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CAPITAL INFLOWS INTO INDIA IN THE POST-LIBERALIZATION PERIOD : AN EMPIRICAL INVESTIGATION

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Abstract:

This paper examines the time series properties of the foreign capital inflows into India in the 1990s, particularly in the period that follows certain liberalization measures in the financial sector. An analysis of the quarterly data on net inflow of capital for the period 1993 to 2003 shows that it has been volatile. However, not all the components of aggregate capital inflows have moved in similar fashion. The paper further analyses how capital inflows adjusted to changes in real exchange rate and other macroeconomic variables in India since 1993. The econometric results indicate that an error-correction mechanism was operating between net inflows of capital and the real exchange rate. Macroeconomic fundamentals did not have any significant effect on the dynamic adjustment of capital inflows, and a co-integration relationship exists between net inflows of capital, real exchange rate and interest rate differential. We argue that co-movement in these variables was due to intervention by the Reserve Bank of India in the foreign exchange market. This policy helped prevent the volatility of the real exchange rate in spite of volatility in net inflows of capital.

I. Introduction

The decade of the nineties witnessed sharp increases in flows of foreign private capital into the developing countries. It is clear from Table 1 that as foreign private capital flows increased tremendously, official development finance lost its predominance in the net capital flows into the developing countries during 1992 to 2004.

Table 1. Net Capital Flows into Developing Countries, 1992-2004 ($bn)

	Net Official flows	Net Private flows	Direct invest-ment, net	Private Portfolio invest-ment, net	Other private flows, net	Total capital flows, net
1992	21.9	102.0	32.3	55.5	14.2	123.9
1993	49.2	108.0	52.1	66.9	-11.0	157.2
1994	25.3	124.7	74.9	89.2	-39.4	150.1
1995	31.4	142.7	84.5	17.8	40.4	174.1
1996	8.4	179.4	108.7	57.3	13.4	187.7
1997	22.5	132.0	128.7	30.2	-26.9	154.5
1998	43.1	55.9	126.4	3.0	-73.5	99.0
1999	30.6	52.9	126.6	7.9	-81.7	83.5
2000	-34.6	45.6	156.3	-9.5	-101.3	31.8
2001	13.5	74.9	177.2	-49.4	-52.9	88.7
2002	12.7	87.0	153.5	-38.0	-28.5	103.4
2003	-52.2	162.6	141.7	10.7	10.2	111.1
2004	-48.3	192.4	167.3	52.7	-27.6	159.3

Source: IMF (various issues), World Economic Outlook

There was a spurt in capital inflows into India too since 1992 following the implementation of trade and investment policy reform as well as the reform in the exchange rate policy. The magnitude of the inflow of capital in India during the 1990s, however, was comparatively less than that in other countries. For example, the peak level of capital inflow was 3.5% of GDP in India in 1993-94, whereas the peak levels of capital inflows were above 20% in Malaysia, 13% in Thailand, 10% in Singapore and Philippines between 1990 and 1993 (Glick, 1998).

One of the most important features of the capital flows into India since 1992 is the change in its composition

from debt to non-debt creating sources. External commercial borrowing, which had been the major source of foreign capital inflows during the eighties, became less important during the nineties. In the nineties, the predominant forms of foreign investment have been portfolio investment and foreign direct investment. A brief account of the net annual capital flows into India since the beginning of the nineties is presented in Table 2. It reveals that net inflow of foreign private capital increased from Rs. 4133 crores (0.63% of GDP) in 1991-92, the year just prior to the deregulation of private foreign investment, to Rs. 8352 crores (1.11% of GDP) in 1992-93. Easing of restrictions on inflow of private foreign capital has also led to its increasing share in gross domestic capital formation from 2.82% in 1990-91 to 4.72% in 1992-93 and 9.54% in 2000-01. In terms of net capital account, inflows of foreign private capital accounted for 70.29% and 59.37% in 1992-93 and 2001-02, respectively, whereas the same stood at only 21.16% in 1985-86.

Table 2. Net Annual Capital Flows into India (in Rs. Crores)

Year	FDI	Portfolio invest-ment	External commercial borrowing	Total inflows of capital	External assist-ance	% Share of net private capital flows in GDP*	Total capital account	Total private flows of capital as a % of GDCF
1990-91	174	11	4034	4219	3965	0.74	12895	2.82
1991-92	316	10	3807	4133	7395	0.63	9509	2.81
1992-93	965	748	-1095	618	5748	1.11	11881	42.00
1993-94	1838	11188	1904	14930	5963	1.73	30412	7.52
1994-95	4126	12007	3238	19371	4798	1.91	28745	7.35
1995-96	7172	9192	4548	20912	3356	2.88	15597	1.07
1996-97	10015	11758	10004	31777	3998	2.32	40502	9.48
1997-98	13220	6696	14558	34474	3463	2.26	37536	9.2
1998-99	10358	-257	18557	28658	3484	3.80	35034	1.68
1999-00	9338	13112	1360	23810	3915	1.23	48101	4.85
2000-01	18406	12609	17553	48568	2079	2.32	44063	9.54
2001-02	29240	9639	-7495	31384	5830	3.17	52858	1.37
2002-03	22552	4738	-11415	15875	-11588	0.64	62029	2.76

Note : * at current prices with 1993-94 as base.
Source: RBI (2003-04), *Handbook of Statistics on Indian Economy*.

As these inflows persisted, many of the less desirable macroeconomic effects became manifest in India, as they did in many other countries in East Asia and Latin America. The general sequence of events goes like this. Capital inflows exert pressures on nominal and real exchange rates, which lead to intervention by the central bank in the foreign exchange market. As a consequence reserve accumulation accelerates and monetary control becomes more difficult. Attempts to sterilize the foreign exchange transactions through either open market operations or increases in reserve requirements lead to an increase in the interest rate, which, in turn, raise the quasi-fiscal cost of the central bank.

The Indian experience with liberalization of foreign private capital inflows, however, has been somewhat different from that of the Latin American and the East Asian countries. The much-discussed currency crises of the nineties, viz. the Mexican in 1994 and in East Asia in 1997-98, all followed financial liberalization measures in those countries, which raised questions indicating possible linkages between liberalization and crisis. These currency crises forced the policy analysts to reexamine the role of economic liberalization measures in promoting growth. The likelihood of the economy's vulnerability due to the adverse effects of financial liberalization has since been seriously looked into, and the effectiveness of various alternative measures to neutralize the adverse effects has been examined.

Almost all the studies on currency crisis identified the presence of large volume of short-term capital flows, or what is called the "hot money", as the main culprit in the East Asian and the Latin American context. What emerges from this literature is that, short-term capital flows, which are volatile in nature, increased financial fragility in these countries. Conventional wisdom suggests that the countries that finance their current account deficits mainly through foreign direct investment are less susceptible to currency crisis. Some recent studies, however, challenged this wisdom. Singh (2002) argues

that surges in FDI do indeed contribute to volatility; and the exchange rate appreciation that they often lead to has further undesirable consequences. Bird and Rajan (2002) report that Malaysia had been subject to currency crisis in 1997 in spite of the fact that the country had proportionately larger share of FDI in the total capital inflows. Claessens, Dooley and Warner (1995) too make similar conclusion after analysing the time-series properties of different types of capital flows in several countries. They show that FDI and other forms of long-term capital flows may be as volatile as the portfolio flows. Their study also underscores the point that concerns about volatility should direct our attention to the movement of net capital inflow, without necessarily treating the components of the net flow separately. Focussing attention on each component of capital flows separately may sometimes be misleading, as the volatility of one component may be dampened by the changes in other components. These studies thus question the supposedly greater stability of FDI over other types of capital flows and raise doubts about the practice of identifying short-term flows as the only ones responsible for creating crisis.

The experiences of Chile and Colombia are in contrast with that of Mexico and East Asia. Both Chile and Colombia have been able to avoid the currency crisis even though they undertook financial liberalization measures. What emerges from the observations made by a number of studies is that appropriate capital control measures played an instrumental role in making the macroeconomic management of these economies successful (Edwards, 2000; Cardenas and Barrera, 1997). Both Chile and Colombia introduced the particular kind of capital control measure called 'the system of unremunerated reserve requirement' on the short-term capital flows, which made these countries less vulnerable to a reversal of capital flows. It may be noted here that, instead of implementing any capital control measures India had liberalized inflows of portfolio capital since 1992.

The fact that draws attention of the policy analysts in this regard is that India managed to avoid a currency crisis when several East Asian countries were engulfed by the crisis that had originated in Thailand in 1997 and soon became contagious. In this context a number of questions come up. Was the nature of capital inflow volatile in India in the nineties? Was it the case that capital flows were volatile but they did not result in volatility of the real exchange rate? Did capital inflows adjust to changes in the real exchange rate and other macroeconomic fundamentals in such a way that they produced the positive outcome? What can we say about the long-term movement in capital inflows?

This paper makes an attempt to answer these questions on the basis of the quarterly data for India for the period 1993.2 to 2003.2. Section 2 presents an overview of various attempts to explain the dynamics of capital flows and discusses how the present study makes a departure – both in terms of method and substantive focus – from the existing literature. Section 3 addresses the first question i.e. whether the nature of capital inflows into India was volatile. To deal with the remaining questions, section 4 presents a framework to relate the temporal changes in capital inflows into India to the changes in the real exchange rate and other macroeconomic fundamentals and discusses the results of the econometric analysis. Section 5 concludes.

Section II: Determinants of Capital Inflows

While analysing the causes of capital flows into the developing countries during the 1990s, it has been a common practice to classify the causal factors into two major categories viz., the country specific or "pull" factor and the global or "push" factor. The country-specific factors include the rates of return in the domestic financial market relative to that in the industrial countries, credit ratings, degree of openness and economic reform policies. Some of the global factors are decline in the rate of interest and slowdown in the economic activity in the developed

countries. It seems that there is no general consensus on whether one set of factors is more important than the other, even though a large number of studies have appeared to deal with this particular issue (Fernandez-Arias, 1996, Fernandez-Arias and Montiel, 1996, Montiel and Reinhart, 1999, Chuhan, Claessens and Mamingi, 1998, Calvo, Leiderman and Reinhart, 1996, Taylor and Sarno, 1997, Hernandez, Mellado and Valdes, 2001).

Calvo, Leiderman and Reinhart (1993) used the principal component method to study capital flows into the Latin American countries during 1988-91, and their emphasis was exclusively on global factors. The study found that the surge in private capital inflows was mainly caused by poor investment opportunities in industrial countries, especially the U.S. It was followed by a series of other studies, which differ in terms of the sample of countries as well as methodology. Fernandez-Arias (1996) applies panel regression technique on 13 middle-income countries from Asia and Latin America covering the period 1989-1992. The study finds that private capital inflows are mainly caused by improvements in the creditworthiness of the developing countries, which in turn is caused by the decline in the global interest rate. Chuhan et.al. (1998) use the panel regression technique to explain portfolio flows into 18 countries from Latin America and East Asia during 1988-1992. They find that the push and pull factors are equally important in explaining portfolio flows into Latin America, whereas in the case of East Asia, the pull factors are more important than the push factors. As in Fernandez-Arias (1996), the push factors in this study also include some proxies for creditworthiness. Montiel and Reinhart (1999) estimate a panel regression on 15 countries for the period 1990-96 in an attempt to explain the volume and composition of various types of capital inflows. The study observes that capital inflows respond to the short-term macroeconomic policies of the capital importing country. The study finds that certain domestic macroeconomic policies, such as sterilized intervention, increase the volume of total capital

flows mainly through increased short-term flows. On the other hand, measures aiming at capital controls seem to have no significant effect on reducing the volume of capital flows. The study further observes that certain push factors, such as the foreign interest rate, play a crucial role in determining both the volume and composition of capital flows. Hernandez, Mellado and Valdes (2001), in a study to estimate the effect of contagion on capital inflows, conclude that the pull factors, which refer to the country's own characteristics, are the primary determinants of private capital inflows. Their study is based on two samples: the first sample includes 26 countries covering the period 1977-1984 and the second sample includes 28 countries over the period 1987-1997. The importance of the domestic factors in explaining capital inflows was also emphasized by Schadler, Carkovic, Bennett and Kahn (1993). This study pointed out that while the external factors might have been important in explaining private capital flows, such influences could not be regarded as dominant. The study further noted that the persistence of capital inflows varied across countries along with the timing and intensity, which indicated that the investors responded to changes in country-specific factors over time. A World Bank Study (World Bank, 1997) further observes that the factors driving inflows have been changing over time. The study finds that the factors influencing portfolio flows to East Asia and Latin America during 1993-1995 are different from those influencing the same countries during 1989-1993, and that the country-specific factors played a much more important role during 1993-95. In a recent study, however, Gordon and Gupta (2003) observe that in the case of India, both the domestic and external factors influenced the portfolio equity flows. They have used a multivariate regression model based on monthly data covering March 1993 to October 2001.

What emerges from these studies is that the different empirical routes that various studies have so far taken, to generalise the findings about the relative importance of various factors that determine the inflow of

capital to any country, have met with limited success. However, the findings are important in explaining specific country experiences in specific periods. In this paper we take a similar view while looking at the Indian experience. In particular, we try to examine in the context of a specific capital importing country, if there is a systematic relationship between the dynamic changes in capital flows over time and the changes in the short-term macroeconomic policies of the country, unlike most of the other studies discussed earlier. Our conjecture is that the temporal changes in net capital inflows into India since 1993 could be explained largely by the movement in the real exchange rate, which was mainly influenced by the policy of foreign exchange market intervention. It is also hypothesized that certain other macroeconomic fundamentals might also have played an important role in this context.

Section III: Pattern of Capital Inflows into India: Assessing Volatility

Here we address the following question: was the nature of capital flow volatile in India in the post liberalization period? We begin with a few stylized facts relating to net private capital flows into India. In this paper the net private inflow of capital is taken to be the sum total of net foreign direct investment, net portfolio investment and net external commercial borrowing. In Figure 1, we report the quarterly figures for net flows of foreign capital into India. It appears that in spite of certain fluctuations, net inflows of capital were increasing over time till the first quarter of 2001. They declined for a short period. However, the rising trend resumed again in the first quarter of 2002. During the last three quarters net capital inflow shows a decreasing trend. The quarterly trend for each component of net inflows of private capital is also reported separately. Figure 2 shows net inflows of foreign direct investment in India. It is clearly evident that during the entire period foreign direct investment exhibited an upward trend. Figure 3 represents net portfolio investment in India. The trend appears to be largely fluctuating over

the entire period. Figure 4 represents the quarterly trend for net external commercial borrowing. In terms of volume, the inflow due to external commercial borrowing appears to be quite low and the trend is almost steady over the entire period except in the two quarters viz., the third quarter of 1999 and the fourth quarter of 2000.

We now turn to the main concern of this section i.e. addressing the question of volatility. The most commonly used measure of volatility, in the literature, is the coefficient of variation. Grabriele, Baratav and Parikh (2000) use the coefficient of variation for the data in levels form to measure instability and the standard deviation of annual percentage change to measure volatility. While comparing the instability and volatility in capital flows across twentyfive developing countries in the 1980s and 1990s, the study observes that private capital inflow was more volatile in the African countries than in the Asian or Latin American countries. Moreover, it was found that the degree of volatility in capital flows increased in the 1990s in most of the countries. Gordon and Gupta (2003) also use the coefficient of variation to measure the volatility of portfolio flows into India in comparison to some emerging market economies and find that the volatility of portfolio flows into India has increased since 1998. Their study, however, notes that the degree of volatility of portfolio flows into India was quite low compared to 17 emerging market economies. Osei, Morrissey and Lensink (2002), however, use the term instability and volatility interchangeably. To measure the volatility of capital inflows across a group of low, lower-middle and upper-middle income countries during 1970-1997, Osei, Morissey and Lensink (2002) use three different measures viz., coefficient of variation, Index I (which is the standard deviation around a simple time trend) and Index II (which is the standard deviation around a forecast trend). The study shows that the ranking of the three categories of countries for various kinds of capital inflows based on these three different measures are not symmetric. The limitation of this study is that it does not

provide any strong reason to prefer one measure to the other. Coondoo and Mukherjee (2003) also measure the volatility of foreign institutional investment in India based on daily data for the period January 1999 to May 2002. Instead of using a scalar measure of volatility, the study emphasises the nature of volatility in a multidimensional manner, and therefore measures the three characteristics of volatility, viz., the strength of volatility, the duration of volatility and the persistence of volatility.

An alternative method of measuring volatility has been suggested by Claessens, Dooley and Warner (1995), while questioning the conventional view to inferring persistence from the labels attached to a particular kind of capital flows. They argue that an adequate definition of volatility should depend on the time-series properties of the particular type of capital inflows, and not on the period of maturity. Portfolio capital flows, which are known to be short-term in terms of maturity, are often referred to as hot money or volatile, whereas long-term capital flows, called 'cold money' are supposed to be less volatile. Claessens et al argue that there might be a substitution or a complementary relationship between the components of capital flows. Therefore, net inflows of capital may or may not be volatile, depending on the net impact on it of each component of capital inflows. Hot flows are those which have low persistence and high volatility, and the reverse is true for the cold flows. In terms of time-series properties, a persistent series is a series that exhibits positive autocorrelation, whereas a transitory series has low or negative autocorrelation. In general, in the case of cold money the series will be highly positively correlated whereas in the case of hot money the series will exhibit zero or negative autocorrelation. One would therefore expect net portfolio capital inflows to have zero or negative autocorrelations whereas net foreign direct investment to exhibit positive autocorrelations.

In this study we have followed the method suggested by Claessens et al., instead of the familiar coefficient of variation. Even though the coefficient of variation is widely

used to measure volatility, it is best suited to the cases of comparisons. A particular value of the coefficient of variation has no meaning unless it is compared with another. One series is more volatile than another one, if the coefficient of variation is higher for the former. The autocorrelation coefficients can instead be interpreted in absolute sense. We have estimated the autocorrelation coefficients for each of the components as well as for net inflows of private capital, and the results are reported in figures 5 to 8. It appears that foreign direct investment and external commercial borrowing exhibit significant positive autocorrelations. On the other hand, portfolio inflows and net capital inflows exhibit no significant autocorrelations. In other words, these two component series have zero autocorrelations. These findings thus support the conventional wisdom that in India in the nineties the portfolio inflow was volatile whereas foreign direct investment was not. What is less appreciated, however, is that the combined effect of these components has produced volatility in the aggregate – in net capital inflows. We find that net inflows of capital have been volatile in India since 1993.

Section IV : Analysing Changes in Capital Inflows into India: A Framework

This section deals with the other questions that we started with, besides assessing volatility. To establish any connection between capital inflows and the factors that are supposed to influence these flows, we need to specify an econometrically estimable model.

Specification

Portfolio balance models aim at explaining how an international investor takes the decision to allocate her portfolio across assets marketed in different countries. In these models the differential in the expected rates of return of two countries' bonds is equivalent to the nominal interest differential minus the expected change in the exchange rate. If the assets of two countries are perfectly substitutable, then this differential in the expected rates

of return will be zero. In the finance literature this is known as uncovered interest parity condition. Following the framework of the portfolio balance models, net inflows of capital can be written as a function of the uncovered interest differential.

$$\text{Thus, } K_t = f\ (I_t - I_t^* - \Delta e_t^e) \qquad (1)$$

where, K_t = net inflows of capital in period t

I_t = domestic rate of interest in period t

I_t^* = world rate of interest in period t and

Δe_t^e = expected rate of change in the exchange rate in period t.

The lower-case letters represent the logarithm of the respective variables.

Let us assume that the agents are forward-looking or rational. Then the expected change in the exchange rate is an unbiased predictor of the actual change in the exchange rate. Therefore we can write

$$\Delta e_t^e = \Delta e_t$$

where Δe_t = actual change in the exchange rate from period t-1 to t.

Thus equation (1) can be written as:

$$K_t = \alpha + \beta\ (I_t - I_t^* - \Delta e_t) + \varepsilon_t \qquad (2)$$

The dynamic specification of this model, which can be interpreted as a more general specification, can now be written as:

$$\Delta K_t = \alpha + \beta_1[(\Delta I_t - \Delta I_t^* - \Delta(\Delta e_t)] + \beta_2 K_{t-1} + \beta_3 (I_{t-1} - I_{t-1}^* - \Delta e_{t-1}) + \varepsilon_t \qquad (3)$$

If $\beta_2 + \beta_3 = 0$, equation (3) may be written as :

$$\Delta K_t = \alpha + \beta_1(\Delta I_t - \Delta I_t^* - \Delta(\Delta e_t)) + \beta_2 \{K_{t-1} - (I_{t-1} - I_{t-1}^* - \Delta e_{t-1})\} + \varepsilon_t \qquad (4)$$

Here the term corresponding to β_2 refers to the error-correction term in the dynamic specification of the model.

Net inflows of capital also depend on a vector of fundamental determinants (Z_t), which include such variables as the rate of inflation, import of capital goods, industrial output, capacity utilization, the current account balance, etc (Cardenas and Barrera, 1997). In our specification we include the rate of inflation and the current account balance as the fundamental determinants of net capital inflows. Other variables could not be included because of the lack of quarterly data. Cardoso and Goldfajn (1998) have argued, in the context of Brazil, that the policy response to capital inflows is potentially an endogeneous variable, and hence may be captured through some instrumental variables. In the case of India, as mentioned earlier, the policy of intervention in the foreign exchange market was implemented simultaneously with the liberalization of capital inflows. To capture the effect of this policy we have used foreign exchange reserves as an instrumental variable in our specification. Thus the resulting specification turns out to be:

$$\Delta K_t = \alpha+\beta_1(\Delta I_t - I_t^*-\Delta(\Delta e_t)) + \beta_2\{K_{t-1} - (I_{t-1}-I_{t-1}^*-\Delta e_{t-1})\} + \gamma Z_t + \delta R_t+\varepsilon_t \quad (5)$$

where Z_t = the vector containing inflation and current account balance in period t

and R_t = f oreign exchange reserves in period t.

Estimation :

The equation that we have estimated differs from (5) in that the first term has been decomposed into interest rate differentials and the change in the exchange rate. This affects the parameterisation of the ECM terms. (3) is therefore re-written as:

$$\Delta K_t = \alpha + \beta_1(\Delta I_t-\Delta I_t^*) + \beta_2(\Delta(\Delta e_t)) + \beta_3 K_{t-1} + \beta_4 (I_{t-1}-I_{t-1}^*) + \beta_5(\Delta e_{t-1}) + \varepsilon_t \quad (6)$$

If $\beta_3+\beta_4+\beta_5 = 0$, (6) can be written as:

$$\Delta K_t = \alpha +\beta_1(\Delta I_t- \Delta I_t^*) + \beta_2(\Delta(\Delta e_t)) + \beta_3(K_{t-1} - \Delta e_{t-1}) +\beta_4(I_{t-1}-I_{t-1}^*-\Delta e_{t-1}) + \varepsilon_t \quad (7)$$

(7) is equivalent to (5). In an estimation of (5), co-integration would imply negative value of the coefficient of the ECM term i.e., $\beta_2 < 0$. In (7), the existence of significant error-correction would be implied by $\beta_3 < 0$.

We have estimated several variants of equation (7) by including and excluding the Z_t and R_t terms. The specifications used for subsequent estimation are as follow:

$$\Delta K_t = \alpha +\beta_1(\Delta I_t-\Delta I_t^*) + \beta_2(\Delta(\Delta e_t)) + \beta_3(K_{t-1}-\Delta e_{t-1}) + \beta_4(I_{t-1}-I_{t-1}^*-\Delta e_{t-1}) + \varepsilon_t \quad (8)$$

$$\Delta K_t = \alpha +\beta_1(\Delta I_t-\Delta I_t^*) + \beta_2(\Delta(\Delta e_t)) + \beta_3(K_{t-1}-\Delta e_{t-1}) + \beta_4(I_{t-1}-I_{t-1}^*-\Delta e_{t-1}) + \beta_5 Z_t + \beta_6 Z_{t-1} + \beta_7 R_t + \beta_8 R_{t-1} + \varepsilon_t \quad (9)$$

$$\Delta K_t = \alpha +\beta_1(\Delta I_t-\Delta I_t^*) + \beta_2(\Delta(\Delta e_t)) + \beta_3(K_{t-1}-\Delta e_{t-1}) + \beta_4(I_{t-1}-I_{t-1}^*-\Delta e_{t-1}) + \beta_5\Delta Z_t + \beta_6\Delta Z_{t-1} + \beta_7\Delta R_t + \beta_8\Delta R_{t-1}+ \varepsilon_t \quad (10)$$

$$\Delta K_t = \alpha + \beta_1(\Delta I_t-\Delta I_t^*) + \beta_2(\Delta(\Delta e_t)) + \beta_3(K_{t-1}-\Delta e_{t-1}) + \beta_4(I_{t-1}-I_{t-1}^*-\Delta e_{t-1}) + \beta_5 Z_{t-1} + \beta_6 R_{t-1}+ \varepsilon_t \quad (11)$$

Before estimating these equations we tested for stationarity of all the variables. Unit root tests were applied to test stationarity of these variables. Table 3 reports the results of unit root tests.

Table 3. Results of Unit Root Test

Variables	DF test	ADF test
LTOTAL	6.30* (with C and T)	-2.49 (with C, 8 lags)
LINTDIF	-1.78 (with C)	-3.71 (with C, 14 lags)
LREQEX	-1.24 (with C)	-2.15 (with C and T, 12 lags)
LREQTR	-1.12 (with C)	-1.47 (with C and T, 11 lags)
DLTOTAL	-10.85* (with C)	-4.81* (with C, 3 lags)
DLINTDIF	-7.29* (with C)	-3.94* (with C, 1 lag)
DLREQEX	-6.99* (with C)	-3.27* (with C, 5 lags)
DLREQTR	-6.94* (with C)	-3.34* (with C, 5 lags)

Note: * implies significant at 1% level

The null hypothesis of a unit root at the level of the variables is accepted in all the variables using Augmented Dickey-Fuller (ADF) test, and it thus establishes nonstationarity of the variables at the levels. However, in the case of net inflows of capital (LTOTAL), the Dickey-Fuller test (DF) result at the level of the variable differs from that of the ADF test. Results of the DF test are, however, in conformity with that of the ADF tests on the first differences of the variables. It appears that, the null hypotheses of unit root in the first difference of the variables are rejected in all the cases. This implies that the series is 'integrated of order one' or I(1).

Equations (8) – (11) are then estimated by ordinary least squares. The results are reported in Tables 4 and 5. In Table 4 we use the exchange rate based on export-based weight as the index of exchange rate whereas in Table 5 we use the exchange rate based on trade-based weight. From Table 4 it appears that the term $\Delta(\Delta e_t)$ (D2LREQEX) is positive and significant either at 5% or 10% level in all the four models. Similarly, the term $K_{t-1} - \Delta e_{t-1}$(ECM1) is negative and significant at 1% level in all the four models. Among the fundamentals, only the lagged value of inflation is positive and significant at 10% level in model 2. The comparison of the $\bar{R}^2$ value indicates that it is highest in the case of model 3. Similarly, the standard error of regression (SER) is the least in the case of model 3. However, as none of the fundamentals (Z_t) viz., inflation, current account balance as well as the foreign exchange reserves is significant in model 3, we cannot consider model 3 as the best specification. Thus, model 1 appears to be the best specification. Similar interpretation holds good for Table 5 too. Comparing the results from the four different specifications it appears that model 1 is the best.

In all the four specifications β_3 is negative and significant. It implies that the dynamics of capital inflows follow error-correction mechanism. Interestingly, the inclusion of the fundamentals does not appear to be a necessary condition for this result, as the effect of none of these variables appears

to be statistically significant. On the other hand, statistically significant error-correction supports the point that a proportion of the disequilibrium error from one period is getting corrected in the next period in such a way that the changes in capital inflows are determined by the changes in the real exchange rate, changes in interest rate differential and past equilibrium errors.

According to the Granger Representation Theorem (Granger, 1983), the presence of the error-correction mechanism indicates that there exists a long-run equilibrium relationship between the variables and they are co-integrated. From our estimated models, as the inclusion of the fundamentals does not appear to be necessary,

Table 4. Estimated Models

Variables	Model 1	Model 2	Model 3	Model 4
C	8.962 (5.629)*	9.632 (1.105)	7.968 (4.505)*	11.560 (0.08)***
DLINTDIF	-0.049 (-0.064)	-0.967 (-1.030)	-0.780 (-0.897)	-0.918 (-1.000)
D2LREQEX	7.710 (1.756)***	7.929 (1.758)***	10.774 (2.225)**	8.204 (1.864)***
ECM1	-1.016 (-6.03)*	-0.963 (5.345)*	-0.891 (-4.729)*	-1.019 (-6.064)*
INTPAR1	-0.197 (-0.571)	-0.792 (-1.322)	-0.392 (-1.050)	-0.837 (-1.543)
INFL		-0.053 (-1.002)		
INFL1		0.115 (1.804)***		0.076 (1.474)
DINFL			-0.070 (-1.444)	
DINFL1			0.071 (1.221)	
CAQ		-1.081E-05 (-0.201)		
CAQ1		2.682E-05 (0.488)		3.940E-05 (0.811)

(Contd.)

(Table 4 Contd.)

Variables	Model 1	Model 2	Model 3	Model 4
DCAQ			-4.828E-05 (-1.180)	
DCAQ1			-6.324E-05 (-1.396)	
LFOREX		2.418 (0.793)		
LFOREX1		-2.477 (-0.885)		-0.166 (0.355)
DLFOREX			3.238 (1.219)	
DLFOREX1			0.866 (0.330)	
	R^2 = 0.56 $\bar{R}^2$ = 0.51 SER = 0.93	R^2 = 0.63 $\bar{R}^2$ =0.50 SER =0.94	R^2 =0.65 $\bar{R}^2$ = 0.53 SER = 0.92	R^2 = 0.61 $\bar{R}^2$ = 0.52 SER = 0.92

Notes: (i) * implies significant at 1% level.
(ii) ** implies significant at 5% level
(iii) *** implies significant at 10% level
(iv) SER stands for standard error of regression

Table 5. Estimated Models

Variables	Model 1	Model 2	Model 3	Model 4
C	8.964 (5.657)*	9.580 (1.103)	7.972 (4.531)*	11.487 (1.78)***
DLINTDIF	-0.039 (-0.051)	-0.957 (-1.021)	-0.774 (-0.893)	-0.908 (-0.993)
D2LREQTR	7.745 (1.840)***	7.847 (1.814)***	10.693 (2.300)**	8.193 (1.944)***
ECM2	-1.016 (-6.061)*	-0.965 (-5.377)*	-0.893 (-4.761)*	-1.020 (-6.100)*
INTPAR2	-0.194 (-0.567)	-0.786 (-1.315)	-0.386 (-1.037)	-0.831 (-1.537)
INFL		-0.051 (-0.969)		

(Contd.)

(Table 5 Contd.)

Variables	Model 1	Model 2	Model 3	Model 4
INFL1		0.114 (1.789)***		0.076 (1.482)
DINFL			-0.067 (-1.400)	
DINFL1			0.072 (1.255)	
CAQ		-1.033E-05 (-0.193)		
CAQ1		2.632E-05 (0.479)		3.891E-05 (0.803)
DCAQ			-4.835E-05 (-1.187)	
DCAQ1			-6.476E-05 (-1.432)	
LFOREX		2.401 (0.789)		
LFOREX1		-2.455 (-0.878)		-0.159 (-0.344)
DLFOREX			3.225 (1.219)	
DLFOREX1			0.869 (0.333)	
	R^2 = 0.57 $\bar{R}^2$ = 0.52 SER = 0.93	R^2 = 0.64 $\bar{R}^2$ =0.51 SER =0.94	R^2 =0.65 $\bar{R}^2$ = 0.53 SER = 0.92	R^2 = 0.62 $\bar{R}^2$ = 0.53 SER = 0.92

Notes: (i) * implies significant at 1% level.
(ii) ** implies significant at 5% level
(iii) *** implies significant at 10% level
(iv) SER stands for standard error of regression

we have tested for co-integration between capital inflows, interest rate differential and the real exchange rate, all of which are nonstationary and integrated of order 1. Results from the test of co-integration, based on the Dickey-Fuller and the Augmented Dickey–Fuller tests, show that the variables are co-integrated. What it implies is that the

dynamics of capital inflows in India in the post-liberalization period was such that an error–correcting mechanism was operating which related dynamic adjustment to capital inflows to the movements in the real exchange rate and the interest rate differential.

Presence of the error-correction mechanism implies that the mechanism of short-run dynamic adjustment was operating from the real exchange rate to net capital inflows. Since 1993, the changes in the real exchange rate in India were mainly due to the intervention by the Reserve Bank of India in the foreign exchange market. These changes in the real exchange rate were, therefore, followed by the changes in net capital inflows, such that a long-run equilibrium relationship holds good between capital inflows, real exchange rate and interest rate differential. The policy of exchange market intervention was therefore instrumental in preventing the volatility of the real exchange rate, which could have resulted from the volatility of the net capital inflows into India.

Section V : Conclusion

This paper examines whether the inflows of capital were volatile in India following the financial liberalization in the 1990s. The analysis shows that, in the period following financial liberalization in India, foreign direct investment and external commercial borrowing were not volatile, whereas the portfolio inflow was volatile. We further observe that the aggregate of these three kinds of inflows, which represents net inflow of capital into India, was also volatile.

The paper also analyses how capital inflows adjusted to changes in real exchange rate and other macroeconomic fundamentals in India since 1993. The econometric results indicate that an error-correction mechanism was operating between net inflows of capital and the real exchange rate. The macroeconomic fundamentals did not have any significant effect on the dynamic adjustment of capital inflows. Further analysis suggests that in the post-liberalization period, a co-integration relationship exists

between net inflows of capital, real exchange rate and interest rate differential. We have argued that co-movement in these variables was due to the policy of foreign exchange market intervention by the Reserve Bank of India. This policy helped prevent the volatility of the real exchange rate, which could otherwise be likely because of the volatility of net capital inflows.

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Fig 1: Net Inflows of Capital to India: 1993.2-2003.2

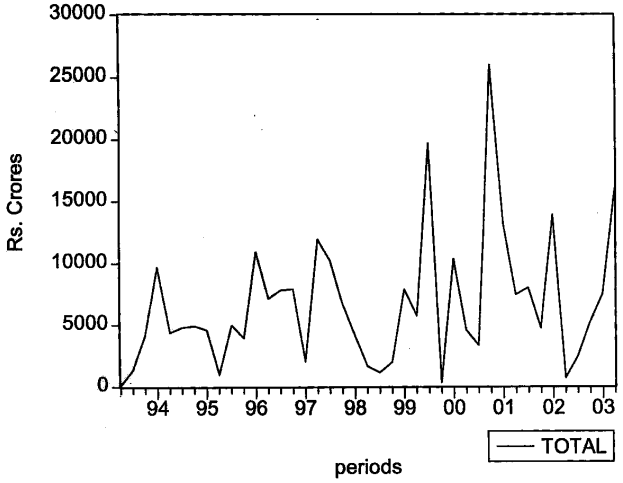

Fig 2: Net Inflows of FDI to India: 1993.2-2003.2

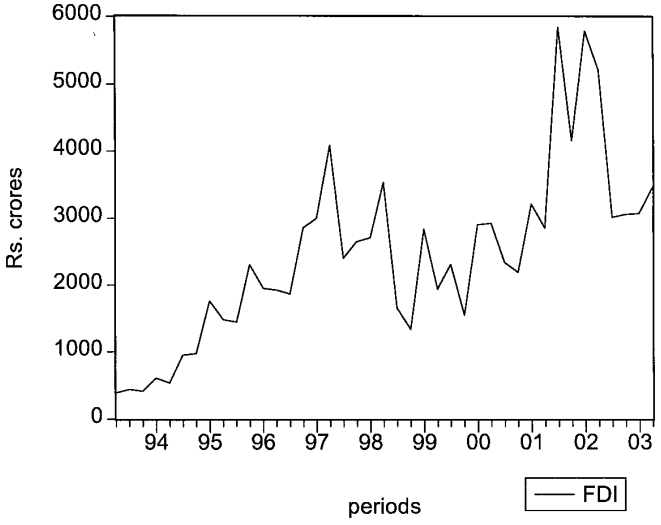

Fig 3: Net Inflows of Portfolio Investment to India: 1993.2-2003.2

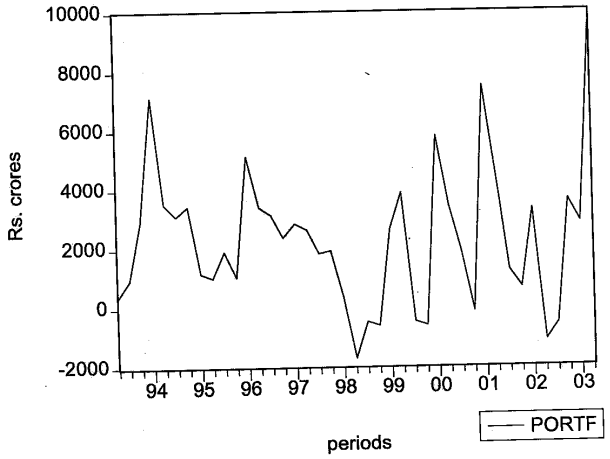

Fig 4: Net Inflows of Commercial Borrowing to India : 1993.2-2003.2

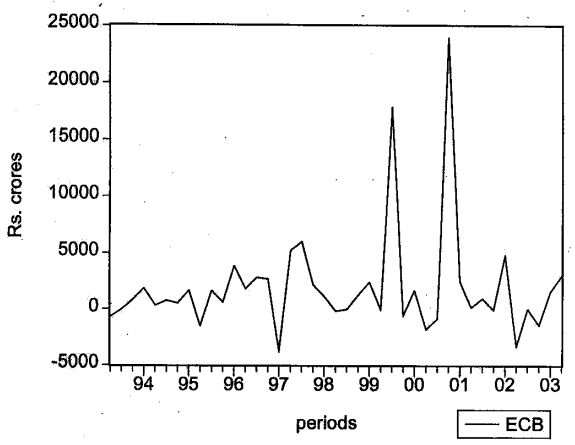

Fig 5: Autocorrelation functions for FDI

Fig 6: Autocorrelation functions for External Commercial Borrowing

Fig 7: Autocorrelation functions for Portfolio Investment

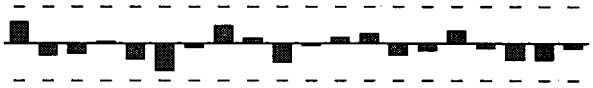

Fig 8: Autocorrelation functions for Net Capital Inflows