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Determining Real Exchange Rates

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The paper re-examines the determinants of the real exchange rate equation, and suggests alternative determinants where appropriate, as well as improvements in proxies from those conventionally used. The paper emphasises the weaknesses of the multi-country approach to empirical study of the real exchange rate.

While real exchange rates are determined for Pakistan, the terms-of-trade variable is found to be insignificant. Excess demand for domestic credit, capital flow, and the "opinions" variable are all found to be inversely related to the RER. Thus government expenditure on non-tradable is positively related; and better specification of the technological change variable shows support for the balance effect.

INTRODUCTION

Real exchange rate [RER] behaviour in developing countries has received significant attention in recent years. These studies have mostly been multi-country studies, using either a Purchasing Price Parity model of the RER or a regression-based model where the RER is regressed on the sets of its determinants. The determinants, to a large extent, are represented by proxies. Edwards (1989) has provided a comprehensive survey of the literature. But in reviewing recent regression-based empirical studies certain shortcomings were observed. This paper addresses these issues. Improvements suggested in the choice of determinants of the RER should provide a better understanding of the behaviour of real exchange rates.

These are reservations about the choice and inclusion or exclusion of some variables. We are also not satisfied with the choice of quite a few proxies, which have been substituted in, for lack of data about specific variables. To evaluate movements in the real exchange rate, it would probably be more appropriate to look at individual countries independently. The choice of proxies would then be more appropriate to the choice of country. The signs on the coefficients could then be interpreted with the underlying economic conditions in the country. The behaviour of Pakistan's RER needs to be examined in such a framework.

NOMINAL AND REAL EXCHANGE RATE BEHAVIOUR IN PAKISTAN

In 1960, at the start of the period under review, the Pakistani economy was

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working with a fixed exchange rate regime. The nominal exchange rate (NER) was officially fixed at Pakistan Rs 4.762 against one US dollar. This official rate of exchange remained unchanged till 1972. In 1972-73 the rupee was devalued settling at Rs 9.90 against the one US dollar –a total devaluation of 130 percent. This new rate of exchange continued within the context of a fixed exchange rate regime till 1982.

In 1982, the policy-makers in Pakistan announced a break from the rupee's peg against the US dollar. A more flexible arrangement was announced whereby the rupee was to be pegged to a basket of major currencies rather then the existing bilateral peg with the US dollar. The official flexible arrangement seems to be no more than a cover for regular devaluations. As the data show, the rupee has been devalued consistently since 1982. However, in no year has the devaluation been as high as the 1972-73 experience.

We have defined the real exchange rate as nominal exchange rate times the ratio of the price of tradable to non-tradable.

$$RER = E\,[PT^*/PN] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

We would follow the convention of using the wholesale price index (WPI) of a large economy as a proxy for the price of tradable variable in our definition of the real exchange rate. The assumption here is that the WPI has a significantly higher proportional content of tradables as against non-tradables. The WPI of choice is that of the United States. This can be justified by the size of the US economy and the bilateral exchange rate arrangements made with the US dollar by most small economies.

The price of non-tradables will be proxied by the domestic consumer price index (CPI). The assumption being that the CPI is weighted heavily by non-tradable goods and services.

$$RER = E\,[WPI(US)/CPI] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

It will be appropriate to look at the RER for Pakistan in three distinct periods, the periods 1960–72, 1973–82, and 1983–1990. The first two periods have been associated with fixed exchange rate regimes; they are separated because of a major devaluation. Annual data have been used because quarterly data are not available for all the variables. Published data for Pakistan for all variables are only available for the period considered. As such, only 31 observations are used and this places a limitation on our analysis.

In 1960 Pakistan was following a fixed exchange rate regime. Figure 1 shows that from 1960 to 1971 the real exchange rate appreciated. After the devaluation of

1972-1973, the authorities continued with a fixed exchange rate regime at the post-devaluation rate of exchange. Figure 1 shows that for both periods of fixed exchange rates significant movement took place in the RERs. This suggests that factors other than the NER seem to be driving the RER in Pakistan.

In 1982 the government announced a change of regime, from a fixed exchange rate to a flexible exchange rate. The 1982–1990 period has witnessed depreciating real exchange rates. This period has also witnessed many regular small devaluations.

The flexible exchange rate regime, which has been in place since 1982, seems to have overcome the problem of real exchange rate overvaluation by a steady stream of nominal devaluations. But this method does not address the structural problems in the economy which are causing the movement towards overvaluation in the first place. We need to look at changes in the determinants of the equilibrium real exchange rate to understand where the pressures towards overvaluation are coming from.

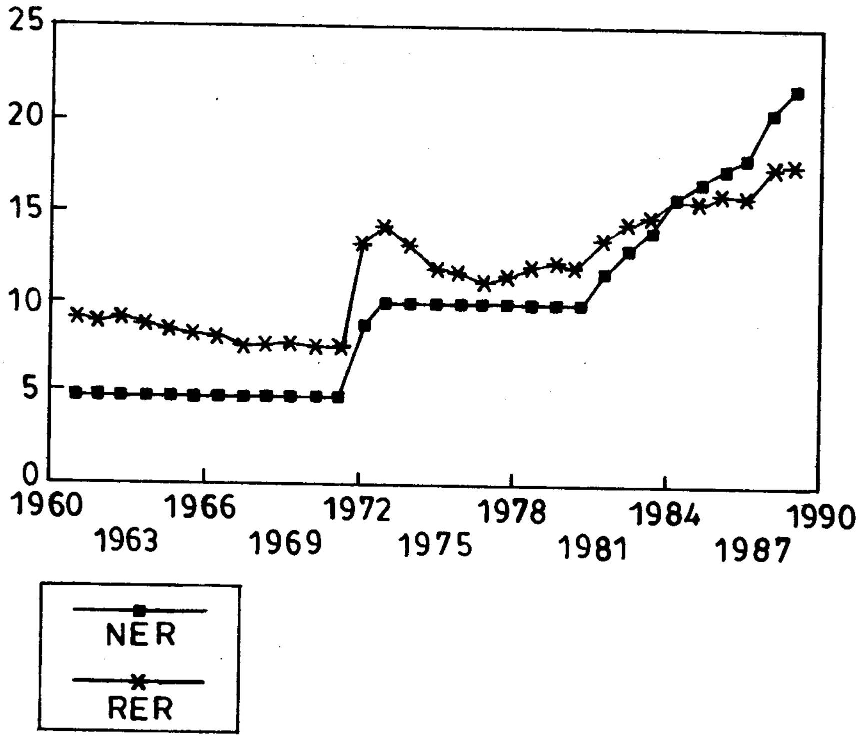

Fig. 1. Nominal and Real Exchange Rates in Pakistan (1960–1990).

FRAMEWORK FOR DERIVING THE REAL EXCHANGE RATE EQUATION

The path of the small open economy's real exchange rate can be influenced by the following determinants/fundamentals, both temporarily and permanently.

External Terms of Trade

Terms of trade can be represented by the relationship of the external relative price of exportables to importables.

$$TOT = P[X^*]/P[M^*] \quad \ldots \quad (3)$$

TOT = Terms of trade.
$P[X^*]$ = Foreign price of exportables.
$P[M^*]$ = Foreign price of importables.

It is important to point out that changes in the terms of trade will have both income and substitution effects on the real exchange rate.

It is not a foregone conclusion that terms of trade depreciation would always cause an exchange rate depreciation. The result would depend upon the relative importance of income and substitution effects; also on the composition of the deterioration in trade, i.e., whether it is coming from increases in the price of importables or decreases in the price of exportables.

Government Consumption

Change in the level of government consumption as well as its composition would have an effect on the path of the equilibrium real exchange rate.

An increase in the consumption of non-tradables would lead to an increase in their demand and price, causing both income and substitution effects.

Data on government consumption of non-tradables is not easily available. The proxy of the ratio of total government consumption to the gross domestic product is commonly used to substitute for government consumption of non-tradables [Edwards (1989)].

$$GC_1 = GC/GDP \quad \ldots \quad (4)$$

GC = Government expenditure.

GC_1 is not a good proxy for government consumption of non-tradables. We have mentioned earlier the difficulty associated with the availability of data for most developing countries on government consumption of non-tradables.

We aggregate government expenditure on education, health, transport and communications, housing, rural development, and social welfare. This aggregate we proxy as a measure of government expenditure on non-tradables. Thus, we define a new variable.

$$GC_N = GCNT/GDP \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (5)$$

$GCNT$ = Government expenditures on non-tradables.

It may be pointed out that in no earlier study estimating the real exchange rate equation has a series for GC_N been used.

Capital Movements

Changes in the extent of capital movements would affect the flow of capital. An increase in capital controls would reduce capital inflows and would appreciate the equilibrium real exchange rate. It is important to point out that the extent of the effect on the equilibrium real exchange rate would depend on whether more of capital inflows are spent on non-tradables as against importables or vice versa.

Net capital inflows, which are spent on importables, would have no effect on the real exchange rate directly. If capital inflows are spent on non-tradables, then foreign currency must be converted into local currency. The resulting increase in domestic money supply would cause an increase in the price of non-tradables, causing an appreciation of the real exchange rate.

A perfect proxy for capital controls is difficult to establish. Different ratios of capital flows to the GDP have been used in the literature. Edwards (1989) uses the lagged ratio of net capital flows to the GDP. Schafer (1989) defines net capital flows as net borrowing and uses its proportion to the GDP as a proxy for capital control.

For our purposes, we would define the following variables for capital control:

$$CAP_1 = [NFB + TRAN + AID + NFIFA] \,/\, GDP \ldots \quad \ldots \quad \ldots \qquad (6)$$

$$CAP_2 = [NTP + NTO + NDFI + NPI + LTCI + STCI] \,/\, GDP \quad \ldots \qquad (7)$$

CAP = Net capital inflow as a proportion of the GDP.
NFB = Net foreign borrowing.
$TRAN$ = Transfers.
AID = Disbursement of foreign aid-debt servicing.
$NFIA$ = Net factor income from abroad.

NTP = Net transfers private.
NTO = Net transfers official.
$NDFI$ = Net direct foreign investment.
NPI = Net portfolio investment.
$LTCI$ = Long-term capital inflow.
$STCI$ = Short-term capital inflow.

Though we have constructed the series for both equations, we do most of our estimations with Equation 7 and its lagged value.

Commercial Policy

This variable will be used to proxy the degree of "openness" in the domestic economy. Cottani, Cavallo and Khan (1986) have used the openness variable to measure the distortions in trade policy.

Trade policy restrictions such as tariffs, taxes, subsidies, and quotas reduce the degree of openness. Reduction in openness increases the gap between the free trade domestic price for tradables and the actual domestic price for tradables.

We shall use two variables to measure the degree of openness in the economy. The ratio of the GDP to the sum of exports and imports (trade) will be one such measure. The ratio of tariff on international trade to the sum of exports and imports will be the other measures.

$$CP_1 = GDP/X + M \quad \ldots \quad (8)$$

$$CP_2 = TINT/X + M \quad \ldots \quad (9)$$

CP = Commercial policy.
X = Exports.
M = Imports.
$TINT$ = Tariff on international trade.

A reduction in openness would imply an increase in the value of both CP variables defined above.

If the economy follows a significant import-restricting policy by way of an increased import tariff, then we would have a reduction in imports. In the case of both CP_1 and CP_2, an increase of value will take place, implying a reduction in openness. A higher resulting price of imports would cause the price of non-tradables to increase (via the mechanism described earlier). As the price of tradables is exogenous, the real exchange rate would appreciate.

If a reduction in openness takes place via an increase in export tariffs, then the production of exports will fall. With factors of production moving to the non-tradables sector, the price of non-tradables would fall and the real exchange rate would depreciate. However, as a result of the decrease in exports, a deficit would occur on the current account balance. This would result in import restrictions and/or foreign exchange rationing. The price of imports would increase and, as a result, the price of non-tradables would also increase. The new equilibrium price of non-tradables would depend on the elasticities of demand for imports and non-tradables and the supply elasticity of non-tradables. From an increase in export tariff, we cannot predict the effects on the real exchange rate. Increase in import tariffs would, however, unambiguously cause appreciation the real exchange rate as we have discussed earlier.

Supply of Domestic Credit

We would define excess supply of domestic credit (EXDC) as domestic credit creation in excess of devaluation, foreign inflation, and real GDP growth. We assume here that the velocity of money is constant. EXDC has an inflationary impact because if it is positive, then the increase in domestic credit or money supply is out of proportion to real output and the prevailing price level. The excess money is spent on both non-tradables and tradables. With the price of tradables being exogenous to the system, the price of non-tradables is driven up, which causes real exchange rate appreciation. Higher prices of non-tradables discourage the production of non-tradables and cause a movement of factors of production to the tradables sector.

Most developing countries exercise significant control over the nominal exchange rate even when they profess to have flexible exchange rates. Usually, the expansion of domestic credit is the instrument of choice to finance fiscal deficits. With a consistent increase in domestic credit, it is not possible to sustain a constant level of RER over the long run, because consistent high EXDC would lead to a fall in reserves and create the pressure for a devaluation of the domestic currency. However, if the exchange rate is fixed, an appreciation could be observed for the real exchange rate in the short run.

$$EXDC = [GDC - TECH_1 - INFL^* - DEV] \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

$EXDC$ = Excess demand for domestic credit.
EDC = Growth in domestic credit.
$TECH_1$ = Real growth of the GDP.
$INFL^*$ = Foreign inflation.
DEV = Devaluation.

Technological Change

Balassa (1964) provided a formal framework to examine the relationship between economic growth and the equilibrium relative price of tradables to non-tradables, although Ricardo and others had earlier postulated a negative relationship between economic growth and the relative price of tradables to non-tradables. Balassa made the case that the rate of productivity growth is higher in countries experiencing a higher rate of growth than in those countries experiencing a somewhat slower rate of growth; also, that the improvements in productivity are greater in the tradable goods sector, as against the non-tradable goods sector. The implication is that the equilibrium relative price of tradables to non-tradables will be declining over time, assuming that we are experiencing positive growth. In such a case, the real exchange rate would be appreciating.

Improvements in technology can be product-augmenting or factor-augmenting. Technological change will also be different across sectors. There can be different effects on the equilibrium real exchange rate, depending on the state of the above. Improvements in productivity have positive income effects, generating an increase in the demand for non-tradables. The resulting increase in the price of non-tradables would appreciate the real exchange rate.

Supply effects also result from technological progress. If the change is factor-augmenting, then the Rybczynski theorem would apply, as in the case of the exogenous increase in factor-availability. In the case of product-augmenting technological change, it is possible that the supply effects dominate the demand effects of technological improvement. Improvements in the supply of non-tradables to the extent of excess supply would cause a fall in the price of non-tradables and cause a depreciation of the real exchange rate.

Measuring technological change is not easy. Edwards (1989) uses the GDP growth rate as a measure of technological change. Implicit in this is the assumption that growth is taking place in the tradables sector. Edwards does, however, mention the shortcomings of this proxy. Schafer (1989) uses per capita growth rate as a measure of technological change. Cottani, Cavallo and Khan (1990) use a time variable in their regressions to capture the residual trend and attribute that to technological change in the tradables sector.

We cannot be satisfied with any of the proxies used, in the studies reviewed by us, to represent growth attributable to technological change. None of them exclusively captures the path of technological change, as the effects of other factors are not eliminated in the computation. Therefore, we may introduce another measure for technological change in the real exchange rate equation for developing countries. We would measure technological change from the Solow residual method, which is also called the multifactor productivity growth, or that part of growth which cannot be explained by the growth of capital or of labour. We have used tables prepared by Siddiqui (1992) for this purpose.

We define as follows the variables discussed in the above paragraphs.

$TECH_1$ = GDP growth rate ... ... (11)

$TECH_2$ = Growth rate attributed to technological change from measuring multifactor productivity growth ... ... (12)

$TECH_3$ = Per capita GDP growth rate ... ... (13)

T = Time trend to capture the residual from the real exchange rate equation, the residual being attributed to technological change (14)

For the purposes of our estimation, we shall basically use $TECH_2$; however we shall estimate also with the other proxies for purposes of comparison.

Fiscal Deficit Ratio

As a measure of fiscal policies, we would use the ratio of fiscal deficit to lagged high power money. We would expect this variable to affect the real exchange rate negatively. An increase in the ratio would cause appreciation of the real exchange rate, given that all other variables are stationary. An overvaluation of the real exchange rate would be the outcome, and the pressures for devaluation would increase, given our old assumption of exogenous terms of trade, the price of tradables, and the rigidity of the nominal exchange rate,

$DEH = DEF/HM$ ... ... (15)

DEH = Ratio of fiscal deficit to high-powered money.
DEF = Fiscal deficit.
HM = High-powered money.

We shall also look at the effects of the following variables being incorporated in the real exchange rate equation.

$INVGDP = INV/GDP$... ... ... (16)

$RGDC$ = Real growth in domestic credit ... ... (17)

$GNER$ = Devaluation of the nominal exchange rate ... ... (18)

$$PCGDP = PC/GDP \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (19)$$

Where INV = Investment, PC = Private consumption.

ESTIMATING THE REAL EXCHANGE RATE EQUATION FOR PAKISTAN

We estimate first the following equation:

$$PER = a_0 + a_1TOT + a_2CAP_2 + a_3[CP_1] + a_4EXDC + a_5TECH_2 + a_6GC_N + D_5 \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (20)$$

The variables have all been defined and explained earlier. For convenience we list them again.

PER = Real exchange rate.
TOT = Terms of trade.
CAP_2 = Capital flows as proportion of the GDP.
CP_1 = Openness variable, a measure of commercial policy. Ratio of the GDP to the sum of exports and imports.
$EXDC$ = Excess demand for domestic credit.
$TECH_2$ = That part of growth which is attributable to technological change.
GC_N = Government consumption of non-tradables/GDP.
D_5 = Dummy variable for different exchange rate regimes.

Equation 20 represents the basic fundamentals which determine the path of the real exchange rate. We have suggested other variables which could also influence the equilibrium real exchange rate. Alternative proxies for measuring openness, technological change, and government consumption of non-tradables have also been used.

The results of the basic Equation 20 and also those of other equations, where more determining variables are added and alternative proxies are incorporated, are presented in Table 1. We have made estimations considering both the real and the monetary variables together and separately.

The results suggest that the basic model has satisfactory explanatory powers. The R^2 are satisfactory. The Durbin-Watson statistics, though not very strong, still do not indicate a degree of auto-correlation, which would have been of concern.

The TOT variable was not statistically significant in any of our regressions, implying a negligible impact of changes in TOT on RER. However, the positive sign observed requires an explanation. We were expecting an unambiguous negative sign for the coefficient of the TOT variable, which would have lent support to the popular view that deteriorating terms of trade cause a depreciation of the real exchange rate. As it has been pointed out, the argument is true only if the income effect dominates. If the substitution effect of the deteriorating terms of trade dominates the income effect, as in the case of the increase in the price of importables, then a reduction in quantity demanded of importables would result. The substitution effect would increase the demand for non-tradables, increasing the price of non-tradables and causing an appreciation of the real exchange rate.

Table 1

Regression Results of the Real Exchange Rate Equation

	20[a]	20[b]	20[c]
INTERCEPT	15.13[7.34]*	3.52[1.71]	3.95[5.55]*
TOT	0.002[0.19]	0.007[1.29]	0.007[.79]
CAP/GDP	–0.17[–2.01]*	–0.003[–0.06]	
$[CAP/GDP]_{t-1}$			–0.245[–2.10]*
EXDC	–0.05[–4.18]*	–0.023[–2.30]*	–0.062[–3.62]*
CP_1	–0.014[–5.82]*	–0.006[–2.03]*	
GC_2			–0.173[–2.03]*
GC_{NT}	0.90[3.61]*		
GC_1		0.153[2.61]*	0.423[4.79]*
INV/GDP			0.140[1.42]
$TECH_Q$	–0.041[–1.01]	0.04[0.02]	–0.061[–1.69]
DEH		–0.004[–0.66]	–0.023[–2.87]*
$[RER]_{t-1}$		0.626[5.40]*	0.751[7.85]*
NOMDEV		0.081[7.39]*	0.08[6.42]*
D_5	3.61[9.26]*	0.726[1.96]*	.303[1.98]*
R^2	.96	.99	.99
ROOT MSE	.715	.314	.313
DW	1.45	1.92	1.85

t-statistics are given in parenthesis.
* Indicates that the coefficients are statistically significant at the 5 percent level of significance.

Although terms of trade have not displayed a very clear or significant trend in Pakistan in 1960–1990, yet it seems that the substitution effect of the change in the price of importables has dominated the income effect.

The coefficient for CAP (both current and lagged) variable was found to be negative and statistically significant in most estimations. This implies that an increase in the capital flow as a percentage of the GDP would result in an appreciation of the real exchange rate. A one percent increase in the capital flow (i.e., CAP/GDP or $(CAP/GDP)_{t-1}$) would appreciate PER by .17 percent to .245 percent.

Both of our openness variables CP_1 and CP_2 were found to be significantly negative in all estimations. A one percent increase in the GDP to total trade ratio is associated with the appreciation of the real exchange rate by 0.014 percent.

The variable for excess supply of domestic credit (EXDC) was negative and significant for all regressions. A one percent increase in the supply of domestic credit appreciates the real exchange rate by 0.05 percent. This variable suggests the pattern of macroeconomic policies for the country under consideration. Excess supply of domestic credit in any amount greater than zero would cause a disequilibrium situation and would contribute towards an overvaluation of the real exchange rate. The coefficients representing this variable are small; they suggest, nevertheless, a significant contribution to disequilibrium over time.

Earlier studies which examined real exchange rates found contradictions to the Balassa effect. The blame can be assigned to the choice of proxies. We believe that the GDP growth, the per capita GDP growth, and a time trend are not very good proxies of technological change.

We have also estimated government expenditures on non-tradables (GC_{NT}). Earlier studies proxied this variable with total government expenditure. The coefficient of this variable was found to be positive and statistically significant. Changes in government expenditures will affect the equilibrium real exchange rate through two channels. We assume first that an increase in government expenditure on non-tradables is financed through an increase in public debt. Then the first effect of the increase in government expenditure would be an increase in the price of non-tradables, leading to an appreciation of the real exchange rate. However, the financing of the increased spending would require increased government borrowing. This would reduce income, causing a reduction in the demand for non-tradables in the private sector, reducing the price of non-tradables, and causing a depreciation of the real exchange rate. The overall effect would depend on the relative dominance of the income or substitution effects. In our estimations, the income effect seems to dominate as one percent increase in GC_{NT} leads to 0.9 percent increase in RER.

It is important to look at the source of financing of government expenditure, whether the increases in expenditure are financed by increased borrowing or by more taxes. Since 1981 the Government of Pakistan has imposed a special *zakat* tax (2.5 percent annually on wealth). Revenues from this tax are earmarked exclusively to be spent on what we have aggregated as expenditures on non-tradable goods. It is important to note that such a tax would reduce income on a broad base.

Since 1984 the Government of Pakistan has also imposed a 5 percent education surcharge on all imports and exports. All revenue from this surcharge is earmarked for expenditure on public education (a non-tradable good).

The ratio of government expenditure to the GDP has been constant or declining from 1980 onwards, and, at the same time, the increased proportion of the financing of these expenditures can be attributable to new taxes. The fact that new taxes were imposed specifically for the purpose of financing of these expenditures provides credibility to the sign observed on the coefficient of government expenditures on non-tradables.

The coefficient for the fiscal deficit ratio (DEH), when included, was negative and, in some cases, significantly so. This suggests that when the ratio of fiscal deficit to high-powered money increases, the real exchange rate appreciates. In the case of a fixed exchange rate, this would result in an overvaluation of the real exchange rate.

In some regressions, we have also included the nominal devaluation variable. The coefficient for this variable has been observed as significantly positive. The size of the coefficient is large, suggesting that nominal devaluations can be used as a useful tool for correcting overvaluation from the equilibrium real exchange rate temporarily. For long-run equilibrium, it would require elimination of the original sources of disequilibrium. In terms of our model, EXDC and DEH would need to be equal to or less than zero.

In the regressions, where they have been included, the coefficients of lagged real exchange rate have been found to be positive and significant. The high values of these coefficients suggest that, with other things being constant, real exchange rates converge rather slowly on their long-run equilibrium.

CONCLUSIONS

Our results and conclusions are different from those drawn from earlier empirical studies on real exchange rates for developing countries. This has been due to the fact that we have redefined some of the determinants of the RER and have also provided improved proxies. We have shown that some of the proxies used in earlier studies were not satisfactory and could also be misleading. Our choice of proxies for technological change and government expenditures on non-tradables is a definite improvement on the earlier approximations.

The choice of doing a single-country study also enabled us to examine the influence of different sets of domestic policies on RER behaviour. Such a study (instead of a multi-country study) also allowed us to increase the number of observations. The time-period (1960–1990) considered by us was twice as much as observed by some of the studies reviewed by us.

The results obtained by us are also different from those of the earlier studies. We do not find any significance for the terms-of-trade variable. The coefficient was positive, and the sign insignificant, in most observations–contrary to what was observed in earlier studies. Thus we offer an explanation on the basis of structural conditions and fiscal policies in the country. The sign on the government expenditure on the non-tradables coefficient was also positive, contrary to conventional theoretical expectations. We have offered an explanation for this observation on the basis of structural conditions and the financing of government expenditures on non-tradables.

We find that our proxy for technological change does not reject outright the Balassa effect as all the other studies reviewed by us have done; a better specification of the technology variable has given us this result.

We have clear unambiguous conclusions from the other variables (something not observed in other studies). Excess demand for domestic credit, capital flow as a proportion of the GDP, and the "openness" variable (the GDP/X + m variable) are all inversely related to the RER.

This paper has thoroughly re-examined the determinants of the real exchange rate equation. And we have suggested alternative determinants, where appropriate. We have also improved some proxies for the determinants used in the earlier studies while pointing out the weaknesses of the multi-country approach to empirical studies of real exchange rates.

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