Management of Capital Flows in India: 1990-2011

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Abstract

Increased integration with global financial markets has amplified the complexity of macroeconomic management in India. The diverse objectives of a robust growth rate, healthy current account deficit, competitive exchange rate, adequate external capital to finance investment, moderate inflation, targeted monetary and credit growth rate, minimizing financial fragilities and maintaining adequate reserves need to be balanced in an era of volatile capital flows. In this paper we analyze India's experience in negotiating the trade-offs between these varied objectives. We find that to minimize risks associated with financial fragilities India has adopted a calibrated and gradual approach towards opening of the capital account, prioritizing the liberalization of certain flows. Using empirical methods we find that instead of adopting corner solutions, India has embraced an intermediate approach in managing the conflicting objectives of the well known Impossible Trinity – monetary autonomy, exchange rate stability and an open capital account. Our results indicate that the intermediate approach has been associated with an asymmetric intervention in the foreign exchange market, with the objective of resisting pressures of appreciation, and resulted in large accumulation of reserves. We also show that sterilization of this intervention has been incomplete at times leading to rapid increase in monetary aggregates and fuelling inflation. Finally, we conclude that while the greater flexibility in exchange rate since 2007, has allowed pursuit of a more independent monetary policy and the exchange rate to act as a shock absorber, the hands-off approach has resulted in reserves remaining virtually stagnant since 2007, leading to a significant deterioration in the reserve adequacy measures.

JEL Classification: E4, E5, F3, F4
Key Words: Capital controls, Macroeconomic trilemma, Financial integration, Foreign exchange intervention, Sterilization, Exchange market pressure, Reserve adequacy.

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1. Introduction

Net capital flows to emerging markets have exhibited a sharp increase in volatility in recent years driven by widely shifting risk perceptions, uncertainty about advanced countries' recovery prospects and quantitative easing in advanced economies. Net private capital flows to emerging markets rebounded strongly in late 2009 after experiencing a massive drop during the Global Financial Crisis (GFC). The trend slowed down in the second half of 2010, then surged again during the first half of 2011. However, the worsening debt crisis in Europe and a downgrade of US sovereign rating in the second half of 2011 caused investor sentiment to deteriorate and net capital flows to plunge across most emerging economies.

India, like other emerging markets, too has been subject to these capricious capital flows, making the macroeconomic management more complex. In particular, greater integration with the global financial markets has enhanced the intricacies involved in balancing diverse objectives of healthy growth rate, sustainable current account deficit, competitive exchange rate, adequate external capital to finance investment, moderate inflation, targeted monetary and credit growth rate, minimizing financial fragilities and maintaining adequate reserves.

Learning from the Latin American debt crisis of the 1980s and the Asian Crisis of the 1990s, India adopted a calibrated approach towards management of capital flows. In particular, it prioritized the liberalization of non-debt creating flows including FDI and portfolio flows. While FDI was favored due to perceived benefits accruing from technological and skill spillovers, portfolio investment was thought to increase depth and innovations in the financial markets. Moreover, these flows, by their very nature, involved risk sharing between foreign investors and their host countries and tended to be more stable than debt flows. We find that the hierarchical nature of the liberalization in India has helped to considerably alter the composition of external liabilities towards FDI and portfolio investments.

We also find that the calibrated approach has meant that liberalization of the capital account has taken place in fits and starts. Consequently, though over time, the net effect has been greater integration with the global capital market, yet India continues to be much less open than other major emerging countries such as Brazil, Republic of Korea and Russia and almost as closed as People's Republic of China (PRC) as far as financial integration is concerned. India continues to retain a complex and extensive system of administrative controls on certain types of capital flows. India has continued to tweak these controls to cool overheated asset prices such as stock and real estate prices as well as stem rapid appreciation of the real exchange rate. Our preliminary analysis indicates that the introduction of these controls were not always associated with a reversal or even a slowdown in the rate of exchange rate appreciation or the stock prices.

Another vital objective of active capital account management is to manage the tradeoffs under the well-known macroeconomic trilemma -- maintaining a stable exchange rate, keeping an open capital account open and retaining monetary autonomy. To analyze how India has negotiated the trilemma, we quantify the various policy objectives under the trilemma. We find that instead of adopting corner solutions, India has opted for the middle ground or an intermediate regime juggling the three policy objectives as per the demands of the macroeconomic situation. We find that in recent years there has been a discernible shift towards greater monetary policy autonomy to tackle growing domestic inflationary pressure. This has been balanced with greater flexibility

of the exchange rate, which has acted as a shock absorber in a period of volatile capital flows. Our results are consistent with recent evidence on India's trilemma management.[1]

In the context of the financial trilemma, it may be reasonable to conjecture that the RBI imposed capital controls to manage exchange rate stability and not exclusively to moderate certain types of capital inflows. To this end, we calculate the exchange market pressure (EMP) index in India, track its evolution over the last couple of decades and also analyze the impact of trade and capital inflows on the EMP indices. We find that a deteriorating trade balance and decline in portfolio equity inflows are associated with a higher EMP while positive changes in stock market returns lower the EMP.

A possible way for authorities to manage the trade-offs under the trilemma is by accumulating or decumulating reserves. We find that RBI has intervened heavily in the foreign exchange market in the face of growing capital flows. Moreover, using empirical methods, we find that much of this intervention has been asymmetric, with the RBI mostly intervening in the foreign exchange market to prevent an appreciation of the currency but adopted a hands-off approach during periods of depreciation. This trend however seems to have dampened in recent times with the RBI allowing the exchange rate to move in either direction.

Asymmetric intervention, unless sterilized, often leads to a sharp increase in reserve money and fuels inflationary pressure. We evaluate the magnitude of sterilization, using empirical tools. We find that between 1998 and 2004, most of the concomitant rise in international reserves was offset by corresponding declines in the net domestic assets through sterilization efforts by the RBI. Thus, the RBI indeed succeeded in insulating the money supply from the effects of its intervention in the foreign exchange market. However owing to rising fiscal costs of sterilization, less than 30% of the rise in international reserves was offset by a corresponding fall in net domestic assets after 2004, implying only a partial sterilization. This resulted in monetary autonomy being partially sacrificed.

Finally, we evaluate the impact of the volatile capital flows on India's external vulnerability. Historically reserve accretion has been a result of net capital inflows being greater than the current account deficit, and RBI intervening in an asymmetric manner. The build-up of reserves meant that India was comfortably placed on the various traditional reserve adequacy indicators, viz: import cover, ratio of reserves to short-term debt and ratio of reserves to monetary aggregates, at the time of the sub-prime crisis in 2007-08. However, since then India's reserve cover has declined sharply following a surge in capital outflows and widening current account deficit. In fact we find that between 2007 and 2011, India witnessed one of the highest erosions of reserve cover across a spectrum of emerging economies.

The rest of the paper is structured as follows. In Section 2, we outline India's approach towards capital account liberalization and its impact on composition of liabilities as well as efficacy of some of the recent measures in stemming exchange rate appreciation and rise in asset prices. Section 3 analyses how India has negotiated the macroeconomic trilemma, outlining the changes in preference accorded to the various policy objectives. It also evaluates the extent to which the

[1] See Hutchison, Sengupta and Singh (2011); Aizenman and Sengupta (2012); Sen Gupta and Manjhi (2012) among others.

trilemma is binding in India. In Section 4, we calculate the Exchange Market Pressure Index to test the conjecture that capital account management in India focused on ensuring exchange rate stability and not exclusively on moderating certain types of capital inflows. We also investigate the principal determinants of EMPI in India. Section 5 analyses the nature of RBI's intervention in the foreign exchange market, and the extent to which RBI has been able to sterilize the impact of these interventions. Finally, in Section 6 we evaluate the impact of rising current account deficit, volatile capital flows on India's external vulnerability.

2. Capital Account Liberalization in India

Capital account liberalization in India has taken place in a gradual manner, and has been viewed as a continuous process rather than a one off event. Throughout most of the post Independence period until the early 1980s, India had a relatively closed capital account. Most of the external financing was primarily confined to external assistance through multilateral and bilateral sources on concessional terms to or through the government. This approach was associated with an import substitution strategy due to export pessimism, and relied on a host of tariffs and quotas to limit the need for foreign exchange.

It was only in the 1980s that the scenario started changing as a widening current account deficit due to higher oil prices, rise in demand for imports as a result of selective liberalization and a sharp depreciation of the rupee in the second half of the 1980s increased the demand for external finance. Consequently, the traditional sources of financing had to be supplemented with additional foreign capital and India resorted to short-term borrowings, external commercial borrowings (ECBs) and deposits by non-resident Indians (NRI).

The subsequent phase of liberalization was under the overall reform process that was initiated after the balance of payments crisis in 1991. On the external front, the reforms included dismantling of trade restrictions, move towards current account convertibility, a market oriented exchange rate regime and a gradual opening up of the capital account. However, with the Latin American debt crisis of the early 1980s and the Asian financial crisis of 1997 fresh in mind, India prioritized certain kinds of flows and agents in the liberalization process (Reddy, 2008 and Mohan and Kapur, 2009). In particular, during the liberalization process, India favoured non debt flows such as FDI and portfolio investment flows over debt flows. Currently, barring a few sectors, FDI is universally allowed. Some of the sensitive sectors such as banking and insurance are subject to caps.

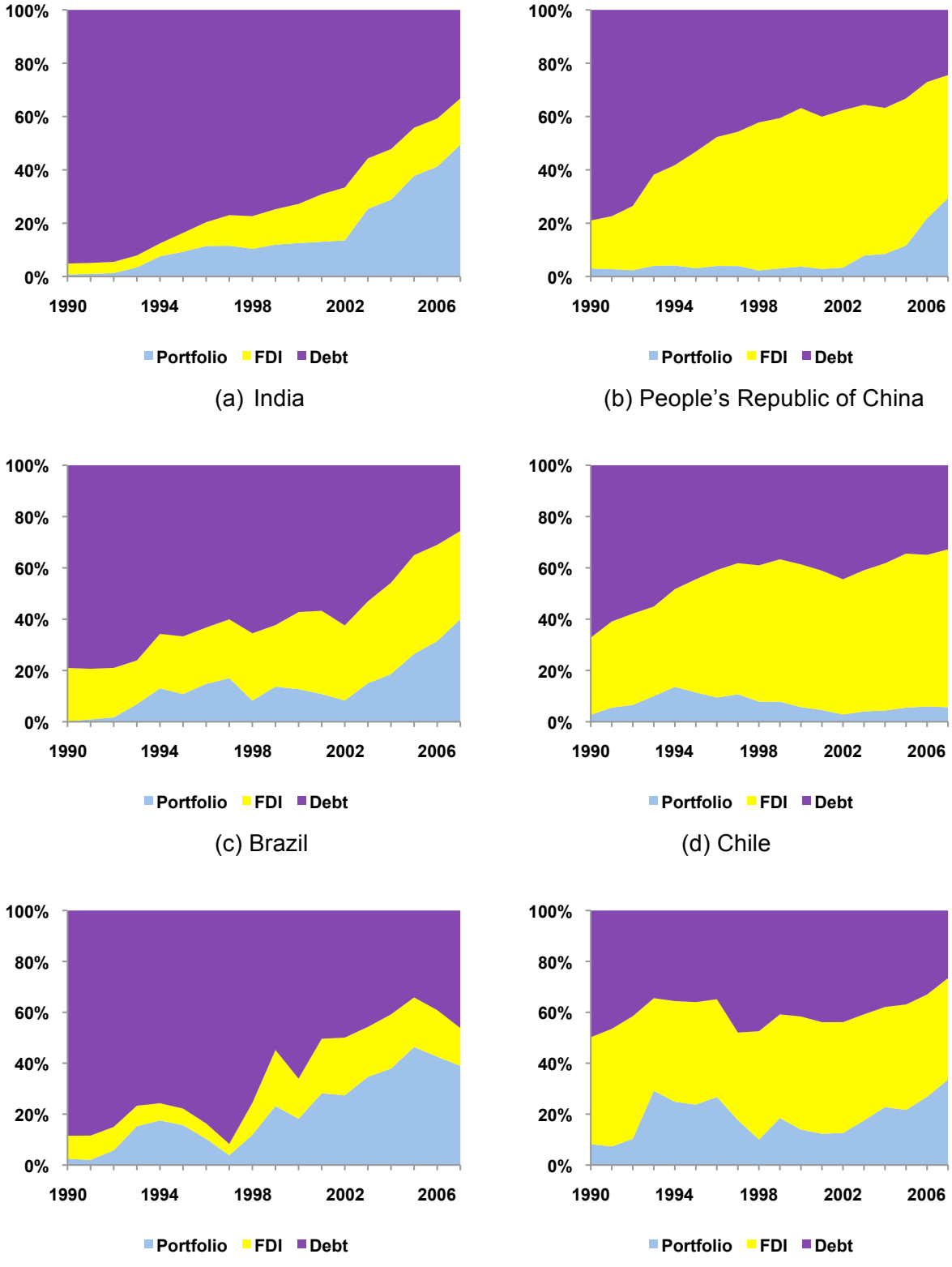
Portfolio flows have also witnessed significant liberalization, though there still exist separate investment caps on sub accounts of foreign institutional investors (FIIs), individual FII and aggregate FII investment in a company. In contrast, debt flows are subject to numerous restrictions including borrowers and lenders having to satisfy eligibility conditions, minimum maturity period, cap on all-in-cost payments made by corporate and end-use restrictions. Table 1 highlights some of the existing measures influencing the inflow and outflow of foreign capital in India.

Table 1: Regulatory Framework for Capital Account Management

	Inflows	Outflows
Foreign Direct Investment	FDI is allowed under the automatic route and government approval route. In several sectors, investment up to 100% is allowed, while a few other sectors have sector-specific caps and guidelines. There are about 10 sectors in which FDI is prohibited.	Indian companies and registered partnerships may invest up to 400% of their net worth without approval. The ceiling is not applicable where the investment is made out of balances held in Exchange Earners' Foreign Currency account or out of funds raised through ADRs/GDRs. Lower limits and extra conditions apply to unregistered partnership and proprietorship firms
Portfolio Equity Investment	Registered FIIs such as pension funds, mutual funds, investment trusts etc. and QFIs are allowed to invest in equity. The ceiling for overall investment for FIIs and QFIs are 24% and 10% of the paid up capital of the company. The ceiling for FII investment can be raised up to the sectoral cap, subject to the approval of the board and the general body passing a special resolution to that effect. The limit is 20% of the paid up capital in the case of public sector banks. NRIs and Persons of Indian Origin (PIOs) can invest in equity up to 10% of the paid up capital of the Indian company, which can be raised to 24% subject to the approval of the general body. Holders of Overseas Citizenship of India certificates have the same rights to invest in India as NRIs (except to invest in agricultural land). QFIs can invest in those mutual fund (MF) schemes that hold at least 25% of their assets in infrastructure sector under the $3 billion sub-limit for investment in MFs related to infrastructure.	The overall limit on residents' investments in companies listed abroad is $200,000 a year. Resident corporations may invest up to 50% of their net worth in shares of listed companies abroad. Indian Mutual Funds are permitted to invest within an overall cap of $ 7 billion.
Portfolio Bond Investments	Registered FIIs may invest in debt securities issued by Indian corporates with an overall limit of $20 billion, with an additional limit of $25 billion in infrastructure bonds and a $20 billion limit on government securities. The investor base for G-Secs has been widened to include SWFs, multilateral agencies, insurance and pension funds. Infrastructure bonds have mandatory holding period. Different limits apply to NRIs.	Only resident individuals may invest in debt securities abroad subject to a yearly limit of $200,000.
Investments in money market	Only NRIs may invest in money market mutual funds.	Residents may purchase these instruments abroad without RBI approval.
Derivatives	These transactions are generally subject to limits and approval. Hedging of nonresidents' investments in India is allowed.	Commercial banks may purchase such instruments for their asset and liability management. Resident companies may use derivatives to hedge commodity price and foreign exchange debt exposures.
Loans	ECBs are allowed through automatic and approval route. ECBs through automatic route are subject to a cap of $20 million for a minimum three-year average maturity and $750 million for a minimum five-year average maturity. ECBs through approval route can be higher than $750 million. External loans are subject to an all-in-cost ceiling and end-use restrictions.	Lending abroad is generally subject to approval, except for certain trade credits and lending to foreign subsidiaries.

Source: IMF (2012) and various RBI and SEBI notifications.

Figure 1: Composition of Liabilities



(a) India

(b) People's Republic of China

(c) Brazil

(d) Chile

(e) Korea, Republic of

(f) Malaysia

Source: Lane and Milessi-Ferreti (2007)

The hierarchy in the liberalization of capital flows has resulted in modifying India's composition of external liabilities in the 'desired' manner.[2] From comprising 95% of India's total external liabilities in 1990, the share of debt liabilities have dropped to 33.2% in 2007. Over the same period the share of portfolio liabilities have increased from less than 1% to nearly 50%, while that of FDI has increased from 4% to 17.2%. As is evident from Figure 1, the change in composition of liabilities in India towards non-debt creating flows has been in line with international experience. However, India along with some of the other emerging markets like Brazil and Korea witnessed a greater preponderance of portfolio flows, while in other countries like PRC and Chile, FDI played a greater role.

Another key objective of management of capital flows is to stem rapid appreciation of the real exchange rate. Rajan and Subramanian (2005), Johnson et al. (2007) and Prasad et al. (2007) show that excessive capital inflows could result in rapid exchange rate appreciation, which can hurt exports of emerging markets. Even a short-term appreciation can have lingering implications in the form of permanent loss of export market share and reductions in manufacturing capacity. To get a preliminary idea about the efficacy of some of the measures aimed at managing capital inflow, we look at the rates of the appreciation immediately before and after the introduction of these measures. Data on the bilateral Rupee-Dollar exchange rate is sourced from the Reserve Bank of India. To be deemed effective these measures must reverse or at least slowdown the rate of appreciation observed prior to their introduction.

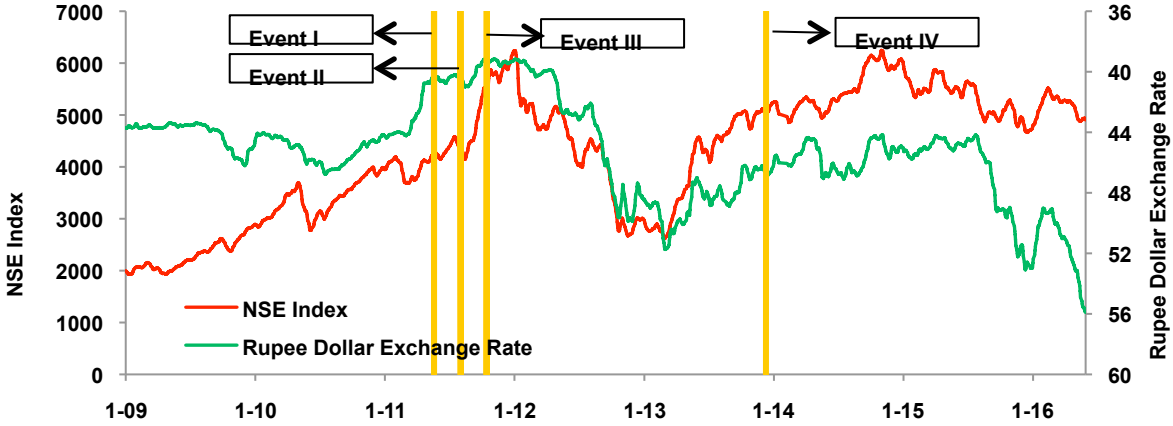
Another objective of managing capital flows is to cool overheated asset prices such as stock and real estate. Prasad and Rajan (2008) contend that in an underdeveloped financial system, foreign capital is likely to be channeled towards easily collateralized, non-tradable investments like real estate, leading to asset price booms, with subsequent busts severely disrupting the economy. Foreign portfolio investment into shallow equity markets also cause sharp valuation swings. Again, for the capital control measures to be effective, the asset prices should exhibit a decline or at least increase at a lower rate than before. With reliable data on real estate prices at the required frequency being unavailable we focus only on the stock market prices. Data on daily stock index is taken from the National Stock Exchange. Figure 2 and Table 2 highlight the impact of some of the measures, enacted during 2007 and late 2009 to manage the inflow of foreign capital, on stock prices and the exchange rate. We focus on the average daily change in the exchange rate and stock prices over a 30 day period before and after the introduction of the measures.

Figure 2 and Table 2 indicate that the evidence of the efficacy of capital controls on restricting exchange rate appreciation is mixed at best. While the reduction of all-in cost ceilings in May 2007 and the restrictions on Participatory Notes in October 2007 led to a reversal of Rupee appreciation, the restrictions on conversion of ECBs into Rupees in August 2007 and the reimposition of the all-in-cost ceilings in December 2009 failed to reverse or slowdown the pace of appreciation significantly. In fact there was a slight increase in the pace of appreciation after the reimposition of all-in-cost ceilings. Even in the case of stock price movement, the impact of capital controls is found to be ambivalent. The stock prices also continued to increase after the introduction of the various capital controls in 2007, although there was a moderation of the pace

[2] Studies such as Kose et al. (2007) find that stocks of FDI and portfolio liabilities are associated with better risk sharing outcomes while stocks of external debt liabilities are not. Moreover, the non-debt flows tend to be more stable than debt flows.

of increase after the reduction in ECB ceiling in May 2007 and restrictions on Participatory Notes (PNs) in October 2007. The latter restriction had a particularly strong impact as the PNs were an important source of FII investment in equities. In contrast, the restriction on conversion of ECBs into Rupees introduced in August 2007 was associated with threefold acceleration in stock prices. Finally, the reimposition of the all-in-cost ceilings and discontinuation of the buyback of Foreign Currency Convertible Bonds had a negative impact on the stock prices.

Figure 2: Impact of Capital Controls on the Currency and Stock Prices



Note: Event I refers to the reduction in all-in-cost ceilings for ECBs. Event II refers to measures introduced to restrict conversion of ECBs into Rupees. Event III refers to SEBI's tightening of rules for purchase of shares and bonds in Indian companies through the participatory note (PN) route. Finally, Event IV refers to reimposition of all in cost ceilings for ECBs that were discontinued during the GFC and discontinuation of the buyback of Foreign Currency Convertible Bonds.
Source: Authors' Calculation

Table 2: Impact of Capital Controls on Currency and Stock Prices

		Average Daily Currency Appreciation		Average Daily Stock Price Increase	
	Date of Introduction	Before	After	Before	After
Event I	May 22, 2007	0.198%	-0.003%	0.395%	0.113%
Event II	August 7, 2007	0.029%	0.027%	0.092%	0.271%
Event III	October 17, 2007	0.125%	-0.026%	0.670%	0.181%
Event IV	December 10, 2009	0.023%	0.026%	0.196%	-0.159%

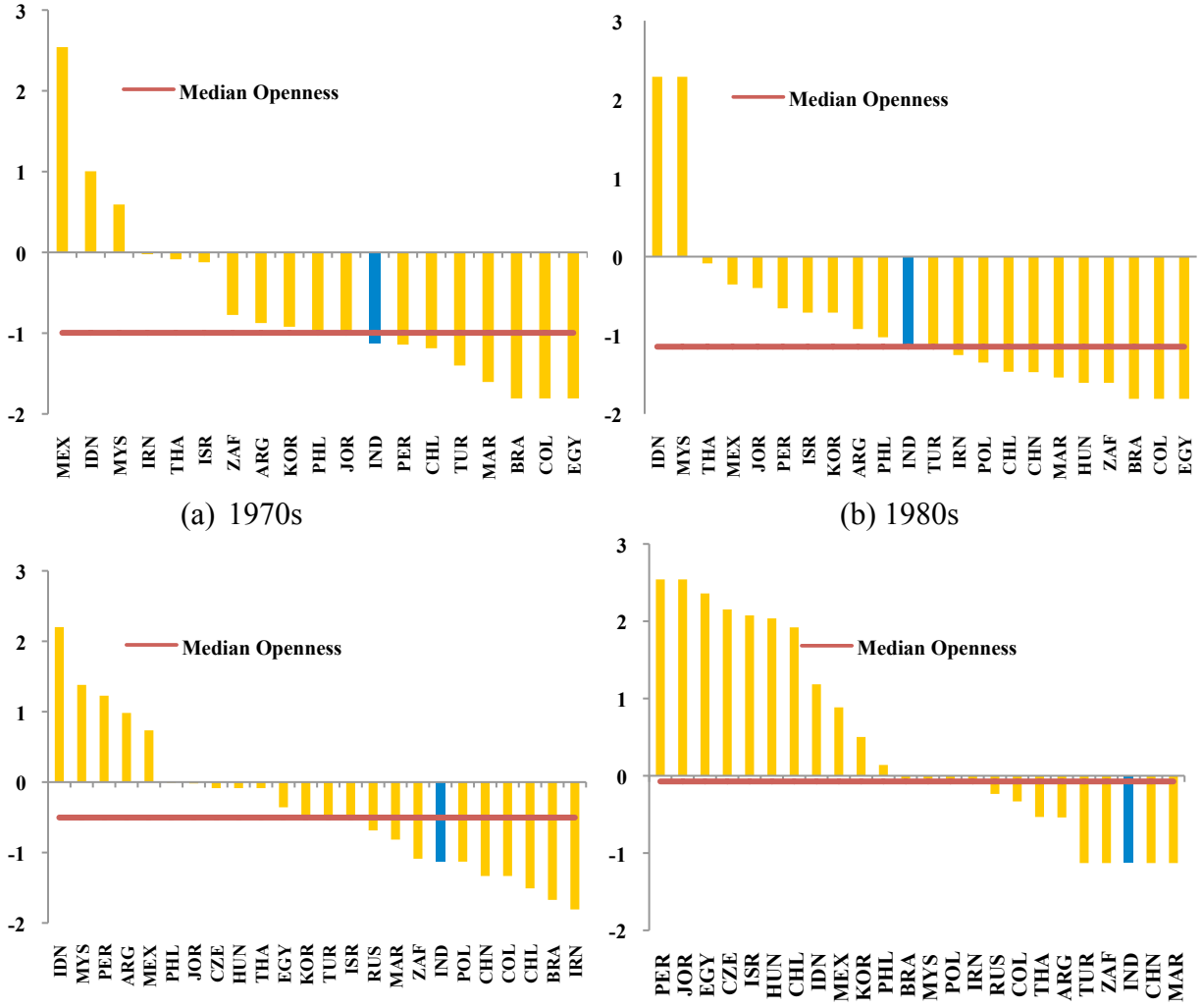
Source: Authors' Calculation

Our simple analysis indicates that the introduction of capital control measures did not always lead to a reversal or even a slowdown in the rate of exchange rate appreciation or the stock prices. However, this is not to conclude that these measures were ineffective due to the absence of counterfactuals. Moreover, to rigorously estimate the efficacy of capital controls, one would have to also look the impact of these measures on the volume and composition of flows (Patnaik and Shah, 2011) and the extent to which they allowed the monetary policymaker to act in an independent manner (Kohli, 2011).

The calibrated approach towards liberalization is reflected in the steady increase in India's extent of financial integration with the rest of the world. Gross capital flows have increased nearly 22 times from $42.7 billion in 1991-92 to over $932.3 billion in 2010-11. As a share of GDP, this

amounted to an increase from 15.5% in 1991-92 to 55.2% in 2010-11. Much of the increase in financial integration occurred between 2003-04 and 2007-08. Given the impressive economic performance indicated by close to 9% growth rate, higher domestic interest rates and a strong currency, India's risk perception was quite low during 2003 to 2007. Furthermore, this period was also associated with favorable global conditions in the form of ample liquidity and low interest rates in the global markets—the so-called period of Great Moderation.

Figure 3: Cross Country Comparison of De Jure Openness



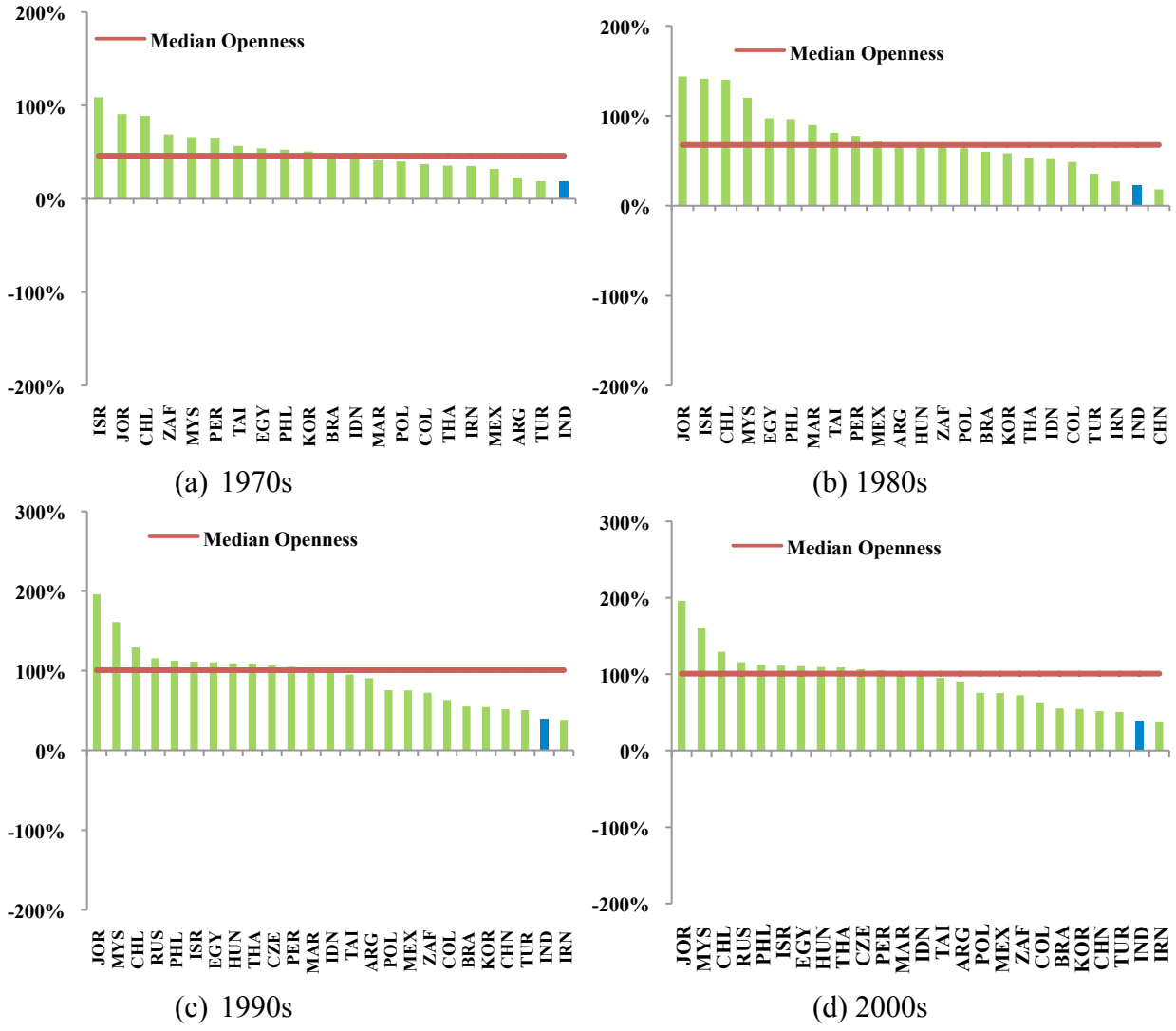
Source: Chinn and Ito (2008)

Despite the sharp increase in extent of financial integration during the last two decades, India has not kept pace with other emerging markets. The extent of capital account liberalization has been primarily determined using two kinds of measures. The first set of measures looks at the de jure openness, and focus on laws governing the movement of capital in and out of the country. Most of such measures are based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions, which provides a binary evaluation on a number of categories of transactions. Several studies including Chinn and Ito (2008) and Edwards (2007) have used these

scores to create an index of capital account openness. Figure 3 looks at the degree of *de jure* capital account openness index developed in Chinn and Ito (2008) across emerging markets. It is evident that over the last 40 years there has been an increase in the extent of capital account openness, reflected in the upward shift of the median line. However, India has not liberalized at the same pace, as a result of which it has shifted from being in the middle of the distribution of countries, ranked according to their openness, during the 1970s and 1980s, towards the more restrictive end of the spectrum in the last two decades.

However, the existence of regulations often does not accurately capture the actual level of financial integration as they depend critically on the effectiveness of the enforcement and macroeconomic fundamentals. A country with strict controls but lax enforcement can experience large private capital flows. Alternately, a country with extremely liberal capital account regime can witness limited flows due to limited opportunities for economic returns.

Figure 4: Cross Country Comparison of De Facto Openness



Source: Lane and Milessi-Ferreti (2007)

The de facto measures focus on an outcome-based measure of financial integration. These measures involve sum of gross flows or gross stocks of foreign assets and liabilities as a ratio of GDP to indicate the extent of risk sharing. Several de facto measures including Lane and Milessi-Ferreti (2007) and Kose et al. (2008) are available. Even according to the de facto measures, India has been at the lower end of the spectrum. According to the Lane and Milessi-Ferreti measure, which is based on the ratio of foreign assets and liabilities to GDP, most of the Latin American as well as East Asian countries have experienced far greater degree of integration, compared to India. Even China, which was lagging behind India in the 1980s, has overtaken India during the last two decades.

3. Negotiating the Trilemma

India's increased integration with the global capital markets during the last two decades has increased the complexity of macroeconomic management in India. In particular, India had to negotiate the well known macroeconomic trilemma. The standard formulation of the trilemma argues that it is impossible to attain monetary policy independence, exchange rate stability and capital market integration simultaneously. Only two of the three objectives can be obtained at a particular point in time. A stable exchange rate regime with an open capital account would imply that the monetary authority can no longer independently vary the domestic interest rate, which will have to follow the foreign interest rate. Alternatively, retaining monetary independence and an open capital account implies that exchange rate movements will be dictated by the volume and direction of capital flows. Finally, the imposition of capital controls breaks the link between the interest rate and the exchange rate and allows a country to retain exchange rate stability with monetary independence.

India, like other emerging markets, seeks to achieve each of the three aforesaid objectives with varying degrees. While capital flows aid growth by providing external capital to sustain an excess of investment over domestic savings, a competitive exchange rate helps to maintain a sustainable current account balance. An independent monetary policy stabilizes the economy in the face of domestic and exogenous shocks. However, given the impossibility of attaining the three goals simultaneously, India had to juggle the conflicting objectives. Moreover, the sharp increase in the volatility of the capital flows during recent years has created a tension between monetary management and exchange rate management. Rajan and Subramanian (2005), Johnson et al. (2007) and Prasad et al. (2007) show that excessive capital inflows could result in rapid real exchange rate appreciation, which can hurt exports of emerging markets. Even a short-term appreciation can have lingering implications in the form of permanent loss of export market share and reductions in manufacturing capacity. Alternatively, if the central bank intervenes to prevent the exchange rate from appreciating, it is likely to lead to an increase in money supply, fueling inflationary pressures.

In this section, we seek to analyze India's management of the conundrum of macroeconomic trilemma, the extent to which India has been bound by the trilemma and if the trilemma has remained underutilized. Following Aizenman et al. (2008, 2010a, b) we quantify the various policy objectives under the trilemma. We use quarterly data and cover the period 1996-97Q1 to

2011-12Q3. Our coverage is dictated by the availability of the data at a quarterly frequency, especially data on GDP.

Monetary Independence (MI)

Following Aizenman et al. (2008, 2010a,b), the extent of monetary independence is measured as the inverse of the quarterly correlation of the interest rates between India and the US. The US is taken as the base country following Aizenman et al. (2008, 2010a, b) and Obstfeld at al. (2010) who argue that Indian monetary policy through this period has been most closely linked to the US. The quarterly calculations are calculated using weekly 3-month Treasury Bill yield for India and the US. The data is taken from Global Financial Database. The index of Monetary Independence is given by

$$MI = \frac{1 - corr\left(i^{Ind}, i^{US}\right)}{1 - (-1)} \tag{1}$$

This index can theoretically take a value between 0 and 1 with a higher value indicating greater degree of monetary independence. However, we find that for India the index ranges between 0.11 and 0.85. Hence we rescale this index to lie between 0 and 1.

Exchange Rate Stability (ERS)

We make use of the methodology introduced by Frankel and Wei (1994) to create an index of exchange rate stability. The degree of influence that major global currencies have on Indian Rupee can be estimated using the following estimation model

$$\Delta \log \varepsilon_{INR,t}^{CHF} = \alpha_0 + \beta_{US} \Delta \log \varepsilon_{USD,t}^{CHF} + \beta_{EUR} \Delta \log \varepsilon_{EUR,t}^{CHF} + \beta_{JAP} \Delta \log \varepsilon_{JPY,t}^{CHF} + \mu \tag{2}$$

where $\varepsilon_{i,t}^{CHF}$ is the exchange rate of currency i against the numèraire currency, which in this case is the Swiss franc where currency i can be the US Dollar, Japanese Yen and the Euro. For the period prior to the introduction of the Euro, we consider the German Deutsche Mark. Under this estimation, $\hat{\beta}_i$ which is the estimated coefficient on the rate at which currency i depreciates against the numèraire currency indicates the weight of currency i in the basket. In the case where the currency under observation is pegged to a particular currency or a basket of currency we will have $\hat{\beta}_i = 1$ or $\sum_{i=1}^{I} \hat{\beta}_i = 1$ for the i currencies that are a part of the basket. Moreover, pegging to an individual or a basket of currencies implies a higher goodness of fit. In our estimation we use daily data, with the data being sourced from the Database on the Indian Economy, Reserve Bank of India and from the Global Financial Database. We apply the estimation over a quarter and take the goodness of fit, or the adjusted R^2 as the measure of exchange rate stability. A higher R^2 indicates greater pegging to an individual or a basket of currencies. Again, we normalize the index so that it lies between 0 and 1.

Capital Account Openness (KO)

The index of capital account openness is based on a *de facto* measure of openness instead of a d*e jure* one as it is the actual volume of flows that creates a conflict between monetary

independence and exchange rate stability as opposed to controls governing the movement of capital. A country with high *de jure* openness can have low capital flows and hence be able to simultaneously stabilize exchange rate and retain monetary autonomy. Alternatively, a country with low *de jure* openness can experience large flows due to low enforcement of capital controls, and face a trade-off between ensuring monetary independence and exchange rate stability. Hence, the index of capital account openness, KO, is based on net capital flows. The index is constructed as the ratio of absolute value of net capital flows to GDP.

$$KO=\frac{|\text{Net Flows}|}{\text{GDP}} \tag{3}$$

The focus on net capital flows is based on the fact that it is the capital account balance that is crucial for the trilemma. If capital inflows in a country were to be matched by an equal amount of outflows, the central bank will still have the option of retaining monetary independence with a stable exchange rate. The construction of the capital account openness index does not impose an upper bound of 1. Hence to make this index comparable with ERS and MI indices, we normalize this index to lie between 0 and 1.

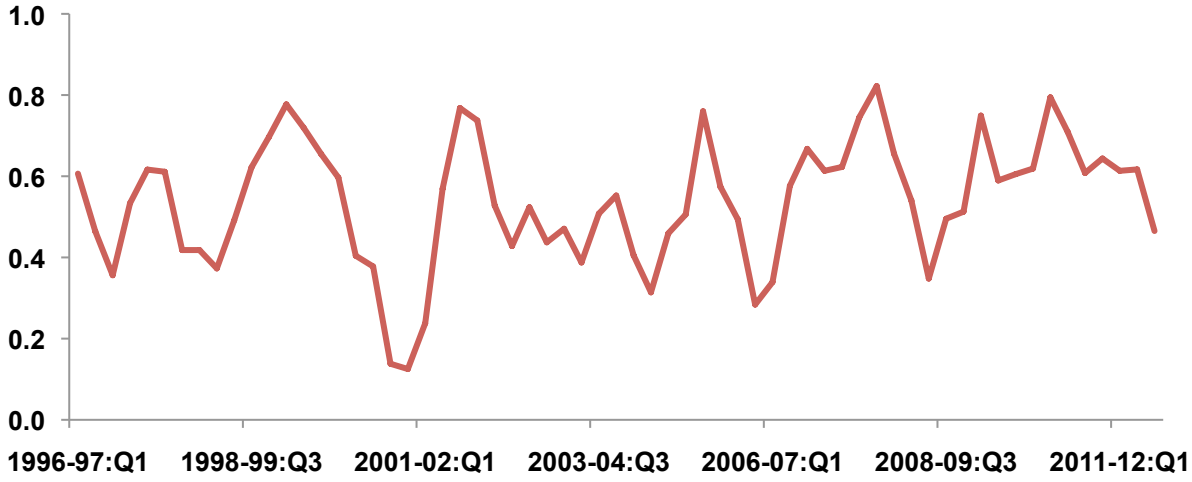
In Figure 5, we highlight the evolution of the three indices over the period 1996-97Q1 to 2011-12Q3. While ERS index exhibited a downward trend since the early 2000s, the KO index witnessed an upswing till the onset of the global financial crisis (GFC). The GFC led to a sharp drop in the KO index, as flows to emerging markets, including India dried up globally. Since 2010-11, KO index has shown signs of revival, although the various components of the capital account have displayed considerable volatility. Finally, the MI index witnessed significant volatility, although there is a perceptible upward trend since early 2000s.

The entire period from 1996-97Q1 to 2011-12Q3 was one of significant changes in domestic and external conditions, and required the balancing of the three trilemma objectives as per the macroeconomic demands. To effectively evaluate the shift in the policy stance over the period of time, we divide the entire sample into four sub-periods; Phase I: 1996-97Q1 to 1999-00Q4, Phase II: 2000-01Q1 to 2003-04Q4, Phase III: 2004-05Q1 to 2007-08Q4 and Phase IV: 2008-09Q1 to 2011-12Q3. While the first three phases include 16 quarters, the last phase includes only 15 quarters.

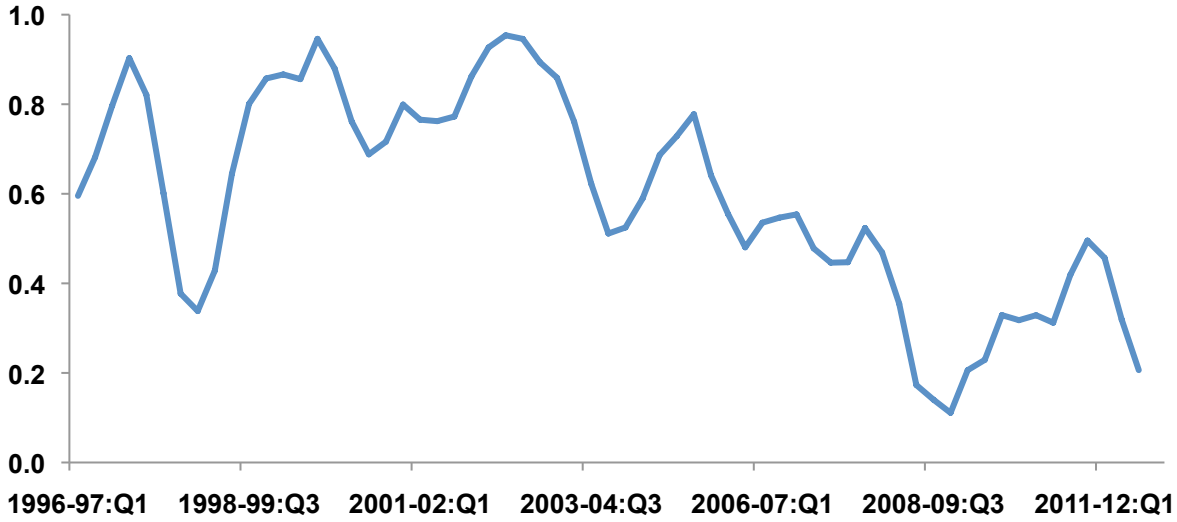
As pointed out in Aizenman et al (2008 and 2010a, b), policymakers can garner greater flexibility vis-à-vis monetary and exchange rate management in the short run by accumulating or decumulating reserves. Consequently we also focus on ΔRes , the absolute change in reserves (as a percentage of GDP).[3] Like the other indices we also normalize ΔRes to lie between 0 and 1, In Figure 6 we illustrate the average of the various policy dimensions during these four phases using the diamond chart developed in Aizenman et al. (2008 and 2010a, b). The rising extent of capital account openness has been associated with a drop in exchange rate stability. The index of monetary independence witnessed a drop in Phase II but recovered in the following phases.

[3] We use data on actual intervention by the RBI to exclude valuation changes. The data is from Handbook of Statistics on the Indian economy.

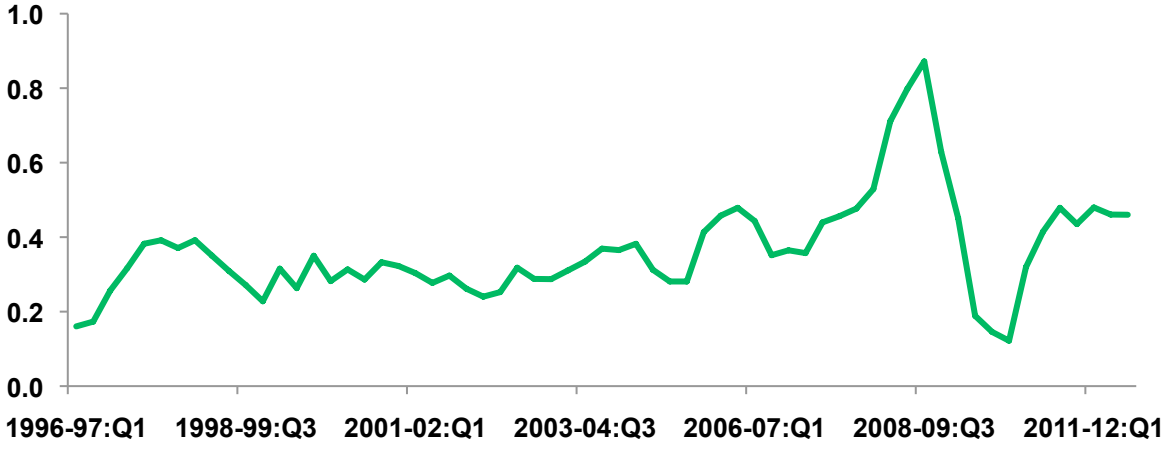
Figure 5: Evolution of the Trilemma Indices



(a) Monetary Independence Index



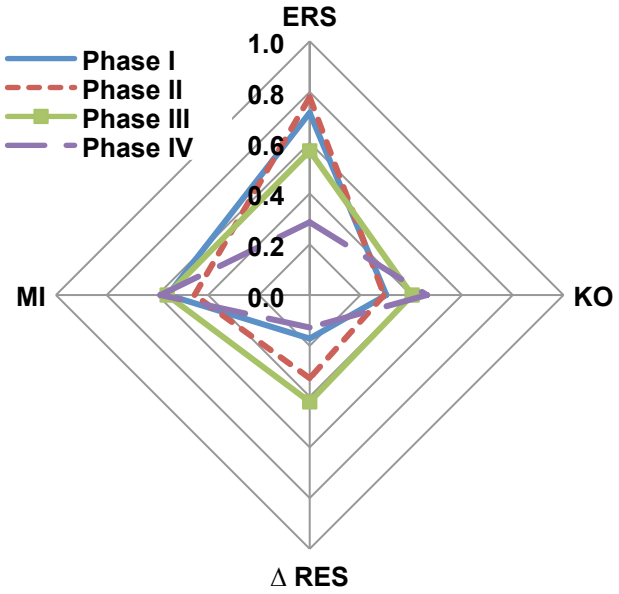
(b) Exchange Rate Stability Index



(c) Capital Account Openness Index

Source: Authors' calculations

Figure 6: Configuration of the Trilemma Objectives and International Reserves



Source: Authors' calculations

Next, we examine the validity of the trilemma framework by testing whether the weighted sum of the three trilemma policy variables adds up to a constant – here set to be 2. We estimate the relationship for the entire period as well as the four phases outlined above. The results are given in Table 3. We find that the overall fit is extremely high with R^2 being above 0.93 across all the specifications. While the estimates for exchange rate stability and capital account openness are significant across all the specifications, it is not the case with monetary independence.

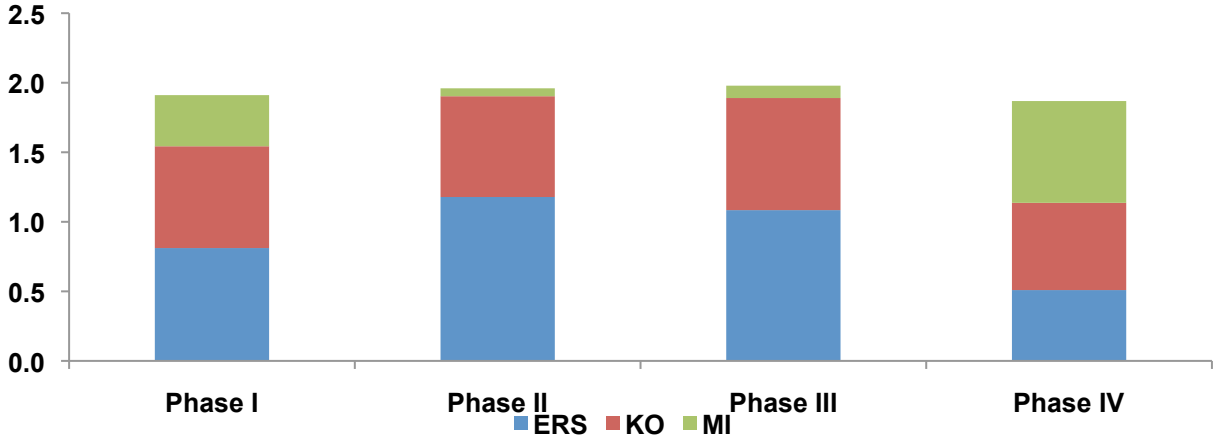
Table 3: Testing the Validity of the Trilemma Framework

	1996-97Q1 to 2011-12Q3	1996-97Q1 to 1999-00Q4	2000-01Q1 to 2003-04Q4	2004-05Q1 to 2007-08Q4	2008-09Q1 to 2011-12Q3
	Whole Sample	Phase I	Phase II	Phase III	Phase IV
Monetary Independence	0.656***	0.684**	0.125	0.158	1.244**
	[3.448]	[1.986]	[0.516]	[0.861]	[2.711]
Exchange Rate Stability	1.388***	1.093**	1.511***	1.908***	1.774*
	[9.444]	[2.268]	[5.001]	[7.813]	[1.813]
Capital Account Liberalization	2.012***	2.419**	2.473***	1.997***	1.357**
	[8.392]	[2.918]	[3.078]	[5.861]	[2.696]
Observations	63	16	16	16	15
R-squared	0.954	0.949	0.980	0.989	0.934

Notes: Robust standard errors in parentheses. *, **, and *** indicate correlations significant at 10%, 5%, and 1% respectively
Source: Authors' Calculations

To obtain the contribution of each trilemma policy orientation we multiply the coefficients with the average for each phase. The results are outlined in Figure 7. The high goodness of fit implies that the contributions add up to being very close to 2 across all the phases.

Figure 7: Configuration of the Trilemma Objectives and International Reserves



Source: Authors' calculations

The increase in exchange rate stability from Phase I to Phase II and Phase III was associated with a sharp drop in monetary independence. During Phase II and III, the RBI intervened heavily in the foreign exchange market to prevent the Rupee from appreciating in the face of strong capital inflows. It purchased $55.6 billion of foreign assets in Phase II, and another $134 billion in Phase III. The RBI tried to sterilize these interventions, initially through depletion of its stock of government bonds. However, as it started to run out of government towards the end of 2003, a new instrument for sterilization --- Market Stabilization Scheme (MSS) bonds were introduced. However, owing to rising fiscal cost of sterilization, the RBI could only partially sterilize the flows, which resulted in loss of monetary independence during Phase II and III. Phase IV witnessed a resurgence of monetary independence with a decline in both exchange rate stability and capital account openness. The outbreak of the subprime crisis in the US led to a flight to safety of foreign capital from India, which intensified after the collapse of the Lehman Brothers. The outflow was managed by allowing the Rupee to depreciate and limit intervention in the foreign exchange market. Several measures such as increasing the cap on foreign investment in corporate bonds and raising the interest rate on non-resident Indian (NRI) deposits were undertaken to attract greater capital inflow. At the same time a more independent monetary policy was pursued to bolster the Indian economy.[4]

Capital flows have remained volatile during most of Phase IV having been influenced by investor uncertainty over the advanced economies' recovery prospects, large swings in risk aversion, loose monetary policy in the advanced economies and changing domestic fundamentals. During this period, RBI intervened in a limited manner in the foreign exchange market and allowed the exchange rate to move with greater freedom. The Rupee appreciated by nearly 17% between March 2009 and April 2010. Similarly, between August 2011 and December 2011, the Rupee depreciated by 19% on the back of a widening current account deficit and weak capital inflows. The drop in capital inflows and greater exchange rate flexibility

[4] The RBI took a series of measures to counter the drop in liquidity in the aftermath of collapse of Lehman Brothers. These included lowering of key policy rates, Cash Reserve Ratio (CRR) and Statutory Liquidity Ratio (SLR) , unwinding of MSS bonds, opening up of new refinance windows, lowering of prudential norms related to provisioning and risk weights.

allowed the RBI to pursue a more independent monetary policy. After the initial softening of monetary policy to stimulate growth, the RBI started tightening the monetary policy from March 2010 in response to high and persistent inflation. This was in contrast with the advanced economies, which were continuing to follow a soft monetary policy to stimulate growth.

Overall, we find that instead of opting for corner solutions, India has adopted an intermediate regime while negotiating the trilemma. In doing so, India has resorted to a multiple instrument approach. The overall policy architecture encompasses active management of capital flows, especially volatile and debt flows, moderately flexible exchange rate regime with the RBI intervening at times to prevent excessive volatility, sterilization through various instruments like MSS bonds and changes in CRR and building up of a stockpile of reserves. In recent years, in response to the increase in volatility of capital flows, India has opted for greater flexibility of the exchange rate, with the objective of retaining higher monetary independence.

4. Impact on the Exchange Market Pressure Index (EMPI)

4.1 Measurement and Evolution of EMP Indices

The RBI's management of capital account could be driven by a desire to moderate certain types of capital inflows or to manage exchange rate stability. It may be reasonable to conjecture that the goal was the latter in the context of financial trilemma. Accordingly in this section we measure the exchange market pressure (EMP) in India, discuss its evolution over time and also analyze a few crucial macroeconomic factors that may have affected the EMP over the last couple of decades. EMP is a combination of exchange rate depreciation and international reserves loss-a concept pioneered by Girton and Roper (1977), and applied frequently in the analysis of EMEs (Frankel, 2009). A positive (negative) EMP indicates a net excess demand (supply) for foreign currency, accompanied by a combination of reserve loss (gain) and currency depreciation (appreciation).

In order to measure EMP in India, we follow the methodology of Aizenman and Sushko (2010) who investigate the factors explaining EMP in emerging markets during the 2000s. The first measure of EMP is the un-weighted sum of percentage nominal depreciation and percentage loss of reserves:

$$EMP_{i,t} = \frac{\Delta e_{i.t}}{e_{i,t-1}} - \frac{\Delta IR_{i.t}}{IR_{i,t-1}} \qquad (4)$$

where $e_{i.t}$ stands for nominal Rupee exchange rate per U.S. dollar and $IR_{i.t}$ denotes international reserve holdings (excluding gold) by India during quarter *t.* $\Delta e_{i.t}$ and $\Delta IR_{i.t}$ denote changes in nominal exchange rate and international reserve holdings respectively between quarters *t* and *t-1*.

Our second measure, EMP (IR/M-Base), is defined as the un-weighted sum of percentage exchange rate depreciation and international reserve loss, with reserve loss deflated by the monetary base or M2:

$$EMP_{i,t}^{IR/M-Base} = \frac{\Delta e_{i.t}}{e_{i,t-1}} - \frac{\Delta IR_{i.t}}{M_{i,t-1} / e_{i,t-1}} \qquad (5)$$

where $M_{i,t-1}$ stands for M2 in local currency units of India in quarter *t-1,* and the monetary base is converted to U.S. dollars. According to the monetary model-based EMP measure popularized by Girton and Roper (1977), specification (2) provides a real measure of international reserve loss, normalized by the monetary base.

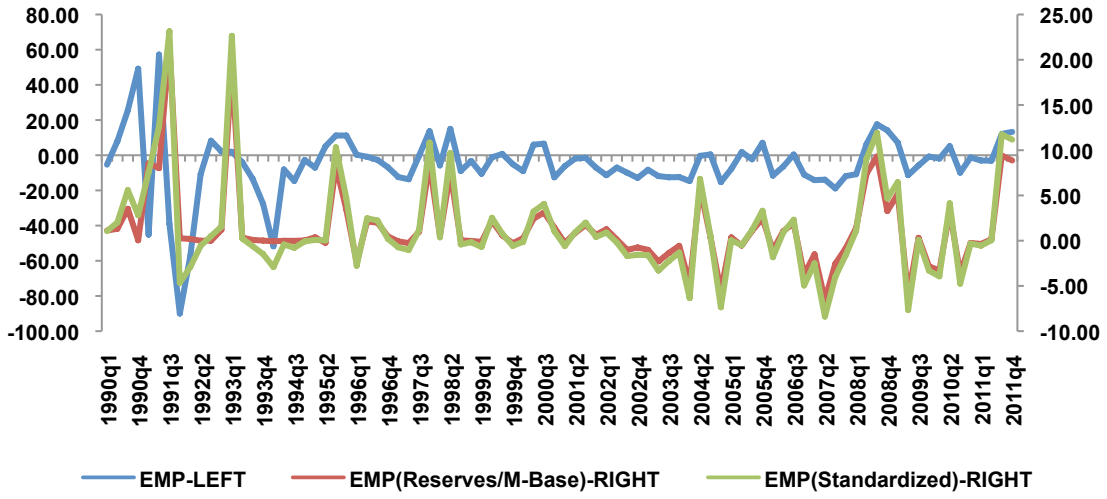
The third and final measure, EMP (Standardized), is the weighted sum of demeaned percentage nominal exchange rate depreciation and percentage loss of international reserves where the weights are inverses of the historical standard deviation of each series:

$$EMP_{i,t}^{S\tan dardized} = \frac{1}{\sigma_{i,\Delta e}}\left(\frac{\Delta e_{i.t}}{e_{i,t-1}} - \mu_{i,\Delta e}\right) - \frac{1}{\sigma_{i,\Delta RES}}\left(\frac{\Delta IR_{i,t}}{IR_{i,t-1}} - \mu_{i,\Delta RES}\right) \qquad (6)$$

where $\mu_{i,\Delta e}$ and $\mu_{i,\Delta RES}$ denote the historical means of percent nominal exchange rate depreciation and percent changes in international reserve holdings. Similarly, $\sigma_{i,\Delta e}$ and $\sigma_{i,\Delta RES}$ represent historical standard deviations of both these series for India.

Figure 7 shows the time-series evolution of the three EMP indices as measured above, with the un-weighted EMP on the left axis and EMP (IR/M-Base) and EMP (Standardized), on the right axis.

Figure 7: Evolution of the EMP Indices: 1990Q1-2011Q4



Source: Authors' Calculations

As can be seen from the figure, all three EMP indices display a fair amount of fluctuations during the early 1990s, representing the period of heightened macroeconomic volatility during and in the aftermath of the 1991 BOP crisis in India. The un-weighted measure of EMP (left axis) indicate that between 1990Q1 and 1990Q4 India went from an average 5% combined nominal appreciation and gains in international reserve holdings to a 50% combined nominal depreciation and international reserve loss. The fluctuations in all three EMP series continue

throughout the 1990s particularly shooting up during the 1997-98 Southeast Asian currency crisis.

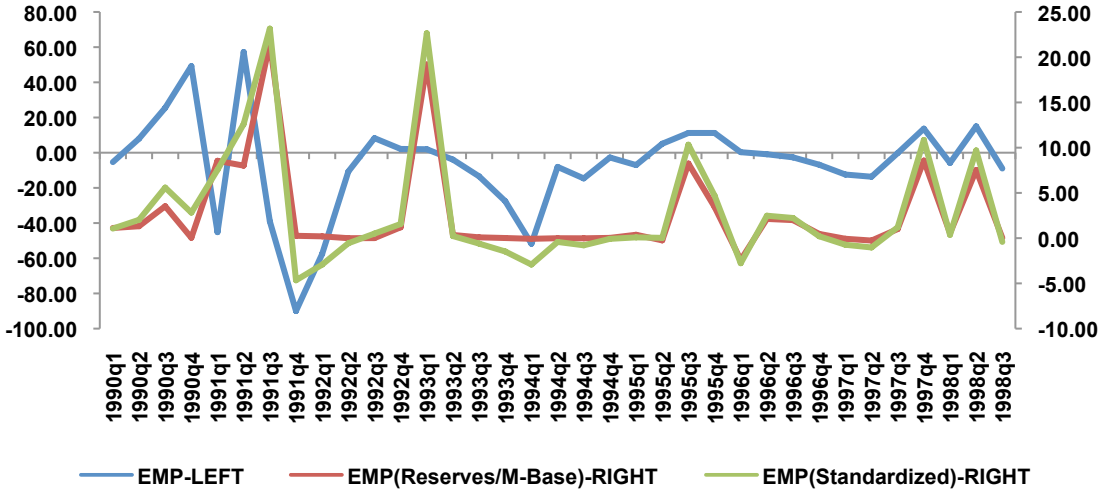
From 1999Q1 to 2008Q1, all three EMP indices are on average negative implying net excess supply of foreign currency, alleviated by a combination of reserve gain and appreciation. According to the un-weighted EMP, during this period Indian economy experienced on average a 7% combined nominal currency appreciation and gains in international reserve holdings. This also coincides with the period of Great Moderation in the global economy during which all EMEs in general experienced nominal currency appreciation and massive accumulation of international reserves.

The downward/negative trend in the EMPs through the early and mid 2000s gets interrupted by a sharp upward movement between 2008Q2 and 2009Q1—the period of global economic and financial turbulence centering around the collapse of Lehman Brothers in the US. Between 2008Q1 and 2008Q4, India went from an average 10% combined nominal appreciation and gains in international reserve holdings to a 14% combined nominal depreciation and international reserve loss. This is quite comparable to the EMP of other EMEs who during the same period went from an average 10% combined nominal appreciation and gains in international reserves holdings to a 20% combined nominal depreciation and international reserve loss (Aizenman and Sushko, 2010).

Like other EMEs, the EMP in India (by all three measures) came down by 2009Q2 and switched back to net nominal currency appreciation combined with hoarding international reserves. This trend continued in India till the end of 2010. Since then however the EMP has been on the rise again given the massive currency depreciation that India has been experiencing in the wake of the Euro-zone sovereign debt crisis.

Figures 8 to 10 depict the EMP indices in India for three sub-periods 1990Q1 to 1998Q3; 1998Q4 to 2004Q1; 2004Q2 to 2010Q3, based on the exchange rate regimes identified in Patnaik, Sethy and Balasubramaniam (2011).

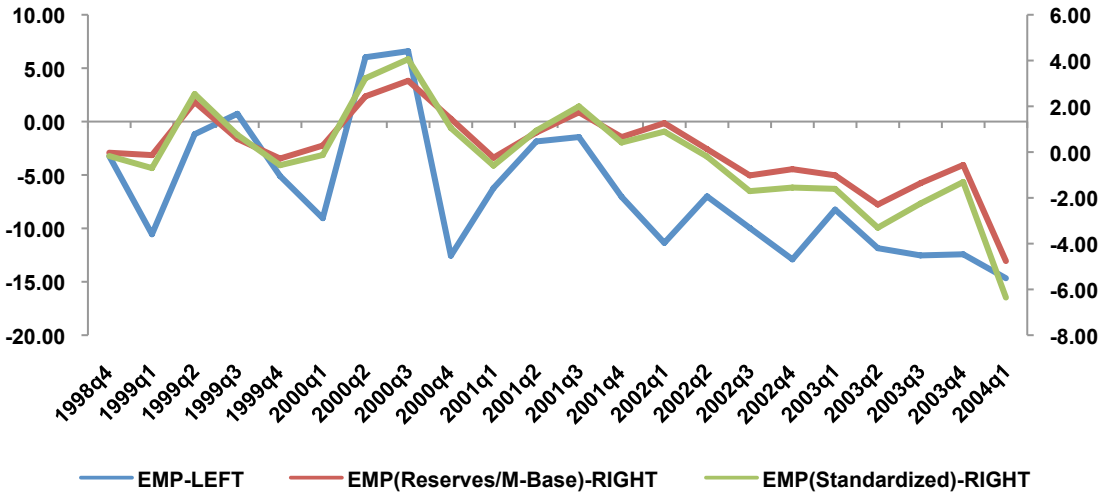
Figure 8: EMP Indices: 1990Q1-1998Q3



Source: Authors' Calculations

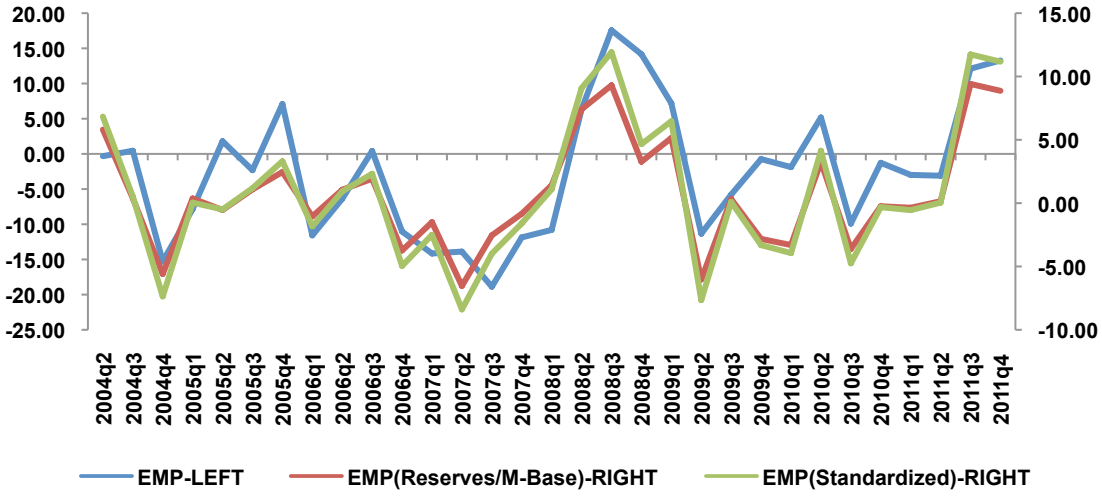
Clearly, positive movements in the EMP (indicating currency depreciation and reserve loss) were relatively more frequent in the first sub-period than in the second reflecting the fact that India had begun to actively accumulate reserves from late 1990s onwards. In Figure 10, the sharp upward movement in the EMP indices coincides with the onset of the global financial crisis (GFC) in 2008Q3.

Figure 9: EMP Indices: 1998Q4-2004Q1



Source: Authors' Calculations

Figure 10: EMP Indices: 2004Q2-2011Q4



Source: Authors' Calculations

4.2 Estimation of EMP determinants

In this sub-section we use a multivariate time-series regression framework in order to estimate the link between EMP and a few selected explanatory variables. The objective is to quantify the statistical as well as economic significance of these factors in accounting for exchange market

pressure patterns over the sample period. Following Aizenman and Sushko (2010) in our first specification we include trade balance to GDP ratio, share of net FDI inflows and net portfolio equity inflows in GDP separately and we also control for year on year WPI inflation.[5] Estimation results are reported in Table 4. The three columns pertain to the three different EMP measures as detailed in the previous section. The last two measures are used as dependent variables in the time-series regressions as robustness check for our baseline results on column 1.

As can be seen from column 1 of Table 2, a deteriorating trade balance is associated with a higher EMP, a result that makes intuitive sense. When EMP is standardized or deflated by monetary base, the estimated coefficient of trade balance continues to have the predicted sign, but it is no longer statistically significant. An increase in net portfolio equity inflows lowers the EMP. This effect is both statistically and economically significant. For instance a 10 percentage points rise (decline) in portfolio equity inflows (outflows) is associated with a 16.7 percentage points lower EMP when measured using the un-weighted index. The association between EMP and equity flows is also robust to the normalization of reserves by monetary base as well as standardization of the EMP index. Neither WPI YoY inflation nor the share of net FDI inflows in GDP seems to have any significant impact on the EMP over the sample period.[6]

Table 4: Factors affecting EMP in India (1990Q1-2011Q4)

Variables	EMP	EMP(Reserves/M-Base)	EMP(Standardized)
Trade Balance (% GDP)	-1.420*** (0.578)	-0.096 (0.263)	-0.095 (0.074)
Net FDI Inflows (% GDP)	-1.073 (0.944)	-0.137 (0.448)	-0.083 (0.124)
Net Portfolio Equity Inflows (% GDP)	-1.667** (0.758)	-0.661* (0.366)	-0.206** (0.098)
WPI Inflation	-1.667 (0.429)	0.198 (0.218)	0.071 (0.058)
Observations	60	60	60
R-Squared	0.1892	0.0858	0.1306

Notes: Robust standard errors in parentheses. *, **, and *** indicate correlations significant at 10%, 5%, and 1% respectively

Source: Authors' Calculation

We had also incorporated percentage change in stock market returns (BSE Index) as well as the ratio of short-term external debt to GDP in the EMP estimations. Stock market returns happened to be highly correlated with WPI inflation and trade balance. When added without these two explanatory variables in the regression, stock market returns were found to be significantly associated with EMP measured using all three indices. In other words, positive changes in stock returns lower the EMP and vice versa. Quarterly data on short-term external debt is available only from 2006Q1 onwards from the Quarterly External Debt Statistics (QEDS) database maintained jointly by the BIS-IMF-World Bank. When added to the estimation, external debt was found to be negatively associated with EMP—a lower short-term external debt ratio

[5] We are constrained by the number of observations and hence have not added too many controls in the EMP estimations for lack of sufficient degrees of freedom.

[6] We also conducted the estimation using Newey-West standard errors and results came out to be the same.

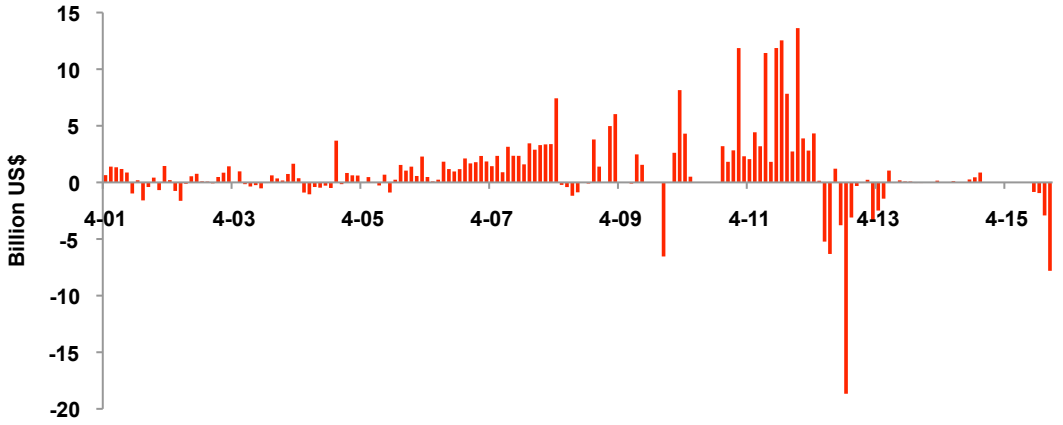
increases the EMP, but the effect was found to be statistically significant only for the un-weighted EMP index. These results are not reported here for brevity but are available upon request. Our results thus primarily highlight the importance of portfolio equity flows and also stock market returns to some extent, in accounting for exchange market pressure in India from 1990Q1 to 2011Q4.

5. Intervention and Sterilization by the RBI

5.1 RBI's Intervention in the Foreign Exchange Market

As discussed in Sections 3 and 4, India has had an active foreign exchange management policy, with active intervention by the RBI in the foreign exchange market and very large growth in foreign exchange reserves, even though India formally moved to market determined exchange rate system in 1993. According to RBI's stated objective, these foreign exchange interventions are aimed at ironing out the excessive volatility of exchange rate, and not necessarily to defend any particular value of the Rupee. However, the sustained buildup of reserves since the early 2000s contradicts this argument. Foreign exchange reserves climbed from around USD $150 billion in mid-2005 to over USD $300 billion in mid-2010, a doubling in just five years and making India one of the largest reserve-holding countries in the world. Management of exchange rate volatility would imply that reserve holdings do not change much over a period of time.

Figure 11: Net Sale or Purchase of US Dollar by RBI



Source: Database of the Indian Economy and Reserve Bank of India

Both the dramatic rise in reserves as well as the monthly intervention data (Figure 11) indicate substantial and sustained US dollar purchases by the RBI, and sales of the Indian currency, in the foreign exchange market. In other words, the RBI has purchased significantly more US dollars than it has sold since April 1997 thereby intervening in the foreign exchange market in an asymmetric manner i.e. by leaning against the wind, in order to prevent the Rupee from appreciating sharply. India also had a current account deficit in the balance of payments from late 1990s onwards implying that the official purchases of foreign exchange were offsetting the substantial private capital inflows into the economy. These capital inflows are in turn related to partial relaxation of capital account restrictions, one part of the macroeconomic trilemma. Hence maintaining a relatively open capital account required the RBI to intervene actively in the foreign exchange market to prevent the resultant Rupee appreciation.

Next, we test the validity of the hypothesis that the central bank in India has intervened in an asymmetric manner in the foreign exchange market. Following Pontines and Rajan (2011) and Srinivasan et al. (2008) we assume that the central bank's loss function takes the following form.

$$L_t = \frac{1}{2}\left(R_t - R^*\right)^2 + \frac{\phi}{2}\left(\tilde{\varepsilon}_t - \varepsilon^*\right)^2 + \frac{\theta}{3}\left(\tilde{\varepsilon}_t - \varepsilon^*\right)^3 \tag{7}$$

Here $\tilde{\varepsilon}$ is the percent change in exchange rate with the exchange rate being defined as the foreign currency price of the domestic currency while R_t is level of reserves. The central bank is concerned with deviation of reserves as well as the exchange rate from their respective target values R^* and ε^* with $\phi > 0$ being the relative weight the central bank puts on stabilizing exchange rate. With India not following a preannounced band or target for the exchange rate, ε^* is assumed to equal zero. The right most term introduces the asymmetry in the loss function. With $\theta > 0$, an appreciation $\left(\tilde{\varepsilon} > 0\right)$ increases the central bank's loss while depreciation $\left(\tilde{\varepsilon} < 0\right)$ reduces the extent of loss.

The central bank faces a trade-off between stabilizing reserves and exchange rate simultaneously as interventions can reduce the extent of exchange rate deviation.

$$\tilde{\varepsilon}_t - \varepsilon^* = \alpha_0 + \alpha_1 R_t + \eta_t \tag{8}$$

where $\alpha_1 > 0$ and η_t is independent and identically distributed with zero mean and variance σ_s^2. Minimizing equation (7) by choosing R, subject to the constraint given in equation (8) yields the following optimality condition.

$$R_t = R^* - \left(\phi\alpha_1\right)\tilde{\varepsilon}_t - \frac{\phi\theta}{2}\alpha_1\tilde{\varepsilon}_t^2 \tag{9}$$

The optimality condition can be reduced to an empirically testable formulation

$$\tilde{R}_t = \beta_0 + \beta_1\tilde{\varepsilon}_t + \beta_2\tilde{\varepsilon}_t^2 + \upsilon_t \tag{10}$$

where $\beta_1 = -\phi\alpha_1$ and $\beta_2 = -\frac{\phi\theta}{2}\alpha_1$.

The reduced form parameters provide information on the degree of asymmetry in exchange rate stabilization with $\theta = \frac{2\beta_2}{\beta_1}$.

To empirically estimate equation (10) we use monthly data from April 1994 to December 2011. The data is sourced from RBI's Database on the Indian Economy. The dependent variable $\tilde{R}_t$ is defined as $\left(\Delta \log R_t\right)*100$ while $\tilde{\varepsilon}_t$ refers to $\left(\Delta \log \varepsilon_t\right)*100$. While the data from April 1997 points

to actual RBI intervention, the data prior to April 1997 refers to changes in reserves, and hence are inclusive of valuation changes.

Zeiliss et al. (2010) argue that the exchange rate regime in India has evolved considerably during the last two decades. Despite India announcing a move to a market determined exchange rate system in 1993, the Rupee continued to be tightly pegged to the US Dollar through most of the subsequent period. It was only from 2004 onwards that India moved to a basket peg. Based on Zeiliss et al. (2010) we identify four sub periods: Phase 1: April 1993 to August 1998; Phase II: September 1998 to March 2004; Phase III: April 2004 to May 2008; and Phase IV June 2008 to December 2011.[7]

We use the Generalized Method of Moments (GMM) to estimate Equation 10. The orthogonality conditions implied by the intertemporal optimization and rational expectations paradigm make the GMM approach appealing. Moreover, the GMM approach does not require strong assumptions about the distribution of shocks. We follow Hansen (1982) and use an optimal weighting estimate of the covariance matrix, which accounts for auto correlation and heteroskedasticity in the error term. We employ a variable lag Newey West estimate of the covariance matrix.

In the GMM estimation, a larger set of instruments improves the estimation performance by including more moment restrictions. However, in relatively small samples, this comes at the cost of the precision of the weighting matrix. Hence, in our analysis the optimal set of instruments is decided by the Hansen (1982) over-identifying restriction test (J statistics) with a rejection of these restrictions indicating that some of the variables fail to satisfy the orthogonality conditions. We use 12 lags of $\tilde{R}_t$ and $\tilde{\varepsilon}_t$, the current value of federal funds rate and its eight lags as instruments.

The estimates of the intervention reaction function and the asymmetric preference parameter are reported in Table 5. The J-statistic indicates that the null hypothesis of valid over-identifying restrictions cannot be rejected at the conventional significance level. Of primary interest to us is the parameter θ, which indicates the extent of asymmetric intervention. As can be seen from Table 1, barring Phase I, θ is positive and economically and statistically significant across all specifications, implying that the RBI has been intervening in an asymmetric manner during appreciation and depreciation pressures since 1998.[8]

Moreover, θ varies across the various phases, indicating shifting weight on the extent of asymmetric intervention. The parameter θ takes the highest value during Phase II indicating the central bank's strong concern for appreciation of the Rupee. Interestingly, despite India's reserves increasing by nearly $196 billion during Phase III, compared to an increase of $87 billion in Phase II, the parameter θ takes a higher value in Phase II. This could be driven by the fact that the dependent variable in our estimation is the growth rate of reserves, rather than the

[7] Zeiliss et al. (2010) further subdivides Phase I into two periods April 1993 to March 1995 and March 1995 to August 1998 with the Rupee being tightly pegged to the US Dollar in the first sub period while witnessing greater flexibility in the second sub period. However, in our analysis due to absence of higher frequency data on reserves, we are forced to combine these two periods to ensure adequate degrees of freedom.

[8] The standard errors of θ are obtained using the delta method.

absolute increase in reserves. While reserves grew by 165% over Phase III, Phase II witnessed a growth of more than 287% due to a very low base at the beginning of the phase. Moreover, as described in Section 4, in Phase III the Rupee experienced far greater volatility, compared to Phase II.

Table 5: Estimates of Policy Preference

(Dependent variable: Percentage change in Reserves)

	Apr 1993 to Aug 1998	Sep 1998 to Mar 2004	Apr 2004 to May 2008	Jun 2008 to Dec 2011
	Phase I	Phase II	Phase III	Phase IV
β_0	-0.023	0.864***	1.138**	0.707***
	[0.035]	[0.026]	[0.05]	[0.033]
β_1	-0.509***	-3.366***	-0.630***	-1.410***
	[0.069]	[0.221]	[0.120]	[0.03]
β_2	0.053	-2.164***	-0.243***	-0.377***
	[0.034]	[0.654]	[0.055]	[0.087]
θ	0.208	1.286***	0.771***	0.535***
	[0.152]	[0.040]	[0.013]	[0.004]
No. of Observations	49	67	50	43
J Statistics	9.38	10.19	9.93	11.55

Notes: Standard errors in parentheses. *, **, and *** indicate correlations significant at 10%, 5%, and 1% respectively

Source: Authors' Calculations

The positive and significant value of θ in Phase IV indicates that the asymmetric intervention continued even during this period, although its extent was lower than previous phases. The lower coefficient was driven by the fact that India witnessed limited pressure of appreciation during this phase as rising risk averseness of international investors and slowing down of domestic growth rate mitigated the capital flows. During the third and fourth quarter of 2008 and again since third quarter of 2011, the Rupee has witnessed strong depreciation pressure. The central bank allowed the Rupee to depreciate during these periods by intervening in a very limited manner in the foreign exchange market. This limited intervention by the central bank at the time of depreciation pressure also contributed to a positive and significant value of θ.

5.2 Sterilization of RBI's Intervention in the Foreign Exchange Market

In the pursuit of managing the macroeconomic trilemma, the RBI intervened actively in the foreign exchange market to ensure currency stability, rapidly accumulated reserves and also sterilized its intervention in order to ensure monetary independence.[9] As mentioned in Section 3,

[9] Intervention is usually defined as the official purchase and sale of foreign currencies that a country's monetary authorities undertake in order to influence future currency movements. In the case of unsterilized intervention monetary authority buys (sells) foreign exchange or foreign assets due to which its monetary base increases (decreases) by the amount of the purchase (sale). On the other hand, through sterilized intervention the central bank can insulate the domestic monetary base from the effect of purchase (sale) of foreign assets by undertaking a corresponding amount of sale (purchase) of domestic or local currency bonds.

from 2000Q1 to 2008Q4 the RBI actively purchased foreign currency assets in order to prevent the rupee from appreciating in the face of strong capital inflows. Between 2000 and 2003 RBI sterilized the interventions (*increase in net foreign assets*) so as not to allow any inflationary impact on monetary policy, by selling off government bonds (*decline in net domestic assets*) and absorbing the excess liquidity from the system. However from 2003-04 onwards the rising fiscal costs of sterilization forced the RBI to only partially sterilize its foreign exchange interventions. In this context, we try to find out to what extent the RBI has succeeded in limiting the impact of international reserve accumulation on the money supply and maintaining monetary autonomy in the face of large inflows of capital into India against the backdrop of financial liberalization.

Table 6: Effect of Net Foreign Assets (NFA) on Net Domestic Assets (NDA)

(Dependent variable: Change in NDA)

Variables	1990M1 to 1998M9	1998M10 to 2004M3	2004M4 to 2010M8
Change in NFA	-0.208 (0.231)	-0.609*** (0.128)	-0.269* (0.152)
Lagged change in NDA	0.226*** (0.0942)	-0.052 (0.187)	0.158* (0.094)
Lagged change in log of IIP	-11829.18 (9543.64)	-9133.15 (10163.47)	115470.10*** (31567.53)
Constant	878.367 (607.9219)	1523.943 (1005.134)	4227.436** (1929.542)
Observations	41	66	76
R-Squared	0.0994	0.2122	0.2487

Notes: Newey-West Standard errors in parentheses. *, **, and *** indicate correlations significant at 10%, 5%, and 1% respectively

Source: Authors' calculations

To this effect we estimate a basic sterilization equation wherein the change in net domestic assets (NDA) is regressed on the change in net foreign assets (NFA). In this regression, the magnitude of the estimated coefficient of NFA is an indicator of the extent to which the RBI has managed to insulate the money supply from international reserve accumulation. We also include the lagged dependent variable and lagged industrial production (12 month lag of log IIP) to control for other factors influencing the growth of money supply in the economy. We use monthly data from the RBI database and divide the sample into sub-periods primarily based on the exchange rate regimes identified in Patnaik, Shah, Sethy and Balasubramaniam (2011). The sub-periods are: 1990M1 to 1998M9 (Rupee pegged to the Dollar); 1998M10 to 2004M3(Rupee moving to a basket peg with relatively more flexibility); 2004M4 to 2010M8 (higher flexibility in Rupee).

As can be seen from Table 6, the estimated coefficient of change in NFA or the sterilization coefficient is statistically significant only in the last two sub-periods and has the highest magnitude (0.61) in the second sub-period which continues from the end of 1998 to the middle of 2004. This implies that almost 60% of the rise in NFA was offset by corresponding fall in NDA through RBI's sale of government bonds. However, the magnitude of NFA goes down significantly in the third sub-period during which less than 30% of the rise in NFA seems to have been sterilized by a concomitant decline in NDA. Thus post 2004 the RBI has on average let the money supply grow in the face of rising net foreign asset holdings and relaxation of capital controls.

Thus, monetary autonomy seems to have been compromised in the later part of 2000s during which capital account restrictions were relaxed significantly and India joined the ranks of several other EMEs who began accumulating massive international reserves--the so called period of Great Moderation. This is also consistent with our previous finding in Section 3 (see Table 3 and Figure 6) that the period 2004-2009 witnessed a loss of monetary independence in the face of rising exchange rate stability, capital account openness and only partial sterilization by the RBI. A partial resurgence of monetary independence happened only after 2010 when exchange rate became more flexible and capital inflows into the economy slowed down owing to renewed global economic turmoil against the backdrop of the Euro zone crisis.

6. India's Reserve Management

As has been described in Section 5.1 above, India's reserve accumulation has been driven by the central bank's policy of leaning against the wind. Reserve accretion was a result of net capital inflows being greater than the current account deficit, with the central bank accumulating the excess flows. The build-up of reserves meant that India was comfortably placed on the various traditional reserve adequacy indicators – import cover, ratio of reserves to short-term debt and ratio of reserves to monetary aggregates -- at the time of the sub-prime crisis in 2007.[10]

Figure 12: Reserve Adequacy Measures in Selected Emerging Economies

(a) Import Cover (b) External Debt Cover

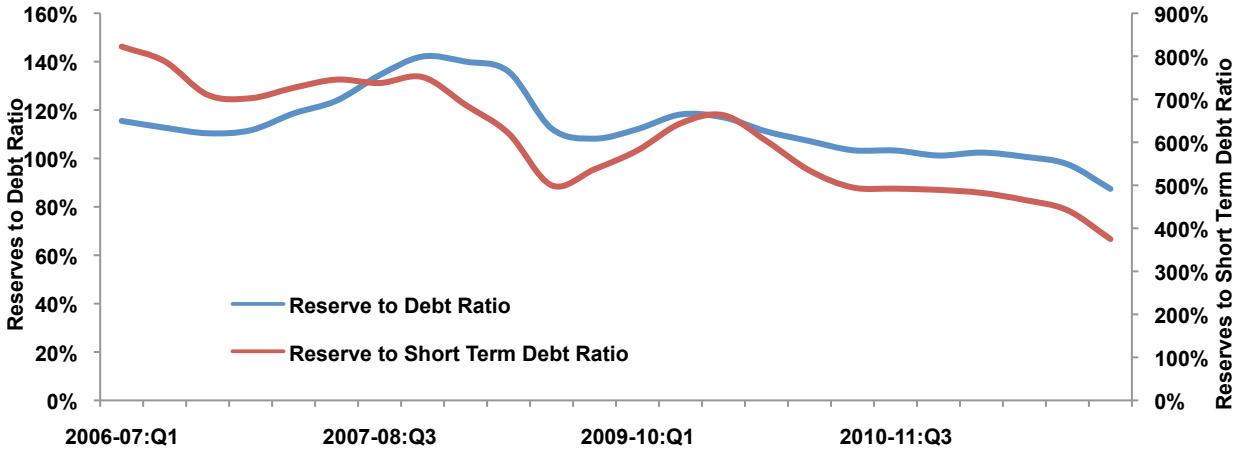
Source: Authors' calculations and World Development Indicators

However, since the outbreak of the sub-prime crisis in 2007, India has been witnessing a rising current account deficit and slowing capital inflows. The widening of the current account deficit has been driven by sluggish demand for Indian exports by advanced countries as well as high crude oil prices. Increase in risk aversion and deterioration of macroeconomic fundamentals have

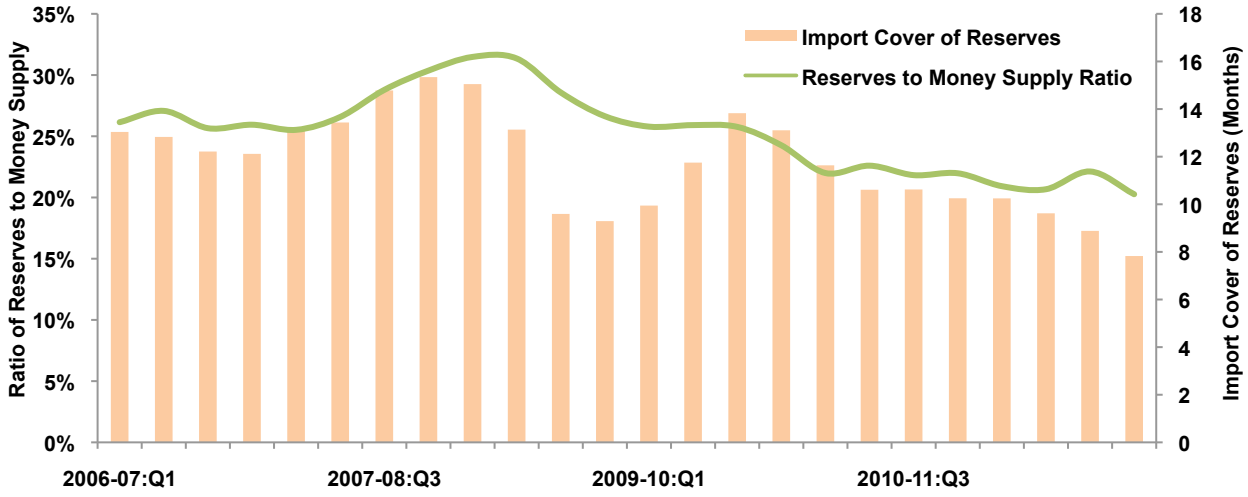
[10] The import cover or the number of months of imports that can be financed if all foreign inflows cease, is an important indicator for countries subject to shocks to the current account, and the balance of payment is dominated by the current account. The short-term debt cover served as a good indicator of crisis risk for most crisis episodes except the recent global financial crisis. Similar to the import cover, the short-term debt cover is based on the formulation that countries should be able to fulfill their immediate debt obligations even if they are cut off from the market for an entire year. The monetary aggregate metric captures short-term foreign currency debt amortization and other forms of net foreign currency exposure of the domestic financial system as well as the threat of a domestic bank run under a convertible currency.

resulted in a slackening of capital inflows. In fact, a cumulative current account deficit between 2008-09Q1 and 2011-12Q3 of $164.3 billion and net capital inflows of $168 billion over the same period meant that the latter was just barely able to finance the deficit. This in turn kept foreign exchange reserves largely stagnant over this period, resulting in significant deterioration of reserve cover. In fact, as can be seen from Figures 12a and 12b, between 2007 and 2011, India witnessed one of the highest erosion of reserve cover across a spectrum of emerging economies.

Figure 12: Tracing the Reserve Adequacy Measures in India



(a) Ratio of Reserves to Debt Stock



(b) Ratio of Reserves to Imports and Money Supply

Source: Authors' calculations and Database on the Indian Economy (RBI)

Figures 13a and 13b trace out the evolution of the various reserve adequacy indicators. India's reserve cover reached a peak around Q2 2008-09, and has been declining steadily since. While at the end of June 2008, India's reserves could fund 136% of India's total external debt, by December 2011, the reserve cover had dropped to only 87%. More importantly, while in June 2011, India's reserves were almost eight times its holding of short-term debt (original maturity), this had halved to less than four times in December 2011. Rising import bill and stagnant

reserves also meant that the import cover of reserves more than halved from 15.1 months to 7.8 months over the same period. The monetary aggregate metric, measured as the ratio of reserves to broad money also deteriorated from around 31.5% in June 2008 to around 20% in December 2011.

The deteriorating reserve cover has prompted the policymakers to introduce a host of measures since the second half of 2011 relaxing the restrictions on pricing and quantum of inflows. Table 6 highlights some of the key measures introduced to encourage ECBs, deposits by NRIs and FII investment in bond and equity markets.

Table 6: Selected Measures to Encourage Capital Inflows

ECBs	• Loans with a maturity of 3 to 5 years can now be raised at a spread of Libor+350 basis points from Libor +300 basis points. • Funds raised through ECBs are to be brought immediately back into India. • Withholding tax on interest payments for ECBs reduced from 20% to 5% for key infrastructure sectors. • ECBs permitted to part finance rupee debt of existing power projects • Companies with Foreign exchange earnings permitted to use ECB funding for prepayment/fresh rupee capital expenditure up to $10 billion.
NRI Deposits	• Interest rates on Non-Resident (External) Rupee (NRE) Term Deposits and Foreign Currency Non-Resident (Banks) (FCNR (B)) deposits were first raised and then completely deregulated.
FII Flows	• Permitting Qualified Foreign Investors (QFIs) to directly invest in the equity and corporate bond market. • FII limits on Government bonds raised from $10 billion to $20 billion. The limit on corporate bonds raised from $15 billion to $20 billion. • Investor base for Government bonds broadened to include Sovereign Wealth Funds, multilateral agencies, foreign central banks, insurance funds and pension funds. • Two-way fungibility in Indian Depository Receipts allowed, subject to a ceiling • Implementation of Advance Pricing Agreement • General Anti Avoidance Rule deferred to 2013-14

Source: Various RBI and SEBI notifications

7. Conclusion

There is now an emerging consensus that countries need to actively manage their capital account to avoid vulnerabilities associated with financial crisis. While it is widely agreed that capital flows aid growth by providing external capital to sustain an excess of investment over domestic savings, in recent years, many emerging markets, including India, have experienced significant volatility in the quantum of capital flows. Such volatility complicates macroeconomic management challenges by feeding into real exchange rate misalignment, excesses in credit market, asset price booms and busts and exacerbating overall financial fragility. Furthermore, the diverse objectives of robust growth rate, sustainable current account deficit, competitive exchange rate, adequate external capital to finance investment, moderate inflation, minimizing financial fragilities and maintaining adequate reserves also need to be balanced in an era of volatile capital flows. All these trade-offs further reiterate the need to actively manage capital

flows. While capital controls can be effective they are generally not foolproof, and are vulnerable to leakages through financial engineering. In such circumstances, a gamut of policy measures has to be used to ensure financial stability of the economy.

In this paper we analyze India's experience in negotiating the trade-offs involved in capital account management. We find that to minimize risks associated with financial fragilities India has adopted a calibrated and gradual approach towards opening of the capital account, prioritizing the liberalization of certain flows. India has also resorted to a multiple instrument approach while dealing with capital inflows. The overall policy architecture encompasses active management of capital flows, increasingly flexible exchange rate regime with the RBI intervening from time to time, sterilization of these interventions through multiple instruments like MSS bonds and CRR, and building up of a stockpile of reserves.

Using empirical methods we find that instead of adopting corner solutions, India has embraced an intermediate approach in managing the conflicting objectives of the well-known financial trilemma, balancing the three policy objectives as per the demands of the macroeconomic situation. We find that in recent years there has been a discernible shift towards greater monetary policy autonomy to tackle growing domestic inflationary pressure. This has been balanced with greater flexibility of the exchange rate, which has acted as a shock absorber in a period of volatile capital flows.

Our results also indicate that the intermediate approach has been associated with an asymmetric intervention in the foreign exchange market by the RBI, with the objective of resisting pressures of currency appreciation, resulting in large-scale reserve accumulation. However sterilization of this asymmetric intervention has been partial at times leading to rapid increase in monetary aggregates and fuelling inflation. Finally, we conclude that while the greater flexibility in exchange rate since 2007, has allowed the pursuit of a more independent monetary policy and has permitted the exchange rate to act as a shock absorber, the hands-off approach has resulted in reserves remaining virtually stagnant since 2007, leading to a significant deterioration in the reserve adequacy measures.

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Appendix: Data Details and Sources

Variable Name	Description	Components	Data Sources
MI	Monetary Independence	Domestic and US interest rates	Weekly 3-month Treasury Bill yields for India and the US from Global Financial Database.
ES	Exchange Rate Stability	Rupee/USD; US Dollar, Japanese Yen, Euro and German Deutsche Mark	Weekly Exchange Rate data from Database on the Indian Economy, Reserve Bank of India; Global Financial Database.
KO	Capital Openness Index	FDI, Portfolio and Debt inflows and outflows and GDP	Lane Milessi Feretti Database; Database on the Indian Economy, Reserve Bank of India.
IR/GDP	International Reserves to GDP Ratio	Foreign Exchange Reserves minus gold and GDP	International Financial Statistics (IMF); Handbook of Statistics on the Indian economy.
Daily Stock Index			National Stock Exchange Database
Trade Balance to GDP Ratio			Global Financial Database.
WPI Inflation	YoY Inflation		Quarterly WPI data from Global Financial Database.
Foreign Exchange Intervention by RBI	Sale/Purchase of Dollars by RBI		Monthly intervention data from CEIC Asia Database and Database on the Indian Economy, .Reserve Bank of India
Net Domestic and Net Foreign Assets of RBI			Database on the Indian Economy, Reserve Bank of India.
Ratio of Reserves to Debt			Database on the Indian Economy, Reserve Bank of India and Ministry of Finance, Government of India
Ratio of Reserves to Monetary Aggregate			Database on the Indian Economy, Reserve Bank of India and Ministry of Finance, Government of India
Import Cover of Reserves			Database on the Indian Economy, Reserve Bank of India and Ministry of Finance, Government of India