ECONOMIC REFORMS, CAPITAL INFLOWS AND MACRO ECONOMIC IMPACT IN INDIA

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ABSTRACT

The study attempts to explain the effects of inflows of private foreign capital on some major macroeconomic variables in India using quarterly data for the period 1993-99. The analyses of trends in private foreign capital inflows and some other variables indicate instability. Whereas net inflows of private foreign capital (FINV), foreign currency assets, wholesale price index, money supply, real and nominal effective exchange rates and exports follow an I(1) process, current account deficit is the only series that follows I(0). Cointegration test confirms the presence of long-run equilibrium relationships between a few pairs of variables. But the dependence of each I(1) variable on FINV invalidates such cointegration except in two cases: cointegration exists between foreign currency assets and money supply and between nominal effective exchange rate and exports, even after controlling for FINV. The Granger Causality Test shows unidirectional causality from FINV to nominal effective exchange rates- both trade-based and export-based-, which raises concern about the RBI strategy in the foreign exchange market. Finally, instability in the trend of foreign currency assets could be partially explained by the instability in FINV with some lagged effect.

JEL Classification: F21, F41, and C22
Keywords: Private foreign capital, economic reforms, instability, India

Introduction

Deregulation of private foreign investment in India started in 1993 in the form of partial liberalization of the capital account. Outflows of capital by the Indian residents remained strictly controlled, whereas inflows and outflows of capital by non-residents were partially deregulated. These changes in policy framework not only led to a surge in inflows of private foreign capital but also contributed to a significant change in the form in which private capital was coming in. External commercial borrowing which was the major source of private foreign capital inflows during the eighties became less important during the nineties. In the nineties, the predominant role of the portfolio investment followed by the foreign direct investment (FDI) has been envisaged[1]. Estimates of portfolio investment through foreign institutional investors (FIIs) and global depository receipts (GDRs) are $9 billion and $6 billion, respectively, covering the period 1993-98 (Ahluwalia, 1999). Distinct changes in the guidelines for portfolio investment and FDI vis-à-vis external commercial borrowing during August and September of 1992 certainly encouraged the former categories (R.B.I, 1992). A look at some of the items in the new guidelines will make it clear:

a) Use of external commercial borrowing would be prioritised to the infrastructure and core sector export-oriented and import-substitution units and also medium-sized / small-scale units. Infrastructure or core sector included power, oil exploration and refining, telecommunication, fertilizer and transport.

b) External commercial loans could be raised only for meeting foreign exchange cost of capital investment. Expenditure on working capital could not be met by external commercial borrowing. In addition, all external commercial borrowing should have a minimum final maturity period of five years.

c) Priority will be given to those proposals for external commercial borrowing which will be used for total export productions, which will be self-liquidating i.e. the principal installments and interest would be entirely serviced out of export-earning and for which no security would be provided by a commercial bank/financial institution in India.

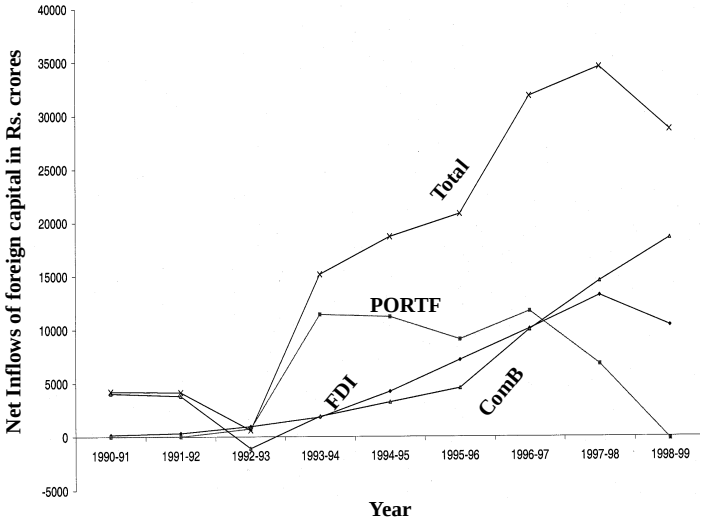
d) Foreign institutional investors (FII) would be welcome to invest in all the securities tradable in the primary and the secondary markets. There will be no restriction on the volume of investment by the FIIs. Moreover, there would be no lock-in period for the proposed investments by the FIIs.

e) FIIs would be given tax-benefits. Concessional tax rate of 20 per cent was proposed for the dividend and interest income. In addition, a tax rate of 10 per cent on long-term capital gains (more than one year) and 30 per cent on short-term capital gain were proposed.

f) In connection with the FDI, the limit of 40 per cent of foreign shareholdings imposed by the Foreign Exchange Regulation Act (FERA) of 1973 on the Indian companies was raised to 51 per cent in July 1991. The approval of foreign direct investment in the priority industries where high technology was thought to be needed was made automatic. Criteria for approval were also made liberalised, in general.

The trend of private foreign capital depicted in Fig.1 shows that portfolio investment exceeded the other two sources between 1993-94 and 1996-97. However, the trend of portfolio investment exhibits instability. On the other hand, the flow of FDI appears to be increasing steadily over the years. External commercial borrowing, the only major source of private foreign capital prior to reform, reached its all time trough in 1992-93 when it became negative. Afterwards it followed an upward trend and it exceeded the other two forms of private foreign capital during the last two years i.e., 1997-98 and 1998-99.

Fig. 1. Net Inflows of Foreign Capital



Foreign direct investment (FDI)

Portfolio investment (PORTF)

External commercial borrowing (CoMB)

Total

A brief account of the net annual capital inflow in India since the beginning of the 90's is presented in Table 1. It reveals that net inflow of private foreign capital increased from Rs.605.2 crores (0.86% of GDP) in 1992-93, the year just prior to the deregulation of private foreign investment, to Rs.15187.5 crores (1.87% of GDP) in 1993-94. Easing of restrictions on inflows of private foreign capital has also led to its increasing share in gross domestic capital formation from 2.85% in 1990-91 to 8.05% in 1993-94 and 9.3% in 1997-98. In terms of net capital account, private inflows of foreign capital accounted for 53.58% and 79.01% in 1993-94 and 1998-99, respectively, whereas the same stood at only 21.16% in 1985-86.

Some important changes may also be observed in the exchange rate policy since July 1991. A significant downward adjustment in the exchange rate took place in July 1991. On July 1, 1991, exchange rate of rupee per unit of dollar was devalued from Rs.21.40 to Rs.23.25 and on July 3 to Rs.26. Since March 1992, dual exchange rate system was instituted. It was characterised by the coexistence of the official exchange rate determined by the RBI and the market rate determined in the inter-bank foreign exchange market. Since March 1993, exchange rate of rupee was left to be determined by the market forces. In March 1993, the exchange rate of rupee per unit of dollar became Rs.31.40 and it remained steady for over two years at that level. But since the middle of September 1995 there were periodic speculative pressures on the exchange rate which called for active intervention by the Reserve Bank of India in the foreign exchange market. In the floating exchange rate regime, the predominant objective of India's exchange rate policy was to maintain a stable REER in order to prevent an erosion in the incentives available to exporters. To meet this objective, it was announced that, "RBI stands ready to intervene to maintain orderly market condition and to curb excessive speculation" (G.O.I, 1995-96). The period after 1993, therefore, witnessed

interventions by the Reserve Bank of India several times to reduce the excess volatility of the exchange rates.

Given these aspects of the reform programme, it is pertinent to analyse the macroeconomic responses in the post-1993 period in India. Importance of this issue can be traced back to different macroeconomic consequences of liberalization of foreign capital in the countries of South-East and East Asia vis-a-vis Latin America. Various studies observed that in the post liberalization period in countries viz., Thailand, Indonesia, Malaysia and Chile both investment and exports grew without any substantial appreciation in real exchange rate. On the other hand, Argentina, Mexico, Brazil, Columbia, Korea and Philippines experienced a strong appreciation of their real exchange rate. In contrast to this difference, it was further noted that in all these countries in both the regions current account deficits and inflation increased (Khan and Reinhart, 1995, World Bank, 1995 and Corbo and Hernandez, 1996). A comparative picture of these two regions in terms of selected macroeconomic indicators in the period of increasing inflow of foreign capital is presented in Table 2.

The objective of this study is to observe and analyse the dynamics of some selected macroeconomic indicators in relation to the inflows of private foreign capital as a consequence of economic reforms in India. The paper is organized as follows: section I discusses the trends in some macroeconomic indicators and tries to explain them. Section II reports the findings of some econometric analyses based on quarterly data from 1993.II to 1999.II. Finally we conclude in section III.

I. Trend behaviour of some Macroeconomic Indicators in relation to Inflows of Private Foreign Capital in India with an Analytical Overview:

This section begins with the question: how might liberalization of capital inflows affect macroeconomic aggregates in an open economy?

An economy seeking to attract foreign capital can experience different macroeconomic consequences under different exchange rate regimes. In what follows we consider the macroeconomic consequences under a floating exchange rate regime and the discussion follows the arguments available in the existing literature.

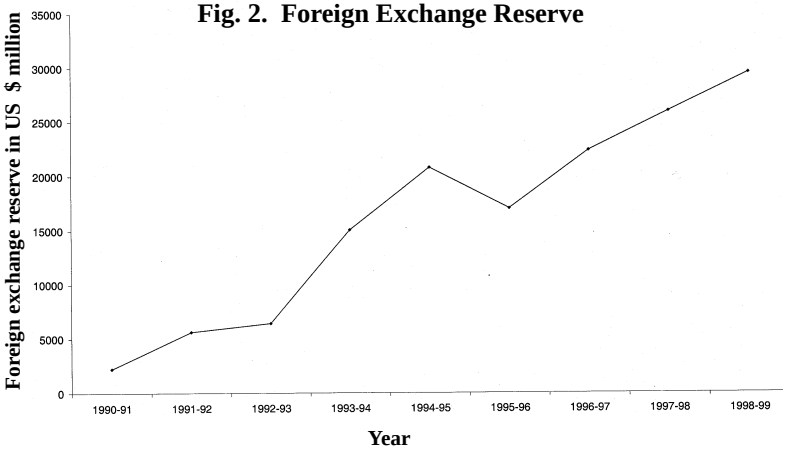
In a floating exchange rate regime, an increase in capital inflows will lead to an appreciation of nominal exchange rate because of an excess supply of foreign exchange. This appreciation under a floating exchange rate regime generally leads to overshooting of nominal as well as real exchange rate. This happens because as the financial market adjusts at a faster rate than the goods market, surge of capital inflows may lead to excessive appreciation of nominal and real exchange rates above their equilibrium levels (Rangarajan, 1998). Overshooting of nominal exchange rate will, in effect, ration the sale of foreign exchange for current transactions. This will affect exports adversely because the consequence will be similar to imposing an implicit tax on exports (Sachs, 1989). Such a rationing, on the other hand, is likely to lead to the development of a black market for foreign exchange. The rationing of foreign exchange will lower the relative price of exports and bias production away from exports. At the same time, imports may have increased due to the appreciation of real exchange rate which, in turn, will have adverse effect on the current account balance. In consequence expected depreciation will generate pressure which will lead to excessive depreciation of nominal exchange rate with some lag. This tendency of instability in nominal exchange rate may result in a loss of confidence on the part of the foreign institutional investors. Such adverse effects due to the instability of the exchange rate may lead to a system of “managed float”. Under this system, the central bank intervenes in the foreign exchange market to reduce the excess volatility in the exchange rate so that the equilibrium is restored. There may be two types of central bank intervention.

In the first type the central bank purchases foreign exchange against the domestic currency. This will help control further appreciation of the nominal exchange rate. On the other side, net foreign assets being one component of reserve money, such intervention leads to the growth of high-powered money and consequently increases the money supply in the economy. With no change in the demand for money this will lead to an increase in domestic absorption. Increased domestic absorption may come through increased spending on either investment or consumption or both. This increased spending will go to both the categories of goods viz., tradables and nontradables. Increased expenditure on tradables will increase the size of trade deficit. On the other hand, increased spending on nontradables will increase the relative price of nontradables to tradables. This, in effect, will have two consequences. One is the reallocation of factors of production towards nontradable sector due to the increase in its relative price. So it is interesting to observe that while a large nontradable sector emerges, the consumer expenditure switches from nontradables to tradables (Corbo and Henandez, 1996). The other consequence is the effect on the real exchange rate. However, the direction of change will depend on the rate of inflation relative to the initial depreciation of the nominal exchange rate. If real exchange rate appreciates there will be further deterioration of the current account balance which will require further intervention by the central bank in the form of buying foreign exchange. On the other hand, if real exchange rate depreciates that may help improve the current account balance. But depreciation of real exchange rate may also fail to produce all the desirable results. Because too much depreciation may lead to reversal of capital inflows simultaneously with the other effect. Hence, that will require further intervention by the central bank but in the form of selling foreign exchange so that nominal exchange rate appreciates to some extent. Such intervention by the central bank will continue till a new “equilibrium” is reached for the exchange rate.

The second type of central bank intervention is known as "sterilized intervention". In this process the central bank buys foreign exchange in exchange of government securities. It helps to curb the growth of money supply in the economy and hence there will be no increase in domestic absorption. In consequence, there will be no increase in the current account deficit too. But it creates an upward pressure on the domestic interest rate and hence increase fiscal deficits (Joshi and Little, 1994). Further an increase in the interest rate may attract more foreign capital which would aggravate the problem of management of capital inflows. Another limitation of sterilized intervention is that the central bank has to incur some costs while using this instrument. The associated cost will be equivalent to the difference between the interest to be paid by the central bank on government securities and the return enjoyed by the central bank on holding foreign reserves. This will happen because sterilized intervention by the central bank in the context of liberalization of private foreign capital will lead to an increase in interest rate for government securities[2].

In the light of the above discussion, let us now analyse the trend behaviour of some macroeconomic indicators in India. For the trend

Fig. 2. Foreign Exchange Reserve



analysis we have chosen the period 1990-91 to 1998-99 which will help to form a comparative picture of the post-reform period and the period just prior to the reform.

The foreign exchange reserve in India has increased considerably since the initiation of economic reforms (Fig.2). The reserve has gone up by US $27286 million between 1990-91 and 1998-99. Although it was steadily increasing since 1991-92, the volume was not quite high during the first three years. The reserve had started to peak up since 1993-94. It happened mainly because of intervention by RBI against the surge of capital inflows. Initially RBI followed "sterilized intervention". But since the treasury bill market was not properly developed this process could not be continued for a longer time. During the later period intervention by RBI was mostly through purchase of foreign currency for domestic currency (Reddy, 1999, Rangarajan, 1998). Consequent upon the increase in foreign currency assets due to RBI intervention in the foreign exchange market, there was a rapid growth in money supply in the post-reform period (Fig.3 and Table 4).

Fig. 3. Money Supply (M3)

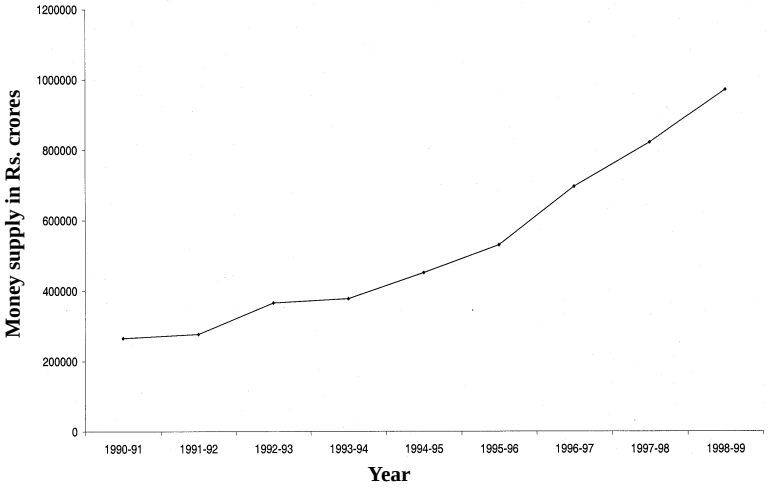
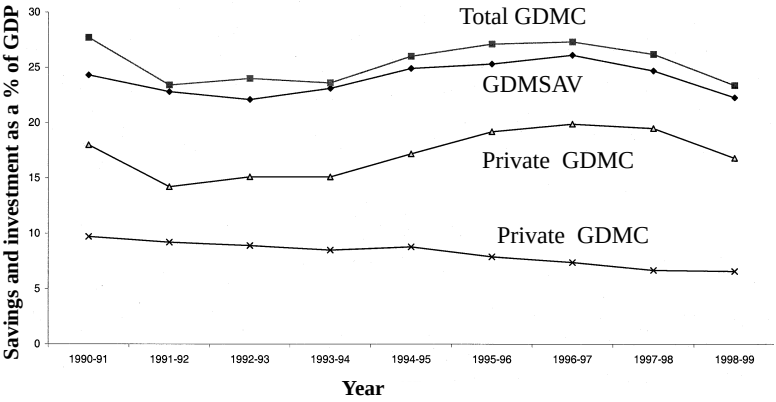


Fig. 4. Savings and investment



Gross domestic savings (GDMSAV)

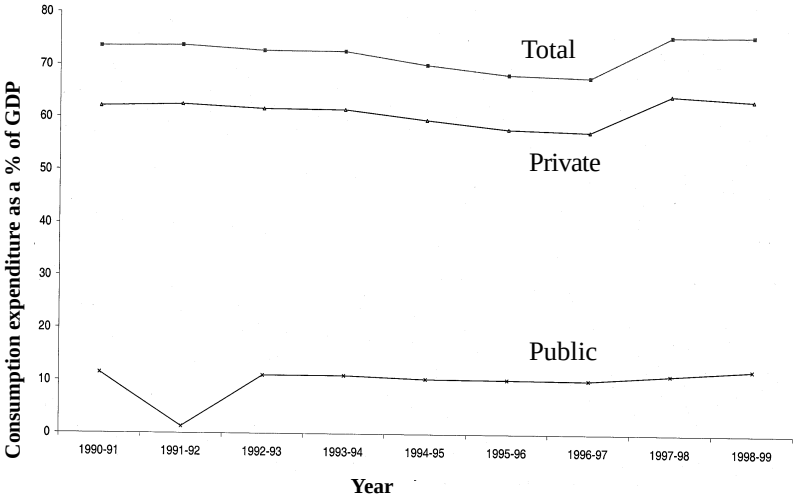
(Total) Gross domestic cap form (GDMC)

(Private) Gross domestic cap form (GDMC)

(Public) Gross domestic cap form (GDMC)

Let us now consider if the increase in money supply led to an increased domestic spending in the post-1993 period. Figure 4 shows that investment as a percentage of GDP follows an upward trend since 1993-94 and continued till 1997-98 when the level of investment was much higher than that during the two years prior to 1993-94. The same figure also reveals one of the important features in the post-reform period, that is, a sharp increase in the private sector investment. However, this achievement should not be attributed entirely to the liberalization of capital inflows because some other reform measures have also contributed towards this end. These reform measures include relaxation of restrictions on industrial licensing and reduction of tariff on imports of capital goods (Athukorala and Sen, 1995). Consumption expenditure as a percentage of GDP, on the other hand, does not exhibit any upward rising trend in general, but sharp increases are observed during the last two years (Fig.5). Total consumption expenditure, combining both private and public,

Fig. 5. Consumption Expenditures



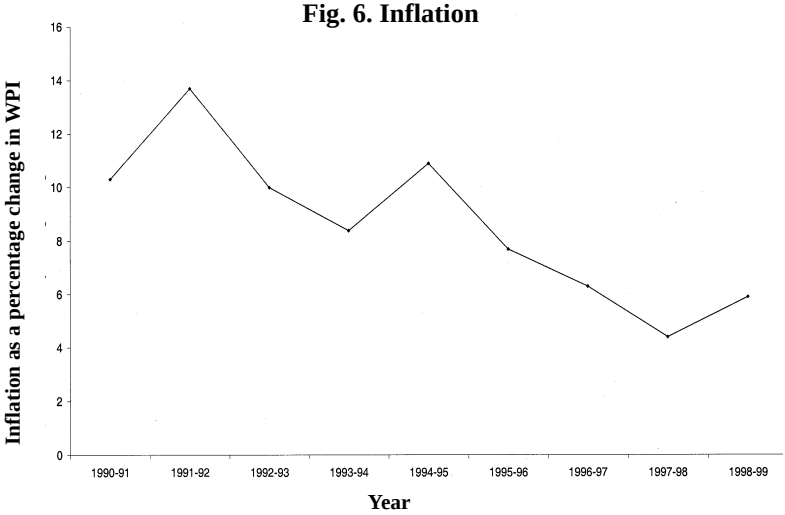
(Total) Consumption Exp. As % of GDP

(Private) Consumption Exp. As % of GDP

(Public) Consumption Exp. As % of GDP Public

increased sharply in 1997-98 to 75.8% of GDP from 67.9% of GDP in 1996-97. Interestingly enough, private consumption expenditure steadily declined after economic reform until 1996-97 and then increased during the last two years (Table 3). While disaggregated data on consumption expenditure are not available, data on different categories of imports suggest that the rising expenditure on consumption was not heavily driven by manufactured imports (Table 3). In contrast to this it may be noted that the Latin American countries experienced a consumption boom mainly driven by imports of consumer durables in the post-liberalization period. The period since 1993-94 also witnessed an increase in real GDP. Although the growth in real GDP has reached its highest value in 1996-97, it was varying between 7.2% and 7.5% during the period 1994-95 to 1996-97 (Table 3). However, it started to decline sharply since 1997-98.

Fig. 6. Inflation



Trend behaviour of savings as a percentage of GDP was almost similar to that in investment except the fact that the gap between savings and investment was widening since 1993-94 (Fig.4).

Trend behaviour of inflation is reported in Fig.6. Increased money supply led to a rise in the inflationary pressure during the initial years after reform viz. between 1990-91 and 1992-93. Due to the policy of targetting inflation stabilization, however, it had been possible to keep inflation below double digit level since 1993-94 excepting the year 1994-95. Nominal effective exchange rate (NEER) and real effective exchange rate (REER), (both export-based and trade-based) reveal a declining trend since 1990-91 and it appears that the nominal effective exchange rate depreciated at a faster rate than the real effective exchange rate (Fig.7). Prior to 1993-94, it had been made possible by the devaluation of nominal exchange rate of the rupee twice in July 1991 and by containing inflation within a stable limit. Even after the liberalization of capital inflows since 1993-94, nominal effective exchange rate did not appreciate mainly because of the direct intervention by the Reserve Bank of India in the

foreign exchange market, as discussed earlier. The real effective exchange rate (REER), however, appreciated between 1993-94 and 1994-95 because of a rise in inflation in India in that period at a faster rate compared to her trading partners. On the whole, movement of both the

Fig. 7. Nominal and Real Effective Exchange Rates (36 country-based weight)

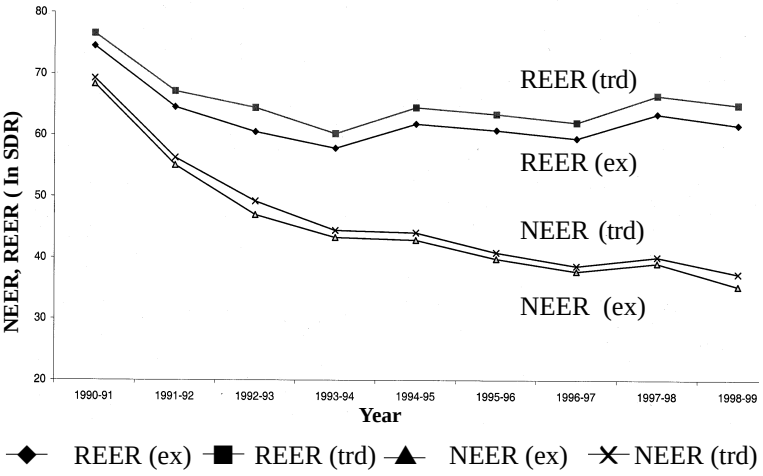
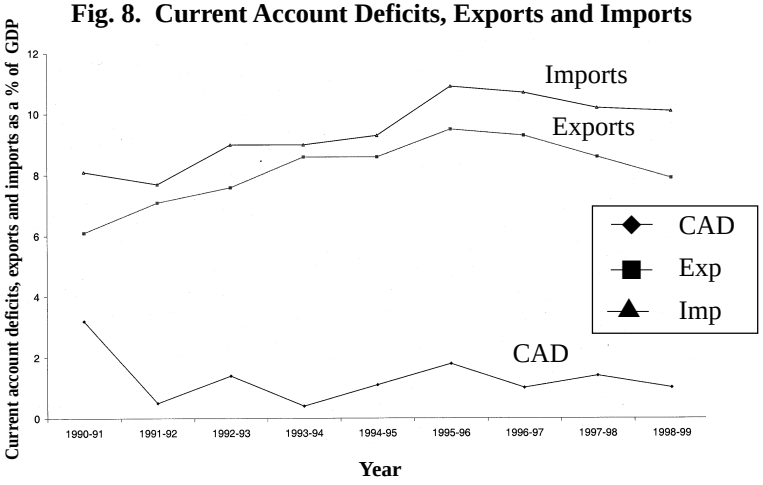


Fig. 8. Current Account Deficits, Exports and Imports



indices of exchange rate in the downward direction during the entire period 1990-91 to 1998-99 indicates that the policy of targetting REER by adjusting NEER seems to have been partly successful during the 1990s.

Depreciation of REER seems to have improved the external trade competitiveness because, it appears from Fig.8 that exports follow an increasing trend since 1990-91. Imports as a percentage of GDP, on the other hand, declined initially to 7.7% in 1991-92 from 8.1% in 1990-91 and started to increase thereafter. In relative terms, imports increased at a faster rate than exports particularly in two years viz., from 1991-92 to 1992-93 and from 1994-95 to 1995-96. Hence, there were sharp increases in the current account deficits during these two periods. If we look at Fig.4 it is visible that, during these two periods there were sharp increases in investment relative to savings too. Despite some fluctuations, the overall trend in the current account deficit appears to be declining (Fig.8). Thus, unlike some of the Latin American countries, the surge in the inflows of capital, did not result in an increase in the current account deficits in India.

II. Findings and Analysis

This section empirically analyses the effects of inflows of private foreign capital on some of the major macroeconomic variables in India using the quarterly data for the period 1993.II-1999.II. We try to understand if the observed fluctuations in the time-series of some macroeconomic variables viz., foreign currency assets[3], wholesale price index, money supply, real and nominal effective exchange rates, exports and current account deficit, as reported in the earlier section, can be explained in relation to the fluctuations in the time series of inflows of private foreign capital. Research done over the past decades shows that before indulging in any econometric modelling using time-series data, one should be concerned about the problem of non-stationarity or unit

root problem. Results from a regression exercise involving nonstationary data is observed to be spurious (Granger and Newbold, 1974 and Granger, 1981). Therefore, the following empirical analysis is carried out in the light of the recent developments in the time-series analysis.

In the first stage, stationarity of the series on each variable is examined using both the Dickey-Fuller (DF) test and Augmented Dickey-Fuller (ADF) test. The DF test is based on the following regression:

$$\Delta Y_t = C + \alpha t + \delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where C is a constant and t is the trend component.

The null hypothesis of unit root in Y_t or nonstationarity of Y_t is rejected if δ is negative and statistically significant. If C and α failed to be statistically significant we run the above regression dropping the constant and trend. Critical values for δ in such a situation are noted to be different from the one in equation (1) above.

For ADF test we include the lagged difference terms as regressors in the above equation i.e.

$$\Delta Y_t = C + \alpha t + \delta Y_{t-1} + \sum_{i=i}^{k} \beta_i \Delta Y_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Following Enders (1995), to select the number of lagged differenced terms we started with a relatively long lag length namely 15 in this case. Since the t -value for β at lag 15 was statistically insignificant we estimated equation (2) with 14 lagged differenced terms and again we tested for statistical significance of the t-value corresponding to β at lag 14. This process is repeated until a lag is found which is statistically significant. The number of lags chosen is reported below each equation under ADF test.

The results are reported in Table 5. All the variables are transformed to natural logarithm, except CAD which includes negative values. DF test shows, for none of the variables at the level, the hypothesis of nonstationarity can be rejected at 1% level of significance. However, it is rejected at 5% level only for some of the variables viz., FINV, FNCA, WPI, and CAD. But the DF test at the first difference of the series shows that stationarity condition is uniformly supported at the 1% level of significance by all the series except CAD. On the other hand, it follows from the ADF test that none of the series, except CAD and NEERX are stationary at the level. However, all the series except REERT, EXP and CAD appear to be stationary at their first difference following ADF test. Therefore, from these results it follows that all the series have unit roots except CAD which is only stationary at the level.

The fact that all the series except CAD are I(1), or nonstationary at the level, is important. What follows from the nonstationarity or the presence of unit root in a time-series variable is that the time-path of the variable is diverging from its equilibrium. The idea of convergence towards equilibrium represents “stability” in the context of difference equation, where lies the conceptual origin of the term “unit root”. Thus the presence of unit root indicates instability. However, if a set of nonstationary variables is observed to be cointegrated then it follows that the variables will come back to equilibrium in the long-run, even if they drift away from equilibrium in the short-run. Hence it is necessary to examine if there exists any cointegrating relationship between the set of variables observed to have I(1) process before drawing any inference regarding their instability.

Before going to the second stage, some diagnostic checking was carried out to verify if the number of differenced lags was selected for ADF test appropriately. The residual analysis for ADF regressions at the

first difference of each variable is reported in Table 6. The appropriate number of lags in ADF regression should not reveal any significant autocorrelation among the residuals or heteroscedasticity. Presence of autocorrelation can be verified using Ljung-Box Q-statistic and Box-Pierce Q-statistic whereas the presence of heteroscedasticity can be verified using the ARCH test. Varying the number of lags in the residuals, considering for example 2, 4 and 6 we observe that residuals exhibit no autocorrelation for all the I(1) series except REERT and REERX. On the other hand, ARCH test supports the assumption of homoscedasticity for residuals of all the I(1) series[4].

In the second stage, tests for cointegration are applied to examine if there exists any long-run equilibrium relationship between any pair of I(1) variables. A number of series are said to be cointegrated if they are nonstationary at the level and have same order of integration but there is at least a linear combination of these variables which is stationary. We have carried out cointegration test for each pair of variables having I(1) series by making use of the methodology suggested by Engle and Granger (1987). The results are reported in Table 7. We find, following either the DF or ADF test results, that all the I(1) variables individually have cointegrating relationship with FINV. In addition, cointegration is observed between the following pairs of variables: FNCA and M3, M3 and WPI, WPI and REERX, WPI and REERT, REERX and EXP, REERT and EXP, NEERX and EXP, NEERT and EXP. The results of cointegration test in the latter sequence of relations suggest that the long-run equilibrium relationship is restored between the following pairs of variables viz, foreign currency assets and money supply, money supply and inflation, inflation and real exchange rate, real exchange rate and exports during the period 1993-99. These long-run relationships, based on the observed data, reflect that the covariate fluctuations for the variables in each pair are correlated over time. These relationships,

however, need to be analysed carefully, because such cointegration relationship between variables in each pair breaks down in most of the cases when we include FINV as a third variable. The results of the test of cointegration, reported in Table 8, reveal that we fail to reject the null hypothesis of no cointegration in all the cases but with two exceptions. These two exceptional cases are (M3, FINV, FNCA) and (NEERX, FINV, EXP) where these two sets are observed to be cointegrated following the DF and ADF tests, respectively. The above results suggest that if we control for the variable FINV, no long-run equilibrium relationship holds between the variables for most of the above mentioned pairs of variables. These findings are indicative of the fact that the increased inflows of foreign capital in India since 1993 might account for the disturbances in the equilibrium relationship between a number of macroeconomic variables with a few exceptions. Exceptions, which follow from our study, are between foreign currency assets and money supply and between nominal effective exchange rate and exports.

The test of cointegration ignores the effect of the past values of one variable on the current value of the other variable. So, finally, we tried the Granger causality test to examine such possibilities. Since the reliability of results of the Granger causality test depends on whether the variables are stationary or not, we applied this test on the first difference of the log transformed series which are reported to be stationary. It is well-known that Granger causality test is sensitive to the choice of lag length. To avoid this problem, as noted in Enders (1995) we have applied Akaike information criterion to choose the optimum lag length[5].

The results are reported in Table 9. Major observations are discussed here. The most important observation is that FINV Granger causes NEERT and NEERX. This has relevance for the exchange rate

policy. What it implies is that the past information on FINV improves the predictability of NEERT and NEERX. As discussed earlier, RBI intervened in the foreign exchange market with certain objectives since 1993, one of which was to "curb excessive speculation". The above finding, however, challenges this objective. The direction of Granger causality from FINV to NEERX and NEERT indicates that even if RBI does not disclose its strategy of intervention a priori, it is possible to speculate about the nominal exchange rate given the past information on the inflows of private foreign capital. We further observe that FINV Granger causes FNCA. This result suggests that, in the post reform period, instability in the trend behaviour of foreign currency assets can be explained partly by the instability in the trend behaviour of the inflows of private foreign capital with some lagged effect. However, no causality is observed between FINV and other variables having I(1) process.

III. Conclusion

A large volume of recent literature, while analysing the experiences of Asian and Latin American countries, reveals that financial liberalization led to severe macro-economic instability in several of those countries and no unique pattern emerged in this respect. This study, therefore, made a modest attempt to analyse the dynamics of some major macroeconomic variables during the post-reform period in India. The main focus of this study lies in analysing the behaviour of some selected macro-economic indicators in relation to the surge in inflows of private foreign capital in India since 1993, the year in which several major reform programmes were initiated. A review of the analytical literature shows that macroeconomic consequences of financial liberalization are the results of the combined effect of monetary, fiscal as well as trade and exchange rate policies followed by the government of a country. So, there is no straightforward way of predicting the resulting macro-economic effects of financial liberalization in any country.

Major observations from the trend analysis, covering the period 1990-91 to 1998-99, are as follows: (a) Inflows of private foreign capital, measured as the aggregates of foreign direct investment, portfolio investment and external commercial borrowing, increased sharply since 1993-94. Although the volume of portfolio investment increased enormously its trend exhibits instability. Flow of foreign direct investment, on the other hand, increased steadily after the reforms. (b) Foreign exchange reserve increased by a considerable amount which indicates intervention of RBI against the surge of capital inflows. Consequently, a rapid growth was observed in money supply. (c) Investment as a percentage of GDP, private investment in particular, followed an upward rising trend. Total consumption expenditure as a percentage of GDP, on the other hand, did not reveal any clear pattern. Private consumption expenditure, however, steadily declined. Real GDP followed an increasing trend. (d) Inflationary pressure was mostly under control except in the three years prior to 1993-94. Except in the two years 1993-94 and 1994-95, real effective exchange rate (both export-based and trade-based) declined sharply. It had been made possible by the downward adjustment of nominal effective exchange rate as well as containment of inflation within a stable limit. (e) Unlike the Latin American countries, current account deficits as a percentage of GDP did not increase sharply excepting the two years 1992-93 and 1994-95.

Some econometric analyses based on quarterly data for the period 1993.II-1999.II reveal a number of interesting observations. It is found that each of the following series viz., inflows of private foreign capital, foreign currency assets, wholesale price index, money supply, real and nominal effective exchange rates and exports follows an I(1) process whereas the only series which follows an I(0) process is the current account deficit. I(1) process indicates instability in the trend behaviour of the variable under consideration. Tests for cointegration are applied

to examine if there exists any long-run equilibrium relationship between any pair of I(1) variables. All the I(1) variables individually have cointegrating relationship with FINV. In addition, cointegration is observed between the following pairs of variables: FNCA and M3, M3 and WPI, WPI and REERX, WPI and REERT, REERX and EXP, REERT and EXP, NEERX and EXP, NEERT and EXP. Further tests shows that such cointegration relationship between variables in each pair breaks down in most of the cases when we include FINV as a third variable. The two exceptional cases where the cointegration relationship exists even after controlling for FINV are foreign currency assets and money supply and between nominal effective exchange rate and exports. Results of the cointegration test are indicative of the fact that the increased inflows of private foreign capital in India since 1993 might account for the disturbances in the equilibrium relationship between a number of macroeconomic variables with a few exceptions.

Finally, the Granger causality test is applied to examine if there is any lagged effect of inflows of private foreign capital on the macroeconomic variables under consideration. The direction of causality from FINV to NEERX and NEERT has some relevance for the exchange rate policy. It raises concern about the strategy of RBI intervention in the foreign exchange market, one objective of which is to curb speculation. Another finding from the causality test, that FINV Granger causes FNCA, suggests that in the post reform period, instability in the trend behaviour of foreign currency assets can be explained partly by the instability in the trend behaviour of the inflows of private foreign capital with some lagged effect.

Notes:

1. Private foreign capital may be classified into three categories viz., (a) foreign direct investment (b) portfolio investment and (c) external commercial borrowing. With the opening of the Indian stock market to foreign institutional investors (FII) and allowing the private corporate sector to issue global depository receipts (GDRs) in 1993, portfolio investment entered as a new category into the private foreign investment in India in the nineties. Nevertheless, liberalization of foreign capital in the form of foreign direct investment can be traced back to the beginning of 1980's with a distinct change in the country's foreign investment policy (RBI, 1991). In 1980 a scheme was introduced to attract investments from the oil-exporting developing countries. Under this scheme investors from the Gulf region were allowed to invest in the equity capital of Indian companies upto 40% of the total paid-up capital. Liberalised investment facilities to non-resident Indians was another important policy decisions taken during early 1980's.

2. Prior to financial liberalization, interest rate on government securities may be deliberately kept at a low level. But financial liberalization will lead to a market-determined interest rate on government securities which will be definitely higher than the earlier level.

3. Since foreign currency assets form the major component of foreign exchange reserve that influence money supply in an open economy, we have included foreign currency assets in our empirical analysis.

4. Absence of serial autocorrelation and heteroscedasticity in the estimated residuals confirm that the power of ADF test is reliable. Absence of heteoscedasticity is evident from the ARCH test results reported in Table 7. It justifies that Phillips-Perron test is not required under this circumstance.

5. Some empirical studies which have applied this criterion include Samanta and Mitra(1993),Masih and Masih(1994), Ghosh(1995).

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Table 1. Net Annual Capital Flows (in Rs. Crores)

Year	FDI (1)	Portfolio investment (2)	External Commercial borrowing (3)	Total Private inflows of capital (1) + (2) + (3)	External Assistan (4)	% share of net private capital inflows in GDP (5)	Total Capital Account (6)	Total private inflows of capital as a % of GDCF (7)
1990-91	173.6	9.9	4034.4	4217.9	3964.9	0.78	12660.8	2.85
1991-92	329.8	9.9	3806.6	4146.3	7394.5	0.67	9812.5	2.86
1992-93	958.7	741.2	-1094.7	605.2	5749.7	0.86	12208.9	0.36
1993-94	1837.8	11444.8	1904.9	15187.5	5963.9	1.87	28341.9	8.05
1994-95	4216	11233.4	3237.8	18687.2	4798.3	1.93	27683	7.21
1995-96	7176.5	9097.1	4548	20821.6	3355.8	1.86	14271.1	6.85
1996-97	10094	11735.2	10003.6	31832.8	3998.3	2.5	39269.4	9.13
1997-98	13193.6	6766.6	14557.4	34517.6	3430.3	2.4	44532.8	9.3
1998-99	10387.7	-219.4	18557	28725.3	3485	1.85	36354	8.06

Notes:

1. GDP at current price for the year 1997-98 is converted to 1980-81 prices. Basic data source is RBI (1999), Handbook of Statistics on Indian Economy. Figures for 1988-99 in this column is obtained from C.S.O (1999), National Accounts Statistics.
2. GDCF at current price is similarly computed and the source till 1997-98 is R.B.I (1999), as stated above. The same figure for 1998-99 is computed on the basis that it is 23.4% of GDP, which information is collected from CMIE (June 2000), Monthly Review of the Indian Economy.
3. Source of “External Assistance” and “Total Capital Account” is R.B.I (1999), Handbook of Statistics on Indian Economy.
4. Source of cols.(1), (2) and (3) is RBI Bulletin, various issues.

Table 2. Selected Macroeconomic Indicators

Country	Annual average from first year of inflows to 1994					
	Year in which the capital inflows began	% change in real GDP	% change in prices	Capital account balance as a % of GDP	Current account deficit as a % of GDP	Real effective exchange rate (% change)
Asia						
Indonesia	1990	6.8	8.7	5.3	2.5	-6.2
Malaysia	1989	8.7	3.6	10.1	4.8	-3.9
Thailand	1988	10.0	5.0	9.4	6.0	1.9
Philippines	1992	2.3	8.5	8.3	4.2	20.9
Latin America						
Argentina	1991	7.7	52.8	4.4	3.1	20.1
Mexico	1989	3.0	16.1	5.7	6.8	23.4
Brazil	1992	3.0	1941.9	2.0	0.2	57.9
Colombia	1991	4.1	25.6	2.8	4.2	37.1
Chile	1990	6.4	17.5	5.5	1.8	13.5

Source: Corbo and Hernandez (1996), International Financial Statistics (IMF) and World Economic Outlook (IMF)

Table 3 : Consumption Expenditure and Imports

	Growth rate of RGDP	Consumption Expenditure as a % of GDP			Manufacturing imports in total imports(%)
		Total	Private	Public	
1990-91	5.4	73.6	62.1	11.5	12.88
1991-92	0.8	73.8	62.5	1.3	13.11
1992-93	5.3	72.8	61.7	11.1	12.64
1993-94	6	72.7	61.6	11.1	16.56
1994-95	7.2	70.2	59.7	10.5	17.75
1995-96	7.2	68.4	58	10.4	19.49
1996-97	7.5	67.9	57.5	10.3	15.83
1997-98	5	75.8	64.5	11.3	17.61
1998-99	3.8	75.9	63.6	12.3	15.02

Notes :

(i) Growth rate of real GDP in col.(1) represents percentage change in GDP at factor cost (at constant prices) and the base is 1980-81 =100

(ii) Source of cols. (1) to (4) is Monthly Review of the Indian Economy, CMIE, various issues

(iii) Source of col.(5) is Foreign Trade Statistics of India, CMIE, various issues

Table 4. Money Supply, Inflation and Exchange Rates

	Money supply (M3) (Rs. Crores)	Inflation	REER (export based)	REER (trade-based)	NEER (export-based)	NEER (trade-based)
1990-91	265828	10.3	74.54	76.59	68.32	69.26
1991-92	277603	13.7	64.55	67.13	55.08	56.29
1992-93	366825	10	60.53	64.47	47.02	49.23
1993-94	378878	8.4	57.86	60.23	43.3	44.47
1994-95	452185	10.9	61.82	64.51	42.88	44.08
1995-96	530802	7.7	60.78	63.44	39.78	40.83
1996-97	696012	6.3	59.45	62.05	37.72	38.6
1997-98	821332	4.4	63.38	66.45	39.05	40.07
1998-99	972204	5.9	61.57	64.88	35.25	37.29

Notes:

(i) Source of col.(1) is RBI Bulletin, RBI, various issues

(ii) Source of col.(2) is Monthly Review of the Indian Economy, CMIE, various issues

(iii) Source of cols. (3) to (6) is RBI Bulletin, RBI, various issues

(iv) Inflation is measured as the % change in WPI and for WPI series base is 1980-81=100

(v) 36 country bilatateral weights are used for REER and NEER and the base is 1985 =100

Table 5. Test for Unit Roots

Variables (X_t)	DF test		ADF test	
	Levels	First Difference	Levels	First Difference
FINV	-3.1930** (with C)	-4.6582 * (no C & T)	-2.0690 (15 lags, with C & T)	-1.6255*** (14 lags, no C &T)
M3	-3.2267 (with C & T)	-6.3117* (with C)	-2.3074 (15 lags, with C)	-2.8578*** (6 lags, with C)
WPI	-3.0611 ** (with C)	-4.3817* (with C & T)	-3.1862 (15 lags, with C &T)	-4.5889* (9 lags, with C & T)
REERT	-2.5224 (with C)	-7.5214* (no C & T)	1..5836 (15 lags, with C & T)	-2.8267 (12 lags, no C &T)
REERX	-2.4996 (with C)	-6.5821* (no C & T)	3.4028 (15 lags, no C &T)	-2.0187** (13 lags, no C &T)
NEERT	-1.9669 (with C & T)	-6.1035** (no C & T)	-1.8982*** (11 lags no C &T)	-4.0576* (11 lags, with C &T)
NEERX	-1.9683 (with C & T)	-5.3986* (no C & T)	-1.7740 (11 lags, no C &T)	-2.7765* (10 lags, no C &T)
EXP	-2.8085 (with C & T)	-8.0557* (with C)	1.7272 (15 lags ,no C & T)	-1.2418 (12 lags, no C & T)

cont'd

Table 5. *Cont'd....*

Variables (X_t)	DF test		ADF test	
	Levels	First Difference	Levels	First Difference
CAD	-4.6727 ** (with C & T)		-5.5617 * (15 lags, with C & T)	
FNCA	-3.3121*** (with C & T)	-4.7181* (with C)	-5.5617* (15 lags, with C & T)	3.2984 (10 lags, with C)

Note:

i. ADF test is based on the regression $\Delta Y_t = C + \alpha t + \delta Y_{t-1} + \Sigma_{i=1}^{k} \beta_i \Delta Y_{t-i} + \varepsilon_t$. The DF test is based on the same equation without the summation of the lagged difference terms on the right hand side. The figures reported in the table are t-values of δ.

ii. 'C' stands for constant and 'T' stands for trend

iii. * signifies statistically significant at 1 % level

iv. ** signifies statistically significant at 5 % level

v. *** signifies statistically significant at 10 % level

Table 6: Residual Analysis for ADF Regression at First Difference

ADF first differenced	Ljung-Box Q	Box-Pierce Q	ARCH Test F-statistic	ARCH Test nR^2
FINV	Q(2) = 1.52(0.46) Q(4) =2.69(0.61) Q(6) = 4.49(0.61)	Q (2) = 1.26(0.53) Q)(4) =2.17(0.70) Q(6)= 3.38(0.76)	F(2) = 0.38(0.68) F(4) = 0.21(0.92) F(6) = 0.64(0.69)	Z(2) = 0.87(0.64) Z(4) = 1.14(0.88) Z(6) = 4.88(0.56)
M3	Q(2) = 0.00(0.99) Q(4) =0.37(0.98) Q(6)= 0.94(0.98)	Q(2) = 0.00(0.99) Q(4) = 0.28(0.99) Q(6) =0.68(0.99)	F(2) = 0.71(0.50) F(4) = 0.79(0.54) F(6) = 0.66 (0.68)	Z(2) =1.54(0.46) Z(4) = 3.53(0.47) Z(6) = 4.82(0.56)
WPI	Q(2) = 2.93(0.23) Q(4) =4.66(0.32) Q(6) =6.48(0.37)	Q(2) = 2.46(0.29) Q(4) = 3.84(0.43) Q(6) =5.16(0.52)	F(2) = 0.30(0.74) F(4) =0.18(0.94) F(6)= 0.68(0.66)	Z(2) = 0.68(0.71) Z(4) =0.97(0.91) Z(6) = 4.94(0.55)
FNCA	Q(2) =1.58(0.45) Q(4) =1.97(0.74) Q(6) = 2.29(0.89)	Q(2) = 1.40(0.49) Q(4) = 1.69(0.79) Q(6) = 1.92(0.93)	F(2) = 0.38(0.69) F(4) = 0.66(0.62) F(6) = 0.37(0.89)	Z(2) = 0.84(0.65) Z(4) =3.02(0.55) Z(6) = 3.05(0.80)
REERT	Q(2) = 3.17(0.20) Q(4) =4.09(0.39) Q(6) =13.17(0.04)*	Q(2) =2.69(0.26) Q(4)= 3.42(0.49) Q(6) =9.76(0.13)	F(2)= 1.79(0.19) F(4) =0.75(0.57) F(6) =1.15(0.39)	Z(2) = 3.49(0.17) Z(4) = 3.36(0.49) Z(6) = 6.96(0.32)
REERX	Q(2) = 3.36(0.18) Q(4) = 4.37(0.36) Q(6) = 10.70(0.09)**	Q(2) = 2.94(0.23) Q(4) = 3.72(0.44) Q(6) = 8.14(0.23)	F(2) = 0.35(0.71) F(4) = 0.16(0.95) F(6) = 0.28(0.93)	Z(2) = 0.78(0.67) Z(4) = 0.86(0.93) Z(6) =2.46(0.87)

(cont'd)

Table 6. *Cont'd.....*

ADF first differenced	Ljung-Box Q	Box-Pierce Q	ARCH Test	
			F-statistic	nR^2
NEERT	Q(2) = 1.76(0.41)	Q(2) = 1.52(0.46)	F(2) = 0.006(0.99)	Z(2) = 0.013(0.99)
	Q(4) =3.68(0.45)	Q(4) = 3.01(0.55)	F(4) = 0.35(0.84)	Z(4) = 1.69 (0.79)
	Q(6) = 4.80(0.57)	Q(6) = 3.81(0.70)	F(6) =0.38(0.87)	Z(6) = 3.07(0.79)
NEERX	Q(2) = 0.08(0.96)	Q(2) =0.06(0.96)	F(2) = 1.62(0.22)	Z(2) = 3.19(0.20)
	Q(4) = 1.17(0.88)	Q(4) =0.92(0.92)	F(4) =1.68(0.20)	Z(4) = 6.20(0.18)
	Q(6) =4.46(0.61)	Q(6) =3.20(0.78)	F(6) =0.84(0.56)	Z(6) =5.68(0.46)
EXP	Q(2) = 0.65(0.72)	Q(2) = 0.56(0.75)	F(2) = 0.18(0.83)	Z(2) =0.42(0.80)
	Q(4) = 1.43(0.84)	Q(4) =1.16(0.88)	F(4) = 0.10(0.97)	Z(4) = 0.54(0.97)
	Q(6) = 3.14(0.79)	Q(6) = 2.37(0.88)	F(6) = 0.09(0.99)	Z(6) =0.85(0.99)

Notes : (i) Q(n) reports Ljung-Box Q/ Box-Pierce Q statistic for the autocorrelations of the n residuals of the estimated model. With 24 observations, T/4 is equal to 6. Significance levels are in parentheses.

(ii) F-statistic and nR^2 provide ARCH test for the heteroscedasticity in the estimated residuals. ARCH test is based on the specification that the squared residuals from the estimated model is related to the lagged squared residuals. Each statistic is estimated using three different lags viz., 2, 4 and 6. nR^2 statistic has a chi-square distribution with degrees of freedom equal to the number of lagged squared residuals and here n refers to the number of observations.

(iii) * indicates significant at 1% level and ** indicates significant at 5% level.

Table 7. Test for pairwise cointegration

Equations: X_t on Y_t	μ	γ	DF	ADF
LFINV on LM3	6.45	0.12	-2.90* (no C & T)	-3.27* (1 lag, no C& T)
LM3 on LFINV	13.14	0.024	-2.26 (with C & T)	-0.9952 (3 lags, no C& T)
LFINV on LWPI	5.87	0.39	-2.89* (no C & T)	-3.2655* (1 lag, no C& T)
LWPI on LFINV	5.59	0.014	-1.38 (with C)	-5.4491 (1lag, with C& T)
LFINV on LFNCA	5.29	0.254	-2.6125 (no C & T)	-2.1417** (5 lags, no C & T)
LFNCA on LFINV	9.80	0.16	-1.6114 (no C & T)	-3.2052 (3 lags, with C &T)
LFINV on LREERT	-13.73	5.26	-2.7195** (no C & T)	-2.16 (5 lags, no C& T)
LREERT on LFINV	4.03	0.015	-2.0771** (no C & T)	12.8368* (10 lags, with C& T)
LFINV on LREERX	-17.78	6.30	-2.7253* (no C & T)	-6.1864* (10 lags, with C&T)

cont'd

Table 7. *Cont' d*

Equations: X_t on Y_t	μ	γ	DF	ADF
LREERX on LFINV	3.97	0.016	-2.1369** (no C & T)	-28.5731* (10 lags, with C& T)
LFINV on LNEERT	6.49	0.442	-3.0257* (no C & T)	-2.0660** (5lags, no C& T)
LNEERT on LFINV	3.64	0.006	-0.6929 (no C & T)	-0.7996 (8 lags, no C& T)
LFINV on LNEERX	6.56	0.428	-3.0268* (no C & T)	-2.0667** (5 lags, no C& T)
LNEERX on LFINV	3.62	0.006	-0.6599 (no C & T)	-3.3511 (3 lags, with C& T)
LFINV on LEXP	3.87	0.418	-2.7207** (no C & T)	-2.1502** (5 lags, no C & T)
LEXP on LFINV	9.62	0.068	-2.4868 (with C & T)	-2.6298 (4 lags, no C& T)
LFNCA on LM3	-11.24	1.67	-3.0379* (no C & T)	-3.3395** (9 lags, with C & T)
LM3 on LFNCA	7.53	0.52	-3.3889*** (with C & T)	-3.3449 (9 lags, with C & T)

con'td

Table 7. *Cont' d*

Equations: X_t on Y_t	μ	γ	DF	ADF
LM3 on LWPI	-0.016	2.34	-1.4261 (no C & T)	-3.1806* (8 lags, no C& T)
LWPI on LM3	0.139	0.41	1.6485*** (no C & T)	-3.2935* (8 lags, no C& T)
LWPI on LREERX	0.75	1.206	-1.9027 (with C & T)	3.3791*** (3 lags, with C& T)
LREERX on LWPI	3.60	0.088	-2.0074** (no C & T)	-7.7701* (10 lags, with C& T)
LWPI on LREERT	-0.38	1.468	-1.8706 (with C & T)	-3.3334*** (3 lags, with C& T)
LREERT on LWPI	3.46	0.12	-1.9661** (no C & T)	-3.4772* (7 lags, with C& T)
LREERX on LEXP	3.83	0.027	-2.1446** (no C & T)	-19.2301* (10 lags, with C & T)
LEXP on LREERX	3.08	1.72	-2.4502 (with C & T)	-15.8815* (9 lags, with C& T)
LREERT on LEXP	3.74	0.04	-2.0952** (no C & T)	-3.7998** (7 lags, with C& T)

Cont'd

Table 7. *Cont'd*

Equations: X_t on Y_t	μ	γ	DF	ADF
LEXP on LREERT	0.68	2.28	-2.2895 (with C & T)	-10.8381* (9 lags, with C& T)
LNEERX on LEXP	6.31	-0.26	-2.9133* (no C & T)	-3.3111* (6 lags, with C& T)
LEXP on LNEERX	21.95	-3.21	-3.4578* (no C & T)	-5.1963* (6 lags, with C& T)
LNEERT on LEXP	6.32	-0.25	-3.0249* (no C & T)	-0.8514 (7 lags, no C& T)
LEXP on LNEERT	22.11	-3.23	-3.5563* (no C & T)	-4.2851* (6 lags, with C& T)

Note:

i. Cointegration regression for two variables X_t and Y_t is given by $X_t = \mu + \gamma Y_t + Z_t$ where μ and γ are constant and cointegrating parameter, respectively.
ii. DF and ADF tests are carried out using regressions similar to that in Table 5.
iii. * indicates significant at 1% level
iv. ** indicates significant at 5% level
v. *** indicates significant at 10% level

Table. 8 Test for Cointegration

Variables	DF test	ADF test
LFINVQ LM3Q LFNCA	-4.8650**	-0.7400
LFINVQ LM3Q LWPI	-3.4596	-3.8497
LFINVQ LWPI LREERX	-1.9165	-1.0948
LFINVQ LWPI LREERT	-1.8686	-1.0545
LFINVQ LEXP LREERT	-1.9000	-0.0209
LFINVQ LEXP LREERX	-1.8856	0.0389
LFINVQ LEXP LNEERX	-2.3841	-6.2334**
LFINVQ LEXP LNEERT	-2.4095	-0.5647

Notes:

(i) Reported results are based on regressions including a constant and a trend .

(ii) Reported results for ADF test correspond to 11 lags, the highest possible number of lags that can be chosen for the given number of observations. ADF test is also tried with other lags going down to the least possible number of lags. The null hypothesis of no cointegration is rejected in none of these case.

(iii) ** indicates significant at 5% level.

Table 9: Pairwise Granger Causality Test

Dependent Variable	Explanatory Variables	m	n	F- Statistic	p-value	Remarks
ΔFINV	ΔFINV, ΔM3	1	1	1.09	0.31	No causality from M3 → FINV
ΔM3	ΔM3, ΔFINV	1	1	0.009	0.92	No causality from FINV → M3
ΔFINV	ΔFINV, ΔWPI	1	1	57	0.23	No causality from WPI → FINV
ΔWPI	ΔWPI, ΔFINV	2	1	0.38	0.54	No causality from FINV → WPI
ΔFINV	ΔFINV,ΔFNCA	1	1	0.075	0.78	No causality from FNCA→ FINV
ΔFNCA	ΔFNCA, ΔFINV	1	1	6.79	0.02	Causality from FINV → FNCA
ΔFINV	ΔFINV, ΔREERT	1	1	2.28	0.15	No causality from REERT → FINV
ΔREERT	ΔREERT,ΔFINV	1	1	2.01	0.17	No causality from FINV → REERT
ΔFINV	ΔFINV, ΔREERX	1	1	2.40	0.14	No causality from REERX → FINV
ΔREERX	ΔREERX, ΔFINV	1	1	2.09	0.16	No causality from FINV → REERX
ΔFINV	ΔFINV, ΔNEERX	1	1	2.04	0.17	No causality from NEERX → FINV
ΔNEERX	ΔNEERX, ΔFINV	1	1	3.74	0.06	Causality from FINV → NEERX
ΔFINV	ΔFINV, ΔNEERT	1	1	2.14	0.16	No causality from NEERT → FINV

cont'd

Table 9 *Cont'd*

ΔNEERT	ΔNEERT, ΔFINV	1	1	3.005	0.10	Causality from FINV → NEERT
ΔFINV	ΔFINV, ΔEXP	1	1	0.29	0.59	No causality from EXP → FINV
ΔEXP	ΔEXP, ΔFINV	4	1	0.13	0.72	No causality from FINV → EXP
ΔFNCA	ΔFNCA, ΔM3	1	1	0.026	0.87	No causality from M3 → FNCA
ΔM3	ΔM3, ΔFNCA	1	1	0.41	0.53	No causality from FNCA → M3
ΔM3	ΔM3, ΔWPI	1	1	0.15	0.70	No causality from WPI → M3
ΔWPI	ΔWPI, ΔΔM3	2	1	0.41	0.53	No causality from M3 → WPI
ΔREERX	ΔREERX,ΔWPI	1	1	2.15	0.16	No causality from WPI → REERX
ΔWPI	ΔWPI, ΔREERX	2	1	1.16	0.29	No causality from REERX → WPI
ΔREERT	ΔREERT, ΔWPI	1	1	2.33	0.14	No causality from WPI → REERT
ΔWPI	ΔWPI, ΔREERT	2	1	0.99	0.33	No causality from REERT→ WPI
ΔREERX	ΔREERX, ΔEXP	1	1	0.49	0.49	No causality from EXP → REERX
ΔEXP	ΔEXP, ΔREERX	4	4	2.12	0.15	No causality from REERX → EXP
ΔREERT	ΔREERT, ΔEXP	1	2	1.06	0.37	No causality from EXP → REERT
ΔEXP	ΔEXP, ΔREERT	4	4	2.27	0.12	No causality from REERT → EXP

Notes: Optimum lag lengths (m, n) are determined by minimizing the Akaike Information Criteria.

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