

## **Framework for Deriving Real Exchange Rates**

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### **INTRODUCTION**

In the last conference we presented a study on Purchasing Power Parity (PPP) and Real Exchange Rates (RER). One of the conclusions we reached was that a PPP-based measure of the RER did not give sufficient insight into the structural problems underlying disequilibrium situation for Real Exchange Rates.

We present a review of recent studies which model the path of Real Exchange Rates determined by sets of determinants. These determinants are usually difficult to quantify and are often represented by proxies. We have reservations about both the choice of some determinants and also appropriateness of the proxies used to represent them.

The purpose of this paper is to critically evaluate frameworks for determining real exchange rates in developing countries. We would suggest a basis for estimation of RER and its equilibrium path.

### **REVIEW OF RECENT STUDIES IN DETERMINING REAL EXCHANGE RATES**

The long-term trend in the real exchange rate of selective countries has been presented by Wood (1988). Wood's empirical measurements of the real exchange rate are consistent with the Purchasing Power Parity concept. He has derived an econometrically testable model from the statistical measure of the real exchange rate. He explains the trend in the real exchange rate by the black market exchange rate discount ratio [an explanation for the difference between world market prices and domestic prices for traded goods, a consequence of commercial policy], the exports share in GDP [measure of openness], relative labour productivity, per capita income and the ratio of demand for nontraded goods to traded goods.

Cottani, Cavallo and Khan (1986) derive a reduced form equation for the real exchange rate as a function of policy and non-policy determinants. The real

exchange rate is defined according to the Purchasing Power Parity concept. Estimations are made for eight countries using annual data from 1961 to 1983. The explanatory variables are the terms of trade, an index for commercial policy, government consumption as a share in GDP, a money supply variable and a trend variable. OLS estimators, country by country, support the hypothesis that an increase in any of the explanatory variables causes a real exchange rate appreciation.

Edwards (1989) has been a major influence on work on determining real exchange rates for developing countries. He regresses the RER on a set of fundamentals/determinants, which are to a large extent represented by proxies. His choice of proxies is however questionable. For example he uses total government expenditures as a proxy for government expenditures on nontradables which is not acceptable. His proxy for technological change, is GDP growth rate, which includes growth that could also be attributed to labour and capital. He measures "openness", by the spread between the black market and official exchange rates. This proxy fails to capture the effects of other possible restrictions to trade. He measures excess demand for domestic credit by the difference between the rate of growth of domestic credit and the GDP growth rate. He thus ignores the effect of devaluation and foreign inflation. He has also made no assumption about the rate of change of velocity of money. He finds that both nominal and real variables have influenced the path of the real exchange rates in his 22 country study.

Cottani, Cavallo and Khan (1990) look at two groups of twelve low and high income developing countries for the period 1960–1983. Their model is similar to that of Edwards (1989), but they do not consider government expenditure on nontradables in their estimations. They also proxy a time trend to capture the contribution of technological change to growth. Which is unacceptable, because the residual may be picking up effects separate from that of technological change. About a third of the coefficients have the wrong sign from theoretical expectations. No attempt is made to evaluate the underlying endogenous conditions of individual countries, which contributed to some of the unexpected signs on the coefficients of variables.

Schafer (1989), using Edwards (1989) model examines real exchange rate behaviour of the countries of Sub-Saharan Africa [1970–1984]. He finds 60 percent of the coefficients for terms of trade, commercial policy and excess domestic credit creation to be negative and significant. The coefficients for net capital inflow are mixed. The coefficients for productivity growth [per-capita are mixed]. The coefficients for productivity growth [per-capita GDP growth] do not support the view that productivity growth leads to real exchange rate appreciation as suggested by

Ballasa (1964) and Samuelson (1964). We did not find Schafer's variables to have satisfactory explanatory power. He gives no explanation as to why a significantly high number of coefficients were giving results contrary to theoretical expectations. Structural conditions and domestic policies of individual countries needed to be examined.

### **EXCHANGE RATE POLICIES AND THE REAL EXCHANGE RATE**

In the early seventies with the breakup of the gold standard, the developed economies moved from fixed exchange rate regimes to more flexible arrangements. The developing countries also moved in the same direction though relatively slowly.

Pegging the domestic currency against a single major currency was the common practice for developing currencies in fixed exchange rate periods. After the mid seventies most developing countries moved towards pegging against a basket of currencies, or followed an arrangement where the domestic currency is frequently adjusted mostly in the downward direction, often called a flexible arrangement.

Aghelvi, Khan and Monteil (1991) using the IMF International Financial Statistics found that the proportion of developing countries which pegged to a single currency declined from 63 percent in 1976 to 38 percent in 1989. Those which preferred to peg to a basket of currencies increased from 13 percent in 1976 to 23 percent in 1989. The Countries following a flexible arrangement increased from 14 percent in 1976 to 33 percent in 1989.

The motivation to peg against a basket of currencies rather than a single currency, has to a large extent been due to the volatility in the exchange rates in major currencies ever since the advent of flexible exchange rates in the early seventies. Fluctuations in major currencies create problems for planners in developing countries. Uncertainty in trade, external debt, foreign exchange reserves and management of public finance are some of the problems.

Flexible arrangements, in exchange rate management in developing countries, are often officially described as adjusting to market conditions independently. However in almost all cases the exchange rate is effectively set by the authorities and adjusted frequently.

Reliance on flexible arrangements has substantially increased in developing countries, which can be attributed to a number of factors. One reason is that the domestic rates of inflation in many developing countries particularly those of Latin America substantially increased in the 1980s. These countries were forced to

depreciate rapidly to maintain external competitiveness. In a number of such countries the nominal exchange rate and domestic inflation were systematically linked. Another reason has been the volatility in the exchange rates of major currencies. Though some countries decided to peg against a basket of currencies, others were reluctant because this would involve frequent adjustments of the exchange rate according to the prearranged formula. Many countries have been reluctant to follow the movements of major currencies which they considered to be transitory. A number of countries also found significant political difficulties with devaluation under a pegged regime. They have found it more expedient to have a more flexible arrangement where by exchange rates can be adjusted on the basis of an under closed basket of currencies. Thus affective devaluation can be camouflaged.

Exchange rate policies in developing countries are designed to maintain external competitiveness at a level consistent with a sustainable balance of payments position. A nominal devaluation would increase the price of tradables. A substitution effect towards nontradables would result, reducing demand for tradables and improving the current account position. Income and wealth effects would also result from the increase in the domestic price level.

As the real exchange rate is critical in maintaining competitiveness in the external sector, it should not deviate significantly from its equilibrium level.

### **EVALUATING THE DETERMINANTS OF THE REAL EXCHANGE RATE**

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 external relative price of exportables to importable.

$$TOT = P[X^*]/P[M^*]$$

$TOT$  = Terms of trade.

$P [X^*]$  = Foreign price of exportables.

$P [M^*]$  = Foreign price of importable.

It is important to point out that changes in 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. 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 effects on the path of equilibrium real exchange rate.

An increase in the consumption of nontradables would lead to an increase in its demand and price causing both income and substitution effects.

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

$$GC_1 = GC/GDP$$

$GC$  = Government expenditure.

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

We would suggest that an aggregate of government expenditure on education, health, transport and communication, housing, rural development and social welfare serve as a proxy for government expenditure on nontradables. We define a new variable.

$$GC_N = GCNT/GDP$$

$GCNT$  = Government expenditures on nontradables.

This proxy variable is expected to be more closely related to government consumption of nontradables. However, in the absence of earlier empirical evidence it is difficult to indicate the direction of bias in the estimates.

### 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 is spent upon nontradables as against importable 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 nontradables, then foreign currency must be converted into local currency. The resulting increase in domestic money supply would cause an increase in the price of nontradables, causing an appreciation of the real exchange rate.

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

We would define the following variables for capital control for our purposes.

$$CAP1 = [NFB + TRAN + AID + NFIFA]/GDP$$

$$CAP2 = [NTP + NTO + NDFI + NPI + LTCI + STCI]/GDP$$

*CAP* = Net capital inflow as a proportion of GDP

*NFB* = Net foreign borrowing .

*TRAN* = Transfers.

*Aid* = Disbursement of foreign aid-debt servicing..

*NFLA* = 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.

## 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 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 suggest two variables to measure the degree of openness in the economy. The ratio of GDP to the sum of exports and imports [trade] is one such measure.

The ratio of tariff on international trade to the sum of exports and imports is another measure.

$$CP_1 = GDP/X + M$$

$$CP_2 = TINT/X + M$$

$CP$  = 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 the way of increase in import tariffs, 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. Higher resulting price of imports would cause the price of nontradables 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 production of exports will fall. With factors of production moving to the nontradables sector, the price of nontradables would fall. The real exchange rate would depreciate. However as a result of the decrease in exports, a deficit would occur on the currency 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 nontradables would also increase. The new equilibrium price of nontradables, would depend upon the elasticities of demand for imports and nontradables and the supply elasticity of nontradables. From an increase in export tariff, we cannot predict the effects on the real exchange rate. Increase in import tariffs would however unambiguously appreciate 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 nontradables and tradables. With the price of tradables being exogenous to the system, the price of nontradables is driven up. The real exchange rate appreciates. Higher prices of nontradables discourages the production of nontradables 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 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 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.

$$EXDC = [GDC - TECH1 - INFL\# - DEV]$$

*EXDC* = Excess demand for domestic credit.

*GDC* = Growth in domestic credit.

*Techn1* = Growth of Real 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 nontradables. Though Pigou (1922) and others had postulated a negative relationship explicitly earlier, between economic growth and the relative price of tradables to nontradables.

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 nontradable goods sector. The implication being, that the equilibrium relative price of tradables to nontradables will be declining over time, assuming that we are experiencing positive growth. The real exchange rate would in such a case be appreciating.

Improvements in technology, can be product augmenting or factor augmenting. Technological change will also be different across sectors. Depending on the



above, we can have different effects on the equilibrium real exchange rate. Improvements in productivity have positive income effects generating increase in the demand for nontradables. The resulting increase in the price of nontradables 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 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 nontradables to the extent of excess supply would cause a fall in the price of nontradables and cause a depreciation of the real exchange rate.

Measuring technological change is not easy. Edwards (1989) uses GDP growth rate as a measure of technological change. Implicit 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 are not satisfied with each 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.

We would 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, also called multifactor productivity growth, or that part of growth that cannot be explained by growth of capital or growth of labour. Siddiqui (1991) has prepared a series for developing countries.

We define the following variables which we have discussed in the paragraphs above.

*TECH1* = GDP growth rate.

*TECH2* = Growth rate attributed to technological change from measuring multifactor productivity growth.

*TECH3* = Per capita GDP growth.

*T* = Time trend to capture the residual from the real exchange rate equation. The residual being attributed to technological change.

### Fiscal Deficit Ratio

As a measure of fiscal policies we would use the ratio of fiscal deficit to lagged high powered money. We would expect this variable to negatively effect the real exchange rate. 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 pressures for devaluation would increase, given our old assumption of exogenous terms of trade, price of tradables and rigidity of the nominal exchange rate.

$$DEH = DEF/HM$$

*DEH* = Ratio of fiscal deficit to high powered money.

*DEF* = Fiscal deficit.

*HM* = High powered money.

It would also be interesting to look at the effects of the following variables being incorporated in the real exchange rate equation.

$$INVGDP = INV/GDP$$

*RGDC* = Growth in real domestic credit.

*GNER* = Devaluation of the nominal exchange rate.

$$PCGDP = PC/GDP.$$

Where *INV* = Investment, *PC* = Private consumption.

The *RER* equation could then be represented as:

$$RER = a_0 + a_1TOT + a_2CAP + a_3[CP] + a_4EXDC + a_5Tech_2 + a_6GC_N + D_5 \dots \dots \dots \dots \dots \dots \dots \dots \quad (1)$$

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

*RER* = Real exchange rate.

*TOT* = Terms of trade.

*CAP* = Capital flows as a proportion of GDP.

*CP* = Openness variable, a measure of commercial policy.

*EXDC* = Excess demand for domestic credit.

*Tech<sub>2</sub>* = That part of growth which is attributable to technological change.

*GC<sub>N</sub>* = Government consumption of nontradables/GDP.

$D_5$  = Dummy variable for different exchange rate regimes.

The above equation would then represent the basic fundamentals which determine the path of RERs. All the variables, except *EXDC*, in Equation (1) represent long term changes in *RER*, which is closely related to the concept of equilibrium real exchange rate (*ERER*). *ERER* can be estimated as a five year moving average of estimated *RER* adjusted for temporary deviations caused by *EXDC* or other such variables if included in Equation (1)

### CONCLUSION

We have looked at the *RER* equation redefining some of the determinants and suggesting improvements in the choice of proxies.

We suggest a basis for the estimation of *RER* and determining its equilibrium path.

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## Comments on “Framework for Deriving Real Exchange Rates”

Having reviewed the paper, it is my opinion that the estimated value of real exchange rate is determined by the following: choice of explanatory variables, measurement of the variables, specification of the model, and the method of the estimation of the model. Throughout the paper however, the authors appear to be concerned with the measurement method of explanatory variables only. A casual reference is made to the choice of the variable being one of the objective for writing this paper. However, not much detail is provided in this regard. As an example, while writing their model Equation (1) authors did not indicate how this model is different from the one suggested by Cottani, Cavallo and Khan (1986). In addition, no comparison is made with most recent studies (in Pakistani context) by Chishti and Hasan (1993). Since this analysis deals only with the measurement problem of the key economic variable, it can be considered just as an exercise which determines the sensitivity of the results to the alternative measurement of the variables.

Let me elaborate on the problem with measurement of variables. I do not see any problem with the standard arguments presented in the present paper. It is often the case that more than one method exists for measurement of the variables. In this paper authors themselves have proposed two methods;  $(GDP/(X + M))$  or Tariff on international trade/ $(X + M)$  for evaluating openness of the economy. Economists such as Turnovsky (1981), on the other hand, have measured the degree of openness by taking the ratio of expenditure on domestic good to total gross national product of the country. Also, the authors argue that the degree of capital movement can be captured by either  $CAP1$  or  $CAP2$ . They do not indicate how they will determine the real exchange rate. In such circumstances, I feel that all we can do is perform some sensitivity test by taking different definitions of the variables and examine the sensitivity of the results to these alternative definitions.

Another limitation I would like to point out is that a single equation model suggested in this paper is quite arbitrary. It is a fact that the variables which determine the real exchange rate are correlated to each other. I believe that the reduced form of the model should be derived from a more realistic macro-economic model which specifically deals with the demand-side and the supply-side effects of

the exchange rate. A model developed by Fisher (1989) can be of great help in this case. Similarly, we should keep in mind the role of expectations regarding exchange rate and the money supply in determining the real exchange rate. In this respect the models developed by Turnovsky (1981) and Edwards (1986) are worth reading. Likewise, the authors should explore different techniques for estimating the model. A simple OLS method may not seem appropriate because of the possibility of multi-collinearity problem.

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