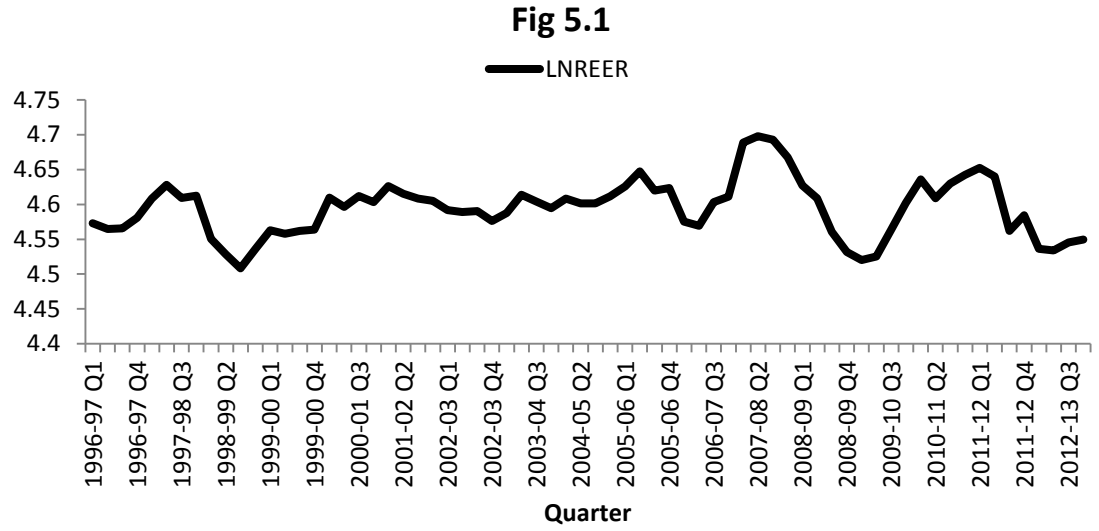
Chapter 5: Econometric Results & their Interpretation

5.1 Time Series Analysis of variables.

5.1.1 Trends of Variables

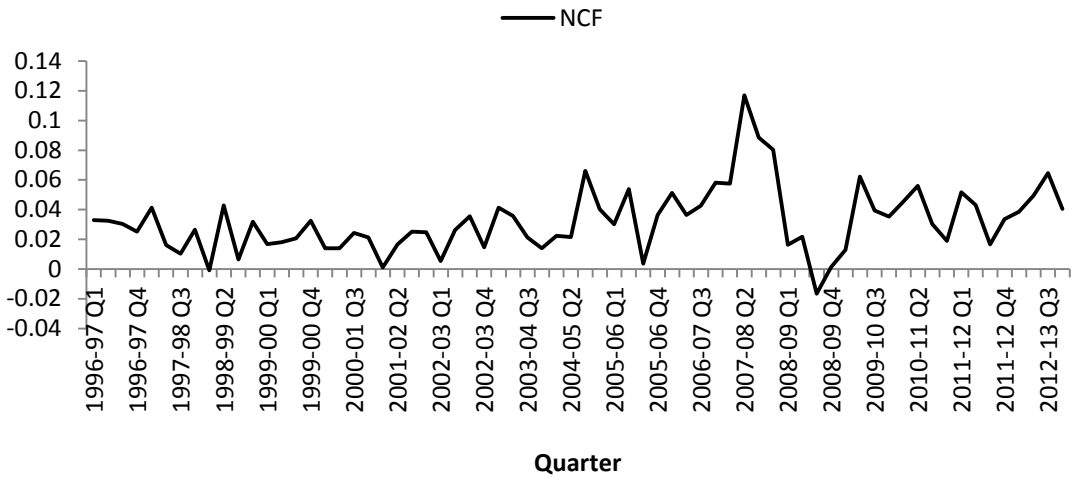
(a) Real Effective Exchange Rate (REER) Index: The time series plot of the natural logarithm of the quarterly REER Indices i.e. LNREER for the estimation period 1996-97 (1996Q1) to 2012-13 (2012Q4) is presented in the Fig 5.1 below:



Source: RBI Handbook of Statistics and Author calculations

(b) **Net Capital Flows:** The Fig 5.2 below traces the trend of the variable NCF (ratio of Net capital flow in the quarter to the quarterly GDP) for the estimation period

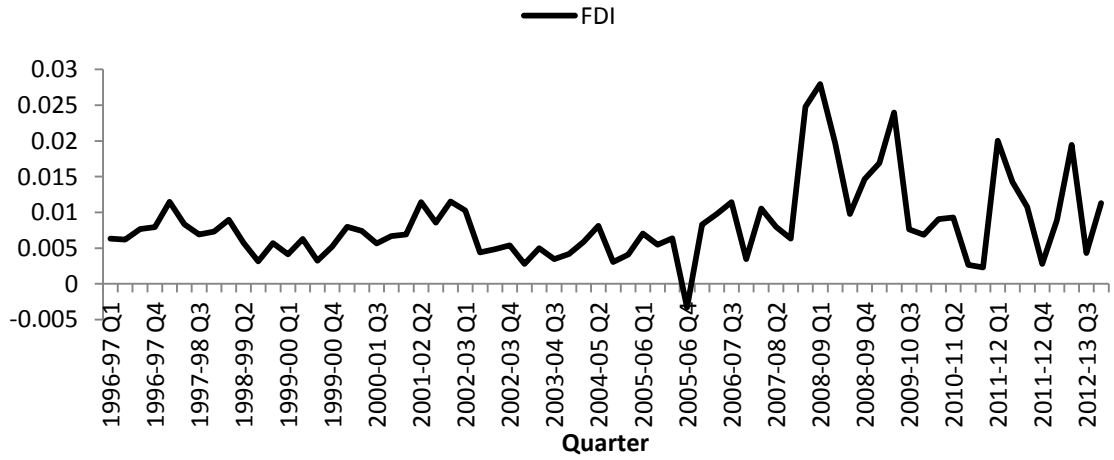
Fig 5.2



Source: RBI Handbook of Statistics and Author calculations

© **Foreign Direct Investment:** The Fig 5.3 below traces the trend of the variable FDI (ratio of Net Foreign Direct Investment flow in the quarter to the quarterly GDP) for the estimation period.

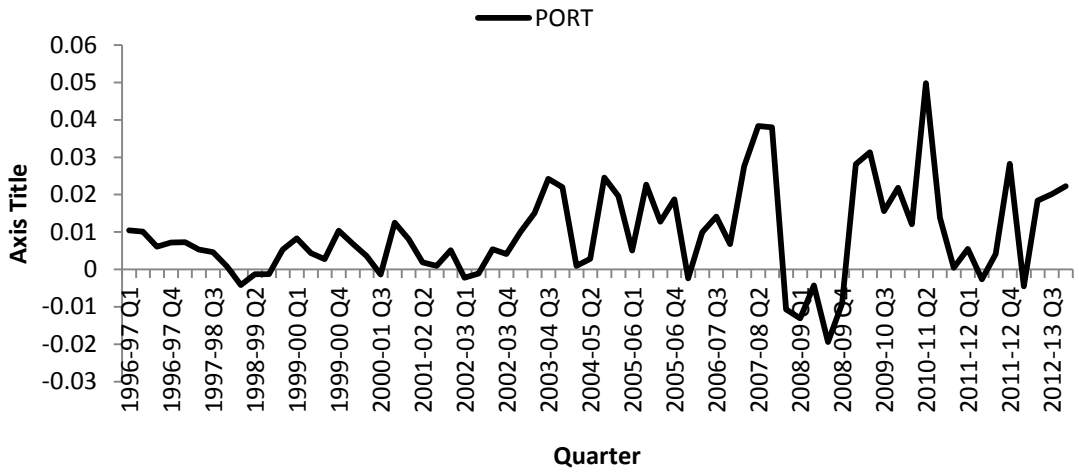
Fig 5.3



Source: RBI Handbook of Statistics and Author calculations

(d) **Portfolio Flows:** The Fig 5.4 below traces the trend of the variable PORT (ratio of Net Portfolio flow in the quarter to the quarterly GDP) for the estimation period.

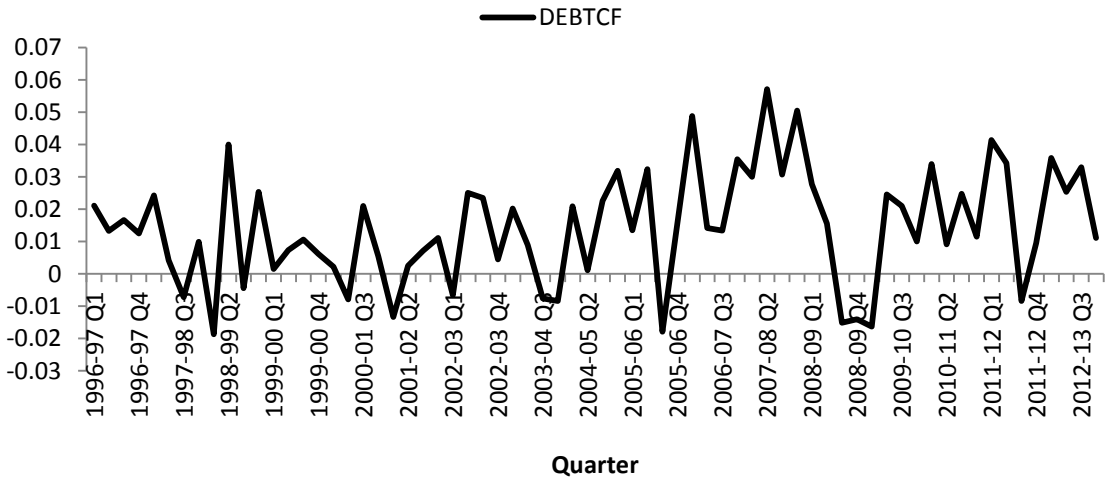
Fig 5.4



Source: RBI Handbook of Statistics and Author calculations

(e) **Debt Creating Flows:** The Fig 5.5 below traces the trend of the variable DEBTCF (ratio of Net Debt Creating flows comprising of Loans, Banking Capital, and Rupee Debt Service in the quarter to the quarterly GDP) for the estimation period.

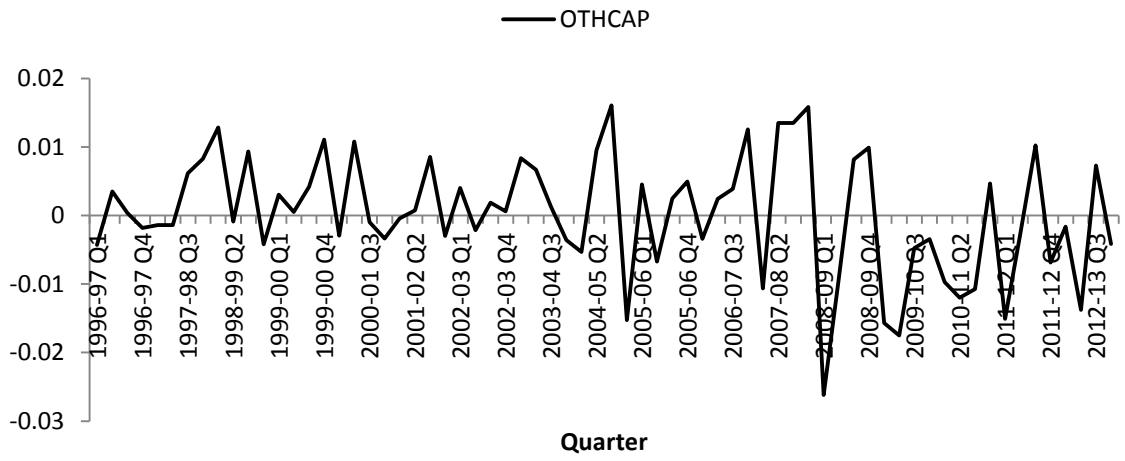
Fig 5.5



Source: RBI Handbook of Statistics and Author calculations

(**f) Other Capital**: The Fig 5.6 below traces the trend of the variable OTHCAP (ratio of Net Other Capital flow in the quarter to the quarterly GDP) for the estimation period.

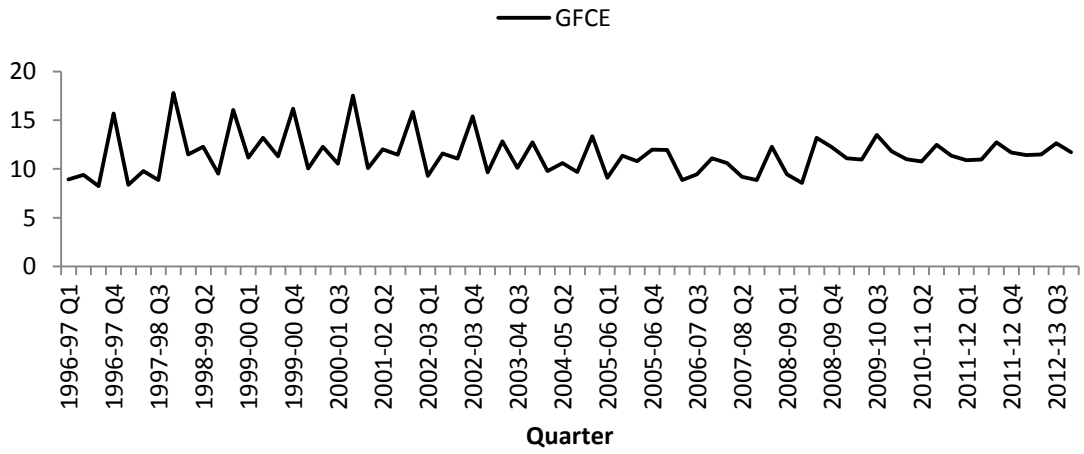
Fig 5.6



Source: RBI Handbook of Statistics and Author calculations

(g) **Government Final Consumption Expenditure:** The trend of variable GFCE (ratio of Government Final Consumption Expenditure in the quarter to the quarterly GDP for the estimation period 1996-97 (1996Q1) to 2012-13 (2012Q4) is indicated in Fig 5.7 below:

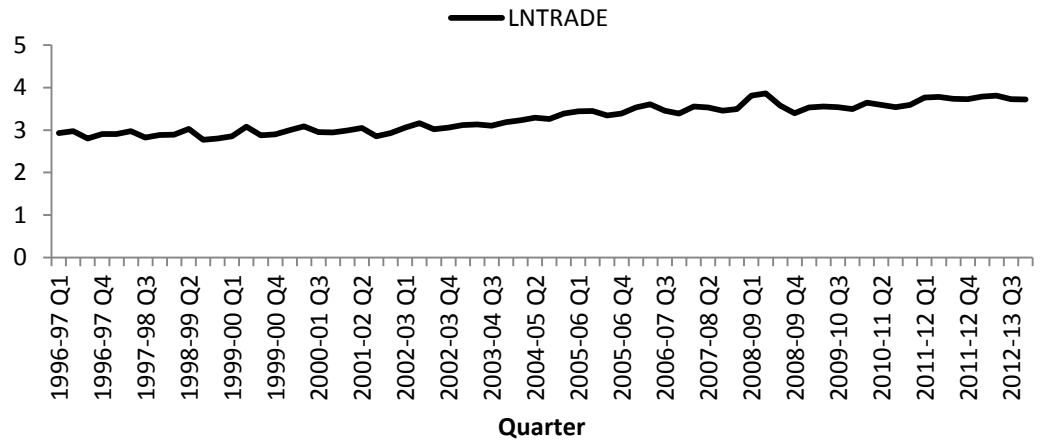
Fig 5.7



Source: RBI Handbook of Statistics and Author calculations

(h) **Trade Openness:** The Fig 5.8 below traces the trend of variable LNTRADE which is the natural logarithm of TRADE openness (ratio of the sum of exports and imports in the quarter to quarterly GDP) for the estimation period 1996-97 (1996Q1) to 2012-13 (2012Q4).

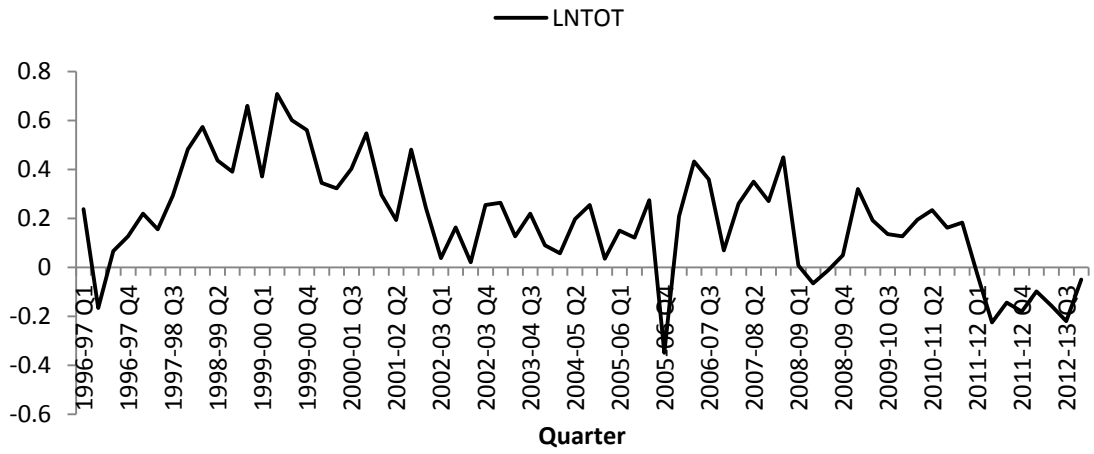
Fig 5.8



Source: RBI Handbook of Statistics and Author calculations

(i) **Terms of Trade** The plot of variable LNTOT the natural logarithm of the quarterly terms of trade for the estimation period 1996-97 (1996Q1) to 2012-13 (2012Q4) is indicated in the Fig 5.9 below:

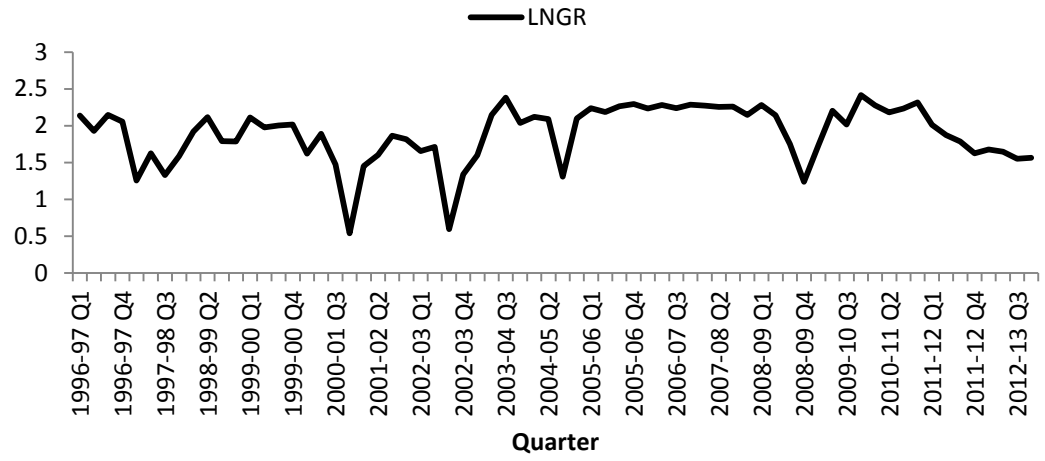
Fig 5.9



Source: RBI Handbook of Statistics and Author calculations

(j) Growth of GDP: The Fig 5.10 below indicates the time series plot of the variable LNGR the logarithm of the growth rate of the quarterly GDP at factor cost at constant prices for the estimation period.

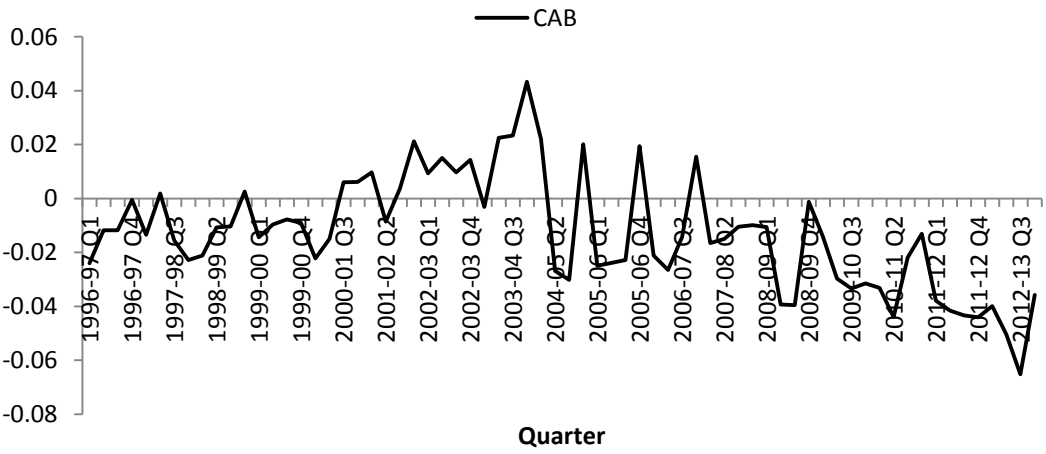
Fig 5.10



Source: RBI Handbook of Statistics and Author calculations

(k) **Current Account Balance;** The trend of the variable CAB (the ratio of the net current account balance in the quarter to quarterly GDP) for the estimation period 1996-97 (1996Q1) to 2012-13 (2012Q4) is indicated in the Fig 5.11 below.

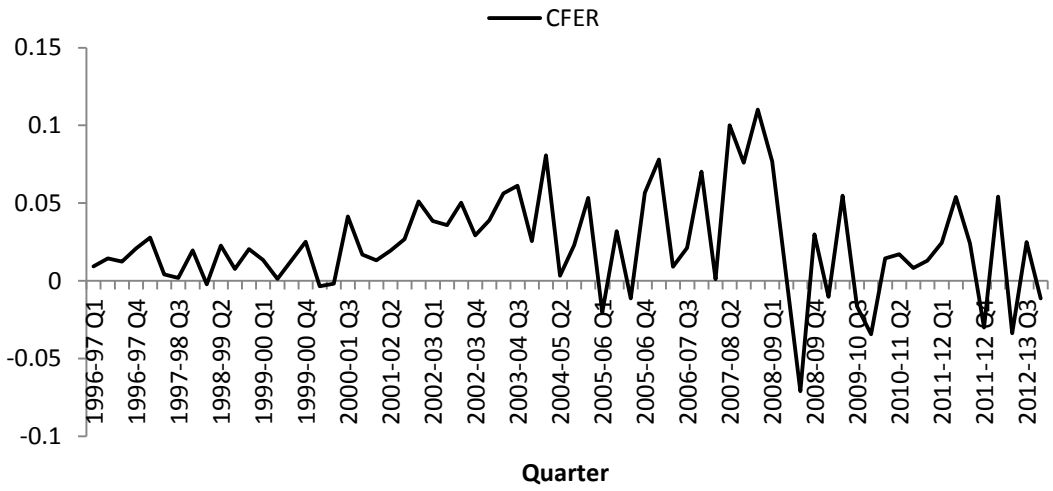
Fig 5.11



Source: RBI Handbook of Statistics and Author calculations

(l) Change in Foreign Exchange Reserves: The Fig 5.12 below indicates the time series plot of the variable CFER (ratio of change in foreign exchange reserves in the quarter to the quarterly GDP) for the estimation period 1996-97 (1996Q1) to 2012-13 (2012Q4).

Fig 5.12



Source: RBI Handbook of Statistics and Author calculations

5.1.2 Descriptive statistics and correlations of the variables in the model:

The Table 5.1 below presents the descriptive statistics of the variables in Model 1 for the estimation period 1996-97Q1 to 2012-13Q4.

Table 5.1

Descriptive Statistics for Variables in Model 1

Varible(s)	LNREER	NCF	GFCE	LNTRADE	LNTOT	LNGR	CAB	CFER
Maximum	4.6980	0.11700	17.7981	3.8639	0.70834	2.4148	0.043296	0.11018
Minimum	4.5080	-0.016652	8.2472	2.7717	-0.34645	0.54003	-0.065225	-0.070908
Mean	4.5948	0.032159	11.4659	3.2798	0.19521	1.8910	-0.012911	0.023324
Std. Deviation	0.040922	0.022026	2.1415	0.32729	0.22356	0.38786	0.021239	0.032151
Skewness	0.20557	1.0465	1.0424	0.11146	-0.028717	-1.2671	0.17626	0.18266
Kurtosis-3	0.026365	2.40741	0.99306	-1.3664	-0.16821	1.9793	-0.21872	0.73080
Coef of Variation	0.0089062	0.68492	0.18677	0.099790	1.1453	0.20511	1.6451	1.3785

Source: RBI Handbook of Statistics & Author calculations

The Table 5.2 below presents the description of variables used in the Model 2.

Table 5.2

Descriptive Statistics for Variables in Model 2

Varible(s)	FDI	PORT	DEBTCF	OTHCAP
Maximum	0.027972	0.049828	0.057123	0.016049
Minimum	-0.0032923	-0019382	-0.018790	-0.026172
Mean	0.0084262	0.0093960	0.014156	0.2405E-3
Std. Deviation	0.0055913	0.012626	0.017347	0.0087298
Skewness	1.4935	0.68231	0.095120	-0.46091
Kurtosis-3	2.6144	0.79318	-0.38548	0.11589
Coef of Variation	0.66356	1.3438	1.2254	36.3042

Source: RBI Handbook of Statistics & Author calculations

Correlations between the variables used in the analysis are presented in the Table 5.3 below.

Table 5.3

Correlations between Variables

	LNREER	NCF	GFCE	LNTRADE	LNTOT	LNGR	CAB	CFER
LNREER	1.0000	0.39438	-0.19962	0.17253	-0.035144	0.25133	0.14351	0.35342
NCF	0.39438	1.0000	-0.14215	0.37403	-0.076674	0.25641	-0.22614	0.49812
GFCE	-0.19962	-0.14215	1.0000	-0.16628	0.21523	-0.22948	0.15870	-0.052110
LNTRADE	0.17253	0.37403	-0.16628	1.0000	-0.56923	0.31163	-0.56700	0.0050074
LNTOT	-0.35144	-0.076674	0.21523	-0.56923	1.0000	-0.023222	0.23066	-0.0082933
LNGR	0.25133	0.25641	-0.22948	0.31163	-0.023222	1.0000	-0.071480	0.13397
CAB	0.14351	-0.22614	.015870	-0.56700	0.23066	-0.071480	1.0000	0.43533
CFER	0.35342	0.49812	-0.052110	0.0050074	-0.0082933	0.13397	0.43533	1.0000

Source: Author calculations

From the Table 5.3 it appears that the of the real exchange rate is positively correlated with the net capital flows, trade openness growth rate of GDP, current account balance and change in foreign exchange reserves and negatively correlated with government consumption expenditure and terms of trade . The Table 5.4 below reports the correlations between the real exchange rates and the components of the net capital flows:

Table 5.4

Correlations between real exchange rate and components of net capital flows

	LNREER	FDI	PORT	DEBTCF	OTHCAP
LNREER	1.0000	0.013016	0.19441	0.33263	0.038935
FDI	0.013016	1.0000	-0.18997	0.15064	-0.40695
PORT	0.19441	-0.18997	1.0000	0.12678	-0.19099
DEBTCF	0.33263	0.15064	0.12678	1.0000	-0.19397
OTHCAP	0.038935	-0.40695	-0.19099	-0.19397	1.0000

Source: Author calculations

From the estimates presented in this Table 5.4 it can be seen that the real exchange rate is positively correlated with the net capital flow components. The estimated correlation between LNREER and PORT & LNREER & DEBTCF is high as compared to other components of net capital flows.

5.1.3 Stationary Properties of the Variables:

The variables in the Models 1 & 2 are subject to Unit Root Tests, the ADF Test and PP Test in order to ascertain their stationarity and order of integration properties. For the quarterly data on variables for the period 1996-97 Q1 to 2012-13 Q4 the results of the ADF Test and PP Test are presented in the Table 5.5:

Table 5.5

Results of Unit Root Tests

Series	Order	Exogenous	ADF Test t-statistic (p value)	PP Test t-statistic (p value)
LNREER	Level	Constant	-4.761667 (0.0002)	-3.103267 (0.0310)
		Constant & Linear Trend	-4.745895 (0.0015)	-3.046587 (0.1277)
NCF	Level	Constant	-4.891145 (0.0001)	-4.921267 (0.0001)
		Constant & Linear Trend	-5.350538 (0.0002)	-5.299399 (0.0002)
FDI	Level	Constant	-5.014212 (0.0001)	-4.961302 (0.0001)
		Constant & Linear Trend	-5.387830 (0.0002)	-5.300916 (0.0002)
PORT	Level	Constant	-5.405416 (0.0000)	-5.439670 (0.0000)
		Constant & Linear	-5.731200	-5.676181

		Trend	(0.0001)	(0.0001)
DEBTCF	Level	Constant	-6.770273 (0.0000)	-6.868259 (0.0000)
		Constant & Linear Trend	-7.231928 (0.0000)	-7.256328 (0.0000)
GFCE	Level	Constant	-1.680792 (0.4360)	-10.62818 (0.0000)
		Constant & Linear Trend	-1.880807 (0.6529)	-10.65427 (0.0000)
	First Difference	Constant	-21.29816 (0.0001)	-37.03903 (0.0001)
		Constant & Linear Trend	-21.10828 (0.0001)	-36.90740 (0.0001)
CAB	Level	Constant	-0.593625 (0.8642)	-3.620344 (0.0078)
		Constant & Linear Trend	-1.618830 (0.7746)	-4.751141 (0.0014)
	First Difference	Constant	-9.726036 (0.0000)	-17.17713 (0.0000)
		Constant & Linear Trend	-9.823498 (0.0000)	-19.38159 (0.0001)
CFER	Level	Constant	-6.988502 (0.0000)	-7.109852 (0.0000)
		Constant & Linear Trend	-6.927756 (0.0000)	-7.054127 (0.0000)
LNTRADE	Level	Constant	0.063339 (0.9603)	-0.914475 (0.7778)
		Constant & Linear Trend	-2.341173 (0.4060)	-5.008520 (0.0006)
	First Difference	Constant	-5.407284 (0.0000)	-13.48976 (0.0000)
		Constant & Linear Trend	-5.404503 (0.0002)	-13.52306 (0.0001)
LNTOT	Level	Constant	-3.833514 (0.0042)	-3.667873 (0.0068)
		Constant & Linear Trend	-4.831060 (0.0011)	-4.831060 (0.0011)
LNGR	Level	Constant	-4.193540 (0.0014)	-4.193813 (0.0014)
		Constant & Linear Trend	-4.303771 (0.0056)	-4.311876 (0.0055)
OTHCAP	Level	Constant	-7.988167 (0.0000)	-7.986862 (0.0000)
		Constant & Linear Trend	-8.668519 (0.0000)	-8.896950 (0.0000)

Source: Author calculations using EViews 5.0

The results of the Unit Root Tests show that the null hypothesis of unit root is rejected for the variables LNREER, NCF, FDI, PORT, DEBTCF, OTHCAP, CFER, LNTOT, and LNGR as per

the test statistics for both the ADF and PP tests. Hence, these variables are stationary *I*(0) in the level. For the variables GFCE and CAB the ADF test statistic fail to reject the null hypothesis for unit root, but the PP test statistic indicates that the null hypothesis of unit root is rejected at even 1% level of significance. Both the ADF and PP tests for the first differences of these series indicate that null hypothesis of unit root is rejected for the first differences and that they are stationary. Both the ADF and PP tests for the variable LNTRADE indicate that the series is nonstationary in the level. However, the first difference of this series is stationary as per both the tests. Hence, the variable LNTRADE is integrated of order one *I*(1).

5.2 Estimation Results of Econometric Model 1

5.2.1 Test for the existence of long run relation between variables for Econometric Model 1

In the first stage of ARDL modeling for Model 1 that specifies the relationship between LNREER (dependent variable) and net capital flow NCF and other explanatory variables, the existence of long run cointegration relationship for the variables is investigated by computing the F test statistic. Given the few observations available for estimation the maximum lag order for the various variables in the model is set at two (m=2) and the estimation is carried out for the period 1996Q1 to 2012Q4.

The F statistic for testing the joint null hypothesis that there exists no long run relationship between the variables as defined above is given in the last row of the results table of the Hypothesis testing Menu using *Microfit 4.0* as shown in Appendix I.

The computed F statistic is F = 3.6476[.003]. The relevant critical value bounds for this test as computed by Pesaran, Shin, and Smith (1996) at the 95% level is given by 2.365 – 3.513. Since the F satistic exceeds the upper bound of the critical value band the null hypothesis of no long run relationship between the variables is rejected. This test result suggests that there exists a long-run relationship between LNREER, GFCE, NCF, LNTRADE, LNTOT, LNGR, CAB, and CFER.

Having rejected the null hypothesis of no long run cointegrating relationship between the variables in Econometric Model 1, the ARDL Model is estimated using Univariate ARDL Cointegration Test option of Microfit 4.0 with the maximum lag m = 2. Microfit estimates $(2+1)^{7+1} = 6561$ models and presents the choice of the selection of the model with optimum

number of lags of variables between different selection criterion. The ARDL model specifications selected based on Schwarz Bayesian Criteria (SBC) and Akaike Information Criterion (AIC) are the same. The ARDL (1,0,1,1,1,0,1,1) estimates for these models are presented in the Table 5.6 below.

Table 5.6

Autoregressive Distributed Lag Estimates of Model 1

ARDL (1,0,1,1,1,0,1,1) Model Dependent variable is LNREER

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNREER(-1)	0.82533	0.067850	12.1639[.000]
GFCE	-0.8526E-3	0.0012375	-0.68899[.494]
NCF	0.83864	0.15507	5.4080[.000]
NCF(-1)	0.53639	0.17918	2.9936[.004]
LNTRADE	0.47747	0.024481	1.9504[.057]
LNTRADE(-1)	-0.045104	0.024377	-1.8502[.070]
LNTOT	-0.28102	0.016046	-1.7513[.086]
LNTOT(-1)	0.032279	0.014565	2.2162[.031]
LNGR	-0.0011571	0.0068497	-0.16892[.867]
CAB	0.54638	0.18782	2.9090[.005]
CAB(-1)	0.63911	0.20793	3.0737[.003]
CFER	-0.67004	0.11699	-5.7273[.000]
CFER(-1)	-0.41978	0.12370	-3.3935[.001]
C	0.80129	0.30736	2.6070[.012]
R-Squared	0.84748	R-Bar-Squared	0.80935
S. E. Of Regression	0.018025	F-Stat. f(13,52)	22.2261[.000]
Mean of Dependent Variable	4.5956	S.D. Of Dependent Variable	0.041281
Residual Sum of Squares	0.016894	Equation Log-Likelihood	179.2742
Akaike Info. Criterion	165.2742	Schwarz Bayesian Criterion	149.9466
DW-Statistic	2.2785	Durbin's h statistic	-1.3556[.175]

Diagnostic Tests

Test Statistics	LM Version	F Version	
A; Serial Correlation	CHSQ (4)=3.0102[.556]	F(4,48)	0.57347[.683]

B; Functional Form	CHSQ (1)=2.1618[.141]	F(1,51)	1.7271[.195]
C: Normality	CHSQ (2) = 0.52422[.769]	Not Applicable	
Hetroscedasticity	CHSQ (1) = 0.30345[.582]	F(1,64)	0.29561[.589]

Source: Author calculations by Microfit (4.0)

A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

5.2.2. Estimated Long Run Coefficients for Model 1

In the second stage of the ARDL modeling for the univariate cointegration test the estimates of the long-run coefficients of the model are computed. The Schwarz Bayesian Criterion and Akaike Information Criterion give the same specification for the optimal lags for the ARDL model. Table 5.7 presents the estimated long run coefficients for Model 1 based on the ARDL(1,0,1,1,1,0,1,1) specifications selected using both the criterion.

Table 5.7

Estimated Long Run Coefficients using the ARDL Approach for Model 1

ARDL (1,0,1,1,1,0,1,1) Model

Dependent variable is LNREER

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
GFCE	-0.004813	0.0072162	-0.67643[.502]
NCF	7.8720	3.2231	2.4424[.018]
LNTRADE	0.015135	0.82143	0.18425[.855]
LNTOT	0.23913	0.091567	0.26115[.795]
LNGR	-0.0066242	0.039296	-0.16857[.867]
CAB	6.7870	2.9149	2.3284[.024]
CFER	-6.2392	2.8750	-2.1702[.035]
C	4.5874	.27324	16.7890[.000]

Source: Author calculations by Microfit (4.0)

The estimated coefficients of the long run relationship are significant for NCF, CAB and CFER and are not significant for GFCE, LNTRADE, LNTOT and LNGR. The estimated coefficients

are positive for NCF and CAB and negative for CFER. This indicates that Net Capital flows and current account balance have a positive statistically significant impact on real effective exchange rate at 5% level while change in foreign exchange reserves have a negative significant impact on real exchange rate at 5% level.

The point estimates for the two ARDL Models are comparable and the estimated standard errors obtained for the model selected by the SBC and AIC are similar.

The long run model corresponding to ARDL (1,0,1,1,1,0,1,1) for the natural log of real effective exchange rate can be written as:

$$LNREERT_t = 4.5874 - 0.0048813*GFCE_t + 7.8720*NCF_t + 0.015135*LNTRADE_t$$

$$+ 0.023913*LNTOT_t - 0.0066242*LNGR_t + 6.7870*CAB_t - 6.2392*CFER_t$$

5.2.3. Error Correction Model (ECM) Estimates for Model 1

In the next stage an error correction model for the selected ARDL Model is estimated. Table 5.8 presents the results of the estimated ECM corresponding to the long run estimates for Model 1 selected using Schwarz Bayesian Criterion using Microfit 4.0. The estimated ECM has two parts. First part contains the estimated coefficients of short run dynamics and the second part consists of the estimates of the error correction term (ECT) that measures the speed of adjustment whereby short-run dynamics converge to the long-run equilibrium path in the model.

Table 5.8

Error Correction Representation for the Selected ARDL Model for Model 1

ARDL(1,0,1,1,1,0,1,1), Dependent variable is dLNREER

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dGFCE	-0.856E-3	0.0012375	-0.68899[.494]
dNCF	0.83864	0.15507	5.4080[.000]
dLNTRADE	0.047747	0.024481	1.9504[.056]
dLNTOT	-0.028102	0.016046	-1.7513[.085]
dLNGR	-0.0011571	0.0068497	-0.16892[.866]
dCAB	0.54638	0.18782	2.9090[.005]
dCFER	-0.67004	0.11699	-5.7273[.000]
dC	0.80129	0.30736	2.6070[.012]
Ecm(-1)	-0.17467	0.067850	-2.5744[.013]
R-Squared	0.62430	R-Bar-Squared	0.53038

S.E. of Regression	0.018025	F-stat. F(8,57)	10.8012[.000]
Mean of Dependent Variable	-0.2288E-3	S.D. of Dependent Variable	0.26302
Residual Sum of Squares	0.016894	Equation Log-likelihood	179.2742
Akaike Info. Criterion	165.2742	Schwarz Bayesian Criterion	149.9466
DW-statistic	2.2785		

Source: Author calculations by Microfit (4.0)

The short-run coefficients estimates show the dynamic adjustment of all variables. The short run coefficients for dNCF, dCAB and dCFER are statistically significant at the 5% level . The coefficient of error correction term ecm(-1) estimated at -0.17467 is highly significant indicating that the real exchange rate, net capital flows, current account balance and change in foreign exchange reserves are cointegrated. The estimated value of the coefficient indicates that about 17.5 percent of the disequilibrium in real exchange rate is offset by the short run adjustment in the same quarter.

5.3 Estimation of Econometric Model 2

5.3.1 Test for the existence of long run relation between variables for Econometric Model 2

For the Model 2 that specifies the relationship between LNREER and the components of net capital flow i.e. Foreign Direct Investment (FDI), Portfolio flows (PORT), Debt Creating Flows (DEBTCF), Other Capital Flows (OTHCAP) along with other explanatory variables, the F test statistic is computed for investigating the existence of long-run relationship between the variables. The variables LNGR, LNTRADE and LNTOT are dropped from the analysis for the reason that the maximum number of variables that can be allowed is restricted by the data points available for estimation and also because the results for Model 1 indicate that the coefficient on these three variables are not statistically significant. Keeping in view the few observations available for estimation, the maximum lag order for the various variables in the model is set at two (m=2). The estimation is carried out for the period 1996Q1 to 2012Q4.

The F statistic for testing the joint null hypothesis namely there exists no long run relationship between the variables as defined above is given in the last row of the results table of the Hypothesis testing Menu using Microfit 4.0 as shown in the Appendix II.

The computed F statistic is F = 3.7906[.002]. The relevant critical value bounds for this test as computed by Pesaran, Shin, and Smith (1996) at the 95% level of is given by 2.365 – 3.513. Since the F satistic exceeds the upper bound of the critical value band this implies that the null hypothesis of no long run relationship between the variables is rejected and that there exists a long-run relationship between LNREER, GFCE, FDI, PORT, DEBTCF, OTHCAP, CAB, and CFER.

Having rejected the null hypothesis of no long run cointegrating relationship between the variables in Model 2, the ARDL Model is estimated using Univariate ARDL Cointegration Test option of *Microfit* 4.0 with the maximum lag m = 2. *Microfit* estimates $(2+1)^{7+1} = 6561$ models and presents the choice of the selection of the model with optimum number of lags of variables between different selection criterion. The ARDL model specifications selected based on Schwarz Bayesian Criteria (SBC) and Akaike Information Criterion (AIC) are ARDL(2,0,0,0,0,0,0,0) and ARDL(1,1,1,1,2,1,2,1) respectively. The ARDL estimates for these models are presented in the Tables 5.9 and 5.10 below.

Table 5.9

Autoregressive Distributed Lag Estimates Model 2

ARDL(2,0,0,0,0,0,0,0) selected based on Schwarz Bayesian Criterion

Dependent variable is LNREER

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNREER(-1)	1.0268	0.10453	9.8234[0.000]
LNREER(-2)	-0.20096	0.10126	-1.9847[0.052]
GFCE	-0.0017211	0.0011604	-1.4832[0.144]
FDI	0.12352	0.59407	0.20793[0.836]
PORT	0.62480	0.021407	2.9186[0.005]
DEBTCF	1.0300	0.20857	4.9385[0.000]
OTHCAP	0.030561	0.35908	0.085109[0.932]
CAB	0.72391	0.17515	4.1330[0.000]
CFER	-0.55469	0.13809	-4.0170[0.000]
C	0.82112	0.32550	2.5226[0.015]

R-SQUARED	0.81545	R-Bar-Squared	0.78580
S.E. of Regression	0.019106	F-stat. F(9,56)	27.4943[0.000]
Mean Of Dependent Variable	4.5956	S.D. of Dependent Variable	0.041281
Residual Sum Of Criterion	0.020442	Equation Log-Likelihood	172.9844
Akaike Info Criterion	162.9844	Schwarz Bayesian Criterion	152.0361
DW- Statistic	2.3234		

Diagnostic Tests

Test Statistics	LM Version	F Version	
A; Serial Correlation	CHSQ (4)= 7.3781[.117]	F(4,52)	1.6362[.179]
B; Functional Form	CHSQ (1) = 0.023236[.879]	F(1,55)	0.019370[.890]
C: Normality	CHSQ (2) = 0.16532[.921]	Not Applicable	
D:Hetroscedasticity	CHSQ (1) = 0.44173[.506]	F(1,64)	0.43123[.514]

Source: Author calculations by Microfit (4.0)

Table 5.10

Autoregressive Distributed Lag Estimates for Model 2

ARDL(1,1,1,1,2,1,2,1) selected based on Akaike Information Criterion

Dependent variable is LNREER

Regressor	Coefficient	Standard Error	T- Ration [Prob]
LNREER (-1)	0.84579	0.074321	11.3803[0.000]
GFCE	-0.1831E-4	0.0012373	-0.014801[0.988]
GFCE (-1)	0.0018557	0.0012959	1.4320[0.159]
FDI	0.14448	0.61803	0.23378[0.816]
FDI (-1)	1.0843	0.63250	1.7143[0.093]
PORT	061917	0.21640	2.8613[0.006]
PORT (-1)	0.60549	0.24908	2.4309[0.019]
DEBTCF	0.96219	0.22530	4.2706[0.000]
DEBTCF (-1)	0.53794	0.21326	2.5225[0.015]
DEBTCF (-2)	0.30632	0.15267	2.0064[0.050]
OTHCAP	-0.11882	0.36092	-0.32920[0.743]

OTHCAP (-1)	0.67974	0.40542	1.6766[0.100]
CAB	0.56588	0.21766	2.5999[0.012]
CAB (-1)	0.61554	0.23183	2.6551[0.011]
CAB (-2)	0.21045	0.15366	1.3696[0.177]
CFER	-0.64118	0.14015	-4.5751[0.000]
CFER (-1)	-0.42895	0.13394	-3.2026[0.002]
C	0.68285	0.34653	1.9706[0.055]
R-SQUARED	0.86154	R-Bar-Squared	0.81251
S.E. of Regression	0.017875	F-stat. F(17, 48)	17.5694[0.000]
Mean Of Dependent Variable	4.5956	S.D. of Dependent Variable	0.041281
Residual Sum Of Squares	0.015337	Equation Log-Likelihood	182.4666
Akaike Info Criterion	164.4666	Schwarz Bayesian Criterion	144.7597
DW- Statistic	2.0009	Durbin's h-statistic	-0.0047451[.996]

DIAGNOSIC TESTS

Test Statistics	LM Version	F Version
A: Serial Correlation	CHSQ (4) = 0.49250[0.974]	F(4,44) = 0.082700[0.987]
B: Functional Form	CHSQ (1) = 1.8817[0.170]	F(1, 47) = 1.3793[0.246]
C: Normality	CHSQ (2) = 0.14038[0.932]	Not Applicable
D: Heteroscedasticity	CHSQ (1) = 0.019105[0.890]	F(1,64) =0.018531[0.892]

Source: Author calculations by Microfit (4.0)

A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

5.3.2 Estimated Long Run Coefficients for Model 2

In the second stage of the ARDL modeling for the univariate cointegration test the estimates of the long-run coefficients of the model are computed. Table 5.11 presents the estimated long run coefficients for Model 2 based on the ARDL(2,0,0,0,0,0,0,0) specifications selected using the Schwarz Bayesian Criterion.

Table 5.11

Estimated Long Run Coefficients for Model 2 using the ARDL Approach

ARDL(2,0,0,0,0,0,0,0) selected based on Schwarz Bayesian Criterion

Dependent variable is LNREER

Regressor	Coefficient	Standard Error	T-Ration[Prob]
GFCE	-0.0098815	0.0072372	-1.3654[0.178]
FDI	0.070920	3.3836	0.20960[0.835]
PORT	3.5873	1.9734	1.8178[0.074]
DEBTCF	5.9138	2.7542	2.1472[0.036]
OTHCAP	0.17547	2.0551	0.085381[0.932]
CAB	4.1563	2.0220	2.0556[0.044]
CFER	-3.1848	1.6935	-1.8806[0.065]
C	4.7145	0.098941	47.6498[0.000]

Source: Author calculations by Microfit (4.0)

Table 5.12 presents the estimated long run coefficients for the ARDL(1,1,1,1,2,1,2,1) specification for Model 2 using the Akaike Information Criterion

Table 5.12

Estimated Long Run Coefficients for Model 2 using the ARDL Approach

ARDL(1,1,1,1,2,1,2,1) selected based on Akaike Information Criterion

Dependent variable is LNREER

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
GFCE	0.011915	0.015874	0.75059[0.457]
FDI	7.9683	6.5021	1.2255[0.226]
PORT	7.9417	4.1960	1.8927[0.064]
DEBTCF	11.7145	5.8803	1.9922[0.052]
OTHCAP	3.6375	3.7174	0.97849[0.333]
CAB	9.0260	4.6986	1.9210[0.061]
CFER	-6.9396	3.9693	-1.7483[0.087
C	4.4281	0.20217	21.9036[0.000]

Source: Author calculations by Microfit (4.0)

The estimated coefficients of the long run relationship are significant for PORT, DEBTCF, CAB and CFER at 10% level and are not significant for FDI, OTHCAP and GFCE. The estimated coefficients are positive for PORT, DEBTCF, and CAB and negative for CFER. This indicates that of all the components of Net capital flows only the Portfolio flows and Debt Creating flows have a positive statistically significant association with real effective exchange rate at 10 %

level. In addition current account balance has a positive significant association with real effective exchange rate at the 10 % level while change in foreign exchange reserves has a negative significant association with the real exchange rate at the 10 % level.

The point estimates for the two ARDL models are very similar, but the estimated standard errors obtained for the model selected by SBC are considerably smaller as compared to the Model selected by AIC.

The long run model corresponding to ARDL (2, 0, 0, 0, 0, 0, 0, 0) for the relationship between real effective exchange rate and the components of net capital flows and other explanatory variables can be written as:

$$LNREERT_t = 4.7145 - 0.0098815*GFCE_t + 0.70920*FDI_t + 3.5873*PORT_t + 5.9138*DEBTCF_t + 0.17547*OTHCAP_t + 4.1563*CAB_t - 3.1848*CFER_t$$

5.3.3. Error Correction Model (ECM) Estimates for Model 2

In the next stage an error correction model for the selected ARDL Model is estimated. Table 5.13 presents the results of the estimated ECM corresponding to the long run estimates for Model 2 selected using Schwarz Bayesian Criterion using Microfit 4.0. The estimated ECM has two parts. First part contains the estimated coefficients of short run dynamics and the second part consists of the estimates of the error correction term (ECT) that measures the speed of adjustment whereby short-run dynamics converge to the long-run equilibrium path in the model.

Table 5.13

Error Correction Representation for the Selected ARDL Model for Model 2

ARDL(2,0,0,0,0,0,0,0) selected based on Schwarz Bayesian Criterion

Dependent variable is dLNREER

Regressor	Coefficient	Standard Error	T-Ration[Prob]
dLNREER1	0.20096	0.10126	1.9847[0.052]
dGFCE	-0.0017211	0.0011604	-1.4832[0.144]
dFDI	0.12352	0.59047	0.20793[0.836]
dPORT	0.62480	0.21407	2.9186[0.005]
dDEBTCF	1.0300	0.20857	4.9385[0.000]
dOTHCAP	0.030561	0.35908	0.085109[0.932]
dCAB	0.72391	0.17515	4.1330[0.000]
dCFER	-0.55469	0.13809	-4.0170[0.000]

dC	0.82112	0.32550	2.5226[0.015]
ecm(-1)	-0.17417	0.070611	-2.4666[0.017]
R-Squared	0.54542	R-Bar-Squared	0.47236
S.E. of Regression	0.019106	F-stat. F(9,56)	7.4655[0.000]
Mean of Dependent Variable	-0.2288E-3	S.D. of Dependent Variable	0.026302
Residual sum of Squares	0.020442	Equation Log-likelihood	172.9844
Akaike Info. Criterion	162.9844	Schwarz Bayesian Criterion	152.0361
DW-statistic	2.3234		

dLNREER1 = LNREER(-1)-LNREER(-2)

Source: Author calculations by Microfit (4.0)

The short-run coefficients estimates show the dynamic adjustment of all variables. The short run coefficients for dPORT, dDEBTCF, dCAB, and dCFER are statistically significant at the 5% level. The coefficient of error correction term ecm(-1) is negative and significant at the 5% level indicating that the real exchange rate, portfolio flows, debt creating flows, current account balance and change in foreign exchange reserves are cointegrated. The estimated value of the coefficient indicates that about 17.42 percent of the disequilibrium in real exchange rate is offset by the short run adjustment in the same quarter.

5.4 Interpretation of Results of ARDL Cointegration Analysis

5.4.1 The F test statistics for the Model 1 indicates that there exists a long run relationship between real effective exchange rate and NCF and other explanatory variables. The ARDL estimates for the long run coefficients in Model 1 indicate that the relationship between LNREER and NCF is statistically significant and positive. Thus for the estimation period 1996-97 to 2012-13 the net capital flows to India have been associated with real exchange rate appreciation. Similarly the current account balance CAB has a positive and statistically significant association with LNREER indicating that the outflows on account of current account deficits have been associated with depreciation of real exchange rate or limiting the appreciation on account of capital flows. The Government spending GFCE has a negative association with LNREER which could be attributed to focus of this expenditure on imports (capital outflow) but this is not statistically significant. Similarly Trade Openness LNTRADE has a positive association with LNREER which is contrary to the expectations as per literature but this is not

statistically significant. Terms of Trade LNTOT has a positive association with LNREER which could be attributed to a rise in demand due to dominance of income effect but this is not statistically significant. Productivity differential captured by LNGR has a negative association with LNREER which indicates that this has been associated with decline in prices of nontradables but this is statistically not significant. The coefficient on CFER in the results is statistically significant and negative. This indicates that accumulation of reserves by RBI has prevented the appreciation of real exchange rate. To some extent this indicates that accumulation of reserves by RBI in the face of increasing capital flows has prevented appreciation of real exchange rates and thus mitigated their adverse consequences on the competitiveness of the Indian economy.

5.4.2 The results of the Error Correction Model for Model 1 indicate that short run coefficients for dNCF, dCAB and dCFER are statistically significant at the 5% level and the coefficient of error correction term ecm(-1) is negative and highly significant indicating that in the short run changes in net capital flows, current account balance are associated with real exchange rate appreciation while increase in foreign exchange reserves is associated with depreciation of real exchange rate. The estimated value of the coefficient indicates that about 17.5 percent of the disequilibrium in real exchange rate is offset by the short run adjustment in the same quarter.

5.4.3 The F test statistics for the Model 2 indicates that there exists a long run relationship between real effective exchange rate and the components of net capital flows and other explanatory variables. The ARDL estimates for the long run coefficients in Model 2 indicate that the relationship between LNREER and FDI is not statistically significant. Thus for the estimation period 1996-97 to 2012-13 there is no significant evidence to indicate that net foreign Direct Investment flows to India have been associated with real exchange rate appreciation. However, the long run coefficients on PORT & DEBTCF are positive and significant at 10% level indicating that the Portfolio flows and Debt creating flows to India have been associated with real exchange rate appreciation indicating loss of competitiveness and overheating of the economy. Similarly, the current account balance CAB has a positive and statistically significant association with LNREER indicating that the outflows on account of current account deficits have been associated with depreciation of real exchange rate or limiting the appreciation on account of capital flows. The coefficient on CFER in the results is statistically significant at 10%

level of significance and negative. This indicates that accumulation of reserves by RBI has prevented the appreciation of real exchange rate.

5.4.4 The results of the Error Correction Model for Model 2 indicate that short run coefficients for dPORT, dDEBTCF, dCAB and dCFER are statistically significant at the 5% level and the coefficient of error correction term ecm(-1) is negative and highly significant indicating that in the short run changes in net portfolio flows, net debt creating flows and the current account balance are associated with real exchange rate appreciation while increase in foreign exchange reserves is associated with depreciation of real exchange rate. The estimated value of the coefficient indicates that about 17.4 percent of the disequilibrium in real exchange rate is offset by the short run adjustment in the same quarter.

5.5 Dynamic Relationship Analysis for Model 1

5.5.1. Selecting the Optimal order of VAR (p) for Model 1

At the first instance the Unrestricted VAR model is set up for Model 1 with REER, GFCE, NCF, LNTRADE, LNTOT, LNGR, CAB and CFER as endogenous variables and C as a vector of intercepts. Given the few observations available for estimation, the maximum lag order for the various variables in the model is set at two (m=2) and the estimation is carried out for the period 1996Q1 to 2012Q4 using the Unrestricted VAR option of Multivariate Estimation Menu of *Microfit* 4.0. Table 5.14 below presents the results of the Test statistics and model selection criteria for testing and selecting the optimal order of the VAR.

Table 5.14
Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Order	LL	AIC	SBC	LR test	Adjusted LR test
2	424.7108	288.7108	139.8143	------	------
1	363.3032	291.3032	212.4756	CHSQ(64)= 122.8152[.000]	91.1810[.014]
0	165.3584	157.3584	148.5997	CHSQ(128)= 518.7049[.000]	385.0991[.000]

****

Source: Author calculations by Microfit (4.0)

The results indicate the maximized values of the log likelihood function given under the heading LL and the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criteria (SBC) that are estimated for all the three VAR (p), p = 0,1,2 models over the same sample period 1996Q3 to 2012Q4. The selection procedure involves choosing the VAR (p) model with the highest value of the AIC and the SBC. Based on this VAR of order 1 i.e., VAR (1) model is chosen.

5.5.2 Generalized Variance Decompositions Estimation for Model 1

Having chosen the order of the VAR, the forecast error variance decompositions are computed. The variance decompositions provide a breakdown of the N step ahead forecast errors of a variable which is accounted for by the innovations in the same or other variables in the VAR. The Generalized Variance Decomposition for the variable REER for a 24 quarter time horizon are computed and the results are summarized in the Table 5.15 below:

Table 5.15

Generalized Variance Decompositions for the Variable REER

Horizon	REER	GFCE	NCF	LNTRADE	LNTOT	LNGR	CAB	CFER
0	1.0000	.0054506	.068549	.048627	.011222	.7830E-3	.7070E-4	.068474
1	.90767	.0081232	.11692	.039999	.0092468	.0072179	.0080678	.063645
4	.73184	.018753	.16562	.031798	.040448	.027581	.025767	.042064
8	.69232	.019556	.16674	.030788	.055254	.031459	.029947	.039749
12	.68972	.019638	.16614	.033642	.056342	.031397	.029898	.039669
16	.68853	.019629	.16619	.035658	.056243	.031557	.029895	.039787
20	.68786	.019618	.16627	.036629	.056164	.031670	.029919	.039869
24	.68755	.019612	.16631	.037055	.056127	.031724	.029934	.039908

Source: Author calculations by Microfit (4.0)

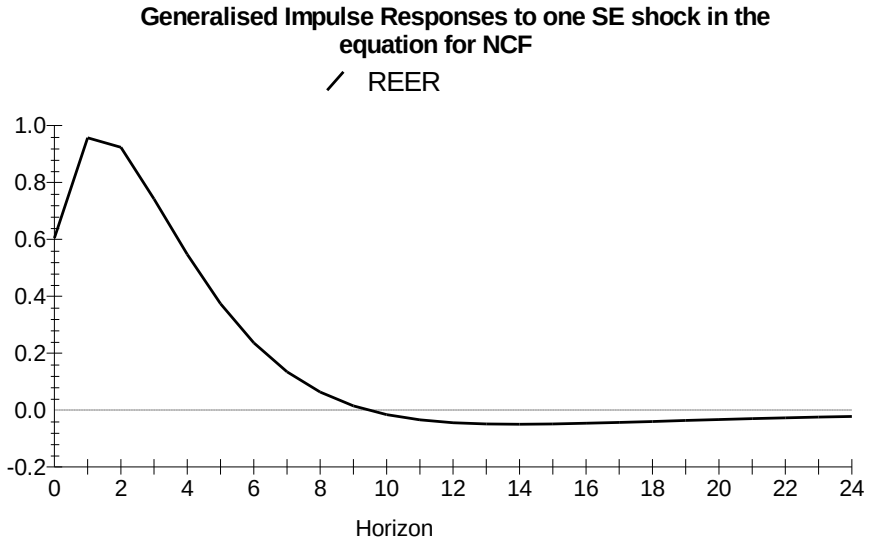
The results indicate that for the Model 1 at the end of the 24 quarter forecast horizon around 69% of the forecast error variance of REER is explained by its own innovations and the net capital flows (NCF) explains about 16.6 % of the total variance. In this model, amongst the determinants of REER, NCF is observed as the most important throughout the horizon for which the estimation is carried out.

5.5.3. Generalized Impulse Response Analysis for Model 1

The forecast variance decompositions only provide the estimates of the proportion of the forecast error variance of the real effective exchange rate that is explained by the innovations in its determinants. They do not indicate the direction or the nature (temporary or permanent) of the variation. The impulse response functions of endogenous variables to one time shock to one of the innovation are estimated to analyze the dynamic relationship among variables.

The Generalized Impulse Response of REER over a 24 quarter horizon to one standard error shock to net capital flows (NCF) as computed by *Microfit* 4.0 is indicated in the Fig 5.13 below:

Fig 5.13



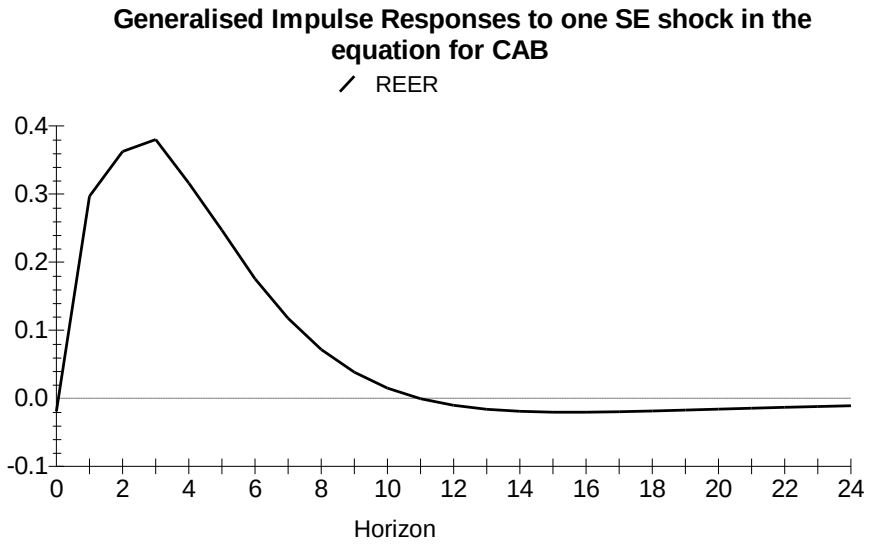
Source: Author calculations by Microfit (4.0)

As seen from the graph above there is an immediate positive effect on REER of one standard deviation shock to the net capital flows. This conforms to sign observed earlier in the ARDL model estimates implying that a shock to the net capital flows is associated with real exchange rate appreciation. The effect on REER peaks at the end of the first quarter and remains significant for the next quarter and then gradually levels over a nine quarter period. The impulse

response indicates that the unanticipated positive net capital flow shocks have significant and persistent impact on the real effective exchange rate in the first six months after the surprise innovation and the effect wears out thereafter.

Fig 5.14 below indicates the Generalized Impulse Response of REER over a 24 quarter horizon to one standard error shock to Current Account Balance (CAB).

Fig 5.14

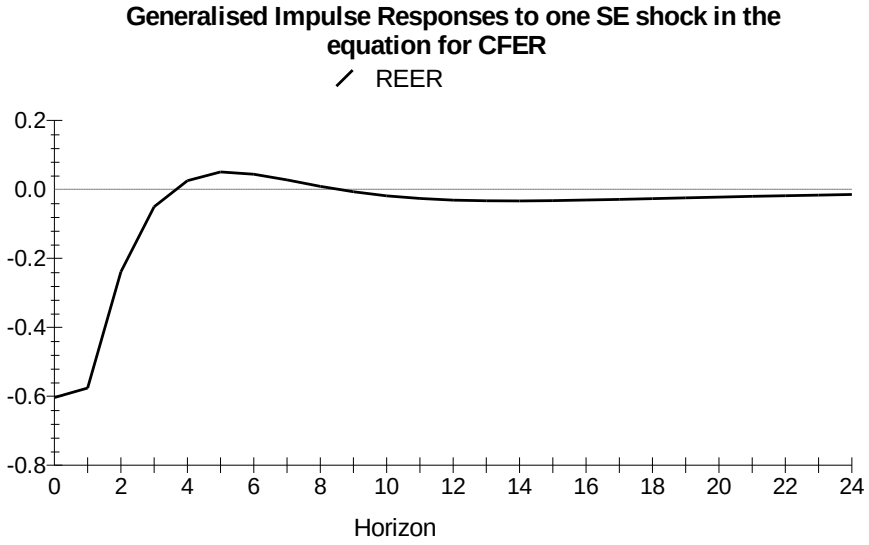


Source: Author calculations by Microfit (4.0)

As seen above, the effect on REER of one standard deviation shock to the current account balance is positive and conform to sign observed earlier in the ARDL model estimates implying that a shock to the current account balance is associated with real exchange rate appreciation. The effect of shock to CAB on REER is relatively gradual as compared to that of net capital flows. It peaks at the end of the third quarter and then gradually levels over ten quarter period. The impulse response indicates that the unanticipated net current account positive shocks are associated with significant impact on the real effective exchange rate in the first nine months after the surprise innovation and the effect wears out thereafter.

Fig 5.15 below traces the Generalized Impulse Response of REER over a 24 quarter horizon for one standard deviation shock to CFER.

Fig 5.15



Source: Author calculations by Microfit (4.0)

As seen from the graph above there is an immediate negative effect on REER of one standard deviation shock to the change in foreign exchange reserves. This conforms to sign observed earlier in the ARDL model estimates indicating that a shock to change in foreign exchange reserves is associated with real effective exchange rate deprecation. The effect on REER remains substantial for the first quarter and then gradually levels at 0.00 after a 3 quarter period implying that the effect of the shock wears out after 9 months. The impulse response indicates that the unanticipated positive shocks to the change in foreign exchange reserves are associated with significant negative impact on the real effective exchange rate in the first nine months after the surprise innovation and the effect wears out thereafter.

5.6 Dynamic Relationship Analysis for Model 2

5.6.1 Selecting the Optimal order of VAR (p) for Model 2

At the first instance, the Unrestricted VAR model is set up for Model 2 with REER, GFCE, FDI, PORT, DEBTCF, OTHCAP, CAB and CFER as endogenous variables and C as a vector of intercepts. Given the few observations available for estimation, the maximum lag order for the various variables in the model is set at two (m=2) and the estimation is carried out for the period 1996Q1 to 2012Q4 using the Unrestricted VAR option of Multivariate Estimation Menu of *Microfit* 4.0. Table 5.16 below presents the results of the Test statistics and model selection criteria for testing and selecting the optimal order of the VAR.

Table 5.16

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Order	LL	AIC	SBC	LR test	Adjusted LR test
2	1033.2	897.2239	748.3273	------	------
1	996.6897	924.6897	845.8622	CHSQ(64)= 73.0682[.205]	54.2476[.802]
0	867.5496	859.5496	850.7910	CHSQ(128)= 331.3484[.000]	246.0011[.000]

****

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

Source: Author calculations by Microfit (4.0)

The results indicate the maximized values of the log likelihood function given under the heading LL and the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criteria (SBC) that are estimated for all the three VAR (p), p = 0, 1, 2 models over the same sample period 1996Q3 to 2012Q4. The AIC and the SBC selection criterion select the order of the VAR as 1 and 0 respectively. The log likelihood ratio statistics (whether or not adjusted for small samples) reject order 0, but do not reject a VAR of order 1. In the light these VAR of order 1 i.e., VAR (1) model is chosen.

5.6.2 Generalized Variance Decompositions Estimation for Model 2

In the next stage the Generalized Variance Decompositions for the variable REER for a 24 quarter time horizon are computed for the VAR (1) model. The results are summarized in the Table 5.17 below:

Table 5.17

Generalized Variance Decompositions for the variable REER in Model 2

Horizon	REER	GFCE	FDI	PORT	DEBTCF	OTHCAP	CAB	CFER
0	1.00000	.011664	.014294	.11471	.049771	.053525	.0014806	.079855
1	.92315	.021512	.028473	.21726	.038103	.032533	.0035156	.077924
4	.78816	.046588	.069147	.31144	.026005	.022268	.012669	.062829
8	.77134	.047988	.076477	.31935	.025260	.022731	.014307	.061598
12	.77125	.047985	.076525	.31933	.025275	.022741	.014314	.061588
16	.77124	.047986	.076528	.31934	.025274	.022741	.014315	.061587
20	.77124	.047986	.076529	.31934	.025274	.022741	.014315	.061587
24	.77124	.047986	.076529	.31934	.025274	.022741	.014315	.061587

Source: Author calculations by Microfit (4.0)

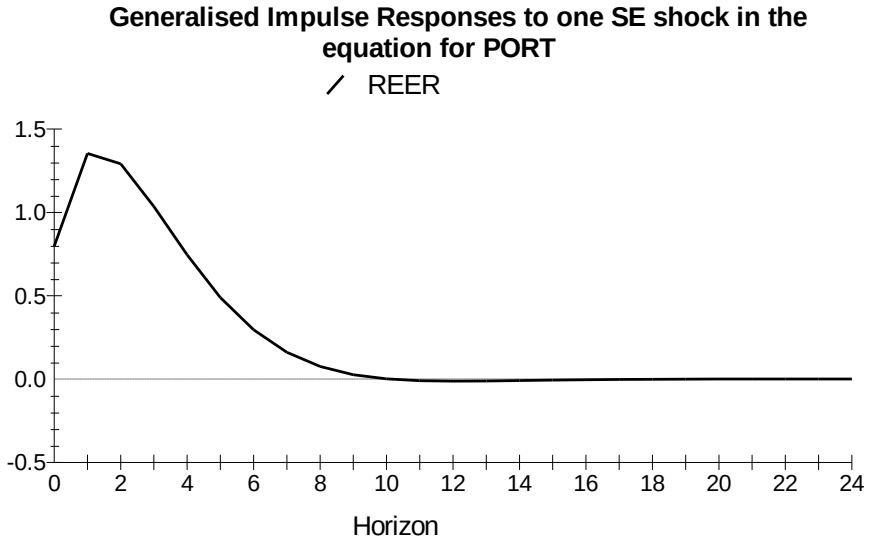
The results indicate that for the Model 2 at the end of the 24 quarter forecast horizon around 77.12% of the forecast error variance of REER is explained by its own innovations and the net portfolio flows (PORT) explains about 32 % of the total variance. In this model, amongst the determinants of REER, PORT is observed as the most important throughout the horizon for which the estimation is carried out. The proportion of variance accounted for by the other components of capital flows i.e., FDI, DEBTCF and OTHCAP is very less as compared to the effect of PORT.

5.6.3 Generalized Impulse Response Analysis for Model 2

In the next stage the impulse response functions of endogenous variables to one time shock to one of the innovation are estimated to analyze the direction and the nature (temporary or permanent) of the dynamic relationship among variables.

The Generalized Impulse Response of REER over a 24 quarter horizon to one standard error shock to net portfolio flows (PORT) as computed by *Microfit* 4.0 is indicated in the Fig 5.16 below:

Fig 5.16

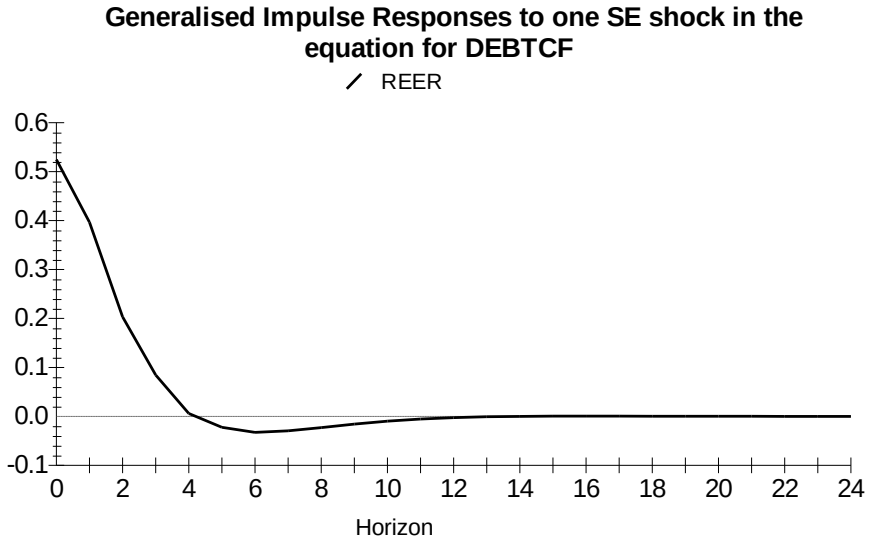


Source: Author calculations by Microfit (4.0)

As seen from the graph above there is an immediate positive effect on REER of one standard deviation shock to the net portfolio flows. This conforms to sign observed earlier in the ARDL model estimates implying that a shock to the net portfolio flows is associated with real exchange rate appreciation. The effect of the shock due to PORT on REER peaks at the end of the first quarter, remains substantial over the next quarter, and then gradually levels off over a 9 quarter period. Another feature of the response function is that the impact on the real exchange rate is more pronounced than the quantum of the shock to net portfolio flows. The impulse response indicates that the unanticipated net portfolio shocks have significant and persistent impact on the real effective exchange rate in the first six months after the surprise innovation and the effect wears out thereafter.

Fig 5.17 below traces the Generalized Impulse Response of REER over a 24 quarter horizon for one standard deviation shock to DEBTCF.

Fig 5.17



Source: Author calculations by Microfit (4.0)

As seen from the graph above there is an immediate positive effect on REER of one standard deviation shock to the net debt creating flows. This conforms to sign observed earlier in the ARDL model estimates implying that a shock to the debt creating flows is associated with real exchange rate appreciation. The effect of shock to DEBTCF on REER gradually levels off over a 4 quarter period implying that the effect wears out over a year. The impulse response indicates that the unanticipated net debt creating flow shocks have immediate significant but short-lived impact on the real effective exchange rate after the surprise innovation and the effect wears out thereafter.

5.7 Interpretation of Results:

5.7.1 The results of the Generalised forecast error variance decompositions for Real Effective Exchange Rate in Model1 indicate that at the end of the 24 quarter forecast horizon around 69% of the forecast error variance of REER is explained by its own innovations and the innovations to net capital flows (NCF) explains about 16.6 % of the total variance. Further amongst the determinants of REER, NCF is observed as the most important throughout the horizon for which the estimation is carried out. This shows that innovations of net capital flow have a significant effect on the real effective exchange rate and the effect remains significant for even 6 year forecast period.

5.7.2 The Generalized Impulse Response Analysis of REER in Model1 shows that there is an immediate positive effect on REER of one standard deviation shock to the net capital flows and that the effect on REER peaks at the end of the first quarter and remains substantial for the next quarter and then gradually levels over nine quarters. This indicates that the unanticipated positive shocks to net capital flows are associated with sharp almost immediate appreciation of the real exchange rate over the first quarter and remains effective for next quarter before leveling off. The effect of shock to Current Account Balance on REER is relatively gradual as compared to that of net capital flows. It peaks at the end of the third quarter and then gradually wears out over 2.5 years. Thus effect of positive shocks to current account balance on real exchange real exchange rate appreciation is relatively gradual and mute as compared to the net capital flow shocks. The results further show that there is an immediate negative effect on REER of one standard deviation shock to the change in foreign exchange reserves. This conforms to sign observed earlier in the ARDL model estimates indicating that a positive shock to change in foreign exchange reserves is associated with real effective exchange rate deprecation. The negative effect on REER remains persistent up to the end of the first quarter and then gradually wears out after nine months. In a way this indicates that accumulation of reserves by RBI in the face of increasing capital flows has prevented appreciation of real exchange rates and thus mitigated their adverse consequences on the competitiveness of the Indian economy.

5.7.3 The results of the Generalised forecast error variance decompositions for Real Effective Exchange Rate in Model 2 indicate that at the end of the 24 quarter forecast horizon innovations to net portfolio flows (PORT) explains about one-third of the total variance of REER. In this model, amongst the determinants of REER, PORT is observed as the most important throughout

the horizon for which the estimation is carried out. The proportion of variance accounted for by the other components of capital flows i.e., FDI, DEBTCF and OTHCAP is very less as compared to the effect of PORT. This shows that amongst all the components of the net capital flows innovations of net portfolio flow have the most significant effect on the real effective exchange rate and the effect remains significant for even 6 year forecast period.

5.7.4 The Generalized Impulse Response Analysis of REER in Model 2 shows that there is an immediate positive effect on REER of one standard deviation shock to the net portfolio flows and that the effect on REER is more pronounced than the quantum of shock itself. The effect peaks at the end of the first quarter and remains substantial for the next quarter and then gradually levels over nine quarters. This indicates that the unanticipated positive shocks to net portfolio flows are associated with sharp almost immediate appreciation of the real exchange rate and the appreciation rises for the first quarter remains effective for the next quarter. The effect of shock to debt creating flows on REER is immediate though less intense and gradually levels off over four quarters (one year). Shocks to other components of capital flows do not have any significant dynamic impact on the real exchange rate. This shows that of all the components of net capital flows portfolio flows are the ones which are associated with sharp and persistent appreciation of the real exchange rate and the degree of impact on real appreciation is more severe than the quantum of the shock itself.

5.8 Summary of Findings

One of the main objectives of this study is to analyze the relationship between capital flows and its components to India and the real exchange rate. The results of the cointegration analysis using ARDL estimation procedure and of the dynamic interactions analysis using Generalized Impulse Response Function and the Generalized Forecast Error Variance Decompositions in an unrestricted VAR framework for the Models 1 & 2, presented in this chapter, indicate the long run equilibrium, the short run and the dynamic association of the net capital flows and its components viz FDI, Portfolio flows, debt creating flows and other capital flows with the real exchange rate for the Indian economy for the estimation period from 1996-97 onwards. In the long run the net capital flows are found to be associated with real exchange rate appreciation and the results are statistically significant. With regard to the components of the net capital flows,

FDI is not found to be associated with changes in real exchange rate in a statistically significant manner, while portfolio flows and debt creating flows are found to be associated with real exchange rate appreciation. The results of the error correction models indicate that in the short run increase in net capital flows, portfolio flows and debt creating flows are associated with real exchange rate appreciation and the results are statistically significant while changes in FDI flows are not significantly associated with changes in the real exchange rate. Thus it can be inferred that net capital flows, portfolio flows and debt creating flows have been associated with overheating and loss of competitiveness of the Indian economy in the post liberalization period. The accumulation of foreign exchange reserves by RBI has prevented the appreciation of the real exchange rate in the face of increase in net capital flows and thereby mitigated its adverse consequences as the change in foreign exchange reserves has been found to be negatively associated with real exchange rate. The results of the dynamic relationships shows that positive shocks to net capital flows are associated with sharp almost immediate appreciation of the real exchange rate and that of all the components of net capital flows, shocks to portfolio flows are associated with sharp and persistent appreciation of the real exchange rate and the degree of impact on real appreciation is more severe than the quantum of the shock itself. Further, innovations of net capital flow and particularly of portfolio flows significantly account for the forecast error variance of the real effective exchange rate over a long horizon.