WORKING PAPER NO. 52

EXCHANGE RATE DYNAMICS WITH FINANCIAL REPRESSION: A TEST OF EXCHANGE RATE MODELS FOR INDIA

KENNETH KLETZER
&
RENU KOHLI

MARCH, 2000

INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS
Core-6A, 4th Floor, India Habitat Centre, Lodi Road, New Dlehi-110 003

Foreword

This paper is part of a collaborative project on Capital Account Convertibility and Macroeconomic Management initiated at ICRIER in April 1999 and supported by a grant from the Ford Foundation. Professor Kenneth Kletzer of University of California at Santa Cruz and Renu Kohli, Senior Fellow at ICRIER on deputation from the Reserve Bank of India, examine the relevance of the monetary approach to exchange rate behaviour for India under the managed float regime in this study. A conventional monetary model is fitted on Indian data, using quarterly observations from 1993 to 1998.

The paper finds support for purchasing power parity in traded goods. Its overall conclusion is that the monetary approach provides a reasonable description of exchange rate behaviour in the period of floating, given the deviations for India from integration of domestic goods and financial markets with the rest of the world.

I hope that this empirical evidence will help understand the role of monetary and exchange rate policy in India in the present environment as we move towards greater liberalisation of the financial sector.

Isher Judge Ahluwalia
Director & Chief Executive
ICRIER, New Delhi

December, 1999

I. Introduction

The floating of major world currencies in the early seventies initiated an empirical trend towards analysis of the role of fundamental factors in determining exchange rates. Amongst the many exchange rate models used, the monetary model has been a popular attempt at explaining exchange rate behaviour, though with mixed results.[1] Much of this research has focused upon experiences of industrialised countries while similar evidence in a developing country setting is relatively sparse.[2] This is partly due to the fact that few developing economies left exchange rate determination to market

[1] A summary of these studies can be found in Levich (1985), MacDonald (1988) and MacDonald & Taylor (1992).

[2] For the application of monetary approach in the context of developing countries see Odedokun (1997) for sub-Saharan Africa, Lyons (1992) and Edwards (1983) for Peru, Fry (1978) for Afghanistan, and Chinn (1998) for East Asian currencies.

forces until recently. Restrictions on international capital mobility and on domestic financial transactions in developing countries create a very different economic environment for exchange rate determination and dynamics for testing the generalised monetary approach to exchange rates. An empirical test of such models in countries with binding restrictions on international capital flows and underdeveloped or repressed financial sectors can help us to understand the role of monetary and exchange rate policies in the developing world.

India is a particularly challenging country for exchange rate models. It shifted to a (managed) floating exchange rate regime in 1993 after a two-year transition period of dual (official and market-determined) exchange rates. This period also coincided with other elements of economic liberalisation such as trade and financial sector reforms and witnessed a significant increase in foreign capital inflows. However, the rupee is not a convertible currency and capital outflows are severely restricted. The floating exchange rate arrangement after 1993 provides us the opportunity to study the importance of the fundamental factors underlying the process of exchange rate determination.

This paper adopts the monetary approach to exchange rate behaviour to explain exchange rate dynamics for India under the managed float. Monetary models of exchange rate behaviour impose the maintained hypothesis of purchasing power parity, in at least traded goods. The long-run relationship between the nominal exchange rate and domestic and foreign price indices is tested first; we find support for purchasing power parity in traded goods in our study period. A standard monetary model is then estimated in a vector autoregression framework. Several specifications of the monetary model are estimated using quarterly data from 1993. We find that relative money supplies, incomes, interest rates, prices and inflation are strongly cointegrated in more than one direction, and that the monetary approach provides a reasonable description of exchange rate behaviour in the floating period.

The paper is organised as follows. Section II places India's exchange rate regime in perspective, Section III outlines the theoretical framework that motivates the empirical estimation in section IV, while Section V concludes.

II. Experience under the Managed Float

The period after 1993 is associated with significant changes in trade and financial sector policy in a fairly stable macroeconomic context. The current account deficit averaged 1.1 per cent of GDP between 1993-99. Exports, as a share of GDP, averaged 8.0 per cent, while imports increased by 1.5 per cent during this time period. Foreign direct investment inflows jumped from 0.24 (1992-93) to 1.6 per cent of GDP (1993-94) with the change in exchange rate regime and continued to rise until 1996-97, after which a perceptible decline is observed. Net capital inflows, which stood at $ 9.1 b in 1993-94, and slowed down by 1995-96 ($ 2.4 b), climbed up to $ 11 b in 1996-97[3], but have displayed a downward trend since. Much of the improvement in balance of payments during this period can be traced to increases in capital account transactions as a result of which foreign exchange reserves more than doubled between 1993 and 1998.

Several institutional and structural changes that complicate the setting for exchange rate determination deserve mention here. The shift to market-determined exchange rates was accompanied by several liberalisation measures in the economy. Trade policy reforms during this period targeted removal of quantitative restrictions and reduction in licensing requirements. A phased move towards current account convertibility involved progressive removal of restrictions on current account transactions. Important policy changes that had a bearing upon capital account transactions included FDI and portfolio investments, and entry as well as operations of the foreign institutional investors in debt and equity markets.

Efforts to integrate and deepen the foreign exchange market during this period have also led to substantial increases in market turnover: the average monthly market turnover (inter-bank and merchant transactions)

---

3 Source : CMIE: Monthly Review of the Indian Economy, May 2000.

increased from $ 50 b (1993-94) to $ 110 b[4] in 1998-1999. Despite increases in foreign exchange market activity and other changes discussed above, the exchange rate was remarkably stable for the first two years following the float. This is evident from the plot of the log spot rate (Re/$), Fig. 2, in the next section. Contrary to international experience where the transition from fixed to floating exchange rates has unambiguously been accompanied by a rise in exchange rate volatility,[5] the rupee-dollar exchange rate exhibits no such tendency. A statistical measure of volatility, the standard deviation of yearly changes, shows practically constant rupee-dollar rate variability (7.6 for 1970-90 and 7.0 for 1993-99). A higher frequency indicator of exchange rate volatility, the standard deviation of monthly movements in the spot rate, shows a marginal increase in nominal variability from 1.43 to 1.7 between the two time periods.

Under floating exchange rate regimes, monetary authorities typically intervene from time to time to reduce or manage fluctuations in the nominal rate. To what extent has the Reserve Bank of India managed the exchange rate? There are several grounds for the belief that the central bank has intervened in the exchange market. The two explicit objectives of exchange rate policy during the floating period have been exchange rate stability and

---

4 Report on Currency and Finance, RBI, Mumbai: pp.VIII-7, 1998-99

maintaining the international competitiveness of the rupee. Consider, for example, the following statements: "…the Reserve Bank of India stands ready to intervene to maintain orderly market conditions and to curb excessive speculation".[6] Or, "…exchange rate management continues its focus on smoothing excessive volatility in the exchange rate…" and "…to ensure that the exchange rate remains consistent with economic fundamentals."[7]

Another notable feature of the post-float period has been the significant increase in changes in foreign exchange reserve holdings, an indicator of intervention. The mean absolute change in foreign exchange reserves during 1970-90 is merely Rs 0.03 which increases to 0.73 after the rupee started to float in March 1993.[8] The monthly intervention activity of the Reserve Bank after 1993 is plotted along with changes in the nominal exchange (spot) rate in Fig. 1 to reveal the association between actual bank intervention and exchange rate movements. It is apparent that intervention is

---

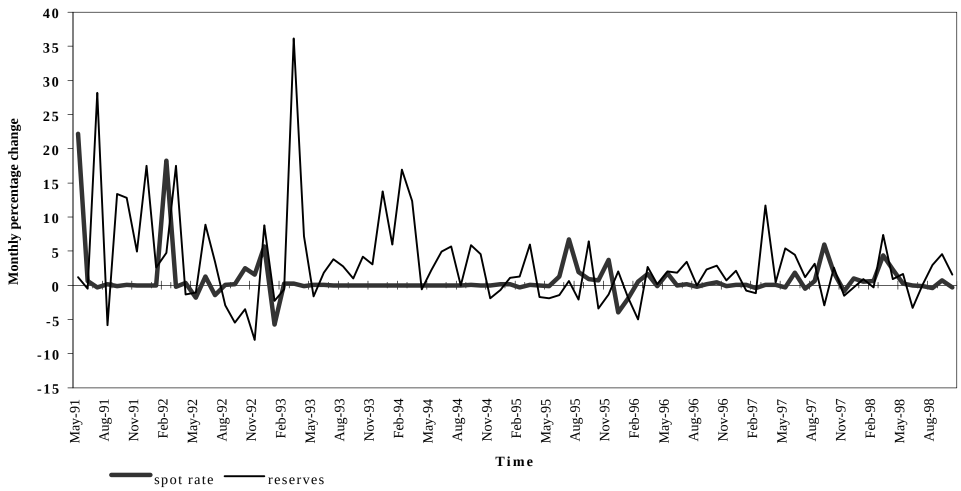
5 See Mussa (1986) for an exhaustive account of this empirical observation.

6 Economic Survey, 1995-96, GOI: 103.

7 Economic Survey, 1997-98, GOI,: 92

8 The average size of intervention for the transition period, 1991-92, which was particularly turbulent, is 0.64 billion).

Fig. 1 Intervention and movements in the spot rate



mainly unidirectional, i.e. an appreciation is usually countered through intervening. purchases by the Reserve Bank. The period immediately following the floating of the rupee, 1993-95, shows an extremely stable exchange value of the rupee vis-à-vis the dollar with the spot rate oscillating between 31.23 – 31.81 rupees per US dollar.

A closer look at the data reveals heavy purchases on the part of the central bank. During this period, it absorbed heavy capital inflows and augmented its foreign exchange reserves, which more than doubled between March 1993 (Rs. 304.47 b) and Dec. 1995 (Rs. 775.18 b). The central bank's own account of this period confirms this observation, viz. "…intervention was aimed at protecting the export competitiveness and consolidating the foreign exchange reserves."[9] Clearly, the central bank was keeping the rupee from appreciating in the foreign exchange market during this time.

A close positive association can be observed between intervention and exchange rate volatility. Table 1 provides evidence of central bank response, i.e. intervention and exchange rate variability confirming the observation from Fig. 1. Note for instance, the co-movement between intervention and volatility between July-Sept. 1995 and Jan.-March 1996. Another evident feature in the table is that intervention often precedes or follows an exchange rate adjustment, as for example, in July-Sept. 1995, Jan-Mar 1996, Jan-Mar 1998 and July-Sept 1998, even though exchange rate movements might not have been extraordinarily volatile. This suggests that exchange rate adjustments are implemented by the central bank.

9 Report on Currency & Finance, 1994-95, RBI: X-17.

Table 1
Exchange Rate Volatility and Intervention in Periods of Pressure

Period	**Nominal exchange rate variability *vis-à-vis* US dollar**		**Interventions**
April-June 1995	0.21[1]	-0.14[2]	5.80[3]
July-Sept. 1995	3.59	1.28	10.30
Oct-Dec 1995	0.66	9.85*	7.88
Jan-Mar 1996	3.95	0.29	12.11
April-June 1996	0.92	0.10	5.21
July-Sept 1997	1.30	1.06	7.69
Oct-Dec 1997	2.80	6.61*	4.55
Jan-Mar 1998	0.99	1.88	10.61
April-June 1998	1.90	5.59*	8.03
July-Sept 1998	0.17	2.56*	10.42

[1]standard deviation of absolute percentage change in the bilateral rupee/dollar exchange rate;

[2]percentage change of the median value of the exchange rate in the current quarter over the median value
of the preceding quarter;

[3]quarterly averages expressed as a percentage of the yearly average of gross intervention undertaken

*Intervention leading to realignment of the exchange rate

The central bank's own account of the depreciation observed in the period Aug.-Sept. 1995 buttresses this observation, viz. "…due to the policy guided correction in the exchange rate of the rupee in the second half of 1995-96, the rupee remained stable during 1996-97."[10]

The preliminary examination of the data reveals considerable intervention by the central bank that is apparently targeted at moderating fluctuations in the foreign exchange market and effecting periodic adjustments in the exchange rate. These interventions are reflected in the fundamentals that help explain exchange rate dynamics and will play a role for interpreting our empirical results.

III. The Monetary Model

The basic monetary approach to the exchange rate is based on the idea that the exchange rate is determined in asset market equilibrium. It assumes that the money market is in equilibrium, that aggregate money demand is stable and the money supply is determined by the monetary authorities. Let the domestic and foreign demand for money functions be given by equations 1 and 2

[10] Report on Currency & Finance, 1995-96, RBI: X-12.

$$m_t - p_t = k + \eta y_t - \delta i_t + u_t \tag{1}$$

and

$$m_t^* - p_t^* = k^* + \eta y_t^* - \delta i_t^* + u_t^* \tag{2}$$

respectively, where all variables in lower case with the exception of interest rates represent logarithms and the *s refers to the foreign country variables. m_t and m_t^* is domestic and foreign money demand, p_t and p_t^* are the respective price levels, variables y_t and y_t^* are income levels at home and abroad, while i is the interest rate. η and δ denote the income elasticity and the interest (semi) elasticity of the demand for money respectively. The link between national price levels, which is an essential element of the monetary approach is through purchasing power parity. This can be stated as

$$p_t = s_t + p_t^* \tag{3}$$

where s_t denotes the logarithm of the exchange rate expressed as the price of foreign currency in units of the domestic currency. Assuming identical elasticities across both countries, rearranging terms in equations (1) and (2) to obtain an expression for the price level and substituting it in the purchasing power parity condition given in equation (3), we obtain the linear expression for the exchange rate s_t (with the subscript *t* suppressed) given by

$$s = (k - k^*) + (m - m^*) + \eta(y - y^*) + \delta(i - i^*) + \mu \qquad (4)$$

The purchasing power parity condition imposed in this equation assumes that nominal prices are perfectly flexible. Changes in the nominal exchange rate are fully reflected by changes in the national price level. The PPP condition indicates that any incipient divergence between the national price levels will give rise to an exactly offsetting change in the exchange rate. Further, it assumed that the country is a price taker in the world market. With perfectly flexible nominal prices at home and abroad and perfect international financial capital mobility, a change in the money stock affects the exchange rate through current and expected future changes in the price level. These are reflected in changes in the nominal but not the real interest rate (via the Fisher effect) in this case. Both assumptions of flexible prices and perfect financial capital mobility are unrealistic a priori. Our estimation equation needs to be modified.

The relevant prices for money market equilibrium and for purchasing power parities are not likely to be the same. For money demand, it is the price level for transactions in the domestic economy that should matter. For purchasing power parity, the appropriate price level will be an index of tradable goods prices. Equation 3, i.e. the price level, can be expressed as a weighted average of the prices of non-tradable and tradable goods[11] (suppressing the subscript *t*):

$$p = \theta p_{NT} + (1-\theta) p_T \tag{3.1}$$

and

$$p^* = \theta p^*_{NT} + (1-\theta) p^*_T \tag{3.2}$$

where p_T and p_{NT} denote, respectively, the prices of tradable and non-tradable goods, and θ is the share of non-tradable goods in the price index. Assuming purchasing power parity to hold only for traded goods,[12] we have

$$p_T = s + p^*_T \tag{3.3}$$

---

11 Frenkel & Mussa (1985).

12 This was first used by Dornbusch (1976) and has subsequently been used by Wolff (1987), Chinn & Meese (1995) and Chinn (1998).

Using equation 3.3 in place of (3) and substituting expressions 3.1- the price level in the money demand function incorporates relative price structures in the two economies as a determinant of the exchange rate

$$=(\quad-\quad^{*})+(\quad-\quad^{*})+h(\quad-\quad)+d(\quad-\quad^{*})+q(\quad q^{*})+m$$

q and q^{*} is the relative price of tradable to non-tradable goods. Equation 5 can be modified further by adding the inflation differential between the two economies. If prices are perfectly flexible, then the inflation and nominal interest differentials are identical. However, in the presence of nominal price rigidities the effect of the inflation rate differential on the nominal exchange rate increases in absolute value as the speed of adjustment to purchasing power parity falls. Adding the inflation differential to the estimation model also allows us to relax the assumption that financial assets are freely tradable. Capital controls imply that real interest rates are unlikely to be equated in either the short or long runs.

The estimation version of the model is:

$$s = a + b_1(m - m^{*}) + b_2(y - y^{*}) + b_3(i - i^{*}) + b_4(p - p^{*}) + b_5(q - q^{*}) + m$$

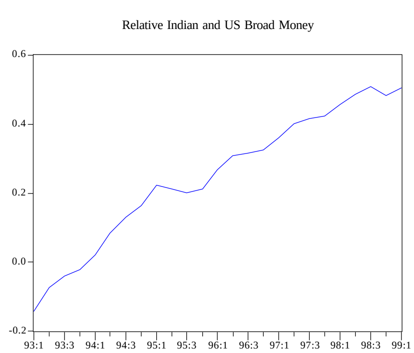
where the b s are parameters to be estimated. The model predicts that b_1 should equal positive one. An increase in the supply of domestic money relative to foreign money raises the exchange rate, i.e. depreciates the domestic currency. b_2, the coefficient on the income differential is predicted to be negative – a rise in relative incomes raises domestic money demand relative to foreign, thereby causing an appreciation of the domestic currency. The interest differential coefficient, b_3, can enter with either a negative or a positive sign. Under perfectly flexible prices, this coefficient is the semi-elasticity of money demand with respect to the nominal rate of interest and would be positive. With price rigidities, it can be negative if there is secular inflation as shown by Frankel (1979). The empirical formulation of the model uses nominal interest rates, without distinguishing between the real rate of interest and inflation expectations. The inflation differential captures effects of imperfect asset substitutability, barriers to capital mobility, domestic financial market repression and price rigidities. It's coefficient should be positively related to the interest semi-elasticity of the demand for money and negatively related to the degree of nominal price rigidity. Finally, b_5, the coefficient on the relative prices variable is expected to take a positive value equal to the share of non-tradable goods in the domestic price index bundle. A rise in the domestic relative price of tradable goods or a loss of competitiveness leads to currency depreciation.

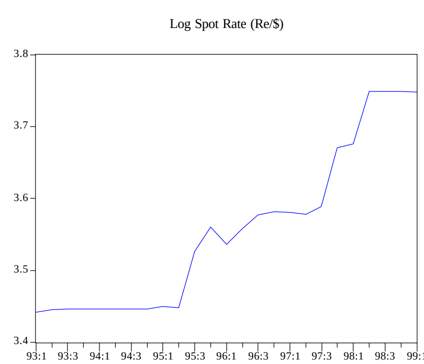
IV. Empirical Estimation

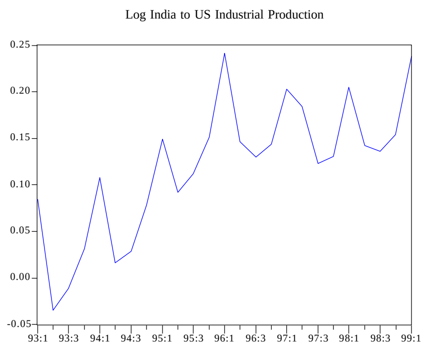
4.1 Data

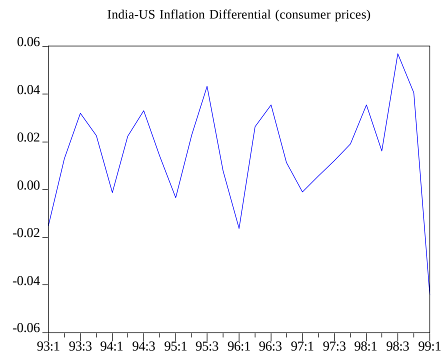
The data are quarterly in frequency and are drawn from the *International Financial Statistics* CD-ROM. Further details are given in Appendix A. All the variables, except interest and inflation rates are in logarithms. Before the formal estimation of the monetary model, a preliminary look at the data is in order. The individual series are plotted below while Table 2 presents some variability indicators of the variables.

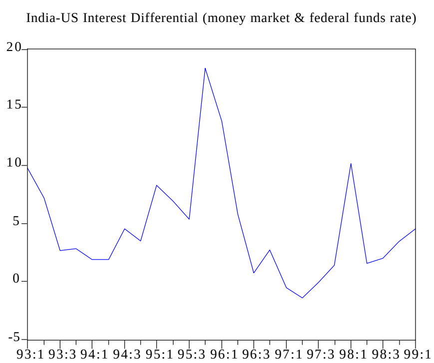
Figs. 2-7






Log India to US Industrial Production
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
93:1 93:3 94:1 94:3 95:1 95:3 96:1 96:3 97:1 97:3 98:1 98:3 99:1


India-US Inflation Differential (consumer prices)
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
93:1 93:3 94:1 94:3 95:1 95:3 96:1 96:3 97:1 97:3 98:1 98:3 99:1


India-US Interest Differential (money market & federal funds rate)
20
15
10
5
0
-5
93:1 93:3 94:1 94:3 95:1 95:3 96:1 96:3 97:1 97:3 98:1 98:3 99:1

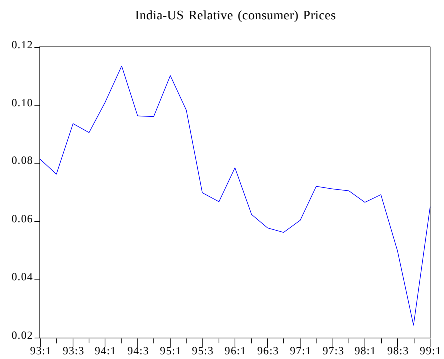

India-US Relative (consumer) Prices
0.12
0.10
0.08
0.06
0.04
0.02
93:1 93:3 94:1 94:3 95:1 95:3 96:1 96:3 97:1 97:3 98:1 98:3 99:1

Table 2
Variability Indicators

Series	Std. Dev.	Std. Dev.
s	0.232	0.056
$m - m^*$	0.165	0.053
$y - y^*$	0.081	0.095
$i - i^*$	5.568	6.670
$p - p^*$	0.017	0.021
$q - q^*$	0.037	0.016

The exchange rate is observed to be on a steadily upward path after the stable period between 1993-95, already commented upon above. The variation in the series is given by the standard deviation of the log-levels and first differences in Table 2. Apart from the short- term interest rate differential (money market and federal funds rate respectively), the exchange rate exhibits more variation than any other variable. The changes in the fundamental determinants indicate output (industrial production) to be the most volatile, exceeding changes in the exchange rate.

4.2 Purchasing Power Parity and Money Demand Stability

Since an essential element of the monetary approach to exchange rate behaviour is the link between domestic and foreign prices through purchasing power parity, this relationship is explored for India for the post-float period. PPP was tested using monthly data for 1993:03-99:12, choosing the United States as the base country. Absolute purchasing power parity requires that the exchange rate equalise the price level in the two countries, whereas relative purchasing power parity requires that the percentage change in the exchange rate equal the differential between the rates of inflation in the two countries.

The heterogeneity in the construction of price indices across countries, the fact that many goods are not traded and the presence of trade restrictions makes empirical tests of PPP potentially difficult and unstable. The literature on empirical tests of PPP has revealed the results to be sensitive to the choice of price index, countries and time period.[13] Keeping these factors in mind, we tested PPP using alternative price index time series. In particular, we used the wholesale and consumer price indices as well as the ratio of the two series for India and US, assuming as before that the wholesale price indices are a better reflection of tradable goods prices. Table 3 presents the results of tests for absolute purchasing power parity.

Table 3
Tests for Absolute PPP

$$S_t = a + b\left(\frac{p}{p*}\right)_t + u_t$$

Series	CointegratingVecto	CPI	WPI	WPI/CPI	Adjustme nt

[13] See Rogoff (1996) for a review of empirical evidence on, and estimation problems with, PPP tests.

		(0.043)			(0.087)
S	Yes		1.048*		0.016
			(0.370)		(0.092)
[illegible]	[illegible]			[illegible]	[illegible]
				(0.518)	(0.105)

All variables are in logarithms. Figures in parentheses are standard errors.
* indicates significance at 1%.

Column 2 of the table reports that the null of no cointegration is rejected significantly in all the cases confirming an equilibrium relationship between the price of foreign exchange and the foreign and domestic price levels, i.e. PPP holds in the long run.

The estimated long-run equilibrium relationships, which test for absolute PPP, are reported in the next three columns. In this version, PPP requires that the coefficient on $b = 1$. The value of the coefficient with respect to the ratio of wholesale prices validates PPP for the 1993-99 period. Consistent with empirical evidence on PPP from numerous other studies, the results are sensitive to choice of price index. When the log of nominal spot rate is regressed on the relative ratios of wholesale/consumer price levels in India and US respectively, we find a positive and statistically significant exchange rate response to this variable. The ratio of wholesale to consumer price levels proxies for the hypothesis that only the prices of tradable goods should be equalised across the two countries The magnitude of the coefficient on this price variable exceeds its predicted value of unity though. The data thus provides support for the hypothesis that parity with foreign price level holds for a more aggregate class of goods and to a large extent, for tradable goods.[14]

Column 6 of the table reports the respective error-correction terms, which indicate the speed at which the exchange rate responds to deviations from its long-run equilibrium value. The point estimates indicate a very slow rate of convergence to long-run equilibrium. For instance, a one unit deviation from long-run PPP in the past period ($t-1$) results in a fall in the Indian wholesale price level by 0.016 units in the period t to eliminate the positive discrepancy from long-run PPP present in period $t-1$.

Finally, tests for the stability of the money demand function during the post-floating period are positive. The log of money supply (M3), output (industrial production), wholesale price level and the interest rate (money

[14] The response of log trade-weighted real effective exchange rate (RER) to relative wholesale and consumer price levels shows that a one-to-one association between prices and the exchange rate does not hold over this time horizon. The coefficient values, though positive and significant, are far from unity. Log real effective exchange rate responds poorly to relative prices of tradable goods. These results are reported in Appendix D.

market rate) were found to be significantly cointegrated[15] at the one percent level of significance, confirming the existence of a long-run equilibrium relationship between these series despite possibly significant short-run deviations.

4.3 Estimation of the Monetary Model

Before estimating the model the time-series properties of the individual series were analysed. Unit root tests (Appendix C) revealed that each of the variables is characterised by a single unit root, i.e. I (1). Lag-length tests[16] indicated that the data-generating process is best characterised as a VAR (1) process.

Tables B1-B8 (Appendix B) present the estimation results. The first section of the table presents the results of the Johansen's cointegration procedure. The top row of this table shows the presence (and number) of cointegrating relationships between the variables. For all the specifications estimated, this procedure confirms the existence of at least one significant

---

[15] The Johansen cointegration test for these series yields a trace statistic of 65.81 (critical value = 54.46), indicating the presence of a cointegrating vector at the one per cent level of significance.

[16] Assuming *a priori* that 4 lags, i.e. one year, might be a reasonable dynamic representation of the data generating process, we began with a lag length of 4 quarters, paring down to a parsimonious lag length using the multivariate generalisations of the AIC & SC as specification indicators. Successive lag lengths indicated a VAR (1) process.

long-run equilibrium relationship between the series.[17] In most cases the variables are tied together in more than one cointegrating vector indicating the stability of the system in more than one direction.[18]

Table B1 shows the performance of the monetary model using broad money as the relevant money stock variable and assuming purchasing power parity to hold only for traded goods. The model fits the data exceptionally well. In the empirical testing of the model we expect the coefficient on $(m-m^*)$ to be positive and statistically insignificantly different from unity. The coefficient on log money stock differential satisfies this homogeneity assumption exactly and supports the monetary model. Most coefficients enter the equation with signs predicted by or consistent with the model and are statistically significant. The exception is the coefficient on the relative price variable $(q-q^*)$, which is negative rather than positive.

The model was re-estimated, dropping $i-i^*$ and $p-p^*$, i.e. the interest and inflation differentials by turn. It is often argued in the context of developing countries that the rate of inflation reflects opportunity cost better

---

17 The trace statistics have not been reported in the table, but are obtainable from the authors on request.

18 The presence of multiple cointegrating vectors is an indication of a 'dynamically' stable system. See Dickey, Jansen & Thornton (1991).

than the interest rate.[19] Is this contention supported by the data? Columns 3 and 4 of Table B1 present estimation results when only one variable representing the measured opportunity cost of holding money is included in the basic equation. Exclusion of the interest rate differential does not significantly alter the performance of the model except that the coefficient magnitudes now change slightly. For example, the estimate for the common semi-elasticity of money demand with respect to income is now closer to one. However, excluding relative rates of inflation results in a very poor fit: the coefficients on the variables are insignificant, incorrect in sign and far from their predicted values. The estimate of the coefficient for the comparative relative prices of tradable goods in terms of non-tradable goods becomes positive. These results should be taken as some indication that the maintained hypotheses necessary to exclude the relative inflation rate term are untenable. This is consistent with our prior that the failure of capital market integration is important. In summary, the most reasonable version of the model based on the statistical tests is the fully-specified version given by equation 1.

---

[19] This is due to the fact that interest rates are mostly controlled and regulated in developing countries. For India, though domestic interest rates have been progressively deregulated beginning September 1990, it would be unusual to expect money holders' preferences to ignore price changes in their money demand function. Moreover, the absence of integrated institutional linkages in the Indian financial structure would suggest the inflation rate to take precedence over the interest rate, as a measure of opportunity cost.

The results of changing the specification of relative prices by substituting the relative price variable by the ratio of wholesale prices for India and the US are presented in B2. The results confirm the model to be robust to the choice of prices made in the monetary framework – the parameter values are very similar to the earlier specification, correctly signed and statistically significant. The persistent negative sign of the coefficient on relative price variable, however, should be noted.

Variations of the definition of the money stock in the basic monetary model were tried. Tables B3 and B4 present these results. In B3, log money stock differential is re-defined to include narrow instead of broad money. This set of regressions repeats the earlier exercise of testing alternative measures of relative prices. The model is robust to the choice of the relative money stock variable with respect to statistical significance and the predicted signs of the coefficients on individual variables. The coefficient estimate for the impact of relative prices now has a correct sign, but the coefficient on the relative money stocks is less than its predicted value. Again, exclusion of the inflation differential from the regression equation alters the results significantly.

Table B4 shows the results for the model with narrow money when relative wholesale prices are substituted for the relative price of traded goods. The pattern is quite similar to the one observed when money stock is defined to be broad money. We believe that the choice between using narrow and broad money in the definition of the relative money stocks should be decided in favour of broad money. This meets the demands of the homogeneity condition on the demands for real balances, but it means that we lose the positive result for the impact of the relative prices of tradable and non-tradable goods. We believe that the inconsistency between the regression results and the basic model in this regard is likely to result from imperfect integration of goods and asset markets.

In the next stage of our analysis, we relaxed the assumption that m and m^* have the same coefficient. That is, we next allowed the coefficients of money demand to differ across these two countries. The basic monetary model equation was re-estimated with the money stock variable entering separately, treating the foreign money stock as exogenous. These results are presented in Tables B5-B6, where the relative price variable is alternated. The coefficient on log US money stock is negative and close to unity, indicating complete adjustment but the domestic money stock coefficient is far below one and moreover, of incorrect sign. The estimates of the coefficients on relative prices of traded goods (B5) and wholesale prices (B6) differ: the first is positive but equal to unity and the second is negative.

Tables B7-B8 show the previous regression run with narrow money, India and US, featuring separately and with alternative definitions of relative prices. The noteworthy feature here is that relative prices for a broader category of goods, i.e. wholesale prices, perform better than the relative prices of traded goods, and that the coefficient on log domestic money stock is below unity (Table B8).

The results can be summarised thus:

i) All variants of money supply, broad, narrow and treating the money supplies as different across the home and foreign country, yield coefficients that are equal to or close to their predicted values. These measures are robust to choice of measured opportunity cost of holding money balances as well as prices. This is confirmed using alternate specifications that include only the interest or the inflation differentials as well as different variables reflecting prices of different categories of goods.

ii) The incomes differential, i.e. the semi-elasticity of income with respect to demand for real money balances is in accordance with the predicted responses in the monetary framework of exchange rate behaviour. The empirical evidence in this paper conforms to the predicted effects that an increase in domestic income relative to foreign income increases demand for real money balances leading to a monetary contraction and a fall in the price level. This impacts upon the exchange rate through an appreciation.

iii) The response of the interest rate differential, the interest semi-elasticity of demand is negative – sensitivity checks show the response to be robust to another measure of opportunity cost, i.e. the inflation differential as well as alternate specifications of money supply and prices. The negative sign on the coefficient of this variable indicates that a rise in the differential in favour of the domestic currency induces an exchange rate appreciation. This evidence is strongly suggestive of price-stickiness. The magnitude of the coefficient on this variable usually lies in the range of -0.003 per cent, indicating a rapid adjustment of price levels.

iv) The coefficient on the inflation differential is always negative, suggesting a rise in the rate of inflation (relative to foreign rate of inflation) causes the rupee to appreciate. This is a contradiction to long-run PPP, and indicates that failures of goods and capital market integration are significant for exchange rate dynamics.

v) The relative price variable does not conform to predicted values when we restrict the money demand functions to be identical. When the foreign and domestic money supplies are entered as separate regressors, i.e. we drop the restrictions on money demand functions, then we do find support for the impact of tradable goods/non-tradable goods price differentials in the data for India.

4.4 Adjustment Response

The second section of tables B1-B8 gives the respective error-correction coefficients. The vector error-correction estimation is done by imposing the error-term obtained from the cointegrating regression in levels, as a restriction upon the VAR, which is estimated in first-differences. Note that we have assumed one cointegrating vector in imposing this restriction, using economic theory to guide our choice of the cointegrating vector. The coefficient estimated for the cointegrating equation reflects the response of each of the fundamental variables at time-period *t* to past period's disequilibrium, i.e. *t-1*.

Several interesting insights are offered by the VECM representation of the monetary approach. One, the exchange rate response to past disequilbrium is always insignificant, that is it does not adjust to restore equilibrium. No matter which specification we choose, this result remains unaltered. Two, in models specified with narrow or broad money stock differentials, the only variable that responds in adjusting to the disequilibrium (the error-correction term) is the inflation differential. This result is unchanged when we substitute relative prices of traded goods with relative wholesale prices. However, when the equations are estimated *without* the relative inflation differential, it is relative money supplies, incomes and prices that move to restore equilibrium in the system. Specifically, relative incomes and prices retain their significance in all the VECM versions.

The third significant feature of the VECM estimation is that when the foreign money stock is treated as exogenous, the adjustment coefficient on US money shows a very significant response. Relative inflation differentials continue to be important in the adjustment process in these regressions. Again, dropping inflation from the regression makes the relative prices respond to disequilibrium.

A puzzling result is the complete insignificant response of money supplies. Given extensive intervention by the central bank, one would expect monetary policy changes to restore equilibrium, since that is a variable directly under the control of the authorities. The foregoing discussion reveals the passivity of the exchange rate in the adjustment process and that prices bear the burden of adjustment.

4.5 Stability of the model

Methodological problems associated with empirical models of exchange rate determination have been well documented elsewhere[20] and hence, we do not enter into a discussion on these issues here. Exchange rate models have been notorious for their parameter instability. Further, the Lucas critique levied at the assumption of a stable policy regime underlying the time-period of estimation, when in fact it is dynamic and therefore constantly changing, provides grounds for suspecting parameter instability. Moreover, the economic and institutional changes in the economy during the period of the float would expectedly impact the market environment in which the exchange rate is determined and affect parameter constancy.

---

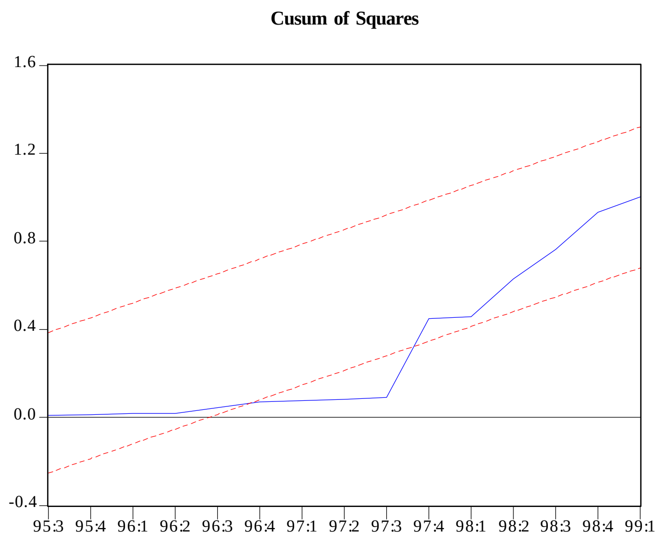
20 Meese & Rogoff (1983 a, b) establish the instability and poor out-of-sample properties of empirical exchange rate models. Meese (1990) discusses methodological issues more fully.

We address some of these issues in this sub-section. We select three models, which *prima facie* appear to be representing exchange rate behaviour most appropriately; using commonly used criteria of statistical significance and conformity with economic theory. These are Tables B1, B4 and B8, i.e. the complete monetary model, using broad money and relative prices of tradable goods, the model using narrow money with relative wholesale prices and the complete model using domestic and foreign broad money stock separately with relative wholesale prices. These models are then subjected to stability and in-sample prediction tests. Of course, a better test for predictive power of the model would be an out-of-sample forecast. But the limited observations available for the short period of the float, i.e. 6 years, are an obvious constraint to splitting the sample for the purpose.

4.6 Stability Tests & In-Sample Forecasts

The plots below show the cusum-of-squares on the recursive residuals for these three specifications. The cusum-of-squares for the monetary model estimated with broad money as the relevant money stock variable (Table B1) with the relative prices of tradable goods, shows the model to be unstable. It strays out of bounds from the last quarter of 1996 to the end of 1997, indicating 1997 to be the year of instability. A Chow forecast test, which estimates the model for the sub-sample comprised of observations 1993:1-

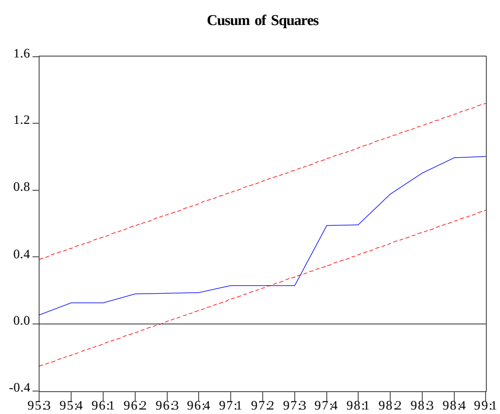
1996:3 and uses these to compute prediction errors in the remaining data points in the sample, confirms the results of the CUSUMSq of residuals above.



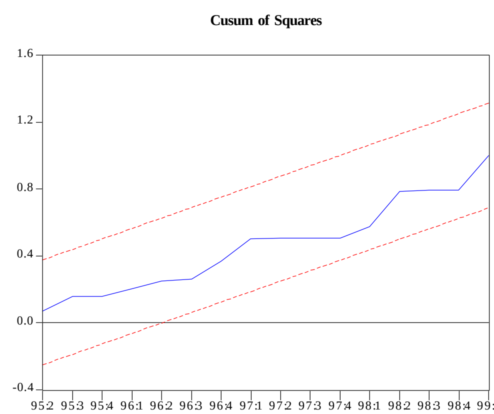
Broad money with relative prices of tradeables

The test yields an F-test statistic of 8.80, strongly rejecting the null hypothesis of no structural change in the exchange rate determination pattern before and after 1997. One explanation for the instability observed in the model could be the exogenous disturbances associated with the East Asian crisis, that are not captured in our specification. As Fig 1 reveals, exchange rate movements were volatile during this period. Controlling for this period and re-estimating the equation shows parameter values to be virtually the same.

Similar tests for stability were done for the narrow money model, with relative wholesale prices (Table B4) and Table B6, where the domestic and foreign broad money stock feature as separate variables. The cusum-of-squares of their respective recursive residuals are plotted below. These models are relatively more stable. The model using narrow money as the relevant money supply variable, strays out of bound between 1997:1-1997:3 and the Chow forecast test for the remaining period, i.e. 1997:4-199:1 confirms[21] this as the source of structural break.



Narrow money with relative wholesale prices



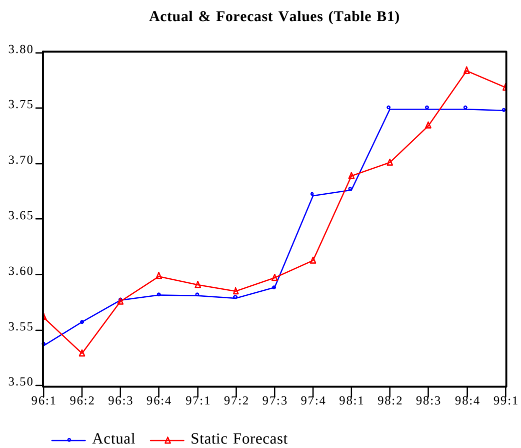
Domestic and foreign broad money stock with relative wholesale prices

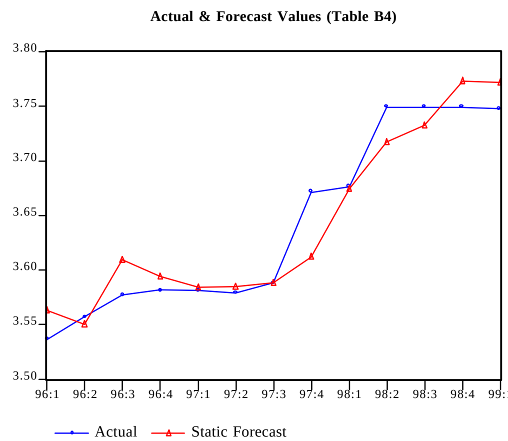
Finally, the model where the domestic and foreign money supplies enter the equation separately (Table B6) proves to be stable as the CUSUMSq above reveals. Again the Chow forecast for this model reports a

21 The test statistic is 2.86 which indicates that the probability of no structural break at this point in the sample cannot be accepted even at the 10 per cent level of significance.

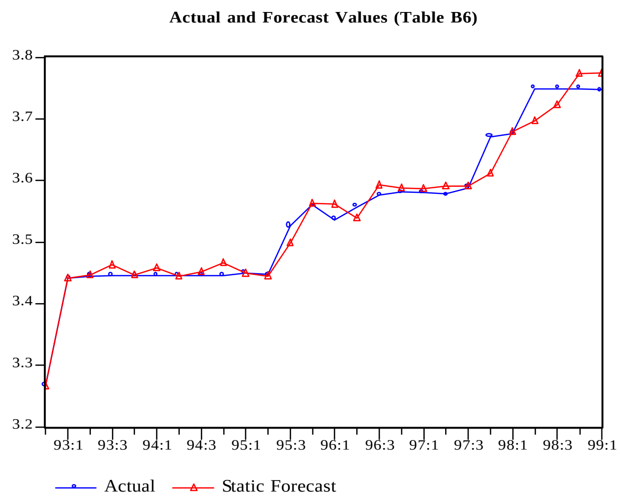
test statistic of 1.33, indicating that the null hypothesis of no structural change in the data before or after 1997:1 cannot be rejected.

Another robustness check is done through examining the in-sample-fit of the estimated regression. The plots below display the actual and forecast values of the three





specifications. These forecasts are in-sample, static forecasts where actual values are used as the lagged dependant variables. This variable performs a series of one-step ahead forecasts for the nominal exchange rate. A compararitve look at the forecasting properties of the three models shows that dropping the assumption of money market equivalence across the two countries yields the best specification. The actual and static forecast values



of this model match very well, suggesting the stability of the model. Note that the model forecasts the peaks in the sample, i.e. exchange rate depreciations, for 1995-96 and 1996-97 very accurately

V. Conclusion

This paper has tested the monetary model of exchange rate behaviour for India for the post-floating exchange rate period. Several variants of the monetary model were tested, experimenting with different definitions of money stock and relative prices. The results suggest that the monetary model performs fairly well given the deviations from integration of domestic goods and financial markets with the rest of the world for India. As predicted by the monetary approach, the elasticity of the domestic-foreign money stock ratio with respect to the nominal exchange rate is unity. While the relative income differential results in a nominal appreciation, the elasticity coefficient is less than 0.5 in all variants estimated. This is quite low compared with similar evidence for other developing countries. For example, Odedokun (1997) estimates the elasticity of the domestic-foreign money stock ratio for a panel of sub-Saharan economies to be above –2 and Edwards (1983) estimates it to be –2.9 for Peru. Chinn's estimates (1998) of incomes elasticity for the East Asian economies lie between 1-3.

While we found PPP to hold in the long-run, the prediction of the monetary model that the percentage change (increase/decrease) in prices is associated with the same percentage depreciation (appreciation) of the domestic currency does not hold completely. The estimated values, i.e. the elasticity of relative domestic and foreign prices, is less than one (0.79). Further, in some specifications, the coefficient on this variable is negative, suggesting sticky prices. A significant result is the passivity of exchange rate response to disequilibrium. The empirical analysis indicates prices' adjustment to eliminate disequilibrium.

Appendix A

The description of the variables is as follows:

s is the quarterly end-of-period nominal rupee-dollar exchange rate(line ae in IFS);

m_t and m_t^* takes into account two alternative definitions of the quarterly end-of-period money supply. Narrow money (line 34) and Broad money which is computed as the sum of narrow money (line 34) and quasi money (line 35) for India and US respectively;

y_t & y_t^* are proxied by the respective industrial production indices (line66);

r is the money market interest rate (line60b);

r^* is the quarterly average of the federal funds rate (line60b);

q & q^* are the log ratios of prices of tradable to non-tradable goods, proxied by the ratio of wholesale/consumer price levels for India and US respectively;

$q - q^* = \log(wpi / cpi) - \log(ppi / cpi^*)$ where

WPI and PPI are the quarterly average of wholesale and producer price levels for India and US respectively (line63);

CPI and CPI* are the quarterly average of consumer price levels for India and US respectively (line64);

p & p^* are the domestic and US consumer price inflation rates calculated as first difference of log CPI.

Appendix B

Table B.1
Johansen Cointegration Results
(Broad money with relative prices, coefficients normalised with respect to log exchange rate s)

Series	(1)	(2)	(3)
No. of C.V	3**,4*	2**	2**
s	1	1	1
$m - m^*$	1.008**	1.187**	0.243
	(0.020)	(0.091)	(0.146)
$y - y^*$	-0.417**	-0.867**	1.002**
	(0.042)	(0.104)	(0.123)
$i - i^*$	-0.003**		-0.003**
	(0.0001)		(0.0007)
$p - p^*$	-3.875**	-5.057**	
	(0.103)	(0.424)	
*	-0.329**	-0.618**	0.783*
	(0.045)	(0.199)	(0.299)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	0.022	0.054	0.014

	(0.341)	(0.236)	(0.276)
$\Delta(m - m^*)$	-0.240	-0.155	-0.145
	(0.249)	(0.173)	(0.216)
$\Delta(y - y^*)$	0.261	0.244	-1.220**
	(0.601)	(0.430)	(0.338)
$\Delta(i - i^*)$	29.429		-76.951*
	(51.185)		(34.159)
$\Delta(p - p^*)$	0.564*	0.417*	
	(0.209)	(0.151)	
$\Delta(q - q^*)$	-0.075	-0.062	-0.160
	(0.184)	(0.127)	(0.147)

Table B.2
Johansen Cointegration Results
(Broad money with wholesale relative prices, coefficients normalised with respect to log exchange rate s)

Series	(1)	(2)	(3)
No. of C.V	3**	1**,2*	2**
s	1	1	1
$m - m^*$	0.984**	1.196**	1.399**
	(0.012)	(0.050)	(0.175)
$y - y^*$	-0.370**	-0.772**	-1.163**
	(0.019)	(0.061)	(0.403)
$i - i^*$	-0.002**		0.0004
	(0.00008)		(0.001)
$p - p^*$	-1.913**	-1.972**	
	(0.058)	(0.196)	
*	-0.289**	-0.680**	-1.632**
	(0.026)	(0.104)	(0.351)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	-0.292	-0.141	-0.210
	(0.429)	(0.295)	(0.196)

$\Delta(m - m^*)$	-0.351	-0.170	0.079
	(0.327)	(0.227)	(0.157)
$\Delta(y - y^*)$	1.0006	0.960	0.931**
	(0.737)	(0.504)	(0.237)
$\Delta(i - i^*)$	44.930		3.440
	(66.557)		(27.804)
$\Delta(p - p^*)$	0.542	0.290	
	(0.328)	(0.246)	
$\Delta(q - q^*)$	0.296*	0.209	0.095
	(0.139)	(0.103)	(0.062)

Table B.3
Johansen Cointegration Results
(Narrow money with relative prices, coefficients normalised with respect to log exchange rate s)

Series	(1)	(2)	(3)
No. of C.V	3**	2**	2**,3*
s	1	1	1
$m - m^*$	0.590**	0.851**	0.531**
	(0.020)	(0.166)	(0.035)
$y - y^*$	-0.379**	-1.940**	0.285**
	(0.042)	(0.452)	(0.054)
$i - i^*$	-0.004**		-0.003**
	(0.0002)		(0.0003)
$p - p^*$	-2.865**	-7.603**	
	(0.147)	(1.590)	
$q - q^*$	0.791**	-0.810	1.173**
	(0.053)	(0.599)	(0.099)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	-0.259	-0.083	-0.067
	(0.389)	(0.118)	(0.489)
$\Delta(m - m^*)$	-0.259	0.0004	-1.681**
	(0.435)	(0.140)	(0.561)
$\Delta(y - y^*)$	0.068	0.187	-1.492*
	(0.550)	(0.168)	(0.573)
$\Delta(i - i^*)$	-39.629		-108.127
	(56.589)		(62.697)
$\Delta(p - p^*)$	0.603**	0.110	
	(0.202)	(0.076)	
$\Delta(q - q^*)$	-0.026	0.065	-0.704**
	(0.199)	(0.058)	(0.193)

Table B.4
Johansen Cointegration Results
(Narrow Money with wholesale relative prices)

Series	(1)	(2)	(3)
No. of C.V	3**.4*	2**	2**.3*
s	1	1	1
$m - m^*$	0.662**	0.838**	0.952**
	(0.023)	(0.110)	(0.155)
$y - y^*$	-0.554**	-1.183**	-1.685**
	(0.045)	(0.191)	(0.541)
$i - i^*$	-0.004**		-0.003*
	(0.0002)		(0.001)
$p - p^*$	-2.733**	-4.066**	
	(0.144)	(0.594)	
$q - q^*$	0.740**	0.554	-0.941*
	(0.058)	(0.273)	(0.431)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	-0.541	-0.209	-0.247
	(0.285)	(0.181)	(0.154)
$\Delta(m - m^*)$	-0.276	-0.308	0.136
	(0.392)	(0.241)	(0.217)
$\Delta(y - y^*)$	0.244	0.079	0.455*
	(0.478)	(0.304)	(0.202)
$\Delta(i - i^*)$	19.807		7.838
	(47.561)		(22.372)
$\Delta(p - p^*)$	0.516*	0.397**	
	(0.235)	(0.138)	
$\Delta(q - q^*)$	0.215	0.149*	0.115*
	(0.110)	(0.069)	(0.051)

Table B.5
Johansen Cointegration Results
(m and m separately with broad money and relative prices)*

Series	(1)	(2)	(3)
No. of C.Vs	4** 5*	3**	3** 4*
s	1	1	1
m	-0.072**	-0.068	8.944
	(0.015)	(0.122)	(7.620)
m^*	-1.273**	-1.662**	7.466
	(0.010)	(0.108)	(7.300)
$y-y^*$	-0.311**	-0.715**	6.465
	(0.008)	(0.073)	(5.304)
$i-i^*$	-0.002**		-0.006
	(0.00004)		(0.005)
$p-p^*$	-2.603**	-2.467**	
	(0.023)	(0.172)	
$q-q^*$	1.015**	0.120	-6.886
	(0.020)	(0.142)	(6.402)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	0.203	-0.171	0.015
	(0.382)	(0.334)	(0.033)
Δm	-0.146	0.056	-0.022
	(0.195)	(0.176)	(0.017)
Δm^*	0.118	0.372**	-0.007
	(0.165)	(0.113)	(0.014)
$\Delta(y-y^*)$	0.696	1.415*	-0.188**
	(0.715)	(0.557)	(0.038)
*	105.381		-12.310**
	(59.754)		(4.210)
$\Delta(p-p^*)$	0.766**	0.207	
	(0.201)	(0.252)	
*	-0.452*	-0.286	0.007
	(0.177)	(0.171)	(0.018)

Table B.6
Johansen Cointegration Results
(m and m separately with broad money and wholesale relative prices)*

Series	(1)	(2)	(3)
No. of C.Vs	4** 5*	3**	3** 4*
s	1	1	1
m	0.510**	0.257*	1.315**
	(0.030)	(0.113)	(0.093)
m^*	-1.017**	-1.458**	-0.858**
	(0.014)	(0.069)	(0.052)
$y - y^*$	-0.163**	-0.618**	-0.198**
	(0.014)	(0.054)	(0.056)
$i - i^*$	-0.002**		-0.0001
	(0.00008)		(0.0004)
$p - p^*$	-1.594**	-1.972**	
	(0.047)	(0.180)	
$q - q^*$	-0.277**	-0.353**	-1.405**
	(0.020)	(0.117)	(0.099)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	-0.244	-0.104	-0.054
	(0.605)	(0.368)	(0.444)
Δm	-0.288	0.016	-0.087
	(0.315)	(0.201)	(0.243)
Δm^*	0.865**	0.487**	0.528**
	(0.151)	(0.111)	(0.118)
*	-0.065	1.075	0.405
	(1.179)	(0.691)	(0.792)
*	37.544		-50.086
	(103.203)		(66.298)
$\Delta(p - p^*)$	0.762	0.286	
	(0.454)	(0.309)	

$\Delta(q-q^*)$	0.227	0.130	0.243
	(0.214)	(0.141)	(0.133)

Table B.7

Johansen Cointegration Results

(m and m separately with narrow money and relative prices)*

Series	(1)	(2)	(3)
No. of C.V.	3**	3** 4*	3** 4*
s	1	1	1
m	0.175*	1.136**	0.219*
	(0.078)	(0.228)	(0.081)
m^*	-1.366**	-0.587*	-1.600**
	(0.009)	(0.251)	(0.103)
$y-y^*$	-0.286*	-1.883**	-0.128
	(0.132)	(0.376)	(0.091)
$i-i^*$	-0.003**		-0.005**
	(0.0006)		(0.0005)
$p-p^*$	-1.669**	-2.080**	
	(0.377)	(0.691)	
$q-q^*$	1.863**	-2.293*	1.629**
	(0.279)	(0.928)	(0.264)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	-1.194	-0.329	-0.383
	(0.443)	(0.161)	(0.350)
	0.366	0.106	0.084
	(0.280)	(0.125)	(0.251)
Δm^*	-0.670**	0.319**	0.757**

	(0.162)	(0.068)	(0.120)
$\Delta(y - y^*)$	-0.067	0.199	-0.028
	(0.411)	(0.167)	(0.347)
$\Delta(i - i^*)$	-80.747		-49.070
	(45.328)		(39.258)
$\Delta(p - p^*)$	0.247	-0.098	
	(0.189)	(0.078)	
$\Delta(q - q^*)$	0.090	0.106	0.075
	(0.137)	(0.050)*	(0.117)

Table B.8

Johansen Cointegration Results:

(m and m separately with narrow money and relative wholesale prices)*

Series	(1)	(2)	(3)
No. of C.Vs	3** 4*	3**	3**
s	1	1	1
m	0.359**	0.487**	0.630**
	(0.100)	(0.134)	(0.124)
m^*	-0.897**	-1.089**	-0.975**
	(0.105)	(0.155)	(0.143)
$y - y^*$	-0.604**	-0.490*	-1.431**
	(0.160)	(0.183)	(0.347)
$i - i^*$	-0.003**		-0.002
	(0.0009)		(0.001)
$p - p^*$	-7.842**	-7.362**	
	(1.128)	(1.045)	
*	1.597**	1.544**	-1.390*
	(0.278)	(0.394)	(0.489)

The Adjustment Coefficient (Vector Error-Correction Estimation):

Series	(1)	(2)	(3)
Δs	0.138	0.105	-0.169

	(0.133)	(0.124)	(0.185)
Δm	-0.082	-0.197*	0.212
	(0.101)	(0.092)	(0.132)
Δm^*	0.219**	0.256**	0.397**
	(0.065)	(0.062)	(0.076)
$\Delta(y - y^*)$	-0.312*	-0.363**	0.099
	(0.133)	(0.124)	(0.210)
$\Delta(i - i^*)$	-19.255		-23.912
	(15.307)		(21.22)
$\Delta(p - p^*)$	0.238**	0.238**	
	(0.060)	(0.057)	
$\Delta(q - q^*)$	0.025	0.025	0.085
	(0.036)	(0.035)	(0.047)

Appendix C

Unit Root Tests

Series	ADF	PP	ADF	PP	With Structur
s	-2.47	-2.03	-3.97	-5.58*	-2.29
$m - m^*$	-2.34	-2.06	-6.17*	-5.39*	-0.66
$p - p^*$	-3.88	-4.89*			-2.73
$y - y^*$	-2.33	-2.64	-7.39*	-15.01*	-0.51
$i - i^*$	-2.16	-3.64	-5.10*	-10.67*	-3.01
$q - q^*$	-1.65	-1.66	-5.97*	-5.67*	-0.79

- * Indicates significance at 1 per cent level. D-F critical values are -4.24, -3.54 and -3.20 at 1, 5 and 10 percent respectively; one per cent and 5 percent critical values for the structural break regression are
- –4.34 and –3.72 respectively.

Appendix D

Tests for Absolute and Relative PPP:

(Dependent Variable is the trade-weighted real exchange rate)

		$s_t = a + b\left(\frac{p}{p^*}\right)_t + u_t$				$\Delta s_t = a + b\Delta\left(\frac{p}{p^*}\right) + u_t$		
Seri	C.V	CPI	WPI	WPI/	ECM	ΔCPI	ΔWP	Δ(WPI/CP
RE	Yes	0.215			-0.347	-	-	0.025
		(0.02			(0.128)	(0.12	(0.48	(0.661)
RE	Yes		0.272		-0.357			

		(0.01		(0.102)
RE	Yes		-	0.463
			(0.06	(0.258)

References

CMIE (2000), Monthly Review of the Indian Economy, May 2000

Chinn, M & R. Meese (1995) Banking on Currency Forecasts: Is Change in Money Predictable? *Journal of International Economics,* 38 (1-2): 161-178.

Chinn, M. D. (1998) On the Won and Other East Asian Currencies, *National Bureau of Economic Research Wkg. Paper* no. 6671.

Dickey, D. A., Jansen, D. W. & Thornton, D. L. (1991) A Primer on Cointegration with Application to Money and Income, *Federal Reserve Bank of St. Louis Review*, 73 (March/April): 58-78.

Wolff, C. P. (1987) Time-Varying Parameters and the Out-of-Sample Forecasting Performance of Structural Exchange Rate Models, *Journal of Business and Economic Statistics*, 5 (1): 87-97.

Dornbusch, R. (1976) The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy, in *Jacob Frenkel & Harry Johnson*, eds, *The Economics of Exchange Rates* (Reading, MA: Addison-Wesley).

Edwards, S. (1983) Floating Exchange Rates in Developing Countries: A Monetary Analysis of Peruvian Experience, *Journal of Money, Credit and Banking*, 15: 73-81.

Frenkel, J. A. & M. L. Mussa (1985) Asset Markets, Exchange Rates and the Balance of Payments, in: *R. B. Jones & P.B. Kenen*, eds. *Handbook of International Economics*, Vol II (North-Holland, Amsterdam).

Government of India, Economic Survey, *Various Issues*.

Levich, R. M. (1985) Empirical Studies of Exchange Rates: Price Behaviour, Rate Determination and Market Efficiency, in: *R. B. Jones & P.B. Kenen*, eds. *Handbook of International Economics,* Vol II (North-Holland, Amsterdam).

Lucas, R. E. Jr. (1976) “Econometric Policy Evaluation: A Critique” In Brunner, K. and Allan Meltzer (Eds.) *Carnegie-Rochester Series on Public Policy, Vol. 1*. Amsterdam, North-Holland, 1976: 19-46.

MacDonald, R. & M.P. Taylor (1992) Exchange Rate Economics: A Survey, *IMF Staff Papers* 39: 1-57.

MacDonald, R. (1988) Floating Exchange Rates: Theories and Evidence (Allen and Unwin, London.).

Meese, R. & K. Rogoff (1983a) Empirical Exchange Rate Models of the Seventies: Do they fit out of sample*? Journal of International Economics*, 14: 3-24.

Meese, R. & K. Rogoff (1983b) The out-of-sample failure of empirical exchange-rate models: Sampling error or Misspecification? In *J. A. Frankel*, ed. *Exchange Rates and Inernational Macroeconomics* (University of Chicago Press, Chicago).

Meese, R. (1990) Currency Fluctuations in the Post-Bretton Woods Era, *Journal of Economic Perspectives*, Vol. 4 (1-2): 117-134.
Lyons (1992)

Mussa, M. (1986) Nominal Exchange Rate Regimes and the Behaviour of Real Exchange Rates: Evidence and Implications, *Carnegie-Rochester Series on Public Policy, Autumn* 1986, 25: 117-213.

Odedokun, M. O. (1997) The Monetary Approach to Analysing Floating Exchange Rate Behaviour in Developing Countries: Evidence from sub-Saharan Countries, 1986-92, *Journal of Development Economics*, 52: 463-481.

Reserve Bank of India Report on Currency & Finance, Various Issues.

Rogoff, K. (1996) The Purchasing Power Parity Puzzle, Journal of Economic Literature, 34: 647-668.

CONTENTS