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THE REAL EFFECTIVE EXCHANGE RATE IN THE ECCU: EQUILIBRIUM AND MISALIGNMENT

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THE REAL EFFECTIVE EXCHANGE RATE IN THE ECCU: EQUILIBRIUM AND MISALIGNMENT

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ABSTRACT

This paper seeks to identify possible causes and the extent of any misalignment in the real effective exchange rate (REER) in the ECCU over the 1990 to 2007 period. The study employs the standard behavioural exchange rate approach to modelling exchange rate equilibrium. A long-run relationship is established between the REER and its fundamental determinants, which is then exploited to evaluate the degree of over or undervaluation. The results indicate that in the early part of the sample, the REER was closely aligned with its equilibrium value. From about 2001 however, the REER became mis-aligned in at most two countries. The empirical analysis presented here highlights the important roles that fiscal policies and capital inflows play in real exchange rate movements.

JEL Classification Numbers: F21, F31, O24
Keywords: Equilibrium Real Exchange Rate, Misalignments, ECCU

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1.0 INTRODUCTION

The real exchange rate is a key relative price in international economics. It guides resource allocation, directly affects a country's welfare and standards of living, and is often used as a measure of international competitiveness. A significant challenge in exchange rate policy consists of determining an exchange rate that simultaneously achieves domestic and external balance. In the ECCU context, it is probably readily apparent due to the structural changes and the external shocks that have confronted these economies that the exchange rate may not equilibrate the domestic and foreign sectors at all points in time. It then immediately follows that the concept of the equilibrium real exchange rate that we have in mind is inherently time-varying in nature, shifted by changes in spending patterns, terms of trade and the level of capital inflows. In the ECCU, the nominal exchange rate is pegged to the US dollar, implying that *real* quantities must adjust to restore equilibrium. This is of significance as it requires flexibility in product and labour markets, which would in turn determine the extent of departures from equilibrium and the time path of adjustment.

The study seeks to provide empirical estimates for some of the main determinants of the REER using panel co-integration techniques. The key advantage of using this technique is that it makes the important delineation between the long run and short run estimates. The long run estimates are used to generate a measure of the equilibrium REER, and in turn, misalignments from the actual REER can easily be calculated. The study contributes to the debate about the 'correct' level of the real exchange rate, and in turn, the degree of misalignment from the "correct" level. This is an issue that has come to the fore in light of the recent depreciation in the REER. The REER has depreciated by 12.1 per cent on a trade weighted basis since 2001, which is perhaps not too surprising given that the US dollar to which the EC dollar is tied - has fallen by 22.8 per cent during the same period. What is a "correct" level for the ECCU's real exchange rate? This question can only be answered if there is an idea of what is the equilibrium exchange rate. It is perhaps readily apparent that the actual level of the real exchange rate may deviate from its "equilibrium" or long-run value. This in and of itself is not necessarily a problem: these differences can result from short-term frictions and adjustment costs for example. Such a circumstance requires neither cause for concern nor any consideration of an appropriate policy intervention. Of more importance are *persistent* deviations causing major and sustained

differentials between actual and equilibrium real exchange rates, resulting in so-called exchange rate "misalignments". Depending on the extent of the departure from equilibrium and the time it takes for such departures to be eliminated some sort of policy response may be appropriate. In the context of a fixed exchange rate quasi - currency board arrangement, the real exchange rate (RER) is one of, if not the most important relative price. Movements in this relative price have important implications for exports, investment, and economic welfare more generally. Indeed, persistent overvaluation in the REER can undermine the fixed exchange rate regime.

This study contributes to the existing literature on real exchange rate misalignments in small open economies in the following ways: (1) provides empirical estimates for some of the main determinants of the REER; (2) determines whether or not the REER in the ECCU is at its equilibrium level and the extent of any misalignments, thereby assisting policy makers to understand the key factors which lead to misalignments; and (3) offers a more systematic framework for assessing the external price competitiveness of the ECCU countries.

The remainder of the paper is laid out as follows; section 2 examines the developments in the REER over the period 1990 to 2007 while section 3 provides a brief review of the empirical literature. The analytical framework is outlined in section 4 and the data and methodology in section 5. Section 6 presents the empirical results while the policy implications are discussed in section 7. Section 8 concludes.

2.0 DEVELOPMENTS IN THE REER (1990-2007)

The EC dollar real effective exchange rate (REER) ended 2007 significantly below the level at the start of the review period in 1990. Notwithstanding, there have been sizeable real appreciations, from 1990 – 1993, and from 1996 - 2001. The REER has depreciated markedly since 2001 in most countries, perhaps associated with the decline in the US dollar exchange rate against major currencies. What have been the forces behind these trends? Figure 1 charts the REER for the eight ECCU countries and its determinants over the sample period.

Some interesting patterns are worth highlighting. At the beginning of the sample period, economic activity slowed dramatically to an average of 2.5 per cent in 1991-1992 from an

average of 5.7 per cent the two years previous, perhaps not unrelated to the global economic slowdown that started in 1991. Government consumption as a share of GDP rose to almost 3.0 per cent in 1991 in an effort to attenuate the worst effects of the recession; this however had the side effect of appreciating the real exchange rate. An increase in tourism inflows improved the relative productivity of the region, further adding to pressures on the real exchange rate.

The REER depreciated from 1993 – 1994, as a result of the fiscal consolidation effort in preparing for the Common External Tariff (CET)[1]. The sizeable productivity gains over the previous four years decelerated sharply, another feature of the depreciation during this period. The ECCU region suffered several major hurricanes during the mid to late 1990s, resulting in an increase in the government consumption to GDP ratio. Reduced access to the European banana market and increased competition from Latin America precipitated a worsening in the terms of trade. The confluence of these factors caused a sizeable appreciation in the real effective exchange rate from 1995 to 2001. The appreciation was most pronounced in St Kitts and St Lucia, and to a lesser extent Anguilla (see figure 2), primarily as a result of foreign direct investment in hotel and tourism capacity. A priori, capital inflows are expected to result in an appreciation of the real effective exchange rate on average.

The ECCU region suffered several major hurricanes during the mid to late 1990s, resulting in an increase in the government consumption to GDP ratio. Reduced access to the European banana market and increased competition from Latin America precipitated a worsening in the terms of trade. The confluence of these factors may have caused the sizeable appreciation in the real effective exchange rate from 1995 to 2001. The appreciation was most pronounced in St Kitts and St Lucia, and to a lesser extent Anguilla (see figure 2).

Since 2001 however, the ECCU's real effective exchange rate has depreciated, reversing entirely the previous appreciation. While productivity gains and capital inflows remained sizeable, the main influence has been the deceleration in the government consumption to GDP ratio, from 3.1 per cent in 2001 to below 2.9 per cent in 2007. The EC dollar was at its most competitive level in 17 years. Although productivity gains and capital inflows have been maintained, the dominant

[1] The CET was implemented in 1993

influences on the real exchange rate throughout the sample period have been government spending and the terms of trade. The depreciation of the REER was also related to the depreciation of the US dollar, to which the nominal exchange rate of the ECCU is tied.

3.0 LITERATURE REVIEW

The empirical literature on estimating equilibrium real exchange rates is quite vast and varied, testament to the perennial interest in the topic from a theoretical and policy perspective. Real and financial globalisation has renewed the interest of theorists concerned about the transmission of, and global adjustment to economic shocks and the role of the exchange rate in the equilibrating process. Policy makers and practitioners are interested because of the implications of misaligned real exchange rates for economic welfare and economic stability more generally.

A clear theoretical and empirical exposition of the behavioural equilibrium exchange rate (BEER) approach utilized in this study is provided by Edwards (1989). The study posited that the long-run equilibrium real exchange rate is a function of "fundamentals" such as the terms of trade, government consumption, productivity and capital inflows. The BEER framework postulated by Edwards is extremely general, in that it also incorporates an analysis of cyclical and nominal influences on the equilibrium real exchange rate (ERER). Thus the extent to which exchange rate mis-alignments can be attributed to structural innovations or unsustainable macroeconomic policies can be assessed. Using this approach, Edwards estimated reduced form behavioural equations for twelve developing countries over the period.1965 – 1980 in a partial adjustment framework. The main results to emerge from this analysis were that short-run movements in the real exchange rate (RER) respond to both real and nominal disturbances; inconsistent macroeconomic policies can generate persistent departures of the actual RER from the ERER; and lastly, the autonomous adjustment mechanism that would move the RER back to equilibrium operated fairly slowly.

Numerous approaches for estimating equilibrium real exchange rates have been devised in the literature (See Horvarth 2005 for a review and extended references). Perhaps the most popular approaches have been the behavioural equilibrium exchange rate approach of Edwards (1989)

and the fundamental equilibrium exchange rate (FEER) popularised by Williamson (1994). Intuitively, the main differences between the two approaches is that the FEER calculates the medium-term real effective exchange rate so as to assess the current value of the actual exchange rate, while the BEER tackles the issue from the opposite end: it explains the actual behaviour of the real exchange rate in terms of 'sustainable' values of relevant economic variables. A comparison of both approaches is provided in Clark and Macdonald (1998). The study computed behavioural exchange rate equations for the US dollar, the German Mark and the Japanese Yen for the period 1960 – 1996 and compared them with FEER's calculated for the same currencies from Williamson (1994). Remarkably, the estimated equilibrium exchange rates and calculated misalignments for the US dollar and the Japanese yen were quite similar, while no such conclusion could be made for the German Mark.

MacDonald and Ricci (2003) applied the BEER approach to South Africa using quarterly data from 1970 – 2002. The study was motivated by the depreciation of the South African Rand in 2002, which was 45.0 per cent weaker than its average level in 1995. The BEER approach was particularly useful in that the authors wanted to assess whether the depreciation of the Rand was an equilibrium phenomenon – whereby no policy intervention is required or indeed even desirable – or a temporary departure from equilibrium. In this case the speed of adjustment back to equilibrium will inform the need for policy responses. The authors regressed the real exchange rate on what have become standard explanatory variables for developing countries including the terms of trade, relative productivity growth, the real interest rate differential, measures of openness, the fiscal balance, and net foreign assets. Using a vector error correction model (VECM), the 'fundamental' variables exhibited expected signs and were significant. The long-run estimates were filtered to remove cyclical influences so as to obtain an estimate of the equilibrium exchange rate. The authors concluded from the analysis that the depreciation of the Rand in 2002 was an equilibrium phenomenon and the currency was not fundamentally misaligned or undervalued.

Mkenda (2001) analysed the main determinants of the real exchange rate in Zambia, and also estimated the degree of misalignment. The study differed from most of the literature in that three measures of the real exchange rate were calculated: an export based RER, an import based RER

and an internal RER. A possible limitation of the study is that a system procedure was not used in estimation; rather the author estimated three reduced form exchange rate equations conforming to the definitions of export, import and internal RER's above.

An important commonality in the studies briefly reviewed above is that they are for the most part single country studies utilising time series techniques. This is an obvious limitation when estimating real effective exchange rates for developing countries, as most macroeconomic data for these countries extend only from the 1970's at best. Thus estimates usually suffer from the short time series available or small samples and are thus are not particularly robust[2]. To help overcome this difficulty, Dufrenot and Yehoue (2005) in an important contribution to the literature utilised newly developed panel co-integration techniques to estimate an equilibrium real exchange rate for a panel of 64 developing countries. Given the number of countries, heterogeneity is likely to be an issue. The study discovered evidence of heterogeneous co-integrating relationships, which militates against the use of pooled-based methods of estimation. This result was taken by the authors as justification to construct misalignment measures on average individual exchange rate deviations rather than a uniform summary measure. Another innovation in the study is the use of common factor analysis, which sought to identify whether the dynamics of the REER are jointly related to a host of unobservable variables, or common factors, regardless of individual country effects. Interestingly, the authors found that low-income countries displayed substantial homogeneity compared to middle-income countries. The dynamics of the REER for the former was governed by 7 common factors, while only 4 common factors were found for the former. Using the estimates from the long run panel equations, the authors constructed misalignment measures by removing the cyclical component from the fundamental variables that are deemed to be important in explaining movements in the equilibrium REER. According to the evidence presented by the authors, the estimated equilibrium real exchange rates and misalignments tracked the historical record of exchange rate over- and under-valuation relatively well.

[2] The example cited by Dufrenot and Yehoue (2005) is particularly instructive. The authors recounted the overvaluation of the CFA franc in 1994 prior to its devaluation. While most studies agreed that the CFA franc was overvalued, measures of the extent of misalignment differed greatly. An accurate measure of misalignment is critical as it informs the size of policy intervention needed.

Calderon (2004) typifies the modern literature on the estimation of equilibrium REER's by utilising a panel co-integration approach. Unlike previous studies, the authors embed their empirical results in a simplified micro-founded economic model of the type pioneered by Obstfeld and Rogoff (1995).[3] The advantage of this approach is that a closer connection to the new open economy macroeconomic literature can be made, and that the real exchange rate that falls out of this approach can be used as a benchmark for evaluating long-run real exchange rate behaviour. The authors applied this approach to 67 developing countries from 1966 – 1997 by estimating the real exchange rate equation by Dynamic Ordinary Least Squares (DOLS). The results were similar to those found in the literature, that is, net foreign assets, relative productivity of traded and non-traded goods, and the terms of trade were found to significantly impact the long-run real exchange rate.

An important precursor to this study can be found in Gelos (1996) who estimated equilibrium real exchange rates for the ECCU countries using annual data from 1976 – 1996. In his study, the author used an eclectic approach to real exchange rate determination by considering three models. The first approach utilised was the traditional PPP framework. Despite all its limitations – neglect of movements in the terms of trade, technological progress and trade liberalisation – PPP can be regarded as a useful benchmark. On this measure, the author found that the real exchange rates of the ECCU countries were overvalued, using 1976 as the base year. The second method considered by the authors was a simple computable general equilibrium model of the type developed by Devarajan, Lewis and Robinson (1993). The analysis is embedded in a three good, two-activity model where the real exchange rate is defined as the relative price of imports to non-tradables. Based on this framework, the authors concluded that the ECCU exchange rates were strongly over-valued. The third approach utilised was the popular framework developed by Edwards (1989). A partial adjustment model was developed in which the dynamics of the real exchange rate adjusts to past deviations, permanent shift factors as relative productivity, terms of trade and capital inflows, as well as temporary factors such as excess domestic credit expansion. The long-run equilibrium exchange rate was estimated in a panel framework and the extent of misalignment (if any) was derived from the coefficient

[3] These types of models are generally denoted as New Open Economy Macroeconomic Models and are open economy variants of the dynamic stochastic general equilibrium models that have become popular in recent years.

estimates. An error correction model was also developed to allow for non-stationarity; the estimates were a bit lower than the partial adjustment model, but both pointed to overvaluation of the real exchange rate and the speed of adjustment in response to stochastic shocks was relatively long at three years.

A similarly heterodox approach was carried out by Harriot and Worrell (1997) who attempted to estimate equilibrium exchange rates for a selection of Caribbean and Latin American countries. In addition to the familiar Edwards (1989) set-up, the authors devised an "intuitive" method of determining the equilibrium real exchange rate by considering several indicators of the real exchange rate such as real GDP growth, inflation, and the balance of payments constraint. Arbitrarily, the authors chose as their metric growth over the last five years, inflation below 5.0 per cent over the last five years and the level of the external balance during a similar time frame. The Edwards (1989) model was estimated in a panel framework. A flavour of the results is as follows: the real exchange rate in Barbados was not significantly different from its equilibrium value over the sample period, while the real exchange rates of Guyana, Trinidad and Jamaica were deemed to be fundamentally misaligned.

More recently Moore, Skeete and Greenidge (2004) made an important contribution to the Caribbean literature on determining equilibrium exchange rates by utilising a vector error correction framework. Building on the work of Edwards (1989) and Clark and Macdonald (1994), the authors estimated equilibrium real exchange rates for Barbados, Guyana and Trinidad over the 1970 to 2001 period. Using variables that has become standard in the literature a co-integrating relationship was derived between the REER and its 'fundamental' determinants. Pursuant to this, the degree of under of over-valuation was calculated, using the sustainable values the fundamentals. It was discovered that the actual REER's for Barbados and Jamaica were over-valued – i.e. above the long-run equilibrium level estimated from the model – whilst the REER for Trinidad and Tobago was under-valued.

An exercise similar to that conducted in this study was presented by Cashin and Pineda (2008). The authors utilised a fundamentals-based approach and a macroeconomic balance approach to estimate the equilibrium real exchange rate in the ECCU. The key difference between the

approaches is that the macroeconomic balance framework derives an estimate of the real exchange rate by projecting the current account balance over the medium-term and then comparing it with as estimate of the equilibrium current account. The real exchange rate is then judged to be over-valued if the projected current account exceeds the equilibrium or sustainable current account. The main conclusion to emerge from both approaches is that the real effective exchange rate of the ECCU does not appear to fundamentally mis-aligned, as the current exchange rate is close to its long-run equilibrium level. This finding generally accords with that of the present work, whereby the real exchange rate is not too far from equilibrium for most countries.

4.0 ANALYTICAL FRAMEWORK

There have been two main approaches to exchange rates equilibrium and misalignments; The Fundamental Exchange Rate (FEER) approach and the Behavioural Exchange Rate (BEER) approach.

FEER Approach

Developed by Williamson (1994), the FEER is the real effective exchange rate that is consistent with internal balance (full employment and price stability) and external balance (sustainable current account). The FEER is associated with the key economic determinants that impact the real exchange rate over the medium term and eschews all short run economic fluctuations. It is calibrated on the assumption of well defined, "ideal" economic conditions, with most of the focuss on the determinants of the external current account.

The FEER approach begins by equating the external current account to the negative of the capital account as follows:

$$CA = \beta_o + \beta_1 q + \beta_2 \bar{y}_d + \beta_3 \bar{y}_f = -\overline{KA} \qquad (1)$$

Where; CA is the current account, q is the real exchange rate, $\bar{y}_d$ and $\bar{y}_f$ are domestic and foreign aggregate output respectively, set at their equilibrium values, and $\overline{KA}$ is the equilibrium capital account. Solving equation (1) for q gives the FEER:

$$FEER = (-\overline{KA} - \beta_0 = \beta_2 \bar{y}_d - \bar{\beta}_3 \bar{y}_f) / \beta_1 \qquad (2)$$

The current exchange rate is described as overvalued when $q_t > FEER_t$ and undervalued when $q_t < FEER_t$.

The FEER is beset with a few limitations, some more serious than others. First, the approach is a recursive one: the current account determines the capital account without any feedback effects. Second, "equilibrium" net capital flows is conceptually difficult and relies much on judgements. Even when $(-\overline{KA})$ in equation (1) is replaced by the $\bar{S} - \bar{I}$ (savings/investment gap), the limitation is still not remedied, since neither savings nor investment is a function of the exchange rate (Clark and MacDonald, 1998). Thirdly, there is no focus on dynamic adjustments, or behavioural factors that affect the real exchange rate. As such, the approach is essentially a normative one, making empirical estimations difficult.

BEER Approach

This approach is based on the empirical estimation of the long-run relationship between the real exchange rate and its fundamentals. Using a generalised reduced form equation, the relationship is expressed accordingly;

$$q_t = \beta_t^{'} Z_{1t} + \beta_{2t}^{'} Z_{2t} + \tau^{'} T_t + \varepsilon_t \qquad (3)$$

Where Z_1 and Z_2 are vectors of economic fundamentals that are expected to affect the real exchange rate in the long–run and medium term respectively. β_1 and β_2 are reduced form

coefficients, T is a vector of transitory factors affecting the real exchange rate in the short-run while τ is a vector of reduced form coefficients and ε_t is the random disturbance term.

From the reduced form estimations, an equilibrium value for the real exchange rate can be derived and hence the misalignment between the actual real exchange rate and its equilibrium can be calculated. Unlike the FEER approach which is a strictly medium-term to long-run approach, the BEER approach is more general and can be used to explain short-term movements in the real exchange rate. In addition, it is easier to implement econometrically.

5.0 EMPIRICAL METHODOLOGY AND DATA

5.1 Econometric Methodology: The BEER Approach

The study uses the Johansen (1995) co integrating framework to investigate the long run relationship between the REER and the fundamental variables discussed above. This method attempts to correct for autocorrelation and endogeneity through the vector error correction mechanism (VECM). The key advantage of using the Johansen methodology in this study is that it makes a clear distinction between the long run and short run estimates. The long run estimates can therefore be used to generate a measure of the equilibrium REER, and in turn, misalignments from the actual REER can easily be calculated. The methodology can also be used to trace the short run response of the REER to shocks in its fundamentals as well as to derive estimates of the speed at which the REER adjusts to its equilibrium level.

The methodology begins by defining the simple vector of the REER and its fundamentals as follows:

$$q_t = [lreer, \lg ov, lprod, ltot, capf]$$

If cointegration is found between the variables listed above, the equilibrium REER can be derived by estimating a vector error correction (VECM) model of the following form;

$$\Delta q_t = \eta + \sum_{i=1}^{p-1} \Psi \Delta q_{t-1} + \Pi q_{t-1} + \varepsilon_t \qquad (4)$$

Where Δ is the first difference operator, η is an nx1 vector of the fundamental variables, Ψ is an nxn coefficient matrix, and Π is an nxn matrix, whose rank determines the number of co integrating relationships. If the matrix Π is of full rank, n, this indicates that no co integration exists between the variables. If the rank of the matrix is r, which is less than n, then there exist nxr matrices α and β such that $\Pi = \alpha\beta'$, where α is the matrix of the speed of adjustment parameters and β is a matrix of co integrating vectors. The β vector can be used to derive the equilibrium REER and therefore allows for the quantification of the misalignments between the actual and Equilibrium REER.

The first step in the estimation process is to determine the order of integration of the variables by employing various unit root tests. Once the order of integration has been identified, the Johansen trace statistic is used to test for the existence of co integration among the non-stationary variables. In order to derive the equilibrium REER, it must first be established that a cointegrating long run relationship exists between the REER and its fundamentals. If a co integrating relationship exists between the non-stationary variables, the model can be estimated using the unrestricted VECM in equation (4) to derive the equilibrium REER. To ensure parsimonious inferences, only the permanent component of the equilibrium REER since the fundamental variables that affect the REER may not be at their steady states, but may be fluctuating around their equilibrium values. The cyclical components of the equilibrium REER is therefore removed using the Hodrick Prescott filter. The gap between the REER and the permanent component of the equilibrium REER (referred to as the PEER) at any point in time is referred to as the misalignment which gives a quantifiable estimate of the degree of over or undervaluation of the actual REER relative to its equilibrium level. The misalignment is calculated as follows:

$$\left[(REER - PEER)/PEER\right]*100 \qquad (5)$$

5.2 Data Description and Sources

Drawing on the theoretical literature as well as being cognisant of the tourism dependent nature of the ECCU countries, this study uses annual data covering the period 1990 to 2007 for the following variables. The ratio of government consumption to gross domestic product (GDP), relative tourism productivity, the terms of trade and the ratio of net capital inflows to GDP.

The ratio of government consumption to GDP *(gov)* is used to proxy the fiscal stance of the government. There have been contrasting views on the effect of government spending on the REER. In the Mundell-Flemming model, the real exchange rate tends to depreciate due to the fall in domestic interest rates as governments' fiscal balance improves, and as national savings increase. In contrast, Dornbush and Fisher (1980) argue that as government fiscal position worsens (through higher spending) this would increase the demand for, and the prices of non tradables. This therefore translates to an appreciation of the REER. A priori, the sign on this variable is uncertain.

Relative productivity *(prod)* is typically proxied by the ratio of domestic gross national product or domestic GDP per capita relative to that of the main trading partners [See, Dufrenot and Yehoue (2005), Koranchelian (2005) and Moore et al (2004)]. In this study however, relative productivity is proxied by the ratio of each county's per capita tourist arrivals to Barbados' per capita tourist arrivals. This proxy is deemed to be an apt measure of productivity differentials for countries such as those in the ECCU which are heavily reliant on tourism. An increase in the ECCU's relative productivity will strengthen economic activity and may boost wages, which could result in an appreciation of the REER. A priori, the sign on this variable is expected to be positive.

The relationship between the terms of trade *(tot)* and the REER depends on the whether the income effect outweighs the substitution effect or vice versa. On the one hand, an improvement in the terms of trade has positive wealth effects, which raises the price of non-tradables, and in turn, appreciates the currency. Under such circumstances, the income effect dominates the substitution effect. On the other hand, an improvement in the terms of trade has a negative

substitution effect on the REER due to lower import prices. A prior, the sign on the terms of trade variable is ambiguous.

The net capital flows *(capf)* variable is calculated as the summation of portfolio and foreign direct investment flows as a ratio of GDP. The effect of net capital flows on the real exchange rate hinges on the magnitude of the capital flows. For large debtor nations, capital inflows exceeding (below) debt service obligations will appreciate (depreciate) the real exchange rate. A prior, the sign on this variable is expected to be positive.

The REER used is based on the trade weighted average of the consumer price indices (CPI) of the country's main trading partners relative to that of the domestic currency. Expressed in logarithms, it is calculated as follows:

$$reer = \sum_{i=1}^{N} w_i \ln(e_i * p^d / p^f) \qquad (6)$$

Where w_i represents the weight for trading country i, e_i is the nominal exchange rate, p^d is the domestic price and p^f the foreign price. Given the above definition, a decline in the REER therefore implies depreciation, while an increase implies appreciation.

The REER, government spending, net capital inflows and GDP are sourced from the Eastern Caribbean Central Bank databases. Tourist arrivals and population data for Barbados are sourced from the International Monetary Fund (IMF) CD-ROM (May 2008), while the terms of trade data are obtained from another IMF source.

6.0 EMPIRICAL RESULTS

Standard panel unit root tests were conducted to assess the unit root properties of all the variables used in the study. These tests vary so as to allow for different forms of cross-sectional dependence, an important issue in a panel data setting. Table 2 presents a summary of panel unit root tests, assuming both cross-sectional dependence and cross-sectional independence. For all the variables except for the productivity variable, five of the tests indicate that the null of a common and an individual unit root cannot be rejected at the ninety-five per cent level of confidence. The test associated with Hadri (2002) differ from the others in that it assumes a null of stationarity. This test was rejected at the ninety five percent level of significance for all the variables (including the productivity variable); in other words, all variables are integrated of the same order, I(1).

Panel unit root tests suffer from an important drawback, in that rejection of the null hypothesis of joint non-stationarity can still occur even if only one of the underlying series in the panel is stationary. To guard against this, table 3 presents the Im, Pesaran and Shin (2003) unit root tests for each series in the panel and for each country. In large part, the test confirms the summary results shown in table 2. The real effective exchange rate appears to be I(1) in all countries except Antigua; the productivity variable appears to be I (0) in six of the eight countries; while capital flows are stationary in levels in Dominica and Montserrat respectively. The tests indicate substantial heterogeneity among the countries, suggesting that taking an ECCU perspective may be slightly risky. Notwithstanding, all the series appear stationary at the ECCU level. The Johansen trace statistic rejects the null hypothesis of no co-integration between the REER and its fundamentals and suggests that there is at most one cointegrating vector. Results are reported in table 2.

It is important to note that the apparent heterogeneity in the unit root tests results has implications for the Johansen co-integration test results, as the test assumes that the series are integrated of the same order. In respect of the VECM estimations of the REER and its fundamentals, a dummy variable is included in the estimation to eliminate the effects of outliers and structural breaks in the data on the estimates. The specification includes four lags for the

changes in each variable and the cointegrating vector is normalised on the REER. The results of the long run equation are reported in table 3. All variables are significant at the five percent level with the exception of the productivity variable. However, the signs on all variables accord with economic theory. Given the magnitudes of the coefficient estimates, the long run relationship between the REER and its fundamentals can be summarised accordingly;

a) A 10 percent increase in the capital flows to GDP ratio is associated with a 0.08 percent appreciation in the REER on average;
b) A 10 percent increase in the ratio of government consumption to GDP is associated with a 3.6 appreciation in the REER on average;
c) A 10 percent increase in per capita tourist arrivals relative to Barbados' per capita tourist arrivals is associated with an appreciation on the REER of 0.08 percent on average;
d) A 10 percent increase the goods and services terms of trade is associated with a 5.9 percent appreciation in the REER on average.

The speed of adjustment parameter of the REER associated with the long run equation is also given in table 3. The coefficient of -0.11 is significant and therefore suggests that on average, about 11 percent of the disequilibrium in the REER from its equilibrium position is eliminated per year. Assuming no further shocks to the system, about half[4] of the disequilibrium gap will be closed within 3 years. The full adjustment of the REER to its equilibrium after a shock is completed in about 9 years. This is a relatively slow speed of adjustment, which reflects the fixed exchange rate regime and perhaps the attendant rigidities in the labour market. A similar result was found for Barbados, where the adjustment of the REER to a shock was fully offset after eight years, Moore et al (2004).

Figure 1 shows the actual REER and the *permanent component* of the estimated equilibrium REER (PEER) for each of the ECCU countries, while figure 2 shows the misalignments between the two for each country. Actual REER values above (below) the equilibrium value are considered as overvaluation (undervaluation).

[4] Half-life deviation is calculated as –ln (2)/ln (k), where k is the error correction coefficient.

As can be seen from the figures, for the earlier part of the sample (1995-2000), for some countries, the REER and its equilibrium value were closely aligned with the misalignment being less than 1 percent. The extent of the undervaluation was 0.33 percent in Anguilla, 0.09 percent in Antigua and Barbuda, 0.77 percent in Dominica, 0.65 percent in Grenada and 0.23 percent in St Kitts and Nevis, while the extent of the overvaluation was 0.92 percent in St Lucia and 0.03 percent in St Vincent and the Grenadines. Only in Montserrat, the misalignment from equilibrium exceeded 1 percent.

The misalignment between the REER and its equilibrium value widened in most countries over the period 2001 to 2007. On average, the degree of undervaluation increased to 1.8 percent in Antigua and Barbuda, in Dominica, to 1.9 percent and in St Kitts and Nevis, to 0.4 percent. The protracted undervaluation in the REER can mostly be explained by lower government spending. In Antigua and Barbuda the ratio of government spending to GDP fell from 22.3 percent in 2002 to 18.7 percent in 2007, in Dominica, from 22.3 percent to 19.2 percent and from 31.4 percent to 23.5 percent in St Kitts and Nevis. In Grenada and St Vincent and the Grenadines the misalignment between the REER and its equilibrium level posted a complete reversal compared to the 1995-2000 period. In Grenada, the REER became overvalued relative to its equilibrium by as much as 1.7 percent on average perhaps as a result of higher capital inflows and government spending in the Post Hurricane[5] period. Capital inflows as a ratio of GDP surged to 24.0 percent in 2007 from 13.2 percent in 2002, while the ratio of government spending to GDP rose to 16.4 percent from 14.2 percent. In St Vincent and the Grenadines the REER became undervalued relative to its equilibrium, averaging almost 1 percent. This may have been associated with the fall in government spending from 20.5 percent of GDP in 2002 to 18.4 percent in 2007.

As at 2007, the empirical estimates show that the REER was undervalued in Anguilla, Antigua and Barbuda, Dominica, St Lucia and St Vincent and the Grenadines with percentage magnitudes as follows; 0.7, 4.1, 3.6, 0.9 and 1.3 respectively. In Grenada, Montserrat and St Kitts and Nevis the estimates show percentage overvaluation in the REER of 4.7, 2.7 and 0.5 respectively.

[5] Hurricane Ivan devastated Grenada in 2004.

The results of the model reported above are deemed the most reliable of all the models[6] estimated since it passes key robustness tests. Table 4 reports the results of the autocorrelation tests of the residuals, which shows that with a lag length of five, the null hypothesis of no autocorrelation cannot be rejected at the 5 percent level from the second lag onwards. The results in table 5 indicate that all four lags used in the VECM are necessary as the null hypothesis that each of the four lags is jointly insignificant is rejected at the 5 percent level. In addition, all the AR roots are within the unit circle suggesting that the model is stable. Given data quality issues however, the results must be interpreted with caution.

7.0 POLICY IMPLICATIONS

The study evinces some key insights, which have important policy implications.

First, the long run estimates show that government spending and the terms of trade are key determinants of the equilibrium exchange rate. Prudent fiscal polices as well as building resistance to unfavourable terms of trade shock, through a diversification of the production base, are essential for stability of the real exchange rate.

Second, the misalignment between the actual REER and its equilibrium widened during the later part of the sample for most countries. In 2007 for example, the REER was below its equilibrium level (undervalued) by as much as 4.1 percent in Antigua and Barbuda and above its equilibrium (overvalued) by as much as 4.7 percent in Grenada. These two examples highlight the important role that fiscal polices and capital inflows play in exchange rate misalignments in the ECCU. Indeed, Grenada stands out as a clear example where an inundation of capital inflows can exert immense upward pressure on the REER that results in misalignments. Policies that are geared toward managing capital flows are therefore important for exchange rate stability.

[6] Only the results of the chosen model are reported.

Third, the speed of adjustment parameter is very slow perhaps highlighting the need for more flexibility in the labour market so that when there is a shock that disturbs the exchange rate, the convergence back to equilibrium can be faster since the nominal exchange rate cannot adjust.

Fourth, the results show that the equilibrium exchange rate is not static and changes as the fundamentals change. An equally important finding is that there is no clear pattern of alignment between the REER and it equilibrium value through out the sample. Polices are therefore needed to ensure that the REER is kept as close as possible to its equilibrium. Diversifying and strengthening the production base to build resistance to negative terms of trade shocks, exercising prudent fiscal polices and lessening labour market rigidities are important to this end.

Fifth, the study provides a more robust framework for assessing external price competitiveness. It is often bandied about that depreciation in the REER signifies an improvement in external competitiveness. As is evident from the analysis, even when the actual REER is depreciating it does not necessarily equate to an increase in competitiveness. As is illustrated in figures 1 and 2, the actual REER can be depreciating but when compared to the equilibrium level, the REER is shown to be overvalued, as in the cases of Grenada, St Lucia and St Kitts and Nevis. This perhaps could help explain the ECCU's conundrum of a depreciating REER along with persistent external current account deficits. Indeed, there is no conundrum. The important point here is that overvaluation or undervaluation is what matters for competitiveness assessments as opposed to depreciation or appreciation.

Finally and perhaps most importantly for the Central Bank, the study provides a framework for deriving a stability criterion for the REER in each country, which can be defined within a band measured as plus or minus two standard deviation around each country's equilibrium level each year. This has clear implications for the bands currently being used of 110 as an upper limit and 90 as a lower limit. The implication is that the exchange rate bands will differ by country and will not be static but will change from year to year as fundamental changes.

Finally and perhaps most importantly, the study shows that the equilibrium exchange rate is not static but changes from year to year as fundamentals change.

8.0 CONCLUSIONS

Drawing on the theoretical literature and being cognisant of the peculiarity of the ECCU countries as small and tourism dependant, this study exploits panel co-integration techniques to estimate the equilibrium REER for each of the ECCU member countries. The most important explanatory variables were found to be the terms of trade, government consumption and capital inflows. Specifically, increases in government consumption and capital inflows are associated with an appreciation of the REER while decreases in the terms of trade are associated with a depreciation of the REER on average. The analysis suggests that in the early part of the sample the actual REER was closely aligned to its equilibrium with the misalignment less than 1 percent in all but one country. In the latter part of the sample, a clear widening of the gap between the actual REER and its equilibrium is observed with the misalignment being as much as 4 percent in two countries. The estimates show that the speed of adjustment of the REER is slow as it takes about nine years to adjust fully to its equilibrium after a shock. The important policy implications of the study are that prudent fiscal polices as well as building resistance to unfavourable terms of trade shocks through a diversification of the production base, and greater labour market flexibility are essential for stability of the real exchange rate. The study makes an important contribution by providing a robust framework for assessing the true external price competitiveness positions of member. In addition, the study offers a structure for defining a stability criterion of the REER in each country, which can be calculated within a band measured around each country's equilibrium level. An important drawback of the study is the use of a system based estimator – the Johansen approach. It is not apparent how this estimator deals with the heterogeneity issue thrown up by the unit root results. An exploration of further estimators is left for future work.

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Appendix

Table 1: Unit Root Test – Levin, Lin and Chu

Variables	Levels	First Difference
lreer	0.540	-7.187*
capf	-0.577	-10.327*
lprod	-1.363	-4.066*
lgov	-1.335	-8.830*
ltot	1.845	-2.693*

Note:

a) Indicates rejection of the null hypothesis at the 5 percent significance level.

Table 2: Panel Unit Root Test Summary: Levels

Method	*lreer*	*capfl*	*lprod*	*lgov*	*ltotgs*
Common Unit Root Process					
Levin, Lin and Chu	0.54	-0.58	-1.19	-1.33	1.85
Breitung t-stat	-0.69	2.91	-2.40*	1.56	5.38
Individual Unit Root Process					
Im, Pesaran and Shin	1.39	-0.04	-1.68	-0.86	1.46
ADF-Fisher	10.17	24.18	23.09	17.67	9.93
Phillips-Perron	7.97	54.00	45.35*	22.64	8.65
Common Unit Root Process					
Hadri	5.77*	6.47*	3.39*	5.56*	6.99*

Notes:

a) * Indicates rejection of the null hypothesis at the 5 per cent significance level

b) All tests except Hadri Z-stat assumes a null of a unit root.

Table 3: Panel Unit Root Test Summary: First Difference

Method	*lreer*	*capfl*	*lprod*	*lgov*	*ltotgs*
Common Unit Root Process					
Levin, Lin and Chu	-7.19*	-10.32*	-9.39*	-8.31*	-2.69*
Breitung t-stat	-3.23*	-7.18*	-3.42*	-5.33*	5.17*
Individual Unit Root Process					
Im, Pesaran and Shin	-5.57*	-9.39*	-8.51*	-7.02*	-5.55*
ADF-Fisher	58.93*	97.60*	89.01*	72.62*	60.15*
Phillips-Perron	60.87*	178.11*	160.77*	75.83*	29.03*
Common Unit Root Process					
Hadri	-0.73	0.94	-0.18	0.58	2.17*

Notes:

a) * Indicates rejection of the null hypothesis at the 5 per cent significance level

b) All tests except Hadri Z-stat assumes a null of a unit root.

Table 4: Panel Unit Root Test: Cross-sectional Independence – Im, Pesaran and Shin

	lreer		*capflows*		*lprod*		*lgov*		*ltot*	
	Levels	Difference	Levels	Difference	Levels	Difference	Levels	Difference	Levels	Difference
ANG	2.35*	4.88*	-0.51	-4.63*	-2.21*	-2.91*	-2.11*	-4.44*	0.07	-3.89*
ANU	-0.16	4.59*	1.28	-5.23*	-2.00*	-3.64*	-1.74	-4.40*	-2.72*	-3.64*
DOM	0.97	2.41*	-4.22*	-4.87*	-2.16*	-3.26*	-1.19	-3.46*	0.15	-1.61
GRE	-1.18	3.09*	-1.83	-4.81*	-1.33	-3.94*	-2.38*	-4.24*	-1.49	-3.82*
MON	-0.94	3.58*	-3.01*	-4.54*	-2.60*	-2.24*	-1.63	-3.56*	0.07	-4.64*
SKN	-1.57	2.85*	-1.82	-4.65*	-2.41*	-4.32*	-1.95	-3.09*	-1.53	-2.04*
SLU	-2.16	2.32*	0.63	-4.94*	-2.24	-3.31*	-1.29	-2.80*	-1.77	-3.67*
SVG	-0.88	3.68*	-2.41	-3.91*	-1.83*	-2.89*	-2.25*	-5.06*	-0.20	-4.31*
ECCU	1.39	-5.57*	-0.04	-9.39*	-1.68	-5.09*	-0.92	-7.02	1.46	-5.55*

Note:

a) * Indicates rejection of the null hypothesis at the 5 percent significance level

Table 2: Johansen Test for the Number of Cointegrating Vectors

Null Hypothesis	Trace Statistics	0.05 Critical Value
r=0	97.746*	95.753
r=1	45.916	69.818

Note:

a) *Indicates rejection of the null hypothesis at the 5 percent significance level.

b) Lag length is set to four based on the Schwarz criterion.

Table 3: Long run Estimates (Normalised on the REER)

capf(-1)	-0.008* [-2.119]
lgov(-1)	-0.363* [-2.851]
lprod(-1)	-0.008 [-0.182]
ltot(-1)	0.591* [2.221]
c	-5.846
Estimate of the speed of adjustment of Δ*lreer*	0.11* [-4.017]

Notes:

a) Signs on long run estimates must be interpreted in the reverse. A positive (negative) sign should be interpreted as having a depreciating (appreciating) effect on the REER.

b) t-statistic in square bracket.
c) *Indicates statistical significance at the 5 percent level.

Table 4: Autocorrelation Test of the Residuals

Lags	P -Value
1	0.015*
2	0.174
3	0.475
4	0.079
5	0.714

Notes:
a) The null hypothesis is that there is no autocorrelation of residuals
b) *Indicates rejection of the null hypothesis at the 5 percent level.

Table 5: Lag Exclusion Test

	Joint
Dlag1	77.734* [0.000]
Dlag2	59.664* [0.008]
Dlag3	59.199* [0.009]
Dlag4	59.603* [0.008]

Notes:
a) Null hypothesis is that lag coefficients are jointly insignificant
b) *Indicates a rejection of the null hypothesis at the 5 percent level
c) P-values are in brackets
d) Degrees of freedom = 36

Figure 1: Real Effective Exchange Rate for ECCU Countries

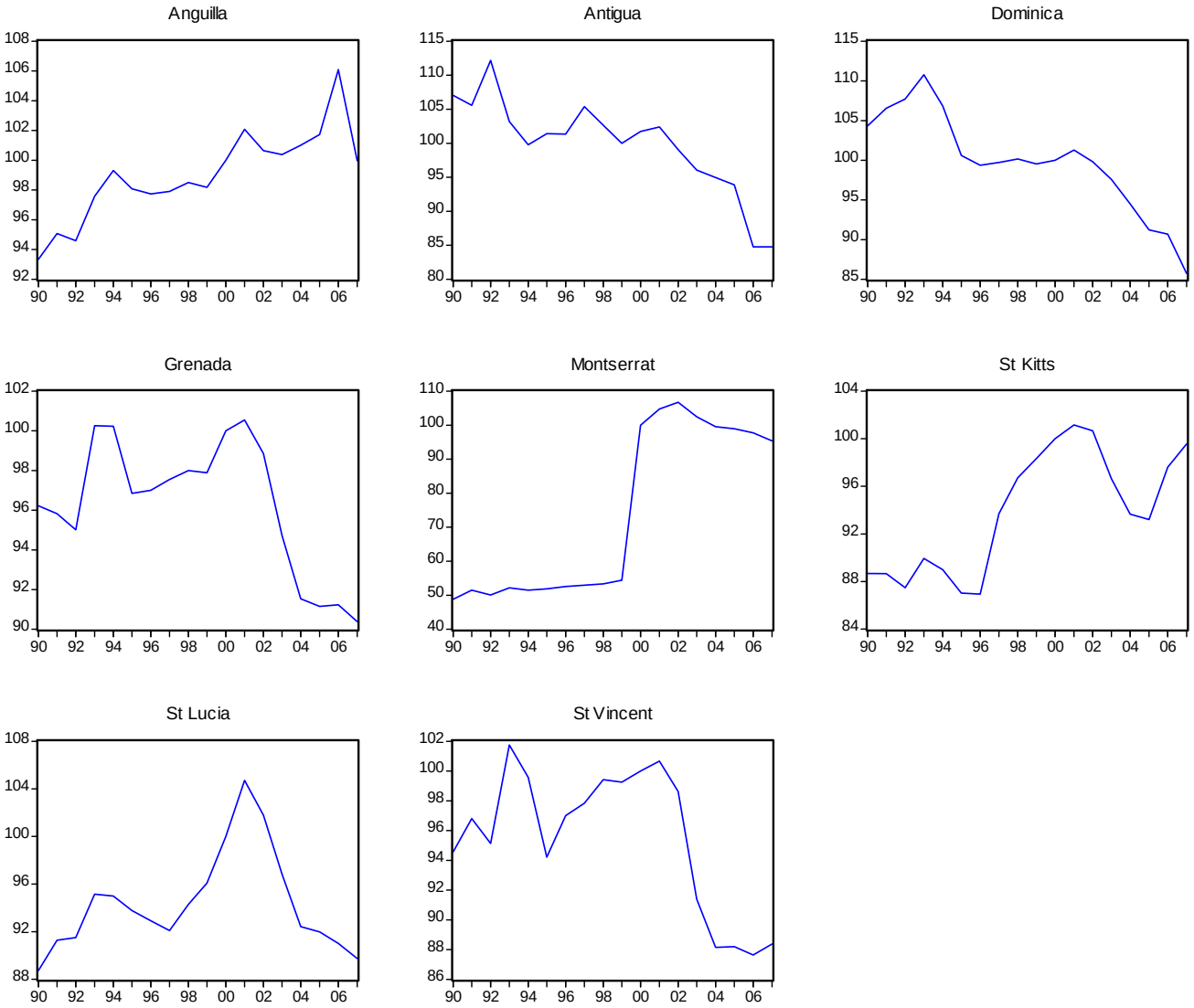

Figure 2: ECCU Real Effective Exchange Rate and Fundamentals

Figure 3: Actual and Equilibrium REER

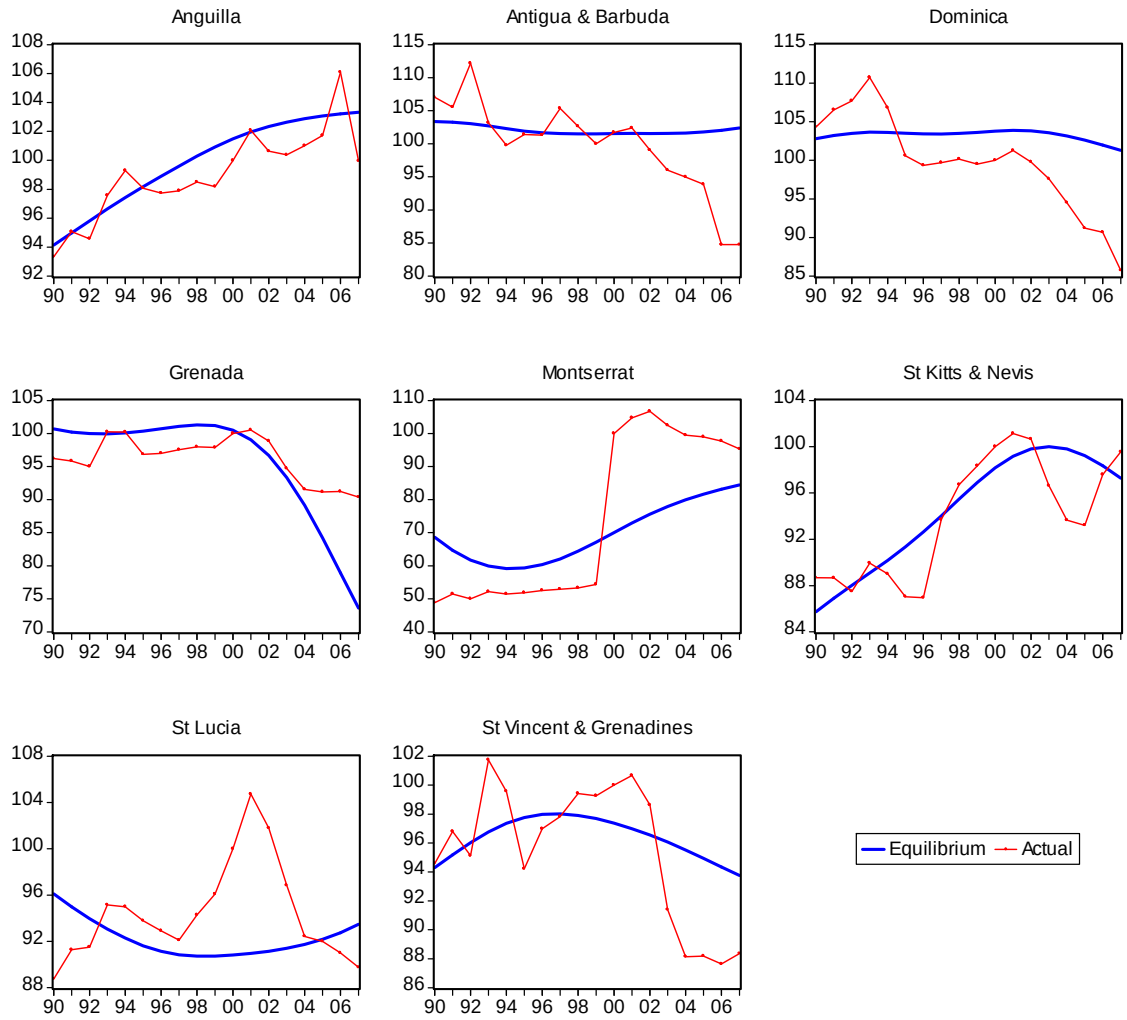

Figure 4 Misalignments (in Percent of Equilibrium Level)