ESTIMATING EQUILIBRIUM REAL EXCHANGE RATES:
A MENU APPROACH

by

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"Estimating Equilibrium Real Exchange Rates- a Menu Approach"

Abstract:

Employing three methodological frameworks, this paper seeks to identify and monitor the evolution of equilibrium Real exchange Rates (RER) for selected developing countries over time. The main findings of this paper are consistent with existing studies with respect to the effect of certain key "fundamentals" (such as Capital Controls and Technological Progress) on RER movements. However, an unusual result is seen in that an improvement in terms of trade is found to depreciate the RER.

1. INTRODUCTION

The Real Exchange Rate (RER) is a measure of international competitiveness. As such, RER rules followed by policy makers will have serious implications for small, open, developing economies which are highly dependent on exports (e.g., tourism and bananas) as a means of generating foreign exchange.

Purchasing Power Parity (PPP) exchange rules have enjoyed popularity in the economic literature for some time now, but within the past decade or so, many articles are moving away from PPP as a measure of international competitiveness and are instead concentrating on another concept of RER, i.e., one defined to be the ratio of a price index of non-tradable goods to tradable goods (P_n/P_t).[1]
A rise in this ratio reflects an appreciation in the Real Exchange Rate. The main criticism of the PPP method is that it postulates an equilibrium RER which is invariant over time. A constant equilibrium RER seems highly implausible. For PPP to be an adequate measure of international competitiveness, surely its (equilibrium) values must reflect underlying changes in an economy's ability to compete with its trading partners. This criticism is noted by Williamson (1994, p.94), among others.

The equilibrium real exchange rate may be defined as the relative price which is consistent with the fundamental external and internal balance and with a sustainable rate of growth. A fundamental balance is one that is not sustained by short term palliatives such as wage freezes, neglect of maintenance, import controls or windfalls. External balance is achieved where the current account is just balanced by net long term capital inflows. For the small open economy, internal balance implies that the demand and supply of non-tradable goods are equal. Growth is sustainable when the pattern of growth over time will not generate future internal or external

[1]For more on PPP exchange rules, see Dornbusch (1982). Authors using the price ratio of tradeables to non-tradeables includes Hansen *et al* (1997), Odedokun (1997) and Edwards (1989).

imbalances.

The equilibrium real exchange rate cannot be observed. It has to be inferred from the relationship between the internal balance, external balance and sustainable growth on one hand and the relative price on the other hand. The methodologies available are summarized in Williamson (1994). They include:

- The use of a structural economic model
- A single methodology suggested by Edwards (1989); and
- Intuitive methodologies based on notional parameters for economic adjustment.

This paper tries alternative methods of estimating the path of the equilibrium real exchange rate for a selection of countries in the Latin America & Caribbean regions using exchange rates calculated from GDP deflators by Bynoe-Mayers (1997).

The remainder of the paper is arranged as follows. Sections 2, 3 and 4 will highlight the three methodologies and empirical results from the equilibrium RER estimation. Section 5 compares the alternative methods and the paper concludes at Section 6.

2. STRUCTURAL ECONOMIC MODEL

A simple structural model which incorporates tradeable and non-tradeable output, and allows for the effects of money and wages on relative prices, is presented in Appendix A. It has the following features. The demand for output of tradeables is infinite and supply varies with the real exchange rate. Output is determined on the supply side. The demand for non-tradeables and imports both depend on real output, the real exchange rate and the extent of monetary expansion, represented by the monetary base. Output of non-tradeables is sold at a price which depends on demand, the price of imported materials, wage costs and interest costs, which are equal to foreign interest rates with allowance for risk and transactions cost premiums. The model is in the tradition of structural models for small economies developed at the Central Bank of Barbados, discussed in Worrell (1997).

The model may be estimated and solved as a system, to produce in-sample forecasts of the current account (the measure of external balance), the price of non-tradeables (the measure of internal balance), and growth of output. Then, by confining these three (3) variables within a target range, an estimate of the equilibrium real exchange rate may be derived. However, this exercise has not been completed. For the moment, the equations are estimated separately, and the parameters of the model provide estimates of the responses of output, inflation and the current account to changes in the real exchange rate. Included in Appendix A are expressions which give the responsiveness of output, inflation and the current account to changes in the real exchange rate.

3. A SINGLE EQUATION METHODOLOGY

3.1 *Model*

This method is similar to that suggested by Edwards (1989). Based on his theoretical analysis, the following equation was formulated to capture its main implications.

$$\Delta \text{Log } e_{i,t} = \theta \{ \text{Log } e^{*}_{i,t} - \text{Log } e_{i,t} \} + \lambda \{ Z_{i,t} - Z^{*}_{i,t} \} - \phi \{ \text{Log } E_{i,t} - \text{Log } E_{i,t} \} \qquad (3.1.1)^{2}$$

$$0 < \theta, \lambda, \phi \in \leq 1$$

where,

e^{*} is the equilibrium RER
e is the (actual) RER
Z is the index of macro-economic polices
Z^{*} is the index of sustainable macro-economic policies
E is the nominal exchange rate
θ, λ, ϕ are adjustment parameters which captures the important dynamic aspects of the model.

Equation (3.1.1) incorporates three of five features derived from the theoretical models by Edwards (1989).[3] The first term on the RHS of equation (3.1.1) measures the autonomous tendency for the actual RER to eliminate mis-alignments between equilibrium and actual RER. The speed at which this is accomplished is captured by θ. The value of θ depends on institutional factors such as capital mobility and the extent of wage indexation rules. Given that the nominal wages are generally inflexible downwards, θ should be small, indicating a slow correction path.

The second term in the equation relates to macro-economic polices pursued by policy-makers. The implication is that if sustainable policies are followed (i.e. $\{Z_{i,t} - Z^{*}_{i,t}\} > 0$,), ceteris paribus, there will be a tendency for the RER to appreciate.

The third term in equation (3.1.1) indicates that the impact of nominal devaluation on RER movements will generate a short-run depreciation. The magnitude of this impact is captured by ϕ. The medium-to-longer term effect of the nominal devaluation will depend on the other two terms in the equation. As pointed out by Edwards (1989, p.134), the nominal devaluations will

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[2] This is similar to *equation 5.2* in Edwards (1989).

[3] The other two features- the inclusion of parallel market rates and the distinction between temporary and permanent changes in the fundamentals- remain for future extensions of this model.

only help in the adjustment process if there is an initial mis-alignment and sustainable macro-economic policies are being followed, i.e. $\{ \text{Log } e^*_t - \text{Log } e_{t-1} \} \neq 0$ and $\{Z_t - Z^*_t\} > 0$. A model which links equilibrium RER with its most salient "fundamentals" will now be specified. Based on a model of equilibrium developed by Edwards (1989, chap.2), the following were deemed to be important in Equilibrium RER movements:

i.) External Terms of Trade
ii.) level and composition of government consumption
iii.) control on capital flow
iv.) exchange and trade controls
v.) technological progress
vi.) capital accumulation (investment to GDP ratio)

The initial problem with this model, as pointed out by Edwards (1989, p.135), is that of data availability. Only fundamentals (i.) and (vi.) have reliable time series. It means, therefore, that either suitable proxies have to be found for the remaining fundamentals , or alternatively, the fundamental(s) would have to be dropped from the specification. The authors decided to eliminate exchange and trade controls from the model and find proxies for the remaining fundamentals. Capital accumulation (investment to GDP ratio) was also left out of the (final) specification because initial empirical results indicated that the associated coefficient was not significant at conventional levels. Edwards (1989) and Odedokun (1997) also reported insignificant coefficients for the ratio of investment to GDP when a lagged endogenous variable was included in the specification. As will be seen later, we also include a lagged endogenous variable in our specification.[4] Because equilibrium RER can not be observed, equ. (3.1.1) can not be estimated directly. We therefore need to specify an equation for equilibrium RER, given as:

$$\text{Log } e^*_{i,t} = \beta_0 + \beta_1 \text{Log (TOT)}_{i,t} + \beta_2 \text{Log (GCN)}_{i,t} + \beta_3 \text{Log (CAPCONTROLS)}_{i,t} + \beta_4 \text{Log (TECH PRO)}_{i,t} + \beta_5 \text{Log (OTHER)} + \varepsilon_{i,t} \quad (3.1.2)$$

where,

e^*_t	: equilibrium RER,
$\text{TOT}_{i,t}$	: terms of trade,
$\text{GCN}_{i,t}$	: government consumption of non-tradeables,
$\text{CAPCONTROL}_{i,t}$	: measure of extent of capital controls over capital flows
$\text{OTHER}_{i,t}$	: other variables that might influence Equilibrium RER
$\varepsilon_{i,t}$	: *one way (fixed) error component, i.e.* $\varepsilon_{i,t} = \varepsilon_i + \nu_{i,t}$

[4]The inclusion of a lagged endogenous variable will have implications for the use of the *DW-statistic* as a test for first order *serial correlation* in the error term.

substituting equation (3.1.2) in equation (3.1.1) and solving for $\text{Log } e_{i,t}$, our model is given by

$$\text{Log } e_{i,t} = \gamma_0 + \gamma_1 \text{Log (TOT)}_{i,t} + \gamma_2 \text{Log (GCN)}_{i,t} + \gamma_3 \text{Log (CAPCONTROLS)}_{i,t} + \gamma_4 \text{Log (TECH PRO)}_{i,t} + \gamma_5 \text{Log (OTHER)}_{i,t} + \zeta \text{Log } e_{i,t-1} + \lambda \{Z_{i,t} - Z^*_{i,t}\} - \phi \{\text{Log E}_{i,t} - \text{Log E}_{i,t-1}\} + \mu_{i,t} \quad (3.1.3)[5]$$

where,

$\gamma_\upsilon = \theta\beta_\upsilon$, $\upsilon = 0,1,\ldots,5$.
$\zeta = (1 - \theta)$
$\mu_{i,t} = \theta \varepsilon_{i,t}$

Proxies used:

Government (total) consumption to GDP ratio (*GCGDP*) is used as a proxy for government consumption of non-tradeables (*GCN*). It is expected that government consumption of non-tradeables will lead to an appreciation in the RER by increasing the relative price of non-tradeables. Edwards (1989, p.136) points out that *GCGDP* is a poor proxy for *GCN* as it is quite possible for *GCGDP* to be increasing while *GCN* is falling. Real growth rate of GDP is used to proxy technological progress (*TECH PRO*). This proxy also tests the Balassa effect.[6] Net Capital Inflows (*NCI*) was used as a proxy for *CAPITAL CONTROL*. The rationale behind this being that, the greater the extent of capital controls, the lesser the (net) inflow of capital will be.

Macro-economic Policies

Three macro-economic policies were specified in the model, namely *EXCRE*, *DEM* and *DCRE*. *EXCRE* measures the excess supply for domestic credit, *DEM* is a ratio of fiscal deficit to lagged money and *DCRE* is the rate of growth of domestic credit.

Annual data (1967- 1995) are used for all the series pooled over all ten (10) countries. Some series covered only a portion of the sample period. The fixed effect method is employed with no weighting applied to the countries. The statistical package used in the regression analysis is

[5]Here $X_{i,t}$ denotes the (pooled) variable X for country i at time period t.

[6]Balassa (1964) posits that productivity growth should appreciate the Real Exchange Rate. Here it is argued that because of pressures of international competitiveness, productivity will be transferred to the tradeable goods sector faster than the non-tradeable goods one. This means that over time, tradeables will be supplied more cost effectively than non-tradeables. Consequently, the price index of tradeable goods will fall faster than its counterpart in the non-tradeable goods sector; leading to an appreciation.

Econometric Views Version 2.0.
This model uses *panel data* observations. There are numerous benefits from using *panel data*. They include (i.) more *information*, (ii.) less *collinearity* among regressors, (iii.) more *efficiency* and (iv.) more *degrees of freedom*. The diagnostics for this data type is fairly technical in nature as most of the traditional diagnostics are mainly for cross-sectional or time series data. As such the necessary tests on this model was not conducted. For details on the tests using *panel data*, see Baltagi (1995). The results on the single equation methodology of this paper should therefore be considered as tentative until these tests have been carried out.

3.2 *Results*

Several variants of equ. (3.1.3) are estimated and reported in TABLE 3.2a. *NOMDEV* has the expected (negative) sign on its coefficients. The coefficients are not as high (in absolute value) as those reported by Edwards in Williamson (1994), ranging from -0.08 to -0.21. This suggests that nominal devaluation is a relatively less-powerful tool for re-alignment in the Caribbean vis-a-vis the countries sampled by Edwards.[7]

The sign on the coefficient of *TOT* is negative for all equations estimated and reported. This is contradictory to estimates obtained by Edwards (1989) and Odedokun (1997). This result, although seemingly perverse, is not inconsistent with the theoretic model developed by Edwards (1989). In the model, the sign on the coefficient of *TOT* is indeterminate. The ambiguity results from the counter-acting nature of the income and substitution effects arising from a change in the price index of imports. [8] As suggested by Elbadawi (1992) and following Odedokun (1997), the *TOT* is dis-aggregated into its constituent parts. The results are reported in *equation 3.2-i* in ***TABLE 3.2 a***. P_x is found to have no significant effect on RER. This result complements the findings of Odedokun (1997). The coefficient on the (log of) P_m is +0.106502, a strange result at first glance which suggests that an increase in the price of imports causes the RER to appreciate. An explanation for this result may be as follows. An increase in the price (index) of imports has an income and substitution effect. The income effect arises because an increase in P_m reduces relative (domestic) income, resulting in expenditure-cuts, part of which would have been spent on non-tradeables (assuming that these are normal good). This would tend to lower the price of non-tradeables, hence leading to RER depreciation. The substitution effect comes about because an increase in P_m implies a relative cheapness of non-tradeables which means that consumers will substitute the relatively dearer good (tradeables) for the relatively cheaper good (non-tradeables). The resulting tendency would be for the price of non-tradeables to raise, leading to an appreciation of the RER.

[7]The countries sampled were Brazil, Colombia, Greece, India, Israel, Malaysia, Phillippines, South Africa, Sri Lanka, Thailand and Yugoslavia.

[8]See Neary (1988) and Odedokun (1997, note 4).

In all the equations estimated, GCGDP is positive and significant in a couple of instances. We cannot, however, make the statement that government consumption of non-tradeables causes an appreciation in the RER as GCGDP is merely a proxy for GCN.

The coefficient on *GROWTH* is negative for all but one equation estimated. This supports the findings of Odedokun (1997) and Edwards (1989) and rejects evidence of the Balassa effect alluded to earlier. Edwards (1989) suggests that this result might stem from using an inept proxy for productivity and not from an invalid theory.

For the most part, the results from the macro-economic policy variables are disappointing. Most of the coefficients are insignificant at conventional levels. This would suggest that macro-economic policies did not affect short-run movements in the RER. This goes against the findings of Edwards (1989) and Odedokun (1997). In equ. (3.25) reported in *TABLE 3.2 a*, however, the coefficient on EXCRE is significant and positive. The equation suggests that the movement in RER is not affected immediately by macro-economic policies, but rather, by policies of three years earlier.

Estimating Equilibrium

In theory, any of the equations reported in *TABLE 3.2 a* could be used to estimate the equilibrium path for the individual countries. The authors decided to use equ. (3.22). The adjustment parameters for the equations are reported in *TABLE 3.2 b*. The adjustment parameters are used to obtain the beta coefficients in equ. (3.1.2). The graphs showing the evolution of the equilibrium real exchange rate (ERER) are given in appendix C. Because our definition of equilibrium RER requires that the "fundamentals" be sustainable values, we did not use actual values to estimate the equilibrium path. Instead, the five year moving averages of the variables are used as suggested by Edwards (1989, p.137). Another method suggested by him is decomposing the "fundamentals" into permanent and temporary components using a method developed by Beveridge and Nelson (1981). The permanent component would then be used in the estimation of ERER. The analysis for Jamaica and Barbados are outlined below.

Application

- Barbados

Chart 3.2 a indicates that the RER for Barbados tracked its equilibrium path for the period 1972 to the mid 1980s. It was, however, consistently 'under-valued' over this period until 1986 when it attained equilibrium levels of RER. Barbados achieved equilibrium again in about 1988 after which it diverged from the equilibrium path up to 1991. Subsequently, however, it seems as if the economy is converging once again to equilibrium. The downturn of the RER could reflect policies (such as wage cuts) which were implemented by the authorities that time.

Colombia

Chart 3.2 b indicates that the (actual) RER for Colombia is consistently below its equilibrium level for the period 1972-77. Both actual and equilibrium RER declined (depreciated) over the period. From 1978 onwards, the mis-alignment is significantly reduced with (actual) RER showing a general upward movement. The period 1979-86 is characterized by (actual) RER 'over-valuation'. The best years for the economy of Colombia (over the sample period) seems to be 1986-88 as equilibrium was achieved, or closely followed, for most of the period.

- Costa Rica

The evolution of actual and equilibrium RERs for Costa Rica are shown in *Chart 3.2 c*. There is a steady increase (appreciation) in the equilibrium RER over the sample period. The (actual) RER experienced sharp movements during the period 1977-85. There seems to have been structural changes in the economy at around 1980 as the actual RER plummeted from above equilibrium level to its lowest level by 1982. The mis-alignment that was evident in 1982 was corrected by 1989 as the (actual) RER appreciated consistently beginning in 1982. Beyond 1989, Costa Rica's (actual) RER remained above equilibrium level.

- Dominican Republic

Dominican Republic's (actual) RER is quite erratic over the sample period. As indicated by *Chart 3.2 d*, the (actual) RER has (for the most part) shown movements of 'over-valuation to under-valuation' (and *vice-versa*) in consecutive time periods. No period of sustained equilibria is identified on the Chart. There seems to have been some structural break for the economy in around 1975 as indicated by the relative plunge (sharp depreciation) in the (actual) RER for that year.

- Guyana

Chart 3.2 e suggests that Guyana's equilibrium RER has not altered much over the sample period. Guyana's (actual) RER has been 'under-valued' for the period 1975-92, but there were signs of convergence (re-alignment) for the up to 1983. Beyond 1983, however, the (actual) RER indicates that a path of general decline, hence increasing the gap with the relatively unchanging equilibrium RER.

- Honduras

Chart 3.2 f illustrates the equilibrium RER mis-alignment for Honduras. The RER for Honduras is below its equilibrium level for the period 1972-84. Within the period sampled, however, two patterns emerged. From 1972-77 there is a consistent divergence of (actual) RER from its equilibrium level. On one hand, the (actual) RER displayed a downward path, and on the other hand, the equilibrium RER continued on a moderate upward slope. This pattern shifted dramatically as of 1978, when the (actual) RER begun a sharp appreciation and eventually re-aligned itself six (6) years later in 1984. This appreciation of the (actual) RER continued until 1987 which resulted in the 'over-valuation' of the (actual) RER over the 1984-87 period. The Chart indicates that 1984-87 was the best period for the economy of Honduras as the mis-alignment was less pronounced over the period. During 1988-92, the (actual) RER was below equilibrium level again, but the magnitude of the mis-alignment is not large as that obtained in the 1972-77 period.

- Jamaica

Chart 3.2 g is used in the analysis for Jamaica. The Chart does not suggest an equilibrium RER for Jamaica over the sample period. The RER for Jamaica was consistently 'over-valued' for the sample period. This is indeed a disappointing result, but one which collaborates the finding of the Intuitive Methodology outlined in Section 4.

- Mexico

Chart 3.2 h shows the mis-alignment for Mexico. The (actual) RER is below its equilibrium level for the period 1972-89, excepting for 1982 when the it jumped slightly above equilibrium RER. The most distinctive pattern that can be seen on the chart is a sharp appreciation of the (actual) RER beginning in 1987 and continuing up to the end of the sample period in 1992. This sharp appreciation was warranted at the outset to eliminate the mis-alignment that prevailed in 1987. However, there is little justification for the continued appreciation of the (actual) RER beyond 1990 when (actual) RER was in line with equilibrium level.

- Trinidad & Tobago

The analysis for Trinidad & Tobago is carried out from *Chart 3.2 i*. The four (4) years period 1979-82 seems to have been an unstable period in the economy of Trinidad & Tobago. This is shown on the Chart by sharp cyclical movements for (actual) RER over the period. The (actual) RER was higher than it needed to have been over the period 1984-89. The mis-alignment is least severe over the 1987-90 period which suggest that this might have been one of the better periods for the economy of Trinidad & Tobago.

- Venezuela

The case for Venezuela is shown in *Chart 3.2 j*. The mis-alignment for Venezuela has not been as severe as the other countries sampled. The period 1982-88 seems to have been the best period for the economy of Venezuela with the (actual) RER moving relatively closely with the equilibrium RER. There is a noticeable decrease in the (actual) RER during the period 1988-90 which shows that the (actual) RER was below its equilibrium level. Attempts were made to correct this, which is implied from the subsequent appreciation of the (actual) RER.

4. AN INTUITIVE METHOD

The equilibrium real exchange rate for a small developing economy is one which secures sustainable growth with low inflation. Growth is considered sustainable if it does not violate the balance of payments constraint. The indicators of the equilibrium real exchange rate are therefore:

- growth over several consecutive years
- low inflation during the growth period; and
- a small deficit or a surplus on the balance of payments current account during that period.

Our intuitive procedure is therefore to evaluate the current situation - that is, during the most recent five years. We then calculate the real exchange rate defined as the relative price of non-tradeables to tradeables. We assess the sustainability of current economic performance: Has the economy grown in the past five years? Has inflation been below 5% during that period? Is the balance of payments current account in surplus or is the deficit small in relation to GDP? If all the answers are positive the current real exchange rate is considered an equilibrium rate. If any one is in the negative the current real exchange rate cannot be considered in equilibrium, and an equilibrium rate must be estimated.

A "quick and dirty" way to estimate the real equilibrium real exchange rate is to examine the history of growth, inflation and the balance of payments. Is there a period of about 5 years when the equilibrium criteria are all satisfied? The real exchange rate during that period would have been an equilibrium rate.

This method is not quite satisfactory because between the current period and the time of the last equilibrium rate there may have been structural changes such that the old equilibrium rate would not be an equilibrium in today's economy. Examples of such structural changes include new exports (such as data processing services), new competitors in tourism, larger or smaller amounts of direct foreign investment, improvement in infrastructure, etc.

A better indicator may be derived from estimates of the effect of changes in the real exchange rate on growth, inflation and the current account. They may be used to calculate the percentage in the real rate needed to bring the current economic indicators into equilibrium. From this we deduce the equilibrium real exchange rate.

Results

- *Barbados*

As may be seen from chart 4.1 the real exchange rate for Barbados appreciated continuously from the mid-1970s to 1991.[9] It has depreciated sharply since then. Is the current real exchange rate an equilibrium one? Growth has been recorded for the last three years, inflation has been kept below 5% and the balance of payments current account is in surplus, but three years is too short a time to say that we have an equilibrium.

We checked for past periods of equilibrium. These are summarised in table 4.1. The periods of sustained growth are 1976 to 1979 and from 1984 to 1989. Inflation performance in the first period was over 5% so we would not consider that an equilibrium period. In the second period, however, inflation was less than 5% and there was a current account surplus on average. This appears to be an equilibrium . The average real exchange rate between 1984 and 1988 was 1.23 (we omit 1989 because the real exchange rate rose 10% in 1989, suggesting that it may have been going out of equilibrium).

The average real exchange rate for 1994 and 1995 is 1.23. That is not conclusive evidence that there is equilibrium because of possible structural changes between the late 1980s and today. However, combined with the fact that current indicators are acceptable, it suggests that the real exchange rate is not badly out of line.

Is there a real exchange rate that might give better outcomes? To evaluate this, we examine what happens if we change the real exchange rate by 10%, as illustrated in chart 4.2. A 10% change in the real exchange rate has a major effect on the current account but no significant effect on output or prices. The current account is already in surplus so there is no need for adjustment on that score.

- Jamaica

The results for Jamaica are presented in chart 4.3. The most recent 5 years does not appear to be an equilibrium, mainly because of high inflation. Moreover, growth has been rather slow, although the current account has averaged only a small deficit, in the region of 2% of GDP.

No equilibrium may be identified over the period recorded in the chart. Growth between 1981 and 1984 was accompanied by high inflation and a current account deficit in excess of 10% of GDP. The period 1986 to 1990 comes closest to equilibrium with rapid growth and a small current account deficit between 1986 and 1988, but inflation remained high. When inflation abated in the years between 1989 and 1991 the current account deteriorated. In the absence of an apparent equilibrium period we have no benchmark for the real exchange rate equilibrium.

Would a depreciation in the real exchange rate serve to produce better outcomes? Our estimates indicate they would not. A 10% depreciation has no discernable effect on output even though it reduces inflation significantly in the late 1990s. However it worsens the current account (see

[9]The charts for this section are in Appendix D

Chart 4.4).

These results offer little guidance on the equilibrium real exchange rate for Jamaica. We probably need more reliable estimates of structural parameters. However it seems that growth is not responsive to relative price changes and that the current account and inflationary responses may be perverse.

- Trinidad and Tobago

The Trinidad and Tobago results are summarised in chart 4.5. We cannot be confident that the current real exchange rate is an equilibrium rate because there was recession in two of the last five years and inflation averaged over 5%. However, the current account is in surplus. Since 1987 the real exchange rate has fluctuated between 0.91 and 1.15.

The economy may have been in equilibrium in the late 1960s, up to 1971. That was a period of sustained growth with low inflation and a sustainable current account. Growth accelerated in the 1970s, especially from 1976 onwards, but high inflation overtook the economy in 1973 and inflation remained above 10% for most of the rest of that decade. The real exchange rate was about 30% higher in the late 1960s than it is today but major changes in terms of trade affecting oil producers would have displaced the equilibrium real exchange rate in the meanwhile. Because Trinidad and Tobago's terms of trade have worsened significantly as a result of changes in the relative price of oil and other commodities, its equilibrium real exchange rate would have depreciated as well.

The principal indicators of economic disequilibrium - growth, inflation and the current account - are quite insensitive to changes in the real exchange rate. Chart 4.6 shows that there is no perceptible response to a 10% depreciation in the real exchange rate. If the current real exchange rate proves not to be in equilibrium a considerable movement will be needed to attain equilibrium. We need a few more years of observing current performance before it becomes clear whether or not Trinidad and Tobago has attained an equilibrium real exchange rate.

- Guyana

The results for Guyana appear in chart 4.7. Guyana has achieved robust growth since 1991 and inflation was brought under control in 1992 but the current account deficit remains above 10% of GDP. However, the Guyanese economy seems able to sustain this current account while reducing the stock of debt, suggesting that the current account may be sustainable. The current real exchange rate therefore appears to be at or near its equilibrium value. Moreover, the real exchange rate has depreciated by 600% since the early 1970s so there may be little purchase from further declines in the rate.

Guyana had a poor record of growth in the 1980s and we must go back to 1973-76 for a period of sustained growth at levels above 2%. That period was not one of equilibrium, with inflation at 41% in 1974 and 13% in 1975.

The historical record gives little guidance with respect to the current equilibrium real exchange rate because of major changes in the policy environment in Guyana involving a radical about-face from state ownership and strict regulation to privatisation and liberalisation of regulations on trade, foreign exchange, prices and exchange rates.

Output and inflation are quite insensitive to a 10% depreciation in the real exchange rate but there is a measurable improvement in the current account (chart 4.8). However, so long as the current account deficit is sustainable there seems no reason to suspect that the current real exchange rate deviates from equilibrium.

- Costa Rica

The picture of Costa Rica's internal and external balances and growth is set out in Chart 4.9. The country witnessed continuous growth from 1970, except for two years, 1981 and 1982. However, inflation has never really been brought under control, remaining above 10% each year, except for 1971, 1972 and 1978. Moreover, the current account of the balance of payments recorded large deficits, in excess of 5% for the period, except for 1988 and 1991. This suggests that Costa Rica may not have achieved an equilibrium real rate of exchange. After a sharp decline in 1981-82 the real exchange rate appreciated through the 1980s, a trend that was arrested only in 1991.

It seems that a depreciation of the real exchange rate would bring the economy closer to equilibrium by moderating inflation and improving the current account performance (See Chart 4.10). A 10% real exchange rate depreciation has little impact on growth, but growth performance is already satisfactory. For equilibrium the economy needs to reduce inflation and the current account deficit. A 10% depreciation has only a modest dampening effect on inflation, but the improvement in the current account is quite significant.

- Honduras

The Honduran economy underwent cycles of growth (Chart 4.11) but the average growth rate was quite high, in the region of 5%. Price increases were very rapid in the 1970s, but inflation was reduced to about 5% in the 1982-88 period, before the economy was overtaken by sharp price increases in the early 1990s. Very large current account deficits in the 1970s and 1980s were reduced to less than 5% of GDP in 1988-90, but the current account worsened seriously thereafter.

Continuing high inflation and a deteriorating current account deficit call into question the real exchange rate for the last five years of our observations. Even though that rate depreciated 12% between 1989 and 1992, inflation remained above 5% and the current account worsened. Taking our three indicators together there is no period during the 1970s and 1980s that unambiguously appears to be in equilibrium. The real exchange rate depreciated in the 1970s, up to 1977, a year when the Honduran economy was near the peak of its growth cycle, but inflation remained high and the current account excessive. The real exchange rate appreciated rapidly after 1977.

Further real exchange rate depreciation may not secure equilibrium. Based on the estimated elasticities of response to a 10% depreciation in the real exchange rate (see Chart 4.12) a modest depreciation hardly improves inflation performance, and the current account worsens, contrary to expectations. These results suggest that the real exchange rate for Honduras may have depreciated too far, and that an appreciation of substantial proportions may be needed to improve the current account performance. However, this might have to be traded off against worsening inflation.

5. COMPARISON OF ALTERNATIVE METHODS

The two methods employed in the empirical analysis do not give exactly the same inference about the real exchange rate for the most recent five years of the sample, for any country (See Table 5.1). However, in most cases the inferences are similar. The conclusions about the equilibrium rate, using alternative methods, are very similar for Barbados and Trinidad and Tobago. For Costa Rica and Honduras the qualitative conclusion is similar, but there is a difference in the degree of over- or undervaluation of the RER. There is a major discrepancy between the two methods for Guyana, but they both convey the same policy message: maintain the current RER. Although one method suggests this is a large undervaluation, the potential loss of policy credibility from a large revaluation argues against any correction. The intuitive method yields no firm result in at least one case, that of Jamaica.

6. CONCLUSIONS AND EXTENSIONS

One makes compromises and assumptions in order to arrive at empirical estimates of real exchange rate equilibrium, whatever the method used, and no method is superior to all others. The art of exchange rate management lies in combining insights from the use of all available techniques. This investigation shows how policy makers may use intuitive analysis to help evaluate the conclusions drawn from a single equation method for estimating the equilibrium real exchange rate. Where intuition confirms the econometric results policy changes may be made with greater conviction. Where the econometric results are not confirmed caution is indicated, and perhaps a holding period for further evaluation before action is taken.

The results of the single equation method indicate that:

- An improvement (increase) in the terms of trade will lead to short run depreciation in the real exchange rates.
- The changes in the price of exports were not significant in explaining short run real exchange rates movements.
- Devaluation is not as effective a tool for correcting real exchange rate misalignment in the Caribbean as in other developing countries.
- Macroeconomic policies such as growth in domestic credit supply and excess credit does not significantly affect contemporaneous values of the real exchange rates.
- Growth in real GDP does not appreciate the real exchange rate, and further, to the extent that growth is a good proxy for productivity, the Balassa effect is not significant in the Caribbean region.

The results of the intuitive methodology are less precise, though they are more closely related to the objectives of exchange rate policy, that is, internal and external balance and sustainable growth. The elasticities of response suggest that real exchange rate changes have a strong effect on the current account of the balance of payments in most countries, and significant effects on inflation in some countries. Real exchange rate changes are not an effective stimulant to growth in any country.

The present research might be extended in several ways. The single equation estimates may be revised to include parallel market exchange rate as an explanatory variable and to incorporate the distinction between permanent and temporary changes in the fundamentals, following the theoretical model of Edwards (1989). The elasticities used in the intuitive method might be checked against independently derived estimates, where available. The model from which the elasticities are derived might be compared with more fully specified models for each economy. These models might be used to derive estimates of the equilibrium real exchange rate directly, in addition to offering more dependable estimates of elasticities for the intuitive approach.

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TABLE 3.2 a *Real Exchange Rates Equations* [a]

Equ. / Variable	3.21	3.22	3.23	3.24	3.25	3.26
$DCRE_t$	0.027085					
	(0.7145)					
DEM_t	-0.023651		-0.024941	-0.024588		
	(0.2266)		(0.2033)	(0.2112)		
$EXCRE_t$			0.014025	0.015556		-0.059168
			(0.8390)	(0.8223)		(0.3625)
$EXCRE_{t-1}$		-0.055458			-0.033488	
		(0.0921)			(0.3352)	
$EXCRE_{t-2}$		-0.024944			-0.020294	
		(0.3873)			(0.5401)	
$EXCRE_{t-3}$					0.064642	
					(0.0378)	
$NOMDEV_t$	-0.141322	-0.117828	-0.140675	-0.142755	-0.109387	-0.254768
	(0.0061)	(0.0195)	(0.0063)	(0.0058)	(0.0418)	(0.0000)
ln TOT_t	-0.102802	-0.211829	-0.102632		-0.209049	-0.083736
	(0.0194)	(0.0000)	(0.0196)		(0.0001)	(0.0668)
ln P_x				-0.089154		
				(0.0705)		
ln P_m				0.106502		
				(0.01696)		
ln $GCGDP_t$	0.021204		0.022808	0.016650		0.127597
	(0.7374)		(0.7100)	(0.7893)		(0.0305)
$GROWTH_t$	-0.013578		-0.005086	0.030945	0.426244	-0.184168
	(0.9561)		(0.9835)	(0.9028)	(0.1258)	(0.4852)
$GROWTH_{t-1}$		-0.083593				
		(0.6984)				
$DBGNP_t$		-0.000565			-0.000634	
		(0.0896)			(0.0600)	
NCI_{t-1}		0.000032			0.0000749	
		(0.3409)			(0.0567)	
NCI_{t-2}		0.0000226			0.0000567	
		(0.5229)			(0.1281)	
NCI_{t-3}		0.000028			0.0000489	
		(0.4273)			(0.2070)	
ln RER_{t-1}	0.501133	0.242717	0.500030	0.509068	0.249092	0.688212
	(0.0000)	(0.0005)	(0.0000)	(0.0000)	(0.0011)	(0.0000)
N	132	134	132	132	117	152
adj. R^2	0.64	0.62	0.64	0.64	0.62	0.69
Durbin 'h'[b]	3.658878	2.7200147	3.6175547	3.3928518	3.6712521	2.444722

a. N is the total number of panel observations. Number in parenthesis is the associated p-value. A p-value less than 0.05 indicates that the coefficient is significant at conventional levels. See Appendix B for variable list.
b. This is a test statistic for serial correlation as the DW-statistic is biased towards 2 in the presence of a lagged dependent variable. For a more complete exposition, see Greene (1997, pp.596).

TABLE 3.2b *Adjustment Parameters Values*[a]

Equ. Parameters	*3.21*	*3.22*	*3.23*	*3.24*	*3.25*	*3.26*
θ	0.499887	0.757283	0.49997	0.490932	0.750908	0.25420
λ_1		0.05548	0.014025	0.015556	0.064642	0.05917
λ_2	0.027085					
λ_3	0.023651		0.024941	0.02459		
ϕ	0.141322	0.117828	0.140675	0.140675	0.109387	0.31105

a. λ_1, λ_2 and λ_3 refer to the adjustment parameters for EXCRE, , DCRE, and DEM, macro-economic policy variables respectively.

TABLE 4.1 *Identifying an Equilibrium Real Exchange Rate for Barbados*

Periods of sustained growth	1976-79	1984-89
Inflation during those periods	>5%	<5%
Current a/c during those periods		surplus on avg.
	↓	↓
	No Equilibrium	Apparent Equilibrium

Average Real Exchange Rate 1984-88 : 1.23

(1989 is an outlier which is omitted)

Table 5.1 *Assessment of Current Real Exchange Rate* (Most Recent five years of sample)

Country	Single Equilibrium	Intuitive
Barbados	Somewhat overvalued, declining towards equi.	Apparently in equi., but too soon to be sure
Columbia	Undervalued, until sharp rise in '92	
Costa Rica	Somewhat overvalued	A significant fall in the RER might bring actual closer to equi.
Guyana	Very large undervaluation	RER is in equi.
Honduras	Somewhat undervalued	Large undervaluation
Jamaica	Large overvaluation	Uncertain
Mexico	RER diverging from equi.: overvaluation	
Trinidad & Tobago	RER equi. on average, but RER rising	Apparently in equi., but too soon to be sure
Venezuela	RER slightly undervalued on average, but rising above equi. in '92	

APPENDIX A

The Model in Logs

$\text{Log } q_t = \alpha_0 + \alpha_1 \log RP + \alpha_2 \log q_t(-1)$

$\text{Log } q_n = \beta_0 + \beta_1 \log q + \beta_2 \log RP + \beta_3 \log mb + \beta_4 \log q_n(-1)$

$\text{Log } p_n = \gamma_0 + \gamma_1 \log q_n + \gamma_2 \log p_t + \gamma_3 \log w + \gamma_4 r_f$

$\text{Log } m = \delta_0 + \delta_1 \log q + \delta_2 \log RP + \delta_3 \log mb + \delta_4 \log m(-1)$

$\text{Log } q = \psi \log q_t + (1-\psi) \log q_n$

$\text{Log } p = \Omega \log p_t + (1-\Omega) \log p_n$

$\text{Log } RP = \log p_n - \log p_t$

$CA = \rho\, p_t\, q_t - m\, p_t$

Definition of Variables

CA: the current account of the BOP
m: real imports
mb: the monetary base
p: the GDP deflator
p_n: the deflator for non-tradeables
p_t: the deflator for tradeables
q: real GDP
q_n: real output of non-tradables
q_t: real output of tradeables
r_f: an international interest rate
RP: p_n/p_t
w: a wage index

The Impact of RER Changes

$$\frac{dq/q}{dRP/RP} = \frac{\psi\alpha_1 + (1-\psi)\beta_2}{1-(1-\psi)\beta_1}$$

$$\frac{dp/p}{dRP/RP} = (1-\Omega)\gamma_1\left(\beta_1 \frac{dq/q}{dRP/RP} + \beta_2\right)$$

$$\frac{dCA/CA}{dRP/RP} = -\frac{P_I^m}{CA}\left(\delta_1 \frac{dq/q}{dRP/RP} + \delta_2\right)$$

APPENDIX B: *VARIABLE LIST AND DATA SOURCES:*

Variable List

DEM	fiscal surplus(DEficit) to Money ratio
EXCRE	EXcess supply of domestic CREdit
DCRE	growth in Domestic CREdit
GROWTH	GROWTH in real gdp
GCGDP	Government Consumption to nominal GDP ratio
INV	gross domestic INVestment to nominal gdp ratio
NCI	Net Capital Inflow
NOMDEV	NOMinal DEValuation of local currency
P_{st}	unit Price of iMports
PVCON	PriVate CONsumption to nominal gdp ratio
P_{x}	unit Price of eXports
RER	Real Exchange Rate
TOT	Terms Of Trade

Data collected from (select) countries in the Latin America & Caribbean region during the period 1967-1995 are used in this study. The countries sampled are Barbados, Jamaica, Trinidad & Tobago, Guyana, Dominican Republic, Mexico, Costa Rica, Honduras, Colombia and Venezuela. The real exchange rate, calculated as the ratio of the price indexes of non-tradeables to tradeables, was sourced from a previous study by Bynoe-Myers (1997). The base year is 1980.

The sources of the remaining variables are IMF's *International Financial Statistics* (IFS) *CD-ROM, July 1997* and World Bank's *World Tables CD-ROM, 1994.*

The exchange rates (line **...rf**), domestic credit (line **...32**), and reserve assets (line **...79dbd**) are

taken from the IFS, *July 1997 CD-ROM*. The exchange rate is defined to be the national currency (n.c.) unit per US dollar.

Nominal GDP, real GDP private consumption, government consumption, gross domestic investment (all in local currency), terms of trade, export and import price indexes GNP per capita (US dollar) are obtained from the *World Tables, 1994 CD-ROM*, with 1987 being the base year for real GDP, terms of trade and import and export price indexes.

Money (defined as currency outside banks + demand deposits) and central government fiscal surplus(deficit) are taken from *World Tables, 1994 CD-ROM*.

Net capital inflow is taken to be the negative values on the current account surplus plus the increase in reserve assets. IFS, *July 1997 CD-ROM* is the source.

EXCRE is calculated as the difference between *DCRE* and lagged *GROWTH*.

Growth in a variable is calculated as the first difference of that variable in the natural logarithms form.

APPENDIX C: *Charts for Single Equation Methodology*

Chart 3.2 a. Equilibrium RER mis-alignment for Barbados

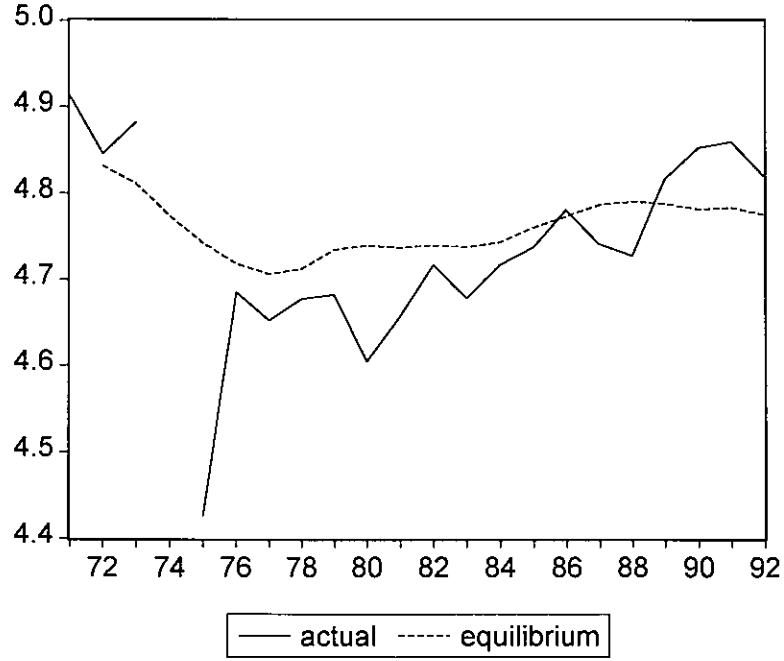


Chart 3.2 b. Equilibrium RER mis-alignment for Colombia

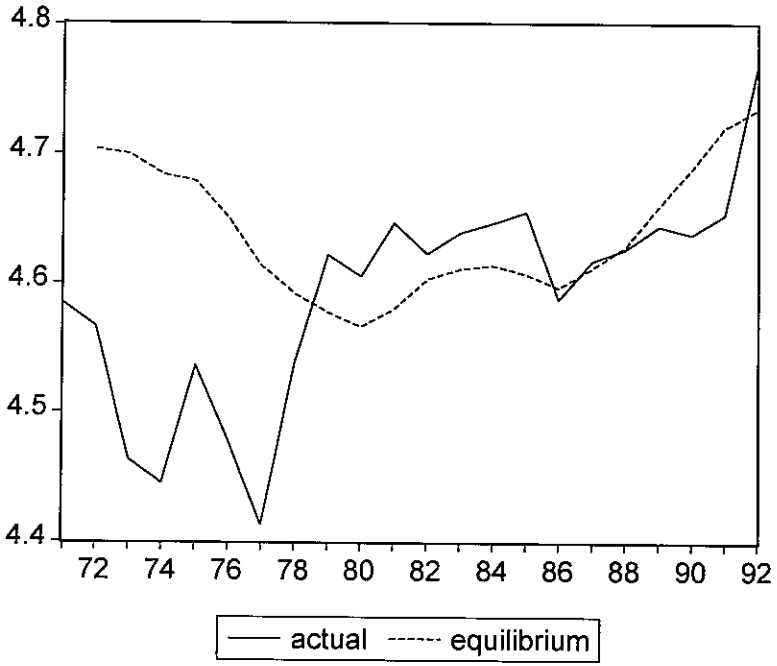


Chart 3.2 c. Equilibrium RER mis-alignment for Costa Rica

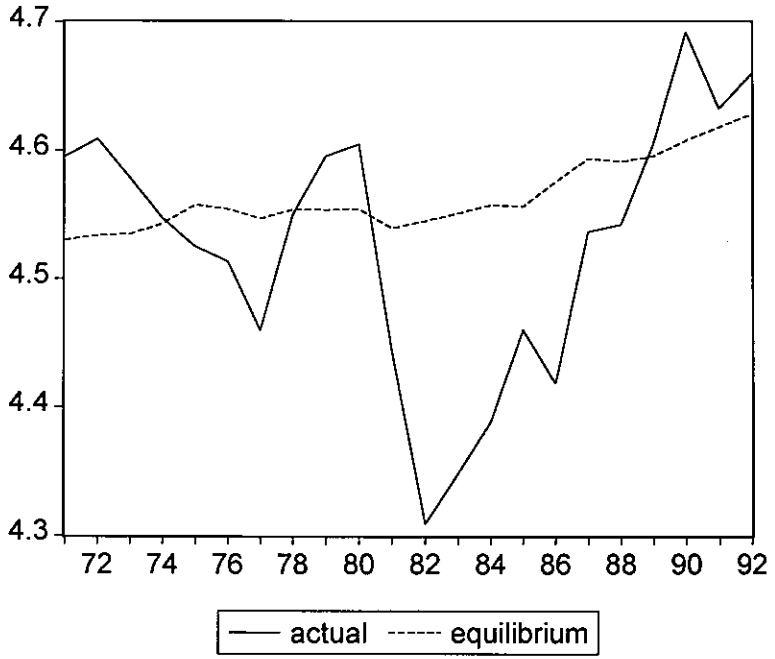


Chart 3.2 d. Equilibrium RER mis-alignment for Dominican Republic

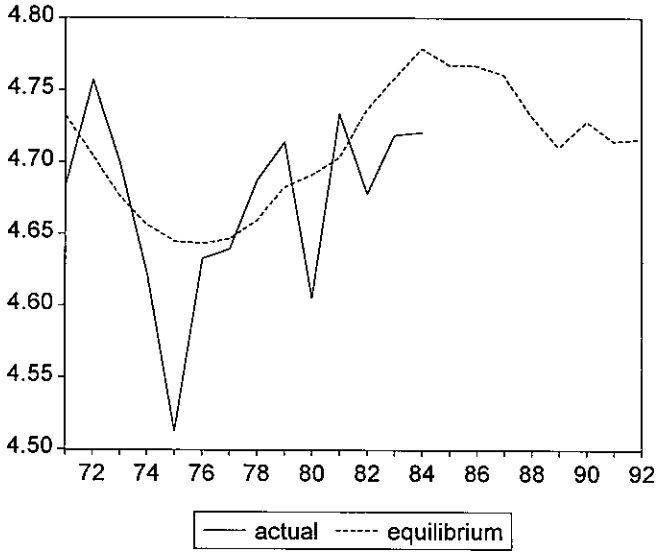


Chart 3.2 e. Equilibrium RER mis-alignment for Guyana

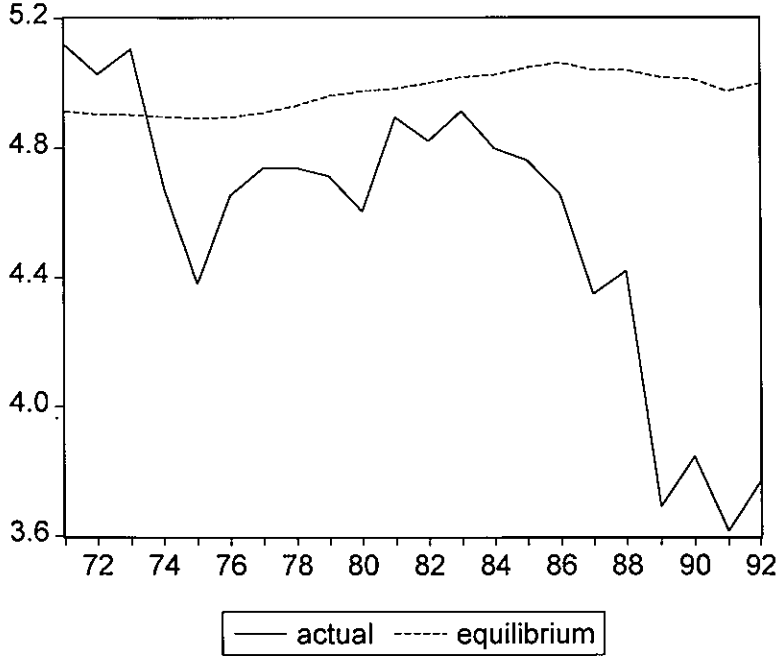


Chart 3.2 f. Equilibrium RER mis-alignment for Honduras

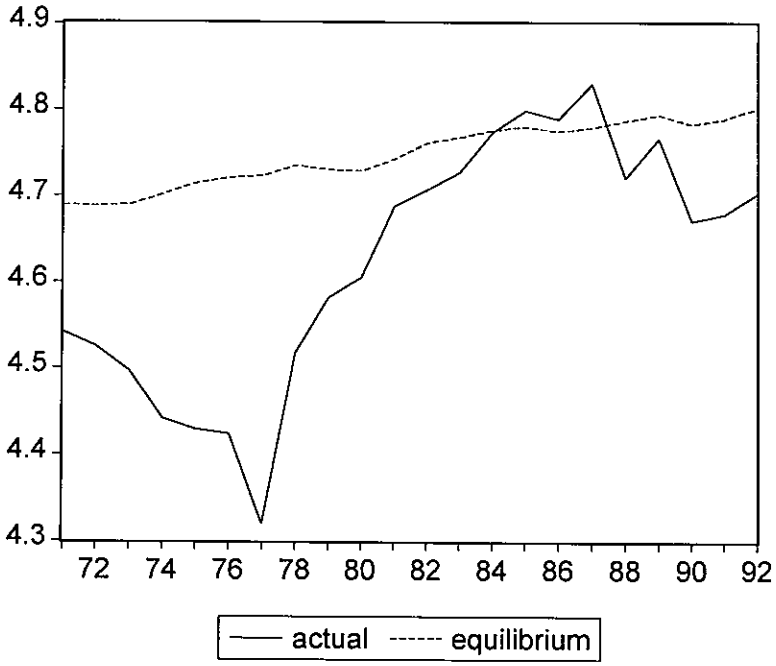


Chart 3.2 g.Equilibrium RER mis-alignment for Jamaica

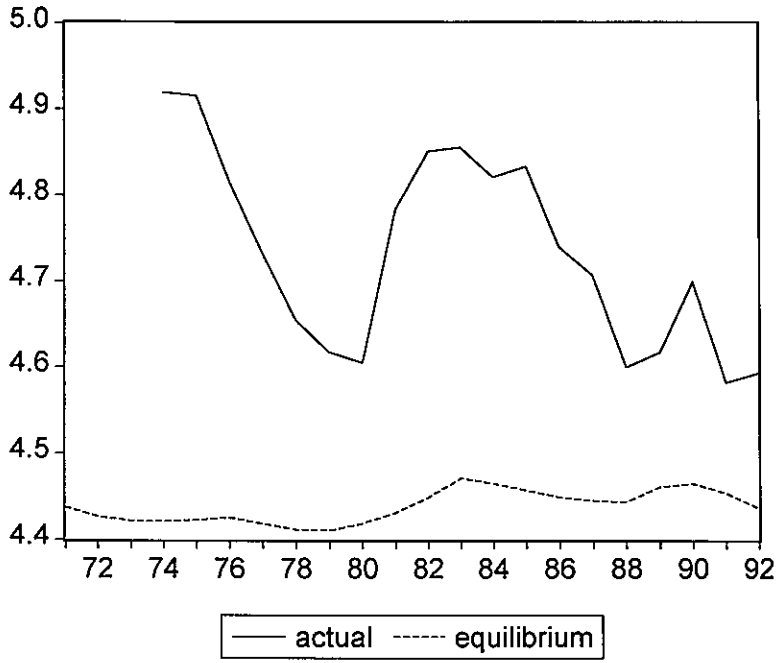


Chart 3.2 h. Equilibrium RER mis-alignment for Mexico

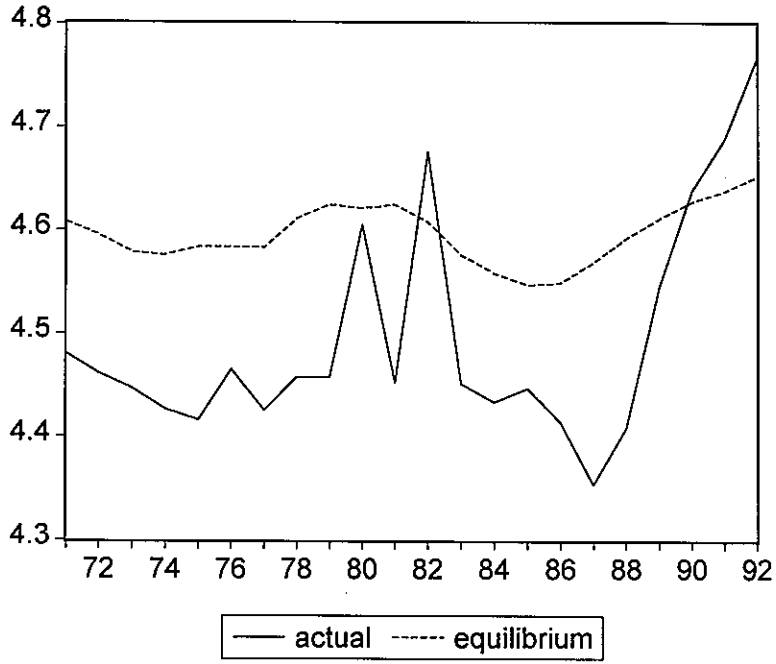


Chart 3.2 i. Equilibrium RER mis-alignment for Trinidad & Tobago

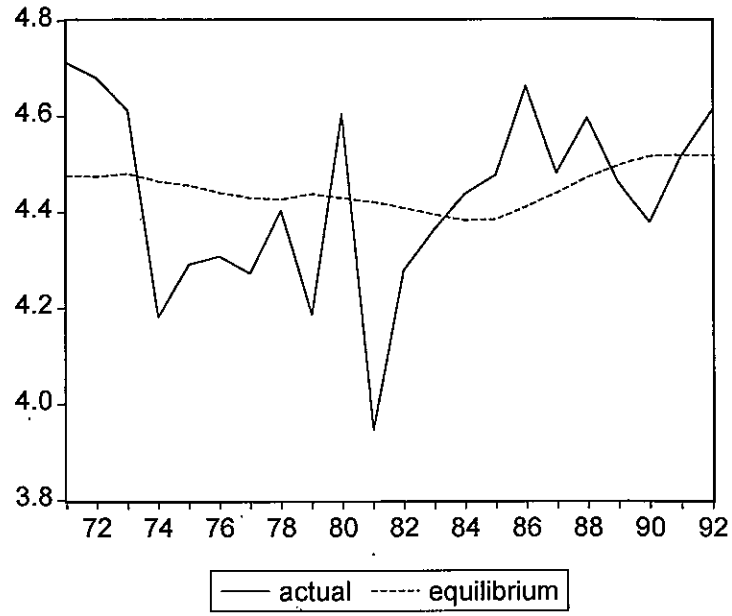
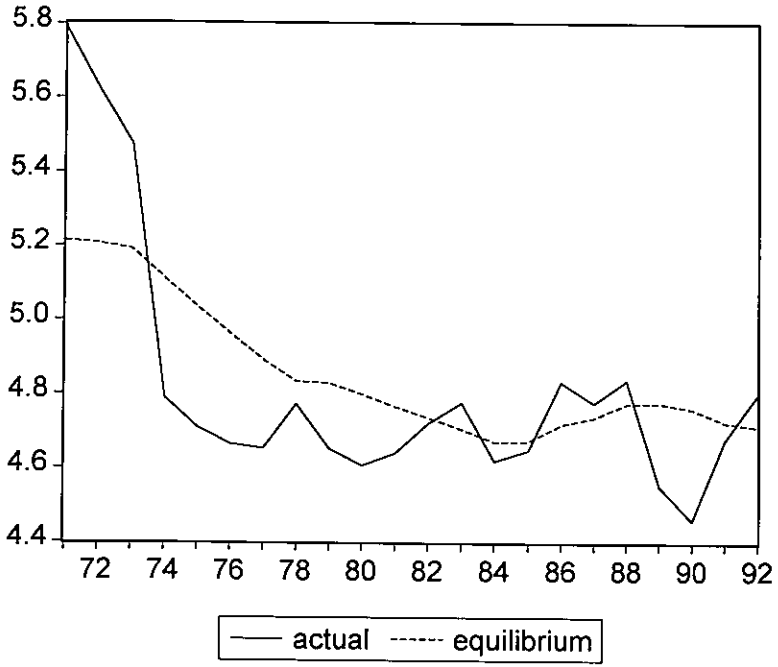


Chart 3.2 j. Equilibrium RER mis-alignment for Venezuela



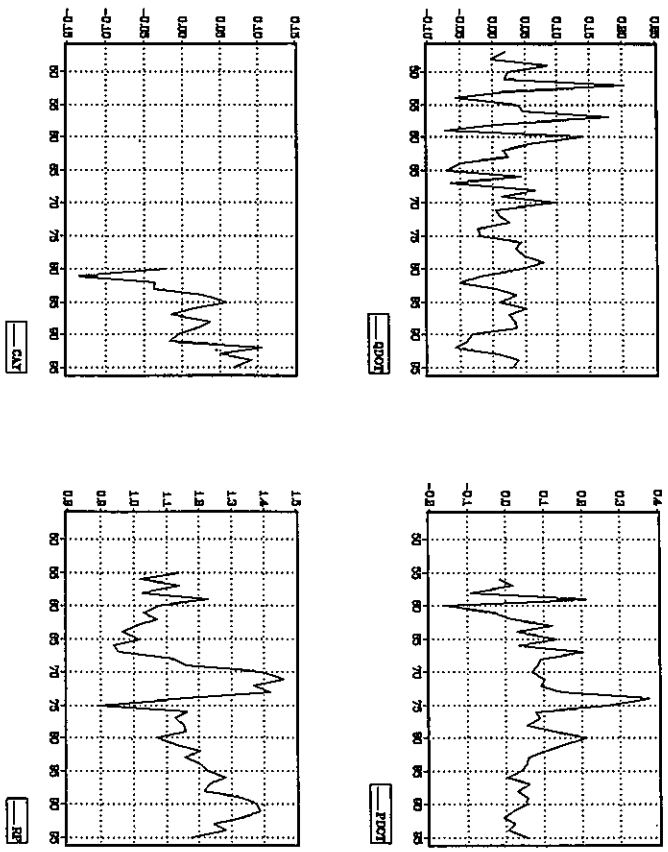
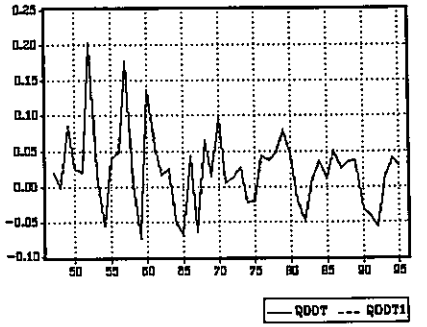
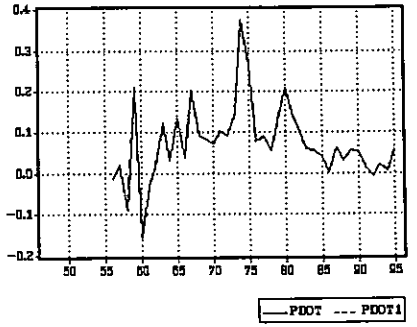


CHART 1 BARBADOS: ACTUALS

CHART 2 BARBADOS SIMULATIONS





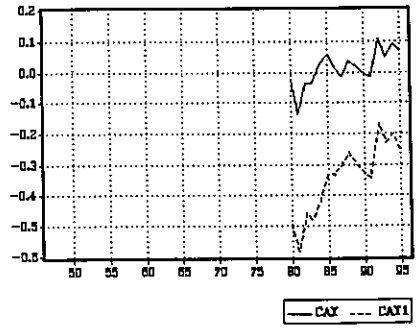


CHART 3 JAMAICA: ACTUALS

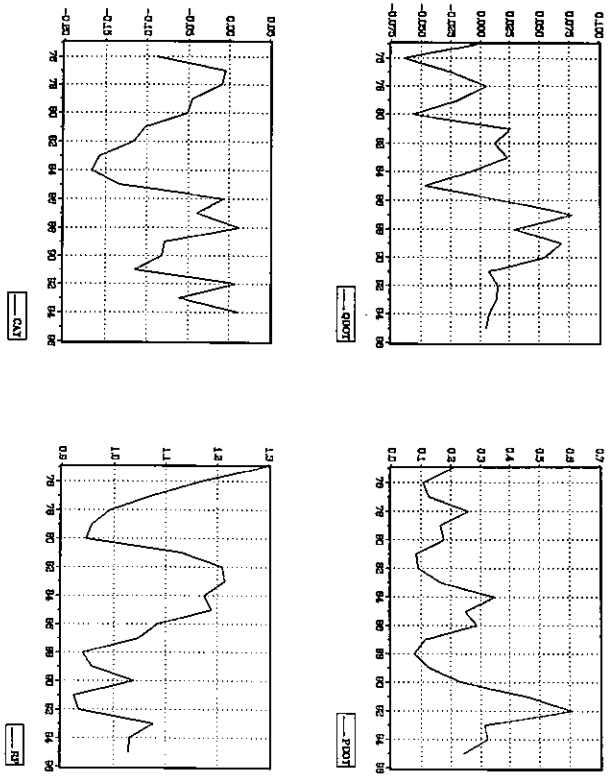


CHART 4 JAMAICA: SIMULATIONS

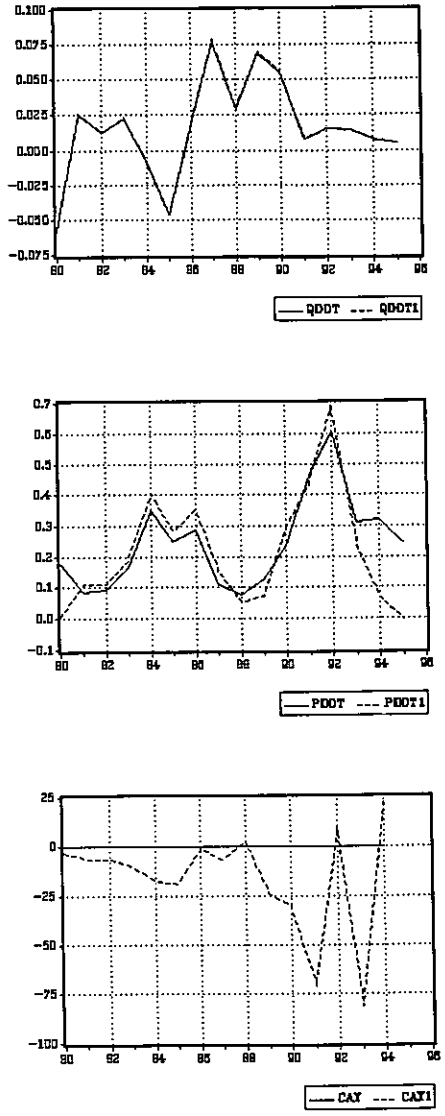


CHART 5 TRINIDAD & TOBAGO: ACTUALS

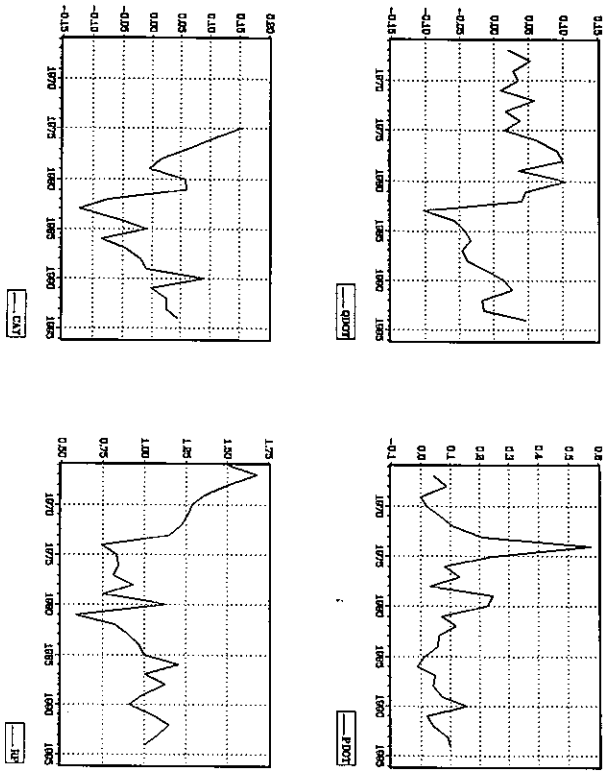
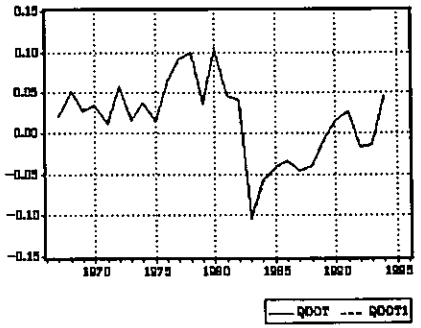
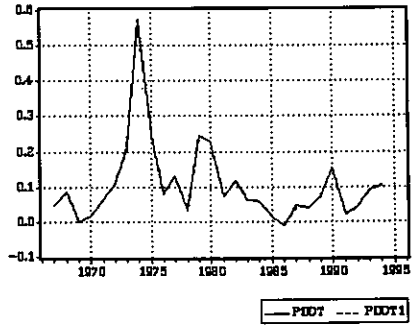


CHART 6 TRINIDAD & TOBAGO: SIMULATIONS





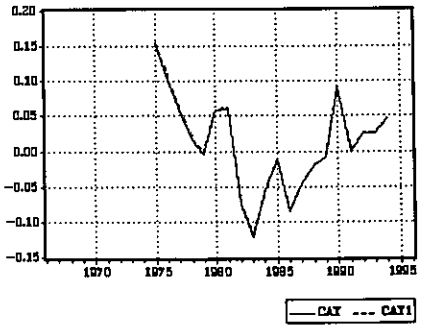


CHART 7 GUYANA: ACTUALS

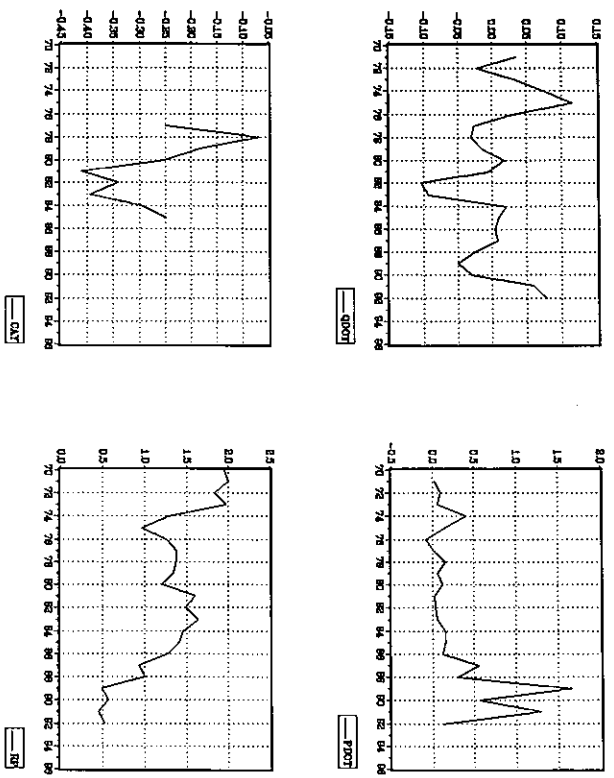
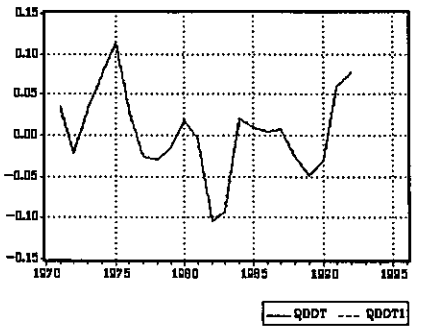
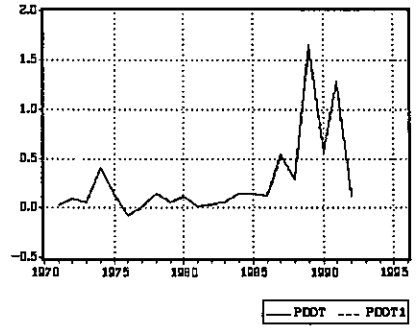


CHART 8 GUYANA: SIMULATIONS





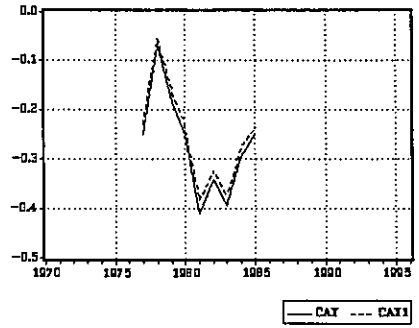


CHART 9 COSTA RICA: ACTUALS

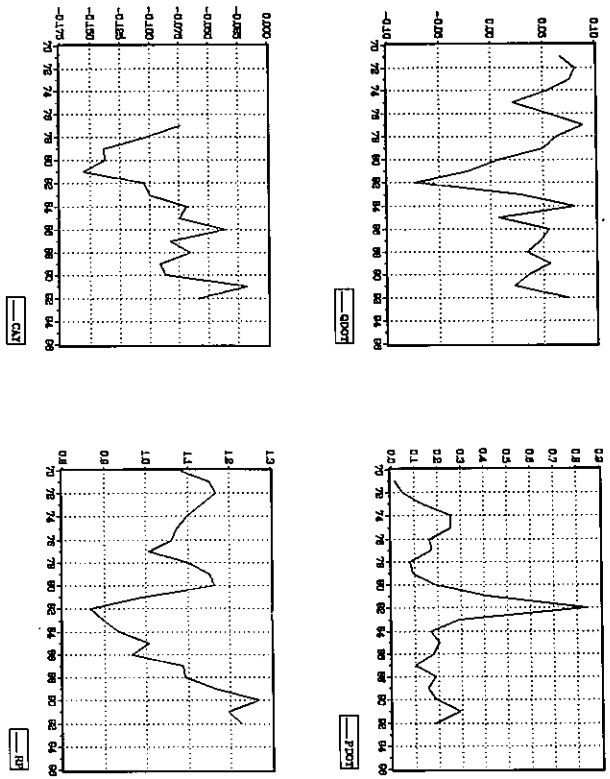
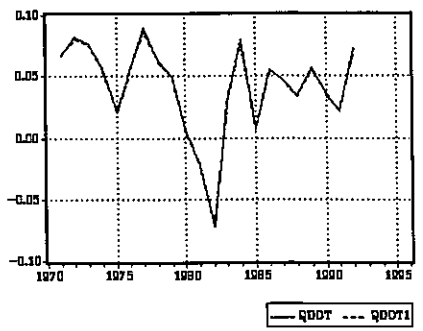
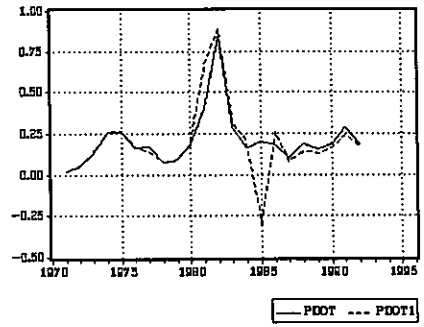


CHART 10 COSTA RICA: SIMULATIONS





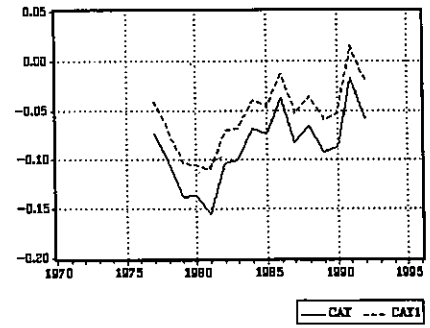


CHART 11 HONDURAS: ACTUALS

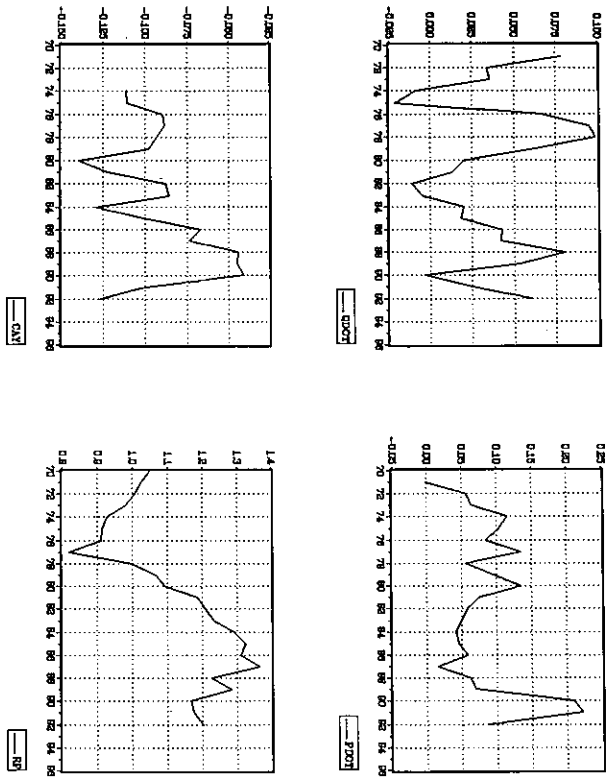


CHART 12 HONDURAS: SIMULATIONS