Exchange Rate Management in India : An Empirical Evaluation

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Drawing from a strand in the literature, this paper develops objective indicators i.e., indices of exchange market pressure, intervention activity and monetary conditions in order to assess the efficacy, in terms of both timing and magnitude, of policy measures in assuaging exchange market pressures. The theoretical underpinning for the indices are drawn from a simple monetary model of exchange rate determination. This indices are found to perform well in tracking exchange market activity and policy action has been successful in relieving exchange market pressure. Simplicity in the computation of these indices and their superiority in terms of quick availability, in encompassing overall developments in the balance of payments and in reflecting market activity recommends their use for operational purposes.

Since March, 1993 i.e., with the institution of the market based exchange rate system the conduct of exchange rate policy in India has attracted close scrutiny and evaluation. In the period from October 1993 to August 1998, the policy stance of ensuring orderly market conditions and allowing the exchange rate to reflect the macro economic fundamentals has been subjected to alternating phases of exchange market pressure, requiring the Reserve Bank of India (RBI) to 'lean against the wind' against speculative attacks and also to 'lean with the wind' in order to ensure soft landings of the exchange rate in the face of the perceived need for correcting overvaluation. The timing and magnitude of the RBI's intervention in the exchange market has been assessed in various forms, ranging from technical charting to mechanistic interpretations of the drift in the real effective exchange rate (REER). A rigorous empirical evaluation of exchange rate management, drawing from theoretical underpinnings has, in general, been lacking.

With the abandonment of the Bretton Woods parities and the failed tryst with freely floating exchange rates indeed, the first major intervention had occurred by late 1974 and early 1975 to stabilise the US dollar - central banks the world over have chosen to manage exchange rate regimes, the degree of management varying from economy to economy depending on macro economic policy objectives and the state of the development and integration of financial markets. The exchange rate regime in India can best be characterised as 'intermediate' between fully managed and freely floating regimes. Exchange rate policy is generally viewed as subserving the monetary policy stance. Given the evolutionary stage in the development of the foreign exchange market and its fractured linkages with the rest of the market continuum, episodes of exchange market turbulence have essentially been viewed as resulting from developments which do not reflect the underlying fundamentals, amplified by unidirectional expectations in an underdeveloped market. The policy response, however, has generally been crafted in terms of the conventional approach to monetary disequilibrium, reflected in reserve changes, exchange rate adjustments and management of monetary conditions, in general, through the use of instruments of monetary policy. Consequently, an important requirement for the successful conduct of exchange rate policy is a reasonably accurate assessment of pressures in the exchange market and the calibration of policy measures in response to market pressures.

Drawing from a strand in the literature, an attempt is made in this paper to develop objective indicators of exchange market pressure and intervention activity so as to evaluate exchange rate management in the context of the ability to assuage market pressures on the exchange rate of the rupee in the market based exchange rate regime (1993:03 to 1998:03). Although the focus of the paper is on the period 1993-98, analysis is conducted for the period

1990-98 since the institution of the market regime was facilitated through important structural and regime changes in the aftermath of the balance of payments crisis of 1990. An index of Exchange Market Pressure (EMP) and its operational variant, the Monetary Conditions Index (MCI) is proposed for the purpose of policy monitoring. The MCI, which has come to be employed as a monitoring indicator by various central banks who target 'rate' variables (in preference over quantity variables) in the conduct of monetary policy, helps to evaluate the extent to which monetary conditions contribute or run counter to exchange market pressures. As the EMP and the MCI take into the overall developments in the balance of payments reflected in the money account, they are relatively efficient alternatives to the conventional REER which is centred on the trade account and yields little insights into balance of payments developments in the face of a mobile capital account. An Indicator of Intervention Activity (IIA) is also constructed to assess the monetary authority's efficacy of managing exchange market pressures reflected in movements of the EMP. These indicators draw upon the inter linkages between monetary policy and exchange rate developments which has been recognised by the authorities in India in the recent period. Thus, the paper provides an empirical framework for evaluating monetary policy in terms of its exchange rate objective. In response to the academic debate on the nature of the exchange rate regime in India, the paper offers a methodology for an ordinal measurement of the degree of 'management' in the exchange rate regime.

In the following Section, a brief review of the select contributions in the literature dealing with the development of the indicators proposed here is presented. In Section II, the theoretical model employed in this paper is described. Section III presents the results of the empirical estimation of the model. In Section IV, an evaluation of India's exchange rate policy in the period since March 1993 to March 1998 is made in terms of the behaviour of the indicators developed in this paper. The final Section contains concluding remarks.

Section I
Review of Literature

With the integration of financial markets globally, massive volumes of turnover has endowed markets with such might that national authorities seem diminutive in comparison and cannot realistically hope to impose their will on the market. Yet central banks repeatedly intervene in foreign exchange markets, usually contesting the market view, hoping to nudge the markets in the desired direction. Conventional wisdom embodied in the asset market approach-essentially the flex-price and sticky-price monetary models holds that sterilised intervention, which leaves the volume of money stock unchanged, is largely ineffective in its impact on the exchange rate through monetary channels of transmission although through the expectations channels, even sterilised intervention can alter the current exchange rate by signaling the future course of monetary policy. For this to occur, however, intervention has to be reinforced by monetary policy measures. In portfolio balance models where the assumption of perfect substitutibility between domestic and foreign assets is relaxed, sterilised interventions have an impact on the exchange rate; however, the initial change in the exchange rate sets off chain reactions in the current and capital accounts of the balance of payments which, over time, reverse the initial exchange rate change. The effectiveness of unsterilised intervention in affecting the exchange rate is undisputed in the received theories of exchange rate determination. Unsterilised intervention, by causing changes in countries' money supplies, delivers a monetary shock to the exchange rate in much the same manner as monetary policy; in fact, under

conditions of perfect substitutibility, monetary policy and unsterilised intervention are undistinguishable in their impact on the exchange rate. Unsterilised intervention is to be regarded as an instrument of monetary policy with no independent power over the foreign exchange market. Investigating whether unsterilised intervention to stabilise the exchange rate is compatible with a regime in which monetary aggregates are used as intermediate targets, Genberg and Roth (1979) showed that efforts to moderate movements of the exchange rate in one period by reducing the money supply through unsterilised intervention will be frustrated in the subsequent periods. The commitment to a monetary target and the gradual equalisation of foreign and domestic interest rates will result in a more than average growth in the money supply. Thus, the impact of unsterilised interventions on the exchange rate is not expected to be realised beyond the short run. Since the mid-eighties, however, central bank interventions have caused markets to take note of their visible effects, suggesting the need for a reconsideration of the conventional wisdom.

Girton and Roper (1977) can be regarded as the seminal contribution to the literature on the development of a measure of exchange market pressure. They developed the measure in the framework of the monetary approach to the balance of payments under which money stock disequilibrium (mismatch between demand for and supply of money) is reflected in reserve movements signifying official intervention under a fixed exchange rate regime or in exchange rate changes in a flexible exchange rate regime. In a hybrid regime, money stock disequilibrium is manifested in a combination of official intervention through use of reserves and some amount of exchange rate movements which correspond to the level of the exchange rate considered desirable from the policy point of view. Domestic monetary policy and the extent to which monetary authorities can pursue an independent exchange rate objective within the monetary policy framework are to be assessed against external monetary conditions. They estimated exchange market pressure in a bilateral model comprising Canada and the USA, with the USA representing world monetary conditions. An attempt on the part of the Canadian monetary authorities to increase the growth rate of money supply results in an almost equivalent rate of depreciation in the exchange rate or a loss of reserves at an equivalent rate in relation to a certain base or some combination of the two. Exchange market pressure was found to be impervious to the composition of the authority's intervention i.e., reserve changes and exchange rate adjustments.

Pradhan, Paul and Kulkarni (1989) adapted the Girton and Roper model to Indian conditions over the period 1976 to 1985, using quarterly data to evaluate the relevance of the monetary approach to exchange rate determination. They found reasonably strong evidence for the 'monetarist' hypothesis that increase in money supply leads to reserve losses and exchange rate depreciation. In their view, the monetary authority in India exercises a choice between altering the level of reserves and allowing the exchange rate to adjust to market pressures in response to excess domestic liquidity shocks. Exchange market pressures were, however, reflected more in reserve losses than in exchange rate adjustments giving credence to the view that exchange rate policy in India is conducted with an exchange rate target in perspective rather than a market approach of ensuring orderly rate determination consistent with the underlying monetary conditions.

Weymark (1995) proposed indices of exchange market pressure and intervention in terms

of what may be regarded as a generalised version of the Girton and Roper approach in a small open economy model with perfect asset substitutibility but without the rigid monetarist assumption of continuous purchasing power parity. While Girton and Roper merely estimated an equation for exchange market pressure in the context of a money demand function in the tradition of the monetary approach, Weymark developed indicators of exchange market pressure which are observable and therefore, useful for policy analysis. Exchange market pressure was defined as the exchange rate change required to relieve excess demand for a currency in the absence of exchange market intervention by the monetary authority. In a managed floating regime, interventions in the form of reserve changes and monetary policy measures in the form of changes in the cost and availability of domestic liquidity are to be translated into exchange rate equivalents and then combined with the observed changes in the exchange rate to yield a composite indicator of exchange market pressure. Despite the fact that sterilisation segregates the money market and the foreign exchange market and can cause a change in the underlying monetary conditions which can obscure exchange market pressure to a certain extent (Pradhan, *et al* pointed out that the absence of sterilisation in framing the EMP model in Girton and Roper is a limitation since the existence of sterilisation can cause simultaneous equation problems), Weymark showed that the market clearing condition necessary to generate the index of exchange market pressure obtains with or without sterilisation. Weymark also proposed an intervention index, developed on the lines of Frenkel's (1980) index of managed float, with the operational advantage of being computable from observable data. Both bilateral and multilateral indices were calculated to evaluate Canada's exchange rate policy over the period 1975 to 1990 using quarterly data. The behaviour of the indices suggested that the pursuit of an exchange rate target was the core objective of the intervention policy in the sample period in Canada.

Section II
The Methodology

In the tradition of the asset market approach to exchange rate determination, the exchange rate is viewed as the relative price of national monies, determined by the relative supplies in relation to demand. Thus, while the demand for exports may be formed by a host of underlying real factors, the timing and magnitude of export proceeds flowing into the foreign exchange market responds to interest rate differentials, exchange rate expectations and exchange market conditions, both spot and forward, with little to do with the real factors that caused the export shipment. Similarly, the decision to contract external commercial borrowing may have been provoked by real developments such as the need for capacity expansion, but the timing of bringing in the funds would depend on interest rate differentials and their movements vis-a-vis the forward premia, current and expected exchange rates and the like.

In any economy, irrespective of the wedges between segments of the financial market spectrum created by exchange controls and other barriers, market agents hold a portfolio comprising, inter alia, stocks of domestic and foreign monies. Given the relative rates of return and the degree of substitutibility beween domestic and foreign assets, they strive to achieve portfolio balance. In the face of a exogenous, domestic monetary shock embodied in an excess supply of money, market agents would reduce domestic money balances and seek to acquire foreign money balances. In a freely floating exchange rate regime, the price of the domestic money would fall i.e., domestic interest rates would decline and the exchange rate would depreciate. Given the relationship between money, interest rates and exchange rates, the decline

in interest rates and exchange rates would cause the demand for domestic money balances to rise until monetary equilibrium is restored. On the other hand, in a fixed exchange rate regime, domestic money balances would be exchanged for foreign goods, services, financial assets and money balances until portfolio balance is restored through the monetary authority meeting the resultant increase in demand for foreign money by losing reserves until monetary balance is restored. In the intermediate forms of exchange rate regimes that characterise the real world, a combination of the effects described obtain. Monetary authorities may, in pursuit of a longer term strategy, seek to contest these short run market outcomes. By signaling their stance through various direct policy instruments reflected in changes in the domestic component of base money and in foreign exchange reserves and through indirect instruments such as changes in strategic interest rates, monetary authorities may attempt to induce shifts in the demand for and supply of domestic and foreign money balances, and thereby change or even reinforce the market view on the monetary conditions.

The model developed here draws heavily upon Weymark while taking into account the specific features of the Indian economy. It is drawn up under the assumptions that the demand for money is 'fairly stable', the emerging role of interest rates as an argument in the money demand function-'interest rates too seem to exercise some influence on the decisions to hold money'- the importance of the exchange rate objective of monetary policy in the context of the emerging linkages between money, foreign exchange and capital markets and a loose form of purchasing power parity which links domestic prices to foreign prices in a probabilistic form for an economy with a growing degree of openness (supported by the use of the REER as an information variable for exchange rate policy). The construction of the model draws inspiration from the underscoring of the need for a multiple indicator approach and the perceived utility of a Monetary Conditions Index in a regime where targeting rate variables assumes importance (Annual Reports of the RBI, 1995-96, 1996-97 and 1997-98; Monetary and Credit policy for the Second Half of 1997-98 and for the First Half of 1998-99).

The model is set out as follows :

(1) $Mdt = a0 + a1*Pt + a2*Yt - a3*It + ut$
(2) $Pt = b0 + b1*Pt^{+} + b2*Et$
(3) $It = It^{+} + E*(Et+1 - Et)$
(4) $Mst = Ms(t-1) + h(\Delta NDA + \Delta NFA)$
(5) $\Delta NFA = -ut *(\Delta Et)$

where,

Mdt	=	Demand for money;
Pt	=	Index of wholesale prices (domestic);
Yt	=	Income/output, proxied by industrial production;
It	=	Nominal interest rate represented by the call money rate, monthly averages;
Et	=	Nominal exchange rate expressed in multilateral form i.e., nominal effective exchange rate (NEER) of the rupee, 36 country bilateral weights;
Ft	=	Forward exchange rate;
Mst	=	Supply of money;
NDA	=	Net domestic assets;

NFA = Net foreign assets;
^ = Respective variables for rest of the world;
u = Policy authorities response coefficient;
h = money multiplier;
Δ = changes in stocks or relevant variables;

Equation (1) is the conventional money demand function employed in India augmented to include the interest rate as an argument signifying the opportunity cost of holding money. Output represented by indices of industrial production in the absence of monthly data on GDP is assumed to be exogenous. Equation (2) represents the version of the functional relationship between domestic prices and foreign prices considered in this model: domestic prices are assumed to be responsive to foreign prices in a functional form but purchasing power parity as a rule is not imposed. Equation (2) essentially allows for the estimation of the exchange rate impact on domestic prices. Equation (3) is the uncovered interest rate parity (UCIP) condition which is set out as an underlying assumption relating to the substitutibility between domestic and foreign assets rather than a relationship proposed for empirical testing. It is presented as a part of the model specification to allow the model to be identified. Equation (4) describes the standard money supply formation process under the money multiplier approach, implying that any increase in nominal money stock could be on account of the last period's money stock plus the increase in net domestic assets and net foreign assets of the monetary authority accruing to the current period's money stock through the money multiplier. Under the assumption that the money market clears continuously, the equilibrium condition would be reflected in the identity Ms = Md. Equation (5) represents the reaction function of the authorities. Under a freely floating exchange rate, the value of ut = 0. The monetary authority does not intervene in the exchange market and hence there is no change in NFA and money supply. When the authorities, on the contrary, peg the exchange rate at a particular level (i.e. ut = ∞), there is unlimited intervention and hence proportionate changes in NFA and money supply. (Here, the general assumption is that the authorities intervene only by changing NFA and not by changing NDA; as Weymark (op.cit) has shown, compensating variations in NDA due to sterilisation do not affect the monetary equilibrium condition. Furthermore, in India, variations in domestic credit are not systematically used to influence the exchange rate of the rupee). The value of ut in equation (5) thus gives an idea about the degree to which exchange rate is managed. ut can assume negative values when interventions are used aggressively to obtain an exchange rate change which is contrary to or significantly larger than market expectations.

Following Weymark, the EMP can be derived as

$EMP_t = \Delta E_t + n \Delta NFA$ where $n = - 1/ [b2 + a3]$

and IIA as

$$IIA_t = n \Delta NFA / EMP_t$$

The calculation of EMP and IIA thus hinges critically upon the calculation of the elasticity 'n' which, in turn, depends upon estimates of the parameters b2 and a3 i.e., the coefficient of the exchange rate as a determinant of the domestic price level and the interest elasticity of the demand for money respectively. These parameters can be obtained be estimating

Equations (1) and (2) of the model.

EMP measures the excess demand/supply for/of foreign exchange associated with the exchange rate policy. It does not measure the actual exchange rate change warranted by conditions of demand and supply but instead the degree of external imbalance and the presence/absence of speculative activity. The critical indicator in the EMP is its sign. Negative values indicate downward pressures on the exchange rate while positive values reflect upward pressures which holds irrespective of the choice of the exchange rate regime. The IIA has a range from $-\infty$ to $+\infty$. Under a freely floating regime, IIA = 0 and under a fixed exchange rate regime, IIA = 1. Under intermediate regimes IIA assumes values between 0 and 1. When the monetary authority leans with the wind, i.e., amplifies the exchange rate pressures generated by the market, the IIA assumes values greater than 1. On the other hand, when the monetary authority contests the market view, the IIA is less than one.

The Monetary Conditions Index (MCI) which has come to be employed as an operating target or more generally, as an indicator of monetary conditions in countries forced to move away from a monetary aggregates approach by the pace of financial innovations, can easily be seen to be a more readily computable version of the EMP. It is a weighted aggregate of the exchange rate and interest rate channels of monetary policy, providing leading information about the monetary conditions since money stock variations impact upon the exchange rate and interest rate with a much reduced lag than upon prices and output. The manner in which monetary policy should be adjusted to offset the deviation of monetary conditions from the desired levels is addressed through targeting the weighted monetary conditions index within a band, the band limits being enforced by, or by the threat of, monetary policy action. The weights assigned to the exchange rate and interest rate generally depend upon their relative influence on output and prices and are usually derived by estimating a money demand function in which the exchange rate and the interest rate are present as explanatory variables. Adjusting money stock to align the MCI with a desirable level would constitute the appropriate stance of policy.

The EMP would indicate the extent of exchange market pressure on account of monetary disequilibria while MCI would directly show the monetary conditions prevailing at any point of time in relation to some base level monetary condition and thereby help the authorities in deciding the degree and timing of monetary policy changes that may be necessary to keep the EMP within manageable limits. A decline in the MCI indicates tightening of monetary conditions whereas an increase in the index reflects easing.

In this paper a standard MCI has been constructed representing a linear combination of the interest rate and exchange rate as follows :

$$MCI = a^* (It - Ib) + b^* (Et - Eb)$$

It and Et represent interest rate and exchange rate at time t and Ib and Eb represent interest rate and exchange rate as at some point which could be considered as equilibrium (and hence base period E and I). a and b represent the weights which are decided on the basis of the respective influence of interest rate and exchange rate on the goal variable.

Section III
Estimation of EMP, IIA and the MCI for India

For generating estimates of the EMP, the IIA and the MCI under the methodology set out in Section III, the data used are as follows: Month-end nominal money stock (M3), monthly indices of wholesale price indices (WPI) as representative of domestic price movements, monthly indices of industrial production (IIP) as the proxy for scale of economic activities in the absence of monthly data on national income, nominal effective exchange rate (NEER) indices to reflect the movement in the exchange value of the rupee vis-a-vis 36 major trading partners of India, monthly average of inter-bank call money rates (CMR) as representative of the opportunity cost of money, and the weighted average of domestic CPIs of 36 major trading partners of India (WOPI) to reflect the movement of international prices. For countries which do not publish data on intervention purchases and sales, changes in the levels of foreign exchange assets are considered for empirical analysis. In the case of India, however, monthly data on intervention purchases and sales are published regularly by the RBI since June 1995 and for the purpose of estimating and comparing the estimates, both change in reserve levels and net intervention purchases/sales data have been considered.

All the equations for the basic model were estimated in log-linear form. Before estimating the coefficients of the two elevant equations for EMP and IIA, the stationarity properties of the variables were checked by using the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) tests.

All the variables considered for estimating the two equations turned out be integrated of order one, [i.e. I(1)], indicating that some linear combination of these variables may represent a long run equilibrium relationship. (For the DF and ADF test statistics see Table-1). In order to establish the long run relationship among variables in the money demand and PPP equations, Johansen and Juselius (JJ) type of maximum likelihood tests of multiple cointegration were conducted for the sample period April 1990 to March 1998. The eigen values and trace statistics for both money demand and PPP relationships (presented in Table-2) indicate the presence of two cointegrated vectors as reported below.

Money demand function

(1) LM3 = 4.04 + 0.80 LWPI + 1.00 LIIP - 0.17 LCMR

Purchasing power parity relationship

(2) LWPI = -9.04 + 3.43 LWOPI - 0.51 LNEER

The DF and ADF tests for errors (presented in Table-3) indicate the errors to be stationary.

Table-3 : DF and ADF tests for errors.

	Without trend	With trend

	DF	ADF	DF	ADF
Residuals of Money Demand Relationship	-5.71	-5.33	-5.77	-5.39
Residuals of PPP relationship	-2.15	-3.71	-2.90	-4.03

Relevant coefficients from the above relationships are used to estimate the exchange market pressure and degree of intervention as follows.

$EMP_t = \Delta NEER_t + u \times \Delta NFA$
Where $u = 1/ -(-0.51-0.17) = 1/0.68 = 1.4705882$
and
$IIA_t = u \times \Delta NFA / EMP_t$

The estimates of EMP and IIA for the period April 1990 to March 1998 are presented in Table-4. Estimates of EMPs and IIA generated by using the actual interventions data are also shown in Table 5.

For the MCI, the weights for exchange rates and interest rates were estimated from the reduced form of Equations (1) and (2) i.e.,

(6) LM3 = 3.80 + 0.74 LWOPI + 1.38 LIIP - 0.05 LCMR - 0.35 LNEER

The eigen values and trace statistics presented in Table-6 suggest the presence of two cointegrating vectors. The residuals of the two vectors were subjected to normality tests; in view of the relatively higher coefficient of variation of the residuals of the second vector, the first vector was chosen for generating the MCI and is reported above [Equation (6)]. The coefficients of LNEER and LCMR suggest that the weights could be as follows: a = 0.125, b= 0.875; a + b = 1. The MCI is presented in Tables 4 and 5 to compare its movements vis-a-vis the EMP and IIA.

Section IV
Exchange Rate Management in India, March 1993 to March 1998 : An Evaluation

In the aftermath of the unprecedented payments crisis of 1990, the exchange rate of the rupee was considered to be significantly overvalued in relation to competitor countries (Rangarajan, 1991). A sharp downward adjustment of the exchange rate of about 18 per cent undertaken as an element of a package of structural reform measures in July 1991 set the stage for more fundamental changes in the exchange rate regime recommended by the High Level Committee on Balance of Payments (GOI, 1991). The *de facto* administered regime based on a basket of currencies of important trading partners which had been in place since 1975 was replaced in 1992 by a dual exchange rate system under which one leg of the exchange rate, applicable to 40 per cent of all current receipts, essential imports and debt service payments, was determined by the RBI and the other leg, which applied to all other transactions, was determined by the market. For transactions routed through the market, the dual exchange rate system implied a depreciation in the exchange rate of 11 per cent. In March 1993, the dual exchange rate system

gave way to a market based system under which the two legs of the exchange rate were unified and were left to be determined entirely by market forces. The RBI indicated its exchange rate stance as allowing the exchange rate to reflect the macro economic fundamentals.

Over the period April 1990 to June 1991 the EMP recorded negative values indicating that downward pressures on the exchange rate had been building up. The downward movement in the MCI during this period suggests that the pressures on the exchange rate were not on account of monetary conditions which were tight reflecting the stance of monetary policy embodied in high interest rates and reserve requirements, import restrictions and penal provisions for delaying export proceeds. The EMP's movements were due to acute excess demand conditions created by the widening of the current account deficit as the terms of trade shock of the Gulf war and the financing gap in the capital account on account of the waning of the international confidence took a vice like grip on the balance of payments. The average IIA for the period at 0.91 indicated the high degree of management of the exchange rate regime essentially through the use of reserves, supported by monetary policy and exchange restrictions.

In July 1991, i.e., the month in which two step downward adjustment in the exchange rate was carried out, the EMP turned positive and remained so for a prolonged period up to July 1992 showing that the devaluation relieved the accumulated exchange market pressure and in fact, resulted in an over correction. This is borne out by the value of IIA which soared to 2.04 in July 1991 suggesting that the value of the exchange rate would have depreciated by less than the extent of devaluation if market forces alone had been in operation. The MCI plunged in July 1991 and continued to exhibit tight monetary conditions up to August 1992, as monetary policy supported the stabilisation measures. The episodes of easing in October 1991 and May 1992 reflected the turnaround in the balance of payments. Inflows under the Foreign Exchange (Immunities) Scheme and the India Development Bonds in October, 1991 combined with some relaxation of cash margin requirements on imports to yield some respite in stringent monetary conditions. By May 1992, further relaxations in margin requirements for imports, interest rate surcharge on import finance, greater access to export refinance, rolling down of punitive rates on post shipment export credit and reductions in primary and secondary reserve requirements announced in April 1992 were reflected in some easing in the MCI.

From August 1992 to February 1993 the EMP turned negative again indicating the return of downward pressures on the exchange rate. The dual exchange rate imposed an implicit tax on export proceeds and remittances which hindered supplies in the foreign exchange market. Consequently, prior to the abolition of the dual exchange rate system in March 1993, downward pressures had been building up and a regime change was overdue. During this period, the MCI edged upwards and thus, the slackening of monetary conditions contributed to exchange market pressure. Throughout this period the IIA remained above 1 and contrary to the general perception arising from the partial influence of the market on the exchange rate, there seems to have been an increase in the degree of management of the regime in relation to the preceding period.

The unification of the exchange rates and the market based system corrected the misalignment of the exchange rate. The speculative attacks on the exchange rates in the period leading up to the presentation of the Union Budget, 1993-94 ebbed away and a remarkable

stability set in. As capital flows built up into a surge, excess supply conditions in the foreign exchange market resulted in a continuous upward pressure on the exchange rate up to March 1995. The EMP remained positive throughout this period except for aberrations in May 1993 and December 1994 when despite purchases from the market by the RBI, the exchange rate appreciated in nominal effective terms. There was also a bunching of debt service payments in December 1994 which in an exception to the general trend of that period, caused a loss of reserves. Throughout the period from March 1993 to March 1995 there were net purchases by the RBI from the market reflecting an effort to prevent nominal appreciation from eroding export competitiveness. The IIA averaged 0.98 during the period, capturing the continuous interventions by the RBI in the market. The MCI eased between June 1993 and April 1994 due to their expansionary effects of capital flows which were only partially sterilised. Although buoyant domestic activity created the conditions for the absorption of the capital flows, the monetary aggregates kept well above their targetted trajectories.

By April 1995 the easy money conditions fed through into the foreign exchange market and the EMP turned negative. Excess demand for foreign exchange was met through reserve depletion instead of being allowed to influence the exchange rate. A marginal weakening of the exchange rate was allowed in August 1995, which was also accompanied by large intervention sales by the RBI. Nevertheless, market conditions embodied in an upward drift in the forward premia and widening spread between buying and selling rates in the spot market indicated sentiments which were contrary to the authorities' view. Downward pressures intensified building up into the first major speculative attack on the exchange rate in the post unification period during the period September 1995 to February 1996. The EMP remained negative throughout except for a brief respite in December 1995. The authorities leaned with the wind in September 1995 by halting intervention sales and allowing market forces relative freedom to depreciate the exchange rate. As a consequence, the IIA fell below 1 and even turned negative. The nominal exchange rate plunged in October 1995 as speculation lengthened the normal leads and lags in receipts and payments. Panic demand for cover and cancellations of forward contracts created persistent mismatches of supply and demand both in the spot and forward segments of the market.

Intervention sales were initially supported by a withdrawal of liquidity from the money market and interest rates were raised. The IIA turned positive in October 1995 as the authorities switched to leaning against the wind. The MCI indicated a tightening of monetary conditions since the announcement of the monetary and credit policy for the first half of the year with a strong decline in the MCI in October 1995. Monetary policy attacked speculative sentiment ruling in the exchange market. Although the stance was eased transiently in November 1995 through reductions in cash reserve requirements, the EMP continued to indicate downward pressure in the exchange market and as such, the easing of monetary conditions in November 1995 though unavoidable, was contrary to the requirements of exchange rate management. There was a brief respite in December 1995 as resumption of capital flows absorbed exchange market pressure. The EMP turned positive in that month. The capital flows enabled purchases by the RBI which resulted in an increase in the IIA. Nominal appreciation in the exchange rate suggested a tightening of monetary conditions. In January and February 1996 the EMP turned negative as exchange market pressures flared up and the exchange rate touched a record low. Monetary policy measures were undertaken along with intervention sales. The MCI tightened

but the IIA declined as interventions were of a lower order than in the preceding months, being replaced by monetary policy measures.

Normalcy was restored in the foreign exchange market in March 1996. The EMP turned positive and remained so up to August 1997. The MCI showed continued tight monetary conditions and the average IIA for the period March 1996 to July 1997 was at about 0.74 indicating a lower degree of management of the exchange rate than in a comparable period of exchange rate stability during March 1993 to August 1995. In fact in the months of April, May and August 1996 and again in January 1997 the management of the exchange rate was in alignment with the market forces. On the other hand, in June, July, and November 1996 and in February, March, May and June 1997 the RBI contested the market view by effecting large intervention purchases and preventing the exchange rate from appreciating.

Downward exchange market pressures began again in September 1997, captured in the negative sign of the EMP. Exchange market pressures became intense in November and December 1997. Alongside a marginal easing of the MCI in September and October 1997 (reflecting the large interventions rather than any relaxation in the policy stance), the EMP which had turned positive in October 1997 when exchange market pressures had eased, became negative again. In January 1998, monetary policy measures eased the MCI. The EMP turned positive reflecting the ebbing of market pressures. After a long hiatus the RBI purchased foreign currencies from the market in that month. The easing of monetary conditions in January 1998 brought about the return of exchange market pressure on the exchange rate as reflected in the sign of the EMP in February, 1998. By March 1998, however, the easy monetary conditions had been reversed and as a result the EMP eased. In comparison with the previous episode of exchange rate volatility during August 1995 to February 1996 there was a relatively greater degree of management in the exchange rate regime during September 1997 to March 1998 (the average IIAs were 0.72 and 0.91 respectively).

Estimates of EMP and IIA generated by using actual net intervention data corroborate the pattern of movement of these indicators based on changes in foreign currency assets. The IIAs were either less than one but very close to one or were greater than one signifying that not only was the exchange rate regime highly managed but also that the actual exchange rates prevailing in the system (in terms of their movements) were mostly in the opposite direction to what would have prevailed in the absence of intervention. The results of the study indicate that the exchange rate policy in India has been actively supportive of the external sector target in terms of a sustainable level of current account deficit.

Section V
Conclusion

The paper demonstrates the use of indicators of exchange market pressures, monetary conditions and intervention activity as contemporaneous 'real-time' tools for the evaluation of exchange rate policy as a subset of monetary policy. While interventions have been the principal operating variable they have been reinforced by monetary policy measures when the exchange market has been driven by speculative activity. In this sense interventions have provided leading indications about the future course of monetary policy. A comparison of the two episodes of exchange market pressures in India in the second halves of 1995-96 and 1997-98 shows that the

RBI's response to speculative attacks has followed a common pattern. While the exchange rate regime in India can be characterised as highly managed, this needs to be viewed against the transitional phase in the evolution of the regime and the development of the markets.

Simplicity in the computation of the indicators proposed in this paper recommends their use for operational purposes. The model specified in Section II is general and specification changes can easily be incorporated to accommodate particular policy requirements. The performance of these indicators could be considered as superior to alternatives such as the real effective exchange rate since they are based on market activity, they draw from overall developments in the balance of payments and monetary conditions in the economy and can be computed with relatively shorter time lags. Policy scenario simulations can be employed to develop forward looking indicators of the type proposed here. Operationalisation of these indicators would involve setting up of bands around thresholds which would trigger policy defence.

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Table 1 : Unit Root Tests with Trend and a Constant (Sample period : April 1990 to March 1998)

Variables	DF	ADF
LM3	-3.84	-2.39
LWPI	-1.32	-1.87
LIIP	-6.16	-2.73
LCMR	-4.64	-2.96
LWOPI	-3.97	-2.41
LNEER	-2.09	-2.17
DLM3	-9.16	-7.38
SLWPI	-6.52	-6.28
DLIIP	-14.87	-9.22
DLCMR	-11.88	-9.72
DLWOPI	-10.06	-9.26
DLNEER	-9.61	-6.98

Note : DF values for LM3, LIIP, LCMR and LWOPI indicate that these variables may be integrated of order zero and can be considered as stationary in their levels. DF equations for these variables, however, do not pass the tests of residual serial correlation (LM statistics) and the heteroscedasticity tests (Engle's ARCH test). Therefore, stationarity properties of the above variables have been tested through ADF test statistics, with appropriate lags for the corresponding ADF equations.

Table 2 : Cointegration Test Statistics (JJ Method)

of Money Demand Function

Null : Alternative Hypothesis	Trace Statistics	5% critical value	Null : Alternative Hypothesis	Maximum Eigen value Statistics	5% critical value
r = 0 : r > = 1	73.5	53.12	r = 0 : r = 1	32.91	28.14
r< = 1 : r > = 2	40.6	34.91	r< = 1 : r = 2	20.81	22.01
r< = 2 : r > = 3	19.79	19.96	r< = 2 : r = 3	13.46	15.67
r< = 3 : r = 4	6.32	9.24	r< = 3 : r = 4	6.32	9.24
Cointegrated Test Statistics (JJ Method) for the PPP equation					
Null : Alternative Hypothesis	Trace Statistics	5% critical value	Null : Alternative Hypothesis	Maximum Eigen value Statistics	5% critical value
r = 0 : r > = 1	38.81	34.91	r = 0 : r = 1	25.51	22.01
r< = 1 : r > = 2	13.31	19.96	r< = 1 : r = 2	7.62	15.67
r< = 2 : r = 3	5.68	9.24	r< = 2 : r = 3	5.68	9.24

Table 4 : EMP, IIA and MCI for India

Year / Month	MCI	EMP	IIA	Year / Month	MCI	EMP	IIA
90m4	100.00			93m1	74.26	-0.06	1.08
90m5	98.25	0.06	1.14	93m2	72.47	-0.02	-0.19
90m6	97.46	-0.01	0.83	93m3	74.12	0.35	0.95
90m7	95.93	-0.08	0.87	93m4	73.47	0.10	1.10
90m8	94.76	0.08	1.14	93m5	72.90	-0.08	1.00
90m9	93.37	-0.30	0.92	93m6	72.93	0.01	0.68
90m10	93.77	-0.26	0.99	93m7	73.34	0.05	0.88
90m11	92.20	-0.26	0.99	93m8	73.12	0.11	0.01
90m12	91.98	-0.44	1.02	93m9	72.64	0.06	1.07
91m1	91.91	1.63	1.00	93m10	73.03	0.06	0.94
91m2	89.89	-0.15	0.84	93m11	73.58	0.06	0.91
91m3	91.76	-0.05	1.28	93m12	73.57	0.29	1.00
91m4	91.52	-0.64	0.99	94m1	74.03	0.10	0.95
91m5	91.85	-0.02	-0.15	94m2	73.69	0.37	1.01
91m6	90.40	-0.17	0.99	94m3	73.26	0.22	1.02
91m7	80.24	0.10	2.04	94m4	73.32	0.00	0.98
91m8	78.82	-0.17	0.95	94m5	73.08	0.04	1.10
91m9	77.87	0.74	1.01	94m6	72.87	0.08	1.05
91m10	79.07	0.52	1.00	94m7	72.12	0.10	1.08
91m11	78.45	0.23	1.03	94m8	72.12	0.01	0.98
91m12	76.22	0.46	1.02	94m9	73.05	0.09	1.03
92m1	76.62	0.08	0.95	94m10	71.76	0.07	1.06
92m2	76.97	0.16	0.96	94m11	71.96	0.01	0.89
92m3	72.93	0.47	1.10	94m12	72.55	-0.04	1.14

92m4	72.85	-0.06	0.68	95m1	73.03	0.02	1.12
92m5	74.41	0.00	-10.37	95m2	72.56	0.02	1.15
92m6	71.64	0.20	1.03	95m3	71.32	0.05	1.30
92m7	71.82	0.06	0.90	95m4	70.58	-0.03	0.85
92m8	71.67	-0.03	1.03	95m5	71.17	-0.01	1.31
92m9	72.01	-0.12	1.02	95m6	71.21	-0.05	0.98
92m10	72.98	-0.07	1.16	95m7	70.88	0.02	0.96
92m11	74.33	-0.15	1.11	95m8	71.30	-0.06	1.11
92m12	73.66	0.18	1.04	95m9	70.25	-0.01	-0.63
95m10	69.63	-0.12	0.84	97m1	68.11	0.01	0.59
95m11	71.33	-0.04	0.98	97m2	68.86	0.00	3.61
95m12	69.08	0.01	0.99	97m3	68.98	0.20	0.99
96m1	68.39	-0.10	0.95	97m4	68.78	0.02	0.90
96m2	67.89	-0.04	0.78	97m5	69.07	0.09	1.04
96m3	71.51	0.13	0.80	97m6	68.40	0.08	1.01
96m4	69.72	0.01	0.46	97m7	69.26	0.04	0.86
96m5	68.99	-0.01	-0.23	97m8	70.08	0.03	0.79
96m6	69.06	0.04	0.98	97m9	69.74	-0.005	0.89
96m7	67.53	0.03	1.26	97m10	69.83	0.03	0.95
96m8	67.49	0.00	-2.81	97m11	68.91	-0.11	0.91
96m9	67.94	0.04	0.95	97m12	68.35	-0.03	0.73
96m10	68.35	0.06	0.95	98m1	71.57	0.04	0.80
96m11	67.60	0.01	1.32	98m2	69.23	-0.02	1.02
96m12	68.03	0.03	0.92	98m3	68.62	0.11	1.05

Note : EMP and IIA are generated by using variations in levels of foreign currency assets.

Table 5 : EMP, IIA and MCI for India

Year/ Month	**MCI**	**INTVN ($mn.)**	**EMP**	**IIA**
95m6	71.21	36	0.00	1.62
95m7	70.88	338	0.03	0.97
95m8	7.30	0	0.01	0.00
95m9	70.25	0	-0.01	0.00
95m10	69.63	-785	-0.08	0.76
95m11	71.33	-110	-0.01	0.92
95m12	69.08	-56	0.00	1.02
96m1	68.39	-402	-0.04	0.88
96m2	67.89	-328	-0.04	8.76
96m3	71.51	960	0.11	0.78
96m4	69.72	368	0.04	0.88
96m5	68.99	101	0.00	8.78
96m6	69.06	785	0.07	0.99

96m7	67.53	294	0.02	1.40
96m8	67.49	247	0.02	1.25
96m9	67.94	672	0.06	0.97
96m10	68.35	840	0.07	0.96
96m11	67.60	132	0.01	1.63
96m12	68.03	551	0.04	0.95
97m1	68.11	550	0.05	0.88
97m2	68.86	925	0.08	0.89
97m3	68.98	2329	0.18	0.99
97m4	68.78	641	0.04	0.95
97m5	69.07	1393	0.09	1.04
97m6	68.40	1335	0.08	1.01
97m7	69.26	1185	0.07	0.92
97m8	70.08	872	0.06	0.89
97m9	69.74	-978	-0.06	0.91
97m10	69.83	189	0.01	0.86
97m11	68.91	-1590	-0.10	0.90
97m12	68.35	-407	-0.03	0.72
98m1	71.57	422	0.03	0.78
98m2	69.23	-681	-0.04	1.01
98m3	68.62	1449	0.08	1.07

INTVN : Monthly net interventions by the RBI in the forex market.
EMP and IIA are generated by using intervention sales/purchases of the RBI.

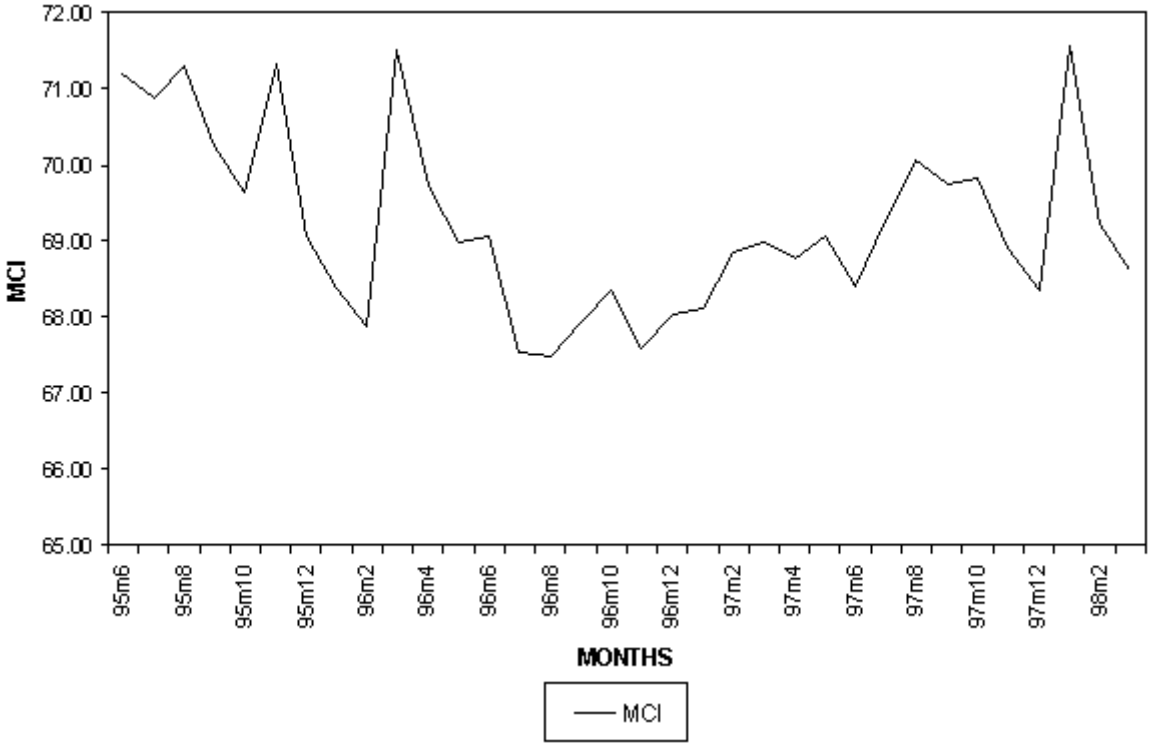
Note :
1. EMP +ve ⇒ Market pressure on the rupee to appreciate
2. EMP -ve ⇒ Market pressure on the rupee to depreciate
3. IIA = 0 ⇒ Free float
4. IIA = 1 ⇒ Completely managed exchange rate.
5. IIA with -ve values ⇒ Authorities actively appreciate/depreciate with respect to the free market value (say an official devaluation)
6. IIA with values greaer than one ⇒ Exchange rate moves in the opposite direction to what would have prevailed in the absence of intervention.
7. Declining MCI indicates tighter monetary conditions and rising MCI represents easy monetary condition.

Table 6 : Cointetration Test Statistics (JJ Method) of Money Demand Function for Estimating MCI

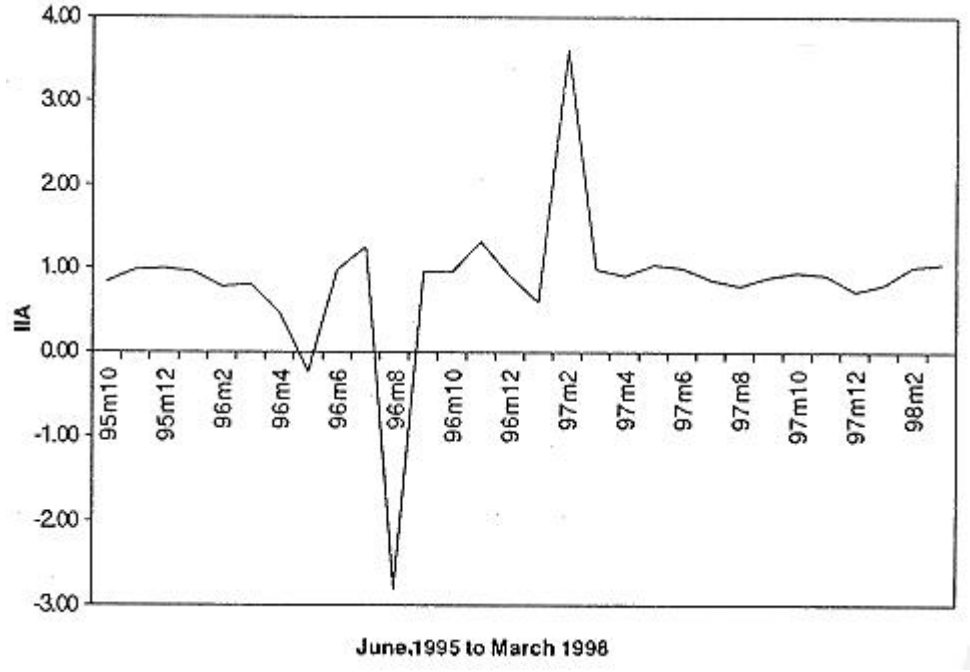
Based on Trace Statistics				
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**
r = 0	r = 1	52.0567	34.4000	31.6640
r < = 1	r = 2	33.8465	28.1380	25.5590

r < = 2	r = 3	15.0778	22.0020	19.7660
r < = 3	r = 4	10.9274	15.6720	13.7520
r < = 4	r = 5	8.0874	9.2430	7.5250
Based on Maximum Eigen Value				
r = 0	r = 1	119.9957	76.0690	71.8620
r < = 1	r = 2	67.9390	53.1160	49.6480
r < = 2	r = 3	34.0926	34.9100	32.0030
r < = 3	r = 4	19.0147	19.9640	17.8520
r < = 4	r = 5	8.0874	9.2430	7.5250

Monetary Conditions Index (MCI) for India

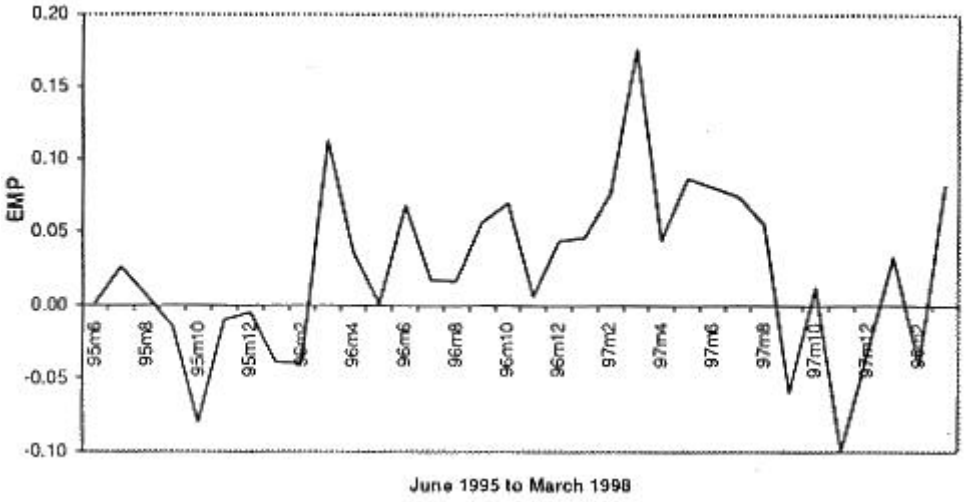


Indicator of Intervention Activity (IIA)



June,1995 to March 1998

Index of Exchange Market Pressure (EMP)



June 1995 to March 1998

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