India and the Rest of the World: Analyses of International Monetary Policy Spillovers

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INDIA AND THE REST OF THE WORLD: ANALYSES OF INTERNATIONAL MONETARY POLICY SPILLOVERS

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ABSTRACT

The US is India's largest trading partner, followed by the European Union. Our study, using the GVAR model, shows that a US Monetary Policy (MP) shock results in a depreciation of the Indian currency vis-a-vis the dollar. This is due to Indian investors preferring to invest in the US, which provides higher returns during a US MP shock. The Eurozone MP shock does not have a significant impact due to the increasing dollarization of the Indian economy. However, the US MP shock propagation diminishes when there is economic policy uncertainty. Our findings have implications for monetary policy conduct in India.

I. INTRODUCTION

Indian economy is considered to be one of the fastest-growing economies in the world, attracting formidable foreign investors from various regions. According to the World Bank projection, the country's economy is expected to surpass that of Japan and Germany within the next five years, becoming the third largest economy in the world (see Kant, 2024 in Economics Times). While the economy has close ties with Europe, the US and other advanced economies, its regular foreign policy and frequent consultations with these countries have always taken wider scope to enhance their cooperation and improve trade partnerships (see European Union (EU) reports, 2023). The bilateral trade between India and the European nations has surpassed £100 billion. In 2019 alone, the EU accounted for more than 22% of FDI inflows into the country, with a total of 79.59 billion in traded goods (see EU reports, 2023). As for its relationship with the US, its bilateral trade with India reached $191 billion in 2022, which positions the country as its largest trading partner. Additionally, the US foreign inflows into India for 2023 account for $6.04 billion and represent the third largest flows for the year (see Economic Times Reports, 2023).

A similar stance is conspicuous in countries like Australia, Singapore and Japan. In 2022, Australian investment in India amounted to $32.4 billion, while the country only invested $12.8 billion in Australia. The economic relationship between India and Japan has further intensified in recent times. While India is the 18th largest trading partner of Japan by total trade volume, Japan took 13th place among Indian trading partners worldwide in 2021 (see Ministry of Foreign Affairs of Japan, 2024). As for Singapore, India is its 8th largest trading partners with over $35 billion. The relationship between the two countries has seen a formidable improvement recently (see High Commission of India in Singapore, 2023).

India's population of over 1.3 billion makes it an attractive market for goods and services. This has resulted in various investors from the US, the Eurozone, and other top economies of the world taking an interest in India. However, this global connection also means that India may be exposed to economic imbalances in its trading partners, leading to potential macroeconomic instability within the country. More closely, the possibility of monetary policy spillovers from major trading partners to India is high. This is because monetary policies significantly influence capital flows between countries with implications on exchange rates and trade (see Chen *et al.*, 2016; Thomas and Kumar, 2019). There is evidence that international monetary policy spillovers significantly impact factors such as capital flows, growth in credit, and bank leverage.

The monetary policy objectives of the country include maintaining price stability while promoting economic growth. The primary monetary authority responsible for achieving this is the Reserve Bank of India (RBI). To achieve a minimum inflation rate within a range of 4% with a 2% tolerance rate, the RBI fixes interest rates. To further strengthen the economy, the idea of switching to inflation targeting was moved and adopted in 2016. This became necessary due to some fallouts from nominal anchoring of 'currency peg' and 'money growth' (Dua, 2023). However, as much as the country is open to various advanced economies of the world, global monetary policies can have wider implications on various macroeconomic variables of the Indian economy, particularly the exchange rate.

The compelling reasons for focusing on the Indian economy resonate more with the stronghold features of its financial markets, which have been resilient to the global financial crisis of 2008. Aside from this feature, the economy is fast-growing, trading globally with many advanced economies and its financial sector is well developed (see Thomas and Kumar, 2019).

Consequently, the study evaluates how much influence the monetary policy actions of the major trading partners of India, particularly the US and the EU, have on its exchange rate[1]. Since the exchange rate is a relative variable, it is expected to respond more swiftly to external shocks than other domestic variables. In the prior studies, the possible monetary policy spillover analysis is rather more emphasized in very few empirical investigations, with much emphasis on only the US conventional monetary policy spillovers (Thomas and Kumar, 2019; Tran and Pham, 2020; Shareef and Prabheesh, 2021; Lakdawala, 2021). For instance, the work of Lakdawala (2021) emphasizes the US monetary spillover on India's financial markets with no consideration for other important advanced economies of the world. However, Thomas and Kumar (2019) focus on the US, the UK, the EU and Japan's monetary policy spillovers on the Indian economy. Although the study is wider in scope regarding monetary spillover, the impact is rather emphasized for asset prices, while Lakdawala (2021) pays attention to only stock markets. However, the link between international monetary spillovers and exchange rates is closer than those previously considered.

Our study uses the Global Vector Autoregressive (GVAR) model, which has two advantages. Firstly, it allows us to factor in any possible interlinkages or interdependencies between international monetary policy shocks and exchange rates in India. For example, the US monetary policy shock does not directly influence the Indian economy but instead functions through the trade channel. This transmission is often overlooked in single-country VAR-based analyses. Secondly, the GVAR methodology captures regional and global shocks from country-specific variables. Instead of using the US GDP or the industrial production index as a proxy for global production or supply, the GVAR methodology aggregates the GDP values of all advanced and emerging economies represented in its database using relevant weightings, making the analyses more robust and representative. Several studies have utilized a similar methodology, as seen in Aor *et al*. (2021), Sikiru and Salisu (2021), Deng *et al*. (2022), Musa *et al*. (2022), Salisu *et al*. (2022, 2023a, 2023b), Tumala *et al*. (2022), and Tian and Wang (2024). However, our study differs in terms of the subject matter for which the methodology is being applied. Unlike previous studies, we use an updated version of the GVAR database, which covers the period from 1979 Q2 to 2023 Q3 (as compiled by Mohaddes and Raissi (2024)). This suggests that the findings of our study provide a recent perspective at the global, regional, and country-specific levels.

Foreshadowing our results, we find that a shock to the US monetary policy significantly affects the Indian rupee, causing it to depreciate against the US dollar. This suggests that whenever there is a sudden increase in the US interest rate, portfolio investors tend to move their assets from India to the US, and vice

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[1] The exchange rate is measured as the value of one US dollar in Indian rupees. When the rate increases, it means the rupee has depreciated, while a decrease implies an appreciation of the rupee.

versa in the case of a sudden reduction in interest rates. On the other hand, a shock to the EU (or Eurozone) monetary policy has no impact on the Indian exchange rate. This could be due to the increasing use of the US dollar in the Indian economy. Furthermore, our study shows that the response of the Indian monetary authority to the US monetary policy shock has not been enough to prevent the depreciation of the Indian exchange rate. We also examine the impact of Economic Policy Uncertainty (EPU) in both the US and EU (as well as the Eurozone) on the exchange rate of India. Our findings suggest that EPU does not affect the exchange rate of India, indicating that investors do not shift their investments from India to the US during times of unexpected uncertainty in the US. We also conduct further analyses to test the response of the Indian exchange rate to the US monetary policy shock in the presence of EPU, and we find that EPU disincentivizes the use of interest rates to attract portfolio investments from India. In other words, investors' preference for investing in the US due to a sudden rise in interest rates tends to diminish with EPU. We conduct robustness tests to validate our findings and highlight our study's implications for the conduct of monetary policy in India.

This study covers other sections in addition to the introduction. After the introduction, Section II discusses some stylized facts about the Indian economy and those of the rest of the world, while Section III documents issues relating to theory and evidence on international monetary policy spillovers. Section IV covers the methodology and presents and discusses the results, while Section V concludes the paper.

II. BRIEF STYLIZED FACTS ABOUT INDIA AND THE REST OF THE WORLD

India's economy, including its trade volume, population, economic activities, and macroeconomic policies, holds a significant position in global discourse. However, a wide range of international factors can also dictate her economy. For instance, financial markets in India can be influenced by the actions of central banks, particularly those of its trading partners across the world. Importantly, the possibility of international spillovers from any policy action becomes rather obvious with the integration of the economic activities of nations globally. We examine this stance by paying attention to three key areas: Monetary policy choices, Exchange rate regime, and Indian trade relations.

A. Monetary Policy Choices

We begin our stylized facts by understanding the monetary policy stance of India, and thereafter, we evaluate the conduct of monetary policy in the major trading partners of India. We note that India's policy rate has not been relatively stable over time (though the rate in the last few months has been hovering around 6.5%). The highest and lowest rates from 2000 till data have been 12.5% and 4%, respectively. The lowest policy rate was recorded around 2020 (an issue that is not unconnected with the COVID-19 pandemic) and the highest in 2000 (see Figure 1). Maintaining a relatively low interest rate by the RBI compared to other emerging economies like Brazil, Russia and South Africa with their current monetary policy rates of 10.25 per cent, 16 per cent and 8.25 per cent, respectively, may have been

deliberately pursued to enhance the exports of the country. When examining the Fed rate movements across time, it becomes clear that the US MPC has been increasing the rate since 2022 to control the present trends in global inflation. This came after a string of rate reductions in response to the COVID-19 pandemic (see Figure 2).

We further examine the conduct of monetary policies of the Eurozone, another key trading partner of India (see Figure 3). If India would ever respond to the shock due to global macroeconomic variables, its response to her key trading partners' policy rates should assume a vital role. It will, therefore, be worthwhile to see how their monetary policy actions may have impacted their trade relations with India. Based on the monetary policy rate, the EU's rate has been near zero from September 2014 until 2022, when it was adjusted upward until it reached 4.5% recently (see Figure 3). However, in the periods before, we notice a higher trend, especially around 2000 and 2008. This rising trend is evident in the US and Indian monetary policy regimes.
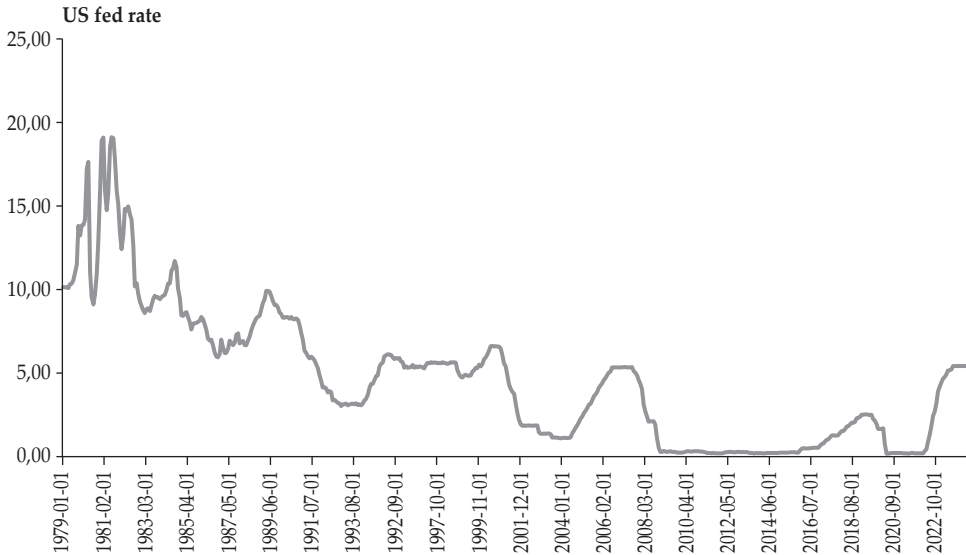
Figure 1.
India's Monetary Policy Rate between 2000 and 2024.

The chart presents the Indian monetary policy rate from 2000 through 2024. Data are sourced from the RBI,
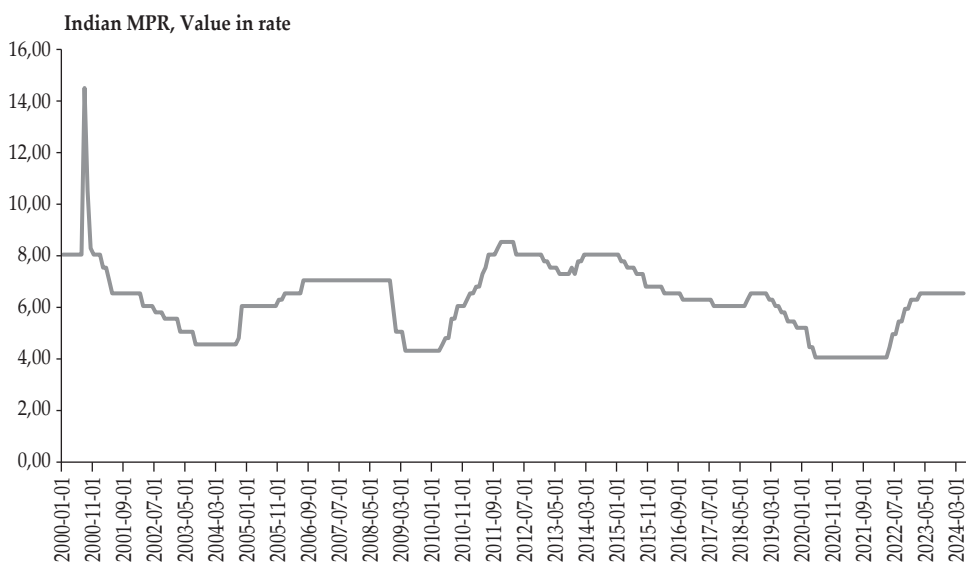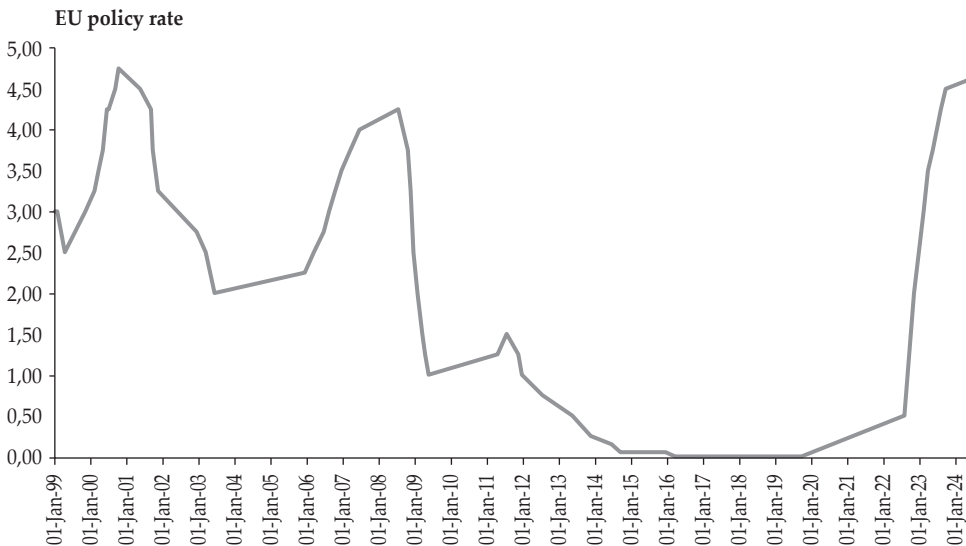
Figure 2.
The US Fed Funds Rate between 1979 and 2024.

The chart presents the monetary policy rate of the US from 1979 through 2024. The policy (rate) decision has been consistently made every two months from 1979 to 2024 (as captured by this figure). Data are sourced from the Fred's statistics.

Figure 3.
European Central Bank (ECB) Monetary Policy Rates (1999 – 2024)

This figure shows the movements in the policy rate of the Euro between 1999 to 2024. The policy (rate) decision has been consistently made during these periods. Data are sourced from ECB.

B. Exchange Rate Regime

Figures 4 and 5 plot the monthly exchange rates of the Indian rupee to the US dollar and Euro, respectively, from 1979 to 2024. The trend shows the upward and downward movements in the value of the Indian rupee relative to the US dollar and Euro. While the upward trend indicates the depreciation of the rupee relative to the US dollar and Euro, the reverse trend shows an appreciation of the Indian currency. We observe from the graph that in many instances, the rupee depreciation is relative to the US dollar and Euro than appreciation. Importantly, we observed that the dollar/rupee and euro/rupee were around 30 before 1993 when the country maintained a fixed exchange rate. However, the periods afterwards, when market forces drove the country's exchange rate, witnessed sharp depreciations in the rate. The reason could be traced to the monetary policy rates behaviour in the two countries. India seems to have been pursuing expansionary monetary policy given the downward movement in their policy rate, especially between 2011 and 2020, before the outbreak of COVID-19, which saw many countries (including India) reducing their rates as part of the measures to contain the pandemic; for a survey of this literature, see Narayan (2021) and Phan and Narayan (2020).

Following the COVID period, the rate was left unchanged until global inflation became a menace, and following the increase in the global geopolitical tension driven by the Russia-Ukraine War and the Houthi attacks on the Red Sea, among others. On the other hand, it appears that each time trade partners like the US and the EU adopt the contractionary monetary policy, the Indian rupee tends to depreciate. Specifically, an increase in the US/EU rate without a corresponding increase in the RBI rate could make Indian investors divest from India and move their investments to the US/EU market, guaranteeing them higher returns. Hence, the plausible reason for the depreciation of the Indian rupee is relative to the US dollar and the Euro, as shown in Figures 3 and 4 below.

Figure 4.
**Monthly Exchange Rate of Indian Rupee to US Dollar (1979 – 2024).**

Monthly exchange rate of Indian Rupee to US dollar (1979 – 2024). The graph plots the rate at which the Indian rupee is being exchanged for a unit of the US dollar. Thus, a (an) downward (upward) movement would suggest appreciation (depreciation) of the Indian rupee relative to the US dollar. Data are sourced from Fred's statistics.

Indian monthly exchange rate, rupee to dollar
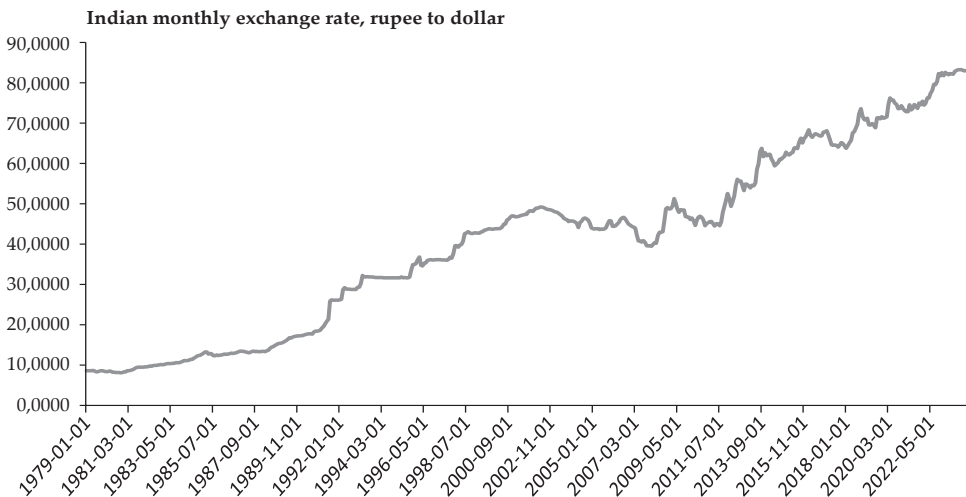
Figure 5.
Monthly Exchange Rate of Indian Rupee to Euro (1979 – 2024).

The graph plots the rate at which the Indian rupee is being exchanged for a unit of Euro. Thus, a (an) downward (upward) movement would suggest appreciation (depreciation) of the Indian rupee relative to the Euro. Data are sourced from investing.com

Indian monthly exchange rate, rupee to Euro
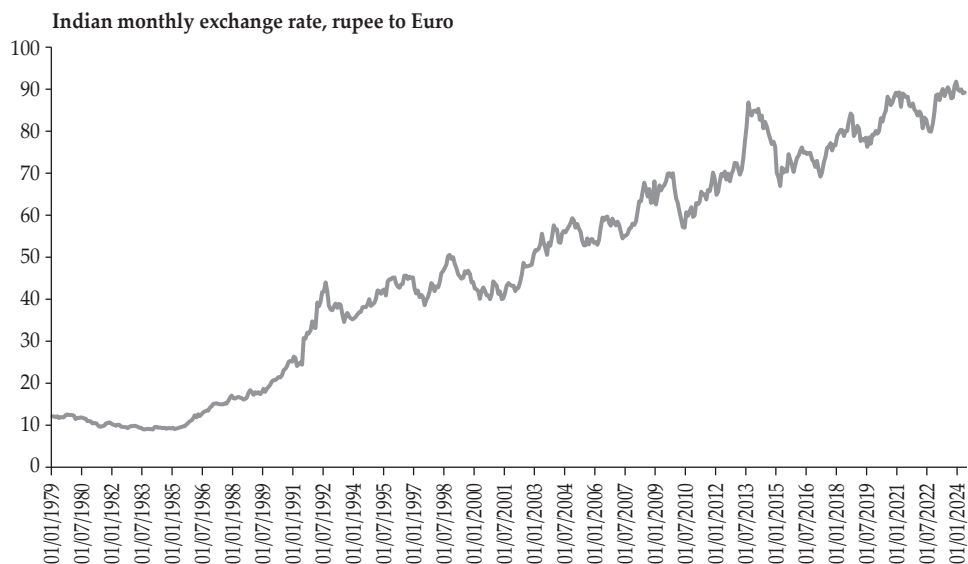
C. Indian Trade Relations

India maintains strong trade ties with developed nations like the US, the EU, Japan, and Canada through the exportation and importation of products such as iron ore, gems, pharmaceuticals, automotive parts, machinery, electronics, chemicals, petroleum products, and high-end consumer goods. Thus, we delve into these (trade) dynamics for India and her other trading partners. We thus look at the trade dynamics between India and her trading partners - the US and the Euro, as enunciated in Figures 6 and 7. In 2022, India's total exports are valued at USD 76.2 billion, with a total value of imports for the same period as USD 43.3 billion, where top exports include refined petroleum and diamonds, and major imports are largely Crude Petroleum, coal Briquettes and Gold. As for 2024 (up till April), its exports were valued at USD 70.0 billion and imports at USD 37.6 billion. However, according to the Observatory Economic Complexity report on Indian bilateral trade with the US, between December 2023 and January 2024, there is a percentage increase of 3.32% and 2.49%, respectively, for exports and imports.[2] India is a major player in the world commodity markets due to its large population, making it one of the biggest consumer commodities like metals and oil. This means that the country is heavily involved in global economic activities, and this could lead to a spillover effect from the monetary policy decisions of its

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2   See the link to the report: https://oec.world/en/profile/country/ind. The data for trade exports and imports are sourced from the World Integrated Trade Solution (WITS), which is available from 1988 to the present.

major trading partners.

Furthermore, the country's trade performance significantly impacts its monetary policy decisions. Import and export volumes can affect price levels, with rising demand for imports of goods like food and gasoline leading to a depreciation in the Indian rupee and higher domestic costs, which raises the level of inflation. In response, the monetary authority may raise interest rates, which can have a negative impact on exports. A trade deficit could also increase the need for foreign assistance to finance imports, affecting the economy's interest rates and liquidity levels. We note that in recent times (see Figures 2 and 5) when the US monetary policy was around 4%, bilateral trade between the two countries took values as follows: Imports stood at $50.90 billion, and the value for exports was around $78.54 billion. However, this represents a significant improvement from the previous years with higher trade volume in favour of India. In this period, there was extremely low MPR for the US and higher for India. This is justified as rising interest rates in India relative to the US will lead to higher portfolio investment inflows to India, and failure of which would mean otherwise. However, the highest bilateral trade increment when the EU monetary policy rate was low occurred in 2019-2020, as exports increased at the same time relative to imports. The increment in the monetary policy rate also brings about the increment in the bilateral trade between the EU and India, with trade exports from India to the EU increasing from $39.7 billion in 2021 to $51.4 billion in 2022 and trade imports increasing from $41.4 billion in 2021 to $64.9 billion in 2022[3]. Results show that the EU monetary policy can influence trade volume between the two regions.

Figure 6.
**US-India Trade Relation (1988 – 2023)**

This chart presents the most recent available trade data (data) between India and the United States, using the total imports and exports volumes (i.e., trade in goods and services). We note that Indian exports relative to imports from the US have been surplus in recent years. Data are sourced from the World Integrated Trade Solution (WITS) and the Indian Ministry of Commerce.

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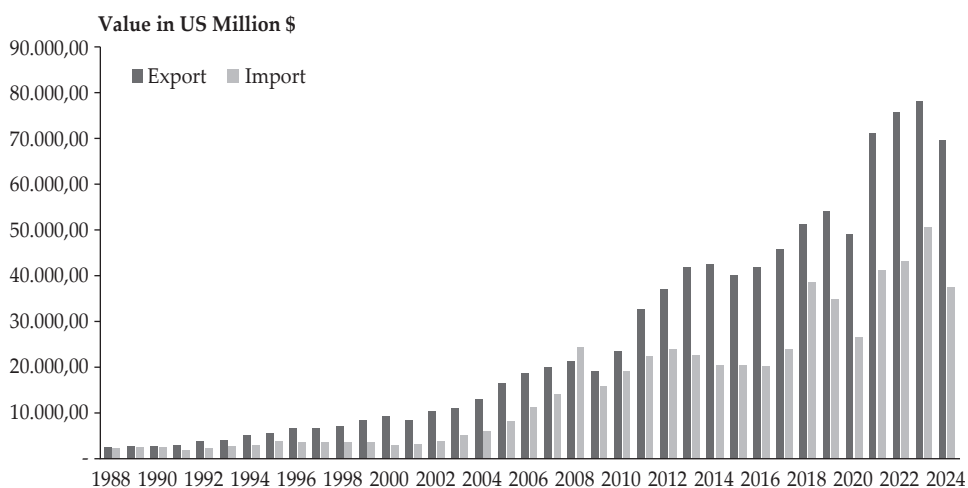
[3] This data are sourced from the WITS and the Ministry of Commerce in India, respectively, for the US and EU.

Figure 7.
Euro – India Trade Relation (1999 – 2022)

This chart presents the most recent available trade relationship (data) between India and the European countries, using the total imports and exports volumes (i.e., trade in goods and services). India largely recorded a trade deficit during the periods covered. Data are sourced from the Indian Ministry of Commerce.
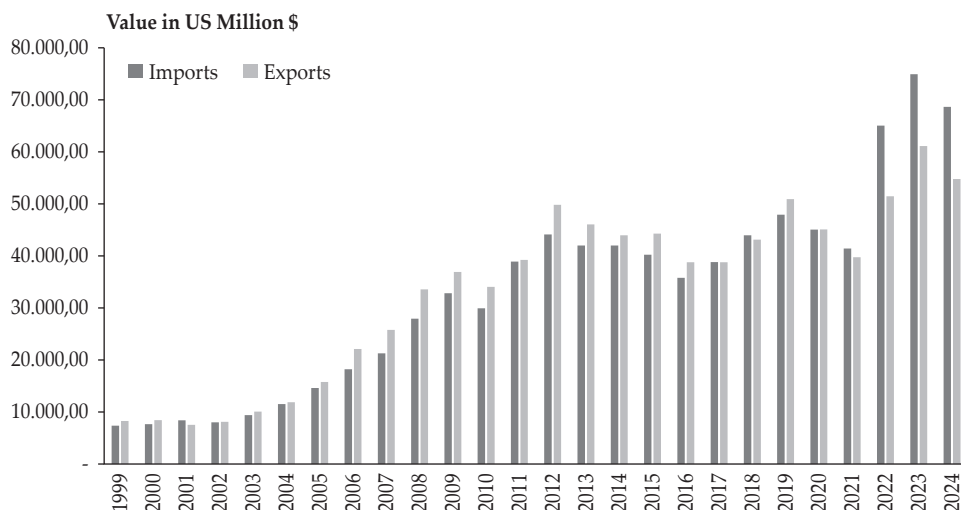
III. THEORY AND EVIDENCE ON INTERNATIONAL MONETARY POLICY SPILLOVERS: A BRIEF REVIEW

Over the years, policymakers and central banks globally have recognized the importance of considering the cross-border impact of monetary policy decisions made by other countries. This is because global monetary policy spillover effects can have significant implications for the economies of neighbouring countries and those with strong economic ties. The literature has widely documented that the transmission of monetary policy spillovers can be swift and significant. For instance, changes in interest rates in one country can impact the capital flows of other countries, leading to changes in their exchange rates, asset prices, inflation, and economic growth. Moreover, the spillover effects tend to be more pronounced for countries with weaker economic fundamentals, such as those with high levels of external debt, limited fiscal flexibility, or weak institutions. Given these risks, policymakers and monetary policy anchors have developed various instruments to manage the spillover effects of global monetary policy. These include policy coordination mechanisms, exchange rate management tools, and capital flow management measures. By using these instruments, central banks and policymakers can minimize the negative impacts of global monetary policy on their economies while maximizing the benefits of international economic integration.

The transmission of international monetary policy spillover occurs when the effects of monetary policy shocks in one country affect the domestic variables of another country. For example, if the US raises its monetary policy rate due to increased aggregate demand, it could have spillover effects on the economic activities of emerging economies, such as India, as explained in Ahmed, Akinci, and Querelto (2021). It has been generally believed that an international policy rate

affects a domestic economy through the trade channel. This theory is supported by Mishkin (1995) and Can, Bocuoglu and Can (2020). It is expected that changes in interest rates will affect both the economies that initiate the change (the "shock giver") as well as the economies that receive the shock (the "shock receiver"). These interactions occur primarily through trade, with foreign exchange being the key component. Thus, the policy targets of the two monetary authorities determine how and to what extent this channel affects the economies involved. According to the literature, countries that rely heavily on foreign currency in trade settlements tend to be more affected by foreign monetary policy. In simpler terms, countries with a higher share of imports invoiced in dollars tend to be more responsive to the monetary policy of the US than others. This also applies to countries with larger imports invoiced in Euros (see Zhang, 2022). A testable hypothesis suggests that if the source economy increases its monetary policy rate more than the recipient economy, the domestic currency of the latter will weaken as capital is expected to flow from the latter to the former. This inflow of capital has significant implications on the recipient country's domestic economy, particularly in terms of weakening its currency, raising import costs, reducing investment in securities and increasing price levels, among other effects.

In the empirical literature, Shareef and Prabheesh (2021) provide evidence on how foreign banks can help propagate international monetary policy to India, which is perceived to be facilitated by the exchange rate. A similar investigation is made on unconventional monetary policy using the same country as the case study. However, rather than using only US policy announcements, three additional policies were considered, such as policy announcements by central banks of the Eurozone, the United Kingdom and Japan (see Thomas and Kumar, 2019). However, the submission remains that all policies considered have no impact on the asset prices of India. Studies have also considered the ECB for monetary policy spillover for small open economies such as Norway, Sweden and Denmark. However, clear evidence suggests that the significance of the ECB in the global propagation of the monetary policy shock is much more certain (see Ter Ellen, Jansen and Midthjell, 2020). There is a gap in the literature regarding how the international monetary policy shock is conveyed in the modelling framework for India. We test how global, regional (such as the EU and the Eurozone) and (international) country-specific monetary policy shocks impact the Indian economy. This is the first study to accommodate all these variants of monetary policy shocks from an international perspective. In addition, we employ the GVAR methodology that takes into account the interlinkages and interdependencies among trading partners, which are often disregarded in traditional VAR and its variants. Ignoring this inherent feature of GVAR tends to misrepresent the propagation of international shocks (see Chudik and Smith (2013)). In the next succeeding section, we provide the intuition behind the GVAR methodology.

IV. METHODOLOGY
A. Brief Theoretical Issues on the GVAR Model
The primary goal of this exercise is to investigate possible monetary policy spillovers from various advanced countries into India's economy. The growing

globalization around the world now gives concerns to pay close attention to the global community in the conduct of monetary and financial policies. The interdependencies that exist between any economy and the global economy when determining interest rates have now become a necessity that needs to be given greater consideration. In a way to ensure an in-depth investigation, we adopt the Global Vector Autoregressive model[4], with updated data till 2023Q3 by Mohaddes and Raissi (2024). This methodology is a global macroeconomic framework that gives a reasonable basis to theory and statistics. Its development came after the Asian financial crisis of 1997, which was to provide evidence measuring the effect of macroeconomic fundamentals on losses attributable to financial institutions across the world (Chudick and Pesaran, 2016). At this time, it was evident that many large banks were highly vulnerable to negative global and regional shocks. However, measuring the impact of the shock required a well-developed macroeconomic model, which the GVAR methodology seems to provide.

Although it was initially designed as a tool for credit risk analysis, the GVAR approach offers a helpful and practical way to build such a model, and it quickly became evident that it has various additional applications. Given its two-stage procedures, it provides the basis for conditional estimation of small-scale country-specific models on the rest of the world. These models are weighted cross-section averages of foreign variables, sometimes known as "star variables," and are viewed as weakly exogenous. These models are expressed as augmented VAR models, symbolized as VARX*. The second stage, however, involves stacking and solving separate country VARX* models concurrently to create a single global VAR model, which helps in forecasting and shock scenario analysis, as typical with low-dimensional standard VAR models.

B. GVAR Model Building

The current structure of the GVAR methodology has 33 countries (including India)[5] and the individual countries are represented as $VARX*(p_i, q_i)$ models across groups of developed and emerging economies[6] such that: i=1,2,...,N. In the expression of the $VARX*(p_i, q_i)$ model, the endogenous variables are expressed as functions of the foreign and common variables while the country-specific endogenous variables are essentially the real GDP, inflation, real equity prices, real exchange rate, short-term interest rate and long-term interest rate. However, the global

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[4] The GVAR methodology was originally introduced by Pesaran, Schuermann, and Weiner (2004), where 11 country/region models were estimated over the period 1979Q1-1999Q4. Dees, Mauro Pesaran, and Smith (2007, DdPS), in collaboration with the European Central Bank, subsequently extended the GVAR framework in a number of ways. The DdPS version of the GVAR model includes 26 countries/regions (covering 90% of world output), the euro area being treated as a single economy, and is estimated from 1979Q1-2003Q4.

[5] See this link for all the required details on the GVAR methodology: https://sites.google.com/site/gvarmodelling/gvar

[6] The GVAR is a tool used to analyze the global economy. However, its database only covers 33 countries. This is because these countries contribute over 90% of the global output, while other economies contribute less than 10%. Some researchers have tried to update the database to include other countries of interest that were not originally included. For instance, Sikiru and Salisu (2021) and Tumala *et al*. (2021) have attempted to do so.

variables are commodity, metal, and oil prices. Each country-specific economic policy uncertainty variable is introduced as an additional variable in the GVAR model to investigate its role in the propagation of international monetary policy spillovers. Thus, the GVAR model is specified as follows:

$$x_{it} = \sum_{\lambda=1}^{p_i} \Gamma_{i\lambda} x_{i,t-\lambda} + \Pi_{i0} x_{it}^* + \sum_{\lambda=1}^{q_i} \Pi_{i\lambda} x_{i,t-\lambda}^* + \Psi_{i0} G_{it} + \sum_{\lambda}^{s_i} \Psi_{i\lambda} G_{i,t-\lambda} + \mu_{it} \quad (1)$$

where the variable x_{it} is a $k_i \times 1$ vector of country-specific variables given as i where the i runs from 1 to N (such that N=33) in a period, say t (where t=1,2,3,...,T). Also, the variable x_{it}^* is the corresponding $k_i^* \times 1$ vector of foreign variables computed as trade-weighted counterparts of the domestic variables. Therefore, $x_{it}^* = \sum_{j=1}^{N} w_{ij} x_{jt}$ from where $\sum_{j=1}^{N} w_{ij} = 1,$[7] and w_{ii}=0. The external common (global) factors are represented with G_{it} and their values are repeated for all the cross-sections. As for the parameters, $\Gamma_{i\lambda}$, for which λ=1,2,3,...,p_i, is a $k_i \times k_i$ matrix of unknown parameters for local variables while Π_{i0} (where λ=0,1,2,...,q_i) is a $k_i^* \times k_i^*$ matrix of unknown parameters for foreign variables, and $\Pi_{i\lambda}$ (where λ=0,1,2,...,s_i) is a $r_i \times r_i$ matrix of unknown parameters for external common factors which are repeated for all the cross-sections; while μ_{it} is a vector (i.e., $k_i \times 1$ vector) of error terms. As a requirement for this approach, all variables representing foreign and common factors are taken as weakly exogenous in this model.

C. Data Issues

As previously discussed, the implication is that the estimated country-specific VAR models are stacked together to build a large GVAR model, which, by implication, gives a stance to have the effect of the global monetary policy shock on Indian economic activities. With the exception of the uncertainty data, all the datasets used in our GVAR covering the period 1979Q2 to 2023Q3 are compiled by Mohaddes and Raissi (2024)[8]. We obtain the uncertainty data via this link: https://www.policyuncertainty.com/. Finally, all the mentioned variables are expressed in logs, except for interest rates and inflation. The updated data by Mohaddes and Raissi is the most recent data, which, by implication, provides recent information about the global economy. Originally, the GVAR was built to accommodate 11 countries from across regions with a scope covering 1979 to 1999 (the period after the Asian financial crisis); the updated one now includes 33 countries that are either developed or emerging economies. In all, their economic activities represent more than 90% of global economic activities. However, the updated data for the present analysis covers quarter 2 of 1979 to quarter 3 of 2023. For the specific subject matter, the output relating to India is taken from the entire results (both for countries and regions) and this can be provided upon request.

We further present basic information regarding data for our analysis in Table 1. We importantly give consideration to the Indian short-term interest rate, US short-term interest rate, EU and US economic policy uncertainty indices and the

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[7] w_{ij} is the weighting matrix obtained from the IMF Direction of Trade flows data.
[8] See the link to the data at: http://www.econ.cam.ac.uk/people-files/emeritus/mhp1/GVAR/GVAR.html.

Rupee exchange rate concerning the US dollar and Euro. On average, Indian short-term interest rate is higher than that of the US with a value of 0.018, positively skewed, less dispersed and relatively leptokurtic – the features that are also typical for US short-term rates. The average exchange rate of the rupee relative to the US dollar is 40.4 and lower than that of the Euro, which is 47.7. However, while highly dispersed, the dollar/rupee is positively skewed, and the euro/rupee is otherwise. They are nevertheless platykurtic. By average value, EU EPU is higher than US EPU, but both maximum and minimum values of US EPU are higher, suggesting why it has a relatively high-hump shape. By dispersion, EU EPU is more dispersed and more positively skewed.

Table 1.
Summary Statistics.

The table presents important information about the variable observations used in this study. It presents information for mean value, standard deviation, skewness, kurtosis, and maximum and minimum values of the data series for Indian short-term interest rate (sr), US short-term interest rate (sr_us), EU economic policy uncertainty (eu_epu), US economic policy uncertainty (us_epu), Dollar/rupee exchange rate (us_repee), and Euro/rupee exchange rate (eu_rupe).

Variable	sr	sr_us	eu_epu	us_epu	us_rupee	eu_rupee
Mean	0.018	0.010	145.001	123.472	40.410	47.702
Maximum	0.031	0.035	433.278	503.963	83.266	91.808
Minimum	0.008	0.000	33.791	44.783	7.732	8.562
Std. Dev.	0.005	0.009	78.575	57.048	21.866	25.873
Skewness	0.016	0.753	1.114	2.252	0.093	-0.081
Kurtosis	3.642	3.098	3.923	11.427	1.995	1.779

V. RESULTS AND POLICY IMPLICATIONS

A. Main Results

We have generated some preliminary results, which include summary statistics, unit root test, and exogeneity test, among other diagnostics (which we have omitted for brevity). Therefore, our presentation focuses on the impact of international Monetary Policy (MP) shocks on the Indian economy. We have analyzed three types of MP shocks: US MP shock spillovers, EU MP shock spillovers (including the Eurozone), and global MP shock spillovers. We have also conducted robustness tests to validate our findings. For example, we have tested how other major trading partners of the US have responded to US MP shock and whether countries that responded differently from India have distinct outcomes compared to India.

Similarly, we have also tested whether countries that have responded similarly to India have similar outcomes compared to India. Additionally, we have evaluated the impact of Economic Policy Uncertainty (EPU) as a mediating factor. This is done by comparing the international MP shock spillovers with and without EPU. Given the trade connection between the US and India on the one hand and between India and the Eurozone on the other, we believe that monetary policy shock in this regard will impact the Indian economy via the exchange rate. To better understand how international monetary shock spillovers affect India, we analyze the Impulse Response Functions (IRFs) of the GVAR model under the mentioned scenarios. The solid lines in the IRF figures represent the median response, while

the dotted lines represent the (5%-95%) lower and upper bootstrapped error bands used to determine the significance of the IRFs.

Figure 8 shows the response of the Indian exchange rate to the US monetary policy shock. The results of the study indicate that the policy has a strong impact on the exchange rate of the Indian economy. While the policy's significance is not immediate, its impact on the target variable occurs within the short-run period and has a wider impact for the very long term. Specifically, the study has found that a one per cent shock in US MP leads to a significant depreciation of the Indian exchange rate by about 0.8 per cent, on average. The study also shows that the impact of the policy is most significant around the 8th period, after which it stabilizes. This means the policy's effects are not immediate and may take some time to manifest. However, once it takes hold, the impact is significant and long-lasting. The intuition behind this evidence is that if the US increases its policy rate relative to India, it signals higher investment returns in the US, which leads to a shift of portfolio investments from India to the US. This, in turn, affects the value of the Indian rupee, causing it to depreciate. The impact of this shift in portfolio investments is significant and has a considerable influence on the Indian economy's exchange rate. These results buttressed the behaviour (of RBI, Fed rates, and the Indian Rupee US Dollar exchange rate) we observed in the stylized facts section (see Figures 1, 2 and 3). In essence, we observed that the policy rates of India and the US move in opposite directions, sparing the last few years where the Indian monetary policy rate closely follows the US rate. As the US pursues a contractionary monetary policy, India, on the other hand, pursues an expansionary one. This opposite co-movement causes the Indian rupee to depreciate in many instances (see Figure 3), thereby supporting our empirical results.

Figure 9 shows the response of the Indian exchange rate to the Eurozone monetary policy shock. The Indian rupee does not show a significant response to the MP shock of the Eurozone compared to its response to the US MP shock. This indicates that the Indian economy is more vulnerable to the US MP shock due to the strong economic ties between India and the US. When the Eurozone is expanded to include other countries in the EU to capture EU shock and global MP shock, the outcome remains the same. It is important to note that India's trade volume with all the 27 Euro countries is still behind the US, which further reinforces the idea that the Indian economy is expectedly less vulnerable to the region's MP shock as compared to the US MP shock.

We have conducted additional analyses to better understand the monetary policy spillover mechanism. This involves analyzing how the Indian short-term interest rate responds to a US MP shock. Our findings, illustrated in Figure 10, indicate that the Indian short-term interest rate does not respond significantly to the US MP shock. This has important implications for the conduct of monetary policy in India. When the US raises its policy rate, it can become attractive to Indian investors. To prevent this, the Indian monetary policy authority may raise the short-term interest rate. However, as the response of the Indian short-term interest does not significantly change with the US MP shock, the Indian exchange rate is expected to depreciate significantly.

We not only analyze the Indian case but also present some additional complementary analyses. We focus on how other major US trading partners'

short-term interest rates and exchange rates react to the US MP shock. By examining these responses, we aim to understand the subject better and further verify the plausibility of the outcome for India. We have focused our attention on three of them: Canada, Japan, and the Eurozone. Canada and Japan are the major trading partners of the United States in terms of individual countries, whereas the Eurozone represents the largest trading partner of the US in terms of region. We have presented the IRFs for each country/region in pairs for the short-term interest rate and exchange rate, labelled as A and B, respectively. The IRFs for Canada, Japan, and the Eurozone are presented in Figures 11, 12, and 13, respectively.

Figure 8.

The figure presents the impulse response function [IRF] of the Indian exchange rate response to a one-standard-deviation positive U.S. monetary policy shock. The median response is represented in solid lines, and the (5%-95%) lower and upper bootstrapped error bands are shown as dotted lines.



Indian exchange rate, rupee to dollar
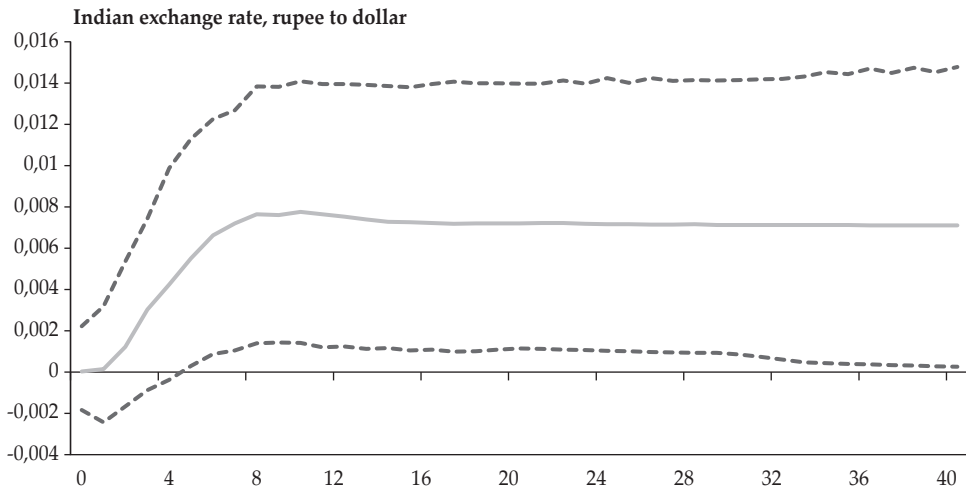
Figure 9.

This figure presents the IRF of the Indian exchange rate response to a positive Eurozone monetary policy shock. See additional note to Figure 8.

Indian exchange rate, rupee to Euro
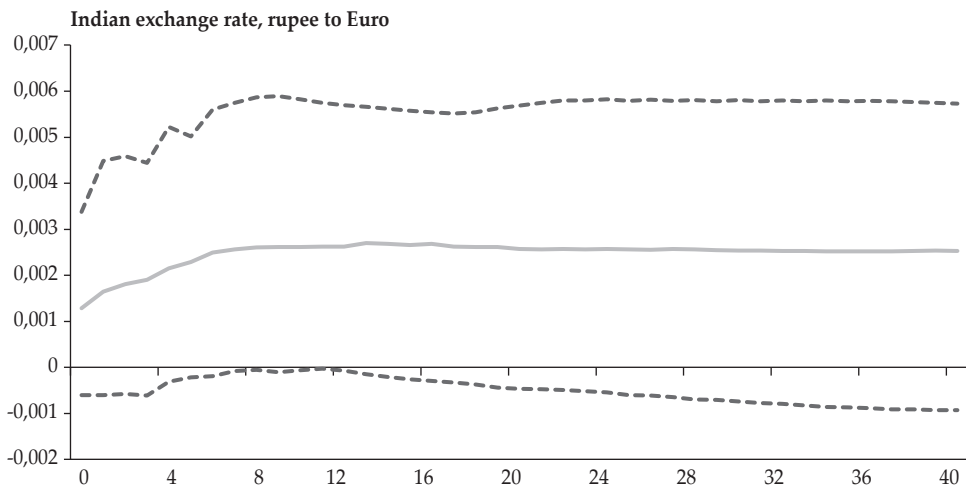
According to our findings, the monetary authority in Canada responds to the US MP shock by significantly increasing the short-term interest rates, which in turn prevents the exchange rate from depreciating against the US dollar. This is unlike the case of India, where the short-term interest rate response is not significant, and the exchange rate depreciates against the US dollar. The response of short-term interest rates against the US MP shock in Japan is also not significant, and hence, the exchange rate depreciates against the US dollar, which is similar to the case of India. On the other hand, in the Eurozone, the short-term interest rate significantly responds to the US MP shock, and the exchange rate does not depreciate against the US dollar. Our results suggest that the supposed impact of the US monetary policy shock on the exchange rate of any significant trading partner can be neutralized if the partner's country responds by raising short-term interest rates. This becomes effective in moderating any adverse effect of the US MP shock. The outcome for India is seen as plausible due to the various robustness analyses.
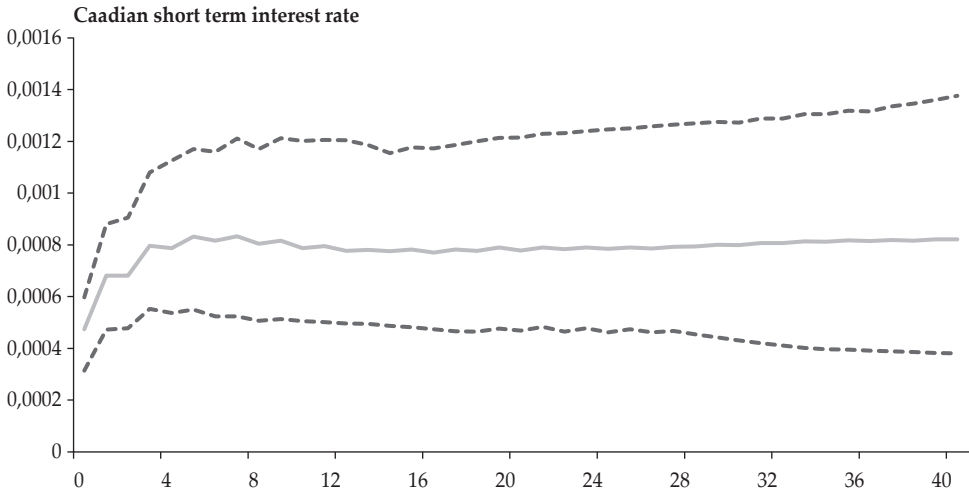
Figure 10.

This figure presents the IRF of the Indian short-term interest rate to a positive US MP shock. See additional note to Figure 8.
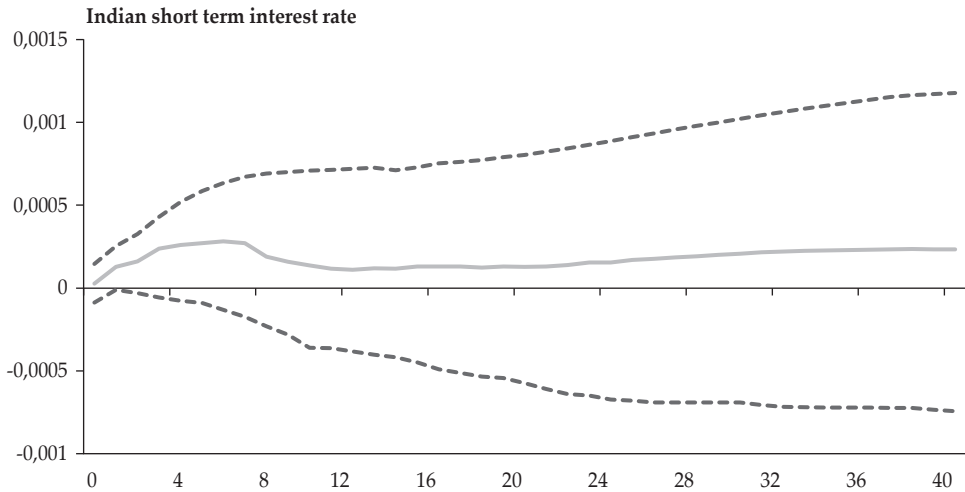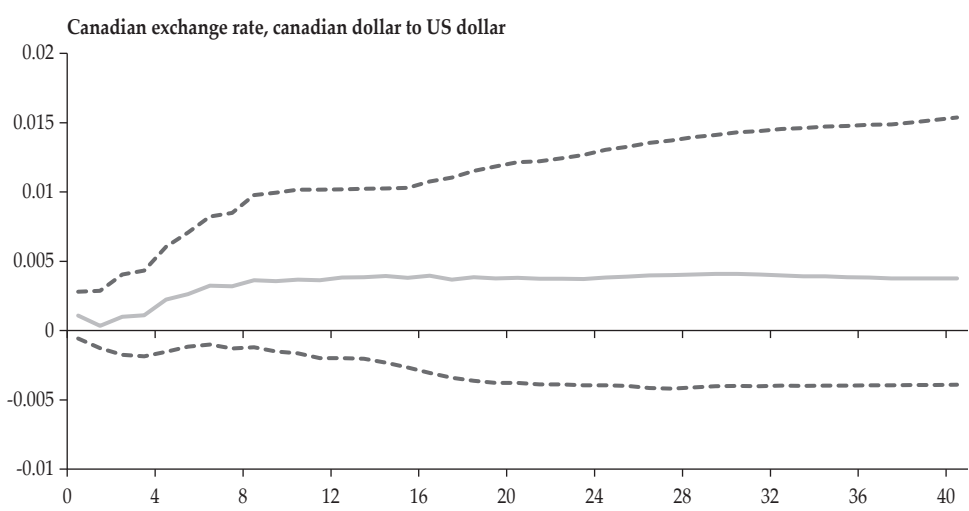
Figure 11A.

This figure presents the IRF of the Canadian short-term interest rate to a positive US MP shock. See additional note to Figure 8.
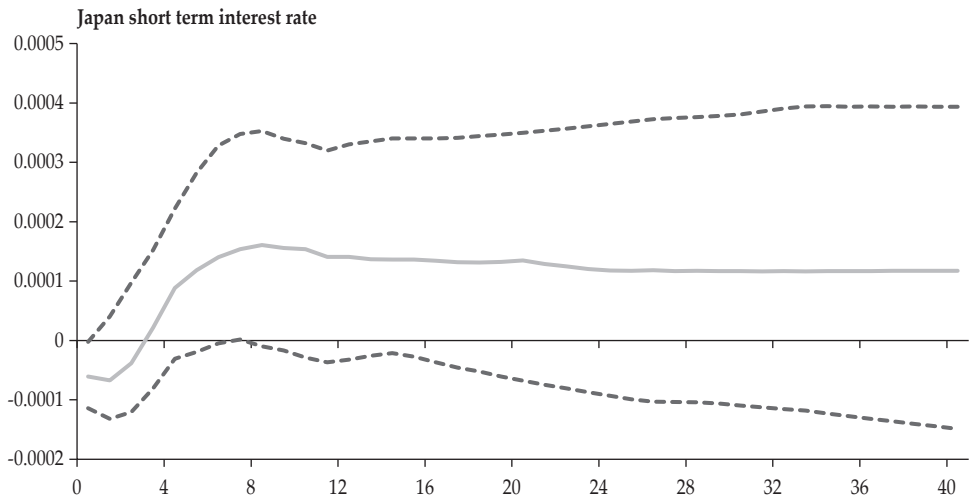

Caadian short term interest rate

Figure 11B.

This figure presents the IRF of the Canadian exchange rate to a positive US MP shock. See additional note to Figure 8.
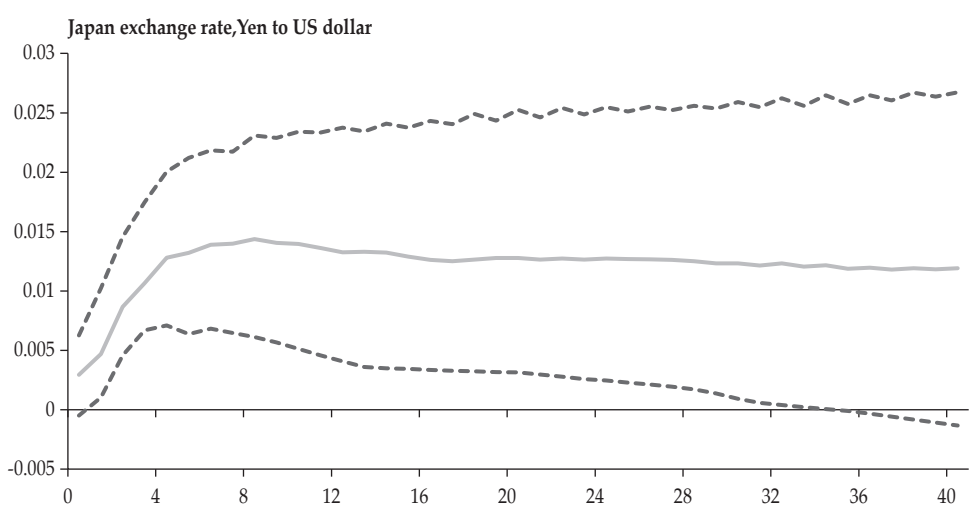

Canadian exchange rate, canadian dollar to US dollar

Figure 12A.

This figure presents the IRF of Japan's short-term interest rate to a positive US MP shock. See additional note to Figure 8.

Japan short term interest rate

Figure 12B.

This figure presents the IRF for Japan's exchange rate to a positive US MP shock. See additional note to Figure 8.

**Japan exchange rate,Yen to US dollar**

Figure 13A.

This figure presents the IRF of short-term interest rates in the Eurozone to a positive US MP shock. See additional note to Figure 8.

Eurozone short term interest rate
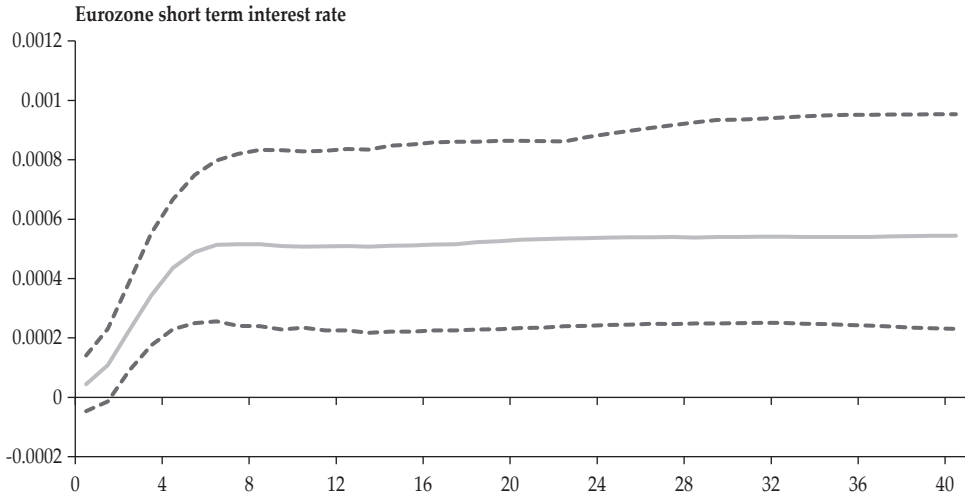
Figure 13B.

This figure presents the IRF of the Eurozone's exchange rate to a positive US MP shock. See additional note to Figure 8.


Eurozoe exchange rate, Euro to dollar
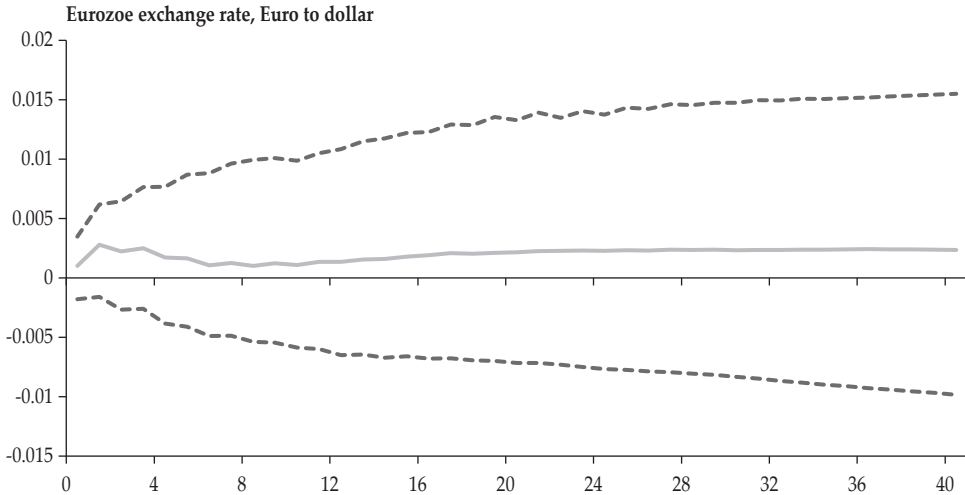
As part of this research, we aim to gain more insights into international monetary policy spillovers to India. To do so, we have analyzed the potential relationship between US economic policy uncertainty and the Indian exchange rate. This same exercise is replicated for the Eurozone. The outcomes of our analysis are presented in Figures 14 and 15.

Our findings indicate that the Indian exchange rate is not significantly affected in either case. This suggests that even during periods of high economic policy

uncertainty in the US and Eurozone, investors in the Indian economy are able to maintain their portfolio investments. As a result, the Indian exchange rate may not depreciate in the face of rising economic policy uncertainty in its trading partners. Overall, our research suggests that the Indian economy is able to withstand high levels of economic policy uncertainty in its trading partners. This is a positive sign for Indian investors, as it suggests that the Indian exchange rate may remain stable despite challenging economic conditions abroad.
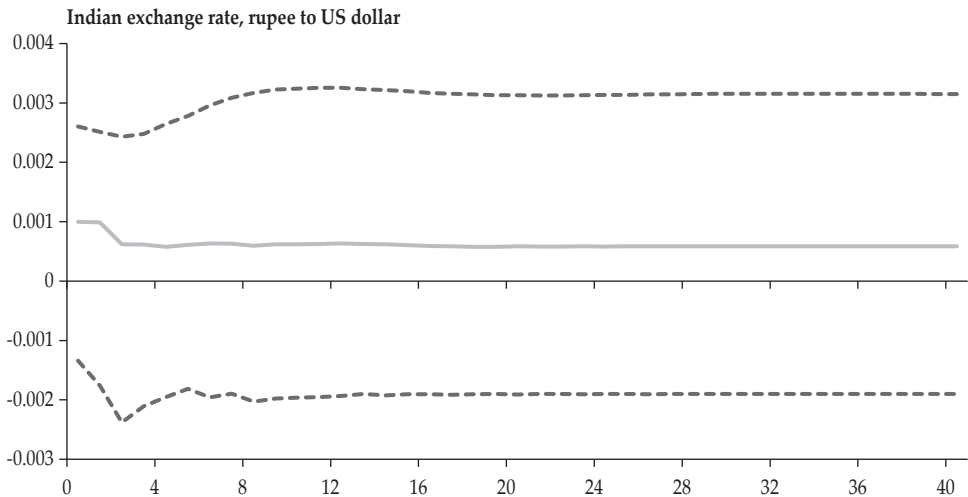
Figure 14.

This figure presents the IRF of the Indian exchange rate response to a positive U.S. EPU shock. See additional note to Figure 8.
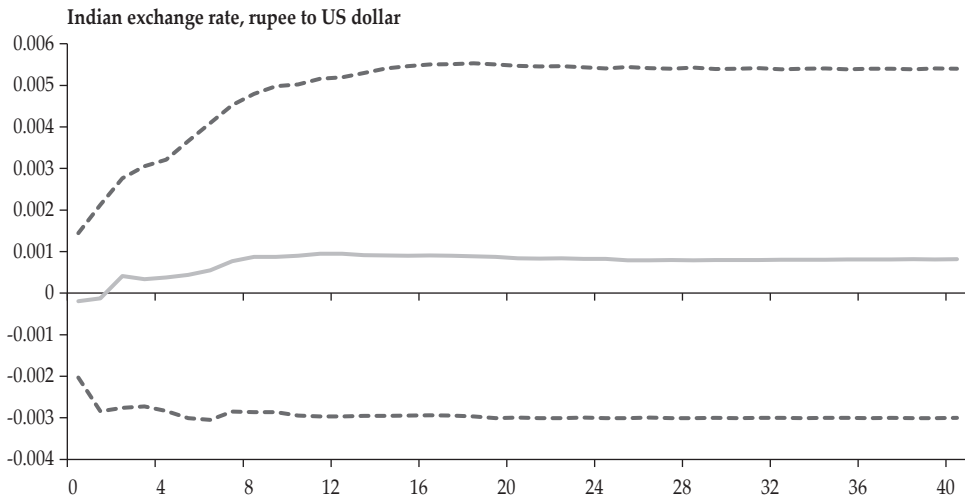

Indian exchange rate, rupee to US dollar
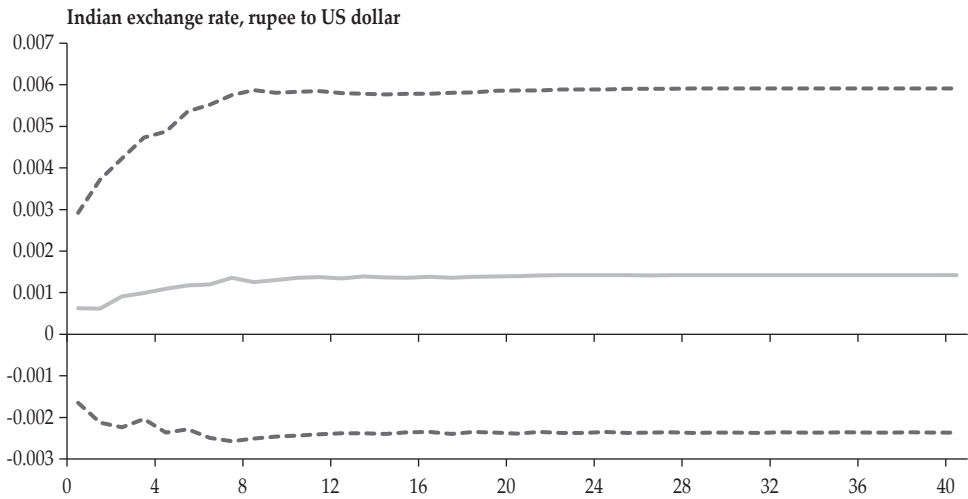
Figure 15.

This figure presents the IRF of the Indian exchange rate response to a positive Eurozone EPU shock. See additional note to Figure 8.


Indian exchange rate, rupee to US dollar

Figure 16.

This figure presents the IRF of the Indian exchange rate response to a positive US MP shock in the presence of EPU.
See additional note to Figure 8.

Indian exchange rate, rupee to US dollar

Figure 17.

This figure presents the IRF of the Indian exchange rate response to a positive Eurozone MP shock in the presence of
EPU. See additional note to Figure 8.

Indian Exchange rate, rupee to US dollar
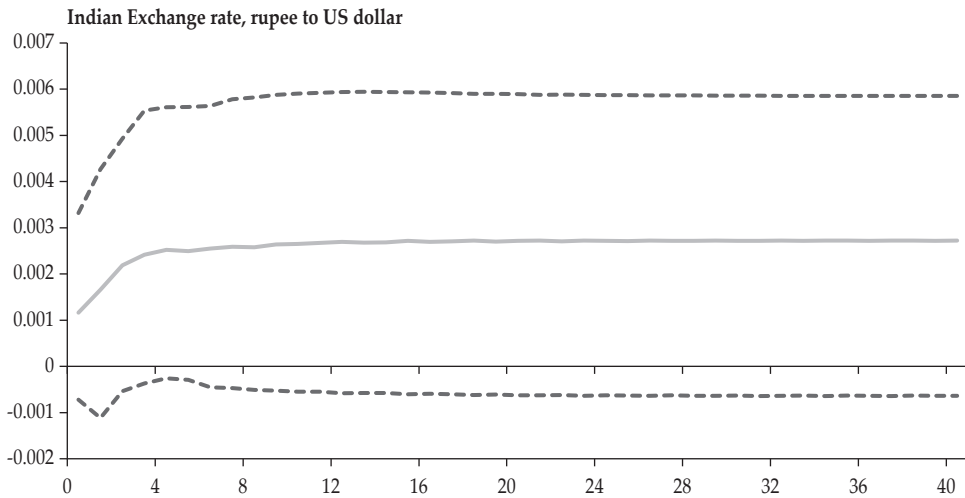
        To ensure a robust finding, we take a step further by emphasizing an instance
of a monetary policy regime in the presence of economic policy uncertainty for
both the US and the Eurozone. We try to experiment with what happens if the US
Fed, for example, decides to raise its policy rate unexpectedly owing to the rising
uncertainties. Unlike in the baseline case where the EPU is not accommodated, we
find that the response of the Indian exchange rate to the US MP shock under this
scenario does not respond significantly to the US MP shock with uncertainties (see

Figure 16). The outcome is not different for the ECB MP shock (see Figure 17). This appears to suggest that investors usually operate on wait-and-see syndrome rather than exercise investment shifting, more importantly when similar uncertainty is noticed with the choice of alternative country. This narrative may explain why the Indian exchange rate is found to be less responsive to the US and Eurozone MP shocks in periods of economic policy uncertainty.

B. Policy Implication

As India continues to grow its trading relations with major open economies such as the US and the EU, it becomes more vulnerable to international monetary policy spillovers. This means changes in the monetary policy of these major economies can have a ripple effect on India's financial system and economy as a whole. For instance, if the US Federal Reserve raises interest rates without any corresponding response from India, it may attract investments from investors seeking higher returns, at least in the short term. This could lead to a stronger dollar and a weaker rupee. These scenarios are confirmed in the stylized facts regarding monetary policy conducts in India and the US.

The implication of these findings is that the monetary policy authority in India must always pay attention to the various monetary policy regimes of allied countries, particularly the US. Specifically, the Reserve Bank of India is expected to react appropriately to any significant policy action undertaken by the US Fed. Such actions tend to have a significant impact on India's exchange rate. Overall, it is essential for India to closely monitor and manage international risk spillovers to maintain stability and promote sustainable economic growth. Although the current policy suggests some positive outcomes, there is a need to further this policy to achieve more desirable outcomes that will strengthen the Indian rupee in response to any external monetary policy shock, particularly from allied trading partners.

VI. CONCLUSION

In this study, we employ the GVAR methodology owing to its ability to simultaneously permit the analyses of the proposed shock spillovers and the consideration of the inherent interlinkages/interdependencies among the countries/regions being examined. The GVAR database comprises 33 countries covering both the developed and emerging economies, and their consideration as the representation of the global economy is premised on their contribution to global output and trade, which accounts for over 90 per cent of the global values. We utilize the recently updated GVAR database, which covers the period of 1979Q2 to 2023Q3, and therefore, we are able to capture more recent dynamics in our analyses, thus making the findings more relevant to the current dynamics in the country of interest.

Our findings indicate that out of the different international monetary policy shocks considered, only the US monetary policy shock is important in influencing the Indian exchange rate. Any shock to the US monetary policy without any corresponding significant response by the relevant monetary authority in India will

cause a depreciation of the Indian exchange rate. This suggests possible portfolio investment shifts between the US and Indian economies. We confirmed similar results in the preliminary examination of our data in Section II. However, this outcome tends to diminish with increasing uncertainties in the US. In other words, any monetary policy shock intended to address uncertainties in the US does not significantly influence the Indian exchange rate. Apparently, in this circumstance, investors in India may want to delay taking advantage of any sudden rise in the US interest rate associated with rising uncertainties.

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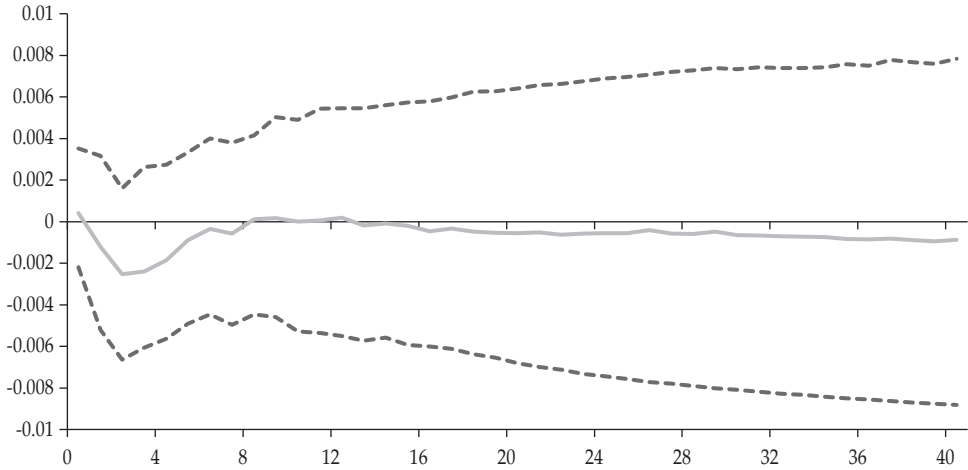
APPENDIX

Figure A1.

The figure presents the IRF of the Indian exchange rate response to a positive EU monetary policy shock. See additional note to Figure 8.
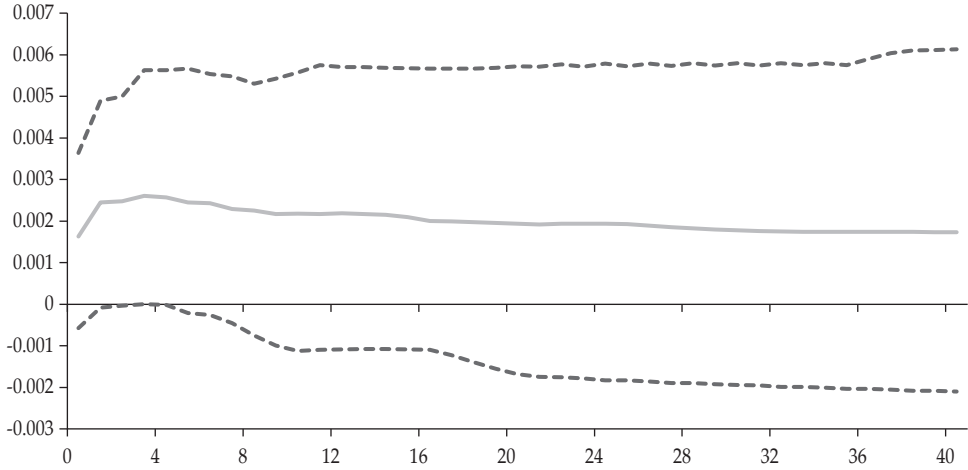
Figure A2.

The figure presents the IRF of the Indian exchange rate response to a positive global monetary policy shock. See additional note to Figure 8.

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