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Capital Flow Components and the Real Exchange Rate: Implications for India

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Abstract

This paper analyzes the relationship between the net capital flow components and the real exchange rate in India for the period 1996–1997 to 2012–2013. The empirical results suggest that there is a strong case for further liberalization of foreign direct investment flows, while greater caution is need in liberalization of portfolio and debt creating flows.

Key words: debt creating flows; foreign direct investment; foreign exchange reserves; foreign portfolio flows; government consumption expenditure; real exchange rate

JEL classification: F30; F36; F40; F62; F65

1. Introduction

India has witnessed a large trend increase in cross border flows since the introduction of the economic reforms process in the external sector in the early 1990s following the Balance of Payment (BoP) crisis. Net capital flows (NCF) to India increased from 7.1 billion USD in 1990–1991 to 8.9 billion USD in 2000–2001 and further to 89.3 billion USD during 2012–2013. Expressed as a percentage of gross domestic product (GDP), the NCF increased from 2.2% of GDP in 1990–1991 to 3.6% in 2010–2011 and further to 4.8% in 2012–2013. The increase in NCF has been accompanied by a significant increase in its components comprising Foreign Direct Investment (FDI) flows, portfolio flows, and debt creating flows in the form of banking capital, external commercial borrowings of corporate entities, and non-resident Indian deposits. The upswing in the capital mobility to India and other emerging markets suffered a brief setback in the global financial crisis in 2008. But after ebbing of the crisis, capital flows to India and other emerging market economies rebounded in late 2009 and 2010.

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The main objective of this research is to comprehensively analyze the relationship between the disaggregated NCF components: FDI flows, portfolio flows, debt creating flows, and the real exchange rate (RER) along with other determinants of RER. FDI, portfolio flows, debt creating flows and other capital flows, government consumption expenditure, current account balance, and change in foreign exchange reserves are used as explanatory variables, and the real effective exchange rate (REER) index is the response variable. The estimation is conducted on quarterly data on the Indian economy from 1996–1997 to 2012–2013. The autoregressive distributed lag (ARDL) approach to cointegration is used to examine the relationship between capital flow and other macroeconomic fundamentals and the RER.

The most significant findings of the research are that among the components of NCF, FDI flows are not found to be significantly associated with the RER appreciation, but portfolio flows and debt creating flows are found to be associated with RER appreciation in a statistically significant manner. Government consumption expenditure is not found to be significantly associated with RER appreciation, thereby limiting the role of fiscal policy in managing capital flows.

The rest of this paper is organized as follows. Section 2 attempts a review of the literature on the impact of capital flows on the domestic economy. Section 3 describes the research methodology, and Section 4 presents the datasets used for analysis. Section 5 reports the results of the econometric analysis, and Section 6 interprets the results and draws conclusions.

2. Theoretical Background and Literature Review

The concept of RER has been most widely used to analyze the impact of capital flows on the economies of the developing countries. The impact of the capital inflows on the domestic economy, which is mainly captured through the appreciation of RER, is referred to as “the transfer problem.” The RER is an important measure of the competitiveness of an economy as it is associated with export growth. RER is the relative price of the domestic goods in terms of foreign goods (e.g., US pizza per Indian pizza):

$$RER = e\frac{P}{P*}, \qquad (1)$$

where e is the nominal exchange rate, the relative price of domestic currency in terms of foreign currency (e.g., dollar per rupee), P is the overall price level in the domestic country, and $P*$ is the overall price level in the foreign country.

The seminal works of Salter (1959), Swan (1960), Corden (1960), and Dornbusch (1974) provide the theoretical framework to draw inferences on the impact of capital flows on the RER in emerging market economies. In theory, a surge in capital inflows in excess of domestic absorption capacity is associated with an increase in expenditure and an appreciation of the RER. The effects of capital inflows on appreciation of RER can be derived from standard open economy models, such as the intertemporal model of consumption and investment in an open economy with capital mobility in the tradition of Irving Fischer (Calvo et al., 1996). The theoretical models assume an economy with two goods—traded and nontraded—and a representative consumer who maximizes utility by choosing the consumption of the two goods over time (Mejia, 1999). In these models, a decline in world interest rate induces income and substitution effects in the capital recipient country, generating an increase in consumption and investment and a decline in savings (which is the converse of higher consumption). Capital inflows generate higher domestic demand of both tradeables and nontradeables in the economy. The rise in demand for tradeables leads to a rise in imports and a widening of the trade deficit. The tradeable goods are exogenously priced. The increase in demand of nontradeables, however, leads to an increase in the relative price of nontradeables, which are more limited in supply than the traded goods, so that the domestic resources get diverted to their production. A higher relative price of the nontradeables corresponds to RER appreciation. The extent of RER appreciation in the economy will depend largely on the intertemporal elasticity of aggregate demand and the income elasticity of demand and supply elasticity for nontradeable goods. The intertemporal elasticity will determine the extent of consumption smoothing and the distribution of expenditure increase through time. The elasticities for nontradeables will determine the extent to which the surge in capital flows will exercise pressure on the nontradeable prices. The appreciation of the RER is indicative of the "Dutch disease effects" (Corden and Neary, 1982) that illustrates the impact of natural resource booms or increases in capital flows on the competiveness of the export-oriented sectors and the import-competing sectors.

The effect of net capital flows on the RER can be different depending upon the composition of capital flows (Combes et al., 2011). In the financial account of BoP, four distinctive types of capital flows usually appear, namely FDI, Portfolio Investments, Debt Creating Flows, and Other Capital. The impact on RER depends on the types of expenditure that each flow is tied to. In economies with supply constraints, capital flows associated with the higher consumption put more pressure on the relative prices of nontradeables, leading to an increase in their relative prices and consequently to RER appreciation. On the other hand, capital flows associated with higher investments, which have significant imported goods content, are less likely to lead to RER appreciation. FDI flows could be related to investment in imported machinery and equipment, which do not suffer from constraints in domestic supply capacity and thus would have no effect on prices of domestic goods and consequently almost no appreciation effect on RER. In addition, the spillover effects of FDI may also improve local productive capacity through transfer of technology and managerial know-how, thereby reducing pressure on the RER (Javorick, 2004). FDI is also more stable as compared to portfolio investment and other investment flows, such as bank lending. The effect of portfolio investment flows on the RER might be different. If portfolio investment flows are oriented towards the modernization of firms in recipient countries, which requires new machinery and new product lines, the impact might be similar to that of FDI. But if they are volatile investments for speculation that do not necessarily increase the production capacity in the economy, then they would lead to a higher appreciation of RER as compared to FDI (Lartey, 2007). The same applies to other investment flows that can be either liabilities of the private or public sector of the economy. Their impact would be different if they are used to finance purchase of nontradeables, or tradeables or are used to finance exports production.

The behavior of RER in response to capital flow components has been examined in several empirical studies. Among the early works, Elbadawi and Soto (1994) studied the impact of the four disaggregated components—short-term capital flows, long-term capital flows, portfolio investment, and FDI for the case of Chile and found that long-term capital flows and FDI have a significant appreciating effect on the equilibrium RER, while the short-term capital flows and portfolio investments did not have any affect.

However, Athukorala and Rajapatirana (2003) found evidence that, for all emerging market countries in their study, on average a 1% increase in other capital flows brings a 0.56% appreciation in RER, but by contrast FDI inflows are associated with depreciation rather than appreciation of the RER. The authors attributed the depreciation effect of FDI on RER on the hypothesis that FDI generally tends to have a more tradable bias compared to other types of capital flows. Further, their analysis indicated that a given level of non-FDI capital flows led to a far greater degree of appreciation of RER in Latin America, where the importance of these flows in total capital inflows is also far greater as compared to emerging Asian countries.

In another recent work, Bakardzhieva et al. (2010) reported that except FDI, other forms of capital flows (i.e., debt, portfolio investments, aid) have a significant positive impact on the RER. Their study reveals that FDI has no significant impact on the RER. Based on these findings, they suggest that while FDI flows might lead to RER appreciation in the short run when the economy receives the flows, its impact is diluted over time as part of the flows start to leave the country in the form of imports of machinery and other capital goods. In addition, the increase in production induced by FDI can lead to downward pressure on prices and result in RER depreciation.

In another important recent study, Combes et al. (2011) analyzed the impact of capital inflows and their composition on the RER. Their results show that among private flows, portfolio investment has the highest appreciation effect—almost seven times that of FDI or bank loans. The authors suggest that the portfolio investment flows, as compared to other private flows, are more volatile and speculative—something generally associated with macroeconomic instability and no improvement of productivity. They further argued that FDI is more stable than portfolio investment and increases productive capacity through transfers of technology and know-how. It is primarily for investment purposes and can lead to imports of new machinery and equipment, which has limited impact on the RER. The appreciation of the RER on account of loans from commercial banks is limited as in the case of

FDI. The authors suggest that bank loans can be directed to some extent to investment financing like FDI, thereby improving productive capacity with a similar inflation potential as that of FDI.

In a more recent study, Jongwanich and Kohpaiboon (2013) examined the impact of capital flows on RERs in emerging Asian countries for the period 2000–2009 using a dynamic panel-data model and found evidence that portfolio investments brought in a faster speed of RER appreciation than FDI, though the magnitude of appreciation by different types of capital flows were similar.

In the literature on the impact of capital flows on RERs in the Indian economy, Biswas and Dasgupta (2012) examined the impact of capital inflows in India on the RER using quarterly data for the period 1994–1995Q1 to 2009–2010Q4 using the Johansen multivariate cointegration test. They found that FDI and workers' remittances affected RER positively. The impulse response analysis results indicated that shocks to FDI had a long-term positive impact on the RER, though it was slightly negative in some of the ending periods. However, a very recent study by Gaiha et al. (2014) explored the relationship between capital flows and RERs in India for the period 2005–2012 using ordinary least squares estimation. They reported that FDI flows had no significant impact on change in the RER. However, portfolio flows and debt flows had a significant appreciation impact on the change in the RER.

The cross-country studies on the effects of net capital flow components indicate that different types of capital flows have different effects on the RER because they act through different channels. In a recent study, Goel and Saradhi (2014) analyzed the relationship between the aggregate NCF and other fundamentals for India for the period 1996–1997 to 2012–2013 using the ARDL approach to cointegration. They reported that net capital flows in India were positively associated with RER appreciation, and the association was statistically significant. But no systematic study is available on the relationship between the RER and different types of flows (e.g., FDI or portfolio or debt flows) in India, especially for the more recent period. This calls for further research on the subject.

3. Research Methodology

3.1 The Conceptual Model and the Selection of Model Variables

In this study, the following variables are used in order to investigate the relationship between the disaggregated components of net capital flows and the RER in the Indian economy.

REER

In order to measure the RER, the REER index is included in the baseline model. The REER index is the weighted geometric average of the bilateral nominal exchange rates of the home currency (Indian rupee, in this case) in terms of foreign currencies adjusted by the ratio of domestic prices to the foreign prices (RBI, 2005):

$$REER = \prod_{i=1}^{n} [(e/e_i)(P/P_i)]^{w_i} , \quad (2)$$

where e is the exchange rate of Indian rupee against a numeraire (i.e., the International Monetary Fund's special drawing rights [SDRs]) in indexed form, e_i is the exchange rate of foreign currency i against the numeraire (SDRs; i.e., SDRs per currency i) in indexed form, the w_i are the weights attached to foreign currency/country i in the index, $\prod_{i=1}^{n} w_i = 1$, P is India's wholesale price index, P_i is the consumer price index of country i (CPI_i), and n is the number of countries/currencies in the index other than India.

FDI, PORT, DEBTCF, and OTHCAP

These are the main explanatory variables in the study. In order to measure the volume of net capital flow components relative to the size of the economy, the ratio of the disaggregated components of capital flows into the Indian economy in the quarter and the quarterly GDP at market prices (at current prices) is used. FDI is the ratio of the net FDI flows in the quarter and the quarterly GDP at market prices (at current prices), PORT is the ratio of the net portfolio flows in the quarter and quarterly GDP at market prices (at current prices), DEBTCF is the ratio of the aggregate of net loans, banking capital, rupee debt service in the quarter and the quarterly GDP at market prices (at current prices), and OTHCAP is the ratio of net other capital in the quarter and quarterly GDP at market prices (at current prices).

GFCE

Government spending is an important fundamental determinant of RER, as it adds to the aggregate demand and impacts the price levels in the economy. In order to measure the size of public spending relative to the size of the economy, government final consumption expenditure (GFCE) in the quarter as a proportion of the quarterly GDP at market prices (at current prices) is used in the analysis. As a sizeable portion of the government expenditure in India is devoted to imports of essential commodities, the association of GFCE with REER is expected to be ambiguous.

CAB

Current account balance has been included in the analysis as a sizeable portion of capital flows in India is used to finance the current account deficit. Capital flows to the extent of utilization for meeting the financing needs of the country are not expected to cause adverse macroeconomic consequences. It is the surplus capital flows over and above the financing requirements that have an adverse impact on the economy. CAB is in the current account balance in the quarter as a proportion of the quarterly GDP at market prices (at current prices). A more negative CAB is expected to be associated with deprecation of the RER.

CFER

The Reserve Bank of India (RBI) maintains foreign exchange reserves in the form of SDRs, gold, foreign currency assets, and reserve tranche position. CFER, which is ratio of change in foreign exchange reserves in the quarter as a proportion of the quarterly GDP at market prices (at current prices), is used as a proxy for capturing the effect on RER of the change in rupee value of the components of foreign exchange reserves, that is, SDRs, gold, foreign currency assets, and reserve tranche position held by the RBI, which is different from the increase/decrease in foreign reserves due to the overall balance of payments. An increase in foreign exchange reserves, to the extent it is accompanied by prevention of an increase in money supply (e.g., due to sterilization) is expected to lead to depreciation of the RER for the Indian economy. On the other hand, an increase in foreign exchange reserves accompanied by an increase in the money supply is expected to lead to appreciation of the RER in the economy.

With this choice of variables, the functional relationship between the RER and the explanatory variables is represented as follows:

$$REER_t = f\{FDI_t, PORT_t, DEBTCF_t, OTHCAP_t, GFCE_t, CAB_t, CFER_t\}, \quad (3)$$

where t refers to time.

To estimate the relationship between the response variable (REER) and the components of the net capital flows (FDI, PORT, DEBTCF, and OTHCAP) and other explanatory variables, the following log-linear specifications are used:

$$\begin{aligned} LNREER_t &= C + \beta_1 FDI_t + \beta_2 PORT_t + \beta_3 DEBTCF_t \\ &\quad + \beta_4 OTHCAP_t + \beta_5 GFCE_t + \beta_6 CAB_t + \beta_7 CFER_t + \epsilon_t, \end{aligned} \quad (4)$$

where ϵ_t is stochastic white noise at time t and $LNREER$ is the natural log of REER.

3.2 Empirical Methodology

3.2.1 Time Series Analysis of Variables

Before estimating the model, the response and explanatory variables are separately subjected to unit roots tests using the augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979) and Philips-Perron (PP) test (Philips and Perron, 1988) for testing the stationarity and order of integration. Usually, all variables are tested with an intercept, with and without a linear trend.

3.2.2 Cointegration Analysis

In the econometric literature, different methodological approaches have been used to empirically analyze the long-run relationships and dynamic interactions between two or more time-series variables. The most widely used methods for estimating the cointegrating vector between a set of time series variables include the Engle and Granger (1987) two-step procedure and the maximum-likelihood approach (Johansen and Juselius, 1990). Both these methods require that all the variables under study are integrated of order one, I(1). This, in turn, requires that the variables are subjected to pretesting to ascertain their orders of integration before including them in particular cointegrating regressions. This introduces a certain degree of uncertainty into the analysis. Apart from this, some of these test procedures have very low power and do not have good small sample properties. One of the relatively recent developments on univariate cointegration analysis is the ARDL approach to cointegration introduced by Pesaran and Shin (1999) and further extended by Pesaran et al. (2001). The main advantage of the ARDL method over the Johansen and Juselius (1990) approach is that it allows for a mix of I(1) and I(0) variables in the same cointegration equation. Another advantage is that the ARDL test is more efficient, and the estimates derived from it are relatively more robust in small sample sizes as compared to the traditional Johansen-Juselius cointegration approach, which typically requires a large sample size for the results to be valid. In addition, the choice of the ARDL bounds-testing procedure allows for both response and explanatory variables to be introduced in the model with lags. This is a highly plausible feature because, conceptually, a change in the economic variables may not necessarily lead to an immediate change in another variable. In some cases, they may respond to the economic developments with a lag, and there is usually no reason to assume that all regressors should have the same lags. Because the ARDL approach draws on the unrestricted error correction model, it is likely to have better statistical properties than the traditional cointegration techniques. The ARDL approach is particularly applicable in the presence of the disequilibrium nature of the time series data stemming from the presence of possible structural breaks as happens with most economic variables.

In view of these considerations, the ARDL approach to cointegration, as suggested by Pesaran et al. (2001) is employed in this research in order to analyze the long-run relationship between REER and FDI, PORT, DEBTCF, and OTHCAP, as well as other explanatory variables. An ARDL ($p, q_1, q_2, \ldots, q_k$) model has the following form (Pesaran and Pesaran, 2009):

$$\varphi(L, p)y_t = \sum_{i=1}^{k} \beta_i(L, q_i)x_{it} + \gamma' z_t + \varepsilon_t ,$$

where

$$\begin{aligned} \varphi(L, p) &= 1 - \varphi_1 L - \varphi_2 L^2 - \ldots - \varphi_p L^p , \\ \beta_i(L, q_i) &= \beta_{i0} + \beta_{i1} L + \ldots + \beta_{iqi} L^{qi} , \end{aligned} \qquad (5)$$

for $i = 1, 2, \ldots, k$, where y_t is the response variable, x_{it} ($i = 1, 2, \ldots, k$) are explanatory variables, L is a lag operator such that $Ly_t = y_{t-1}$, and z_t is an $s \times 1$ vector of deterministic variables, including the intercept term, time trends or seasonal dummies, or exogenous variables with fixed lags.

The ARDL procedure involves two stages. In the first stage, the existence of the long-run relationship between the variables under investigation is tested by computing the *F* statistics for testing significance of the lagged levels of the variables in the error-correction form of the ARDL model. Once the existence of a long-run relationship is established, in the second stage the long-run coefficients and the error-correction model are estimated. Equation 5 is estimated by the ordinary least squares method for all possible values of $p = 0,1,2,\ldots,m$ (where m is the maximum lag order) and $q_i = 0,1,2,\ldots,m$ ($i = 1,2,\ldots,k$) for a total of $(m+1)^{k+1}$ different ARDL models. All models are estimated for the same sample period, namely $t = m+1, m+2,\ldots,n$. Thereafter, one of the $(m+1)^{k+1}$ estimated models is selected using one of the following four model selection criteria: the R^2 criterion, the Akaike information criterion (AIC), The Schwarz Bayesian criterion (SBC), or the Hannan and Quinn criterion. Thereafter, the long-run coefficients and their asymptotic standard errors for the selected ARDL model are computed.

4. Data Sources

The dataset comprises the quarterly data for the Indian economy for the period 1996–1997Q1 to 2012–2013Q4. The REER index used in the study is the monthly trade-weighted 36 currency REER indices obtained from the *Handbook of Statistics* published by the RBI (2014). The quarterly REER indices were obtained by averaging the monthly indices for the quarter.

In this study, FDI, PORT, DEBTCF (which in turn comprises Loans, Net Banking Capital, and Net Rupee Debt Service), OTHCAP, GFCE, and CAB, are measured as ratios of their quarterly values to quarterly estimates of GDP at market prices (at current prices; base year 2004–2005). The CFER is measured as a ratio of the change in foreign exchange reserves (in rupees) from the end of the previous quarter to the end of the present quarter to the quarterly estimates of GDP at market prices (at current prices; base year 2004–2005). The data for net capital flow components, current account balance, and foreign exchange reserves were obtained from the *Handbook of Statistics* (RBI, 2014). The data for quarterly GDP at market prices (at current prices) and GFCE base year 2004–2005 were obtained from the National Account Statistics of the Central Statistical Office, Ministry of Statistics and Programme Implementation.

5. Estimation Results

5.1 Stationary Properties of the Variables

For the quarterly data on variables for the period 1996–1997Q1 to 2012–2013Q4, the results of the ADF test and PP test are presented in Table 1.

Table 1. Results of Unit Root Tests

			ADF test		PP test	
Series	**Order**	**Exogenous**	***t* statistic**	**(*p* value)**	***t* statistic**	**(*p* value)**
LNREER	Level	Constant	–4.761667	(0.0002)	–3.103267	(0.0310)
		Constant and linear trend	–4.745895	(0.0015)	–3.046587	(0.1277)
FDI	Level	Constant	–5.014212	(0.0001)	–4.961302	(0.0001)
		Constant and linear trend	–5.387830	(0.0002)	–5.300916	(0.0002)
PORT	Level	Constant	–5.405416	(0.0000)	–5.439670	(0.0000)
		Constant and linear trend	–5.731200	(0.0001)	–5.676181	(0.0001)
DEBTCF	Level	Constant	–6.770273	(0.0000)	–6.868259	(0.0000)
		Constant and linear trend	–7.231928	(0.0000)	–7.256328	(0.0000)
OTHCAP	Level	Constant	–7.988167	(0.0000)	–7.986862	(0.0000)
		Constant and linear trend	–8.668519	(0.0000)	–8.896950	(0.0000)
GFCE	Level	Constant	–1.680792	(0.4360)	–10.62818	(0.0000)
		Constant and linear trend	–1.880807	(0.6529)	–10.65427	(0.0000)
	First difference	Constant	–21.29816	(0.0001)	–37.03903	(0.0001)
		Constant and linear trend	–21.10828	(0.0001)	–36.90740	(0.0001)
CAB	Level	Constant	–0.593625	(0.8642)	–3.620344	(0.0078)
		Constant and linear trend	–1.618830	(0.7746)	–4.751141	(0.0014)
	First difference	Constant	–9.726036	(0.0000)	–17.17713	(0.0000)
		Constant and linear trend	–9.823498	(0.0000)	–19.38159	(0.0001)
CFER	Level	Constant	–6.988502	(0.0000)	–7.109852	(0.0000)
		Constant and linear trend	–6.927756	(0.0000)	–7.054127	(0.0000)

Notes: ADF is the augmented Dickey-Fuller test; PP is the Philips-Perron test; LNREER is the natural log of the real effective exchange rate; GFCE is government final consumption expenditure; CAB is current account balance; CFER is the change in foreign exchange reserves; FDI is net foreign direct investment; PORT is net portfolio flows; DEBTCF is net debt creating flows; OTHCAP is net other capital flows. Source: Author's calculations by EViews 5.

The results of the unit root tests show that the null hypothesis of unit root is rejected for the variables LNREER, FDI, PORT, DEBTCF, OTHCAP, and CFER 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 fails to reject the null hypothesis for unit root, but the PP test statistic indicates that the null hypothesis of unit root is rejected at the 1% significance level. 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.

5.2 Results of Cointegration Analysis

In the first stage, the existence of a 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 variables in the model is set at two ($m = 2$), and the estimation is carried out for the period 1996Q1–2012Q4. The computed *F* statistic for testing the joint null hypothesis that there exists no long-run relationship between the variables is $F = 3.7906$ (0.002). The relevant critical value bounds for this test as computed by Pesaran et al. (1996) at the 95% confidence level are 2.272 and 3.447. Because the *F* statistic 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 and one or more of GFCE, FDI, PORT, OTHCAP, DEBTCF, CAB, and CFER.

Next, the ARDL model is estimated using the univariate ARDL cointegration test option of Microfit 4.0 with the maximum lag $m = 2$. Microfit estimated $(2 + 1)^{7+1}$ = 6,561 models and presented the choice of the selection of the model with optimum number of lags of variables between different selection criteria. The ARDL model specifications selected based on the SBC and the 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 2 and 3, respectively.

In the second stage, the estimates of the long-run coefficients of the model were computed. Tables 4 and 5 present the estimated long-run coefficients for the ARDL(2,0,0,0,0,0,0,0) and ARDL(1,1,1,1,2,1,2,1) specifications selected using the SBC and AIC criterion, respectively.

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 LNREER and the components of net capital flows and other explanatory variables can be written as follows:

$$\begin{aligned} LNREER_t = {} & 4.7145 - 0.0098815 \times GFCE_t + 0.70920 \times FDI_t \\ & + 3.5873 \times PORT_t + 5.9138 \times DEBTCF_t \\ & + 0.17547 \times OTHCAP_t + 4.1563 \times CAB_t - 3.1848 \times CFER_t . \end{aligned} \quad (6)$$

Table 2. Autoregressive Distributed Lag Estimates of the ARDL(2,0,0,0,0,0,0,0) Selected Based on Schwarz Bayesian Criterion

Regressor	Coefficient	*SE*	*t* ratio	*p* value
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^2	0.81545	$\bar{R}^2$	0.78580	
SE of regression	0.019106	*F* statistic *f*(13,52)	27.4943	(0.000)
M of response variable	4.5956	*SD* of response variable	0.041281	
Residual sum of squares	0.020442	Equation log-likelihood	172.9844	
AIC	162.9844	SBC	152.0361	
DW statistic	2.3234	Durbin's *h* statistic		

Notes: Response variable is LNREER. *SE* is standard error; LNREER is the natural log of the real effective exchange rate; GFCE is government final consumption expenditure; CAB is current account balance; CFER is the change in foreign exchange reserves; FDI is net foreign direct investment; PORT is net portfolio flows; DEBTCF is net debt creating flows; OTHCAP is net other capital flows; C is constant term; *M* is mean; AIC is Akaike information criterion; *DW* is Durbin-Watson; *SD* is standard deviation; SBC is Schwarz Bayesian criterion. Source: Author's calculations by Microfit 4.0.

Table 3. Autoregressive Distributed Lag Estimates of the ARDL(1,1,1,1,2,1,2,1) Selected Based on Akaike Information Criterion

Regressor	**Coefficient**	***SE***	***t* ratio**	***p* value**
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^2	0.86154	$\bar{R}^2$	0.81251	
SE of regression	0.017875	*F* statistic *f*(13,52)	17.5694	(0.000)
M of response variable	4.5956	*SD* of response variable	0.041281	
Residual sum of squares	0.015337	Equation log-likelihood	182.4666	
AIC	164.4666	SBC	144.7597	
DW statistic	2.0009	Durbin’s *h* statistic	−0.0047451	(0.996)

Notes: Response variable is LNREER. *SE* is standard error; LNREER is the natural log of the real effective exchange rate; GFCE is government final consumption expenditure; CAB is current account balance; CFER is the change in foreign exchange reserves; FDI is net foreign direct investment; PORT is net portfolio flows; DEBTCF is net debt creating flows; OTHCAP is net other capital flows; C is constant term; *M* is mean; AIC is Akaike information criterion; *DW* is Durbin-Watson; *SD* is standard deviation; SBC is Schwarz Bayesian criterion. Source: Author’s calculations by Microfit 4.0.

Table 4. Estimated Long-Run Coefficients Using the ARDL(2,0,0,0,0,0,0,0) Model Selected Based on Schwarz Bayesian Criterion

Regressor	**Coefficient**	***SE***	***t* ratio**	***p* value**
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)

Notes: Response variable is LNREER. *SE* is standard error; LNREER is the natural log of the real effective exchange rate; GFCE is government final consumption expenditure; CAB is current account balance; CFER is the change in foreign exchange reserves; FDI is net foreign direct investment; PORT is net portfolio flows; DEBTCF is net debt creating flows; OTHCAP is net other capital flows; C is constant term. Source: Author’s calculations by Microfit 4.0.

Table 5. Estimated Long-Run Coefficients Using the ARDL(1,1,1,1,2,1,2,1) Model Selected Based on Akaike Information Criterion

Regressor	Coefficient	*SE*	*t* ratio	*p* value
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)

Notes: Response variable is LNREER. *SE* is standard error; LNREER is the natural log of the real effective exchange rate; GFCE is government final consumption expenditure; CAB is current account balance; CFER is the change in foreign exchange reserves; FDI is net foreign direct investment; PORT is net portfolio flows; DEBTCF is net debt creating flows; OTHCAP is net other capital flows; C is constant term. Source: Author's calculations by Microfit 4.0.

6. Interpretation of Results and Concluding Remarks

The ARDL estimates for the long-run coefficients indicate that the relationship between LNREER and FDI is not statistically significant, suggesting that there is no significant evidence of association between net FDI flows to India and RER appreciation. However, the long-run coefficients on PORT and DEBTCF are positive and significant at the 10% level. This indicates that the portfolio flows and debt creating flows to India have been associated with RER appreciation, indicating loss of competitiveness and overheating of the economy. Similarly, the CAB has a positive and statistically significant association with LNREER, indicating that the outflows due to current account deficits have been associated with depreciation of RER or limiting the appreciation due to capital flows. The coefficient on CFER in the results is statistically significant at the 10% level of significance and negative, which indicates that to some extent the accumulation of reserves by RBI in the face of increasing net capital flows has prevented the appreciation of RER. Government consumption expenditure is not found to be significantly associated with RER appreciation.

The evidence that FDI flows are not associated with RER appreciation and overheating of the Indian economy suggests that that there is a strong case for further liberalization of these flows by removing procedural bottlenecks and improving facilitation for investment. FDI flows are accompanied with transfer of technology and management practices, and cause an increase in domestic capital formation leading to a boost in production. On the other hand, the evidence that portfolio flows and debt creating flows are associated with real appreciation and overheating of the Indian economy suggests that there is a strong case for greater caution in liberalization of these flows.

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