

EQUILIBRIUM REAL EXCHANGE RATE FRAMEWORK

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1.0 Introduction

The equilibrium real exchange rate (ERER) is defined as the real exchange rate (RER) which simultaneously achieves internal balance (clearing of the domestic market for nontradable goods and services) and external balance. External balance is a current account balance consistent with long-run sustainable capital inflows. This newer approach to the determination of the ERER posits that the equilibrium changes over time in response to changes in the “fundamentals” that determine it. This contrasts with other concepts of the ERER, such as that given by purchasing power parity, which assumes that the ERER is constant over time.

To my knowledge, three analyses of Ghana’s have been made: Youngblood (1993), Elbadawi (1994), and Morrissey et al. (2004). The first two use single equation methods, specifically an error-correction model, while Morrissey et al. estimate a cointegrated system to obtain estimates of the ERER. These 3 studies, which cover different time periods, show a strong agreement on what constitutes the fundamentals for Ghana’s ERER. The period covered by Youngblood was 1956-1990, while Elbadawi’s 1994 analysis covered 1965-1990 and Morrissey’s covered 1966-2000. All studies used annual data. The fundamentals that determine the long-run ERER in Ghana are the terms of trade, openness (a proxy for commercial and trade policy), and capital flows. All three studies of Ghana’s ERER examined a broader set of fundamentals and found that these were the significant ones for Ghana.¹

This brief outlines a relatively easy method of obtaining estimates of the ERER, from which the extent of misalignment of the observed real exchange rate (RER) can be calculated.

Misalignment of the RER from the ERER is calculated as:

$$DEV_t = \left(\frac{RER_t - ERER_t}{ERER_t} \right) \times 100$$

where DEV_t is the percentage deviation of the observed RER from its equilibrium in period t. If real exchange rates are measured in terms of foreign currency units per cedi (as in Elbadawi), so that an increase in the RER is a real appreciation, then positive deviations imply that the RER is overvalued and negative deviations imply that the RER is undervalued. For example, a negative deviation means that the RER is below its equilibrium value, so that it is “less appreciated” (in real terms) than it should be. On the other hand, if the RER is measured in terms of cedis per foreign currency unit (as in Youngblood (1993) and Morrissey et al. (2004)), then a negative deviation implies that the RER is overvalued and that the RER needs to depreciate to correct the misalignment.

¹ The Morrissey study also found that total factor productivity was a fundamental determinant.

2.0 ERES Fundamentals and Calculation of the Observed ERES

Terms of trade. The terms of trade data for 1965-1999 were taken from the African Development Indicators database. Data were updated through 2004 by applying the percentage changes in the terms of trade reported in various IMF documents.² In applied work it has usually been found that a permanent improvement in the terms of trade causes the ERES to appreciate because of the income effect of the improvement.³

Net capital inflows. Net capital inflows (as a percentage of GDP) are used as a proxy for capital controls. In models of ERES determination, a permanent increase in net capital inflows (interpreted as a reduction in the tax on foreign borrowing) leads to an appreciation of the ERES via the intertemporal substitution effect. The tax reduction increases the discount factor applied to future consumption thereby making future consumption more expensive. This increases the demand for current consumption, which raises the price of nontradables, thereby resulting in a real appreciation.

I use a broader measure of capital inflows than do the authors of the other studies. I measure net capital inflows (as in my 1993 study) as the negative of the trade balance plus changes in reserve assets. This means that private remittances and official unrequited transfers (grants)—items normally included in the current account—are counted as part of capital inflows.

Commercial Policy (Openness). Models of ERES determination ascribe a critical role to the effects of import and export taxes. Permanently higher levels of these taxes (i.e., reducing the openness of the economy) lead to ERES appreciation. This occurs because future consumption becomes more expensive. In response, people tend to favor current consumption; as the demand for all goods increase, the price of nontradables rises, so the ERES appreciates. In applied work it is very difficult to obtain a sufficiently long time series of import and export taxes. Consequently, these are proxied by the ratio of exports plus imports to GDP. An increase in this ratio reflects an increase in the openness of the economy to international trade, presumably caused by a reduction in trade taxes (both explicit and implicit).

Exports and imports as reported in the System of National Accounts (i.e., as part of GDP reportage) are available from the IMF's *International Financial Statistics* from 1975-1997. For 1998-2003, I converted dollar values of exports and imports from Ghana's balance of payments statistics to cedis using period average exchange rates. After a comparison of BOP data with GDP data for the period 1975-1997, I adjusted the BOP data upwards by the average of the difference between these two series over the 1990-1997 period. BOP exports (converted to cedis) were increased by 5.1% and BOP imports were increased by 21.8%. The much larger increase in imports results because BOP imports are reported on an f.o.b. basis, while they are

² For example, the IMF's document "Fourth Review Under the Poverty Reduction and Growth Facility, Requests for Waiver of Performance Criteria and for Extension of the Commitment Period" (January 31, 2002), Table 3 (Selected Economic and Financial Indicators, 2000-06) contains the terms of trade change for 2000.

³ Theoretically a change in the terms of trade has both an income and an offsetting substitution effect. If the substitution effect dominates, then an increase in the terms of trade would lead to a depreciation in the ERES. However, this is not usually found in empirical work.

reported on a c.i.f. basis in the national accounts. To extend the series back to 1965, I used the data from my earlier study.

Calculating the Multilateral RER.

I computed a trade-weighted multilateral RER with weights based on the currency of transaction, rather than with reported trade flows with Ghana's trading partners. The first step was to compute the bilateral RER's for the cedi against these 3 currencies:

$$BRER_{it} = \left(\frac{E_{it} \times P_{it}^*}{P_t} \right)$$

where $BRER_{it}$ is the bilateral real exchange rate (measured in cedis per foreign currency unit i in period t), E_{it} is the nominal exchange rate index (cedis per foreign currency unit i in period t), P_{it}^* is the foreign consumer price index (CPI) of country i in period t , and P_t is Ghana's CPI in period t . The nominal exchange rate index and all CPI's had a base year of 2000, so that the index value in that year equaled 1.0.

Prior to 1999, when the euro came into existence, I computed a weighted average of the bilateral real exchange rates with France, the Netherlands, Germany and Italy. (I used these countries to represent euro countries because in my earlier study they were significant trading partners with Ghana.) Because consumer price indexes were not available for Germany prior to 1991 (perhaps because of the unification with East Germany), two weighted averages were constructed for the period 1965-1998. For 1965-1990, the weights assigned to the franc, guilder, and lira were 15%, 71%, and 14% respectively. From 1991-1998, the weights assigned to the franc, guilder, lira, and mark were 9%, 47%, 6%, and 38%, respectively.⁴ Thus, the BRER index for the "euro" from 1965-1998 was:

$$BRER_{euro,t} = \sum_{i=1}^n \alpha_i BRER_{it}$$

where $n=3$ (for 1965-1990) or $n=4$ (for 1991-1998) and α_i are the weights assigned to each currency in the "euro" area.

The multilateral real exchange rate (MRER) is then computed as the weighted average of the dollar, pound and "euro" RER's with the following weights: 80% (dollar), 10% (UK pound), and 10% (euro). The MRER, terms of trade, openness, and net capital inflows are shown in **Figures 1-4**.

The 5 year moving averages of the fundamentals reveal distinct trends since 1982 that affect the ERER. There has been a secular decline in the terms of trade of 50% between 1982 and 2004. The openness of the economy has increased dramatically by 550%. Net capital inflows as a percentage of GDP have also increased steadily from a capital outflow of 1% in 1982 to inflows of almost 18% by 2004; trend net capital inflows have also increased substantially from 1999 to 2003, nearly doubling (as a percentage of GDP) over this period. Based on the discussion above of the theoretical effects of changes in the fundamentals, the trends in the terms of trade and

⁴ These are the renormalized weights for Ghana's trade with these countries in 1980. The original weights (which were used in my earlier study) were 10.5% (Germany), 12.1% (Netherlands), 2.6% (France), and 2.3% (Italy).

openness would cause the ERES to depreciate, while the trend in net capital inflows would create pressures for ERES appreciation. Based on movements in the observed RER, changes in the fundamentals causing ERES depreciation have dominated the appreciating affect of net capital inflows.

3.0 ERES Estimates and RER Misalignment

In the theory of ERES determination, permanent movements in the fundamentals cause permanent changes in the ERES and temporary changes in the fundamentals result in transitory changes in the ERES. In this brief I focus on permanent changes in the fundamentals and how they have affected the equilibrium RER over time. I represent permanent changes in the fundamentals as 5 year moving averages⁵. Permanent movements in the ERES are computed the same way. These averages, and the annual values of each series, are plotted in **Figures 1-4**.

Following Youngblood (1993) and Elbadawi (1994), I estimate the permanent long-run relationship between the fundamentals and the MRES by a cointegrating regression of the log levels of the MRES on a constant and the log levels of the fundamentals (net capital inflows as a proportion of GDP, which are sometimes negative, are entered unlogged into the regression). The results are shown in **Table 1**, along with the results of Youngblood (1993) and Elbadawi (1994) for comparison. The results for the latter two studies are very similar except for the signs. Elbadawi calculates the RER as the foreign currency price of the cedi, while I calculated it as the cedi price of foreign exchange. Interestingly, my results for the period 1965-2003 are very similar to the results I obtained in my earlier study, particularly the coefficients on openness and net capital inflows. All coefficients have the signs predicted by the theory of ERES determination.

The results obtained by Morrissey et al. (2004) using a system of equations (in contrast to our single equation approach) are similar with the exception of the effects of changes in the terms of trade. They found that an increase in the terms of trade depreciates the equilibrium RER, indicating that the substitution effect outweighs the income effect of this relative price change. One aspect of the Morrissey study that I found puzzling concerns their measure of the trade-weighted RER. Examining the graph of this series (Fig. 6 in their paper) shows that the RER depreciated only slightly from 1998 onwards. This contrasts with our calculations of the RER (**Fig. 1**) which shows a sharp depreciation of 65%. Even though my trade weights differ significantly from those used by Morrissey (who used Direction of Trade Statistics), there should have been a noticeable depreciation in 2000. Perhaps their terms of trade effect reflects the relative constancy of the RER over the 2000-2002 period. The terms of trade deteriorated by 20% in 2000 alone; a significant depreciation in the RER would reinforce the dominance of the income effect as Youngblood and Elbadawi found.

The coefficients from the cointegrating regression and the permanent levels of the fundamentals (shown as 5 year moving averages in **Figures 2-4**) were used to compute the permanent levels of the ERES. The 5 year moving averages of the observed RER were plotted against the ERES (**Fig. 5a**) and the misalignment of the permanent level of the RER from its permanent

⁵ More sophisticated time series techniques are available for decomposing movements in a time series variable into its permanent and temporary components (e.g., Beveridge and Nelson (1981) and Hodrick and Prescott).

Fig. 1. Multilateral Real Exchange Rate (1990=1.0)

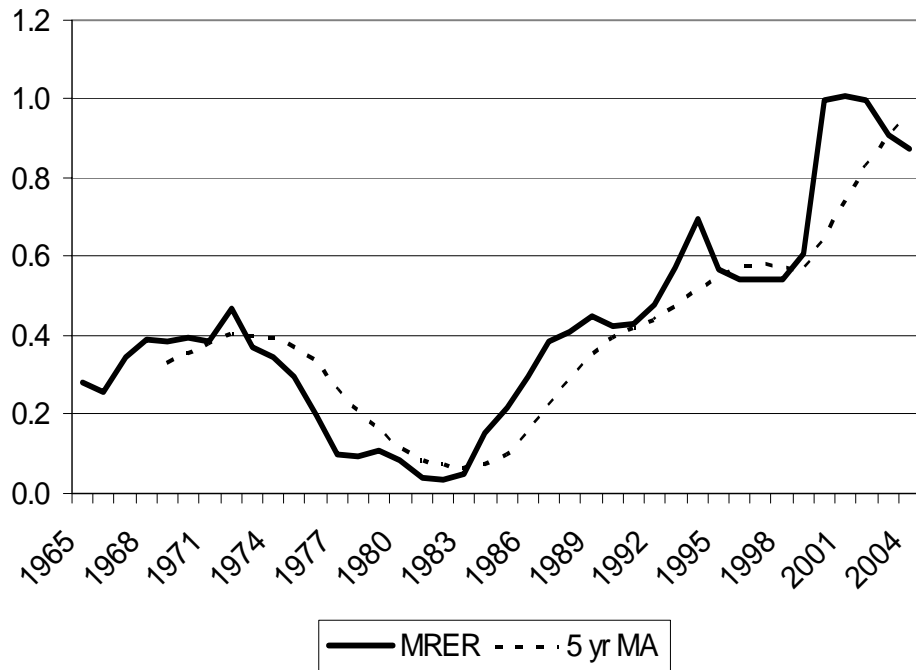


Fig. 2. Terms of Trade (2000=1.0)

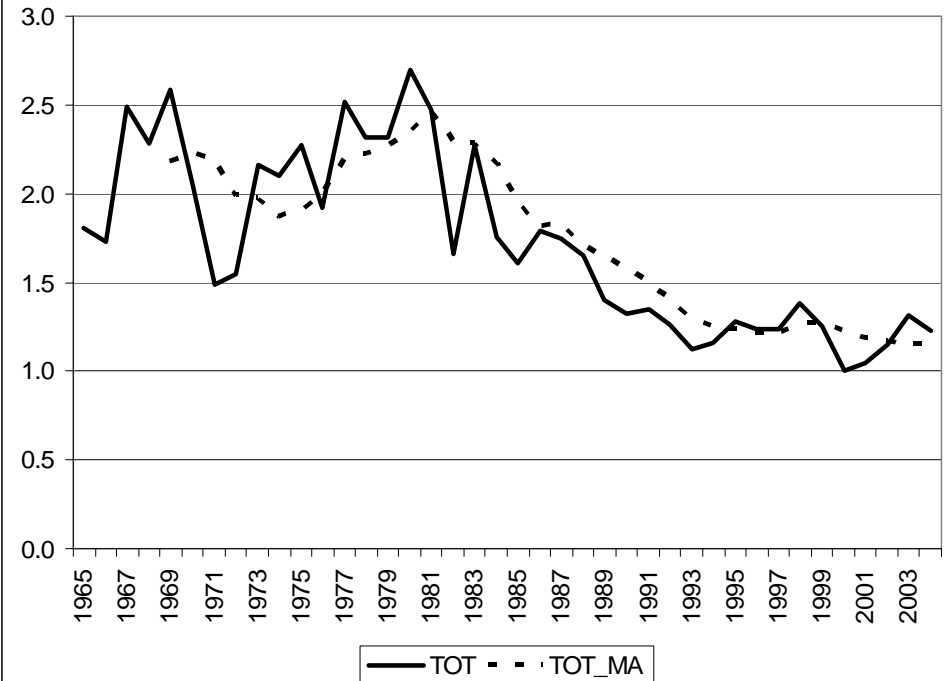


Fig. 3. Openness (proportion of GDP)

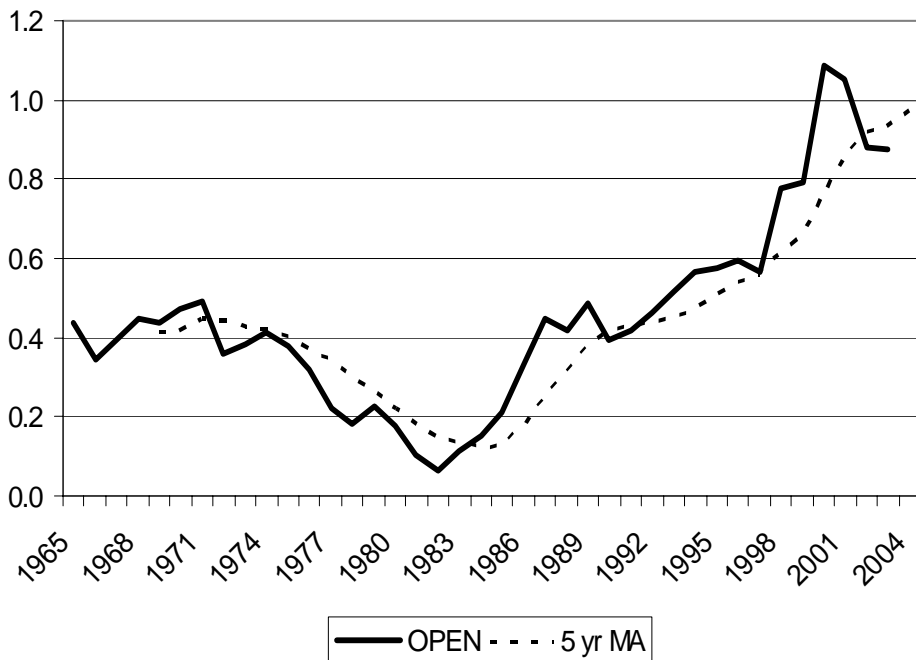
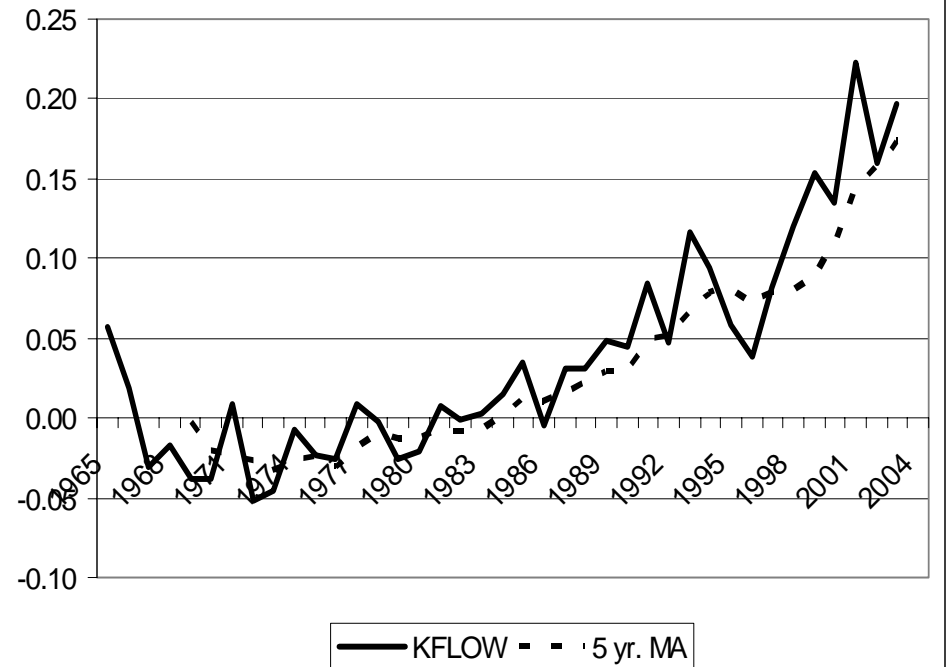


Fig. 4. Net Capital Inflows (proportion of GDP)



equilibrium level were computed as the log differences between the RER and the ERER (Fig. 5b).

Table 1. Cointegrating Regressions

| | Current | Youngblood (1993) | Elbadawi (1994) |
|---------------------|--------------------|----------------------|--------------------|
| Range | 1965-2003 | 1956-1990 | 1965-1990 |
| Constant | 0.571 (4.507) | 2.106 (9.958) | 1.07 (2.49) |
| LTOT | -0.855 (-4.593) | -0.337 (-2.966) | 0.30 (4.13) |
| LOPEN | 1.245 (18.668) | 1.454 (13.007) | -1.52 (-18.9) |
| KFLOW | -2.741 (-3.552) | -2.955 (-1.908) | 2.53 (2.86) |
| Adj. R ² | 0.95 | 0.90 | 0.95 |
| CRDW | 1.167 ⁺ | 2.120 ⁺ | 1.823 ⁺ |
| ADF* | n.a. | 3.98 ⁺ | 5.45 ⁺ |
| No. obs. | 39 | 35 | 26 |

t statistics in parentheses

CRDW = cointegrating regression Durbin-Watson; critical values for rejecting the null hypothesis of non-cointegration are .455 (1%), .282 (5%), .209 (10%).

ADF = augmented Dickey-Fuller test; critical values are 3.73 (1%), 3.17 (5%), 2.91 (10%).

+ indicates significance at the 1% level

There were two periods of significant overvaluation (negative values in Fig. 5b): 1979-1983 and 1999-2002. The first corresponds to the time of economic disarray preceding the Economic Recovery Program (ERP). The second resulted from the use of a nominal exchange rate anchor that was not supported by a consistent fiscal policy. Presently, the permanent level of the RER appears to be close to the permanent level of the ERER.

It is important to stress that I am looking at *permanent* changes in both the ERER and the observed RER. A more complete modeling of the dynamics of the observed RER with respect to permanent and transitory changes in the fundamentals, and in other macroeconomic policy variables that can keep the observed RER away from its equilibrium path, would be needed to ascertain the actual misalignment of the observed RER. (This modeling has been done in the papers cited in this brief.) Youngblood (1993) found that an excess supply of domestic credit was significant in explaining the divergence of the observed RER from its equilibrium path and that nominal devaluation could help move the RER towards its equilibrium. Elbadawi (1994) did not find significance in any variables other than changes in the fundamentals in estimating his error-correction model of the RER, but did include a dummy variable for the policy changes associated with the ERP in 1984. The results of Morrissey et al. (2004) were similar to Elbadawi's in that macroeconomic policies (other than those represented by shift dummies) were

Fig. 5a. Permanent Components of Equilibrium and Observed RER's

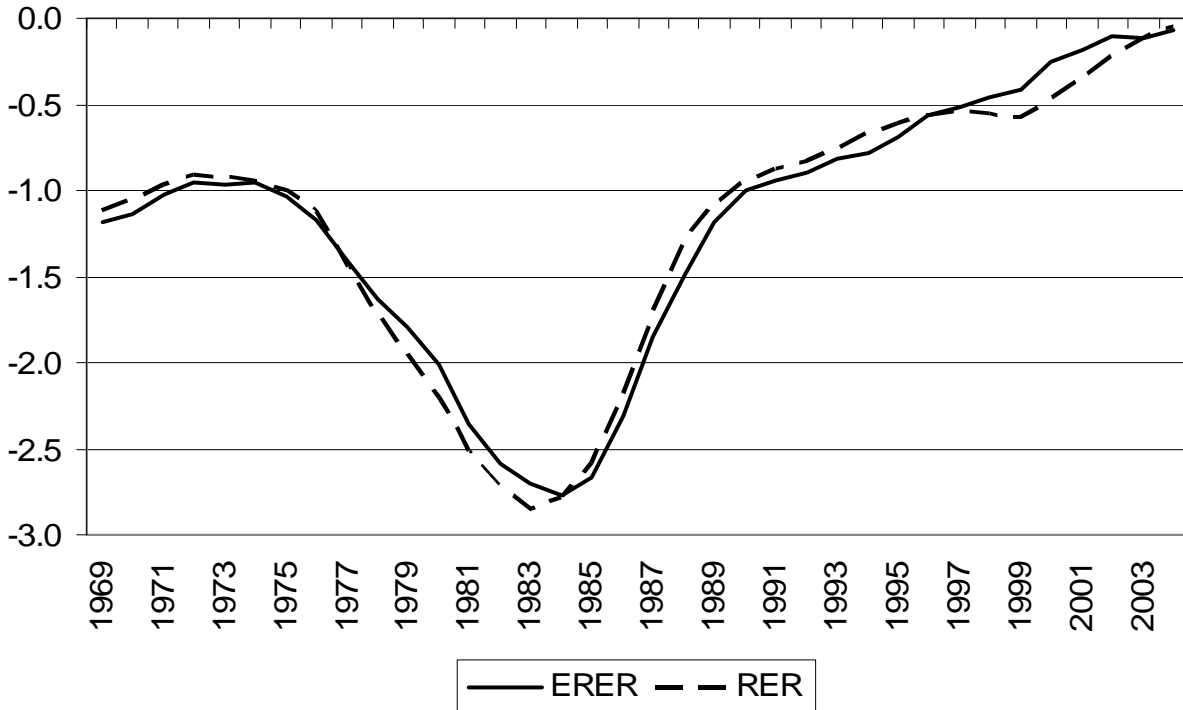
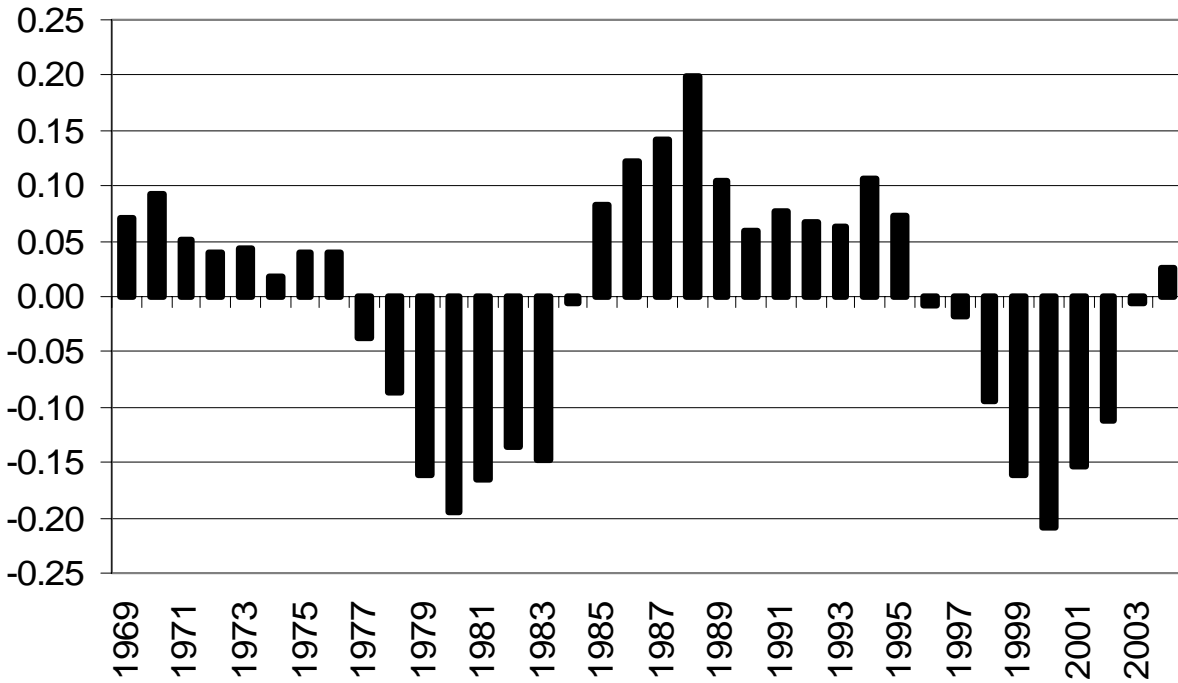


Fig. 5b. RER Misalignment (+/- = under/overvaluation)



not significant in the error-correction model of RER dynamics. All three authors found that temporary changes in the fundamentals (captured as first differences of the logged levels) were significant and could move the RER away from its equilibrium path, albeit only temporarily.

Although an estimate of the misalignment of the RER from its equilibrium path is not presented here, the methods used in this brief can be used to estimate the influence of the fundamentals on the permanent path of the ERER. This can be compared to a simple measure of the permanent path of the RER (proxied by a 5 year moving average) to obtain important insights into the deviation of the RER from its equilibrium path. It is also important to note that the theory of ERER determination holds that significant deviations of the RER from its equilibrium path will be eliminated over time. The speed of adjustment towards equilibrium depends on the short-run dynamics of the fundamentals and on other macroeconomic policies.

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