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Analyzing India's Exchange Rate Regime§

ABSTRACT We analyze India's exchange rate regime through the prism of exchange market pressure. We estimate the various regimes that India's de facto exchange rate has been through during the period 2000 to 2020. We find four specific regimes of the Indian rupee differentiated by the degree of flexibility of the exchange rate. We document the manner in which the Exchange Market Pressure (EMP) Index in India has either been resisted through foreign exchange market intervention, or relieved through exchange rate change, across these four *de facto* exchange rate regimes. In particular, we find that after the 2008 Global Financial Crisis, the rupee-dollar exchange rate was relatively more flexible and the share of the exchange rate in EMP absorption was the highest. After 2013, there was a change in the way the EMP was absorbed. The exchange rate was actively managed using spot as well as forward market intervention. We also find that the response of the Reserve Bank of India (RBI) to EMP has been asymmetric. When there has been pressure to appreciate, the RBI has typically responded by purchasing reserves. On the other hand, during the periods in which there has been pressure to depreciate, only a tiny fraction of the reserves were used for resisting the pressure. Such pressure is absorbed by rupee depreciation.

Keywords: *Exchange Rate Regime, Forex Intervention, Reserves, Exchange Market Pressure, Structural Change*

JEL Classification*: E58, F31, F41*

1. Introduction

The exchange rate regime of a country depends on the manner in which the currency of the country is managed with respect to other countries' currencies. There are primarily three different types of exchange rate regimes—freely floating, fixed and pegged, or managed floating. Most developed countries of the world have freely floating exchange rate regimes wherein the central

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banks do not intervene in the foreign exchange markets to stabilize currency fluctuations. On the other hand, there are countries such as Hong Kong which have a fixed parity with the US dollar and the Hong Kong Central Bank uses its monetary policy to maintain this peg. A majority of the emerging economies lie somewhere in between these two extremes. They are mostly characterized by "managed floating" exchange rate regimes or some version of a "pegged" regime, with their respective central banks intervening in the foreign exchange market on a regular basis.

India falls in this category. In 1993, India officially moved towards a "market determined exchange rate" from a fixed peg to the US dollar. This was part of the liberalization and deregulation reforms of the early 1990s. There has been a currency market since then, and at the same time, the Reserve Bank of India (RBI) actively trades in this market.[1] In this paper, we infer and document the evolution of India's Exchange Rate Regime (henceforth, ERR) over a long period of time, from 2000 to 2020. We introduce a novel angle of analyzing the ERR, by using an Exchange Market Pressure Index (henceforth, EMP). Specifically we ask how the EMP was managed across the different exchange rate regimes. The degree of foreign exchange intervention and the degree of flexibility in the exchange rate are likely to differ across the regimes based on the response of the central bank to the EMP.

The official *de jure* classification of ERR of a country often diverges substantially from the *de facto* ERR that exists in practice (Reinhart and Rogoff 2004). Full information about the exchange rate regime is often not disclosed by the central banks and hence the ERR needs to be uncovered from historical data using statistical methods. Given the active foreign exchange intervention by the RBI, it is difficult to decipher India's ERR by simply looking at the level of the exchange rate or the volatility. The actual rate that is observed is partly an outcome of the underlying macro-financial conditions or shocks faced by the economy and partly of the intervention policy or currency policy of the central bank.

IMF's AREAER report (till 2004) has classified India's *de facto* ERR as "managed floating with no pre-determined path for the exchange rate." The existing literature classifies India's ERR as a *de facto* pegged exchange rate to the USD in the post-liberalization period (Patnaik 2004; 2007; Patnaik and Shah 2009; Zeileis et al. 2010). Using data on market-determined parallel exchange rates, Reinhart and Rogoff (2004) classify India's *de-facto* ERR (in the post-liberalization period) as a "peg to US dollar" from August 1991 to June 1995, and a "crawling peg to US dollar" from July 1995 to December 2001. Calvo and Reinhart (2002) use a metric of currency flexibility that combines exchange rate volatility, reserves volatility, and interest rates volatility. They find that the currency flexibility in India has not changed in the 1979–1999 period despite the move to a "market-determined" ERR in 1993.

1. See Patnaik (2004; 2007) for more details.

The RBI intervenes in the forex market with the stated goal of "containing volatility" (Patnaik 2005) but there is evidence that the central bank intervenes in an asymmetric manner, buying US dollars and selling rupees in order to prevent a currency appreciation (Sen Gupta and Sengupta 2013). This shows that India offers an interesting case study for deciphering the underlying ERR using a data-driven analytical framework.

The EMP measures the pressure on the exchange rate, which is either resisted through foreign exchange market intervention or relieved through an exchange rate change. In a floating ERR, when macro-financial shocks hit the economy, this exerts pressure on the exchange rate and the exchange rate freely fluctuates according to market forces. In a pegged or a managed ERR, when shocks materialize, there is EMP and the exchange rate does not change or changes much less. Instead, the central bank intervenes in the foreign exchange market to absorb the EMP.

In the last decade, significant advances have been made in the literature in the context of dating exchange rate regimes and also in terms of measuring exchange market pressure. New and relatively more sophisticated statistical tools are being used in these fields which offer greater conceptual clarity. In this paper, we make use of these methodological innovations.

We estimate the exchange rate regimes in India using the methodology outlined in Zeileis et al. (2010). Their method is an improvement on a much-used linear regression framework popularized by Frankel and Wei (1994). Once we find the ERR, we study the exchange market pressure that prevailed during each of the regimes. For this, we use a new EMP index proposed by Patnaik et al. (2017), who measure the EMP by analyzing the amount of adjustment needed in the exchange rate to remove any excess demand or excess supply of the currency that may exist in the foreign exchange market in the absence of any currency intervention.

We look at the evolution of this EMP measure in India over the last two decades and document the manner in which the RBI may have responded to changes in the EMP across the different exchange rate regimes. Specifically we ask whether the RBI attempted to manage the EMP by intervening in the foreign exchange market or let the exchange rate move absorb the EMP. As mentioned above, an attempt to manage or counter the EMP would lead to stabilization of the exchange rate, which has direct implications for the underlying ERR.

We also try to understand the transition from one regime to the next. The COVID-19 pandemic has triggered unforeseen consequences for economies all over the world. While on one hand, the US Federal Reserve has announced a massive fiscal stimulus which is already causing overheating of the economy, on the other hand, India continues to struggle with economic recovery. Towards the end of our paper, we briefly discuss what this pandemic might imply for India's exchange rate dynamics going forward and what policy options might be available in this context.

If the objective is to stabilize the exchange rate, this can be done using three instruments from the central bank's toolkit: (i) forex intervention, (ii) capital controls, and (iii) monetary policy. According to the Impossible Trilemma, which is a key insight of modern-day open economy macroeconomics, a country cannot simultaneously have an open capital account, a fixed exchange rate, and monetary policy independence. This implies that if India has an open capital account, and the RBI prefers to fix the exchange rate, monetary policy is driven solely by the need to maintain the fixed exchange rate.

Alternatively, if the RBI wishes to retain monetary policy autonomy and at the same time fix the exchange rate, it has to impose capital controls. In other words, if the decision is to manage the exchange rate as opposed to letting the exchange rate float, then this objective can be fulfilled in multiple ways. In this paper, we primarily analyze how the RBI used forex intervention to manage the exchange rate from time to time. In future research, we plan to delve deeper into the use of monetary policy and capital controls to stabilize the exchange rate across ERR.

Our paper is closely related to the sizeable literature that exists by now on analyzing exchange rate regimes (see for example, Bubula and Ötker-Robe 2002; Levy-Yeyati and Sturzenegger 2003; Reinhart and Rogoff 2004; among others). This literature mostly developed in the 2000s when it became increasingly clear that a country's *de jure* ERR (announced by the central bank) is not always the same as its *de facto* ERR. Our study is also related to existing work on dating structural breaks in India's exchange rate (see for example, Patnaik and Shah 2009).

The contribution of our work is to analyze the ERR through the prism of the EMP, and also to use the Zeileis et al. (2010) methodology to study the ERR in India for more than a 20-year period. Most of the existing studies end in 2008. Extending the sample period gives us the opportunity to throw light on the evolution of the *de facto* ERR over a long period of time.

We find that during our sample period, India witnessed four ERRs, roughly spanning the periods from 2000 to 2004, 2004 to 2008, 2008 to 2013, and 2013 to December 2020. In three out of the four regimes, the pressure on the rupee was to appreciate. The RBI responded to this appreciation pressure by intervening in the forex market and buying dollars, which resulted in a large accumulation of reserves. In one regime, in the aftermath of the 2008 Global Financial Crisis, there was pressure on the rupee to depreciate. The RBI mostly allowed the rupee to freely fluctuate in this time period. This is consistent with the evidence we provide in the paper which confirms that the RBI intervenes in the forex market in an asymmetric fashion, predominantly buying dollars when the rupee faces an appreciation pressure. In the fourth and last ERR in our sample ranging from 2013 to 2020, following the taper tantrum, the rupee was being actively managed through currency trading in both the spot and forward markets.

In the rest of the paper, we describe the methodology used to estimate the ERR and discuss the results we obtain for India in Section 2. In Section 3, we introduce the EMP measure and analyze the exchange rate regimes using this EMP Index. We discuss the transition periods from one regime to the next in Section 4. In Section 5, we discuss the ERR during the period of the COVID-19 pandemic and touch upon the way forward. Finally, we end with our concluding remarks in Section 6.

2. Exchange Rate Regimes

We estimate the exchange rate regimes prevalent in India from 2000 onwards using the structural change dating methodology described in Zeileis et al. (2010). They devise a data-drive, inferential framework to study the evolution of the ERR. Their method is based on the standard, linear exchange rate regression model popularized by Frankel and Wei (1994), which has been used in a number of studies to analyze a country's *de facto* ERR.[2] The model uses the returns on cross-currency exchange rates expressed in terms of a suitable numeraire currency.

To apply this method, we use the New Zealand dollar (NZD) as the numeraire currency, given its stability over a long period of time.[3] The underlying model that is estimated is as follows:

$$y_t = x^T_t \beta + u_t \ (t = 1, ..., n) \qquad (1)$$

where y_t are the returns of the target currency, in our case, the Indian rupee (INR) in terms of NZD and the x_t are the vectors of returns of a basket of currencies at time t. For our purpose, we use the US dollar, Japanese yen, Euro, and British pound all expressed in terms of the NZD. These are the most important floating currencies in the world.[4] We use the weekly returns of these exchange rates in order to reduce the noise in the data and also to ease the computation burden of the regime-dating algorithm.[5] This regression picks up the extent to which the INR/NZD rate fluctuates in response to fluctuations in any of the currencies on the right-hand side of the equation.

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2. See, for example, Kawai and Akiyama (2000), McKinnon (2001), Baig (2001), Ogawa (2002; 2004), Bowman (2005), Patnaik (2005), Bénassy-Quéré et al. (2006), Ogawa and Kudo (2007), Frankel and Wei (2007), Ogawa and Yang (2008), Shirono (2008), Patnaik and Shah (2009), Kawai and Pontines (2016), among others.

3. While Zeileis et al. (2010) used the Swiss Franc as the numeraire currency, we use the NZD instead because in recent years the SWF has been actively managed with respect to the Euro. However, as mentioned in Frankel and Wei (1994; 2007), for the managed exchange rates, the results of the regression analysis do not critically depend on the choice of the numeraire.

4. Since our sample period starts from 2000, we can safely use the Euro which was introduced as the official currency of the Euro zone from 1999 onwards.

5. We compute log-difference returns (in percentages) of all the currencies, i.e., 100 (log p_t–log p_{t-1}), with p_t being the price of a currency at time t expressed in terms of a numeraire currency.

For example, if the INR is pegged to the USD, then the corresponding beta value will be close to 1 and all the other beta values will be close to zero. If on the other hand, the INR is not pegged to any of these currencies, then all the beta values will be different from 0 and will reflect the true trade and financial linkages of the economy with the rest of the world. If the INR is instead pegged to a basket of currencies, then the beta values would reflect the corresponding weights of the currencies in that basket. In the case of reduced exchange rate flexibility, the R-squared of this regression would also be very high, while lower values would be obtained for floating currencies.

Using this linear regression model, one can find out the relationship that exists between the y_t and x_t currencies over a specific period of time. However, one cannot infer whether this relationship is stable within a given time period, whether it remains stable with future incoming observations, and in case of instabilities in the model parameters, when and how the estimated regime underwent a change. In other words, this regression model alone cannot help in understanding if and when changes in ERR take place.

Exchange rate regimes can change due to changes in the policy interventions by the central bank. However, the precise timing of these interventions is often not known which makes it difficult to assess the time-window over which this model can be fitted. As a result of these interventions, the underlying model parameters would change. In order to estimate the changes in the ERR, we need a methodology that takes into account the parameter instabilities and dates the regime changes based on these instabilities. This is the main premise of the Zeileis et al. (2010) method. They use statistical procedures for testing the stability of the ERR based on past data, monitor the stability of the regimes as new data comes in, and estimate the break points when the ERR changes using the structural change methodology of Bai and Perron (2003).

The conventional method of estimating structural changes in the exchange rates was based on the algorithm devised by Bai and Perron (2003) juxtaposed on the Frankel and Wei (1994) ordinary least squares regression model mentioned in Equation (1). One shortcoming of this method was that it did not take into consideration changes in the error variance as a full model parameter. A change in the underlying ERR necessarily involves a change in the error variance and hence excluding this parameter would result in an incomplete picture. The error variance captures the flexibility of the ERR. If for example, the INR is pegged to the basket of five currencies, then the error variance will take a low value, whereas if the INR is in a floating ERR, then the error variance will be relatively high.

Zeileis et al. (2010) extend the dating algorithm of Bai and Perron (2003) to the maximum-likelihood and quasi maximum-likelihood (ML and QML) models, include the error-variance in the set of model parameters over and above the estimated beta coefficients, and assume that the error is normally distributed.

In particular, they estimate a quasi-normal model specified by the following density function:

$$f(y|x, \beta, \sigma^2) = \varphi((y - x^T \beta)/\sigma)/\sigma \quad (2)$$

where $\varphi(.)$ is the standard normal density function with combined parameter $\theta = (\beta^T, \sigma^2)^T$ which has a length of $k = c+2$ (i.e., c currency coefficients or betas, intercept and error variance). In this way, they are able to assess the parameter instability *jointly* for β and σ^2. They then devise a unified framework for testing and monitoring the stability of these parameters and apply the dating algorithm of Bai and Perron (2003) to their maximum-likelihood model.

They assume n observations of y_t and x_t such that the conditional distribution $y_t|x_t$ follows the quasi-likelihood function $f(y_t|x_t, \theta_t)$, with θ_t being a k-dimensional parameter, as mentioned above. The hypothesis they test is that the parameter is stable over time, i.e.

$$H_0: \theta_t = \theta_0 \ (t = 1, 2, ..., n) \quad (3)$$

The alternative hypothesis is that θ_t changes over time (which is what we would expect in the case of changes in the ERR). If the parameters θ_t are stable over time, they can be estimated by minimizing the corresponding negative log-likelihood function (i.e., $-\log f(y_t|x_t, \theta_t)$).[6]

If the null hypothesis in Equation (3) is rejected, i.e. there is evidence that the parameters do change over time, then the dating algorithm can be applied to find out when these changes take place. If the break-dates are known *a priori*, then estimation of the model parameters would be relatively straightforward for each of the regimes or segments. Typically however, the break-points are not known. In that case, the optimal number of regimes (and hence break-points, m) can be computed by using some information criteria (such as the BIC and a modified BIC suggested by Liu et al. (1997)).

Zeileis et al. (2010) applied their methodology to India to uncover the *de facto* ERR. Using their methodology, we too find four distinct exchange rate regimes in India during our sample period, 2000–2020, with the first two regimes overlapping with the last two segments found by Zeileis et al. (2010). We report the dates of these regimes along with the corresponding, estimated coefficients of the basket of currencies, the standard errors as well as the values of the error-variance and the R-squared in Table 1.

- The first regime ranges from January 2000 to March 2004, and can be categorized as one where the rupee was closely pegged to the US dollar. The highly statistically significant coefficient of the US dollar is close to 1 (0.95) while the coefficients of the remaining four currencies are close

6. Further details on the tests and the monitoring mechanism can be seen from Zeileis et al. (2010).

TABLE 1. INR Exchange Rate Regimes, 2000–2020

Start/End	*USD*	*JPY*	*EUR*	*GBP*	*Sigma*	*R-squared*
January 14, 2000 to March 19, 2004	0.95*** (0.02)	0.00 (0.02)	–0.01 (0.02)	0.00 (0.02)	0.24	0.97
March 26, 2004 to February 29, 2008	0.75*** (0.05)	0.09** (0.04)	0.03 (0.07)	0.05 (0.06)	0.51	0.86
March 7, 2008 to November 22, 2013	0.63*** (0.06)	–0.05 (0.05)	0.11* (0.06)	0.02 (0.06)	0.95	0.61
November 29, 2013 to December 31, 2020	0.87*** (0.04)	–0.04 (0.04)	–0.02 (0.05)	0.00 (0.03)	0.59	0.73

Source: Bank of International Settlements (BIS) database and authors' calculations.
Note: Standard errors in parentheses. *p < 0.1; ** < 0.05; ***p < 0.01.

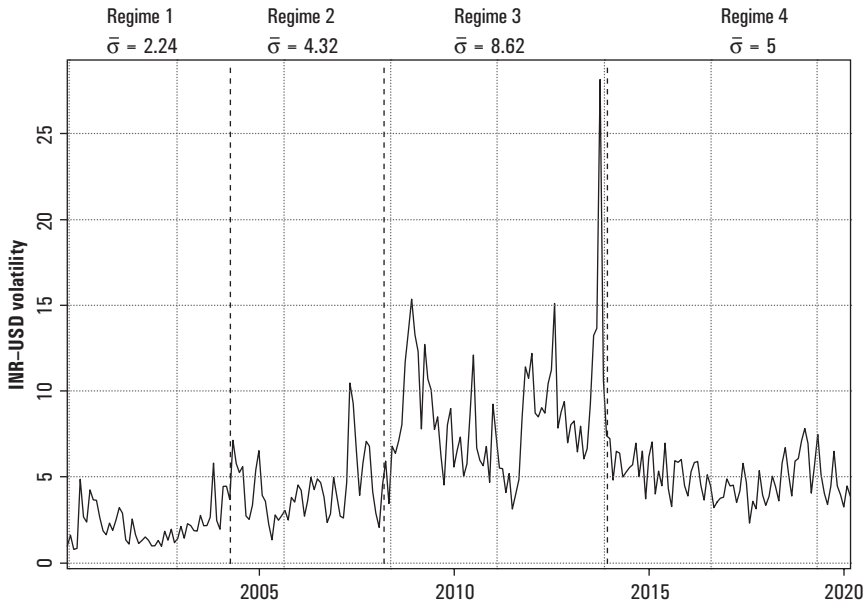
to 0. The σ is the lowest in the sample period and the R-squared value is the highest, further confirming a pegged ERR.

- The second regime spans the period March 2004 to February 2008. The R-squared value comes down from 0.97 to 0.86 and the σ goes up from 0.24 to 0.51. The INR seems to have shifted to a less tight peg where the weight of the USD, though still the highest, is lower than regime 1.
- The next regime goes from March 2008 to November 2013, and is characterized by the lowest value of the R-squared, and the highest value of σ. This can, therefore, be classified as the most flexible ERR in our sample period. The estimated coefficient of the USD is also the lowest, implying that much less weight was assigned to the dollar in the basket of currencies.
- The fourth and final regime lasts from November 2013 to the end of our sample period. It is the longest period under one single exchange rate regime. The flexibility of the INR gets reduced as compared to the previous regime as shown by the increase in the R-squared value and decrease in σ. The weight of the USD is also the second highest in the sample period, implying that the INR went back to being relatively more "pegged" to the dollar, as compared to its increased flexibility in the preceding ERR.

We next plot the annualized volatility of the rupee-dollar exchange rate as well as the level of the exchange rate across the four regimes in Figures 1 and 2, respectively. Consistent with our categorization of the ERR, we find that the average currency volatility was the highest in Regime 3 (8.62 percent) and lowest in Regime 1 (2.24 percent). The volatility increased in a staggered fashion, implying a gradual increase in the flexibility of the exchange rate which peaked in Regime 3, and then declined sharply in the last regime (5 percent), almost down to the same level as Regime 2, indicating a more managed ERR.

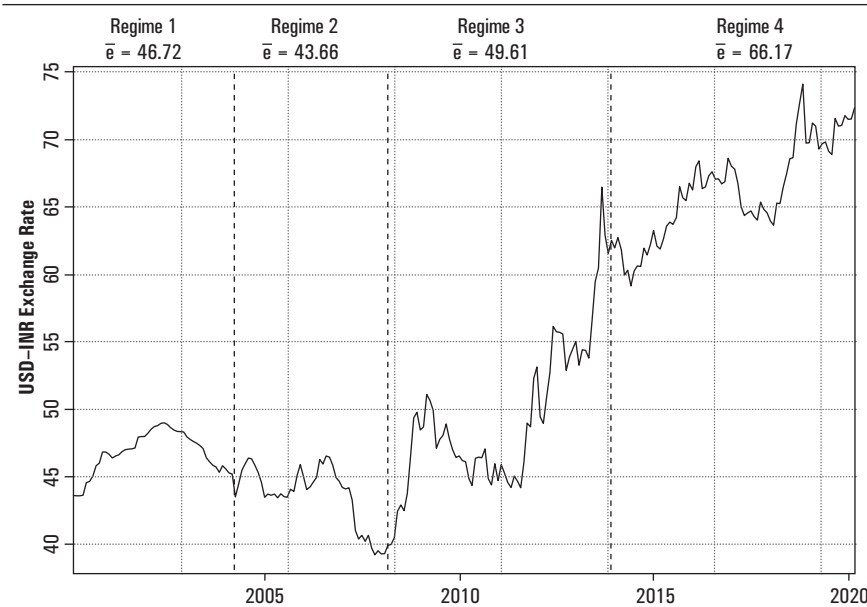
Figure 2 shows that while there were brief phases of currency appreciation, especially towards the beginning of our sample period, overall the rupee has been

FIGURE 1. Exchange Rate Regimes and Volatility of the INR/USD Exchange Rate



Source: BIS database and authors' calculations.
Note: This graph plots the annualized volatility of the INR/USD nominal exchange rate across the different exchange rate regimes. The mean currency volatility ($\bar{\sigma}$) in each regime has been mentioned at the top of the graph.

FIGURE 2. Exchange Rate Regimes and the INR/USD Nominal Exchange Rate



Source: BIS database and authors' calculations.
Note: This graph plots the level of the INR/USD nominal exchange rate across the different exchange rate regimes. The average exchange rate values ($\bar{e}$) in each regime has been mentioned at the top of the graph.

depreciating. This largely reflects the underlying macroeconomic fundamentals of the Indian economy, specifically the inflation differential between the US and India. The only exception seems to be Regime 2 during which the rupee, on average, seems to have appreciated.

3. Exchange Market Pressure

Exchange market pressure measures not only the change in the exchange rate that is observed, but also the foreign exchange intervention that prevented a movement of the exchange rate. The ERR analysis focuses on observed changes in the currency. The EMP allows us to understand how much of the observed change was policy-determined.

3.1. Measuring the EMP

The EMP is the total pressure on the exchange rate, resisted primarily through forex intervention (thereby causing a change in reserves) or relieved through the exchange rate change. There exist several measures of EMP in the literature that combine changes in the exchange rate and reserves, but most of them suffer from problems of units. Some other measures have tried to resolve this problem by normalizing the exchange rate and reserves and weighing them by the inverse of their respective volatilities (or using alternative weights).[7] However, as pointed out by Pontines and Siregar (2008), all these EMP indices are characterized by the common problem of the arbitrary choice of weights.

This, in turn, can result in misleading conclusions about the EMP, especially during the ERR changes. For example, having the inverse of the standard deviation of the exchange rate and reserves as the weights imply that in a fixed ERR, the weight assigned to movements in the exchange rate by construction would be infinity (Patnaik et al. 2017). This means that if in a country with a fixed ERR, small changes in the exchange rate are allowed, this will show up as very high EMP values because of the large weight assigned to exchange rate movements and small weight assigned to reserve changes.

The EMP measure proposed by Patnaik et al. (2017) avoids these problems and also measures the EMP in consistent units, i.e., percentage change in the exchange rate. They calculate the EMP as the actual change in the exchange rate that took place and the change that would have occurred in the absence of any forex intervention. They estimate the following equation to derive the EMP measure:

$$EMP_t = \Delta e_t + \rho_t I_t \quad (4)$$

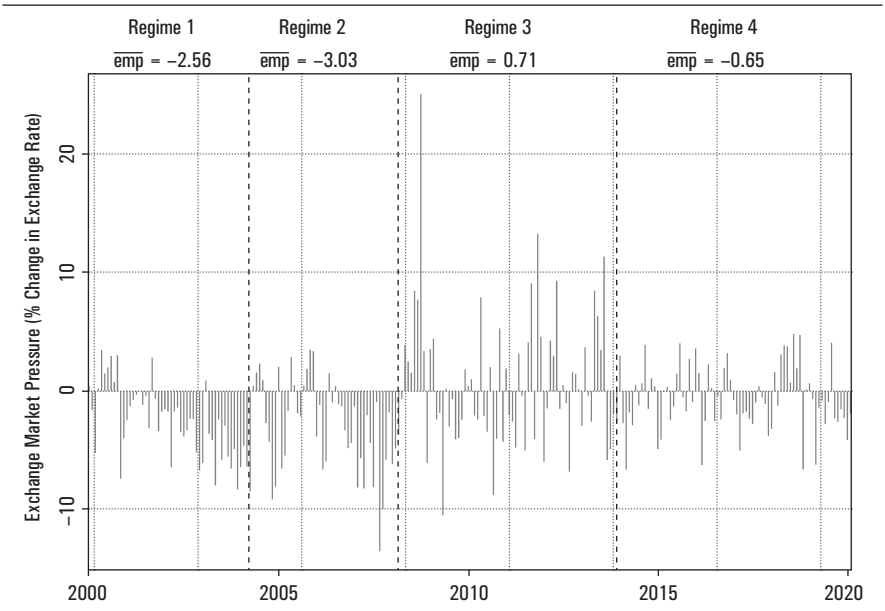
7. See, for example, Eichengreen et al. (1996), Sachs et al. (1996), Kaminsky et al. (1998), Pentecost et al. (2001), Klaassen (2011), among others.

where, Δe_t is the percentage change in the nominal exchange rate, I_t is the actual intervention in the forex market measured in billion dollars, and ρ_t is the percentage change in the exchange rate associated with $1 billion forex intervention. They estimate the value of ρ_t which they call the conversion factor. $\rho_t I_t$ is, therefore, the exchange rate change that would have materialized had there been no forex intervention. This, added to the actual change in the exchange rate, gives a comprehensive measure of the pressure faced by the exchange rate.

A negative EMP value denotes an appreciation pressure vis-à-vis the US dollar, whereas a positive EMP value captures the depreciation pressure. The EMP index is expressed in units of percentage change in the exchange rate over a one-month period.

We plot the EMP over our sample period in Figure 3 and highlight the four exchange rate regimes using vertical lines.[8] We find that during the first, second,

FIGURE 3. Exchange Rate Regimes and Exchange Market Pressure Index



Source: Authors' calculations based on Patnaik et al. (2017).

Note: This graph plots the Exchange Market Pressure index across the four exchange rate regimes. The average EMP index values ($\overline{emp}$) in each regime has been mentioned at the top of the graph. This EMP measure is constructed based on Equation (4) and using data on forex intervention, percentage change in exchange rate and the same rho values as in Patnaik et al. (2017). A negative EMP index denotes pressure on the currency to appreciate whereas a positive EMP implies pressure on the currency to depreciate.

8. The EMP for India refers to the pressure on the rupee to appreciate or depreciate vis-à-vis the US dollar. As shown in Table 1, the dollar consistently comes up as the currency against which the rupee is managed during the period of our study. Also as shown by Ilzetzki et al. (2017), the US dollar continues to be the world's dominant anchor currency. In the case of India, as of 2012, 86 percent of the exports and 80 percent of the imports were denominated in dollars.

and fourth ERR, the EMP was mostly negative. This implies that the rupee experienced a pressure to appreciate for a majority of the sample period. The direction of the EMP changed around the time of the 2008 Global Financial Crisis. During the third ERR, which ranges from 2008 to 2013, the rupee primarily faced a pressure to depreciate.

When we look at Figures 2 and 3 in conjunction with each other, the implications are interesting. During three of the four regimes, the EMP and the actual movement of the exchange rate seem to have been in the same direction. In Regimes 1 and 2, the EMP shows a pressure on the rupee to appreciate and the exchange rate seems to have actually appreciated. In Regime 3, the EMP shows a pressure on the rupee to depreciate and the currency seems to have actually depreciated. However, this does not seem to be the case for Regime 4. In the next section, we explore this in greater detail and for this we look into the response of the RBI to the EMP across the four exchange rate regimes.

3.2. Managing the EMP across Exchange Rate Regimes

In this section, we ask how the EMP was managed across the four exchange rate regimes. Specifically we look into the proportion of EMP that was resisted through forex intervention and the proportion that was relieved through the exchange rate change in each of the regimes.

Equation (5) shows the share of the EMP absorbed by the exchange rate change ($\Delta e_t/EMP_t$) and the share of the EMP absorbed by forex intervention ($\rho_t I_t/EMP_t$). If the ERR is a pegged (flexible) or actively (less actively) managed one, the share of forex intervention in the EMP absorption would be relatively higher (lower) and the corresponding share of the exchange rate would be lower (higher).

$$\begin{aligned} EMP_t &= \Delta e_t + \rho_t I_t \\ 1 &= \Delta e_t/EMP_t + \rho_t I_t/EMP_t \end{aligned} \tag{5}$$

In Table 2, we report the average values of shares of the EMP absorbed by the exchange rate change and forex intervention for all the four exchange rate regimes. Here we look at the currency spot market intervention. We also report the average values of the EMP, the actual change that took place in the exchange rate, and the net spot market intervention (dollar purchase less dollar sale) during these regimes.

We find that during Regime 1 (2000–2004), the EMP and the exchange rate moved in the same direction. The average EMP was –1.95 percent, indicating a pressure on the rupee to appreciate. The actual change in the exchange rate was –0.005 percent, meaning that the exchange rate appreciated but by much less than what was implied by the EMP. This was because during this period, the RBI intervened in the forex market and bought enough reserves to counter the currency appreciation but not to change the direction of movement of the

TABLE 2. Exchange Market Pressure (EMP) Management across Exchange Rate Regimes

FX Regimes	*EMP^*	*Change in Exchange Rate^*	*Net Spot Intervention# (USD Bn)*	*Share of Exchange Rate*	*Share of Intervention*
January 14, 2000 to March 19, 2004	–1.945	–0.005	1.140	–0.094	1.094
March 26, 2004 to February 29, 2008	–2.075	–0.174	2.792	0.653	0.347
March 7, 2008 to November 22, 2013	1.017	0.647	–0.804	1.029	–0.029
November 29, 2013 to February 29, 2020	–0.526	0.186	2.074	0.603	0.397

Source: RBI and BIS databases, EMP index from Patnaik et al. (2017) and authors' calculations.

Note: The columns report averages across the four exchange rate regimes.

#Net spot intervention is the purchase of dollars minus the sale of dollars. A positive value means more USD were bought, on average, during the regime, while a negative value means more USD were sold.

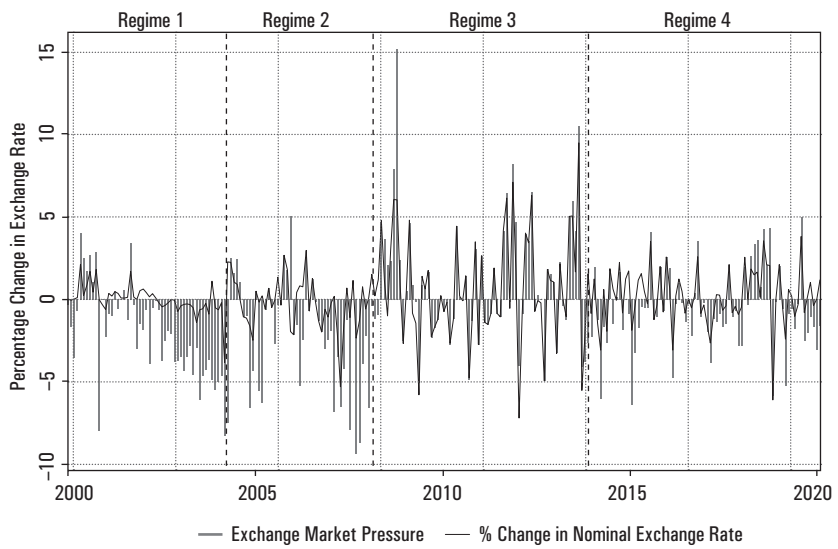
^A positive value corresponds to currency appreciation and a negative value to currency depreciation. While the last regime continues till the end of our sample period (December 2020), here we only show till February 2020 because after that the country was hit by the COVID-19 pandemic and we analyze the exchange rate dynamics of the pandemic period in a subsequent section.

exchange rate. As Table 2 shows, the average net spot market intervention (dollar purchase net of dollar sale) by the RBI was $1.14 billion. The average share of spot market intervention was also higher than the share of the exchange rate in EMP absorption; in fact, it was the highest in the sample period. This can also been seen in Figure 4, which plots the EMP series against the actual change in the nominal exchange rate. This is consistent with the description of Regime 1 as one where the rupee was mostly pegged to the dollar as shown in Table 1.

By comparison, the rupee was relatively less managed in Regime 2 (2004–2008). The actual appreciation in the exchange rate (–0.174 percent) was significantly lower than the appreciation pressure indicated by the EMP (–2.075 percent), implying that forex intervention by the RBI continued to have a role to play. The appreciation pressure on the rupee in this regime was the highest in our sample period. This might explain why the RBI's average net purchase of dollars ($2.79 billion) was also the largest in this regime. At the same time, the share of the exchange rate (65 percent) was higher, indicating that the rupee was allowed to fluctuate more.

This trend of the RBI intervening and buying dollars to prevent or lower the extent of rupee appreciation was reversed during Regime 3 (2008–2013). The average change in the exchange rate was closer in magnitude to the average value of the EMP. This was the only period in our study during which the RBI became a net seller in the currency spot market. In the aftermath of the 2008 crisis, the rupee faced depreciation pressure, as shown by the positive, average EMP value of 1.02. The RBI sold dollars in the forex market as a result of which

FIGURE 4. Exchange Market Pressure (EMP) and Change in Exchange Rate across Regimes



Source: BIS database, EMP index from Patnaik et al. (2017) and authors' calculations.

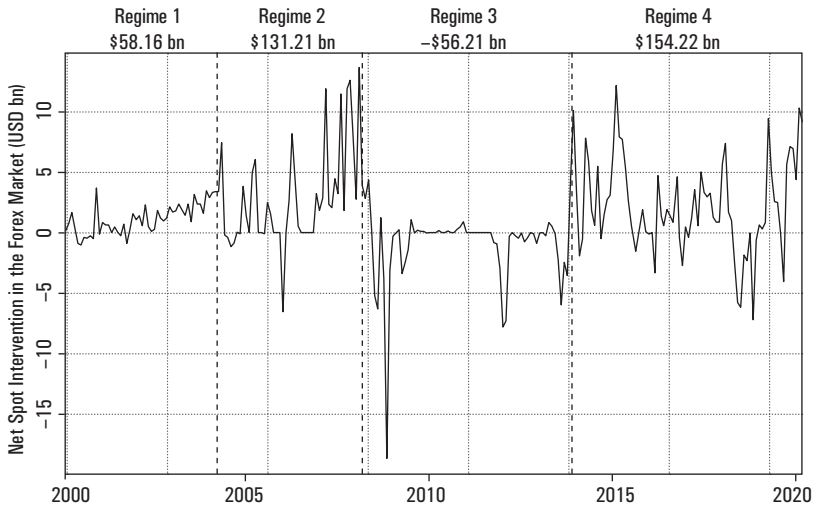
the exchange rate depreciated but by less (0.65 percent on average) than what was implied by the EMP.

Attempts by the RBI to resist the currency depreciation by selling reserves did not contribute significantly to EMP management. The EMP was primarily relieved through the exchange rate change, as can also be seen from Figure 4. The absolute magnitude of the average change in the exchange rate was the highest in this regime and the share of the exchange rate change in the EMP absorption was also the highest. This shows that during this period, the exchange rate was predominantly in a floating regime. This confirms our earlier observations based on the results presented in Table 1, which showed that this was the only regime in our sample period when the rupee came closest to being a flexible currency.

The contrast between Regimes 1 and 2, on one hand, and Regime 3, on the other hand, are further highlighted in Figure 5, which plots the EMP series against the net spot market intervention. The figure clearly shows that spot market intervention was relatively lower during Regime 3, and in the direction of the dollar sale, whereas the higher interventions in Regimes 1 and 2 were mostly in the direction of dollar purchases. Figure 6 plots the gross intervention by the RBI in the forex market (dollar sale + dollar purchase). The figure shows similar magnitudes during Regimes 1 and 2. During Regime 3, the turnover in the forex market was the lowest. It went up again in Regime 4.

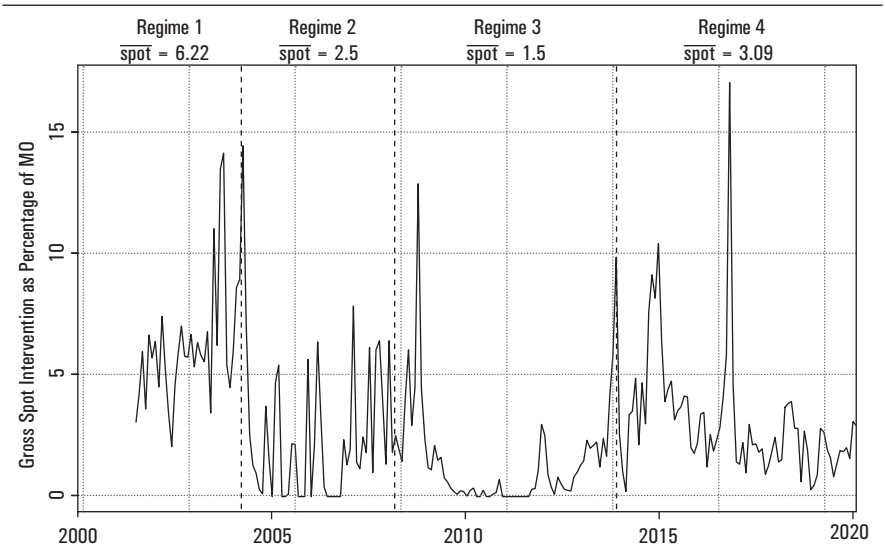
During the last and most recent regime (2013–2020), the average EMP was –0.53 percent and the actual change in exchange rate was 0.19 percent. This means that on average, there was a pressure on the exchange rate to appreciate

FIGURE 5. Net Intervention in the Currency Spot Market



Source: RBI database and authors' calculations.
Note: Total spot intervention by RBI in forex market (in USD billion) is mentioned at the top of each regime's duration in the graph.

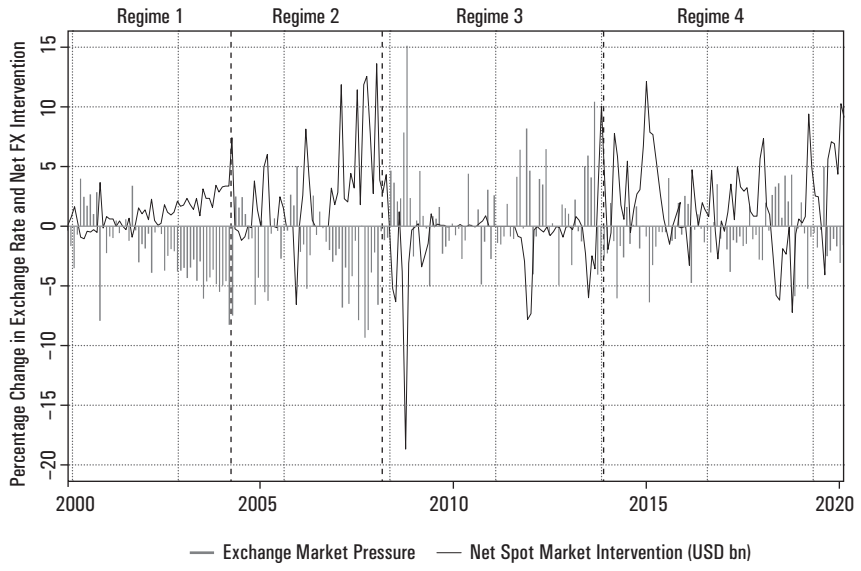
FIGURE 6. Gross Turnover in the Currency Spot Market



Source: RBI database.
Note: This is a graph of the total dollar sale and purchase by the RBI expressed as a share of MO (*spot*). The average spot values ($\overline{spot}$) are reported at the top of each regime's duration in the graph.

but the exchange rate depreciated. The only way this could have happened was if the RBI did "excessive intervention" in the forex market to buy dollars. If the RBI bought enough dollars to counter the currency appreciation or simply to reduce the currency volatility, then the exchange rate, on average, would still

FIGURE 7. Exchange Market Pressure (EMP) and Net Spot Market Intervention



Source: RBI database, EMP index from Patnaik et al. (2017) and authors' calculations.

have appreciated but the magnitude of appreciation would have been less than what was reflected in the EMP, as was the case in Regimes 1 and 2.

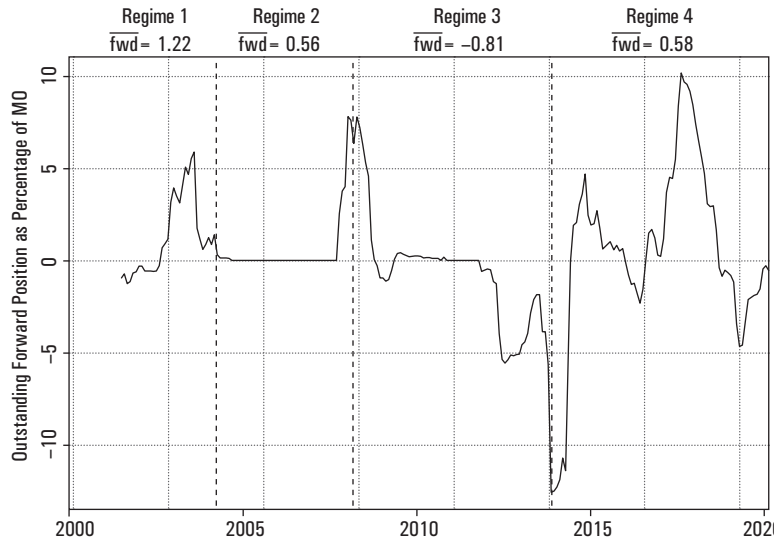
It is interesting to note a sort of anomaly in this context. As can be seen in Figure 7, in Regime 2, when RBI's net dollar purchase was the highest ($2.79 billion), the appreciation pressure on the rupee was also the highest (–2.08 percent), whereas in Regime 4, even though the net purchase was the second highest ($1.86 billion) in the sample period, the appreciation pressure on the rupee (–0.53 percent) was the lowest during our study period. This potentially indicates "excessive" forex intervention by the RBI. The average share of the exchange rate in the EMP absorption was higher than that of spot market intervention but Regime 4 was clearly one where the exchange rate was more managed as compared to the previous ERR and was, in fact, largely similar to that in Regime 2. This corroborates our findings from Table 1 as well.

Over and above intervening in the currency spot market, the RBI also intervenes in the forward market. Figure 8 shows the monthly outstanding position of the RBI in the currency forward market as a percentage of the total money supply.[9]

In Figure 9, we plot the EMP measure against the RBI's net foreign exchange intervention in a four-quadrant graph. The figure sheds some more light on the RBI's asymmetric intervention in the currency market. For a majority of the time, the RBI has been a net buyer of dollars in response to an appreciation

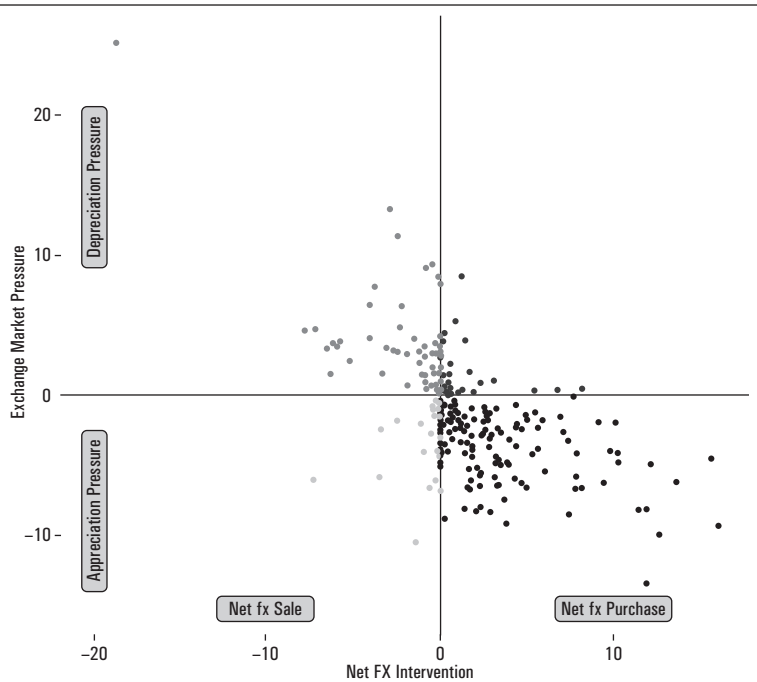
9. In the absence of detailed data on the RBI's forward market interventions, we are not able to delve deeper into this particular aspect of currency management.

FIGURE 8. Outstanding Position in the Currency Forward Market



Source: RBI database and authors' calculations.
Note: This is a graph of the monthly outstanding forward position as a share of M0 (*fwd*). The average values ($\overline{fwd}$) are shown at the top of each regime's duration in the graph.

FIGURE 9. RBI's Asymmetric Intervention in the Forex Market



Source: RBI database, EMP index from Patnaik et al. (2017) and authors' calculations.
Note: This is a four-quadrant graph plotting the monthly net forex (fx or FX) intervention by the RBI against the Exchange Market Pressure index.

pressure on the rupee, as seen from the density of the scatter plot in the lower right hand quadrant of the graph. This further suggests that the RBI does not intervene in the forex market only to contain volatility of the rupee because if that had indeed been the case, then we would have seen a more well-rounded distribution of the scatter plot.

4. Understanding the Regimes and the Transitions

In this section, we delve deeper into the transitions from one ERR to the other to throw some light on the underlying macroeconomic conditions. While it is difficult to exactly pinpoint the factors that cause regime changes, we provide a descriptive analysis of the events leading up to a regime transition. The idea here is that the manner in which the EMP was managed in one regime versus the other might have been a function of the underlying macroeconomic conditions or shocks faced by the economy during the transition periods.

We primarily analyze the transitions across the regimes from the perspective of changes in capital flows, resultant changes in the EMP, and how this was subsequently managed by the central bank. As discussed in Ilzetzki et al. (2017), forex intervention and accumulation of reserves by countries since the early 2000s have much to do with the desire to stabilize exchange rates in an environment of increased capital market integration.[10] Figure 10 shows the evolution during our sample period of the forex reserves holding of the RBI across the four ERR.

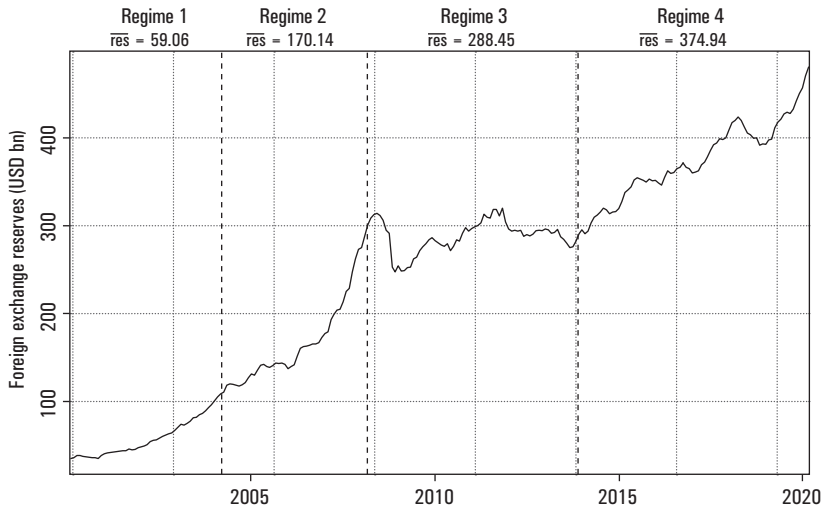
4.1. Transition to Regime 2 (March 2004)

The transition from Regime 1 to Regime 2 was shaped by the depletion of government bonds on the RBI's balance sheet towards the beginning of 2004, thereby hampering the process of sterilization of the RBI's net dollar purchases in the forex market.

During the first exchange rate regime (January 2000 to March 2004), the Indian economy received a total capital inflow of roughly $220 billion and witnessed an outflow of $175 billion. The net capital inflows led to the appreciation pressure as reported in Table 2. This, in turn, caused the RBI to intervene in the forex market and conduct an aggregate net purchase of dollars of $58.2 billion. Reserves went up sharply from $34 billion in 2000 to $110 billion by early 2004, registering an average annual growth rate of around 33 percent, the highest in our sample period. Most of this forex intervention by the central bank was sterilized

10. While we describe what the various regimes in India were during our period of study, we do not go into the potential rationale behind the central bank's actions. For example, we are not trying to explain why the RBI let the rupee depreciate in 2008–2013 or why the RBI attempted to prevent an appreciation in the 2013–2020 period. This may be taken up in future research.

FIGURE 10. Exchange Rate Regimes and Foreign Exchange Reserves



Source: RBI database.

Note: This graph plots the level of the foreign exchange reserves (*res*) held by the RBI across the different exchange rate regimes. The average value of the reserves ($\overline{res}$) in each regime has been mentioned at the top of each regime's duration in the graph.

as a result of which inflation could be kept insulated from the consequences of RBI's reserve accumulation.

The purchase of dollars and full sterilization by the RBI had led the market participants to believe that once the stock of government bonds on the RBI's balance sheet was exhausted, the RBI would stop buying dollars as it would not want to do unsterilized intervention lest it fuels inflationary pressures. As a consequence, when that happened, i.e., when the RBI indeed ran out of government bonds, the rupee would appreciate. This further pushed up the level of capital flows into India as foreign investors believed that the rupee was a one-way bet. Either the rupee dollar rate would stay where it was, if the RBI kept intervening, or the RBI would stop intervening and the rupee would appreciate. This would increase the dollar returns of rupee assets.

As a result, the pressure on the currency to appreciate continued unabated and the RBI did not stop buying dollars either. In 2004, a new arrangement for sterilization of forex intervention was put in place. Under this system, the RBI could continue to peg to the USD, buy dollars and sell Market Stabilization Scheme (MSS) bonds whose sole purpose was sterilization. This allowed the RBI to continue its purchase of dollars without worrying about how to sterilize them.

4.2. Transition to Regime 3 (March 2008)

In March 2008, Bear Sterns in the US had a liquidity crisis. These were the first signs of trouble in the US financial system that eventually led up to the Global

Financial Crisis, culminating in the collapse of Lehman Brothers in September 2008. For emerging economies like India, this was the beginning of pressure on the currency to depreciate. Net capital inflows fell sharply by 93 percent, from $106 billion in 2007–2008 to a mere $7 billion in 2008–2009. The average EMP went from an appreciation pressure of –5.8 percent in 2007 to a depreciation pressure of roughly 2.6 percent in 2008 in response to the massive capital outflows. The ERR turned from one of a pegged rupee that was not being allowed to appreciate to one that was much more volatile with the RBI permitting it to depreciate.

4.3. Transition to Regime 4 (November 2013)

The exchange rate transitioned to the fourth and last regime in November 2013. The events leading up to this date may help throw some light on the transition. In May 2013, the erstwhile Federal Reserve Chair Ben Bernanke announced that the US Fed would soon commence tightening of monetary policy and would taper the quantitative easing program that had been initiated in the aftermath of the 2008 crisis. This episode was widely known as the "taper tantrum." In response to this announcement, the US 10-year yield went up drastically, which in turn, triggered massive capital outflows from emerging market economies including India. India's net capital inflows nearly halved from $89.3 billion in 2012–2013 to $48.8 billion in 2013–2014. This was the second biggest decline in net inflows in our sample period, the largest being during the 2008 Global Financial Crisis. This resulted in a sharp currency depreciation.

In April 2013, the EMP value for India was –2.58 percent, indicating pressure on the currency to appreciate. This increased to 8.46 percent in May 2013, implying a strong pressure on the rupee to depreciate. The average EMP for the period January–April 2013 was –0.55 percent, while the average EMP for the next four-month period from May to August 2013 increased to 7.41 percent. In fact, if we ignore the turbulent period of the 2008 Global Financial Crisis, August 2013 witnessed the highest depreciation pressure on the rupee in our sample. Figure 1 shows the sharp increase in currency volatility during this period. Volatility went up from 6.8 percent in May 2013 to 28.2 percent by September 2013, once again the highest in our sample period. This goes on to show the kind of pressure and volatility experienced by the rupee-dollar exchange rate towards the end of Regime 3.

The RBI and the government responded to the sharp and rising depreciation pressure on the rupee, in the immediate aftermath of the tapering announcement, in multiple ways. These involved restrictions on the currency derivatives markets, a series of steps by the RBI to squeeze liquidity in the banking system and raise short-term interest rates, tariff hikes, restrictions on gold and silver imports, tightening of capital controls to discourage capital outflows by firms

and households, increasing investment limits for foreign institutional investors, liberalizing external commercial borrowing by Indian firms, and so on.

The 91-day Treasury Bill rate, which is a reasonable proxy for the overall monetary policy stance, went up from roughly 7.5 percent in May 2013 to 12 percent in October 2013, a dramatic increase of 440 basis points. At the same time, however, the RBI did not actively intervene in the forex market to defend the rupee. Between May and October 2013, it sold a net amount of only $10 billion in the spot market. In other words, the rupee defense was carried out mostly through monetary policy and capital controls.

It seems that after a prolonged period of minimal intervention to stabilize the currency (2008–2013), the measures undertaken in the wake of the taper tantrum episode to reduce liquidity in the system and defend the exchange rate may have triggered a change in the ERR. As shown in Figure 1 earlier, from December 2013 onwards, the average volatility of the currency came down from 8.6 percent to 5 percent, indicating a more managed exchange rate.

5. The Pandemic and Beyond

During the period of the COVID-19 pandemic (March 2020 to March 2021), specifically in the April–June and July–September quarters of 2020, India witnessed a current account surplus after 17 years of deficit. Exports from India are expected to rise, going forward, as the US economy and world trade recover from the shock imposed by the pandemic. In addition, India remains an attractive investment destination with both Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI) flows coming into India.

Between March 2020 and February 2021, the average EMP was –1.95 percent, implying that the rupee faced an appreciation pressure, whereas on average, the rupee appreciated by 0.2 percent. The RBI did an aggregate net purchase of $70 billion during this period, presumably to reduce the extent of rupee appreciation. Foreign exchange reserves went up from roughly $475 billion in March 2020 to close to $580 billion by March 2021. Our estimation of the ERR shows that the pandemic period was a part of Regime 4, which started in November 2013. In other words, the trend of the RBI intervening in the forex market to buy dollars and to manage the EMP by reducing currency appreciation continued during the pandemic.

With the opening up of the trade and the capital accounts, the currency market has grown very large.[11] Old solutions, like buying a few billion dollars to

11. The gross turnover in the currency spot market in January 2000 was roughly $2.34 billion (total dollar sale and purchase by the RBI). This had gone up to $47.92 billion by February 2021. This only captures trading by the central bank.

prevent appreciation, or selling a few billions from the central bank's reserves to prevent a currency depreciation, may no longer work. Moreover, the Indian economy is struggling to recover from the adverse impact of the COVID-19 pandemic, which has dealt a severe blow to economic growth. In the event of an external shock, such as the US Fed announcing a tightening of monetary policy, similar to the 2013 taper tantrum episode, the rupee might depreciate sharply against the dollar. If the RBI attempts to defend the currency either by tightening liquidity in the domestic financial system or by raising interest rates to discourage capital outflows, this may hamper the growth recovery process. The RBI would need to weigh the pros and cons of a currency defense strategy, especially from a medium-term perspective, before embarking on a drive to prevent the rupee from depreciating.

6. Conclusion

The research on *de facto* exchange rate regimes is an evolving field. In this paper, we have tried to understand India's exchange rate regime using the techniques developed in the field in recent years. The *de facto* exchange rate regime literature is limited in that while it uses observed data on exchange rates, it is unable to integrate this behavior with the policy intentions of the central bank. We, therefore, use the techniques developed in the Exchange Market Pressure literature to understand how the pressure on the exchange rate is absorbed, through forex interventions, or relieved through the movements of the exchange rate. This brings into the analysis the exchange rate policy of the central bank.

We find four periods in India's *de facto* ERR. Among these, we find that there was one regime (2008–2013) in which the rupee faced a pressure to depreciate and it was a period of relatively high volatility of the rupee. The other three periods saw pressure on the rupee to appreciate and relatively low volatility of the rupee. In these periods, the RBI accumulated reserves. We also provide evidence that the RBI has been intervening in the forex market in an asymmetric fashion to prevent the rupee from appreciating.

In this paper, we have not been able to measure the role of monetary policy (Goldberg and Krogstrup 2018) or of capital controls (Akram and Byrne 2015). The techniques for measuring these in absorbing the exchange market pressure are still evolving. This is thus an agenda for future research.

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Comments and Discussion*

Chair: **Raghuram Rajan**
University of Chicago and former RBI Governor

Poonam Gupta
NCAER

I enjoyed reading this paper and found it particularly interesting because it relates to some of my own work. The main point made in the paper is that India manages its exchange rate, or in other words, it stabilizes the value of its exchange rate. In order to do so, it actively uses foreign exchange reserves. The paper notes that India deviated from this practice during the period 2008–2013.

The paper also suggests that managing the exchange rate and reserve policy in such a fashion would be difficult under the current inflation targeting framework. It cautions that if an external capital flow reversal event, such as the tapering talk of 2013, were to occur now, the country may have no option but to deploy capital flow measures or capital controls under its current monetary policy framework.

One of my main comments is that the paper is silent on issues related to capital flows to the emerging markets; and therefore, it misses the context within which the emerging markets respond the way they do. The evidence shows that capital flows to emerging markets are fickle "anytime, anywhere" (Bluedorn et al. 2013). Capital flows are fickle in two ways. First, there are episodes of surges when, irrespective of whether a country has absorptive capacity or not, there can be a deluge of capital inflows. Such inflows are mostly driven by external events—e.g., a reduced risk sentiment, ample global liquidity, or easy US monetary policy. When such capital flow surges happen, countries experience exchange rate and asset price appreciation. These surges are eventually followed by the episodes of reversals. The reversals can be of different types—sudden stops, sudden pauses, or emerging market sell-off episodes. Some of the recent emerging market sell-off episodes include the tapering event in 2013, and similar events in 2015 and 2018.

A typical anatomy of the sudden stops, and to some extent that of the emerging market sell-off events, is that they are often preceded by capital flow surges, which result in large appreciations of the exchange rates. When capital flows reverse, they are followed by steep depreciations. This pattern leads to

* To preserve the sense of the discussions at the India Policy Forum, these discussants' comments reflect the views expressed at the IPF and do not necessarily take into account revisions to the conference version of the paper in response to these and other comments in preparing the final, revised version published in this volume. The original conference version of the paper is available on NCAER's website at the links provided at the end of this section.

the question as to whether an emerging market is served well by such episodes of capital flows, which are driven by external factors, and result in such large fluctuations in the exchange rate.

Eichengreen and Gupta (2015) analyzed the tapering event of 2013 and showed that the impact of the tapering was larger in countries which had received large volumes of capital flows prior to 2013, and in countries where the exchange rates had appreciated, resulting in large current account deficits. We also know that India was among the fragile five countries during the 2013 tapering event.

Ordinarily, just like most of the other emerging markets, India manages its exchange rate policy. It practices a manage float, modulates the large variations in exchange rates without targeting a specific level, and uses reserves in doing so. However, as the current paper by Patnaik and Sengupta mentions, between 2008 and 2013, India followed a passive exchange rate policy. It allowed the exchange rate to appreciate and did not build its reserve buffers, and eventually had to face the consequences of the tapering event. Clearly, therefore, a hands-off approach to the exchange rate did not work very well.

Besides, emerging markets have access to very few safety nets in order to insulate themselves from the capital flow surges and stops. One potential safety net could be the swap lines with other large central banks. But these are mostly unavailable, untested, and potentially ineffective. Another option could be the IMF contingent lines, but this too has not proven to be a credible alternative. So, all that the emerging markets have for insulating themselves against the vagaries of capital flows is international reserves.

Thus, in my view, the practice of modulating the exchange rate and maintaining reserves has served India well. While India does maintain a safe level of foreign reserves, its pace of reserve accumulation and level of reserves is comparable to that of other countries.[1]

The second point I would like to raise is regarding the policy toolkit that countries use when they encounter a capital inflow or outflow episode. A World Bank working paper by Gupta and Masetti (2018) considers a broad set of policy tools, including capital flow measures. In the paper, the capital flow measures are divided up into those on resident flows, non-resident flows, inflows, and outflows. The other policies include monetary policy, macro-prudential regulations, exchange rate, and forex reserves. The paper finds that the countries, in general, divide up the burden of sharp increases or reversals in capital flows across the last four measures, i.e., they let their exchange rates react, manage reserves, and use monetary policy. They also use macro-prudential measures but less frequently.

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1. The authors may also cite and include the institutional view of the IMF, which supports the use of reserves in the kind of conditions I mentioned—when capital flows are totally externally determined, and if the other fundamentals are in place, then the use of resources is legitimate and it does work. The way India practices monetary policy is in line with the IMF's institutional view.

Hence, based on the above evidence, I differ from the suggestion by the authors Patnaik and Sengupta that if a tapering-like event were to happen now, during its inflation targeting regime, India will not have any policy options.

Thus, the policy matrix available to emerging markets is much broader than is indicated in the trilemma framework. These policy choices include exchange rate modulation using reserves, interest rates, liquidity measures, cash-reserve ratio, macro-prudential measures, and an active communication strategy. All these were put to good use in 2013 when, despite being impacted very sharply by the tapering event, India managed to emerge from it relatively unscathed. Albeit, one policy measure that was used at that time, and is not advisable in my view, is that of capital flow restrictions in the midst of a sell-off episode. This is something India did experiment with briefly and it backfired.

Capital flow measures may be deployed in two different ways: one as a structural policy tool, which amounts to liberalizing or closing the capital account gradually; the other is in a more counter-cyclical way around the time of the capital flow surges and stops. However, once a sudden stop or a sell-off event happens, sudden capital controls can backfire and generate an additional adverse impact from the market. Indeed, the 2015 paper on "Tapering Talk," by Eichengreen and Gupta establishes that capital inflows are further liberalized during the episodes of sudden stops. There are very few cases when they were actually reversed.

What, if anything, changes during the inflation targeting? A World Bank working paper by Eichengreen, Gupta, and Choudhary (2020) shows that the exchange rate has been less volatile in India during the period of inflation targeting. This can be attributed to low and stable inflation during this period, or to the policy credibility.

So, it may be concluded that emerging markets continue to integrate globally a process that is arguably irreversible. In the process, they are exposed to the volatility triggered by global shocks. The burden of adjustment may be better shared between the exchange rate and reserves rather than letting the exchange rates over-react on each side of the capital flow cycle. The available policy matrix is wider than what the traditional trilemma framework indicates. Capital flow measures are better deployed as a structural policy tool. An active use of the capital flow measures during this period can backfire. And in any case, with low and stable inflation, and greater market credibility, the need for intervention or the need to manage the exchange rate may be less rather than more during the inflation targeting framework.

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I would like to thank NCAER for the invitation to discuss this very interesting and informative paper. I think the paper succeeds in its task of providing a very thorough, data-based, and analysis-based narrative of the exchange rate regimes that have prevailed in India over the last 20 years. The paper also does what a good paper in a policy forum should do, namely raise interesting questions that deserve discussion and further analysis. Two broad questions, of course, come to mind. First, did the Indian policymakers, notably RBI, get it right over the past two decades? And second, then what should the policy toolkit be over the next decade?

On the paper itself, as noted by one of the authors, Rajeswari Sengupta, it rests on previous two solid pieces of previous research. I would have liked to see in this paper more discussion borrowed from Felman, Patnaik, and Shah of how the parameter rho is measured—rho is the change in the exchange rate associated with a given intervention. And if you dig into the underlying research, you realize that the measurement of rho is quite a delicate art. So from Patnaik, Felman and Shah, you see that to estimate rho, you need to have countries first which have had both regimes; you have to make assumptions about the volatility of the exchange market pressure being similar across those two periods; and the fixed and the floating regimes have to be adjacent, so you can't have too long a window of time or a break in between. This, I think, makes it quite a delicate task. And I would have liked to see more acknowledgement of that in the paper and some robustness checks, to convince us that these four regimes are indeed the ones that we should be focusing on.

I also missed a discussion of whether there is path dependence in the regime. Is it the case that some shock triggers a change in the regime but then the RBI sort of continues in that mode, even if there may be a need to adjust or is it just that a regime goes on until there is another large shock or, as Rajeswari was suggesting in her presentation, though, this is not in the paper, is it that when

the governor changes, the regime changes? As she mentioned, they do have a very interesting previous paper in which they show that monetary policy choices are correlated with who was in charge. And I think this begs a similar analysis.

Let me now turn to the first of the two big questions: Did India get it right? Of course, everyone is aware that in the 1950s and 1960s, Friedman said that we should just let the rupee go and he said, "Look at Canada, they are doing it right." What is clear is that India remains far from Canada. The paper very nicely shows that the RBI has used a very complicated multiple-targets, multiple-instruments strategy. And the answer that I think we want to know from the analysis is: In the end, what is the assessment of the RBI's strategy and the policy choices that were made?

My approach, like that of my co-discussant, Poonam Gupta, will be to look at the cross-country experience to give some clues on that question. As I said, the paper itself is somewhat silent on the merits of what the RBI was doing. And this is in contrast with the views expressed by the authors elsewhere. For instance, on the taper tantrum, Ila Patnaik, some years ago, had said that the rupee is falling and India should let it and had made statements like "the RBI has used these instruments in the past and the results have not been pretty." So, I would like to see a bit of a connection between the dispassionate tone of this paper—just saying that the RBI adjusted to shocks using these different mechanisms—and the kind of passionate views expressed in opinion articles and elsewhere.

As I said, I will use the cross-country evidence to provide a window on whether the RBI was doing it right. Of course, the fact that all central banks were doing it is no guarantee that everybody got it right. There's a lot of groupthink in central banks. But at least it shows that the RBI was not going rogue, it was doing what other central banks were doing. I will draw on a report that we just finished last year at the Independent Evaluation Office of the International Monetary Fund (IEO-IMF) that looked at how countries have dealt with capital flow volatility. There was a lot of background work supporting that report. We reviewed the experience of 27 countries and did some detailed analysis for 12 countries. And we found results that were similar to what Poonam showed from the Gupta and Masetti paper of 2018. What we found is that countries typically have used a combination of instruments and they have also used generally the full range of policy instruments. So it is not as though the countries have said, "We are going to intervene and do nothing else." Fiscal policy and other instruments were also adjusted, namely instruments beyond the ones that the authors look at in this paper. So, countries generally adjust in the right direction, sometimes they cannot adjust fiscal or they choose not to, but they try to move all instruments sort of in the right direction. And then there are some differences across countries: we found that Latin America and Asia tend to rely more on macro-prudential and foreign exchange intervention, whereas emerging Europe seems to be more willing to let the exchange rate adjust.

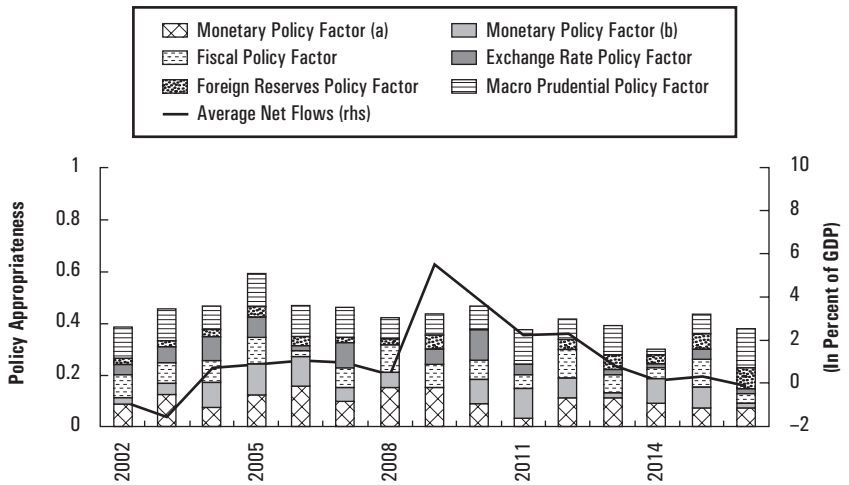
We also found that capital flow and capital controls were not really used to avoid adjustment on other fronts; in fact, their use, if anything, was complementary. So this is a point also that Viral Acharya and Arvind Krishnamurthy have made in a recent paper on how Emerging Market Economies (EMEs) use instruments in a kind of multiple fashion, using them all to bolster one another. I was also comforted to find that the results of our work are very similar to what Rakesh Mohan from his extensive experience and own analysis concluded recently in the *Economic and Political Weekly* (EPW), namely, that countries have basically practiced flexible inflation targeting. Foreign exchange intervention has been the rule rather than the exception. I am quoting Rakesh Mohan here: "Capital account management has been practised to reduce volatility. A variety of monetary policy instruments have been used, not just the policy interest rate, and financial stability concerns have led to the use of various macro-prudential policies."

One other point which came up in our discussions with countries and also in analysis, including at the IMF, is that in certain circumstances, exchange rate movements actually amplify shocks rather than dampen them in the face of volatile flows. So the reluctance to use them is not always just coming from the sort of fear of floating necessarily, but actually a fear that this will make the situation worse.

Figure 1 given on the next page is a kind of example from the work that I have been talking about. You do not need to look at the detail, what you need to know is that we looked at six different policy levers that could be used. And the purpose of the chart is simply to show that all the levers are shown, namely, it is not as though a country said, "I am just going to use macro adjustment" (shown as Macro Prudential Policy Factor), or "I am just going to use intervention" (shown as Foreign Reserves Policy Factor). Typically over the last 20 years, on average across Asian emerging markets, all levers have been adjusted, and generally too we are adjusted in the right direction.

So based on this, what should the policy toolkit be for the next decade? I will use the conclusions of our own IEO report plus the other IPF, namely the IMF's work on a so-called Integrated Policy Framework (IPF). Our own report suggested that from the country experience, and from the recent research, there is some support for the pre-emptive use of capital controls, in some circumstances. I agree with Poonam that, once the capital flow episode gets going, controls can backfire and be counter-productive. But pre-emptive use in some cases can work. We give examples of such use for Korea for Peru. And one particularly, I think convincing example, is that of Iceland in 2016, after they had got over the initial crisis, and flows started coming back. The advice they got from the usual circles was: "Well, your surge is not as big as it was in 2008–2009, there is no need for controls". And they said: "That's exactly the point. We do not want to wait till the surge gets as big as it did last time, we are going to impose some controls now and manage it now". And they got out of that episode because they did it

FIGURE 1. Use of Different Policy Levers in Asia (2002–2016)



Source: IEO staff calculations.
Note: "rhs" stands for right-hand-side y-axis.

in a sort of pre-emptive fashion. So I think that the Iceland experience as well as the kind of long-standing use by Korea and Peru is something that should be kept on the table for discussion. This is the pre-emptive use of capital controls rather than using them once an episode is underway. And the conclusions from the IMF's Integrated Policy Framework so far are also pushing in this direction. What they say is that the difficult trade-offs faced by policymakers warrant the use of multiple tools under certain conditions, the optimal policy combinations depend on the nature of the shocks, and the rules do not take the form of complete reliance on exchange rate flexibility under all circumstances. And the results suggest that in the presence of frictions of the kind still prevalent in many EMEs and links, there is a case for using a multiplicity of tools, including macro-prudential and capital controls, to balance the risks. And precautionary reserve accumulation during normal times also provides a buffer that can be used.

So let me conclude on this note. I look forward to further work in the area by these two authors. I think it would be good to incorporate monetary policy instruments and capital controls into the framework for measuring exchange market pressure. And I hope that this research will draw out the implications for the design of an overall strategy for the RBI. Like Poonam, I am less worried about whether inflation targeting creates tensions, because I think that in practice, the RBI, as the recent interview with the Governor showed, is not likely to become an inflation nutter, but continue to practice flexible inflation targeting and keep other goals in mind. I hope that the authors will continue to work on these issues and give us some guidance on whether India should remain far from Canada or if it should listen to Friedman and just let the rupee go. Thank you.

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General Discussion

Raghuram Rajan opened the general discussion by focusing on RBI interventions in the foreign exchange market as shown in Figure 6 of the paper. The fact that the Bank has engaged in both sales and purchases over short time periods is suggestive of an emphasis on reducing volatility without trying to fix the rupee's level. Policymakers were particularly worried that, in an inflation-targeting regime that still had achieved only limited credibility, those downside movements could easily become more fundamental and sustained.

He argued that there were two mechanisms by which that might occur. First, on the fiscal side, oil purchases are hugely subsidized. Therefore, any fall in the rupee would convert into a larger fiscal deficit with problematic ramifications on the future exchange rate. Second, the corporate sector has large unhedged dollar liabilities; and without a decent bankruptcy regime, downward movements in the rupee could translate into corporate stress, lower economic activity, and additional downward pressure. He reasoned that those efforts to limit volatility are not inconsistent with an inflation-targeting regime if you believe that volatility in the rupee will create dramatic surges in price inflation, making it more difficult to maintain the regime.

He agreed with Poonam Gupta that India needed a high level of own reserves because it did not have significant allies that would provide assistance in periods of financial crisis. In the 2013 taper tantrum, it was able to arrange a swap line, with Japan, but assistance was refused by the United States. He did not perceive the IMF as a viable alternative because of the associated negative stigma effects.

Currently, India has sufficient foreign exchange reserves to provide a high level of protection, sufficient to take care of any contingency.

Finally, he pointed to the ability of the government to tighten or loosen the limits on private families' export of funds as a form of macro-prudential control. He thought the control of mutual funds inflows and outflows had a similar potential as a form of regulatory control.

Suman Bery asked whether the authors were arguing that there has been no exchange rate targeting in recent years, as suggested by Raghuram Rajan's remarks. He noted that some countries, such as Brazil, believe that a flexible exchange rate regime, can be a useful shock absorber and an important part of an inflation-targeting regime. However, it is possible that India's regime is not yet at that stage.

Arvind Subramanian noted that the East Asian exchange rate policy had been quite asymmetric after the Global Financial Crisis, and he wondered if it was reflective of a need for self-insurance, as emphasized by Raghuram Rajan, or a form of *de facto* mercantilism in which countries do not allow the exchange rate to appreciate in order to maintain a strong export position. While there were both purchases and sales in the case of India, there has been a very large net accumulation of reserves. He understood the need to accumulate reserves as part of a self-insurance policy, but argued that it did raise significant competitive concerns. He thought that the paper should have done more to address that aspect.

Kenneth Kletzer suggested that the paper needed to do more to consider external shocks and the role of volatility. He believed that more should be said about the trilemma of combining full monetary autonomy, a fixed exchange rate regime, and an open capital account. In addition, there is a potential trade-off between the output gap and meeting the inflation target. If there is a supply shock there is a trade-off, but with a demand shock there is no trade-off. But that framework does not address the issue of volatility. He believed that many central banks avoided a strict interpretation of the goals and emphasized a centering around their various targets.

Karthik Muralidharan questioned why the response to volatility did not emphasize the development of a currency futures market to allow for the growth of hedging. Anant Narayan asked whether there should be a focus on the real exchange rate instead of the nominal rate.

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