The Extent of Exchange Rate Flexibility in India: Basket Pegger or Closet US Sollar Pegger?

Tony Cavoli and Ramkishen S. Rajan*
*School of Commerce, University of South Australia, Adelaide, Australia.
*School of Public Policy, George Mason University, VA.

This article examines the degree of *de facto* exchange rate flexibility for India over the last two decades. While there is a diversity of methods that measure *de facto* exchange rate regimes, none individually encapsulate all the applicable characteristics of an actual regime. It is therefore essential to employ a range of measures so that as many of the salient characteristics possible are captured, as well as to ensure the robustness of the results. While the Reserve Bank of India (RBI) is commonly believed to target the Real Effective Exchange Rate (REER), the results in this paper indicate that the Indian rupee is predominantly influenced by the US dollar, with the euro slowly gaining in significance as well.

JEL Classification: F31, F33
Keywords: India, Currency Basket, Managed Float, Real Effective Exchange Rate (REER), Reserve Bank of India (RBI)

1. Introduction

A defining characteristic of developing Asia as an economic entity is the acute intra-regional heterogeneity that exists among Asian economies in terms of levels of economic development, rates of economic growth, and economic

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structures. A similar degree of heterogeneity is apparent in the types of exchange rate regimes officially operated by Asian central banks. For instance, China and Malaysia maintained firm US dollar (USD) pegged regimes until 21 July 2005, and Hong Kong continues to do so. Korea, Philippines, Thailand and Indonesia officially operate inflation targeting regimes with the interest rate as the monetary policy instrument (Cavoli and Rajan 2005). India and Singapore are commonly believed to operate managed floats in the sense of targeting the effective or trade-weighted exchange rate. In particular, while the Monetary Authority of Singapore (MAS) has officially targeted its nominal effective exchange rate (NEER) (around a band) since 1981, it is generally believed that the RBI targets the REER, at least over the medium term (Kumaraswamy 2003).[1]

While recent research has focused on East Asia (see Cavoli and Rajan 2005, on Indonesia, Korea, Philippines and Thailand, and Cavoli and Rajan 2006, on Singapore), scant attention has been paid to India, which is a large and rapidly growing economy and is gradually integrating with the global economy (Figure 1 summarizes trends in India's balance of payments). This article focuses on the degree of *de facto* exchange rate flexibility. How flexible is the Indian rupee (INR), and to the extent that the INR is managed, what is it being managed against, that is, the USD, euro, yen, or a basket of currencies? These are some of the issues explored in this article.

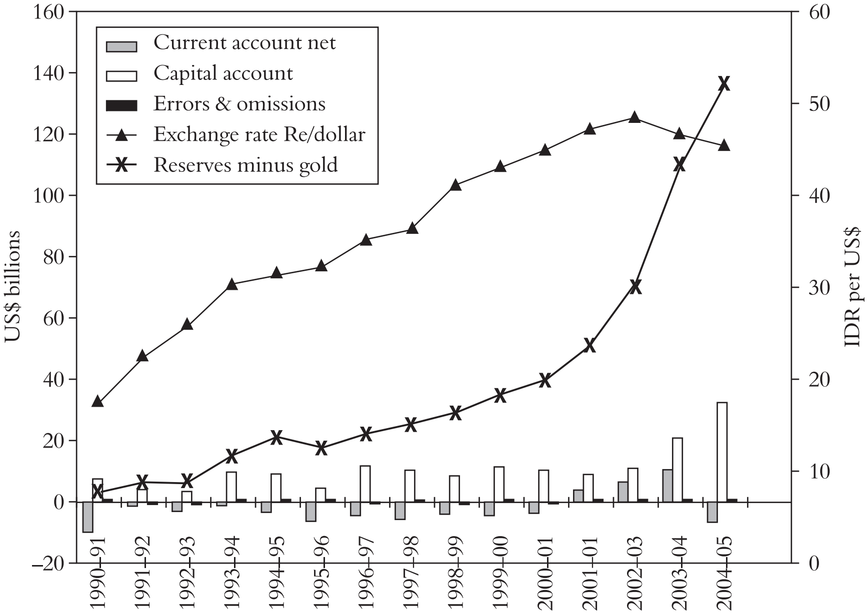
Diverse methods are commonly used to measure *de facto* exchange rate regimes. However, no single measure encapsulates all the applicable characteristics of an actual regime. It is, therefore, essential to employ a range of measures so that maximum number of the salient characteristics of each regime are captured, as well as to ensure the robustness of the results. Section 2 examines the degree of influence that a vector of major currencies has on the home currency. This is done by employing Frankel and Wei (1994) regressions for the INR.[2] The method essentially involves conducting an Ordinary Least Squares (OLS) test of the local currency on other currencies that are considered to influence the former. The basic estimation is augmented here by employing time-varying parameter estimation techniques through recursive OLS. Section 3 constructs and examines two exchange rate flexibility indices centred on the nexus between exchange rates and

[1] We say 'generally believed' as the RBI has, since 1993, Officially stated that the focus of its exchange rate policy is to 'manage volatility'. Of this could mean many things. Joshi and Sanyal (2004) argue that India has been pursuing REER targeting with respect to five target currencies, viz. US, Japan, UK, Germany and France at the 1993–94 level.

[2] Such regressions have recently been used in several subsequent studies, including McKinnon (2001), Gan (2000), and Cavoli and Rajan (2005, 2006).

FIGURE 1

Trends in India's balance of payments transactions, 1990–2004



Source: Reserve Bank of India (RBI) and www.indiainfoline.com
Note: India's fiscal year is from 1 April to 31 March.

foreign reserves. The first involves some preliminary testing around a simple index, while the second constructs an alternative index based on those from Baig (2001), Bayoumi and Eichengreen (1998), and Glick and Wihlborg (1997). Section 4 further examines the degree of exchange rate flexibility by using a simple Generalised Autoregressive Conditional Heteroskedasticity (GARCH) technique such as that found in Dominguez (1998), and Guimãeres and Karacagdag (2004). Section 5 concludes the article with a brief summary.

Note that unless otherwise stated, the empirical analysis in the article is based on monthly observations for the period 1985:1 to 2004:12.[3] The data is from the IMF International Financial Statistics (IFS). Exchange rate data are taken from line RF (RH for the pound sterling) and the cross rates for the local currency against the yen, pound, euro and Swiss franc are calculated from the quoted bilateral exchange rates. Foreign reserves data for India are calculated as net foreign assets (*line 11–line 16c*) scaled by lagged money base

[3] Data using euros are for the period 1999:1 to 2004:12.

(*line 14*). The NEER and REER data for India are from the RBI (www.rbi.org.in).

2. Regression-based Approach to Exchange Rate Movements

This section examines the degree of influence between the target currency (Indian rupee or INR) and a vector of major currencies including the US dollar, the Japanese yen, the UK pound and the euro. We do this by employing Frankel–Wei regressions as shown in Equation 1 below:

$$\Delta e_t = \alpha_0 + \alpha_1 \Delta US_t + \alpha_2 \Delta JP_t + \alpha_3 \Delta UK_t + \alpha_4 \Delta EU_t + \mu_t \quad (1)$$

All currencies are expressed in logs, the numeraire currency is the Swiss franc, and *e* refers to the INR.

The higher the values of α corresponding to each major currency, the larger is the degree of influence of that currency on the INR. As such, a high degree of influence provides some information about the possible degree to which the local currency is fixed to the major currency. However, a large (close to 1) coefficient value does not automatically imply a pegged exchange rate; it may merely reflect a naturally occurring market-driven correlation between two currencies. As such, the standard deviation of the α coefficients provides additional useful information. A small standard deviation is more likely to imply an attempt to systematically maintain the correlation between two currencies by way of intervention (Baig 2001), whereas a larger one potentially supports the idea of the two currencies being naturally correlated. We use a time series of monthly observations from 1985:1 to 2004:12 for most of the regressions except in the case of the euro wherein the sample is 1999:1 to 2004:12. This allows us to examine the particular significance of the euro as a major currency since it actually came into existence.

The standard time-invariant OLS estimates for India are summarized in Table 1. It is noticeable that the USD is the dominant currency in determining the value of the INR (about 80 per cent), both in magnitude and in statistical significance (also see Shah and Patnaik 2005). The influences of both the yen and the pound appear to be small and are statistically insignificant. Another noticeable result is the economic and statistical significance of the euro parameter for the estimates in the second and third columns of Table

1, as well as an increase in the overall goodness of fit.[4] This is suggestive of the euro becoming a more significant currency in determining movements in the Indian rupee post-1999 (about 20 per cent). However, it is somewhat unclear whether the euro's t-stat (2.01–2.63) is actually indicative of policy intervention or is capturing market-induced movements. In other words, we are not able to clearly decipher whether the results are capturing the possibility that the RBI is closely pegging the INR to the euro as a conscious policy decision, or merely reflecting a market-driven phenomenon (since Europe is India's largest trading partner). The relative insignificance of the yen on the INR—in contrast to East Asian currencies (see Cavoli and Rajan 2005, 2006)—is understandable in view of the rather weak economic linkages between the two countries including with regard to trade (and investment) (Table 2).

TABLE 1

Frankel–Wei OLS estimates

Dependant variable	*Indian rupee*	*Indian rupee*	*Indian rupee*
Constant	0.01(4.46)***	0.00(0.47)	0.00(0.53)
US dollar	0.83(17.43)***	0.90(19.18)***	0.86(15.65)***
Japanese yen	0.03(0.48)	0.07(1.52)	0.06(1.36)
UK pound	0.07(1.16)	–	0.11(1.22)
Euro	–	0.28(2.43)**	0.25(2.01)**
Adj R-sq	0.62	0.90	0.90
DW	1.76	1.64	1.63
Obs	241	72	72

Source: Authors

Notes: Figures in brackets are t-stats. All currencies are expressed per Swiss Franc and are in log differences. (*), (**) and (***) represent 10 per cent, 5 per cent and 1per cent significance levels, respectively.

We expand the Frankel–Wei analysis by re-estimating Equation 1, using recursive OLS estimates. Recursive OLS simply involves estimation of the equation by repeatedly using sub-sets of the sample data that are increased by one observation with each iteration.[5] Such recursive estimates allow us to

[4] Given the possibility of multi-collinearity between the euro and pound sterling, we consider a specification with the euro and pound included simultaneously, as well as the case without the sterling. As can be seen from Table 1, the results are largely unchanged.

[5] We estimated the initial regression by using the same number of observations as there are coefficients to be estimated in the vector. Thus, the first 18 months of values are volatile and ignored given the low degrees of freedom. As a robustness exercise, we also employ Kalman Filter tests, of which recursive OLS is a special case. The results are broadly unchanged and, therefore, not reported here.

TABLE 2

Direction of merchandise trade for, 2002*

	Export share (%)	*Import share (%)*	*Total trade share (%)***
		India	
USA	20.7	7.2	13.4
Eurozone-12	21.9	20.4	21.1
UK	4.7	4.5	4.6
Japan	3.5	3.0	3.2
Emerging Asia***	12.0	14.6	13.4
Others	37.2	50.2	44.2
Total	100	100	100

Source: Directorate General of Commerce and Industry, India
Notes: *) India's fiscal year for 2002–2003.
**) Total trade = Exports plus Imports.
***) Emerging Asia includes ASEAN, Korea and China and India.

track the evolution of the coefficients over time. It thus allows us to ascertain whether one of the major currencies is becoming more or less influential in comparison to another.

The results of the recursive regressions are presented in Figure 2. Each figure contains the dynamic properties of the coefficients for the US dollar, the Japanese yen, the pound and the euro. The influence of the euro is especially apparent in the latter part of the sample. Figure 2 makes clear that the USD is clearly the dominant influence on the INR over the sample. It is noticeable that the influence of the USD has actually increased over the sample from about 0.6 to around 0.9. It can also be seen that, from 1985 to 1993, the degree of influence of the pound was around 0.2 to 0.3, but from 1993 onwards, it became all but negligible. Note also that the influence of the yen increased slightly post 1999. After a period of some fluctuation, the influence of the euro on the INR seems to be increasing. Interestingly, while the euro's influence on the INR has risen quite markedly in significance over the last few years, it has not done so at the expense of the USD.[6]

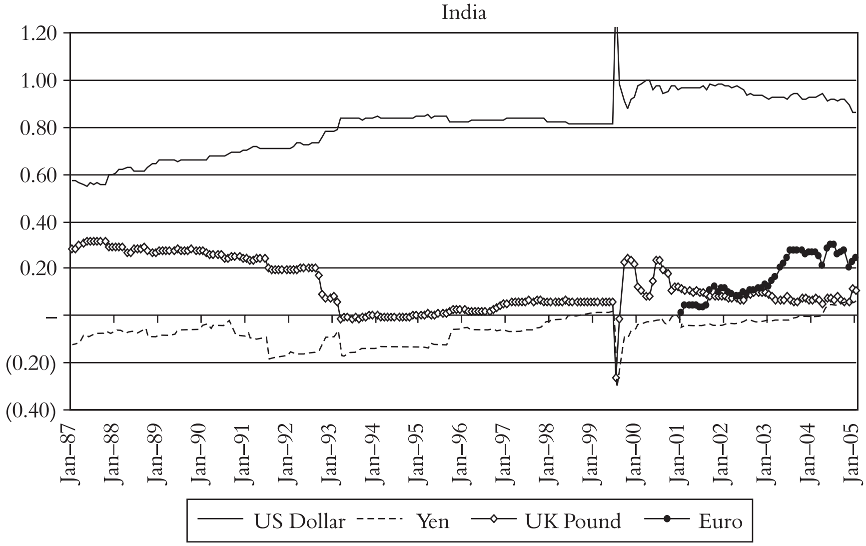
3. Exchange Rate Flexibility Indices

Another common measure of exchange rate behaviour, adopted in this article, is the exchange rate flexibility index. There are a number of different types of such indices based on the idea of exchange market pressure (EMP). The

[6] This leaves us with the next question as to exactly what type of USD pegger India is. We return to this issue in section 5.

FIGURE 2

Recursive OLS estimates of Frankel–Wei regression



Source: Authors.

theoretical foundation for EMP stems from a basic monetary model incorporating the demand for money, its supply and relative purchasing power parity (PPP) (see for instance, the seminal contribution from Girton and Roper 1977, as also Tanner, 2001, Pentecost, et al., 2001, and Guimãeres and Karacadag, 2004).

$$Index\ 1 = \boldsymbol{\Delta} e - \boldsymbol{\Delta} f = \Delta d - \Delta p^{*} - \beta \Delta y + \alpha \Delta i \qquad (2)$$

Equation 2 is the usual equation for EMP. The level of flexibility of an exchange rate regime (or the degree of exchange market pressure) can be ascertained from the left-hand side of equation 2—the relationship between the exchange rate and foreign reserves, $(\Delta e - \Delta f)$.[7] A low index value in this instance may imply either less exchange rate flexibility or a higher level of intervention. Other things being equal, a higher reserve volatility reduces the index value, possibly suggesting that reserves are being employed as a monetary policy tool in order to limit the exchange rate flexibility. A caveat is in order. Ideally, one would need to cleanse the reserve data to focus only on reserves change due to policy intervention rather than valuation changes.

[7] The other variables in equation (2) are, respectively, change in domestic credit, change in foreign prices, change in foreign output, and change in the domestic interest rate.

However, this is not possible, as most countries do not provide data on the currency composition of reserves.

Figure 3 presents values of *Index* 1 for India by using a number of bilateral currency pairs as well as the REER and the NEER. The index is constructed by taking the absolute value of the log difference of each exchange rate series and the absolute value of the (per cent) difference between the level of reserves (net foreign assets) and their HP (Hodrick–Prescott filtered) trend and scaled by lagged money base. De-trending the reserves data is designed to control for the possible central bank stockpiling of reserves for precautionary motives. Specifically, we know that India, like most of its other Asian counterparts, has been accumulating reserves since 1998, a reflection of the fact that the currency has been suppressed relative to its short-term market value (Figure 1).[8] However, we are interested here in the management of volatility as opposed to the management of the value of the exchange rate. Reserve differences (from trend) are scaled by lagged domestic monetary base in order to compare the magnitude of the reserve change in relation to the stock of money base in the system.[9] The result is an index that is more easily interpretable than if absolute values were to be taken.

Table 3 presents some descriptive statistics and stationarity test results for *Index 1* for India. From the individual currency pairings in Table 3, it can be seen that the mean and median index values for the exchange rate versus the US dollar (USD) are lower than the others. This signifies the possibility of intervention in that currency pair (INR/USD), while the higher mean/median values for the other currency pairs and the higher standard deviation in the yen provides evidence of additional exchange rate flexibility (or less intervention). Importantly, these figures confirm the Frankel–Wei tests in the previous section wherein a high degree of influence of the USD on the INR was revealed.

We can use *Index 1* to investigate whether the index has changed over time. This might offer evidence of a change in regime or a change in the index value of one currency at the expense of another. As such, we conduct stationarity tests to ascertain if there is any mean-reversion in the data. Table 3 also presents the results of two such tests for each country and currency, such as ADF and Kwiatkowski-Phillips-Schmidt-Shin (KPSS).[10] All the ADF

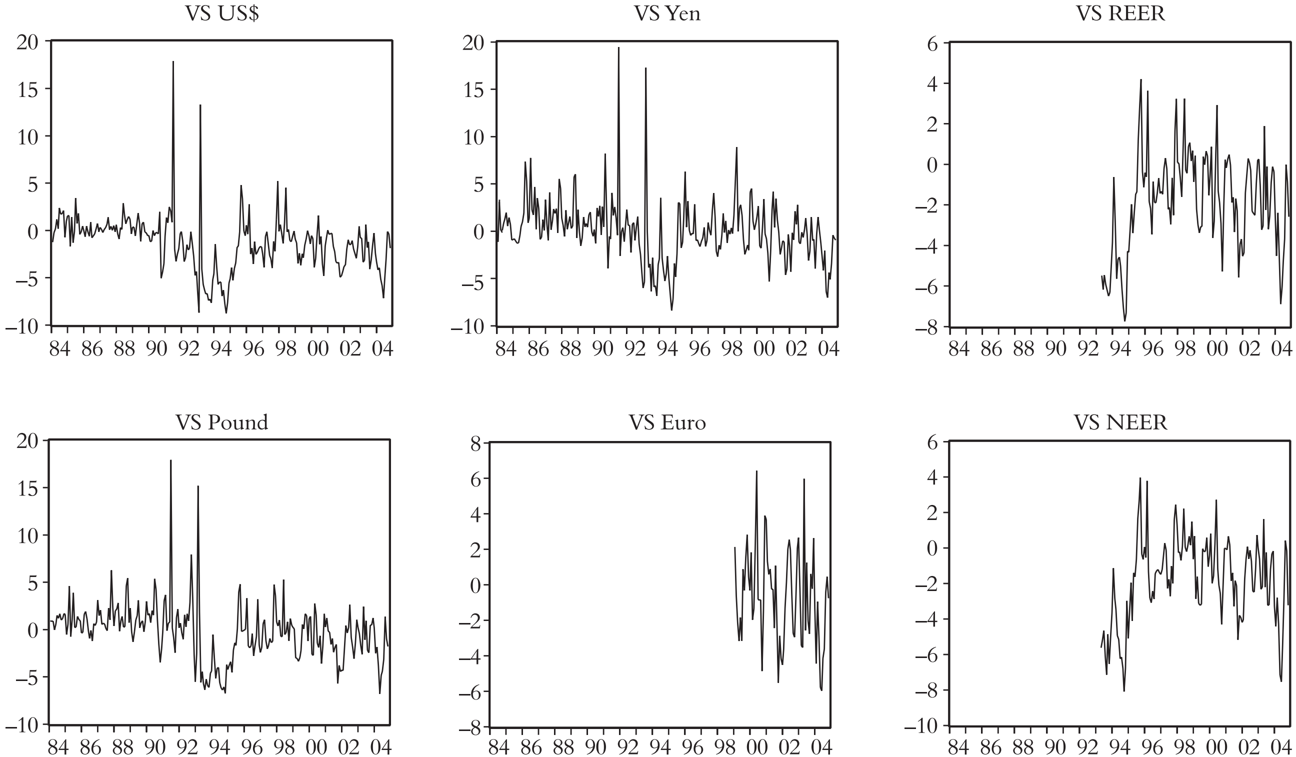
8 See Willett et al. (2005), for a discussion of problems with trends in reserves data and various ways of dealing with it.

9 This method of measuring reserve changes is quite common in the EMP literature (for instance, see Bayoumi and Eichengreen 1998; Tanner 2001; Pentecost et al. 2001; and Baig 2001). We will consider these measures at a later stage.

10 It is well-known that the ADF test has low power in predicting the difference between unit root and near unit root processes. As such, the KPSS test for stationarity is included for robustness. The lag length for ADF and KPSS tests are selected by applying the Schwartz criteria.

FIGURE 3

***Index 1*, Exchange rate flexibility index for Indian rupee**



Source: Authors.

TABLE 3

Index 1, Descriptive statistics and unit root tests of the Indian rupee

	vs. USD	*vs. Yen*	*vs. Euro*	*vs. Pound*	*vs. REER*	*vs. NEER*
Mean	–1.33	0.04	–0.72	–0.23	–1.46	–1.84
Median	–0.92	–0.07	–0.68	0.02	–1.30	–1.49
Maximum	17.91	19.47	6.43	17.93	3.79	3.98
Minimum	–8.79	–8.40	–5.98	–6.81	–8.33	–8.09
Standard dev.	2.92	3.24	2.66	3.00	2.32	2.39
Skewness	1.23	1.36	0.27	1.22	–0.41	–0.34
Kurtosis	12.00	10.51	2.89	10.16	3.49	2.95
Observations	250	250	70	250	122	139
ADF	–6.89	–11.28	–5.20	–9.74	–4.98	–4.71
1% level	–4.00	–4.00	–2.60	–4.00	–3.48	–3.48
5% level	–3.43	–3.43	–1.95	–3.43	–2.88	–2.88
10% level	–3.14	–3.14	–1.61	–3.14	–2.58	–2.58
KPSS	0.16	0.11	0.05	0.11	0.25	0.24
1% level	0.22	0.22	0.22	0.22	0.22	0.22
5% level	0.15	0.15	0.15	0.15	0.15	0.15
10% level	0.12	0.12	0.12	0.12	0.12	0.12

Source: Authors.
Note: Lag length for ADF and KPSS tests are selected by Schwartz Criteria.

tests for India show a rejection of the null hypothesis of a unit root, suggesting that the index has not shifted over time. The results for the KPSS test for the currency *pairs* tested are consistent with the ADF results in that they present a non-rejection of the null of stationarity. In contrast, the evidence for REER and NEER is mixed, with the KPSS tests showing a rejection of stationarity and the ADF tests showing a rejection of a unit root (non-stationarity).

Using *Index 1* as a baseline measure, we can construct alternative measures of exchange rate flexibility. Consider the following:

$$\text{Index } 2 = \Delta e \,/(\Delta e + \Delta f) \qquad (3)$$

where Δe (Δf) are as calculated in the previous section with the exception that we take the 12 monthly mean of Δe and Δf to form non-overlapping annual mean absolute deviations in each series. The index is intentionally constructed in this manner such that it returns a value between zero and one. The closer *Index 2* is to one, the more flexible will be the exchange rate regime for each year.[11] Following Baig (2001), Bayoumi and Eichengreen

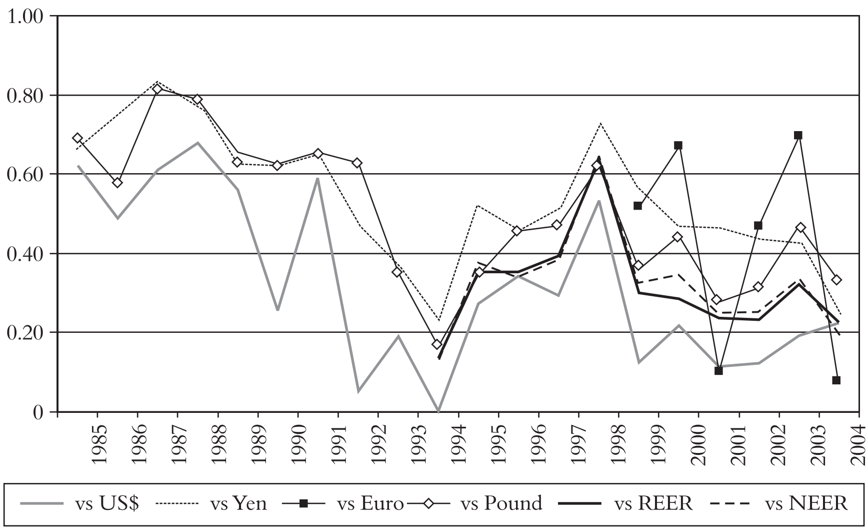
[11] Note that 1- $\Delta e\,/(\Delta e + \Delta f) = \Delta f\,/(\Delta e + \Delta f)$, which is defined as a measure of exchange rate intervention. An index such as Index 2 can also be constructed by using standard deviations, e.g. $\sigma_{\Delta e} / \sigma_{\Delta e} + \sigma_{\Delta f}$. See Baig (2001), and also Calvo and Reinhart (2002), where variances are used. The index values using standard deviations were also calculated as a robustness exercise. The results are broadly similar to those for index 2 and are not reported here. They are available on request.

(1998) and many others, we exclude interest rate volatility, partly because it is not always clear whether interest rate variations capture policy changes or general market conditions. In addition, even if we could show that the central bank has pursued an activist interest rate policy, it could either be used in support of exchange rate stability (taht is the price target) or in defence of a certain target level of reserves (that is the quantity target).

The results of the estimations of *Index 2* are highlighted in Figure 4. It is apparent that the Indian rupee's flexibility against the yen, pound and euro has remained quite high over the entire sample period. The degree of flexibility of the USD seems to have reduced materially since about 1996. Of particular significance is the fact that after 1996, the index of the INR vis-à-vis the USD has consistently been lower than even the REER-based index, indicating a possible USD peg in the latter part of the sample. The results are consistent with those of *Index 1* and the Frankel–Wei tests with regard to the important role played by the USD in 'impacting' the INR.

FIGURE 4

***Index 2*, Exchange rate flexibility index for Indian rupee**



Source: Authors.

4. Simple Garch Model of Indian Rupee

The final method of examining exchange rate flexibility is to estimate a simple GARCH model. The GARCH model essentially allows us to observe the conditional volatility of the exchange rate, h_t, once the influence of the effect of possible intervention and other influences are controlled for. In effect, it provides information about the underlying flexibility of a currency. We are interested in estimating a simple model with a view to assessing the relationship between reserves and the exchange rate, and to investigate whether the results are consistent with the results in previous sections. As with Dominguez (1998), the effect of possible intervention (using reserves) is captured in the mean equation, equation 3 by Δf_t, and in the variance equation, equation 5 by its absolute value $|\Delta f_t|$.[12] We estimate the following model:

$$\Delta e_t = b_0 + b_1(L)\Delta e_{t-1} + b_2\Delta f_t + b_3X_t + \mu_t \tag{4}$$

$$\mu_t \sim N(0, h_t) \tag{5}$$

$$h_t = \beta_0 + \beta_1(L)\,\mu_t^2 + \beta_2(L)h_{t-1} + \beta_3|\Delta f_t| + \beta_4|X_t| + \varepsilon_t \tag{6}$$

where all variables are as defined previously except X_t, a vector of other variables deemed to influence the (log difference of) exchange rate and $|\cdot|$ is the absolute value operator. The elements of X_t employed in this study are those from equation 2 and the decision about their inclusion was determined, along with lag length for Δe and the ARCH and GARCH terms, by applying the Schwartz Criteria. Other ARCH-based estimation methods (such as EGARCH) were also considered and assessed by the Schwartz Criteria.

Table 4 presents the estimates to the model. There is some evidence across both equations of statistically significant relationships between reserve changes and exchange rate changes, which, in a sense, provide an empirical justification for the indices used in the above sections. However, it is interesting to note that reserve changes are statistically significant for the USD in the mean equation but not in the variance equation. This is a possible indication of a desire for the authorities to lean against the wind with regard to the USD. Figure 5 presents the conditional standard deviations, $\sqrt{h_t}$, of the INR against the USD, yen, pound and euro. The flexibility of the INR against the USD is clearly lower than for other currencies. This is consistent with the analyzes in the previous sections. The high variability of the series might suggest that while the correlation between the INR and the USD is high, it might not be reflective of *systematic* intervention.

[12] In a recent paper using this technique, Guimarães and Karacadag (2004) adopt an asymmetric component threshold GARCH (ACT-GARCH) model that tests volatility at different time horizons. This is made possible because of the availability of daily intervention data for Mexico and Turkey.

TABLE 4

GARCH estimates for Indian rupee

	Indian rupee per:			
Dep variable	*US*	*Yen*	*UK*	*Euro*
Mean equation				
Constant	0.21***	0.68***	0.53***	0.35
Lagged Δe	0.02	0.23***	0.16***	0.31***
Δf	–0.10 ***	–0.03	0.01	0.05
Variance equation				
Constant	0.01	5.76*	1.42**	1.76 ***
ARCH (1)	4.25***	0.06	0.62	0.15***
GARCH (1)	0.08 *	–0.32	0.58***	0.79 ***
ARCH (2)			–0.37	
GARCH (2)			0.09	
$\lvert\Delta f\rvert$	0.02	3.25 **	–0.17 **	–0.48 ***

Source: Authors.

Notes: The table presents estimates from the GARCH model given by Equations 4-6. Lag length and variables present above were selected on the basis of SBC criteria. The exception is Δf as we wish to assess the relationship between it and Δe.
(*) (**) and (***) represents 10 per cent, 5 per cent and 1per cent significance levels, respectively.

5. Concluding Remarks

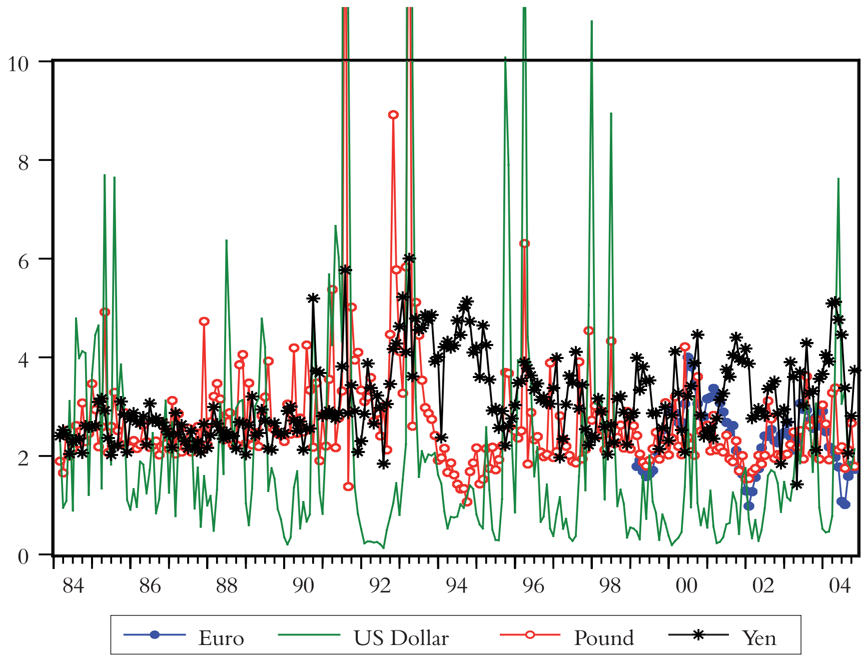
Despite the fact that different types of exchange rate flexibility measures are designed to capture different characteristics of exchange rate behaviour, our empirical analysis appears to indicate that there is a great deal of convergence in the way exchange rate regimes can be viewed over the sample. The time-varying coefficients from the recursive OLS tests for India reveal that the US dollar has become increasingly influential towards the latter part of the sample period. This is suggestive of a greater desire by the RBI to manage the currency vis-à-vis the US dollar (also see Shah and Patnaik 2005). The exchange rate flexibility index reiterates this conclusion; the degree of flexibility of the Indian rupee against the US dollar decreased steadily since 1996–97. The recursive OLS tests and the flexibility index also seem consistent with respect to the Indian rupee's movements against other major currencies.

The conclusion that the Indian rupee is a *de facto* soft US dollar peg is consistent with Reinhart and Rogoff (2004), who have classified India as a *de facto* crawling peg to the US dollar (that is, a peg with a drift).[13] To be more

[13] Using slightly different exchange rate flexibility indices than those used in this article, Willett et al. (2005), arrive at a similar conclusion on the Indian rupee and even go on to use it as a benchmark for pegged regimes. Also see Patnaik (2004), who concludes that India has been operating a soft US dollar peg and goes on to detail India's experience with managing such an arrangement, focusing on capital flows and reserve build-up.

FIGURE 5

Conditional standard deviations from the GARCH model (equations 4–6) for the Indian rupee



Source: Authors.

specific, Reinhart and Rogoff (2004) characterize India as a *de facto* crawling US dollar peg between July 1995 and December 2001, and a *de facto* peg (no crawl) between August 1991 and June 1995.[14] The empirics in this article also suggest that the euro is gradually gaining greater importance in influencing movements in the Indian rupee, but more so at the expense of the pound and yen rather than the US dollar. If the euro continues to gain in importance, one might have to eventually re-classify India as a (dual) basket peg over time. However, as of now, it seems to be a soft or *de facto* dollar pegger. While India has been relatively successful in its monetary policy framework to date (Joshi and Sanyal 2004), as the country continues to liberalize its capital account, continued heavy management of the exchange rate will invariably complicate its overall macroeconomic policies.

Tony Cavoli, *School of Commerce, University of South Australia, Adelaide, Australia. Email: tony.cavoli@unisa.edu.au
Ramkishen S. Rajan, *School of Public Policy, George Mason University, VA. Email: rrajan1@gmu.edu

References

Baig, T. 2001. 'Characterising Exchange Rate Regimes Post-Crisis East Asia', Working Paper No.01/152, IMF.

Bayoumi,T. and B. Eichengreen. 1998. 'Exchange Rate Volatility Intervention: Implications of the Theory of Optimum Currency', *Journal of International Economics*, 45(2):191–209.

Calvo, G. and C. Reinhart. 2002. 'Fear of Floating', *Quarterly Journal of Economics*, 117(2): 379–408.

Cavoli, T. and R. Rajan. 2005. 'Have Exchange Rate Regimes in Asia Become More Flexible after the Crisis? Revisiting the Evidence', mimeo, April.

———. 2006. 'Managing in the Middle: Characterising Singapore's Exchange Rate Policy', mimeo, February.

Dominguez, K.M. 1998. 'Central Bank Intervention and Exchange Rate Volatility', *Journal of International Money and Finance*, 17(1):161–90.

Frankel, J. and S.J. Wei. 1994. 'Yen Bloc or Dollar Bloc? Exchange Rates in the East Asian Economies' in T. Ito and A. Krueger (eds), *Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flows.* Chicago: University of Chicago Press.

Gan, W.B. 2000. 'Exchange Rate Policy in East Asia after the Fall: How Much Have Things Changed?', *Journal of Asian Economics,* 11(4): 403–30.

Girton, L. and D. Roper. 1977. 'A Monetary Model of Exchange Market Pressure Applied to the Post-War Canadian Experience', *American Economic Review*, 67(4): 537–48.

Glick, R. and C. Wihlborg. 1997. 'Exchange Rate Regimes and International Trade' in P. Kenen and B. Cohen (eds), *International Trade and Finance: New Frontiers for Research*. New York: Cambridge University Press.

Guimãeres, R.F. and C. Karacagdag. 2004. 'The Empirics of Foreign Exchange Intervention in Emerging Market Countries: The Cases of Mexico and Turkey', Working Paper 04/123, IMF.

Joshi, V. and S. Sanyal. 2004. 'Foreign Inflows and Macroeconomic Policy in India', mimeo, Oxford University.

Kumaraswamy,V. 2003.'Exchange Rates—REER Logic May Be Unsustainable', *Business Line*, February 21.

McKinnon, R. 2001. 'After the Crisis, the East Asian Dollar Standard Resurrected: An Interpretation of High-Frequency Exchange-Rate Pegging' in J. Stiglitz and S. Yusuf (eds), *Rethinking the East Asian Miracle*. New York: World Bank and Oxford University Press.

Patnaik, I. 2004. 'India's Experience with the Implementation of a Pegged Exchange Rate', mimeo, April.

[14] Reinhart and Rogoff (2004) define a *de facto* peg on the basis of whether a monthly exchange rate change remains within a one per cent band over a rolling five-year period with at least an 80 per cent probability. If the exchange rate has a drift, it is classified as a crawling peg.

Pentecost, E.J., C. Van Hooydonk and A. Van Poeck. 2001. 'Measuring and Estimating Exchange Market Pressure in the EU', *Journal of International Money and Finance*, 20(3): 401–18.
Reinhart, C.M. and K. Rogoff. 2004.'The Modern History of Exchange Rate Reinterpretation', *Quarterly Journal of Economics*, 199(1): 1–48.
Shah, A. and I. Patnaik. 2005. 'India's Experience with Capital Flows: The Elusive Quest for a Sustainable Current Account Deficit', Working Paper No.11387, NBER.
Tanner, E. 2001. 'Exchange Market Pressure and Monetary Policy: Asia and Latin America in the 1990s', *IMF Staff Papers,* 47(3):311–33.
Willett, T.D., J. Kim and I. Nitithanprapas. 2005. 'Some Methodological Issues in the Classification of Exchange Rate Regimes', mimeo, July.