SOME IMPLICATIONS OF REAL EXCHANGE RATE TARGETING IN INDIA

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Abstract

The paper examines some macroeconomic implications of exchange rate policy against the broader backdrop of structural adjustment programmes. In particular, the evolving implications for inflation and the real interest rate arising from short-run policies regarding the real exchange rate (RER) are analysed for the Indian economy, which is undergoing cautious but substantial liberalisation of financial markets and the external sector. The paper also investigates the role of important macroeconomic (behavioural and policy) variables in explaining the long-run movements of the RER in India.

JEL classification: F41.

Foreword

Most countries today view high export growth as critical for their development efforts. Consequently, nominal exchange rates are often formulated with a view to targeting some real exchange rate that will make exports competitive.

In the wake of the South-East Asian crisis, India's exports are likely to come under increasing competitive pressure as these economies recover from the post-crisis liquidity squeeze to fully exploit the benefits from their sharply depreciated currencies. Exchange rate management and real exchange rate targeting are likely, therefore, to acquire greater importance than usual for policy makers in India in the coming months.

A policy of real exchange rate targeting usually aims at controlling the level of real exchange rate either in an effort to keep it at a constant level in the face of domestic or external shocks or to achieve a different (typically more depreciated) level. However, despite government efforts to target the real exchange rate, it is also true that the real exchange rate is not a policy tool in the long run. Thus, real exchange rate targeting is only possible in the short to medium term; deviations from the long run equilibrium have macroeconomic costs. Specifically, policies of depreciating the nominal exchange rate to achieve more depreciated levels of the real exchange rate can lead to higher levels of inflation in the economy when capital mobility is low. In case of high capital mobility, these costs are manifest in higher real interest rates in the economy.

This paper by Urjit R. Patel and Pradeep Srivastava investigates the macroeconomic costs of real exchange rate targeting in India to assess the extent to which nominal depreciation can result in higher inflation or real interest rates in the economy. Since nominal depreciation can affect the real exchange rate only temporarily, the paper also analyzes the determinants of real exchange rate in India over the long run.

It is hoped that the rigorous analytical framework of this paper will help clarify the complex issues arising from exchange rate management in an open economy.

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SOME IMPLICATIONS OF REAL EXCHANGE RATE TARGETING IN INDIA

I. Introduction

Beginning with the Southern Cone countries of Latin America in the 1970s, structural adjustment programs have now been implemented in an overwhelming majority of countries worldwide. In India, structural reforms were initiated tentatively in the mid-eighties and more substantially following the external account crisis in 1991.[1.] The consequent transformation of the economy, resulting from increasing liberalisation of the external and financial sectors, is likely to pose new challenges for the Indian policy makers. This paper focuses on one such issue by analysing important links between exchange rate policies and domestic financial variables. A defining characteristic of the Indian reforms (and some earlier Asian experiments) has been the cautious pace of adjustment relative to the `shock therapy' of Eastern Europe or the rapid liberalisation undertaken in some Latin American countries. The Indian economy is currently on the threshold of full capital account convertibilty which will be a culmination of a process initiated as many as six years ago. This slow transition, therefore, provides an excellent opportunity to study the evolving links between the external economy and domestic financial variables. To that extent, the analysis presented here is also of some interest to many other countries that too are attempting similar adjustment towards greater integration into the global economy.

The importance of exchange rate management is related to the fact that the emphasis, in most structural adjustment programs, on boosting export-led growth by increasing the country's competitiveness has meant that exchange rate policies and the real exchange rates are increasingly viewed as critical determinants of a country's performance. When not fully flexible - as in most developing countries - nominal exchange rates are often formulated by governments with a view to target some real exchange rate (defined as the price of domestic goods relative to foreign prices). A policy of `real exchange rate targeting' usually aims at controlling the level of the real exchange rate, either in an effort to keep it at a constant level in the face of domestic or external shocks, or achieve a different (typically more depreciated) level (Calvo et. al. (1995)).

A good example of RER targeting is provided by Brazil where, since 1968, the nominal exchange rate was changed by small percentages at irregular intervals of time, depending upon the inflation differential between Brazil and the United States (Calvo et. al. (1995)). Other Latin American countries have also followed such rules: for example, Colombia between 1986 and 1990, and Chile between 1985 and 1992.

RER targeting does not appear to be confined to Latin American countries alone. In

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1. For comprehensive formal analysis and discussion of the crisis, and the reform programme undertaken in its aftermath, see Buiter and Patel (1992; 1997).

Table 1 below we present deviations of the nominal (bilateral) exchange rates from the PPP exchange rates for four Asian countries (Malaysia, Indonesia, Korea and China). The latter are computed as the ratio of nominal exchange rate times P^*(U.S. CPI) to P (the domestic CPI), and set equal to the actual value of the exchange rate in 1980. Values for the subsequent years are updated from this date onwards. It is found that China, Korea and Indonesia have aggressively sought to keep their currencies increasingly `undervalued' against the U.S. Dollar; in other words, compensating for higher inflation alone does not fully explain the extent of the relevant currency's decline in value. Malaysia, on the other hand, has kept its RER at a relatively constant level. For example, from 1987-1995, Malaysia maintained its currency at approximately 10% discount from the RER of 1980.

Table 2 presents similar data on the nominal (bilateral) exchange rate in India over the same period computed using the method above. It is seen that for most of the sample period, i.e., 1980/81-1996/97,[2.] the observed exchange rate was dramatically undervalued relative to the PPP exchange rates. This is more sharply evident in Figure 1 which shows the behavior of the real exchange rate in India using monthly data for 1980:1-1997:3.[3.] The nominal exchange rate and the PPP exchange rate are also shown in the same figure. Between 1980 and 1996, the RER in India has more than doubled. As noted above, this period has been characterized by substantial changes in policies, beginning in 1985 and accelerating in 1991. However, it can be seen that the gap between the nominal and the PPP exchange rates has widened steadily since 1981, with the period after 1987 showing a significant increase in the gap. This is, of course, linked to the large devaluations in 1991 and 1993. Thus, the rate of devaluation in India since 1981 has far exceeded the inflation differentials between India and the rest of the world, the latter proxied here by the US rate of inflation. This would be consistent with attempts by the government to target the RER and enhance India's external competitiveness.

Needless to say, the doubling of the RER does not by itself indicate targeting by the government. Indeed, one could argue it shows just the reverse: that the economy has been buffeted by adverse shocks that entail a depreciating RER for equilibrium, and that the government has passively allowed the shocks to pass through into the RER. However, it is difficult to conceive of such major adverse shocks to the economy in the past 15 years. In particular, for most of the 1990s, the monsoons have been good, price of oil stable, changes in external terms of trade relatively small, and fiscal deficits relatively conservative.[4.] Indeed the most significant shocks to the economy have been in the form of large-scale policy reforms in the 1990s. Following Dornbusch and Werner (1994), however one could argue that the trade and financial reforms undertaken in India should result in a stronger currency, i.e., a real appreciation. Finally, as seen during October 1995 to

2. The Indian financial year runs from April to March.

3. The monthly real exchange rate data pertaining to India, throughout the paper, is the inverse of the IMF index of the real effective exchange rate.

4. In comparison, especially, to the second half of the 1980s.

February 1996, the Reserve Bank of India (RBI) has not fought shy of aggressively seeking to maintain values of the rupee it has deemed appropriate. In response to intense downward pressure on the Rupee, the RBI undertook net sales of foreign currency of almost U.S.$ 1.7 billion during this period, along with complementary measures such as withdrawal of liquidity from the money market.[5.] Similarly, over the first half of 1997, the RBI bought more than U.S.$5 billion to prevent the Rupee's nominal appreciation. Implicit in such aggressive defense is a target exchange rate held "correct" by the monetary authorities. This policy commitment on part of RBI is also stated explicitly in its 1995/96 Annual Report as "(T)he broad objective of the exchange rate policy will be to ensure a reasonably stable real effective exchange rate".[6,7.]

Despite governments' efforts at targeting the RER, it is also true that the RER is not a policy tool in the long run (Edwards (1995)). In particular, nominal devaluations *per se* cannot alter the long run behaviour of the RER in the neoclassical framework. Examining the behaviour of real exchange rates in the aftermath of 29 devaluation episodes, Edwards (1989) finds that there are significant real effects one year after devaluation but these effects erode completely beyond the third year. Thus, targeting of the RER is only possible in the short to medium term, and the deviations from long run equilibrium have macroeconomic costs. In the long run, the RER depends upon real and financial fundamentals of the economy including government fiscal variables, levels of capital stock, total factor productivity, etc.

In this paper, we analyse both these issues related to the RER behaviour in the Indian context. Specifically, the analysis focuses on two primary questions: (i) what are the long run determinants of the RER? That is, what structural variables predicted by theory display a stable long-run relationship with the RER in India? And, (ii) what are the macroeconomic implications of RER targeting? As discussed later, RER targeting in the short run can lead to substantial increases in the rate of inflation or the real interest rates in the economy. The extent to which this is borne out by the Indian experience is evaluated empirically in this paper.

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5. RBI Annual Report 1995/96, p. 86.

6. Op. cit., p. 86.

7. Targeting the RER would also imply that inflation differentials between the domestic and world economy would precede changes in the nominal exchange rates. Consequently, for India we evaluated the incremental predictive content of inflation differentials for exchange rate changes using Granger tests of causality with the inflation level in the US as a proxy for world inflation. When the sample included the period 1963-1996, no significant evidence of Granger causality was found in either direction. For the period since 1985 only, inflation differentials show one-way Granger causality vis-à-vis the nominal effective exchange rates at 1% level of significance.

The outline of the paper is as follows. In the next section, we look at the short-run aspects of RER management and investigate the impact of RER targeting on the real interest rates and the rate of inflation in the economy. It is worth noting that the latter exercise is somewhat complicated by the fact that the period of substantial regime shift in policy stance covers only the previous 10 years or so. Our results should, in that sense, be viewed as preliminary in nature with the full evidence yet to be played out in the economy. In section III we look at the long-run aspects of RER behaviour in India by analysing the structural variables that display stable relationships with the RER. This is done by using cointegration analysis. Finally, section IV contains some concluding remarks and implications for policy.

II. Macroeconomic Impact of RER Targeting

Neoclassical theory suggests that, in an open economy, either the money supply or the nominal exchange rate can serve as a nominal anchor. Such an anchor is deemed necessary for macroeconomic stability since, in the long run at least, all nominal variables will converge to the pre-set rate of growth of either the money supply or the exchange rate. However, a consequence of RER targeting is that both the exchange rate and the money supply become endogenous. In other words, targeting the RER establishes a feedback from domestic inflation to the nominal exchange rate and, therefore, countries adopting such rules sacrifice the role of nominal exchange rate (and of the money supply) as nominal anchor. An obvious question, then, is what are the inflationary consequences of RER targeting? This question is of particular concern for policy makers in India given the polity's low tolerance for price increases, and it constitutes the focus of the analysis in this section.

A number of recent studies have analysed the inflationary consequences of RER targeting. Lizondo (1993), for example, uses a model with both domestic and foreign financial assets to show RER targeting leads to higher inflation since domestic inflation and the RER are linked through seigniorage or the inflation tax.[8] Specifically, the demand for non-traded goods depends positively on the real exchange rate (defined as the price of traded goods to non-traded goods) and real private wealth. Real private wealth, in turn, depends negatively on revenues from the inflation tax. The higher the inflation tax payments, the lower is the private sector demand for nontradables, and thus the higher is the real exchange rate that equilibrates the nontradables market. Hence, equilibrium in the nontradables market requires that the steady-state inflation rate be that which generates, through its impact on inflation tax revenues, a level of real private wealth which is consistent with the targeted real exchange rate. Thus, attaining a more depreciated RER requires higher inflation tax payments, which in turn implies a higher rate of inflation.[9]

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8. See also Montiel and Ostry (1991).

9. Implicit is the assumption that inflation elasticity of money demand is less than one (i.e., higher inflation implies greater inflation tax revenues), and that the seigniorage revenues are spent by the government on tradables goods.

If there is no capital mobility, it can also be shown using the same framework that a temporary depreciation of the currency can be achieved without significantly affecting the inflation rate, but instead resulting in higher interest rates. Thus, for example, the targeting of a more depreciated real exchange rate will require, for equilibrium in the nontradables market, a one-time increase in the price level with a concomitant decrease in household wealth. Subsequently, the ensuing current account surplus would be sterilised by the monetary authority by offsetting decreases in net domestic assets (i.e., sale of government bonds). This would result in higher rates of interest which would also mitigate the incipient excess demand pressures in the nontradables market.[10.]

An alternative mechanism is shown by Calvo et. al. (1995) to also lead to higher inflation in response to RER targeting. In particular, inflation affects the relative price of intertemporal consumption through changes in the nominal rate of interest. The nominal interest rate affects the price of consumption since money is required to buy goods. Hence, if inflation and thus the nominal rate of interest, are expected to be lower in future than today, the consumption of traded goods falls relative to the future. Since consumption of non-traded goods cannot change, because their output is assumed constant, the exchange rate depreciates to accommodate the lower consumption of traded goods. Therefore, targeting a more depreciated RER requires that inflation be higher today than in the future.

The main empirical implications of these theoretical models are twofold. First, since the impact of policy makers on the RER is only transitory, the behaviour of the RER will be characterised by temporary shocks that represent, *inter alia*, attempts at targeting.[11.] Second, if there is some degree of capital mobility in the economy, inflation will accelerate during periods in which the RER is depreciated relative to its permanent `steady-state' level. Otherwise, if there is no capital mobility, the impact will be on the real interest rates instead.

Although officially India, until recently, had a completely closed capital account, and even now it is only partially open, some capital flows have always taken place through the curb (informal or black) market. This is partially borne out by the difference in the value of the Rupee between the curb rate and the official rate. Some evidence for these rate differentials is provided in Table 3 where it can be seen that the premium in the curb market during some years was as high as 50 percent. However, the transactions in the parallel market need not only represent arbitrage between the domestic and international financial

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10. Note that household consumption in these models depends upon disposable income, interest rate and household wealth. The transmission mechanism described here is a modified version of that in Montiel and Ostry (1992) who postulate interest parity even in the absence of capital mobility and focus instead on parallel exchange rates.

11. Note that the RER can also be affected by other types of temporary shocks in the economy.

markets; it is widely believed that they also include repatriation of cash income and profit to evade taxes. The specific extent to which capital is mobile in practice in the Indian case is, therefore, an empirical issue.

Before undertaking the empirical analysis below, we check the time-series properties of the RER and inflation over the period 1980-1996. The results are presented in Table 4 and show that the RER, as expected, has one unit root.[12.] The rate of inflation, on the other hand, is a stationary variable with no deterministic trend, i.e., it is level stationary.

II.1 Relative Magnitude of Temporary Shocks to the RER

Using monthly data for the period 1980-1996, we use Cochrane's (1988) methodology to determine the relative importance of temporary and permanent shocks to the RER in India. This technique provides a measure of the persistence of shocks to a variable by examining the variance of its long differences. In particular, suppose that a variable y can be represented in the following manner:

$$Y_t = \mu Y_{t-1} + u_t, \text{ where } u_t \sim N(0,\grave{e}^2). \qquad (4.1)$$

Now if Y follows a pure random walk, then $\mu = 1$ and the variance of its n-differences grows linearly with the difference, i.e.,:

$$var(Y_t - Y_{t-n}) = n\grave{e}^2. \qquad (4.2)$$

If $\mu < 1$ and Y is a stationary process, the variance of its n-differences is given by:

$$var(Y_t - Y_{t-n}) = \grave{e}^2(1-\mu^{2n})/(1-\mu^2). \qquad (4.3)$$

The ratio $(1/n)var(Y_t - Y_{t-n})/var(Y_t - Y_{t-1})$ is equal to one if Y follows a random walk process and converges to zero if Y is stationary. If Y has both permanent and temporary components, the ratio will converge to the ratio of the variance of the permanent shock to the total variance of Y. Consequently, the closer that ratio is to unity, the lower is the relative importance of temporary shocks.

Table 5 summarises the findings of the application of the Cochrane procedure to the monthly RER series. It is found that temporary shocks are important in explaining the variance of the RER; they explain close to 30 percent of the variance. Therefore, we may safely conclude that temporary shocks play an important role in the behaviour of the RER in India. Note again that this methodology does not allow discriminating between the sources

12. The tests, which are explained in detail at the bottom of Table 4, are due to Kwiatkowski, Phillips, Schimdt and Shin (1992) and Phillips and Perron (1988). The former has stationarity as the null and the latter has a unit root as its null.

of these shocks. Consequently, not all of these temporary shocks can be attributed to `temporary policy shocks' such as devaluations; other shocks, such as to the terms of trade, for example, could also lead to temporary movements in the RER away from its permanent trend component.

II.2 RER Targeting and Rate of Inflation

We use two methods to assess the proposition that inflation will accelerate when the authorities attempt to depreciate the real exchange rate beyond its equilibrium level. In the first case, we test whether nominal devaluations used by authorities translate into changes in prices in the economy, i.e., the exchange rate `pass through' into domestic inflation. A positive finding, namely that there is significant exchange rate pass through would not allow much direct inference about the impact of real exchange rate targeting on inflation. However, a finding that exchange rate changes do not significantly affect the rate of inflation in the economy would suggest the likelihood that RER targeting may not be inflationary. As shown in the estimated regression below, this is indeed the case for our sample.

Pass-through Regressions of Inflation on Devaluation

$$\delta = \underset{(4.72)}{0.02^{*}} + \underset{(1.21)}{0.07}\ \Delta e - \underset{(-0.11)}{0.01}\ \Delta e_{-1} + \underset{(1.1)}{0.07}\ \Delta e_{-2}$$

$R^2 = 0.04$ DW = 1.88

and,

$$\delta = \underset{(4.4)}{0.02^{*}} + \underset{(1.69)}{0.09^{**}}\ \Delta e - \underset{(-0.67)}{0.03}\ \Delta e_{-1} + \underset{(1.75)}{0.09^{**}}\ \Delta e_{-2} - \underset{(-0.02)}{0.001}\ \Delta e_{-3} + \underset{(0.96)}{0.12}\ \delta_{-1} - \underset{(-4.54)}{0.49^{*}}\ \delta_{-2} + \underset{(0.31)}{0.03}\ \delta_{-3}$$

$R^2 = 0.32$ DW = 1.91,

where ð= rate of inflation; Äe=rate of depreciation; and figures in parentheses are t-statistics.

* Significant at 1% level of significance

** Significant at 10% level of significance

The first equation above shows the results of regressing inflation only on the current and lagged values of nominal exchange rate depreciation. Although there is no residual autocorrelation, the fit is quite poor with a low R-square and insignificant coefficients. In the second equation, we also include lagged values of inflation as explanatory variables. The result is a higher R-square and somewhat greater statistical significance of the coefficients of exchange rate depreciation. However, while lagged inflation is significant at 1% level of significance, the coefficients of depreciation are barely significant at the 10% level. These results are qualitatively similar for alternative specifications using different lag lengths for the right hand side variables and show that nominal depreciation has had little to no impact on the rate of inflation in India during the past 15 years.

A more direct method for testing the impact of RER targeting on inflation involves a two-step approach used, for example, by Calvo et. al. (1995). First, employing the Beveridge-Nelson technique, the exchange rate is decomposed into its `permanent' (or steady-state) component and `temporary' (or cyclical component).[13.] The identifying criterion for this technique is that the former captures the nonstationary component of the variable, while the latter captures its stationary element. Second, we examine the pairwise correlations between the cyclical component of the real exchange rate and inflation (which was also shown to be a stationary variable).

Since the inverse of the IMF index of the real exchange rate is used here, an increase in the index denotes a real *depreciation*. Thus, when the cyclical component is negative, the actual exchange rate is `overvalued' relative to its equilibrium steady-state level. Therefore, we should observe a positive correlation between inflation and the cyclical or temporary component of the real exchange rate. Table 6 presents estimated correlations between inflation and the RER, as well as its cyclical components. For the full sample, covering 1980-1996, inflation is positively correlated with both the RER and its cyclical component. The correlation, however, is significant only at 10% level of significance and is completely insignificant if we look at the period prior to the liberalisation

13. The trend-cycle decomposition of the RER was obtained using the Beveridge and Nelson (1981) technique as modified by Cuddington and Winters (1987). After appropriate differencing, the best fit for the monthly RER series was obtained from an ARMA (0,1) process.

reforms in the economy. These results are consistent with those of the pass-through regressions reported above. In contrast, however, the gradual opening up of the economy seems to have been accompanied by a greater correlation between inflation and the cyclical component of RER: for the post-reform period, the correlation is somewhat higher and significant at the 1% level of significance.

Overall, therefore, the results suggest a relatively benign trade-off between exchange rate targeting and domestic inflationary pressures at least over the pre-reform period. Combined with the earlier finding, that temporary shocks are important in explaining variability of the RER, we may safely conclude that India has had modest success in RER targeting, although this may be increasingly more difficult as the reforms proceed and the economy continues to open up. These findings also suggest that the official controls on capital flows have been relatively successful in preventing such flows in practice. Another reason why RER targeting has been successful vis-à-vis inflation lies in the fact that the nominal depreciations needed for the purpose of RER targeting have been relatively small since the underlying inflation rate in India has been low in comparison with many other developing countries. Futhermore, the recourse to running the printing presses for residual financing of the fiscal deficit has been modest in India in comparison to, say, some Latin American countries, which also happen to actively pursue a policy of maintaining PPP by continually changing their nominal exchange to correct for higher inflation.

II.3 RER Targeting and Real Rate of Interest

Given lack of major impact on inflation in India, has targeting the RER affected the real rates of interest instead? The theoretical framework discussed earlier suggests that, absent high capital mobility, real interest rates would increase if the RER is depreciated aggressively. This is indeed the case in India for the period since 1992, as reported in Table 7. It is found that the correlation between the cyclical component of the real effective exchange rate and the real interest rate is reasonably high at 0.36.[14] Since the sample is too small to determine whether or not the real rates of interest display a unit root, Table 7 presents correlation of temporary component of RER with both the level of real interest rate as well as its deviations from a deterministic trend. The latter is also found to be quite high at 0.40; both correlations are significant at 1% level of significance.

In sum, therefore, as would be expected in a relatively closed economy, the impact of RER targeting has been less on inflation and more on the real rates of interest. In evaluating the impact of RER on real interest rates, the period since 1992 was used because it coincided with the onset of financial liberalisation, including a gradual freeing up of the interest-rate structure. Prior to that period, most interest rates in the economy were regulated and not market determined. As India moves closer to completely market-determined interest rates, the impact of RER targeting on the real interest rates is likely to be even higher.

III. Long-Run Behaviour of RER: A Cointegration Analysis

As noted earlier, the RER is not a policy tool in the long run notwithstanding government efforts at targeting; nominal devaluations *per se* cannot alter the RER over the long run. Theoretically, the RER at any point in time depends upon a number of fundamental and policy variables as evident from the numerous models of RER determination in the literature.[15] Thus, determining the relevant set of economic variables that underlie the RER behaviour remains an empirical issue. This section, consequently, investigates the long-run determinants of the RER in India.[16]

In the absence of large scale capital flows, as in India with her relatively closed capital account, the focus of models of RER determinants is in the goods market. The models typically specify the Salter-Swan framework with tradables and non-tradables sectors in the economy. The supply in the non-tradables sector is fixed by the assumption of full employment and the real exchange rate, given by the ratio of price of tradables to non-tradables, is determined by the non-tradables' price clearing that market. A number of variables suggested by these theoretical models are considered in the empirical analysis below. These are:

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14. The interest rate we use is the inter-bank call money rate.
15. See, for example, Edwards (1989), and Faruqee (1995).
16. The trade weighted real effective exchange rate index compiled by the Reserve Bank of India is used in the empirical analysis.

(i) *Investment/GDP ratio (I/GDP)*: If more investment goes into the non-tradables sector, such as the high proportion of public investment in India, then increases in I/GDP would lead to greater supply of non-tradables, implying a lower price of non-tradables and a RER depreciation.

(ii) *Seigniorage/GDP ratio (Sgn/GDP)*: In the simplest case, an increase in seigniorage leads to higher domestic inflation and, ceteris paribus, a RER appreciation, especially if government revenues are spent on nontradables. However, other models suggest that an increase in seigniorage would lead to lower household wealth, implying a lower demand for nontradables and thus an RER depreciation. Implicit in this argument is the assumption that the government does not return the inflation-tax revenue as lump sum transfers to households and, instead, spends the revenue on tradable goods.

(iii) *Terms of trade (TOT)*: TOT, defined as the ratio of unit value of imports to the unit value of exports, have an inverse relationship with the RER. An adverse shock to the TOT, raising the prices of imports, for example, leads to a depreciation of the RER. Most traditional models emphasise the income effect generated by the change in the external terms of trade. A deterioration in the TOT reduces real income and results in a decline in the demand for nontradable goods. Therefore, to restore equilibrium the relative price of nontradables has to decline (i.e., there has to be an equilibrium real depreciation).

(iv) *Fiscal deficit/GDP ratio (Def/GDP)*: A higher fiscal deficit is associated with greater spending on non-tradables, which therefore leads to RER appreciation.

(v) *Capital inflows (Cap/GDP)*: Greater capital inflows lead to appreciation of the RER due to greater demand in the market for non-tradables.

(vi) *Tariffs*: An increase in tariff is usually found to result in an appreciation of the real exchange rate. If exportable goods, importable goods and nontradable goods are substitutes *everywhere* in demand (a sufficient condition), an increase in tariff will increase the demand for nontradable goods.[17.] The traditionally accepted view has been that a reduction in tariffs in a small country will require a real depreciation to maintain external balance. A lower tariff will reduce the domestic price of importables, and consequently increase the demand for imports, which will, in turn, generate an external imbalance. Now assuming that the Marshall-Lerner conditions hold, this will require a real devaluation to restore equilibrium.

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17. If, on the other hand, there is complementarity in consumption, it is possible that either an imposition of, or an increase in, tariffs will generate a real equilibrium depreciation.

Since the central consideration in the present exercise involves identification and estimation of the long-run relationship between the RER and its fundamental determinants, a natural conceptual framework is provided by cointegration analysis. As a matter of definition, a set of N difference-stationary variables is said to be cointegrated if there exists at least one linear combination of these variables that is stationary. The stationary linear combination is called the cointegrating vector and defines their long-run relationship. Intuitively, cointegrated variables may drift apart temporarily but must converge systematically over time. Thus, the real exchange rate may be subject to numerous temporary shocks but its behaviour in the long-run would be systematically related to these fundamentals.

In the analysis below, we deploy a two-step procedure for testing for the existence of cointegrated relationships. As first step, we check the order of integration of the variables and present the results in Table 8. The RER, the seigniorage-GDP ratio, the investment-GDP ratio, the implied tariff level, the TOT and foreign capital flow-GDP ratio are broadly found to be all I(1) variables, i.e., they are difference stationary. In the second stage we determine whether the above variables are related by one or more common cointegrating vectors.[18.] It is found that for the full small sample period (1960/61-1995/96) there is one common cointegrating vector (in logarithmic form) that relates RER, the seigniorage-GDP ratio (Sgn/GDP), the investment-GDP ratio (I/GDP), implied tariff level, the terms of trade (TOT) and foreign capital inflow-GDP ratio (Cap/GDP).[19.] We failed to obtain a common cointegrating vector when the fiscal deficit-GDP ratio was included. Table 9 reports the standardised eigenvectors and adjustment coefficients, denoted by, respectively â and á in the usual notation. The first column of â is the estimated cointegrating vector, which can be written in the following form:

$$RER = \tilde{a}_0 - 1.42\ I/GDP - 0.71\ Sgn/GDP - 1.09\ TOT + 1.09\ Tariff + 10.86\ Cap/GDP.$$

18. The procedure put forward by Johansen (1988) and Johansen and Juselius (1990) is used.

19. Since inflows were negative in some years, we could not take the log of cap/gdp. Note that, although not reported, cointegration tests with productivity as one of the variables were also undertaken and showed the existence of a cointegrating vector. However, productivity data for India is available for a much shorter period (1973/74-1992/93), than covered in the results reported here.

All coefficients have their anticipated (or at least plausible) signs. The RER appreciates with an increase in capital inflows and an increase in protection. On the other hand, it depreciates due to an increase in the investment-GDP ratio, an increase in seigniorage and a worsening in the terms of trade. The coefficients in the first column of á in Table 9 measure the feedback effect of the (lagged) disequilibrium in the cointegrating relation onto the variables in the vector autoregression. In particular, 0.05 is the estimated feedback coefficient for the (log of the) RER equation. The numerical value seems to imply slow adjustment to remaining disequilibrium in the system.

IV. Concluding Remarks

This paper has investigated the evolving links between exchange rate policies and domestic financial variables in India, an economy undertaking cautious liberalisation of its financial and external sectors. It also considers long-run determinants of real exchange rates in India where a primary finding is that several macroeconomic variables seem to impinge on the RER through the period 1960/61-1995/96. In particular, the results indicate the importance of capital flows and trade protection in causing an appreciation of the equilibrium RER should not be overlooked. On the other hand, as the investment ratio rises in the years to come as a consequence of the reforms that are being introduced, the RER should depreciate.

The analysis in the paper shows that real exchange targeting has more than a transitory effect in case of India. In particular, inflation has not accelerated when nominal devaluations are used as a policy tool to enhance competitiveness of domestic exporters. Consequently, unlike in many Latin American countries, RER targeting has been relatively successful in India without substantial costs in terms of higher inflation. However, the relatively benign trade-off between RER targeting and inflation may deteriorate as reforms lead to greater degree of capital mobility. Furthermore, in the past three years or so, the economy has had to endure higher real interest rates at least partly as a consequence of RER targeting. The main point is that RER targeting does have costs in terms of less than desirable implications for the economy as a whole and that these need to be kept in mind when deciding to what extent should central bank-led devaluations *per se* be deployed.

In highlighting the growing links between exchange rate policies and domestic financial variables, the paper has focused on an issue that has not attracted attention before in the Indian context but which is likely to acquire increasing policy significance in the near future. For most of its history India has, at least officially, maintained a closed capital account. More recently, as part of the on-going reforms, the capital account has been partially opened up for two classes of investors, namely foreign institutional investors (FIIs) and non-resident Indians (NRIs), and currently plans have been drawn up to achieve full convertibility of the Indian Rupee in three years. As shown by the results in the paper, it cannot be guaranteed that policy induced changes in the nominal exchange rate will be as beneficial for the purpose of RER targeting in the new environment. A more sustainable policy would be to have a multi-pronged approach based on the structural determinants of equilibrium RERs, which include the relative openness of the trade regime, investment rate, the government's fiscal stance and productivity.

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Table 1

Deviation of nominal exchange rates from PPP exchange rates for Indonesia, Korea, China and Malaysia[a.]
(in percent)

Year	Indonesia	Korea	China	Malaysia
1981	1.8	11.5	-6.5	-0.6
1982	5.1	12.5	-9.9	-1.0
1983	11.8	13.0	-10.9	-0.4
1984	18.5	10.8	-11.9	-0.7

1985	19.9	9.6	-5.1	-3.9
1986	23.3	10.6	-0.6	-4.9
1987	30.4	9.8	4.6	-8.2
1988	35.5	13.9	25.7	-9.4
1989	37.7	14.9	38.1	-11.3
1990	47.6	18.5	33.4	-13.6
1991	55.3	24.5	34.5	-13.4
1992	62.4	28.4	41.9	-12.0
1993	73.6	30.8	60.3	-11.4
1994	84.2	36.0	88.4	-10.3
1995	96.6	38.3	119.8	-8.1
1996	110.6	41.3	133.1	-7.2

[a.] Plus sign indicates domestic currency is undervalued.

Table 2

Deviation of nominal Rupee-U.S. Dollar exchange rate from PPP exchange rate[b.]
(in percent)

Year	Deviation
1981/82	0.7
1982/83	-2.1
1983/84	3.1
1984/85	5.7
1985/86	8.1
1986/87	10.8
1987/88	15.6
1988/89	19.2
1989/90	22.1
1990/91	28.9
1991/92	38.7
1992/93	47.9
1993/94	57.2
1994/95	71.6
1995/96	79.8
1996/97	86.7

[b.] Plus sign indicates domestic currency is undervalued.

Table 3

Black Market Premium, Indian Rupee-U.S. Dollar Exchange Rate[c.]

Year	Rupee-U.S.$ Ex. Rate	Black Market U.S.$ Ex. Rate	Black Market Premium (in percent)
1963/64	4.8	6.8	41.8
1969/70	7.5	11.5	53.3
1971/72	7.5	7.3	-2.9
1973/74	7.4	9.3	24.9
1979/80	8.1	8.8	8.2
1980/81	7.9	8.5	7.5
1981/82	9.0	11.0	22.7
1982/83	9.7	12.0	24.1
1985/86	12.2	13.1	7.1
1991/92	24.5	26.5	8.3
1993/94	31.4	34.5	10.0
1994/95	31.4	34.5	10.0
1995/96	33.4	36.4	9.0

[c.] The black market exchange rate is available for certain days only; therefore, the figures in the first column of the table should only be taken as indicative. The data has been collected and kindly made available to us by the archives section of **Vyapar** newspaper published in Bombay.

Table 4

Unit root tests: 1980:1-1996:12

Series	**η_μ**	**η_τ**	**Z(â)**	**Z($t_\hat{a}$)**	**Z($\ddot{O}_3$)**
Real exchange rate					
Level	6.638	1.261	-7.95	-2.56	4.01
First difference	0.329	0.261	-152.80	-11.27	63.20
Inflation	0.208	0.109	-114.1	-8.94	40.21
Critical values (95%)	**0.463**	**0.146**	**-25.1**	**-3.66**	**7.16**

Note:

(i) The two KPSS statistics, η_μ and η_τ, are based on the following:

$$Y_t = \hat{\imath}t + \tilde{A}_t + \hat{a}_t \qquad \text{where}$$

$$\tilde{A}_t = \tilde{A}_{t-1} + u_t \quad ; \qquad u_t \sim \text{i.i.d.}(0, \acute{o}_u^2)$$

where Y_t is modeled as the sum of a deterministic trend, a random walk and a stationary error, $\hat{a}_t$; the initial value of $\tilde{A}_t$ is treated as fixed and serves the role of an intercept. To test for level stationarity instead of trend stationarity (η_τ) , $\hat{\imath}$ is set equal to zero and the residuals are from a regression of Y on only the intercept. This statistic is denoted by η_μ. Kwiatkowski, Phillips, Schmidt and Shin (1992) provide critical values for tests of both level and trend stationarity.

(ii) The Phillips-Perron statistics, Z(â), Z($t_\hat{a}$), Z($\ddot{O}_3$), are based on:

$$Y_t = \acute{a}_0 + \acute{a}_1 t + \hat{a}(L)Y_{t-1} + u_t.$$

These are derived in Phillips and Perron (1988) for the null that $\hat{a}=1$ and $\acute{a}_1=0$. $Z(t_{\hat{a}})$ makes use of the t-statistic on $\hat{a}$, $t_{\hat{a}}$ (for $\hat{a}=1$), and $Z(\ddot{O}_3)$ is the regression F-test of Dickey and Fuller (1981).

Table 5

Temporary and random walk components of the real exchange rate 1980:1-1996:12

$(1/n)\ \grave{e}_n^2/\grave{e}_1^2$ for various n (where n are months)			
24	48	72	96
1.673	1.504	0.863	0.733

Table 6

Pairwise Correlations: Inflation and Real Exchange Rate[d.]

	Full Sample	**Pre-Reform**	**Post-Reform**
Inflation			
Real exchange rate	0.12 (1.64)	0.13 (1.57)	0.17 (2.33)
Cyclical component of the real exchange rate	0.12 (1.64)	0.13 (1.57)	0.17 (2.33)

[d.] Figures in parantheses are t values.

Table 7

Pairwise Correlations: Real Interest Rate and Real Exchange Rate[e.]

	Post-Reform
Real interest rate	
Real exchange rate	0.41 (2.88)
Cyclical component of the real exchange rate	0.36 (2.47)
Cyclical component of real interest rate	
Real exchange rate	0.40 (2.80)
Cyclical component of the real exchange rate	0.36 (2.47)

[e.] Figures in parantheses are t values.

Table 8a

Unit root tests (level)[f.]: 1960/61-1995/96

Series	$Ç_{\mu}$	$Ç_{\tau}$	Z(â)	Z($t_{â}$)	Z($Ö_3$)
Real exchange rate	1.291	0.187	-10.68	-2.40	2.92
Fis.def.-GDP ratio	1.176	0.238	-7.76	-2.21	2.29
Inv.-GDP ratio	1.181	0.083	-17.86	-3.27	5.22
Seigniorage-GDP ratio	1.146	0.041	-37.61	-7.25	18.73
Implied tariff	0.821	0.072	-11.85	-2.55	3.71
Terms of trade	0.255	0.190	-5.38	-0.92	1.63
Capital flows/GDP	0.409	0.340	-16.66	-3.28	5.29
Critical values (95%)	0.463	0.146	-25.1	-3.66	7.16

Table 8b

Unit root tests (first difference): 1960/61-1995/96

Series	$Ç_{\mu}$	$Ç_{\tau}$	Z(â)	Z($t_{â}$)	Z($Ö_3$)
Real exchange rate	0.075	0.054	-30.86	-5.56	13.28
Fis.def.-GDP ratio	0.121	0.084	-37.35	-6.69	19.46
Inv.-GDP ratio	0.059	0.052	-40.09	-7.58	23.42
Seigniorage-GDP ratio	0.032	0.025	-49.98	-16.38	50.90
Implied tariff	0.099	0.057	-27.44	-4.60	9.88
Terms of trade	0.281	0.103	-25.74	-3.78	7.00
Capital flows/GDP	0.097	0.048	-42.24	-10.20	27.13
Critical values (95%)	0.463	0.146	-25.1	-3.66	7.16

[f.] The two KPSS statistics, $Ç_{\mu}$ and $Ç_{\tau}$, are explained at the bottom of Table 4.

Table 9

A Cointegration Analysis of the Indian RER: 1960/61-1995/96

Eigenvalues Hypotheses[g.]	ëmax 95% crit. val.	ëtrace 95% crit. val.
r=0	41.4*	107.8*
r≤1	32.87	66.43
r≤2	15.36	33.57
r≤3	8.074	18.21
r≤4	6.949	10.13
r≤5	3.185	3.185

Standardised eigenvectors â						
RER	1.000	0.275	2.549	2.941	0.239	-12.18
inv-GDP	1.419	1.000	-13.01	4.021	-0.387	-1.449
TOT	1.094	0.491	1.000	-1.124	-0.036	-11.11
tariff	-1.089	-0.126	14.68	1.000	-0.126	-8.248
cap-GDP	-10.86	-2.870	-291.6	32.55	1.000	-232.2
sgn-GDP	0.7102	-0.140	-0.640	0.441	0.039	1.000
Standardised adjustment coefficients á						
RER	0.052	-0.018	-0.004	-0.034	-0.073	-0.001
inv-GDP	-0.033	-0.543	0.009	-0.025	0.070	0.000
TOT	-0.087	-0.822	-0.012	0.006	-0.032	0.004
tariff	-0.029	-0.109	-0.009	-0.024	0.351	0.004
cap-GDP	-0.007	0.045	0.001	0.001	-0.005	0.000
sgn-GDP	-0.921	0.917	-0.011	-0.258	0.083	0.006

[g.] r denotes number of cointegrating vector(s).

[*] Null rejected at 95% level.