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Communication is a key element in functioning of modern central banks, who are placing greater emphasis on transparency and accountability. The increasing preference for a collegial method of monetary policy decision making and thrust on financial stability have

laid more emphasis on structured policies/strategies for communication in the realm of central banking.

The framework of central banking policy in India has evolved around its objectives specified under the Reserve Bank of India Act, 1934, viz. “to regulate the issue of Bank notes and keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage; and to operate a modern monetary policy framework to meet the challenge of an increasingly complex economy, where the primary objective is to maintain price stability while keeping in mind the objective of growth.”

core function of issuance of bank notes and currency management as well as its agency functions such as management of public debt, banker to Government (Centre and States) and banker to the banking system, including regulation of bank reserves. As a full-service central bank, it also propels the development and consolidation of the country’s financial system and supports inclusive growth.

Table VI.1: Fraud Cases – Bank Group-wise						
(Amount in ₹ crore)						
Bank Group/Institution	2019-20		2020-21		2021-22	
	Number of Frauds	Amount Involved	Number of Frauds	Amount Involved	Number of Frauds	Amount Involved
1	2	3	4	5	6	7
Public Sector Banks	4,410	1,48,224	2,901	81,901	3,078	40,282
	-50.7	-79.9	-39.4	-59.2	-33.8	-66.7
Private Sector Banks	3,065	34,211	3,710	46,335	5,334	17,588
	-35.2	-18.5	-50.4	-33.5	-58.6	-29.1
Foreign Banks	1,026	972	520	3,280	494	1,206
	-11.8	-0.5	-7.1	-2.4	-5.5	-2
Financial	15	2,048	24	6,663	10	1,305

Institutions						
	-0.2	-1.1	-0.3	-4.9	-0.1	-2.2
Small Finance Banks	147	11	114	30	155	30
	-1.7	-	-1.6	-	-1.7	-
Payments Banks	38	2	88	2	30	1
	-0.4	-	-1.2	-	-0.3	-
Local Area Banks	2	-	2	-	2	2
	-	-	-	-	-	-
Total	8,703	1,85,468	7,359	1,38,211	9,103	60,414
	-100	-100	-100	-100	-100	-100
-: Nil/negligible.						
Note: 1. Figures in parentheses represent the percentage share of the total.						
2. The above data is in respect of frauds of ₹1 lakh and above reported during the period.						
3. The figures reported by banks & FIs are subject to change based on revisions filed by them.						
4. Frauds reported in a year could have occurred several years prior to the year of reporting.						
5. Amounts involved reported do not reflect the amount of loss incurred. Depending on recoveries, the loss incurred gets reduced. Further, the entire amount involved is not necessarily diverted.						
Source: RBI Supervisory Returns.						

The Reserve Bank's approach is to communicate its policy stance and its assessment of the evolving situation by providing rationale as well as supporting information and analysis to all of output and employment (Pattanaik, 2001). The inflation pass-through via exchange rate can also introduce volatility in commodity prices (Ndou et al., 2019). An increase in cross-border capital flows is believed to be an important factor in increased volatility in exchange rates (Caporale et al., 2017).

Capital flows are broadly categorised into foreign direct investment (FDI) and foreign portfolio or institutional investment (FPI or FII).¹ With the gradual opening of the economies around the globe, investors have got an opportunity to invest in other countries to maximise their returns, leading to an increase in cross-border FPI flows. In the US, cross-border FPI transactions in bonds and equities markets were 4 per cent of its GDP in 1975 which increased to 245 per cent by 2000 (Hau and Rey, 2006). The growth in FPIs has been much more than FDI flows. FPI flows are considered to be most volatile, sometimes called ‘hot money’ (In-Mee Baek, 2006) as these flows are motivated purely by returns and are susceptible to economic outlook.

ness in terms of their regulatory framework, restrictions, sectoral caps, etc. Hence, exchange rates may respond differently depending on the size of the economy and the volume of flows in EMEs.

A major obstacle in studying portfolio flows into EMEs is the lack of data availability. Very few developing countries provide segment-wise portfolio investment data. Usually, researchers source portfolio flows data from US Treasury International Capital (TIC) system, which has various limitations described by Caporale et al. (2017). Further, the data on net portfolio flows taken from the US TIC System covers only transactions involving US residents. Another data source for cross-country FPI flows is IIF (Institute of International Finance) dataset, which is comparable with the IMF and World Bank database as it follows balance of payments-based methodology. Yet another data source is the EPFR dataset (<https://epfr.com/>), which covers portfolio flows related to the mutual fund industry and exchange traded funds, as a subset of the overall portfolio flows (Ananchotikul and Zhang, 2014).

Among the studies focusing on the BRICS economies, Altunöz (2020) evaluated the dynamics of net portfolio flows in bond and equity and exchange rates for India, Brazil and Russia. The author sourced the portfolio flows data from US TIC System for the period 1997 to 2017. Using non-linear two-state Markov switching specification, the author got mixed results. He found that the net bond flows led to an increase in exchange rate volatility in Russia. However, there was no impact seen in the case of Brazil. Overall, the author found that net equity flows from emerging economies to the US led to an increase in volatility in domestic exchange rates.

While studying the BRICS and other economies, Aydoğan et al. (2020) examined the role of portfolio flows in the exchange rate volatility in Brazil, Russia, India along with Indonesia, Mexico and Turkey. The study found a correlation between the overall portfolio flows and exchange rate volatility. On the other hand, portfolio flows in the bond market, and the correlation was only in the case of Brazil and Mexico. These results indicated that portfolio flows in bond and equity markets were country specific. Gautam et al. (2020) evaluated the relationship between exchange rates and capital flows in the BRICS countries for the period 1994:Q1 to 2019:Q2. The authors employed the ARDL bound technique and found a positive relationship among the BRICS exchange rates.

Kodongo and Ojah (2012) examined the relationship between net foreign portfolio flows and exchange rates in the major countries of Africa. The authors used monthly portfolio flows data from IIF for 1997:M1 to 2009:M12. Their findings of Granger causality test did not suggest any direction of causality between exchange rates and net portfolio inflows. However, in the case of South Africa, the authors found a bi-directional causality between exchange rate and portfolio flows.

International capital flows are also dependent on the exchange rate regime and openness of the economy. Jiang (2019) provided a comparative analysis of the exchange rate regimes in the BRICS countries and found that Brazil was the only country with a free-floating exchange rate system among BRICS countries. In contrast, the other four countries followed a managed float exchange rate system, though with some differences.

In the case of India, many studies have explored the relationship between foreign capital flows and exchange rate volatility. RBI (2021) analysed the drivers of INR-USD volatility for the period 1996:Q2 to 2019:Q4 using vector auto-regression framework and found the FPI flows to be most volatile among different instruments of capital flows. However, it also found that the INR-USD volatility reduces with an increase in net FPI inflows. By contrast, the other types of capital flows increased the INR-USD volatility.

Kohli (2015) evaluated the role of FPI flows and other macroeconomic variables in determining the INR volatility. Using generalised method of moments, the author observed that financial openness and gross portfolio flows were major external factors impacting rupee volatility. Furthermore, after replacing net portfolio flows with gross flows, the author observed that the flows reduce exchange rate volatility in the short-term. Dua and Sen (2013)

examined the relationship between real exchange rate and volatility of capital flows between 1993 and 2010. The authors identified that net capital inflows and their volatility jointly impacted INR-USD exchange rate. Further, the findings suggested that capital inflows appreciated the exchange rate, resulting in a huge trade deficit.



III. Stylised Facts

BRICS is a dominating group in international trade and finance. Regarding the size of these economies, China dominates with a GDP of USD 14.7 trillion followed by India having a USD 2.6 trillion economy. Brazil and Russia have a similar economic size of USD 1.4 trillion while South Africa's GDP is USD 0.3 trillion. In terms of foreign trade, China dominated the group with USD 2.59 trillion exports in 2020 ([Table 1](#)).

Any change in the foreign exchange market directly or indirectly impacts the economy through various channels, like exports and imports, capital flows, and external borrowings. A stable exchange rate lowers the risk for exporters and importers, increases international trade, and improves the growth potential, by making it easy for an entrepreneur to work on future projects and investments. Thus, ensuring orderly conditions in domestic forex market is the

primary concern of policymakers. It has been observed that during the Global Financial Crisis and Taper Tantrum, exchange rate movements in BRICS countries were high resulting in heavy interventions by the central banks of these countries to stabilise their exchange rates ([Annex Chart A.1](#)).

After the balance of payments crisis in 1999, the Brazilian economy underwent many institutional reforms, including changes in the monetary policy framework. In 1999, the Brazil Central Bank (BCB) adopted the inflation targeting (IT) framework and a floating exchange rate regime. Despite the floating exchange rate regime, BCB intervenes in the market more frequently and publishes intervention data on a daily basis. Among BRICS central banks, BCB is unique in terms of intervention. To illustrate, it invested around USD 50 billion in 2012-13 as interventions in the onshore derivatives market (Garcia, 2013).

Bank of Russia (BoR) has gradually shifted its focus from exchange rate targeting to the inflation targeting in 2015. To smoothen exchange rate volatility, the BoR intervenes in the foreign exchange market with the buying and selling of USD and Euro. During the Global Financial Crisis of 2008-09, when Ruble volatility was high, the BoR intervened heavily and sold foreign currency. Further, during the Russia and Ukraine conflict in 2014, the Ruble experienced an all-time high volatility.

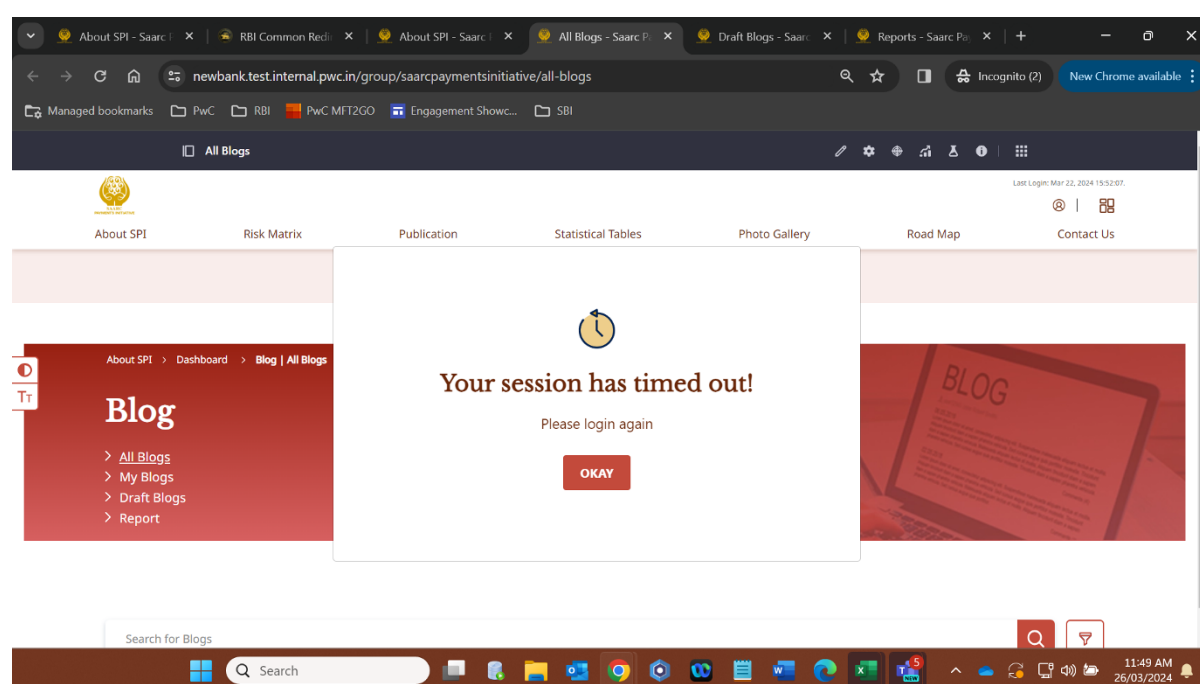
Like other BRICS' currencies, the INR also experienced high volatility during the GFC period. However, in comparison to GFC, the magnitude of volatility was quite high during the Taper tantrum episode in 2013.

The Chinese Yuan has been comparatively stable among the BRICS' currencies mainly as the Yuan was pegged with US dollar up to July 2005. As per the official statements from the People's Bank of China (PBOC), it now has a managed floating system with reference to a basket of currencies. Further, the PBOC has claimed that Renminbi (RMB) is market determined. The PBOC had a fixed daily band of RMB/USD +/- 0.3 per cent from 2005 to 2007. Subsequently, the band widened to +/- 0.5 per cent from 2007 to 2012 and 2 per cent up to 2014. On August 11, 2015, the PBOC surprised market by consecutive three times devaluation of the RMB, reducing its value by 3 per cent against USD.

Regarding currency intervention, China has frequently used exchange rates to benefit its export-led economic growth. On the intervention issue, the US treasury has often labelled

China as a “currency manipulator”. Since January 2020, however, the US Treasury lifted its description for China as a currency manipulator. The Phase One Trade agreement between China and the US required changes to the former’s policies and practices in several key areas, including currency issues. In this settlement, China had made upfront commitment to refrain from devaluation of its exchange rate to boost exports.

Historically, the South African Reserve Bank (SARB) has intervened in the foreign exchange market in both spot and derivative markets. The overall objective of the SARB’s intervention operations is not to manage the exchange rate but to keep it competitive against its trading partners. Its other objective is to build up foreign exchange reserves.



IV Data and Methodology

The estimation shows that the dataset is suitable for the GARCH framework. The statistically significant coefficients for all BRICS countries (except Brazil) [β_1 , which is return on exchange rate (-1) in the mean equation] indicates that past exchange rate values can largely decide the present value of the exchange rate return. The significant coefficients of β_2 in case

of all the countries indicates that the foreign portfolio flows are impacting the level of the returns on the

exchange rate

ARCH and GARCH terms (α_1 and α_2 respectively) in the variance equation are statistically significant (except for South Africa where only the GARCH term is statistically significant), and both coefficients are positive and are close to one (1) indicating presence of ARCH and GARCH effects in the model. The FPI coefficients in all these countries are found to be statistically significant and negative, pointing out that net FPI inflows reduce volatility in the returns. The interpretation of this sign can be ambiguous - rooted on the already mentioned granger causality test. Again, one possible interpretation could be that in the dynamic forex market FPI inflows, central bank interventions can be simultaneous.

We have tested the residual diagnostics for all five countries and found that the residuals and squared residuals are not serially correlated and have no heteroskedasticity in ARCH-LM test. Further, following Meese and Rogoff, (1983) the RMSE values have been compared with a random walk model for all five BRICS country cases. It has been observed that all the RMSE values of the model are lower than its counterpart of random walk models ([Annex Table A.4](#)). Hence, it is reasonable to conclude that the model offers a good fit.

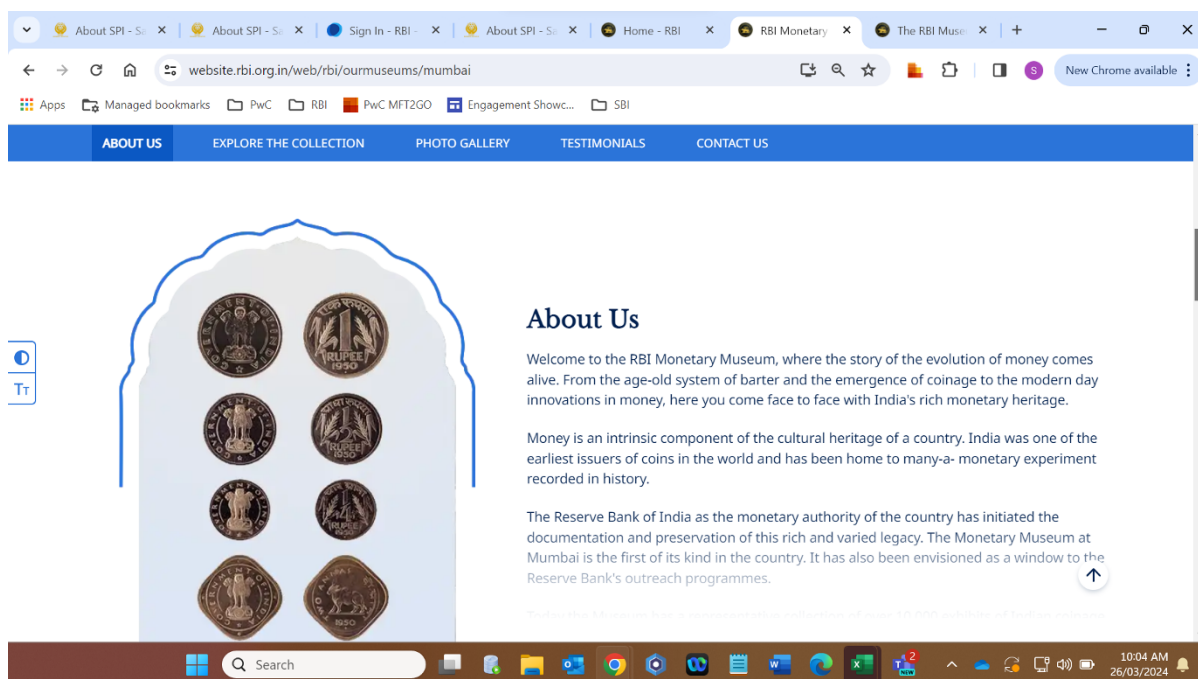
Moving to the estimation results of equations 5 to 7, we observed that FPI flows – both in bond and equity – have statistically significant coefficients for all the BRICS countries (except Russia for bond flows) ([Table 7](#)). Further, all the β_3 coefficients signs are negative indicating equity flows are creating appreciation pressure on the domestic currencies. In the variance equation, both ARCH and GARCH terms are statistically significant (except South Africa, where only GARCH term is significant) and close to one, indicating that once volatility is high, it remains high for a long period. Further, the bond and equity coefficients

are statistically significant indicating both types of FPI flows have an impact on exchange rate volatility in the returns. The negative coefficients of bond flows for Brazil and South Africa indicate that the FPI flows in bond segment reduce volatility in returns. However, in the case of India the sign is positive, reflecting that the bond flows increase volatility in the exchange rate returns. The equity flows coefficient is positive for Brazil and South Africa, indicating that equity flows increase volatility in the exchange rate returns whereas the coefficients are negative in the case of Russia, India and China signifying that equity flows reduced volatility in the returns.

Financial asset prices are widely used for predicting exchange rate movements. This paper examines the relationship between the INR/USD exchange rate and select commodity market and stock market variables using a non-parametric causality-in-quantiles approach. The paper finds that changes in crude oil, gold, stock prices and VIX exhibit causality with the exchange rate for all quantiles barring the two extreme ends of the conditional distribution. The causal relationship of the West Texas Intermediate (WTI) oil price, domestic and global stock indices and gold price with the exchange rate of the INR/USD is stronger in mean than in variance, while it is stronger in variance for the Brent crude oil price and net foreign portfolio flows.

JEL classification: C32, F31, G10, Q02

Keywords: Exchange rate, commodity price, stock price, volatility, quantile causality



Introduction

The impact of volatility in domestic and international asset prices on the exchange rate of the Indian Rupee (INR) has increased considerably over time due to greater financial and trade integration. Excessive exchange rate volatility for an extended period may have a negative effect on many economic indicators and pose significant financial stability risks (RBI, 2022). The aim of this paper is to study the causal linkages of domestic and global market indicators with the exchange rate of INR, using the non-parametric causality-in-quantiles technique.

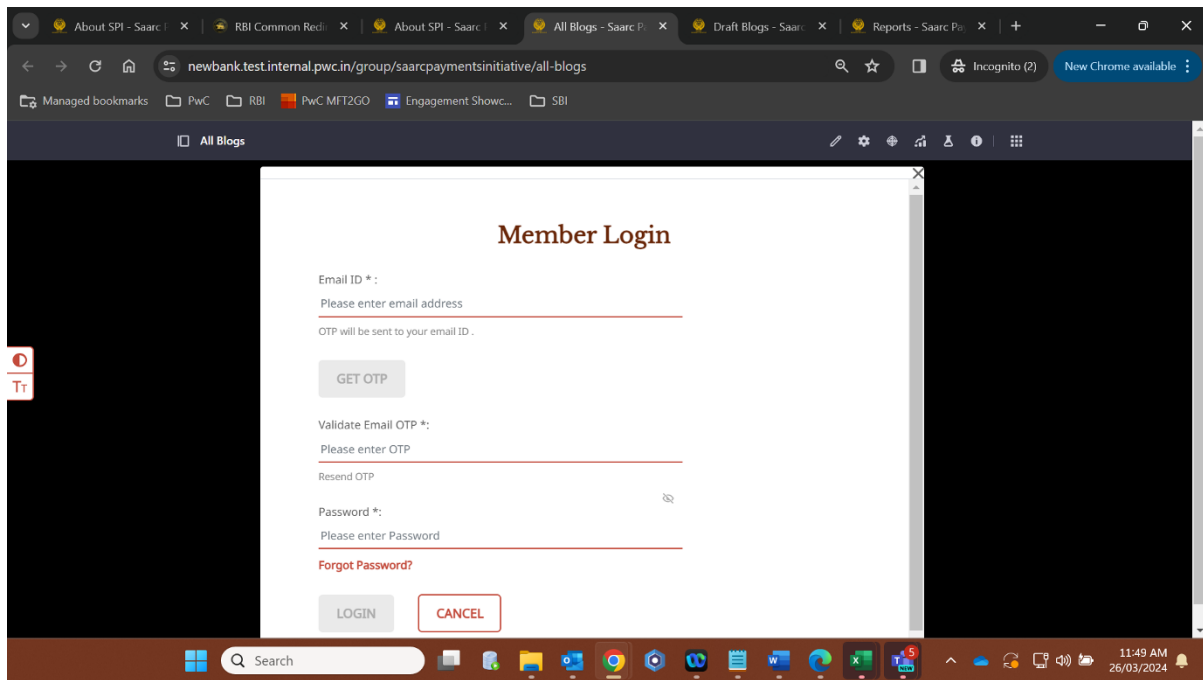
There is a vast literature on the determinants of exchange rate and econometric techniques that could help to predict the exchange rate. The early literature focused on studying the short- and long-run relationships between these variables using Granger causality, cointegration and error correction techniques. Some studies empirically tested the time-varying co-movements and dynamic volatility spillover impact of various macro-economic variables on the exchange rate using various formations of GARCH (Generalised AutoRegressive Conditional Heteroskedasticity) modelling. There are also recent studies providing evidence on the inter-dependencies among these variables and the exchange rate using the wavelet multi-resolution analysis.

The linkages between the macro-economic and financial variables on the one hand, and the exchange rate on the other as captured through the aforementioned approaches are based on the conditional mean distribution of the exchange rate. The results based on conditional mean analysis may be ambiguous, especially when the distribution of a given variable is fat-tailed, as is the case with daily exchange rate returns. Thus, the conditional mean-based method may not delineate the complete causal relationship between two variables.

To address such methodological limitations, the present study uses the conditional quantile method that captures the linkage of one variable with another under various foreign exchange market conditions² i.e., across different quantiles of the exchange rate. The study is based on a long-time series data spanning April 2002 to May 2020, with daily frequency as against monthly, quarterly or annual data typically used in other studies, facilitating a deeper study of the dynamics of the exchange rate changes. The study examines the pairwise causal relationship between exchange rate return and a comprehensive set of macro-economic and financial variables using a non-parametric causality-in-quantiles technique recently developed by Balcilar et al. (2017a).³

This is the first study to the best of our knowledge that examines the causality of exchange rate using a comprehensive set of market indicators and daily data for India. The present study makes useful contributions to the existing literature. First, the non-parametric causality-in-quantiles approach helps in - (i) identifying dependencies for higher order (causality in variance) as there can be weak causality in return (mean) among financial variables but there can be significant causality in variance, due to volatility spillovers; (ii) exploring the dependence structure using a nonparametric procedure, that reduces the probabilities of misspecification errors, (iii) studying non-linear time series having structural breaks, as most of the financial variables (especially with daily frequency) are non-linear. In fact, all variables used in this study are found to be non-linearly related to the exchange rate. Further, it helps to find the presence of causality at each point of the respective conditional distributions during the period of low fluctuations (the lower quantiles), normal fluctuations (median), and high fluctuations (the upper quantiles) of exchange rate return and volatility. This is also important when the dependent variable has fat-tails, as is the case with exchange rate return.

The rest of the study is organised as follows: [Section 2](#) presents the literature review, [Section 3](#) discusses data and methodology, and [Section 4](#) provides the empirical findings. Finally, [Section 5](#) concludes.



2. Literature Review

Since March 1993, the exchange rate regime of India can be deemed as market-determined with no fixed target (Jalan, 2000). As per the International Monetary Fund's (IMF) classification of exchange rate regimes of member countries as specified in the Annual Report on Exchange Rate Arrangements and Exchange Restrictions (AREAR), India follows a flexible exchange rate regime. The movement of the exchange rate is determined by the demand and supply dynamics of the US dollar (USD) in India, which in turn is influenced by several macroeconomic factors such as the trade balance, current account balance, net capital flows, movements in major global currencies, domestic and global political and economic developments, market expectations of relative interest rates and relative inflation for the INR and USD. The Reserve Bank intervenes intermittently, to maintain orderly market conditions by containing excessive volatility in the exchange rate (BIS, 2013). Pattanaik and Sahoo (2003) investigated the effect of RBI intervention on exchange rate and found that the intervention is effective in achieving the stated objective of policy.

The Indian foreign exchange market has undergone significant changes with improved institutional and market infrastructure, a wide range of instruments and a more liberal regulatory structure. As per the Bank of International Settlements triennial survey of turnover in the foreign exchange market (2019), over-the-counter trades in the Indian rupee constituted 1.7 per cent of the total USD 6.6 trillion global foreign exchange market (BIS, 2019). The turnover of the average daily USD-INR pair increased to USD 110 billion in April 2019 from USD 56 billion in April 2016.

As a result of the calibrated and gradual opening of the capital account and other external sectors of the Indian economy, the forex market has become increasingly integrated with the rest of the world. This is reflected in the increased volume of capital flows and growing trade in the foreign exchange market. Consequent to all these developments, the INR/USD exchange rate has witnessed extended periods of calm followed by intermittent extreme volatility due to sharp fluctuations in capital flows.

As noted earlier, several studies have been undertaken to analyse the interdependencies among the foreign currency market (exchange rate), the commodity market (oil and gold price), the stock market (domestic and global) and capital flows (foreign portfolio investment). As all these markets are closely integrated, fluctuations in any one can have a direct or indirect impact on the others. In this section, we briefly review the empirical studies conducted for examining the relation of the exchange rate with the above-mentioned financial variables. The relevance of each variable in determining exchange rate movements is mentioned along with the related literature.

2.1 Exchange Rate vs Oil Price

The oil price has been referred to as a non-monetary factor of exchange rate movements in the literature. “For an oil-importing country, rise in the price of oil worsens the balance of payments and eventually leads to currency depreciation, while it generates the current account surplus for oil exporters” (Krugman, 1983). In countries having large oil imports, a small increase in the real oil price can result in a rise in the price of tradable goods and may result in the depreciation of the domestic currency.

Chen and Chen (2007) showed the presence of causality from oil price to the exchange rate for G7 countries. Based on Hiemstra and Jones (1994) nonlinear causality test, Bai and Rath

(2019) found a unidirectional causality from oil price to exchange rate for two emerging economies, China and India. The results of Tiwari et al. (2013) using the wavelet multi-resolution technique showed no causal relationship between exchange rate and oil price at the lower time scales (high frequencies) but found the presence of causality at higher time scales (lower frequencies) for India. Ghosh (2011) and Mishra and Debasish (2017) investigated the linkages between oil price and exchange rate for India using GARCH and exponential GARCH (EGARCH) models, respectively. Their results showed that an upsurge in oil price results in a weakening of the Indian currency against US dollar. Studies based on linear and non-linear models indicated mixed results for causal relationship between exchange rate and oil price; however, they miss out to explain the linkages of oil price return at various states of exchange rate returns.

Our study attempts to explain the existence of causality-in-mean as well as causality-in-variance from oil price to exchange rate over the entire conditional distribution.

2.2 Exchange Rate vs Gold Price

The significance of gold as an alternate financial asset increases during a period of uncertainty. After the global financial crisis, gold prices shot up considerably due to a surge in its demand all over the world. Various studies on determining the linkages between exchange rate and gold price focus on the role of gold as a hedge or safe haven. Capie and Wood (2005) found gold as a potential hedge against the USD and observed that US dollar exchange rates (sterling-dollar and yen-dollar exchange rates) are inversely associated with gold prices. Mark (2011), using dynamic conditional correlations for various USD-linked exchange rates, showed that gold is a weak safe haven and a strong hedge against the USD.

Using cointegration and Granger causality tests, Apergis (2014) found the gold price as a strong predictor of the Australian dollar/US dollar exchange rate. Reboredo and Rivera-Castro (2014) showed the existence of a positive relation between gold price and USD depreciation for a varied set of currencies at all time scales using the wavelet multi-resolution analysis. Wang and Lee (2011) investigated the role of gold as a hedge against the yen and their results showed that it depends on the extent of fall in yen. Balcilar et al. (2017b) used causality-in-quantiles technique to test bi-directional causality between exchange rate and gold price for gold-producing countries. The results suggest that gold price return causes

exchange rate return as well as exchange rate volatility, while only exchange rate return causes gold price volatility for most of the countries used in the study.

Our study, using the causality-in-quantile, explains the relationship of gold price return with respect to exchange rate return under different market conditions while other studies on exchange rate return specific to India are based on empirical analysis based on the conditional mean.

2.3 Exchange Rate vs Stock Price

Forex and stock markets are among the highly liquid financial markets globally. The interdependency between these two markets has increased over time due to the increase in capital flow and internationalisation of stock markets. Studying linkages between these markets may help to predict interconnectedness and volatility transmission between them. Numerous studies confirm linkages between stock and forex markets in the literature. Chien-Hsiu Lin (2012) found that the co-movements between exchange rates and stock prices are more robust during a crisis period than a normal period in emerging Asian markets. Cristiana and Carmen (2012) also found causality between these two variables in their study for selected developed and emerging financial markets. Malarvizhi and Jaya (2012) examined the co-movement between exchange rate and Indian stock market return and found the presence of bidirectional causality between the two variables. Reboredo et al. (2016) examined the dependence between the exchange rate and the stock price for emerging economies at extreme points using copula functions. The results of this study indicate the existence of asymmetric downside and upside spillover effects from one market to the other.

Mitra (2017) found evidence of bidirectional volatility spillover and long-term relationship between stock price and the exchange rate using GARCH model. Simona et al. (2019) explored the co-movements between foreign exchange and the stock market by applying a dynamic conditional correlation mixed data sampling (DCC-MIDAS) model. Their results suggested the presence of higher conditional correlations during certain crisis episodes between the two markets. Kalra's (2011) study found that an increase in the global volatility index (VIX) results in the depreciation of east Asia currencies. The methodology based on causality-in-quantile is more general in the sense that it detects the presence or absence of causality from domestic and global stock markets to exchange rate markets under various

heterogeneous market conditions of the exchange rate, thus supplementing the literature further, while other studies based on conditional mean are not able to ascertain the same.

2.4 Exchange Rate vs Multiple Financial Variables

Various studies have explored the co-movements and interlinkages among these financial variables using their return and volatility. Samanta and Zadeh (2012) examined interlinkages among gold price, oil price, exchange rate and stock market returns using spillover indices. The findings of the study suggested the existence of a long-run relationship between these markets. Ciner et al. (2013) examined the relationship of stock, bond, gold and oil prices with exchange rate using a dynamic conditional correlation analysis and quantile regression based on the daily data of the US and the UK. Their results indicated that gold acts as a hedge against the exchange rate and bond market for the equity. Further, their results based on quantile regression suggested that gold consistently plays the role of a safe haven when the exchange rates fall significantly.

Jain and Biswal (2016) for their study on India based on DCC-GARCH method inspected the relationship between the global price of gold, crude oil, exchange rate, and the stock market. Their results suggested a fall in gold price or crude oil price causes a weakening of the exchange rate and the stock price index. Atul et al. (2015) found the existence of one-way causality from gold prices to both stock prices and exchange rate using daily data for India. Mollick and Sakaki (2019) examined the relationship of select major currencies with respect to the USD, international oil price and world equity returns using a vector autoregression (VAR) method. Their study proposed that commodity currencies appreciate subsequent to positive oil price shocks and safe-haven currencies weaken with positive global equity shocks.

Against the backdrop of the literature discussed above, the present study investigates the predictability of exchange rate return and volatility using select financial variables. There can be diverse interlinkages between the financial variables and exchange rate under different degrees of exchange rate movements. The causality-in-quantile helps to measure the causality for each point of the conditional distribution of exchange rate return and volatility. The study is important to fill the gap in the existing literature by finding the financial indicators causing exchange rate movements specific to India and providing useful insights to portfolio managers.

3. Data and Methodology

3.1 Data

Daily data from April 2, 2002 to May 29, 2020 (excluding weekends and holidays), constituting 4,395 observations are used for analysis. High frequency data capture more dynamics of the financial time series data which are typically quite volatile. The study period covers various phases of exchange rate fluctuations including the global financial crisis of 2008-09. However, the selected period for some variables varies as per data availability. These variables are: India VIX (expected stock market volatility index calculated using the NIFTY Index option prices), VIX (expected stock market volatility index calculated using S&P 500 index option prices) and MSCI emerging markets index [Morgan Stanley Capital International index, an indicator to assess equity market performance in emerging markets]. Exchange rate (INR/USD), closing prices of stock indices of BSE, NSE, US S&P 500 index, UK FTSE 250 index and net portfolio investment flows (in rupees million) are sourced from the CEIC database. The gold price (per ounce) is taken from the World Gold Council and is denominated in USD.⁴

The oil prices data used are the spot prices taken from the Energy Information Administration (EIA), US Department of Energy. Both WTI and Brent crude oil prices (Europe price at FOB) are in USD per barrel.⁵ Data for VIX, India VIX and MSCI emerging market index are taken from NSE and other relevant sources.⁶

We have calculated the returns of the variables by taking the first difference of their natural logarithm and then multiplying by 100. Net foreign portfolio investment data are adjusted for negative values before taking log difference as per the standard practice, i.e., by adding a constant positive number which makes the minimum number (negative) in the whole series to a small positive number. For all variables except VIX and India VIX return, the data are in natural logarithm form.

The descriptive statistics of the data as per the required transformation of the data as discussed above are given in [Appendix Table A1](#). The average of daily returns of all the variables is positive (negative for MSCI emerging market return), small as compared to standard deviation and close to zero showing the absence of any type of trend in the data.

It is evident that the stock price return in India is higher as compared to the global stock price return in the US, the UK, and emerging markets. The volatility of these variables as represented by standard deviation shows that the exchange rate has lower variability as compared to return on stock and commodities prices. Oil price returns and stock indices returns, as mentioned in the literature, are some of the most volatile variables among all commodity prices. The skewness statistics of exchange rate return and net portfolio flows are positive and skewed to the right (more positive return than negative return), while it is negatively skewed for all other return variables.

The kurtosis value for each variable is significantly higher than normal distribution indicating that the series is highly peaked and thus leptokurtic. This implies that returns have larger, thicker tails than the normal distribution which reveals the occurrence of extreme returns more frequently. The Jarque–Bera test statistics show that not all the variables are normally distributed.

All the variables are tested for stationarity at the level and if they are not stationary when the first difference (log difference) is taken. All the variables except net FPI, VIX and India-VIX are found to be $I(1)$. Net FPI, VIX and India-VIX are $I(0)$. Since VIX and India-VIX are volatility indices, the analysis is done by taking the log transformation of these two series. As we are examining the pair-wise causality between two financial time series, we have used the return of net FPI even though it is stationary at the level.

The dynamic behaviour of these variables are shown in [Figures A1](#) and [A2](#), depicting these series in actual and in return form, respectively. [Figure A1](#) shows that all the commodity prices, stock prices and exchange rates have shown an upward trend in general. During the periods 2003-2008 and 2009-2011, the exchange rate recorded appreciation (downward movement) as a result of huge capital inflows in India. However, the exchange rate recorded a sharp depreciation during the periods of global uncertainties - the global financial crisis (2007-2009); post-announcement effects of quantitative easing programmes by the US Federal Reserve from May 23, 2013 to September 4, 2013 (Fed taper tantrum); and the recent COVID-19 pandemic (February 27, 2020 to May 29, 2020).

[Figure A2](#) shows that most of the series exhibit strong clustering behaviour and sharp movements during the heightened global uncertainties. We have used both international oil prices, Brent crude and WTI oil price in our study as Brent is the benchmark price in India

while WTI is the international oil price. The stock indices of the US and the UK are taken as both the countries have significant cross-border transactions in terms of trade and foreign investments with India. Both BSE and NSE indices are used due to their varied compositions.

We check for the existence of nonlinearity in the relationship between exchange rate return with the selected variables in the study by applying the BDS test developed by Brock, Dechert and Scheinkman (1996).⁷ The test is exercised on each residual of VAR(1) model of exchange rate return with selected variables and on the residuals obtained from the AR(1) model of exchange rate return. [Table A2](#) presents the results of the BDS test which indicate rejection of the null hypothesis at various embedding dimensions (m). This proves statistically that there is a non-linear relationship between the exchange rate return and each selected variable. The results of linear Granger causality indicate all variables except MSCI return, net FPI and India VIX, significantly cause exchange rate ([Table A3](#)). However, any inference based on linear Granger causality results may lead to mis-specification errors as there exist non-linear relationships among the variables.

We conduct the Bai and Perron (2003) test and find multiple structural breaks (the VAR(1) model of exchange rate return with selected variables and the residuals obtained from AR(1) model of exchange rate return, [Table A4](#)). The Bai and Perron test is based on a dynamic programming algorithm which optimises the exhaustive computational procedure for testing multiple breakpoints of global minimiser of squared residuals (SSR). This approach can allow for autocorrelation and heteroskedasticity in the time series. In the test, we employ quadratic spectral kernel-based HAC (heteroskedasticity-autocorrelation-consistent (HAC) correction) covariance estimation using pre-whitened residuals.

The results detect two structural breaks in NSE and S&P 500 returns on September 11, 2008 and April 3, 2014, respectively. There is no break observed in the VAR(1) model of exchange rate return incorporating BSE return, Net FPI, India VIX and VIX. There are three structural breaks in the VAR(1) model with WTI and two breaks with Brent crude oil price. Most of the break dates are during the global financial crisis and the ensuing quantitative easing programmes by the Federal Reserve. The presence of non-linearity and structural breaks in the selected variables support the use of a nonparametric causality-in-quantile approach, as this test is robust to such mis-specifications.

3.2 Methodology

We use the methodology developed by Balcilar et al. (2017a) for uncovering nonlinear causality through a hybrid approach using the methodology of Nishiyama et al. (2011) and Jeong et al. (2012). We represent the dependent variable exchange rate returns as y_t and the independent variables (selected variables) as x_t .

Communication is a key element in functioning of modern central banks, who are placing greater emphasis on transparency and accountability. The increasing preference for a collegial method of monetary policy decision making and thrust on financial stability have laid more emphasis on structured policies/strategies for communication in the realm of central banking.

The Reserve Bank's communication policy follows the guiding principles of relevance, transparency, clarity, comprehensiveness and timeliness: it strives to continuously improve public understanding of developments in the multiple domains under its ambit.

The framework of central banking policy in India has evolved around its objectives specified under the Reserve Bank of India Act, 1934, viz. "to regulate the issue of Bank notes and keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage; and to operate a modern monetary policy framework to meet the challenge of an increasingly complex economy, where the primary objective is to maintain price stability while keeping in mind the objective of growth."

Consistent with the above, the Reserve Bank's macroeconomic and monetary policy has focussed on maintaining price stability, ensuring adequate flow of credit to sustain the growth momentum, and securing financial stability. The financial stability objective are enabled by

the powers vested with it for regulation and supervision of the Indian financial system and its constituents, the money, debt and foreign exchange segments of the financial markets and the country's payment and settlement system support. These are augmented by the critical functions relating to maintenance of foreign exchange reserves and the role as the lender of last resort. The Reserve Bank pursues its core function of issuance of bank notes and currency management as well as its agency functions such as management of public debt, banker to Government (Centre and States) and banker to the banking system, including regulation of bank reserves. As a full-service central bank, it also propels the development and consolidation of the country's financial system and supports inclusive growth.

The Reserve Bank's approach is to communicate its policy stance and its assessment of the evolving situation by providing rationale as well as supporting information and analysis to all stakeholders.

In its medium-term Vision Statement for 2019-22, termed as 'Utkarsh 2022', the Reserve Bank has set out for itself the following mutually reinforcing objectives:

Transparent communication, clear interpretation and accurate articulation of the multifarious objectives of the Reserve Bank are the goals of its communication policy. The composite mandate necessitates open, clear and structured communication for its effective functioning as well as for supporting the expanding boundaries of its policy instruments.

The communication policy of the Reserve Bank has the following principal goals:

- - Providing clarity on its role and responsibilities;
 - Building confidence in its policy measures;
 - Improving transparency and accountability;
 - Anchoring expectations of all economic agents to enhance the efficacy of monetary policy and to minimise undue speculation;
 - Increasing awareness about financial stability;
 - Dissemination of information with minimum time lag;
 - Ensuring timeliness and credibility through effective communication; and

- Deepening engagement with the multi-lingual and multi-cultural society.

Attention of banks/financial institutions (FIs) is drawn to the Reserve Bank advisory on [“Roadmap for LIBOR Transition” dated July 08, 2021](#) wherein banks/FIs, inter-alia, were (i) encouraged to cease, and also encourage their customers to cease, entering into new financial contracts that reference London Interbank Offered Rate (LIBOR) as a benchmark and instead use any widely accepted Alternative Reference Rate (ARR), as soon as practicable and in any case by December 31, 2021 and (ii) urged to incorporate robust fallback clauses in all financial contracts that reference LIBOR and the maturity of which was after the announced cessation date of the LIBOR settings.

2. With the concerted efforts of banks/FIs as well as industry associations like the Indian Banks’ Association, a smooth transition with respect to LIBOR settings that have ceased to be published/become non-representative after December 31, 2021 has been achieved. The transition away from LIBOR was also facilitated by the continuing publication of US\$ LIBOR settings in five tenors which provided a longer transition period particularly for the insertion of the fallback clauses in legacy financial contracts that reference LIBOR. New transactions are now predominantly undertaken using ARRs such as the Secured Overnight Financing Rate (SOFR) and the Modified Mumbai Interbank Forward Outright Rate (MMIFOR). At the same time, there have been instances of a few US\$ LIBOR linked financial contracts undertaken/facilitated by banks/FIs after January 1, 2022. Also, while banks have reported that substantial progress has been made towards insertion of fallback clauses, the process is yet to be completed for all contracts where such fallbacks are required to be inserted.

3. After June 30, 2023, the publication of the remaining five US\$ LIBOR settings will cease permanently. While certain synthetic LIBOR settings will continue to be published after June 30, 2023, the Financial Conduct Authority (FCA), UK, which regulates the LIBOR, has made it clear that these settings are not meant to be used in new financial contracts. The MIFOR, a domestic interest rate benchmark reliant on US\$ LIBOR, will also cease to be published by Financial Benchmarks India Pvt. Ltd. (FBIL) after June 30, 2023.

4. Banks/FIs are advised to ensure that no new transaction undertaken by them or their customers rely on or are priced using the US\$ LIBOR or the MIFOR. Banks/FIs are also advised to take all necessary steps to ensure insertion of fallbacks in all remaining legacy financial contracts that reference US\$ LIBOR (including transactions that reference MIFOR). Fallbacks in such contracts should be inserted at the earliest so as to ensure that transition of any remaining US\$ LIBOR-linked contracts is completed well before the deadline of end June 2023 and any disruptions due to a last-minute rush to insert fallbacks is avoided. Banks/FIs are advised not to rely on the availability of synthetic LIBOR rates as a substitute for fallbacks in legacy contracts.
5. Banks/FIs are expected to have developed the systems and processes to manage the complete transition away from LIBOR from July 1, 2023. Continued efforts in sensitising customers on the steps to be taken to manage the associated risks will enable a smooth completion of the final leg of the transition.
6. The Reserve Bank will continue to monitor the efforts of banks/FIs for ensuring a smooth transition from LIBOR.

The framework of central banking policy in India has evolved around its objectives specified under the Reserve Bank of India Act, 1934, viz. “to regulate the issue of Bank notes and keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage; and to operate a modern monetary policy framework to meet the challenge of an increasingly complex economy, where the primary objective is to maintain price stability while keeping in mind the objective of growth.”

Consistent with the above, the Reserve Bank’s macroeconomic and monetary policy has focussed on maintaining price stability, ensuring adequate flow of credit to sustain the growth momentum, and securing financial stability. The financial stability objective are enabled by the powers vested with it for regulation and supervision of the Indian financial system and its constituents, the money, debt and foreign exchange segments of the financial markets and the country’s payment and settlement system support. These are augmented by the critical functions relating to maintenance of foreign exchange reserves and the role as the lender of last resort. The Reserve Bank pursues its core function of issuance of bank notes and currency management as well as its agency functions such as management of public debt,

banker to Government (Centre and States) and banker to the banking system, including regulation of bank reserves. As a full-service central bank, it also propels the development and consolidation of the country's financial system and supports inclusive growth.

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This site provides bank-wise information on liabilities and assets and earnings and expenses of scheduled commercial banks (including Regional Rural Banks) for the period 1989-90 to 2000-01. The information contained in the site is based on the published annual accounts of banks. Besides detailed annual accounts data, a number of ratios have also been included. The site incorporates intelligent search/selection features that allow extraction of data in a manner useful for the analysis.

The work of preparation of this site was organised in the Division of Banking Studies, Department of Statistical Analysis and Computer Services of the Bank. Considerable time and effort have been spent in collating, compiling and ensuring extensive coverage and accuracy of the data. The officers and staff deserve deep appreciation.

It is hoped that this publication will be useful to all academic researchers, policy makers and bankers.

This paper examines whether foreign portfolio flows are responsible for exchange rate volatility in the BRICS economies. Applying the GARCH (1, 1) model to monthly data from January 2000 to July 2021 on exchange rate returns, this paper finds that net portfolio flows in bond and equity markets impact exchange rate returns and volatility in the returns of the BRICS currencies. However, the BRICS countries have been successful in reducing currency volatility through foreign exchange market interventions. Further, net inflows are associated with appreciation in the BRICS currencies, except for that of Brazil during the post-GFC period.

JEL Classification: F31, F32, G15

Keywords: Portfolio flows, bond, equity, exchange rate volatility, BRICS countries, currency appreciation, GARCH (1, 1), granger causality

Introduction

Globalisation plays a major role in the modern economic development. Product innovations and advancements in information and technology have upgraded humankind's living

standards. Greater global financial integration has resulted in increased international trade in goods and services, labour force migration for better employment and capital flows for optimal use and higher returns. However, globalisation can also lead to financial instability and associated losses of output and employment (Pattanaik, 2001). The inflation pass-through via exchange rate can also introduce volatility in commodity prices (Ndou et al., 2019). An increase in cross-border capital flows is believed to be an important factor in increased volatility in exchange rates (Caporale et al., 2017).

Capital flows are broadly categorised into foreign direct investment (FDI) and foreign portfolio or institutional investment (FPI or FII).¹ With the gradual opening of the economies around the globe, investors have got an opportunity to invest in other countries to maximise their returns, leading to an increase in cross-border FPI flows. In the US, cross-border FPI transactions in bonds and equities markets were 4 per cent of its GDP in 1975 which increased to 245 per cent by 2000 (Hau and Rey, 2006). The growth in FPIs has been much more than FDI flows. FPI flows are considered to be most volatile, sometimes called ‘hot money’ (In-Mee Baek, 2006) as these flows are motivated purely by returns and are susceptible to economic outlook.

The speculative nature of the FPI flows, sudden inflows and outflows can create volatility in the emerging market economies (EMEs). By contrast, FDI is influenced by economic fundamentals and tends to be less volatile (Uctum and Uctum, 2011). Rafi and Ramachandran (2018) examined currenc

The literature gives vital importance to understanding the empirical relationship between foreign capital flows and nominal exchange rates. Dornbusch (1980) has argued that exchange rate adjusts instantaneously to clear the asset market while other asset classes adjust steadily. Bonser-Neal (1996) provided three main reasons for exchange rate volatility – first is the change in market fundamentals, including income, interest rates, productivity, and money supply, second is the change in future expectations of economic fundamentals and policies; and third is the change driven by speculators/hedgers.

Most of the previous studies on the linkages between exchange rates and FPI flows focus on the advanced economies. Hau and Rey (2006) empirically estimated the relationship between exchange rates, equity prices, and capital flows using multiple frequency data (daily, monthly, and quarterly) for 17 OECD (Organisation for Economic Co-operation and

Development) countries in comparison with the US. The authors found that portfolio flows were closely associated with changes in exchange rates, and net equity flows were positively interrelated with appreciation in foreign currency. Ali et al. (2014) analysed the effect of bond and equity portfolio flows on exchange rate volatility using two-state Markov-switching models for Canada, countries in the European Union, Japan and the UK. The authors found that the relationship between net portfolio flows and exchange rate volatility was non-linear for all currencies, excluding the Canadian dollar. In the case of Canada, net portfolio inflows are not found to be impacting the exchange rate volatility. The same group of authors extended the analysis for the US against Australia, Canada, the European Union, Japan, Sweden, and the UK from January 1988 to December 2011 (Caporale et al., 2015) and observed that the effect of exchange rate uncertainty on net equity flows is negative in the Euro area, the UK and Sweden. However, it was positive in the case of Australia. Overall, the findings suggested that any type of portfolio flows (bond or equity) heightened exchange rate uncertainty in the receiving country and led to financial instability.

Using the VAR model, Froot et al. (2001) analysed the relationship among net portfolio flows, equities and currency returns. The authors observed a positive and contemporaneous relationship between net portfolio inflows and lagged equity and currency returns for 44 countries. Similarly, Brooks et al. (2004) observed that the portfolio outflows from the euro area to the US led to Euro depreciation against the US Dollar. While Siourounis (2003), using monthly data and applying an unrestricted VAR model, found that portfolio equity flows rather than portfolio bond flows impacted the exchange rates dynamics from 1988 to 2000 for USD vis-à-vis the Pound, Yen, Deutsche Mark and Swiss Franc.

In comparison to AEs, there are a few country-specific studies on EMEs, such as for Turkey (Uctum and Uctum, 2011) and South Africa (Frankel, 2007). Most studies relating to EMEs include a group of these countries, such as Combes et al. (2012) for 42 economies, Ananchotikul & Zhang (2014) for 17 economies, Caporale et al. (2017) for Asian EMEs, In-Mee Baek (2006) for Latin American economies and Aydoğan et al. (2020) for six EMEs. Combes et al. (2012) examined the long-run cointegrated inter-relationship between capital flows, exchange rate flexibility and the real effective exchange rate for 42 advanced and emerging economies from 1980 to 2006. The authors found that all capital inflows were associated with an appreciation of the real effective exchange rate. Among the various capital flows, portfolio inflows had the most significant impact on the appreciation of the currencies.

Ananchotikul and Zhang (2014) examined 17 emerging economies and found that global risk aversion is a major factor impacting exchange rate volatility. However, the magnitude of the impact was more dependent on country-specific characteristics, such as financial openness of the economy, the exchange rate framework, and other macroeconomic variables like inflation, current account balance, etc. In line with findings of the other studies, the authors confirmed that portfolio flows impact exchange rate returns.

Although the representation of EMEs in the literature is limited, these economies offer interesting cases for understanding the relationship between capital flows and exchange rate volatility because they are at different stages of openness in terms of their regulatory framework, restrictions, sectoral caps, etc. Hence, exchange rates may respond differently depending on the size of the economy and the volume of flows in EMEs.

A major obstacle in studying portfolio flows into EMEs is the lack of data availability. Very few developing countries provide segment-wise portfolio investment data. Usually, researchers source portfolio flows data from US Treasury International Capital (TIC) system, which has various limitations described by Caporale et al. (2017). Further, the data on net portfolio flows taken from the US TIC System covers only transactions involving US residents. Another data source for cross-country FPI flows is IIF (Institute of International Finance) dataset, which is comparable with the IMF and World Bank database as it follows balance of payments-based methodology. Yet another data source is the EPFR dataset (<https://epfr.com/>), which covers portfolio flows related to the mutual fund industry and exchange traded funds, as a subset of the overall portfolio flows (Ananchotikul and Zhang, 2014).

Among the studies focusing on the BRICS economies, Altunöz (2020) evaluated the dynamics of net portfolio flows in bond and equity and exchange rates for India, Brazil and Russia. The author sourced the portfolio flows data from US TIC System for the period 1997 to 2017. Using non-linear two-state Markov switching specification, the author got mixed results. He found that the net bond flows led to an increase in exchange rate volatility in Russia. However, there was no impact seen in the case of Brazil. Overall, the author found that net equity flows from emerging economies to the US led to an increase in volatility in domestic exchange rates.

While studying the BRICS and other economies, Aydoğan et al. (2020) examined the role of portfolio flows in the exchange rate volatility in Brazil, Russia, India along with Indonesia, Mexico and Turkey. The study found a correlation between the overall portfolio flows and exchange rate volatility. On the other hand, portfolio flows in the bond market, and the correlation was only in the case of Brazil and Mexico. These results indicated that portfolio flows in bond and equity markets were country specific. Gautam et al. (2020) evaluated the relationship between exchange rates and capital flows in the BRICS countries for the period 1994:Q1 to 2019:Q2. The authors employed the ARDL bound technique and found a positive relationship among the BRICS exchange rates.

Kodongo and Ojah (2012) examined the relationship between net foreign portfolio flows and exchange rates in the major countries of Africa. The authors used monthly portfolio flows data from IIF for 1997:M1 to 2009:M12. Their findings of Granger causality test did not suggest any direction of causality between exchange rates and net portfolio inflows. However, in the case of South Africa, the authors found a bi-directional causality between exchange rate and portfolio flows.

International capital flows are also dependent on the exchange rate regime and openness of the economy. Jiang (2019) provided a comparative analysis of the exchange rate regimes in the BRICS countries and found that Brazil was the only country with a free-floating exchange rate system among BRICS countries. In contrast, the other four countries followed a managed float exchange rate system, though with some differences.

In the case of India, many studies have explored the relationship between foreign capital flows and exchange rate volatility. RBI (2021) analysed the drivers of INR-USD volatility for the period 1996:Q2 to 2019:Q4 using vector auto-regression framework and found the FPI flows to be most volatile among different instruments of capital flows. However, it also found that the INR-USD volatility reduces with an increase in net FPI inflows. By contrast, the other types of capital flows increased the INR-USD volatility.

Kohli (2015) evaluated the role of FPI flows and other macroeconomic variables in determining the INR volatility. Using generalised method of moments, the author observed that financial openness and gross portfolio flows were major external factors impacting rupee volatility. Furthermore, after replacing net portfolio flows with gross flows, the author observed that the flows reduce exchange rate volatility in the short-term. Dua and Sen (2013)

examined the relationship between real exchange rate and volatility of capital flows between 1993 and 2010. The authors identified that net capital inflows and their volatility jointly impacted INR-USD exchange rate. Further, the findings suggested that capital inflows appreciated the exchange rate, resulting in a huge trade deficit.

III. Stylised Facts

BRICS is a dominating group in international trade and finance. Regarding the size of these economies, China dominates with a GDP of USD 14.7 trillion followed by India having a USD 2.6 trillion economy. Brazil and Russia have a similar economic size of USD 1.4 trillion while South Africa's GDP is USD 0.3 trillion. In terms of foreign trade, China dominated the group with USD 2.59 trillion exports in 2020 ([Table 1](#)).

Any change in the foreign exchange market directly or indirectly impacts the economy through various channels, like exports and imports, capital flows, and external borrowings. A stable exchange rate lowers the risk for exporters and importers, increases international trade, and improves the growth potential, by making it easy for an entrepreneur to work on future projects and investments. Thus, ensuring orderly conditions in domestic forex market is the primary concern of policymakers. It has been observed that during the Global Financial Crisis and Taper Tantrum, exchange rate movements in BRICS countries were high resulting in heavy interventions by the central banks of these countries to stabilise their exchange rates ([Annex Chart A.1](#)).

After the balance of payments crisis in 1999, the Brazilian economy underwent many institutional reforms, including changes in the monetary policy framework. In 1999, the Brazil Central Bank (BCB) adopted the inflation targeting (IT) framework and a floating exchange rate regime. Despite the floating exchange rate regime, BCB intervenes in the market more frequently and publishes intervention data on a daily basis. Among BRICS central banks, BCB is unique in terms of intervention. To illustrate, it invested around USD 50 billion in 2012-13 as interventions in the onshore derivatives market (Garcia, 2013).

Bank of Russia (BoR) has gradually shifted its focus from exchange rate targeting to the inflation targeting in 2015. To smoothen exchange rate volatility, the BoR intervenes in the foreign exchange market with the buying and selling of USD and Euro. During the Global Financial Crisis of 2008-09, when Ruble volatility was high, the BoR intervened heavily and

sold foreign currency. Further, during the Russia and Ukraine conflict in 2014, the Ruble experienced an all-time high volatility.

Like other BRICS' currencies, the INR also experienced high volatility during the GFC period. However, in comparison to GFC, the magnitude of volatility was quite high during the Taper tantrum episode in 2013.

The Chinese Yuan has been comparatively stable among the BRICS' currencies mainly as the Yuan was pegged with US dollar up to July 2005. As per the official statements from the People's Bank of China (PBOC), it now has a managed floating system with reference to a basket of currencies. Further, the PBOC has claimed that Renminbi (RMB) is market determined. The PBOC had a fixed daily band of RMB/USD +/- 0.3 per cent from 2005 to 2007. Subsequently, the band widened to +/- 0.5 per cent from 2007 to 2012 and 2 per cent up to 2014. On August 11, 2015, the PBOC surprised market by consecutive three times devaluation of the RMB, reducing its value by 3 per cent against USD.

Regarding currency intervention, China has frequently used exchange rates to benefit its export-led economic growth. On the intervention issue, the US treasury has often labelled China as a "currency manipulator". Since January 2020, however, the US Treasury lifted its description for China as a currency manipulator. The Phase One Trade agreement between China and the US required changes to the former's policies and practices in several key areas, including currency issues. In this settlement, China had made upfront commitment to refrain from devaluation of its exchange rate to boost exports.

Historically, the South African Reserve Bank (SARB) has intervened in the foreign exchange market in both spot and derivative markets. The overall objective of the SARB's intervention operations is not to manage the exchange rate but to keep it competitive against its trading partners. Its other objective is to build up foreign exchange reserves.

IV Data and Methodology

The estimation shows that the dataset is suitable for the GARCH framework. The statistically significant coefficients for all BRICS countries (except Brazil) [β_1 , which is return on exchange rate (-1) in the mean equation] indicates that past exchange rate values can largely decide the present value of the exchange rate return. The significant coefficients of β_2 in case

of all the countries indicates that the foreign portfolio flows are impacting the level of the returns on the exchange rate.

ARCH and GARCH terms (α_1 and α_2 respectively) in the variance equation are statistically significant (except for South Africa where only the GARCH term is statistically significant), and both coefficients are positive and are close to one (1) indicating presence of ARCH and GARCH effects in the model. The FPI coefficients in all these countries are found to be statistically significant and negative, pointing out that net FPI inflows reduce volatility in the returns. The interpretation of this sign can be ambiguous - rooted on the already mentioned granger causality test. Again, one possible interpretation could be that in the dynamic forex market FPI inflows, central bank interventions can be simultaneous.

We have tested the residual diagnostics for all five countries and found that the residuals and squared residuals are not serially correlated and have no heteroskedasticity in ARCH-LM test. Further, following Meese and Rogoff, (1983) the RMSE values have been compared with a random walk model for all five BRICS country cases. It has been observed that all the RMSE values of the model are lower than its counterpart of random walk models ([Annex Table A.4](#)). Hence, it is reasonable to conclude that the model offers a good fit.

Moving to the estimation results of equations 5 to 7, we observed that FPI flows – both in bond and equity – have statistically significant coefficients for all the BRICS countries (except Russia for bond flows) ([Table 7](#)). Further, all the β_3 coefficients signs are negative indicating equity flows are creating appreciation pressure on the domestic currencies. In the variance equation, both ARCH and GARCH terms are statistically significant (except South Africa, where only GARCH term is significant) and close to one, indicating that once volatility is high, it remains high for a long period. Further, the bond and equity coefficients are statistically significant indicating both types of FPI flows have an impact on exchange rate volatility in the returns. The negative coefficients of bond flows for Brazil and South Africa indicate that the FPI flows in bond segment reduce volatility in returns. However, in the case of India the sign is positive, reflecting that the bond flows increase volatility in the exchange rate returns. The equity flows coefficient is positive for Brazil and South Africa, indicating that equity flows increase volatility in the exchange rate returns whereas the coefficients are negative in the case of Russia, India and China signifying that equity flows reduced volatility in the returns.

Financial asset prices are widely used for predicting exchange rate movements. This paper examines the relationship between the INR/USD exchange rate and select commodity market and stock market variables using a non-parametric causality-in-quantiles approach. The paper finds that changes in crude oil, gold, stock prices and VIX exhibit causality with the exchange rate for all quantiles barring the two extreme ends of the conditional distribution. The causal relationship of the West Texas Intermediate (WTI) oil price, domestic and global stock indices and gold price with the exchange rate of the INR/USD is stronger in mean than in variance, while it is stronger in variance for the Brent crude oil price and net foreign portfolio flows.

JEL classification: C32, F31, G10, Q02

Keywords: Exchange rate, commodity price, stock price, volatility, quantile causality

Introduction

The impact of volatility in domestic and international asset prices on the exchange rate of the Indian Rupee (INR) has increased considerably over time due to greater financial and trade integration. Excessive exchange rate volatility for an extended period may have a negative effect on many economic indicators and pose significant financial stability risks (RBI, 2022). The aim of this paper is to study the causal linkages of domestic and global market indicators with the exchange rate of INR, using the non-parametric causality-in-quantiles technique.

There is a vast literature on the determinants of exchange rate and econometric techniques that could help to predict the exchange rate. The early literature focused on studying the short- and long-run relationships between these variables using Granger causality, cointegration and error correction techniques. Some studies empirically tested the time-varying co-movements and dynamic volatility spillover impact of various macro-economic variables on the exchange rate using various formations of GARCH (Generalised AutoRegressive Conditional Heteroskedasticity) modelling. There are also recent studies providing evidence on the inter-dependencies among these variables and the exchange rate using the wavelet multi-resolution analysis.

The linkages between the macro-economic and financial variables on the one hand, and the exchange rate on the other as captured through the aforementioned approaches are based on

the conditional mean distribution of the exchange rate. The results based on conditional mean analysis may be ambiguous, especially when the distribution of a given variable is fat-tailed, as is the case with daily exchange rate returns. Thus, the conditional mean-based method may not delineate the complete causal relationship between two variables.

To address such methodological limitations, the present study uses the conditional quantile method that captures the linkage of one variable with another under various foreign exchange market conditions² i.e., across different quantiles of the exchange rate. The study is based on a long-time series data spanning April 2002 to May 2020, with daily frequency as against monthly, quarterly or annual data typically used in other studies, facilitating a deeper study of the dynamics of the exchange rate changes. The study examines the pairwise causal relationship between exchange rate return and a comprehensive set of macro-economic and financial variables using a non-parametric causality-in-quantiles technique recently developed by Balcilar et al. (2017a).³

This is the first study to the best of our knowledge that examines the causality of exchange rate using a comprehensive set of market indicators and daily data for India. The present study makes useful contributions to the existing literature. First, the non-parametric causality-in-quantiles approach helps in - (i) identifying dependencies for higher order (causality in variance) as there can be weak causality in return (mean) among financial variables but there can be significant causality in variance, due to volatility spillovers; (ii) exploring the dependence structure using a nonparametric procedure, that reduces the probabilities of misspecification errors, (iii) studying non-linear time series having structural breaks, as most of the financial variables (especially with daily frequency) are non-linear. In fact, all variables used in this study are found to be non-linearly related to the exchange rate. Further, it helps to find the presence of causality at each point of the respective conditional distributions during the period of low fluctuations (the lower quantiles), normal fluctuations (median), and high fluctuations (the upper quantiles) of exchange rate return and volatility. This is also important when the dependent variable has fat-tails, as is the case with exchange rate return.

The rest of the study is organised as follows: [Section 2](#) presents the literature review, [Section 3](#) discusses data and methodology, and [Section 4](#) provides the empirical findings. Finally, [Section 5](#) concludes.

2. Literature Review

Since March 1993, the exchange rate regime of India can be deemed as market-determined with no fixed target (Jalan, 2000). As per the International Monetary Fund's (IMF) classification of exchange rate regimes of member countries as specified in the Annual Report on Exchange Rate Arrangements and Exchange Restrictions (AREAR), India follows a flexible exchange rate regime. The movement of the exchange rate is determined by the demand and supply dynamics of the US dollar (USD) in India, which in turn is influenced by several macroeconomic factors such as the trade balance, current account balance, net capital flows, movements in major global currencies, domestic and global political and economic developments, market expectations of relative interest rates and relative inflation for the INR and USD. The Reserve Bank intervenes intermittently, to maintain orderly market conditions by containing excessive volatility in the exchange rate (BIS, 2013). Pattanaik and Sahoo (2003) investigated the effect of RBI intervention on exchange rate and found that the intervention is effective in achieving the stated objective of policy.

The Indian foreign exchange market has undergone significant changes with improved institutional and market infrastructure, a wide range of instruments and a more liberal regulatory structure. As per the Bank of International Settlements triennial survey of turnover in the foreign exchange market (2019), over-the-counter trades in the Indian rupee constituted 1.7 per cent of the total USD 6.6 trillion global foreign exchange market (BIS, 2019). The turnover of the average daily USD-INR pair increased to USD 110 billion in April 2019 from USD 56 billion in April 2016.

As a result of the calibrated and gradual opening of the capital account and other external sectors of the Indian economy, the forex market has become increasingly integrated with the rest of the world. This is reflected in the increased volume of capital flows and growing trade in the foreign exchange market. Consequent to all these developments, the INR/USD exchange rate has witnessed extended periods of calm followed by intermittent extreme volatility due to sharp fluctuations in capital flows.

As noted earlier, several studies have been undertaken to analyse the interdependencies among the foreign currency market (exchange rate), the commodity market (oil and gold price), the stock market (domestic and global) and capital flows (foreign portfolio investment). As all these markets are closely integrated, fluctuations in any one can have a direct or indirect impact on the others. In this section, we briefly review the empirical studies conducted for examining the relation of the exchange rate with the above-mentioned financial

variables. The relevance of each variable in determining exchange rate movements is mentioned along with the related literature.

2.1 Exchange Rate vs Oil Price

The oil price has been referred to as a non-monetary factor of exchange rate movements in the literature. “For an oil-importing country, rise in the price of oil worsens the balance of payments and eventually leads to currency depreciation, while it generates the current account surplus for oil exporters” (Krugman, 1983). In countries having large oil imports, a small increase in the real oil price can result in a rise in the price of tradable goods and may result in the depreciation of the domestic currency.

Chen and Chen (2007) showed the presence of causality from oil price to the exchange rate for G7 countries. Based on Hiemstra and Jones (1994) nonlinear causality test, Bai and Rath (2019) found a unidirectional causality from oil price to exchange rate for two emerging economies, China and India. The results of Tiwari et al. (2013) using the wavelet multi-resolution technique showed no causal relationship between exchange rate and oil price at the lower time scales (high frequencies) but found the presence of causality at higher time scales (lower frequencies) for India. Ghosh (2011) and Mishra and Debasish (2017) investigated the linkages between oil price and exchange rate for India using GARCH and exponential GARCH (EGARCH) models, respectively. Their results showed that an upsurge in oil price results in a weakening of the Indian currency against US dollar. Studies based on linear and non-linear models indicated mixed results for causal relationship between exchange rate and oil price; however, they miss out to explain the linkages of oil price return at various states of exchange rate returns.

Our study attempts to explain the existence of causality-in-mean as well as causality-in-variance from oil price to exchange rate over the entire conditional distribution.

2.2 Exchange Rate vs Gold Price

The significance of gold as an alternate financial asset increases during a period of uncertainty. After the global financial crisis, gold prices shot up considerably due to a surge in its demand all over the world. Various studies on determining the linkages between exchange rate and gold price focus on the role of gold as a hedge or safe haven. Capie and

Wood (2005) found gold as a potential hedge against the USD and observed that US dollar exchange rates (sterling-dollar and yen-dollar exchange rates) are inversely associated with gold prices. Mark (2011), using dynamic conditional correlations for various USD-linked exchange rates, showed that gold is a weak safe haven and a strong hedge against the USD.

Using cointegration and Granger causality tests, Apergis (2014) found the gold price as a strong predictor of the Australian dollar/US dollar exchange rate. Reboredo and Rivera-Castro (2014) showed the existence of a positive relation between gold price and USD depreciation for a varied set of currencies at all time scales using the wavelet multi-resolution analysis. Wang and Lee (2011) investigated the role of gold as a hedge against the yen and their results showed that it depends on the extent of fall in yen. Balcilar et al. (2017b) used causality-in-quantiles technique to test bi-directional causality between exchange rate and gold price for gold-producing countries. The results suggest that gold price return causes exchange rate return as well as exchange rate volatility, while only exchange rate return causes gold price volatility for most of the countries used in the study.

Our study, using the causality-in-quantile, explains the relationship of gold price return with respect to exchange rate return under different market conditions while other studies on exchange rate return specific to India are based on empirical analysis based on the conditional mean.

2.3 Exchange Rate vs Stock Price

Forex and stock markets are among the highly liquid financial markets globally. The interdependency between these two markets has increased over time due to the increase in capital flow and internationalisation of stock markets. Studying linkages between these markets may help to predict interconnectedness and volatility transmission between them. Numerous studies confirm linkages between stock and forex markets in the literature. Chien-Hsiu Lin (2012) found that the co-movements between exchange rates and stock prices are more robust during a crisis period than a normal period in emerging Asian markets. Cristiana and Carmen (2012) also found causality between these two variables in their study for selected developed and emerging financial markets. Malarvizhi and Jaya (2012) examined the co-movement between exchange rate and Indian stock market return and found the presence of bidirectional causality between the two variables. Reboredo et al. (2016) examined the dependence between the exchange rate and the stock price for emerging economies at

extreme points using copula functions. The results of this study indicate the existence of asymmetric downside and upside spillover effects from one market to the other.

Mitra (2017) found evidence of bidirectional volatility spillover and long-term relationship between stock price and the exchange rate using GARCH model. Simona et al. (2019) explored the co-movements between foreign exchange and the stock market by applying a dynamic conditional correlation mixed data sampling (DCC-MIDAS) model. Their results suggested the presence of higher conditional correlations during certain crisis episodes between the two markets. Kalra's (2011) study found that an increase in the global volatility index (VIX) results in the depreciation of east Asia currencies. The methodology based on causality-in-quantile is more general in the sense that it detects the presence or absence of causality from domestic and global stock markets to exchange rate markets under various heterogeneous market conditions of the exchange rate, thus supplementing the literature further, while other studies based on conditional mean are not able to ascertain the same.

2.4 Exchange Rate vs Multiple Financial Variables

Various studies have explored the co-movements and interlinkages among these financial variables using their return and volatility. Samanta and Zadeh (2012) examined interlinkages among gold price, oil price, exchange rate and stock market returns using spillover indices. The findings of the study suggested the existence of a long-run relationship between these markets. Ciner et al. (2013) examined the relationship of stock, bond, gold and oil prices with exchange rate using a dynamic conditional correlation analysis and quantile regression based on the daily data of the US and the UK. Their results indicated that gold acts as a hedge against the exchange rate and bond market for the equity. Further, their results based on quantile regression suggested that gold consistently plays the role of a safe haven when the exchange rates fall significantly.

Jain and Biswal (2016) for their study on India based on DCC-GARCH method inspected the relationship between the global price of gold, crude oil, exchange rate, and the stock market. Their results suggested a fall in gold price or crude oil price causes a weakening of the exchange rate and the stock price index. Atul et al. (2015) found the existence of one-way causality from gold prices to both stock prices and exchange rate using daily data for India. Mollick and Sakaki (2019) examined the relationship of select major currencies with respect to the USD, international oil price and world equity returns using a vector autoregression

(VAR) method. Their study proposed that commodity currencies appreciate subsequent to positive oil price shocks and safe-haven currencies weaken with positive global equity shocks.

Against the backdrop of the literature discussed above, the present study investigates the predictability of exchange rate return and volatility using select financial variables. There can be diverse interlinkages between the financial variables and exchange rate under different degrees of exchange rate movements. The causality-in-quantile helps to measure the causality for each point of the conditional distribution of exchange rate return and volatility. The study is important to fill the gap in the existing literature by finding the financial indicators causing exchange rate movements specific to India and providing useful insights to portfolio managers.

3. Data and Methodology

3.1 Data

Daily data from April 2, 2002 to May 29, 2020 (excluding weekends and holidays), constituting 4,395 observations are used for analysis. High frequency data capture more dynamics of the financial time series data which are typically quite volatile. The study period covers various phases of exchange rate fluctuations including the global financial crisis of 2008-09. However, the selected period for some variables varies as per data availability. These variables are: India VIX (expected stock market volatility index calculated using the NIFTY Index option prices), VIX (expected stock market volatility index calculated using S&P 500 index option prices) and MSCI emerging markets index [Morgan Stanley Capital International index, an indicator to assess equity market performance in emerging markets]. Exchange rate (INR/USD), closing prices of stock indices of BSE, NSE, US S&P 500 index, UK FTSE 250 index and net portfolio investment flows (in rupees million) are sourced from the CEIC database. The gold price (per ounce) is taken from the World Gold Council and is denominated in USD.⁴

The oil prices data used are the spot prices taken from the Energy Information Administration (EIA), US Department of Energy. Both WTI and Brent crude oil prices (Europe price at FOB) are in USD per barrel.⁵ Data for VIX, India VIX and MSCI emerging market index are taken from NSE and other relevant sources.⁶

We have calculated the returns of the variables by taking the first difference of their natural logarithm and then multiplying by 100. Net foreign portfolio investment data are adjusted for negative values before taking log difference as per the standard practice, i.e., by adding a constant positive number which makes the minimum number (negative) in the whole series to a small positive number. For all variables except VIX and India VIX return, the data are in natural logarithm form.

The descriptive statistics of the data as per the required transformation of the data as discussed above are given in [Appendix Table A1](#). The average of daily returns of all the variables is positive (negative for MSCI emerging market return), small as compared to standard deviation and close to zero showing the absence of any type of trend in the data.

It is evident that the stock price return in India is higher as compared to the global stock price return in the US, the UK, and emerging markets. The volatility of these variables as represented by standard deviation shows that the exchange rate has lower variability as compared to return on stock and commodities prices. Oil price returns and stock indices returns, as mentioned in the literature, are some of the most volatile variables among all commodity prices. The skewness statistics of exchange rate return and net portfolio flows are positive and skewed to the right (more positive return than negative return), while it is negatively skewed for all other return variables.

The kurtosis value for each variable is significantly higher than normal distribution indicating that the series is highly peaked and thus leptokurtic. This implies that returns have larger, thicker tails than the normal distribution which reveals the occurrence of extreme returns more frequently. The Jarque–Bera test statistics show that not all the variables are normally distributed.

All the variables are tested for stationarity at the level and if they are not stationary when the first difference (log difference) is taken. All the variables except net FPI, VIX and India-VIX are found to be $I(1)$. Net FPI, VIX and India-VIX are $I(0)$. Since VIX and India-VIX are volatility indices, the analysis is done by taking the log transformation of these two series. As we are examining the pair-wise causality between two financial time series, we have used the return of net FPI even though it is stationary at the level.

The dynamic behaviour of these variables are shown in [Figures A1](#) and [A2](#), depicting these series in actual and in return form, respectively. [Figure A1](#) shows that all the commodity prices, stock prices and exchange rates have shown an upward trend in general. During the periods 2003-2008 and 2009-2011, the exchange rate recorded appreciation (downward movement) as a result of huge capital inflows in India. However, the exchange rate recorded a sharp depreciation during the periods of global uncertainties - the global financial crisis (2007-2009); post-announcement effects of quantitative easing programmes by the US Federal Reserve from May 23, 2013 to September 4, 2013 (Fed taper tantrum); and the recent COVID-19 pandemic (February 27, 2020 to May 29, 2020).

[Figure A2](#) shows that most of the series exhibit strong clustering behaviour and sharp movements during the heightened global uncertainties. We have used both international oil prices, Brent crude and WTI oil price in our study as Brent is the benchmark price in India while WTI is the international oil price. The stock indices of the US and the UK are taken as both the countries have significant cross-border transactions in terms of trade and foreign investments with India. Both BSE and NSE indices are used due to their varied compositions.

We check for the existence of nonlinearity in the relationship between exchange rate return with the selected variables in the study by applying the BDS test developed by Brock, Dechert and Scheinkman (1996).⁷ The test is exercised on each residual of VAR(1) model of exchange rate return with selected variables and on the residuals obtained from the AR(1) model of exchange rate return. [Table A2](#) presents the results of the BDS test which indicate rejection of the null hypothesis at various embedding dimensions (m). This proves statistically that there is a non-linear relationship between the exchange rate return and each selected variable. The results of linear Granger causality indicate all variables except MSCI return, net FPI and India VIX, significantly cause exchange rate ([Table A3](#)). However, any inference based on linear Granger causality results may lead to mis-specification errors as there exist non-linear relationships among the variables.

We conduct the Bai and Perron (2003) test and find multiple structural breaks (the VAR(1) model of exchange rate return with selected variables and the residuals obtained from AR(1) model of exchange rate return, [Table A4](#)). The Bai and Perron test is based on a dynamic programming algorithm which optimises the exhaustive computational procedure for testing multiple breakpoints of global minimiser of squared residuals (SSR). This approach can allow for autocorrelation and heteroskedasticity in the time series. In the test, we employ

quadratic spectral kernel-based HAC (heteroskedasticity-autocorrelation-consistent (HAC) correction) covariance estimation using pre-whitened residuals.

The results detect two structural breaks in NSE and S&P 500 returns on September 11, 2008 and April 3, 2014, respectively. There is no break observed in the VAR(1) model of exchange rate return incorporating BSE return, Net FPI, India VIX and VIX. There are three structural breaks in the VAR(1) model with WTI and two breaks with Brent crude oil price. Most of the break dates are during the global financial crisis and the ensuing quantitative easing programmes by the Federal Reserve. The presence of non-linearity and structural breaks in the selected variables support the use of a nonparametric causality-in-quantile approach, as this test is robust to such mis-specifications.

3.2 Methodology

We use the methodology developed by Balcilar et al. (2017a) for uncovering nonlinear causality through a hybrid approach using the methodology of Nishiyama et al. (2011) and Jeong et al. (2012). We represent the dependent variable exchange rate returns as y_t and the independent variables (selected variables) as x_t .

Communication is a key element in functioning of modern central banks, who are placing greater emphasis on transparency and accountability. The increasing preference for a collegial method of monetary policy decision making and thrust on financial stability have laid more emphasis on structured policies/strategies for communication in the realm of central banking.

The Reserve Bank's communication policy follows the guiding principles of relevance, transparency, clarity, comprehensiveness and timeliness: it strives to continuously improve public understanding of developments in the multiple domains under its ambit.

The framework of central banking policy in India has evolved around its objectives specified under the Reserve Bank of India Act, 1934, viz. “to regulate the issue of Bank notes and keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage; and to operate a modern monetary policy framework to meet the challenge of an increasingly complex economy, where the primary objective is to maintain price stability while keeping in mind the objective of growth.”

Consistent with the above, the Reserve Bank’s macroeconomic and monetary policy has focussed on maintaining price stability, ensuring adequate flow of credit to sustain the growth momentum, and securing financial stability. The financial stability objective are enabled by the powers vested with it for regulation and supervision of the Indian financial system and its constituents, the money, debt and foreign exchange segments of the financial markets and the country’s payment and settlement system support. These are augmented by the critical functions relating to maintenance of foreign exchange reserves and the role as the lender of last resort. The Reserve Bank pursues its core function of issuance of bank notes and currency management as well as its agency functions such as management of public debt, banker to Government (Centre and States) and banker to the banking system, including regulation of bank reserves. As a full-service central bank, it also propels the development and consolidation of the country’s financial system and supports inclusive growth.

The Reserve Bank’s approach is to communicate its policy stance and its assessment of the evolving situation by providing rationale as well as supporting information and analysis to all stakeholders.

In its medium-term Vision Statement for 2019-22, termed as ‘Utkarsh 2022’, the Reserve Bank has set out for itself the following mutually reinforcing objectives:

Transparent communication, clear interpretation and accurate articulation of the multifarious objectives of the Reserve Bank are the goals of its communication policy. The composite mandate necessitates open, clear and structured communication for its effective functioning as well as for supporting the expanding boundaries of its policy instruments.

The communication policy of the Reserve Bank has the following principal goals:

- - Providing clarity on its role and responsibilities;
 - Building confidence in its policy measures;
 - Improving transparency and accountability;
 - Anchoring expectations of all economic agents to enhance the efficacy of monetary policy and to minimise undue speculation;
 - Increasing awareness about financial stability;
 - Dissemination of information with minimum time lag;
 - Ensuring timeliness and credibility through effective communication; and
 - Deepening engagement with the multi-lingual and multi-cultural society.

Attention of banks/financial institutions (FIs) is drawn to the Reserve Bank advisory on [“Roadmap for LIBOR Transition” dated July 08, 2021](#) wherein banks/FIs, inter-alia, were (i) encouraged to cease, and also encourage their customers to cease, entering into new financial contracts that reference London Interbank Offered Rate (LIBOR) as a benchmark and instead use any widely accepted Alternative Reference Rate (ARR), as soon as practicable and in any case by December 31, 2021 and (ii) urged to incorporate robust fallback clauses in all financial contracts that reference LIBOR and the maturity of which was after the announced cessation date of the LIBOR settings.

2. With the concerted efforts of banks/FIs as well as industry associations like the Indian Banks’ Association, a smooth transition with respect to LIBOR settings that have ceased to be published/become non-representative after December 31, 2021 has been achieved. The transition away from LIBOR was also facilitated by the continuing publication of US\$ LIBOR settings in five tenors which provided a longer transition period particularly for the insertion of the fallback clauses in legacy financial contracts that reference LIBOR. New transactions are now predominantly undertaken using ARRs such as the Secured Overnight Financing Rate (SOFR) and the Modified Mumbai Interbank Forward Outright Rate (MMIFOR). At the same time, there have been instances of a few US\$ LIBOR linked financial contracts undertaken/facilitated by banks/FIs after January 1, 2022. Also, while

banks have reported that substantial progress has been made towards insertion of fallback clauses, the process is yet to be completed for all contracts where such fallbacks are required to be inserted.

3. After June 30, 2023, the publication of the remaining five US\$ LIBOR settings will cease permanently. While certain synthetic LIBOR settings will continue to be published after June 30, 2023, the Financial Conduct Authority (FCA), UK, which regulates the LIBOR, has made it clear that these settings are not meant to be used in new financial contracts. The MIFOR, a domestic interest rate benchmark reliant on US\$ LIBOR, will also cease to be published by Financial Benchmarks India Pvt. Ltd. (FBIL) after June 30, 2023.

4. Banks/FIs are advised to ensure that no new transaction undertaken by them or their customers rely on or are priced using the US\$ LIBOR or the MIFOR. Banks/FIs are also advised to take all necessary steps to ensure insertion of fallbacks in all remaining legacy financial contracts that reference US\$ LIBOR (including transactions that reference MIFOR). Fallbacks in such contracts should be inserted at the earliest so as to ensure that transition of any remaining US\$ LIBOR-linked contracts is completed well before the deadline of end June 2023 and any disruptions due to a last-minute rush to insert fallbacks is avoided. Banks/FIs are advised not to rely on the availability of synthetic LIBOR rates as a substitute for fallbacks in legacy contracts.

5. Banks/FIs are expected to have developed the systems and processes to manage the complete transition away from LIBOR from July 1, 2023. Continued efforts in sensitising customers on the steps to be taken to manage the associated risks will enable a smooth completion of the final leg of the transition.

6. The Reserve Bank will continue to monitor the efforts of banks/FIs for ensuring a smooth transition from LIBOR.

The framework of central banking policy in India has evolved around its objectives specified under the Reserve Bank of India Act, 1934, viz. “to regulate the issue of Bank notes and keeping of reserves with a view to securing monetary stability in India and generally to operate the currency and credit system of the country to its advantage; and to operate a modern monetary policy framework to meet the challenge of an increasingly complex

economy, where the primary objective is to maintain price stability while keeping in mind the objective of growth.”

Consistent with the above, the Reserve Bank’s macroeconomic and monetary policy has focussed on maintaining price stability, ensuring adequate flow of credit to sustain the growth momentum, and securing financial stability. The financial stability objective are enabled by the powers vested with it for regulation and supervision of the Indian financial system and its constituents, the money, debt and foreign exchange segments of the financial markets and the country’s payment and settlement system support. These are augmented by the critical functions relating to maintenance of foreign exchange reserves and the role as the lender of last resort. The Reserve Bank pursues its core function of issuance of bank notes and currency management as well as its agency functions such as management of public debt, banker to Government (Centre and States) and banker to the banking system, including regulation of bank reserves. As a full-service central bank, it also propels the development and consolidation of the country’s financial system and supports inclusive growth.

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- Building confidence in its policy measures;
- Improving transparency and accountability;
- Anchoring expectations of all economic agents to enhance the efficacy of monetary policy and to minimise undue speculation;
- Increasing awareness about financial stability;
- Dissemination of information with minimum time lag;
- Ensuring timeliness and credibility through effective communication; and
- Deepening engagement with the multi-lingual and multi-cultural society.

আরবীআইএ ফরেক্সমাং ব্যবহার করা এবং ফরেক্স ব্যবহারে মাঠে ইলেক্ট্রোনিক ট্রেডিং প্ল্যাটফর্ম যোগ্যতা মাঠে অধিকৃত নথি তেবী সংস্থাআনী অলর্ট সূচীজারী করে ছে

আরবীআইএ ফরেক্সত লেনদেনে কববিলই আবু ফরেক্স ট্রেডিংর বাবে ইলেক্ট্রনিক ট্রেডিং প্ল্যাটফর্ম চলাবলই অনুমতিপ্রদান করা নহয়

আরবীআইএ নে ফরেক্সমধ্যে ডীল করণ্যাসাঠী আণফরেক্স ট্রানজাকশনসাঠী ইলেক্ট্রনিক ট্রেডিং প্ল্যাটফর্ম অপারেট করণ্যাসাঠী অলর্ট লস্টি জারী কেলেলী নাহী

আরবীআইএ ফরেক্সে ডলি করার জন্য এবং ফরেক্স ট্রানজাকশনের জন্য ইলেক্ট্রনিক ট্রেডিং প্ল্যাটফর্ম পরিচালনা করার জন্য অনুমোদিত ন

ಫಾರುಕ್‌ಸನ್‌ಲಲ್ ವಯವಹರಿಸಲು ಮತು ಫಾರುಕ್‌ಸನ್ ಟರಾನ್‌ಸಾಕ್‌ಷನ್‌ಗಳಿಗೂ ಎಲೆಕ್ಟರಾನಿಕ್
 ಟರೇಡ್‌ಂಗ್ ಪಾಲಿಟಿಫಾರಮ್‌ಗಳನ್ನು ನರ್ವಹಿಸಲು ಆರ್‌ಬಿಐ ಅಲರ್ಟ್ ಲಿಸ್ಟ್ ಅನ್ನು ನೋಡಿದೆ

ಶಾರಿಶಾಹಿ ಉದ್ದೇಶ ರೇ ಡಿಲ್ ಕರಿವಾ ವಾಹಿ ಲವ್ ಉದ್ದೇಶ ರಾತ್ನಾಕರ್‌ನ್ ವಾಹಿ ಹಿಹ್‌ರೇ-ದಿಕ್ ರೇಡೇಡ್
 ಲ್ಲಾಫರ್‌ನ್ ವರಿಲಾಹಿ ಕರಿವಾ ವಾಹಿ ಅಪಿಕ್ತ ನ ಲಿವಾ ಘಾಖಾಫಿಕ್‌ರ ಅಹರ್‌ ರಾಹಿ ಹಾಹಿ ಕರಿಲಾ

ಫಾರುಕ್‌ಸನ್ ಡಿಲ್ ವಯಡ್‌ನ್ ಮರಿಯು ಫಾರುಕ್‌ಸನ್ ಟರಾನ್‌ಸಾಕ್‌ಷನ್‌ಲ ಕ್ಷಂ
 ಎಲೆಕ್ಟರಾನಿಕ್ ಟರೇಡ್‌ಂಗ್ ಪಲಾಟ್‌ಫಾರ್ಮ್‌ನು ಆಪರೇಟ್ ವಯಡ್‌ನ್ ಆರ್‌ಬಿಐ ಅಧಿಕಾರಂ
 ಇವ್‌ವಡನ್ ಸನ್‌ಫಲ ಜುಬಿಲಾನ್ ಜುರ ವಸಿದ್

لئے کے دین لین کے کرنسی ملکی غیر اور نمٹے میں کرنسی ملکی غیر فہرست کی انتباہ کی اداروں ربی
 نہیں مجاز لئے کے چلانے کو فارم پلیٹ ٹریڈنگ الیکٹرانک

ஆர்பிஐ அந்நிய சலாவணி பரிவர்த்தனைகளுக்கும் மின்னணு வர்த்தக தளங்களை
 செயல்படுத்த மற்றும் அந்நிய சலாவணி பரிவர்த்தனைகளுக்கும் அங்கீகரிக்கப்படாத
 நிறுவனங்களின் எச்சரிக்கை பட்டியலை வழங்குகிறது

ಶಾರಿಶಾಹಿ ಉದ್ದೇಶ ರೇ ಡಿಲ್ ಕರಿವಾ ವಾಹಿ ಲವ್ ಉದ್ದೇಶ ರಾತ್ನಾಕರ್‌ನ್ ವಾಹಿ ಹಿಹ್‌ರೇ-ದಿಕ್ ರೇಡೇಡ್
 ಲ್ಲಾಫರ್‌ನ್ ವರಿಲಾಹಿ ಕರಿವಾ ವಾಹಿ ಅಪಿಕ್ತ ನ ಲಿವಾ ಘಾಖಾಫಿಕ್‌ರ ಅಹರ್‌ ರಾಹಿ ಹಾಹಿ ಕರಿಲಾ

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day Name English	ida y Name Hindi	ay Name Tamil	ida y Name Assamese	iday Name Bengali	ida y Name Gujarati	ay Name Kannada	ay Name Malayalam	ay Name Marathi	ay Name Oriya	iday Name Punjabi	ay Name Telugu	day Name Urdu
Uttara rayana Pun yaka la, Mak ara San kran ti Festi val	उत्तरायण पुण्यकाल, मकर संक्रान्ति महोत्सव	உத்தராயண புனியகால, மகர சங்கராந்திரா விழா	উত্তরায়ণ পুণ্যকাল, মকর সাংক্রান্তি উৎসব	উত্তরায়ণ পুণ্যকাল, মকর সাংক্রান্তি উৎসব	ઉત્તરાયણ પુણ્યકાલ, લા, મકર મહર ા સંક્રાંતિ ઉત્સવ	ಉತ್ತರಾಯಣ ಪುಣ್ಯಕಾಲ, ಮಕರ ಸಂಕ್ರಾಂತಿ ಉತ್ಸವ	ഉത്तरായണ പുണ്യകാല, മകര സംക്രാന്തി ഘോഷോത്സവ	उत्तरायणा पुण्यकाळा, मकरा संक्रांती उत्सव	ଉତ୍ତରାୟଣ ପୁଣ୍ୟକାଳ, ମକର ସଂକ୍ରାନ୍ତି ଘୋଷୋତ୍ସବ	ਉਤਰਾਯਾਨ ਪੁਨਯਕਾਲ, ਮਕਰ ਸੰਕਰਾਨਤੀ ਮਹੋਤਸਵ	ఉత్తరాయణ పుణ్యకాల, మకర సంక్రాంతి ఉత్సవ	ناپارتا ایکینوی لا، مکارا رکنس انتی تہوار
Rep ubli c Day	गणतन्त्र दिवस	காடிர யரசு தினம்	গণতন্ত্র দিবস	গণতন্ত্র দিবস	ગણતંત્ર દિવસ	ಗಣರಾಜ್ಯ ದಿವಸ	റിപ്പബ്ലിക് ദിനം	प्रजा सत्ता क दिन	ଗଣତାନ୍ତ୍ରିକ ଦିବସ	ਗਣਤੰਤਰ ਦਿਵਸ	రొపబ్లిక్ దినం	ريپبلڪ دین

	స					దం	దీన					
Mah a Shiv aratr i	మహా శివ రాత్రి	మకా షివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి	మహా శివ రాత్రి
Uga di Festi val	గుడి పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	కూత పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ	గూర్ పడ వా / ుగా ది త్యో హార / తేల గు నవ వర్ ష దవి స / సజ

	ర దవి స		ద వి స	స	ద వి స	శ్రీ మ దం	గి క్ దీ ం	క ద ని	దీ ద న	చ ద వి స	ద న	
Mah a Shiv aratr i	మ హా శ వి రా త్ ర తి	మ కా శ్శి రా త్త ర తి	మ శ శ బ తి	మ శ శ బ తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి	మ హా శ వి రా త్ ర తి
Uga di Festi val	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	క థ ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /	గు డి ప ద వా / ఉ గా ద వి త యో హ ర / తె ల గు న వ వ ర్ ష ద వి స /

