_{t+1}$

[20]See footnote 6.

[21]See Engle and Granger (1987).

specification. The speed at which this automatic adjustment operates depends on parameter b_0, which falls in the interval [0,1]. A value of b_0 equal to one indicates prompt adjustment in just one period; the smaller the value of b_0, the slower the adjustment is.

In addition to the long-run (equilibrium) impact of the fundamentals on the RER, which is captured by the cointegration vector, temporary changes in the fundamentals may also have short-run effects which are captured by the vector b_1. The effects of short-run shocks in exchange rate and macroeconomic policies are given by the coefficients in b_2. For example, as pointed out by Edwards (1989), a nominal devaluation will help the adjustment process only to the extent that the initial situation is one of overvaluation, and only if the nominal exchange rate adjustment is accompanied by supporting macroeconomic policies; i.e., in terms of our equation the error-correction term is negative and other policy variables included in vector Z (e.g., the rate of domestic credit expansion net of real GDP growth) do not offset the effects of the nominal devaluation.

3.2 Estimating the sustainable level of fundamentals

Although a long-run model for the RER can be easily estimated, determining the equilibrium RER involves finding a practical approximation to the concept of "sustainability" on the part of the fundamentals. Here again stochastic non-stationarity proves to be a useful property. Following the fundamental theorem of time series, any series can be represented as a combination of autoregressive and moving average components; when a series contain one unit root (i.e., series are non-stationary), such decomposition applied to the first difference of the original data allow us to distinguish between the permanent and transitory components of shocks to the variable. By removing the transitory shocks, we obtain the permanent (or sustainable) evolution of the fundamentals which, in conjunction with the estimated parameters of the cointegrating model, is used to determine the equilibrium RER. Of the several time-series decomposition techniques,[22] we use the approach of Newbold (1990), which shows that the permanent component, z_t, of any non-stationary variable y_t can be expressed by:

[22]For example, Beveridge and Nelson (1981), Campbell and Mankiw (1987), and Cochrane (1988).

$$\Delta z_t = \mu + \frac{1 - \theta_1 - \theta_2 - \ldots \theta_q}{1 - \rho_1 - \rho_2 - \ldots \rho_p} \epsilon_t \qquad \textbf{(14)}$$

where μ and the θs and the ρs are the parameters describing the ARMA(p,q) process of the first difference of y_t and ϵ_t are the innovations of the original series.

4. THE ECONOMETRIC ANALYSIS

We have selected 7 countries for the empirical analysis of our model. Four African countries (Ghana, Kenya, Mali, and Cote d'Ivoire) were chosen on the basis of the representativeness of their experiences, while three other LDCs (Chile, India, and Mexico) were included as benchmark development strategies. The selection of the four African countries is interesting because it reflects an important divide in SSA, between the fixed exchange rate economies of the CFA monetary unions[23] (represented by Cote d'Ivoire and Mali) and the other 'flexible' exchange rate economies (Ghana and Kenya).

The experience of African countries is discussed below. Regarding non-African countries, Chile has become the classical example of a successful program of market deregulation and opening of the economy during the 1980s. On the contrary Mexico, which claimed to have liberalized its economy along similar lines, is a case of failed reform. The recent collapse of the Mexican peso, in which a misaligned RER played a significant role, makes this an interesting case for deriving policy lessons. Finally, the economic evolution of India, with its inability to undertake deep reforms, is a benchmark of slow growth in a semi-closed economy with mildly misaligned RER.

4.1 RER, Adjustment and Structural Reforms in Sub Saharan Africa

The timing of economic crises that have impacted SSA since the 1980s and the policy responses to them have differed quite considerably between CFA and non-CFA countries. While crises affected the non-CFA countries during the late 1970s and first half of the 1980s, CFA countries benefitted from the discipline of monetary union and the depreciation of the French franc vis-a-vis the US dollar, and weathered away -or at least, delayed- the storm. Since 1986, however, the CFA countries started to experience serious adjustment problems due to the strengthening of the Frenc franc and a precipitous decline in terms of trade. As fiscal imbalances accumulated, CFA countries

[23]The CFA zone comprises two separate monetary unions: the West African Monetary Union (UMOA) and the countries which belong to the Bank of Central African States (BEAC). The former includes Benin, Burkina Faso, Cote d'Ivoire, Mali, Niger, Senegal, and Togo. The latter consists of Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, and Gabon.

were unable to achieve a real depreciation through a eduction of domestic prices alone, given their low initial inflation levels.[24]

While many non-CFA countries were consolidating reforms and adjusting to external shocks in the second half of the 1980s, the CFA countries experienced substantial RER overvaluation, loss of competitiveness, and protracted recession.[25] After the 1994 devaluation of the CFA franc by 50%, there is preliminary evidence that the zone has finally began to address its problems, with some progress being made on real exchange rate alignment, strengthening fiscal positions, and hopefully restoring export competitiveness and growth.[26] However, the continued pegging of CFA countries to a strengthening French franc is bound to generate problems in the not too distant future.

Exchange rate policy reform has been by far the most successful (and perhaps easiest) component of adjustment in the non-CFA region of SSA; until recently, though, it has been the more elusive aspect of the reform in the CFA countries. In the former group, monetary retrenchment and adequate nominal devaluations, coupled with modest fiscal adjustments, have allowed substantial reductions in the parallel market premia and considerable depreciation of the RER towards a more depreciated equilibrium level (the latter reflecting worsening terms of trade and more open trade regimes). Recently, however, the slowdown in RER depreciation in some countries and a reversal in others has been observed as a result of fiscal policy considerations. In the long run, therefore, the sustainability of previous gains in competitiveness in the non-CFA countries and the more recent ones in the CFA zone, will very much depend on further institutional and policy reforms at the fiscal front.

Regarding the countries chosen for our study, they clearly reflect the substantial differences in terms of the reform record, economic performance and, to some extent, the structure of the economy of SSA economies. When considering the two CFA countries, several differences could be cited. Cote d'Ivoire is a middle income country with a relatively well diversified economy, the largest in the monetary union. In contrast, Mali is a small, landlocked economy with a GDP only one fourth

[24]Elbadawi (1995) presents a comprehensive review of the African adjustment experiences.

[25]See for example Elbadawi and Majd (1992) and Devarajan and Hinckle (1994).

[26]Devarajan and Hinckle (1994) provide a persuasive argument in favor of the parity change in the CFA, as an essential step for restoring growth and reducing poverty. However, they also point out that the devaluation was only a first step that must be followed by a program of economic reform to generate export-oriented private sector-led sustainable growth.

that of Cote d'Ivoire. Nevertheless, and despite its historical success in terms of economic growth before the late 1970s, Cote d'Ivoire has suffered the most from the real currency appreciation and, along with the other large economies in the CFA (Cameroon and Senegal), it was believed to be much more overvalued than the smaller economies, such as Mali (see Baffes et al., 1996; M'Bet and Madeleine, 1994).

Among the two non-CFA countries the differences are also important. The Kenyan economy is relatively more diversified than that of Ghana and the private sector has a much stronger base. Unlike Ghana, the Kenyan economy did not experienced major swings between very expansive and unsustainable macroeconomic policies in the late 1970s and early 1980s, and a substantial structural adjustment -including exchange rate unification and real depreciation- thereafter. On the contrary, Kenyan economic policies have generally been steady, albeit a slight worsening in terms of inflation control and exchange rate competitiveness in the 1990s. During the last five years, both economies have experienced important capital inflows and, while the RER appreciated briskly in Kenya, it actually depreciated in Ghana. An important element in determining this dissimilar behavior is that in Kenya a large part of the foreign resources is used to finance public expenditure through sales of Treasury bills at relatively high interest rates. This, in turn suggests that the RER appreciation may be inconsistent with long-run equilibrium, i.e., the currency is overvalued.

4.2 Time Series Pre-Testing: Unit Roots and Granger-Causality Tests

All variables in the model were tested for unit roots,[27] to verify whether they can be represented more appropriately as difference or trend stationary processes, using the standard Dickey-Fuller test. Despite some criticism on their low power against near unit-root processes[28], we used the ADF test because of it performs satisfactorily when the available number of observations is reduced. Our sample spans a long horizon for most countries (1960-1994) although at low frequency (annual data), allowing us to estimate long-run cointegrating relationships adequately, but precluding us from

[27]A description of the data is in the appendix.

[28]See Hamilton (1994) for a comprehensive survey on this topic.

more sophisticated time-series testing for unit roots. Appendix Table 1 presents the results. It is apparent that, with the only exception of short-term capital inflows, all fundamentals present evidence of non-stationarity. Rejection of the unit-root hypothesis for the first difference of these variables ensures that we are dealing with integrated processes of first order, I(1). On the other hand, short-term capital inflows and nominal devaluations were found stationary.

Causality, as discussed below, is an important issue when testing cointegration and in general for macroeconomic model building. We used Granger's test to determine whether the RER is caused by the fundamentals. The test consists of running a regression of the RER against own lags and lags of a fundamental (e.g., TOT, openness, etc); if the block of lags of the fundamental is statistically significant, then the fundamental is said to contain information useful for predicting RER and thus "cause" the RER. The test is run reversed to check for mutual causality or feedback effects.[29] The results, which in general support the notion of the RER as Granger-caused by fundamentals, are presented in Appendix Table 2. It is apparent that with the exception of public investment, in the majority of the cases causality goes from fundamentals to the RER and not vice-versa. This is particularly important in the case of capital inflows in which there is clear evidence of causation for countries which have received important inflows after reforming their economies, such as Chile, Ghana, and Cote d'Ivoire. Likewise, it is not strange to find lack of causation in the case of partial or non-reformers, such as India and Kenya. The only result which is to some extent surprising is that of public investment, in which for most countries causation goes from the RER to public investment. This would signal that public investment is not an adequate proxy for the fraction of government expenditure in non-tradable goods; however, the lack of other proxy prevent us from dropping it. As in the cases of mutual caustion discussed below, care must be taken when estimating cointegration vectors to accommodate this problem. We acknowledge, however, that causality can change as a result of policy shocks and other breaks, which are likely to be present in the long period of analysis; the small number of observations available, however, preclude us from making a formal testing of these breaks.

[29]Note that, though causality can appear as a spurious result, absence of causality is never a spurious result (Granger and Newbold, 1974); finding absence of feed-back effects supports the notion that the cointegration vectors are free of nuisance parameters.

4.3 Estimating the Long-Run Cointegrated Equilibrium

Once confirmed that the variables behave as integrated processes of the same order, tests for cointegration can be undertaken. We use the two-step procedure for estimating cointegration-error correction models suggested by Engle and Granger (1987). In the first step the cointegrating regression is estimated by ordinary least squares; its errors are used in the second step to estimate the error-correction mechanism and the short-term dynamic model. Despite evidence that this procedure may be non-optimal because of the presence of nuisance parameters (Campbell and Perron, 1991), we rely on it because (a) as discussed below, in this particular case the estimation is likely to be free of nuisance parameters and, (b) the low frequency of data makes VAR and nonlinear specifications less appealing, since in small samples they may yield inconsistent/inefficient results (Hargreaves, 1994). Two conditions ensure that the OLS estimation of the cointegration regression is asymptotically optimal: errors should be non-correlated and right-hand side variables should not be Granger-caused by left-hand side variables (Phillips and Loretan, 1991). The results in Table 1 show that errors in the cointegration regressions are stationary while, as discussed, the evidence in Appendix Table 2 show that in general the RER does not Granger-cause the fundamentals. These two elements, in turn, imply that the estimation is likely to be free of nuisance parameters.

The above considerations allow us to estimate directly the cointegration regressions. The results, presented in Table 1, strongly corroborate the theoretical model outlined in section 2, thus permitting the interpretation of equation (12) as the long-run equilibrium relationship. The fit of the regression is high for most countries and residuals show no sign of serial correlation.[30] Note that we have omitted the standard deviation of the estimated parameters because, as mentioned, the distribution of cointegrating parameters is unknown.

One of the most interesting findings in Table 1 is that of the importance of the volume of trade (degree of openness) in determining the level of the RER. In all countries a negative parameter supports the notion that reforms aimed at reducing tariffs and eliminating trade restrictions are consistent with a more depreciated RER. The size of parameters differ, as expected, since some

[30]The estimation of the model for Mali excludes the country risk component in (r^*+r_A) due to the lack of the necessary data.

countries have engaged in far reaching liberalization programs (e.g., Ghana and Chile) while other have been reluctant to open their economies (Kenya and, in particular, India). The size of these parameters is of importance; in the case of Chile, for example, tariffs were reduced from a high 80% average during the 1960-1974 period to a low level of 20% in the 1975-92 period and, subsequently, the volume of trade increased from 25% to 55% of the GDP. With an elasticity of the RER to openness which clusters around 1, three-quarters of the observed 45% depreciation of the RER can be linked to the increase in trade volume.

When analyzing the estimated parameters for African countries it is interesting to note their consistency with the discussion of their experiences in section 4.1. The results are also consistent with the evidence obtained by Baffes et al. (1996) and M'Bet and Madeleine (1995) for the cases of Cote d'Ivoire and Burkina Faso (a small economy comparable to Mali), which suggest that the effects are stronger in the larger CFA countries. One interpretation of this evidence is that during the recession -which impacted Cote d'Ivoire the most-, trade policies have been used as a tool for achieving current account balance. To the extent that trade has been much more restrictive in recent years in Cote d'Ivoire than in Mali, the estimated parameter in the latter is understandingly larger in the former.

A second important evidence is that of capital inflows; considering the results in Edwards (1989) and Elbadawi and Soto (1994) as a first approach to modelling the data we separated capital inflows among short-run capital flows (including portfolio investment and short-run net lending) and long-run capital inflows (comprising foreign direct investment and long-term net lending). This is consistent with unit root tests which suggest that in most countries short-term capital inflows are stationary, so that it would be inappropriate to include them in the cointegrating vector. Nevertheless, for Mexico and Cote d'Ivoire we obtained better results using total capital inflows; note, however, that short-term inflows are non-stationary in Mexico. As expected from the theoretical model, the estimated parameters of capital inflows are positive, implying that a sustained increase in foreign exchange appreciates the real exchange rate. The magnitude of the implied elasticities[31] --in the range of 0.5 to 1 for more open economies such as Ghana, Mali or Chile-- suggests that the effects of

[31]Since the parameters corresponds to a semi-elasticities, the elasticity depends on the period of analysis. For the 1975-1993 period, the implied elasticities are Chile (1.1), Cote d'Ivoire (0.2), Ghana (0.6), Kenya (0.2), Mali (0.6), Mexico (1.0). India (0.1).

inflows are quite strong and, again, raises doubts on the ability of the authority to counterbalance this effect and sustain a real exchange rate above the long-term equilibrium by altering its policy mix (e.g., reducing public expenditures). The data for Ghana shows that long-term capital inflows increased from 0.6% on average during the 1976-1982 period to 3.4% of GDP in the 1983-1993 period. Other things constant, this change in the capital account of the balance of payments would induce an appreciation of the RER of about 10%.

The effect of foreign interest rates, inclusive of country risk, is also interesting since in all countries an increase in r* or r_A induces a depreciation of the RER. In fact, the point estimates of the parameters suggest that the effects are milder in those countries in which the economy is more open (e.g., Ghana and Chile), where an increase in real international interest rates of 2 percentage points would depreciate the RER around 1% or 2%. On the contrary, in countries such as India, Kenya or Mexico the effects would by quite strong (6% to 12%). A possible explanation for the large difference in responses lies in observing that in the structure of the country risk two elements play an important role: the covariance of domestic and foreign inflation and the variance of the RER. In the former economies, where financial and commercial openness impose more discipline to the authorities, inflation tends to co-vary with international inflation as it becomes more difficult to recourse to the inflation tax. Likewise, the variance of the RER might be also smaller in more open economies since the government is less able to use distortionary non-market restrictions (such as quotas, licensing, etc) to affect the evolution of the RER. It should be acknowledged, however, that in closed economies it is possible to fix the nominal exchange rate, thus reducing its variance and, consequently, r_A.

The results for the ratio of government expenditures to GDP are mixed. In most countries we obtained the expected positive elasticity, implying that fiscal spending tends to appreciate the RER (Chile, Cote d'Ivoire, Ghana, Kenya and Mali). However, in Mexico and India negative parameters were obtained. The composition of government expenditures also matters; in four countries (Chile, Cote d'Ivoire, Mali, and Mexico) a negative parameter implies that the public sector concentrates more on non-traded goods than the private sector. In the rest of the countries (Ghana, Kenya and India) a positive parameters implies the opposite. In general, the small magnitude of the estimated parameters points to the fact that the effects are, at best, minor. In particular, in those countries where

there have been claims that an increase in public saving is required to sustain a high RER in the presence of capital inflows (such as Chile or Ghana), our results add to mounting evidence that measures outside the fiscal area should be used.

The effects of shocks to the terms of trade, as remarked in Section 2, are theoretically ambiguous. The negative sign obtained for some countries (Chile, India, Mali) suggests, contrary to conventional results, the dominance of substitution over income effects. Two non-exclusive explanations can be suggested for this phenomenon: (a) it is likely that in these regressions TOT captures only substitution effects in the demand for traded goods, because income effects are channeled through the expansion of trade volumes -directly captured in the degree of openness- and/or in the increase of sustainable long-run capital inflows; (b) a more convoluted explanation suggests that if wages are indexed backwards -as it was the practice in most developing countries in the 1960-1993 period- and foreign demand expands, the increase in exports and aggregate demand would induce a rise in prices (or inflation) which, in turn, implies a reduction in current real wages. The cut in real salaries allows the supply of non-tradables to increase, thus reducing the RER.[32] In any case, the effects are not very large as elasticities, positive or negative, are in the range of 0.2 to 0.5 (in absolute terms). It is also interesting to note that the size of the effect does not seem to be linked to the degree of dependence of countries on a dominant export good (e.g. copper in Chile, cocoa in Ghana, or oil in Mexico). In turn, this would imply that commodity price volatility, and consequently, terms of trade fluctuations might not be responsible for large (and sustained) RER deviations from the equilibrium.

These estimated cointegration equations are used below to estimate the short-term dynamic models. However, prior to discussing the results on the error-correction models it is important to note that the cointegration estimations of the RER are remarkably stable along the 35-year period. Standard stability tests (Cusum and Cusum of squares) as well as the recursive estimation of residuals and parameters show little evidence of instability (not reported for space limitations, but available upon request).

[32]In the case of Chile, the negative sign has been reported frequently (e.g., Elbadawi and Soto, 1994; Schmidt-Hebbel and Serven, 1995; and Valdés et al, 1990).

4.4 The Error-Correction Models

To perform the estimation of the short-run model of the RER we follow the methodology suggested by Phillips and Loretan (1991). Its main difference with standard error-correction models is that it includes *leads* of the right-hand side variables to capture the presence of potential feed-back effects from the RER to the fundamentals. Drawing on our previous results on causality, we test those variables in which there was some evidence of two-way causality, such as openness in Ghana and government expenditure in India. Additionally, we include devaluations of the nominal exchange rate and capital flows, the latter as a double check on our previous results on causality.

The results in Table 2 reveal a wealth of dynamic effects that were missing in static studies, which will certainly help understanding the behavior of the RER and sharpening our predictions. A key parameter in the estimation of ECM is, naturally, that associated with the error-correction term. As mentioned, it measures the degree of adjustment of the actual RER with regards to its equilibrium level. The estimates of the speed of adjustment in Table 2 show wide disparities, as expected from countries with radically different development strategies, ranging from a rather fast adjusters (Ghana, Mexico, Kenya, and Chile) to very slow adjusters (India and Cote d'Ivoire). The parameters in the former group are comparable to those found in other studies with similar methodology (Elbadawi and Soto, 1994; World Bank, 1995). Nevertheless, note that, with the only exception of Cote d'Ivoire, these estimates are much larger than the 0.19 obtained by Edwards (1989) for a group of developing countries using a partial adjustment model, which would suggest that very little adjustment actually takes place or, conversely, that the adjustment may take an extremely long period to complete. The comparison also shows how different results can be when a dynamic specification is proposed and tested, instead of assuming (ex-ante) a partial adjustment model.[33]

The error-correction coefficients can be manipulated, in the context of the error-correction specification, to derive the corresponding adjustment speed in terms of the number of years required to eliminate a given exogenous shock. According to our calculations in order to eliminate 95% of a

[33]An adjustment parameter of 0.19 implies that a shock dissipates in about 30 years.

shock to the RER, it would takes less than 2 years in Chile, Ghana, Mexico and Kenya, 5 years in Mali and India, and around 10 years in Cote d'Ivoire.[34]

Regarding the estimated parameters, first note that leads of the fundamentals (including public investment) are not significant, consistent with prior evidence on causality which suggested the absence of feed-back effects.[35] In addition, short-term capital inflows -which proved to have no effect in the long-run- are important in some countries in the short-run (it should be recalled that since short-term capital inflows were included in total capital inflows in Mexico and Cote d'Ivoire they were not tested separately). Second, note that in Chile and Ghana the size of the coefficient of openness in the short-run model does not differ markedly from that of the long-run model, implying that the markets internalize the effects of increased openness quickly (within one year), but in Cote d'Ivoire only one-half of the long-run effect materializes on impact. On the contrary, in Mexico the short-run coefficient is positive implying a perverse effect on the short-run RER dynamics. Likewise, in some countries only on third to one half of the change in "country risk and foreign interest rate" has direct effects on the RER, creating a dynamic pattern of adjustment toward the equilibrium level of the RER. Note that while static models can capture the long run relationship, they miss the implicit dynamics of shocks which, even when having small direct effects, tend to build an important long-run effect.

The most interesting result concerns the effects of nominal devaluations on the RER. As anticipated by causality tests, feedback effects between the two variables were likely to exist. Both in the case of Ghana and Chile, the estimated parameter for anticipated devaluations is positive, consistent with rational expectations models of the current account balance (see Obstfeld, 1985). On the other hand, the contemporaneous (and lagged) effect is negative, which is consistent with previous empirical literature (Edwards, 1985). The aggregated effect, nevertheless, recovers the superneutrality of monetary models, i.e., that monetary shocks do not have effects on the rate of

[34]Adjustment periods were calculated as: $(1-\alpha) = (1-ß_0)^t$, where t is the number of periods, $ß_0$ is the error-correction coefficient and $\alpha = 0.95$.

[35]Non-significant lags and leads were sequentially deleted. The results are not affected by the ordering of deletion since colinearity among fundamentals is small.

change of real variables (like the RER) because the latter effect offset the previous negative effect.[36] In other countries -Kenya, India, and Mexico- the *lead* effect is smaller than the contemporaneous effect, which could be consistent with the notion that anticipations are less than perfect (for example, when not all agents are equally informed). In the latter, neutrality of nominal exchange rates is preserved, but not superneutrality.

4.5 The Equilibrium RER and the Misalignment Index

The estimated cointegration equation can be used also to compute the equilibrium real exchange rate, ERER, which is determined by the sustainable or permanent values of the fundamentals. The computation is not straightforward, however, because fundamentals are integrated processes, i.e., their fluctuations correspond to a combination of permanent and transitory shocks, of which only the former are of interest when computing the ERER. As mentioned in Section 2, to disentangle permanent and transitory shocks we use Newbold's (1990) version of the Beveridge and Nelson (1981) decomposition method, which generates a measure of the permanent component as the gain function of the innovations of an ARIMA model. Appendix Table 3 presents details of the time-series estimation. In general, some of the fundamentals of the RER can be characterized as random-walk processes for which all innovations are permanent. In particular, and as expected for most countries, the TOT were found to behave as random walks, except for the cases of Mexico and Ghana for which we have evidence that their terms of trade are dominated by the world price of their main exports (oil and cocoa, respectively). Notwithstanding this, gain functions in these latter two cases are close to 1, which means that shocks are mostly permanent (in fact, in small samples it is extremely difficult to disentangle a random-walk process from a near unit root process). Likewise, country risks were also found to behave as pure random-walks. In the case of the rest of the fundamentals, the estimated gain function is usually less than 1, implying that only a fraction of each shock remains in the long-run.

[36]A joint Wald test cannot reject the null hypothesis that the sum of both coefficients is zero at 95% confidence.

It should be noted that this decomposition, which yield a unique dynamic path for each fundamental, does not provide a unique solution for the ERER in terms of the intercept.[37] Hence, the intercept needs to be adjusted according to some criterion. In general, practitioners either are not aware of this limitation or prefer to use the estimated constant from the cointegrating vector. In a previous paper, Elbadawi and Soto (1994) use a resource-balance criterion and scale the ERER index so that its average is equal to the average of the actual RER over the years in which the resource balance is 'close' to its equilibrium level (for empirical purposes, the resource balance was dubbed 'close' to the equilibrium if it was positive). It should be acknowledged that this is not the only possible criterion and, in fact, it can be misleading to the extent that sustainable levels of current account deficits are omitted from the computation.[38]

In this paper we scale the ERER using a scoring function, based on the distance of the fundamentals to their sustainable level, as determined by the above mentioned decomposition. The methodology assumes that the observed RER should be 'close' to its equilibrium level at the point in which the deviation of observed fundamentals from their sustainable level is at a minimum. In that particular instant, and since the transitory shocks to fundamentals are the smallest, the distance between the equilibrium RER and the value predicted by the cointegrating model is, consequently, the smallest in the sample. Nevertheless, in order to reduce the risk of choosing a realization of the shocks to fundamentals which is not representative, we use the average of the three smallest scores.[39]

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[37]This is because the rational expectations solution for the ERER is not unique. If we assume the unknown ERER function to be given by $g^*(x)$ and the corresponding rational expectations solution to be given by a general Taylor approximation $g(x/\theta)$ (which is assumed to approximate $g^*(x)$ fairly closely); then, using the regression on the observed RER: $y = g(x/\theta) + \epsilon$ to estimate $g(x/\theta)$ by $\hat{g}(x/\theta) = g(x/\theta)$ does not guarantee that $\hat{g}(x/\theta)$ and $g(x/\theta)$ are equal for each point x in the space of the fundamentals (see Elbadawi, 1983 on the validity of the Taylor series interpretation of the regression estimators).

[38]Recently, there has been an increasing interest on the part of econometricians to develop a more systematic approach to "intercept corrections" in time-series models, which could potentially improve the performance of a model (see Hendry and Clements, 1995 and Clements and Hendry, 1994). These developments, however, do not offer useful insights for this particular problem.

[39]The score function is calculated by minimizing the unweighted sum of the squares of the differences of the normalized fundamentals to their normalized permanent value. The minimum is achieved when transitory shocks are at their lowest level. We conjecture that this simple scaling procedure could be consistent with a signal extraction model.

Table 3 and Figure 1 present the estimated equilibrium RER computed with the corrected RER cointegration equation and the estimated permanent component of the fundamentals; the corresponding RER misalignment is calculated as:

$$RER\ \ Misalignment\ = \frac{RER - ERER}{ERER}$$

Our estimates agree with those of Edwards (1987) and Elbadawi (1994) in that the ERER show some variability. It follows that at least part of the observed RER variability is related to equilibrium behavior, and that analyses of real exchange rate misalignment based on historical comparisons of observed RER levels (i.e. the PPP approach) may lead to erroneous conclusions.

The graphs in Figure 1 show a remarkable success on the part of the computed index in reproducing well known overvaluation (and undervaluation) episodes of the recent macroeconomic history of the different countries. In the case of Chile, the computed misalignment is as high as 65% in the administration of Dr. Allende, in which populist policies induce a marked expansion in both fiscal expenditures and domestic credit.[40] After the reform process, the fixing of the nominal exchange rate in 1979 and the massive flow of foreign borrowing induced a wave of wide misalignment in the RER (which peaked at 15% in 1981). It was not until 1985, when the government came up with a high-real-exchange-rate macroeconomic proposal that the RER reversed the chronic tendency towards appreciation. A key element in regaining private sector confidence was the establishment of a rather wide nominal exchange band with central parity adjusted frequently to maintain the alignment of the Chilean peso vis-a-vis a basket of major currencies (US$, DM, and Yen). Nevertheless, the success of reforms induced foreign capital to flow back to Chile and it became increasingly costly for the Central Bank to sustain the exchange rate. The large volume of capital inflows continued to suggest a more appreciated equilibrium RER, a fact acknowledged by the government with successive nominal revaluations of the Chilean peso of around 10% in 1992 and 1995.

The computed misalignment indices also reproduces salient episodes in the Mexican case; after a period of relatively small deviations from the equilibrium level (1965-1972), the oil shocks of

[40]A comprehensive account of the Chilean experience with reform can be found in Bosworth et al (1994).

1973 and 1978 induced two waves of major misalignments in the RER. The former hit hard oil-importing Mexican producers[41] leading to the abandonment of the fixed exchange-rate policy that had lasted since the 1950s, while the latter, which benefitted now oil-exporting Mexico, induced a protracted appreciation of the RER -which reached 50% just before the moratorium declaration of October, 1982. Mexico's moratorium, in turn, sparked the Debt Crisis of the early 1980s and induced a period of macroeconomic instability and low growth not only in Mexico but in the entire Latin American region. Despite large nominal devaluations (240% in 1982 and 150% in 1986 and again in 1987) and the establishment of numerous controls, the RER continued to show a tendency towards appreciation, reflecting unsustainable macroeconomic policies. The latter were characterized by large fiscal deficits (as high as 11% of GDP) and reliance on inflationary taxes to balance the budget. Stabilization was not achieved until the 1988 *Pacto* -a political agreement on economic reforms, privatization, and fiscal control-, in which the promise of a far-reaching transformation of the economy and backing by the international financial institutions led to a 100% real depreciation within a year and the elimination of the RER misalignment.[42] As evidenced by the collapse of the Mexican economy in 1994, sound macroeconomic policies were not maintained and reforms were mainly inconsequential inducing, in turn, a marked appreciation of the currency and a speculative attack which led to a loss of reserves of US$ 40 billion. It is interesting to note that the computed index is also consistent with this, showing an increasing misalignment (as high as 20%) in 1992 and 1993.

The simulation of our model for African countries is equally interesting and consistent with the description of events in section 4.1 for the cases of Ghana, Kenya, and Mali. The latter is most interesting because it shows that the 50% nominal devaluation in the CFA zone in 1994 is mainly designed for larger countries. For smaller economies, such as Mali, the model suggests that a devaluation would amounted to an overkill (higher inflation) which had, in fact, occurred. This would also explain why small countries were promised some compensations by France (the external anchor of the Union) in the form of development assistance. For Cote d'Ivoire, however, the computed misalignment does not fit easily with our *a-priori* understanding about the evolution of the economy.

[41]Mexico discovered vast oil fields in 1975 and developed the industry just before the second oil shock.

[42]An excellent description of Mexican reforms -and lackthereof- in this period as well as a premonitory analysis of the unsustainable RER policies is presented in Dornbusch and Werner (1994).

Finally, the evolution of the RER in India reflects, throughout most of the period, the conservantiveness in macroeconomic policies which has been characteristic in the last decades. The computed misalignment index does not exceed 20% and it is never a sustained phenomenon. Conservativeness, however, has not been a reflection of prudent macroeconomic management only, but responds also to a web of market regulations and foreign exchange controls which, most likely, have induced the slow rate of growth which is a benchmark of the economy -on average, growth has been only 2.5% per capita in the 1970-1991 period, (World Bank, 1993). In recent years this strategy has begun to exhaust, forcing the authorities to open timidly the economy and allow more space for private sector activities. In fact, at the end of the sample period the computed misalignment exhibits a deteriorating trend and expands to reach over 25% in 1991, for the first time in the last 35 years.

5. AN EMPIRICAL COMPARISON OF THE ERER AND THE FEER

The purpose of this section is to compare our approach to that of Williamson (1994) when forecasting the out-of-sample behavior of the RER. Our interest is double; first, we investigate the appropriateness of the time-series decomposition of the fundamentals and, second, we would like to determine the extent to which the reduced-form ERER model deviates from the FEER full-model projections.

We study the Chilean case in the 1995-2000 period because, in addition of data availability, important volumes of investment in mining will put particular pressure on the RER in the near future, as new mines enter into operation. According to experts, it is expected that in those five years copper exports will double its 1994 level (35% of total exports at current international copper prices), expanding from US$ 4 billion to US$ 8 billion. Regarding the computation of the permanent component of fundamentals, the exercise is useful to determine whether a period to some extent abnormal in Chile's economic history is appropriately captured by the Beveridge-Nelson decomposition or, as Williamson fears, the method gets entangled in the particulars of the estimation period.

The FEER model is very simple, consisting of the estimated cointegrated regression for the RER, but adding equations to endogenize the three fundamentals that could be more dependent on

the current level of the RER: exports, imports, and capital inflows. Given the deterministic nature of copper exports, we separate total exports in the former and non-copper exports. Terms of trade are assumed exogenous since the country has a diversified export portfolio and also because Chile's share in copper markets, though important, has never been dominant so as to affect systematically the international price. Regarding policy variables, we assume that government consumption maintains its 1990-93 level of around 10% of GDP, while public investment increases marginally from 4.5% of GDP to 5%. Finally, international interest rates and country risk maintain its 1993-94 levels, which do not differ markedly from the previous 4-year period.

The following is the estimated model; in all equations we use a two-stage least-squares procedure to instrument-out the RER. Instruments vary according to each equation corresponding, in general, to lagged dependent variables and the RER. Note that equations are estimated as ratio to GDP, which implies unitary scale-elasticities in the demand for imports and constant returns to scale in non-copper exports. Serven and Solimano (1989) provides empirical estimates which are consistent with this assumption..

Total Imports

$$Log\frac{Imports_t}{GDP_t} = 1.89 + 0.26\,Log\frac{Gov.Cons_t}{GDP_t} - 0.31\,LRER_{t-1} + 0.63\,Log\frac{Imports_{t-1}}{GDP_{t-1}} \qquad \textbf{(16)}$$

(2.19) (1.99) (−2.73) (4.84) $R^2 = 0.86$ $D.W. = 2.31$

Non Copper Exports

$$Log\frac{Exports^{*}_{t}}{GDP_{t}} = 4.17 + 2.28\frac{Excess\,Demand_{t}}{GDP_{t}} - 0.32\,LRER_{t-1} + 0.85\,Log\frac{Exports^{*}_{t-1}}{GDP_{t-1}} \quad \textbf{(17)}$$

(1.79) (2.28) (−1.51) (10.47) $R^2 = 0.96$ $D.W. = 1.51$

where Excess Demand reflects excess of domestic demand over potential GDP, the latter calculated using a simple log-trend model. The star above Exports indicate that it corresponds to non-copper exports. The rationale for including the excess demand variable is that during periods of economic boom, exports of fruits and other primary exports with high income elasticity are deviated to satisfy the domestic demand.

Capital Inflows

$$\frac{LRCI_{t}}{GDP_{t}} = 1.79 - 68.97\,(r^{*}_{t} + \rho_{t}) + 6.78\,\Delta LRER_{t-1} + 0.47\frac{LRCI_{t-1}}{GDP_{t-1}} \quad \textbf{(18)}$$

(2.31) (−2.15) (1.63) (3.81) $R^2 = 0.66$ $D.W. = 2.43$

where ρ is the country risk. Note that it is the RER devaluation what determines capital inflows and not its level, thus yielding a dynamic specification for the level of the endogenous variables.

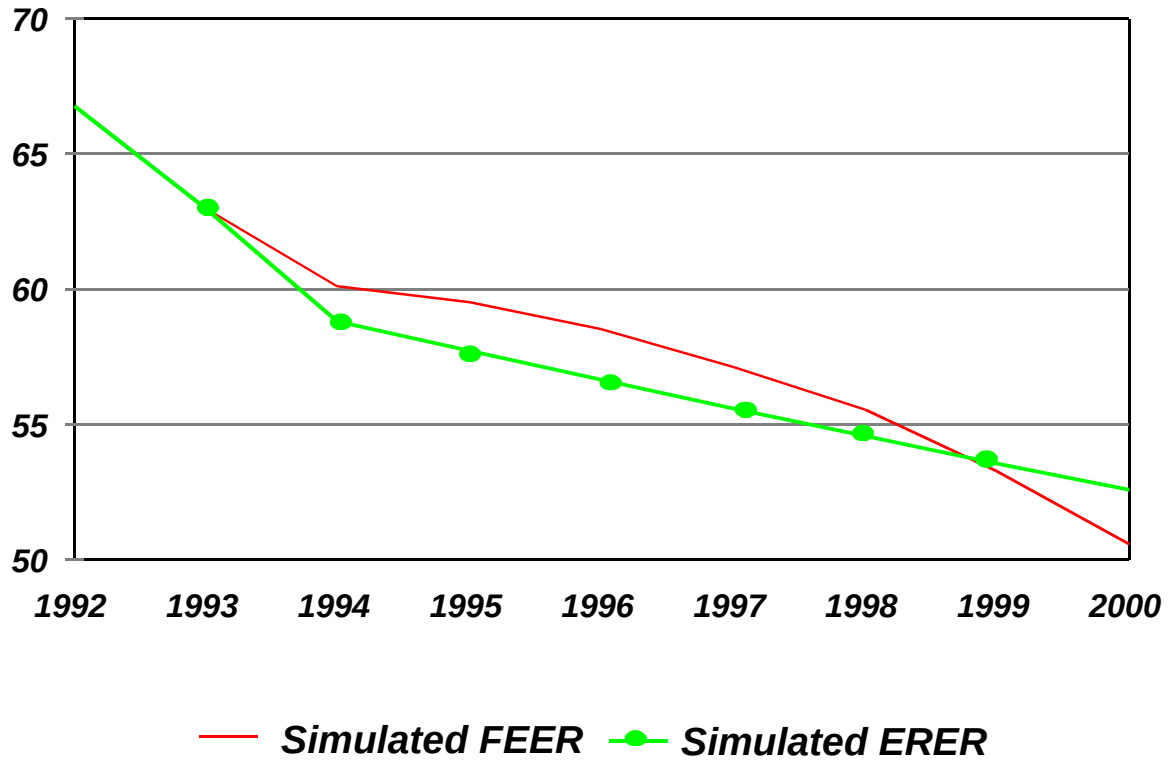
The predicted levels of the exogenous variables, which are required to simulate the model in Williamson's approach, were obtained from recent forecasts by Chilean authorities and can be summarized as follows:

- GDP grows at 7.5% per year, corresponding to the average of the 1986-1994 period. Consequently, current GDP is expected to be at his potential level.
- As mentioned copper exports will double in the 1995-2000 period (at an average rate of 12% per year). The international price of copper is assumed equal to the average of 1993-1994.

- International real interest rates are fixed at 2.5% in real terms, which is slightly above the observed level of 1993 and 1994 (1.5%).

Regarding the equilibrium RER model, we extend the computation of sustainable fundamentals to the 1995-2000 period and compute the ERER straightforwardly. The results of the simulation are presented in figure 2. As expected given the small size of the misalignment in 1994, at the start of the simulation period both the FEER and computed ERER coincide. Both methodologies forecast an appreciating long-run level for the RER, reflecting the massive expansion in trade and capital inflows, which hovers around 15-20% below current levels. The dynamics of both methodologies differ. As the effect of increased copper exports is felt -first, directly in trade volumes and, afterwards, indirectly through imports and capital inflows- the ERER shows a faster appreciation rate than the FEER. Nevertheless, the gap between both methods never exceeds 4% in the entire forecast period.

Figure 2
Simulated ERER and FEER for Chile



6. CONCLUSIONS

As stated in the introduction to this paper, it is not an overstatement to suggest that the issues related to the determinants of the RER, its evolution over time and its position relative to equilibrium now occupy a central role in the academic and policy debates on economic adjustment and, increasingly, in the discussions on long-term growth and development strategies. However, in spite of its importance, the research on the empirical determination of RER --in both developed and developing countries alike--, the calculation of its equilibrium path and the assessment of the misalignment of the RER can, at best, be described as inadequate. This study contributes to this literature by estimating the long-run cointegrated equilibrium of the RER and a set of fundamentals consistent with "internal" and "external" balances. The cointegration model allows a re-interpretation of static estimates of the equilibrium RER model to be consistent with long-run forward-looking behavior and flexible short-run dynamics. Furthermore, the stochastic non-stationary nature of fundamentals provides a natural empirical measure for the concept of sustainability of fundamentals. To put this equilibrium RER concept and its modelling implications in perspective, the paper also provides a selective review of salient "normative" and "positive" issues related to different concepts or RER equilibria.

The model was applied to the cases of 7 developing countries, including four African countries. The selection of the African countries is interesting because it reflects an important divide in SSA, between the fixed exchange rate economies of the CFA monetary union (represented by Cote d'Ivoire and Mali) and the other flexible exchange rate economies (Ghana and Kenya). Inter-country differences within each group further enrich the analysis. The remaining non-African countries studied --Chile, India, and Mexico-- were included as benchmark cases for comparison purposes, since they represent very interesting contrasts in terms of medium-term adjustment as well as longer-term development strategies.

The estimation results of the long-run cointegration equilibrium equation of the RER and the corresponding dynamic error-correction specification strongly corroborate the theoretical model and mostly agrees with results from previous studies. Our results suggest that, except for the case of

Mexico, only long-run capital flows and foreign direct investment are cointegrated with the long-term equilibrium RER. The estimated elasticities range from 0.5 to 1 for more open economies such as Chile, Ghana and Mali; in turn, this suggest that the effects of inflows are quite strong and raises doubts on the ability of the authority to counterbalance this effect and sustain a real exchange rate above the long-term equilibrium by altering its policy mix (e.g., reducing public expenditures). Short-run capital flows and portfolio investment, on the other hand, were found to have only transitory effects on the RER. This findings agree with the view that, if capital flows are determined to be genuinely long-term, the change in the RER is a true equilibrium phenomenon, and in this case no policy action will be required. The effect of foreign interest rates, inclusive of country risk, is also quite interesting since in all countries an increase in the rate or the risk premium induces a depreciation of the RER.

The rather appreciable effect estimated for capital inflows in the relatively open trade economies (Chile and Ghana) is in sharp contrast with the positive but small estimated effect for the ratio of government expenditure to GDP. For all cases, except India and Mexico, this effect was estimated to be positive, which implies that the fiscal spending tends to be concentrated on non-traded goods compared to the private sector and, consequently, that sterilizing the appreciating effects of capital inflows would require substantial fiscal retrenchment.

In terms of the long-run effect of other fundamentals, the estimated elasticity of the volume of trade (degree of openness) is most interesting. The results support the notion that trade liberalization requires a more depreciated equilibrium RER. It also corroborates the view that without real depreciation, trade liberalization could be difficult to sustain (as in the case of Cote d'Ivoire since the mid 1980s until de 1994 devaluation). As expected, the size of the parameter differ since some countries have engaged in far reaching liberalization programs (e.g., Chile and Ghana) while others have been reluctant to open their economies (Kenya and, in particular, India).

The effects of shocks to the terms of trade, as remarked in Section 2, are theoretically ambiguous. The negative sign obtained for some countries (Chile, India, Mali) suggests, contrary to conventional results, the dominance of substitution over income effects. While the empirical regularity has been a positive rather than negative parameters our results are corroborated, in the case of Chile,

by other studies (Schmidt-Hebbel and Servén, 1995; Valdés et al, 1990) Two possible explanations for this phenomenon are discussed in section 4.

The results of the dynamic error-correction models reveal a wealth of dynamic effects that were missing in static studies, which will certainly help understanding the behavior of the RER and sharpening our predictions. Excepting nominal exchange rates devaluations and long-run capital flows in Cote d'Ivoire, leads of fundamentals were not significant, consistent with other paper's conclusions on the absence of feed-back effects. This adds to the robustness of our conclusion that causation seems to run from capital inflows to the RER Finally, the results regarding the effects of nominal devaluations on the RER are most interesting. The negative contemporaneous (and lagged) effect is consistent with the empirical literature (Edwards, 1985), while the estimated positive parameter for anticipated devaluations corroborates the predictions of rational expectations models of the current account balance (see Obstfeld, 1985). For the cases of Chile and Ghana, the combined effect of lead and current devaluations on the RER is null, rendering the models "superneutral" in a monetary sense. In other countries -Kenya, India, and Mexico- the lead effect is smaller than the contemporaneous effect, which could be consistent with the notion that anticipations are less than perfect.

In addition to providing estimates of the order of magnitudes of the influence of capital inflows and other fundamentals, our approach allows computing indices for the equilibrium RER and the RER misalignment Using proxies for the sustainable level of the fundamentals --suggested by their underlying data generating processes-- and a new scoring method for scaling the computed equilibrium index, the estimated long-run equation was used to derive indices of the equilibrium RER The estimated RER index and the corresponding degree of misalignment were fairly successful in reproducing the salient episodes and characteristics of the recent macroeconomic history of the seven countries. In addition, as means for assessing the robustness of the simulation of the equilibrium RER and misalignment of our model, we specified a multiple equation model following the FEER concept of Williamson (1994) and use it to derive similar indices for Chile. Comparisons of the two sets of predictions show that in terms of the long-run path they are quite similar, despite some differences in the dynamic adjustment.

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Figure 1
Real Exchange Rate Misalignment

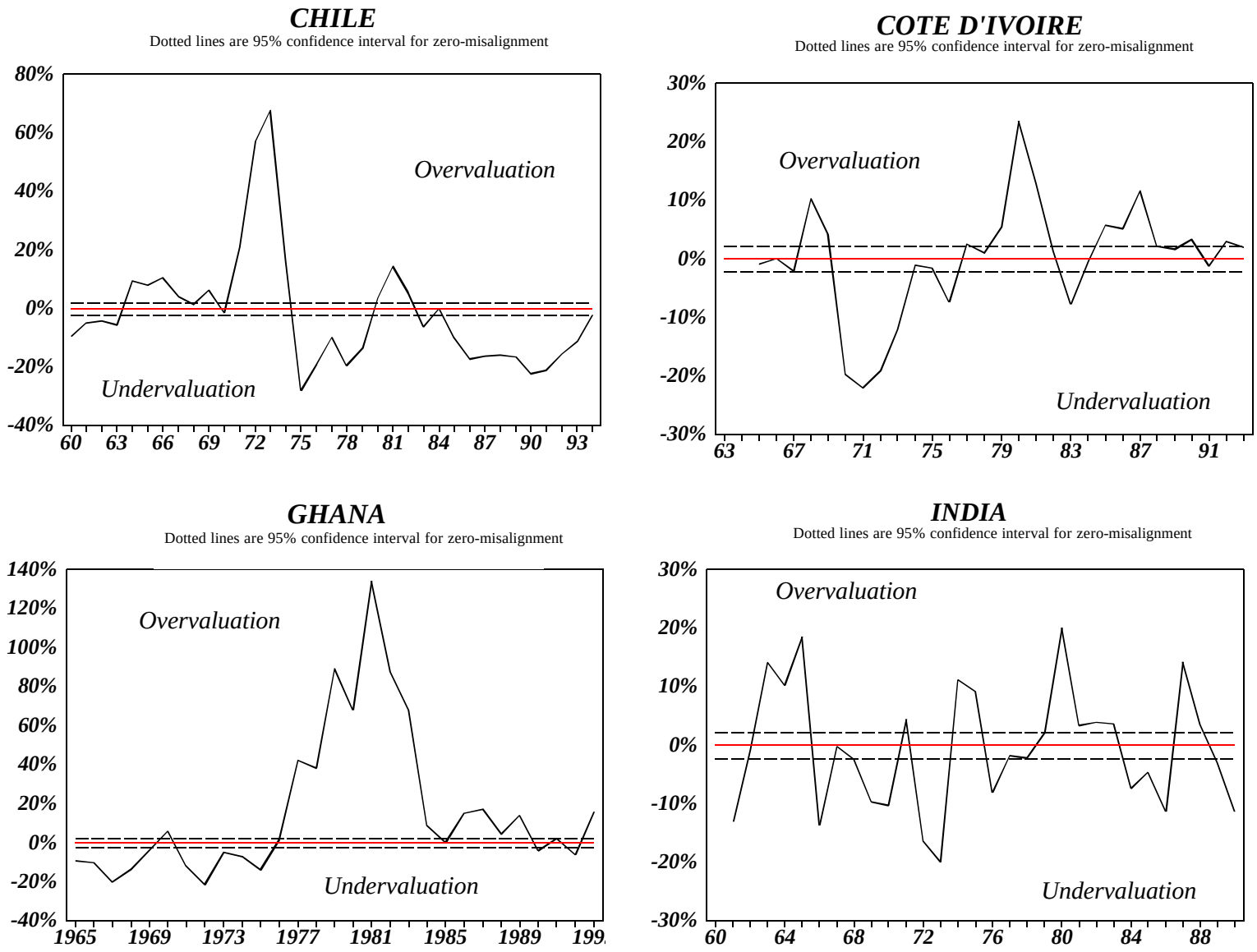

Figure 1
Real Exchange Rate Misalignment (cont)

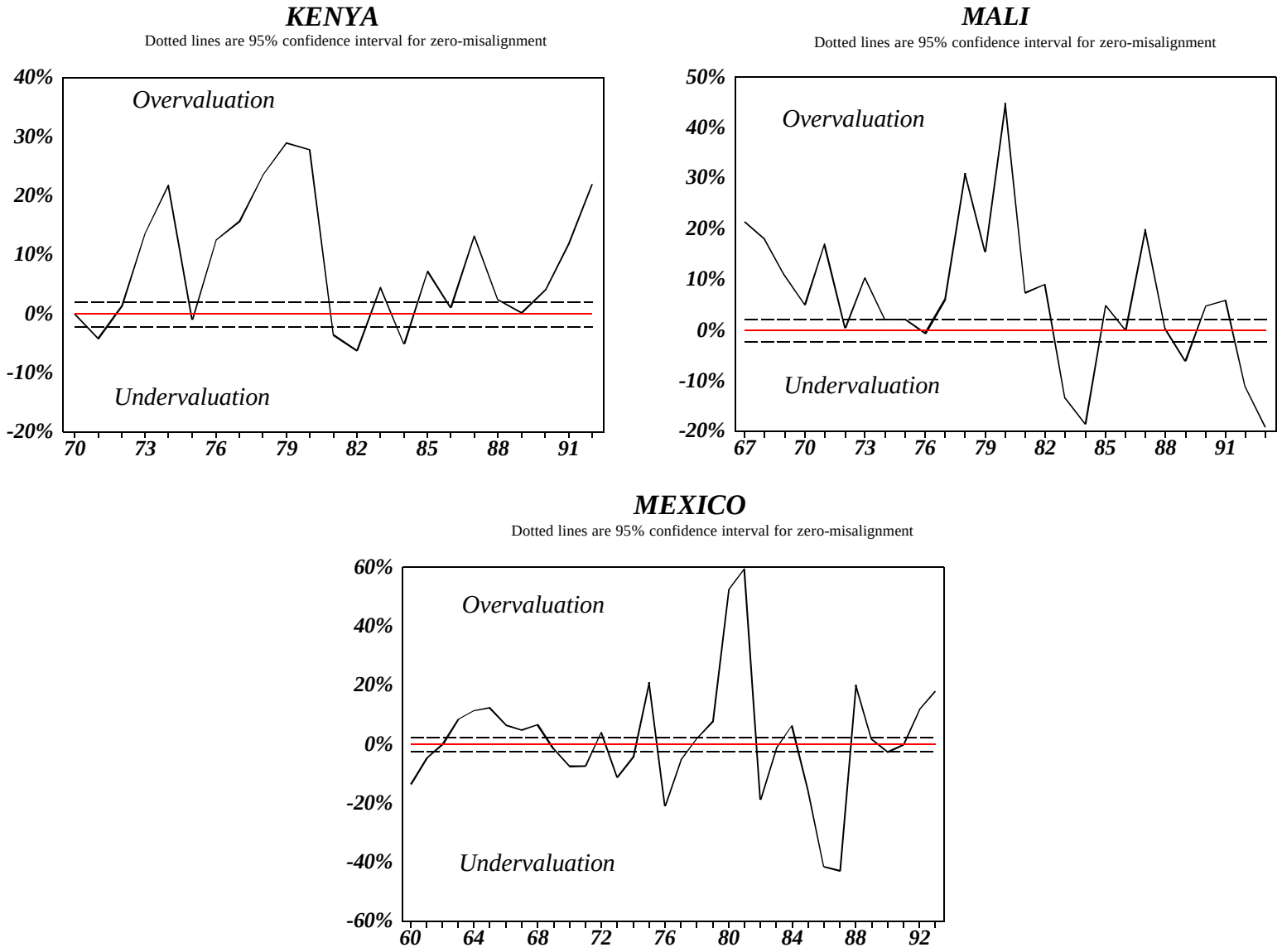

Table 1
Cointegration Models

Variable	Chile	Cote d'Ivoire	Ghana	India	Kenya	Mali	Mexico
Openness	-1.233	-1.417	-1.640	-0.546	-0.111	-0.383	-0.253
Terms of Trade	-0.151	0.161	0.190	-0.121	0.389	-0.363	0.239
Long Run Capital Inflows	0.318	0.636	1.686	0.059	0.536	0.027	0.037
Government Consumption	0.214	0.243	0.365	-1.245	0.765	0.193	-0.400
Public Investment	-0.179	-0.026	0.232	0.614	0.187	-0.367	-0.181
Foreign Interest Rate + Country Risk	-0.044	-1.158	-0.168	-3.800	-3.194	-2.410	-6.913
Constant	3.97	9.032	0.722	8.552	0.722	7.100	5.619
Adjusted R^2	0.95	0.78	0.94	0.81	0.80	0.67	0.71
Durbin-Watson	1.44	1.23	1.46	1.86	1.44	1.87	1.74
Dicky-Fuller on Residuals	-4.03	-3.51	-3.66	-5.37	-3.66	-4.67	-5.0
Period	1960-94	1963-93	1960-93	1960-91	1970-92	1968-93	1960-93

Note: Capital Inflows in Mexico and Cote d'Ivoire includes long and short term flows.

Table 2
Error Correction Models

Variable	Chile	Cote d'Ivoire	Ghana	India	Kenya	Mali	Mexico
Cointegrating Error Term $_{t-1}$	0.588 (3.89)	0.205 (1.88)	0.603 (2.58)	0.299 (2.47)	0.655 (4.92)	0.326 (3.43)	0.550 (2.85)
ΔOpenness	-.039 (-8.40)	-0.590 (-2.86)	-1.245 (-7.05)	-		-	0.867[a] (4.61)
ΔTerms of Trade	-	-	-	-	0.136 (-2.59)	-	-
ΔLagged Terms of Trade	-	-	-	-	-	-	-
ΔLong Run Capital Inflows	-	0.005 (4.32)	0.038 (1.90)	-	-	-	0.028 (3.64)
ΔLagged Long Run Capital Flows	-	-	-	-	-	-	-
ΔLead Long Run Capital Flows	-	0.004 (2.48)	-	-	-	-	-
ΔGovernment Consumption	-0.62 (-3.94)	-	-	-0.378 (-2.34)	0.517 (2.29)	0.492 (2.78)	-
ΔPublic Investment	-0.128 (-3.02)	-		-		-	-0.306 (-2.31)
$\Delta(r^* + r_A)$	-0.005 (-11.81)	-	-0.226 (-4.95)	-0.975 (-1.64)	-0.979 (-1.72)	-0.699 (-1.70)	-4.605 (-3.37)
ΔLagged $(r^* + r_A)$	-	-	-	-	0.775 (2.89)	-	-
ΔShort Term Capital Inflows	0.007 (3.28)	-	-	-0.047[a] (-1.12)	-	-0.013 (-2.94)	-
Nominal Devaluation	-0.096 (-4.92)	0.704 (5.29)	-0.176 (-1.36)	-0.724 (-8.89)	-0.631 (-7.28)	-0.839 (-10.00)	-0.391 (-6.33)
Lead Nominal Devaluation	0.080 (5.20)	-	-0.152 (-1.37)	0.242 (3.28)	0.244 (3.73)	-	0.139 (2.59)
Lagged Nominal Devaluation	-	-	0.196 (1.96)	-	-	-	-
Adjusted R^2	0.83	0.87	0.85	0.83	0.80	0.88	0.81

Durbin-Watson	1.77	1.79	1.70	1.48	1.78	2.02	1.54

Note: (a) lagged.

Appendix A.
Data Sources and Definitions

The data were obtained mostly from IMF and World Bank publications. The definition of variables and their source are:

Sources

- All national accounts figures (including GDP, government consumption, public investment, exports, and imports) were obtained from different World Bank databases and publications.

- All balance of payments and monetary figures (including CPI, nominal and real exchange rates, domestic and international interest rates) were obtained from the IMF database IFS in CD ROM. Terms of trade were obtained and/or constructed from import and export price indices for each country as they appear in the IFS yearbook from the IMF.

Definitions

Real Exchange Rates: When available, it corresponds to the multilateral real effective exchange rate. Otherwise, it corresponds to the bilateral rate to the US$.

Openness: Corresponds to the ratio of exports plus imports to GDP. Although it is an indirect measure of openness, it has the advantage of capturing non-tariff barriers.

Capital Flows: Corresponds to the observed transactions in the form of foreign direct investment and long-term loans (long-run capital inflows) and to portfolio investment and short-term lending (short-term inflows), all expressed as percentage of GDP using the official nominal exchange rate.

Public Investment: Expressed as a ratio to GDP, it usually excludes investment undertaken by public enterprises and decentralized agencies.

Real Interest Rates: Calculated ex-post, using nominal rates and observed CPI inflation.

Country Risk Index: The instantaneous variances and covariances of the risk measure (r_A) were obtained using monthly data on nominal exchange rates, domestic CPI and the US CPI, for the period 1960-1994 (420 observations). For each year we computed the variance of inflation in each country of the sample, the variance of the bilateral RER (to the US$) and the covariance of domestic and US inflation.

Devaluations: It corresponds to the change in the log of the nominal exchange rates.

Appendix Table 3
ARIMA Models for Fundamentals*
(variables in first differences)

	Random-Walk	MA(1)	MA(2)	MA(other)	AR(1)	AR(2)	AR(other)	R^2	DW	Gain Function
Chile: Terms of Trade	✓									1.00
Openness		0.49			0.45	-0.76		0.40	1.52	1.11
Capital Inflows				-0.88 (5)	-0.26			0.41	1.97	0.16
Gov. Consump.		0.57	0.83		-0.61	-0.76		0.04	1.92	1.00
Pub. Investment	✓									1.00
$r^* + r_A$	✓									1.00
Cote d'Ivoire: Terms of Trade		-0.72	1.00		-0.37	0.68	-0.56	0.38	1.93	0.99
Openness	✓									
Capital Inflows		1.01	0.89		-1.13	-0.74		0.18	2.06	0.95
Gov. Consump.	✓									
Pub. Investment		0.85	0.82		-1.08	-0.73		0.17	1.95	0.91
$r^* + r_A$	✓									1.00
Ghana: Term of Trade		-0.89			1.11	-0.48		0.22	1.89	0.30
Openness						0.32		0.19	1.90	0.76
Capital Inflows		0.67			0.23			0.19	2.00	0.25
Gov. Consump.	✓									1.00
Pub. Investment	✓									1.00
$r^* + r_A$	✓									1.00
India: Terms of Trade	✓									1.00
Openness	✓									1.00
Capital Inflows		0.89			-0.49	-0.50		0.26	2.00	0.95
Gov. Consump.	✓									1.00
Pub. Investment		0.33		-0.78 (3)		0.67	-0.28 (3)	0.30	2.15	0.90
$r^* + r_A$	✓									1.00

Appendix Table 3 (cont.)

ARIMA Models for Fundamentals*

(variables in first differences)

	Random-Walk	MA(1)	MA(2)	MA(other)	AR(1)	AR(2)	AR(other)	R^2	DW	Gain Function
Kenya: Terms of Trade	✓									1.00
Openness		-0.94	0.83		0.58	-0.56		0.20	1.73	0.95
Capital Inflows	✓									1.00
Gov. Consump.	✓									1.00
Pub. Investment		-0.42	0.66	-0.84 (3)	0.41	-0.44		0.62	1.82	0.41
$r^* + r_A$	✓									1.00
Mali: Terms of Trade	✓									1.00
Openness		0.25			-0.39	-0.36		0.10	2.18	0.72
Capital Inflows		-0.47		-0.39(3)	0.27	-0.31	0.33	0.25	2.15	0.11
Gov. Consump.	✓									1.00
Pub. Investment	✓									1.00
$r^* + r_A$										
Mexico: Terms of Trade		-0.97	0.35		0.67			0.11	1.97	1.00
Openness		-0.49		0.66 (3)	0.63	-0.40		0.28	2.15	0.95
Capital Inflows			0.28	-0.74(3)	-0.13 (3)	-0.48	0.52(3)	0.06	2.05	0.39
Gov. Consump.		-0.49	-0.49	0.94(3)	-0.43			0.56	1.69	0.70
Pub. Investment	✓									1.00
$r^* + r_A$	✓									1.00

Note: (*) all parameters significant at 5% unless otherwise noted.

Appendix Table 1
Unit Root Tests for Fundamentals
Augmented Dickey-Fuller Tests

	Chile	Cote d'Ivoire	Ghana	India	Kenya	Mali	Mexico
Real Exchange Rate	-1.70	-1.47*	-1.92*	-1.43**	-0.42*	-1.72	-2.45
Δ Real Exchange Rate	-6.01	-4.1	-3.16	-7.19	-3.00	-4.54	-6.06
Terms of Trade	-1.83	-0.78	-1.12*	-2.67*	-0.72	-0.91	-1.78
ΔTerms of Trade	-5.91	-4.36	-3.72	-4.65	-6.71	-5.44	-7.18
Openness	-0.81**	-0.93	-1.94*	-0.46	-2.43	-2.36	-2.31
ΔOpenness	-4.03	-4.8	-3.8	-4.05	-5.76	-5.20	-4.97
Capital Inflows	-2.43	-1.26	-2.21*	-2.11	-1.86	-1.86	-2.79
ΔCapital Inflows	-6.29	-4.62	-4.19	-5.6	-4.24	-4.87	-4.84
Gov. Consumption	-1.72	-1.54	-1.68*	-1.15	-1.49	-0.83	-1.35
ΔGov. Consumption	-5.76	-6.95	-2.93	-5.06	-4.39	-3.06	-5.42
Public Investment	-0.98	-1.85	-2.36	-2.32	-1.71	-2.84	-2.46
Δ Public Investment	-5.12	-6.6	-7.21	-7.49	-6.74	-5.21	-6.03
$r^* + r_A$	-2.65	-2.76	-1.92	-2.51	-1.63	-	-2.99
$\Delta r^* + r_A$	-6.34	-6.46	-4.83	-5.51	-3.73	-	-5.40
Nominal Exchange Rate	-1.34	-0.39*	0.52*	1.03	-0.31*	-2.81	0.09*
ΔNom. Exchange Rate	-2.66	-3.8	-2.96	-5.84	-3.62	-3.47	-3.26
Short Term Inflows	-4.35	-4.94	-6.62	-3.49	-4.26	-3.94	-2.74

Note: (*) Includes 1 lag; (**) includes 2 lags. Critical values for the null hypothesis of one unit-root are -2.62 at 10% and -2.96 at 5%.

Appendix Table 2
Granger-Causality Tests

H_0 = The RER is not Granger caused by:
H'_0 = This variable is not Granger caused by the RER

Country	Null Hypothesis	Terms of Trade	Government Consumption	Public Investment	Openess	Capital Inflows	r^*-r_A	Nominal Devaluation
Chile	H_0	1.44	3.39*	1.31	2.25*	2.72*	3.73*	9.34**
	H'_0	1.14	1.62	2.91*	0.01	0.85	0.75	2.38
Cote d'Ivoire	H_0	4.87*	0.40	3.33*	4.50*	5.97*	6.57**	2.19
	H'_0	0.10	0.10	0.18	0.21	1.26	1.96	1.01
Ghana	H_0	2.01	1.61	9.50**	2.51*	2.90*	8.37*	2.40
	H'_0	0.26	5.41*	20.57**	11.80**	1.96	2.48	3.81*
India	H_0	0.96	3.27*	0.34	0.90	0.23	0.27	12.71**
	H'_0	0.69	4.03*	2.97*	3.95*	1.10	0.11	9.87**
Kenya	H_0	0.13	0.81	0.72	0.15	2.46*	0.10	3.33*
	H'_0	0.08	0.69	3.06*	0.64	0.73	1.14	2.22
Mali	H_0	0.45	1.54	0.72	0.39	2.47*	0.10	11.57**
	H'_0	0.21	0.78	3.07*	0.05	0.73	1.14	7.8*
Mexico	H_0	4.58*	1.05	1.99	1.34	3.37*	5.08*	11.50*
	H'_0	1.30	2.35	5.25*	0.95	4.95*	0.15	7.78**

Note: (*) rejects the null hypothesis at 5%, (**) rejects the null hypothesis at 1%. Country risk is not available for Mali; estimation includes only r*.