Steven J. Green School of International & Public Affairs
Department of Economics

COVID-19 and Exchange Rates: Spillover Effects of U.S. Monetary Policy

Hakan Yilmazkuday

Department of Economics

Florida International University

Working Paper 2210

June 2022

11200 SW 8th Street, Miami, Florida 33199

https://economics.fiu.edu/

COVID-19 and Exchange Rates: Spillover Effects of U.S. Monetary Policy[1]

Hakan Yilmazkuday[2]

June 3, 2022

Abstact: This paper investigates the spillover effects of U.S. monetary policy on exchange rates of 11 emerging markets and 12 advanced economies during the pre-COVID-19 period of 2019 versus the COVID-19 period of 2020. The investigation is achieved by a structural vector autoregression model, where year-on-year changes in weekly measures of economic activity, exchange rates and policy rates are used. The empirical results suggest evidence for the spillover effects of U.S. monetary policy for several countries during the pre-COVID-19 period, whereas they have been effective only for certain countries during the COVID-19 period that can be explained by the disease outbreak channel. It is implied that policies keeping the pandemic under control may help mitigate the unforeseen economic effects of the COVID-19 crisis.

JEL Classification: E52, E58, F31, F42

Key Words: COVID-19; Coronavirus; Exchange Rates; Monetary Policy; Spillover Effects

Conflict of Interest: The author has no relevant financial or non-financial interests to disclose.

[1] The author would like to thank Editor Katherine Virgo and an anonymous referee for their helpful comments and suggestions. The author is also grateful for Kimberly Green Faculty Fellowship and the Steven J. Green School of International and Public Affairs for their continuous support.

[2] Department of Economics, Florida International University, Miami, FL 33199, USA. Phone: 305-348-2316. Fax: 305-348-1524. E-mail: hyilmazk@fiu.edu

1. Introduction

The Coronavirus Disease 2019 (COVID-19) has reduced economic activity in an unprecedented way. This reduction has resulted in extraordinary unemployment levels around the world. Accordingly, several central banks, including the U.S. Federal Reserve System, have reacted to the economic developments due to COVID-19 by reducing their policy rates.

This paper investigates the spillover effects of U.S. monetary policy on exchange rates during the pre-COVID-19 period of 2019 and the COVID-19 period of 2020. The main objective is to investigate whether these spillover effects have been effective during the COVID-19 period. The motivation for investigating these spillover effects comes from earlier studies such as by Maćkowiak (2007), Ho et al. (2018), Hanisch (2019) or Tillmann et al. (2019), among others, who have shown that economic activities in both advanced economies and emerging markets are affected by the U.S. monetary policy. This can be due to international movement of capital through bond markets as in Albagli et al. (2019), through bank capital flows as in Bruno and Shin (2015), or through portfolio flows into equity funds as in Fratzscher et al. (2018). It is also possible for these spillovers to affect risk perceptions and thus domestic credit costs as in Kalemli-Özcan (2019). The corresponding effects of on the exchange rates are due to the relative yield of dollar-denominated instruments as the U.S. monetary policy changes portfolio positions between the U.S. and international assets as suggested in studies such as by Albagli et al. (2019).

The magnitude of the spillover effects of U.S. monetary policy can be heterogenous across countries depending on their reaction to the COVID-19 pandemic as discussed in studies such as by Haroon and Rizvi (2020), Iyke (2020), Mdaghri et al. (2020), Feng et al. (2021) , Garg and Prabheesh (2021) or Aloui (2021) who have shown that volatilities in exchange rates (or financial market frictions) are correlated with the country-specific developments in COVID-19 cases or deaths. Therefore, it is essential to have a country-specific investigation of spillovers, as achieved in this paper. More importantly, as central banks in other countries may react to the U.S. monetary policy as suggested in studies such as by Gray (2013), Obstfeld (2021), Rey (2015), Georgiadis (2016), Chen et al. (2016), Albagli et al. (2019), Azad and Serletis (2020), it is also important to control for the monetary policy of individual countries while investigating the spillover effects of U.S. monetary policy.

This paper achieves such an investigation by estimating the spillover effects of U.S. monetary policy on exchange rates. Country-specific analyses are conducted for 11 emerging markets and 12 advanced economies, where monetary policies of these countries are also controlled for. The formal investigation is by a structural vector autoregression (SVAR) model, where year-on-year growth rates of weekly measures of economic activity, exchange rates, and policy rates are used during the pre-COVID-19 versus COVID-19 periods.

The spillover effects of U.S. monetary policy are investigated by accepting the U.S. economy as an exogenous block to be used in the SVAR estimation of each country. We focus on the cumulative impulse response of exchange rates (constructed as appreciation of currencies) to a negative shock on the (shadow) federal funds rate. We also investigate the contribution of (shadow) federal funds rate to the exchange rate volatility of domestic currencies based on the forecast error variance decomposition.

The empirical results suggest that there is evidence for the spillover effects of U.S. monetary policy for almost all countries during the during the pre-COVID-19 period, whereas they have been effective for only certain countries during the COVID-19 period. When we further investigate the reasons behind the heterogeneity across countries, we show that only the exchange rates of countries that were successful in fighting against COVID-19 were subject to the spillover effects of U.S. monetary policy during the COVID-19 period, consistent with earlier studies such as by Haroon and Rizvi (2020), Iyke (2020), Mdaghri et al. (2020), Feng et al. (2021), Garg and Prabheesh (2021) or Aloui (2021) who have shown that volatilities in exchange rates (or financial market frictions) are correlated with the country-specific developments in COVID-19 cases or deaths. Important policy implications follow regarding how the disease outbreak channel, as discussed in studies such as by Iyke (2020) or Feng et al. (2021), can be considered to fight against the economic and financial implications of COVID-19 through government interventions.

2. Theoretical Motivation

This section discusses the transmission channels of U.S. monetary policy from a theoretical perspective. Keynesian and neo-Keynesian models, as well as models with financial market frictions, are discussed to understand how the literature connects U.S. monetary policy shocks to exchange rate movements in other countries.

In Keynesian models, as discussed in studies such as by Rey (2016), a U.S. monetary loosening would increase (import) demand in the U.S. and thus exports by other countries (i.e., demand-augmenting effect). At the same time, this U.S. monetary loosening would decrease bond returns in the U.S. relative to other countries, resulting in a depreciation of the U.S. dollar and thus more imports by other countries (expenditure-switching effect). Overall, in normal times, both imports and exports of other countries can increase following a U.S. monetary loosening, meaning that the overall effects on value of the U.S. dollar and other currencies are uncertain. As indicated in studies such as by Vidya and Prabheesh (2020), this uncertainty has increased even further during the COVID-19 outbreak as global trade networks have been affected negatively, especially due to lockdowns in many countries resulting in the manufacturing sector coming to a standstill.

Similarly, in neo-Keynesian models as discussed in studies such as by Obstfeld and Rogoff (2000), Obstfeld and Rogoff (2002), Corsetti and Pesenti (2001), Benigno and Benigno (2003), there is a trade-off between output stabilization and strengthening of the terms of trade to achieve the optimal monetary policy in all countries. This trade-off also implies that the U.S. monetary policy spillovers are not certain, especially when monetary authorities in other countries react to the U.S. monetary policy.

Financial market frictions can also play an important role regarding the spillover effects of U.S. monetary policy as discussed in studies such as by Gertler and Bernanke (1989), Bernanke and Gertler (1995), Bernanke et al. (1996), He and Krishnamurthy (2013), Brunnermeier and Sannikov (2014), Curdia and Woodford (2015) or Gertler and Karadi (2015). Specifically, following a U.S. monetary loosening, excessive risk-taking through financial intermediation can result in an increase in U.S. asset prices, especially when the financial risk perception is higher in other countries (e.g., during the COVID-19 period). Therefore, although the reduction in the interest rate is usually associated with the depreciation of the U.S. dollar (and thus the appreciation of other currencies), financial market frictions can reverse this relationship.

In sum, as indicated by Iyke (2018), several fundamental macroeconomic indicators such as foreign interest rates (partly representing foreign monetary policy), terms of trade and financial indicators, among others, play important roles in the determination of exchange rates and thus the spillover effects of U.S. monetary policy. During the COVID-19 outbreak, As disease outbreak has been identified as an alternative channel of exchange rate behavior during the COVID-19 outbreak as in studies such as by Iyke (2020), it is implied that the spillover effects of U.S. monetary policy might have changed as well during this period. Therefore, the mixed theoretical evidence for the spillover effects of U.S. monetary policy to exchange rates requires an empirical investigation to understand which channels dominate in application before and during the COVID-19 outbreak, depending on the economic developments and financial risk perception. Accordingly, as COVID-19 has affected both the economy and the financial risk perception in all countries, this paper investigates the pre-COVID-19 period represented by the year of 2019 and the COVID-19 period represented by the year of 2020 separately. This is essential to understand whether the U.S. monetary policy spillovers have been different during the COVID-19 period. As monetary authorities in other countries can react to the U.S. monetary policy, this paper also controls for the monetary policy of other countries while investigating the spillover effects of U.S. monetary policy, as we detail next.

3. Estimation Methodology and Data

We are interested in the spillover effects of U.S. monetary policy on exchange rates of countries. The investigation is achieved by using the SVAR model of $z_t = (\Delta y_t^{US}, \Delta i_t^{US}, \Delta e_t^{US}, \Delta y_t^c, \Delta i_t^c, \Delta e_t^c)'$, where Δy_t^{US} represents percentage changes in the U.S. economic activity, Δi_t^{US} represents changes in the U.S. policy rate, Δe_t^{US} represents percentage changes in the U.S. exchange rate (constructed as the appreciation of the U.S. dollar), Δy_t^c represents percentage changes in the economic activity of country c, Δi_t^c represents changes in the policy rate of country c, and Δe_t^c represents percentage changes in the exchange rate of country c (constructed as the appreciation of the domestic currency).

In formal terms, the SVAR model is given by:

$$A_o z_t = a + \sum_{k=1}^{4} A_k z_{t-k} + u_t \quad (1)$$

where $z_t = (\Delta y_t^{US}, \Delta i_t^{US}, \Delta e_t^{US}, \Delta y_t^c, \Delta i_t^c, \Delta e_t^c)'$ as described above. In this expression, u_t is the vector of serially and mutually uncorrelated structural innovations. For estimation purposes, the model is expressed in reduced form as follows:

$$z_t = b + \sum_{k=1}^{4} B_k z_{t-k} + e_t \quad (2)$$

where $b = A_o^{-1}a$, $B_k = A_o^{-1}A_k$ for all k. It is postulated that the structural impact multiplier matrix A_o^{-1} has a recursive structure such that the reduced form errors e_t can be decomposed according to $e_t = A_o^{-1}u_t$.

The recursive structure imposed on A_o^{-1} requires an ordering of the variables used in the estimation for which we use the one already given by the ordering of the variables in z_t. Specifically, for the U.S. economy, the Federal Reserve System reacts to the changes in output on the impact, whereas output is not affected by the policy rate on the impact (although it can be affected in later periods). Following studies such as by Bjørnland (2009), exchange rate is affected by the changes in the policy rate on the impact, whereas policy rate is not affected by the exchange rate on the impact (although it can be affected in later periods). When the spillover effects of U.S. monetary policy in country c are investigated, a block exogeneity is used to ensure that the variables in country c (namely, $\Delta y_t^c, \Delta i_t^c$ and Δe_t^c) cannot have any impact on the U.S. variables (namely, Δy_t^{US}, Δi_t^{US} and Δe_t^{US}). Finally, the same ordering of the domestic variables is considered within each country (as in the case for the U.S. economy).

All percentage changes are in annual terms that are calculated by using weekly data with respect to the previous year; i.e., they represent year-on-year growth rates in weekly variables, and, thus, all variables are controlled for seasonality by construction. In order to compare the pre-COVID-19 and COVID-19 periods, two seperate weekly sample periods, namely the weeks of 2019 and the weeks of 2020, are employed in the empirical investigation. When the spillover effects of U.S. monetary policy in country c are investigated, individual estimations are achieved for 11 emerging markets and 12 advanced economies.[3]

Percentage changes of economic activity in the U.S. Δy_t^{US} are measured by Organisation for Economic Co-operation and Development (OECD) Weekly Tracker of Economic Activity (2021). Changes in the U.S. policy rate Δi_t^{US} are measured by using the updated version of the daily shadow federal funds rate provided by Rezende and Ristiniemi (2018) to control for the zero-lower bound. Percentage changes in the exchange rate of the U.S. Δe_t^{US} are calculated by using the "Trade Weighted U.S. Dollar Index" obtained from Federal Reserve Economic Data (2021).

Percentage changes in economic activity Δy_t^c of country c are again measured by OECD Weekly Tracker of Economic Activity (2021). Changes in the policy rate of country c, Δi_t^c, are measured by using the updated version of the daily shadow policy rate provided by Rezende and Ristiniemi (2018) to control for the zero-lower bound in Sweden, the Euro Area and the United Kingdom; for other countries, they are calculated by using the daily central bank policy rates obtained from Bank for International Settlements (2021a). Percentage changes in the exchange rate of country c, Δe_t^c, are calculated by using the daily effective exchange rate indices obtained from Bank for International Settlements (2021b).

Regarding the time-series properties of the model variables, they are confirmed to be stable as none of the roots lie outside the unit circle. The estimation is achieved by a Bayesian approach with independent normal-Wishart priors. This corresponds to generating posterior draws for the structural model parameters by transforming each reduced-form posterior draw. In particular, for each draw of the covariance matrix from its posterior distribution, the corresponding posterior

[3] These are the only countries available based on the intersection of all data sets. The list of emerging markets is as follows: Argentina, Brazil, China, Colombia, India, Indonesia, Mexico, Romania, Russia, South Africa, Turkey. The list of advanced economies is as follows: Australia, Canada, Czechia, Denmark, Euro Area, Iceland, Israel, Korea, New Zealand, Norway, Sweden, United Kingdom.

draw for A_o^{-1} is constructed by using by triangular factorization so that the sizes of shocks are standardized to unity.

In the Bayesian framework, a total of 2,000 samples are drawn, where a burn-in sample of 1,000 draws is discarded. The remaining 1,000 draws are used to determine the structural impulse responses and the forecast error variance decomposition. While the median of each distribution is considered as the Bayesian estimator, the 16th and 84th quantiles of distributions are used to construct the 68% credible intervals (which is the standard measure considered in the Bayesian literature).

4. Estimation Results

Since we are interested in the spillover effects of U.S. monetary policy on exchange rates of countries, especially during the COVID-19 period, we focus on the cumulative impulse response of exchange rates (constructed as appreciation of currencies) to a negative shock on the (shadow) federal funds rate. We also investigate the contribution of (shadow) federal funds rate to the exchange rate volatility of domestic currencies based on the forecast error variance decomposition. We achieve these investigations for the weeks of 2019 and 2020 separately.

For the year of 2019, cumulative impulse responses of domestic exchange rates (constructed as appreciation of currencies) after one year following a negative shock on the (shadow) federal funds rate are given Table 1 for all countries and as continuous responses in Figure 1 for selected countries.[4] As is evident, following a negative shock on the federal funds rate, the U.S. dollar depreciates for any period after the shock. Based on the discussion during the

[4] The corresponding figures for all countries are available in the Online Supplemental Appendix.

theoretical motivation above, it is implied that according to Keynesian models that the demand-augmenting effect has been more active during the pre-COVID-19 period. It is also implied that (unexpected) lower interest rates in the U.S. might have resulted in capital outflows due to financial arbitrage opportunities in other countries during the pre-COVID-19 period.

Regarding the spillover effects of U.S. monetary policy, domestic exchange rates (constructed as appreciation of currencies) have increased for almost all countries during the pre-COVID-19 period represented by the year of 2019, except for Brazil, India, and Turkey for which the credible intervals include insignificant effects on exchange rates after one year. These results suggesting that there is evidence for the spillover effects of U.S. monetary policy are consistent with earlier studies such as by Maćkowiak (2007), Georgiadis (2016), Chen et al. (2016), Ho et al. (2018), Hanisch (2019), Albagli et al. (2019) or Azad and Serletis (2020). Based on the discussion during the theoretical motivation above, it is implied that exchange rates of several countries have appreciated through financial arbitrage opportunities (capital inflows) following an unexpected U.S. monetary loosening during the pre-COVID-19 period, except for certain countries with potential higher financial risk perceptions in 2019.

When the same investigation is achieved for the year of 2020, the corresponding results for the COVID-19 period are given in Table 1 and Figure 2, where the value of the U.S. dollar has been mostly stable following a negative shock on the federal funds rate. This can be explained by the U.S. dollar being a safe-haven currency during economic crises as indicated in studies such as by Iyke (2020). Based on the discussion during the theoretical motivation above, this result is also consistent with earlier theoretical models, where the demand-augmenting effect has been cancelled by the expenditure-switching effect according to the Keynesian view, there has been a trade-off between output stability and strengthening the terms of trade according the neo-Keynesian view, or higher financial risk perception in other countries has resulted in an increase in the U.S. asset prices according to the financial market frictions.

Regarding the spillover effects of U.S. monetary policy during the COVID-19 period, domestic exchange rates have been stable in almost all countries (i.e., credible intervals include insignificant effects on exchange rates) following a negative shock on the federal funds rate in 2020. The only exceptions are the currencies of China and New Zealand that have appreciated following a negative shock on the federal funds rate during the COVID-19 period.

As in studies such as by Haroon and Rizvi (2020), Iyke (2020), Mdaghri et al. (2020), Feng et al. (2021), Garg and Prabheesh (2021) or Aloui (2021) who have shown that volatilities in exchange rates (or financial market frictions) are related to the developments in COVID-19 cases or deaths, we further investigate whether we can explain these two exception currencies (of China and New Zealand) by the same developments. When we focus on the number of COVID-19 cases obtained from Our World in Data (2021), we in fact observe that China and New Zealand are the only countries in our sample having their number of COVID-19 cases per million people below thousand during 2020. Similarly, when we focus on the number of COVID-19 deaths obtained from Our World in Data (2021), we observe that China and New Zealand are the only countries in our sample having their number of COVID-19 deaths per million people below ten during 2020.

It is implied that policies keeping the pandemic under control may help mitigate the unforeseen economic effects of the COVID-19 crisis. We further investigate this possibility by using several alternative COVID-19 policies conducted by governments that are obtained from COVID-19 Government Response Tracker (2021). Based on this data set, China and New Zealand are the countries that have the most effective contact tracing among all countries in our sample. Therefore, as China and New Zealand also have the lowest number of COVID-19 cases and deaths, by using contact tracing, policy makers may mitigate not only the pandemic but also the corresponding unforeseen economic effects.[5] For sure, this policy suggestion is not without caveats as the deviation of China and New Zealand from other countries may also be due to China being the first country getting exposed to COVID-19 (and thus taking policy measures earlier than other countries) or due to the exchange rate volatility in New Zealand during 2020, partly due to the internal political climate.

Overall, similar to studies such as by Aloui (2021) who has shown that the unforeseen COVID-19 crisis has disturbed and modified the behavior of investors, it is implied according to the results of this paper that the unexpected shocks on federal funds rates have not been effective on the exchange rate of several countries during the COVID-19 period. This contrasts with the results based on the pre-COVID-19 period during 2019, when there is evidence for the spillover effects of the U.S. monetary policy on the currencies of almost all countries. Therefore, the unforeseen COVID-19 crisis has in fact disturbed and modified the behavior of investors in the global financial markets.

The sharp difference between the pre-COVID-19 period and the COVID-19 period can be observed in Table 1. As is evident based on the median values, the cumulative reaction of domestic currencies has been about 59% for the average country during the pre-COVID-19 period, and it has been reduced to about 14% during the COVID-19 period. Although the reactions of domestic currencies are similar for advanced economies versus emerging markets during the pre-COVID-19 period, they have been higher for advanced economies during the COVID-19 period. This result is also consistent with earlier studies such as by Georgiadis (2016), Albagli et al. (2019) or Azad

[5] This is also consistent with earlier studies such as by Baker et al. (2020), Summers et al. (2020), Bradshaw et al. (2021) and Browne (2022) who have shown evidence for the effectiveness of contact tracing on reducing the spread of COVID-19.

and Serletis (2020) who have shown evidence for the heterogeneity across countries regarding the spillover effects of the U.S. monetary policy.

When we investigate the contribution of (shadow) federal funds rate to the exchange rate volatility of domestic currencies based on the forecast error variance decomposition, the corresponding results are given in Table 2 for all countries (reported after one year) and in Figures 3 and 4 for selected countries in a continuous way. As is evident, the spillover effects of U.S. monetary policy have been much higher during the pre-COVID-19 period compared to the COVID-19 period. Specifically, the contribution of a shock on the federal funds rate has been about 34% for the average country during the pre-COVID-19 period, whereas it has been reduced to about only 11% during the COVID-19 period. This comparison holds for the average advanced country and the average emerging market as well.

In sum, there is evidence for the spillover effects of U.S. monetary policy for almost all countries during the during the pre-COVID-19 period, whereas they have been effective for only certain countries during the COVID-19 period that can be explained by the disease outbreak channel as in studies such as by Iyke (2020).

5. Concluding Remarks and Policy Suggestions

This paper has investigated the spillover effects of U.S. monetary policy on exchange rates of 11 emerging markets and 12 advanced economies during the pre-COVID-19 and COVID-19 periods. The formal investigation has been achieved by country-specific structural vector autoregression models, where year-on-year percentage changes in weekly economic activity, exchange rates and policy rates have been used. The results suggest that there is evidence for the spillover effects of U.S. monetary policy for almost all countries during the pre-COVID-19 period, whereas they have been effective only for certain countries during the COVID-19 period that can be explained by the disease outbreak channel as in studies such as by Iyke (2020).

Important policy implications follow. Specifically, as China and New Zealand are the only countries of which currencies have appreciated following a negative shock on the federal funds rate during the COVID-19 period, and these are the only countries in our sample that have been successful in keeping their COVID-19 cases and deaths under control, it is implied that the unforeseen effects of the COVID-19 crisis that have disturbed and modified the behavior of investors as discussed in studies such as by Aloui (2021) can be avoided by keeping the pandemic (i.e., COVID-19 cases and deaths) under control.

As discussed in studies such as by Feng et al. (2021) in the context of exchange rate volatility, controlling the pandemic can be achieved through government interventions such as restricting internal movements, public information campaigns or closing schools. Such an approach is also consistent with earlier studies such as by Haroon and Rizvi (2020) or Mdaghri et al. (2020) who have shown that flattening curve of coronavirus infections can help reduce uncertainty among international investors which, in turn, can result in the appreciation of domestic currencies following a negative shock on the federal funds rate due to higher international liquidity.

Acknowledgements

The author would like to thank Editor Katherine Virgo and an anonymous referee for their helpful comments and suggestions. The author is also grateful for Kimberly Green Faculty Fellowship and the Steven J. Green School of International and Public Affairs for their continuous support.

References

1. Albagli, E., Ceballos, L., Claro, S., & Romero, D. (2019). Channels of US monetary policy spillovers to international bond markets. *Journal of Financial Economics*, *134*(2), 447-473.
2. Aloui, D. (2021). The COVID-19 pandemic haunting the transmission of the quantitative easing to the exchange rate. *Finance Research Letters*, *43*, 102025.
3. Azad, N. F., & Serletis, A. (2020). Monetary policy spillovers in emerging economies. *International Journal of Finance & Economics*, *25*(4), 664-683.
4. Baker, M. G., Wilson, N., & Anglemyer, A. (2020). Successful elimination of Covid-19 transmission in New Zealand. *New England Journal of Medicine*, *383*(8), e56.
5. Bank for International Settlements (2021a). Available at https://www.bis.org/statistics/cbpol.htm.
6. Bank for International Settlements (2021b). Available at https://www.bis.org/statistics/eer.htm.
7. Benigno, G., & Benigno, P. (2003). Price stability in open economies. *The Review of Economic Studies*, *70*(4), 743-764.
8. Bemanke, B., & Gertler, M. (1989). Agency costs, net worth, and business fluctuations. *American Economic Review*, *79*(1), 14-31.
9. Bernanke, B. S., & Gertler, M. (1995). Inside the black box: the credit channel of monetary policy transmission. *Journal of Economic perspectives*, *9*(4), 27-48.
10. Bernanke, B., Gertler, M., & Gilchrist, S. (1996). The financial accelerator and the flight to quality. *The Review of Economics and Statistics*, *78*(1), 1-15.
11. Bjørnland, H. C. (2009). Monetary policy and exchange rate overshooting: Dornbusch was right after all. *Journal of International Economics*, *79*(1), 64-77.

12. Bradshaw, W. J., Alley, E. C., Huggins, J. H., Lloyd, A. L., & Esvelt, K. M. (2021). Bidirectional contact tracing could dramatically improve COVID-19 control. *Nature communications*, *12*(1), 1-9.

13. Browne, C. J., Gulbudak, H., & Macdonald, J. C. (2022). Differential impacts of contact tracing and lockdowns on outbreak size in COVID-19 model applied to China. *Journal of Theoretical Biology*, *532*, 110919.

14. Brunnermeier, M. K., & Sannikov, Y. (2014). A macroeconomic model with a financial sector. *American Economic Review*, *104*(2), 379-421.

15. Bruno, V., & Shin, H. S. (2015). Cross-border banking and global liquidity. *The Review of Economic Studies*, *82*(2), 535-564.

16. Chen, Q., Filardo, A., He, D., & Zhu, F. (2016). Financial crisis, US unconventional monetary policy and international spillovers. *Journal of International Money and Finance*, *67*, 62-81.

17. Corsetti, G., & Pesenti, P. (2001). Welfare and macroeconomic interdependence. *The Quarterly Journal of Economics*, *116*(2), 421-445.

18. COVID-19 Government Response Tracker (2021). Available at https://github.com/OxCGRT/covid-policy-tracker.

19. Cúrdia, V., & Woodford, M. (2016). Credit frictions and optimal monetary policy. *Journal of Monetary Economics*, *84*, 30-65.

20. Federal Reserve Economic Data (2021). Available at https://fred.stlouisfed.org/.

21. Feng, G. F., Yang, H. C., Gong, Q., & Chang, C. P. (2021). What is the exchange rate volatility response to COVID-19 and government interventions?. *Economic Analysis and Policy*, *69*, 705-719.

22. Fratzscher, M., Lo Duca, M., & Straub, R. (2018). On the international spillovers of US quantitative easing. *The Economic Journal*, *128*(608), 330-377.

23. Garg, B., & Prabheesh, K. P. (2021). The nexus between the exchange rates and interest rates: Evidence from BRIICS economies during the COVID-19 pandemic. *Studies in Economics and Finance*, 38(2), 469-486.

24. Georgiadis, G. (2016). Determinants of global spillovers from US monetary policy. *Journal of international Money and Finance, 67*, 41-61.

25. Gertler, M., & Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, *7*(1), 44-76.

26. Gray, C. (2013). Responding to a monetary superpower: Investigating the behavioral spillovers of US monetary policy. *Atlantic Economic Journal*, *41*(2), 173-184.

27. Hanisch, M. (2019). US monetary policy and the euro area. *Journal of Banking & Finance*, *100*, 77-96.

28. Haroon, O., & Rizvi, S. A. R. (2020). Flatten the curve and stock market liquidity–an inquiry into emerging economies. *Emerging Markets Finance and Trade*, *56*(10), 2151-2161.

29. He, Z., & Krishnamurthy, A. (2013). Intermediary asset pricing. *American Economic Review*, *103*(2), 732-70.

30. Ho, S. W., Zhang, J., & Zhou, H. (2018). Hot money and quantitative easing: The spillover effects of US Monetary policy on the Chinese Economy. *Journal of Money, Credit and Banking*, *50*(7), 1543-1569.

31. Iyke, B. N. (2018). Macro determinants of the real exchange rate in a small open small island economy: Evidence from mauritius via bma. *Buletin Ekonomi Moneter dan Perbankan, 21*(1), 57-80.

32. Iyke, B. N. (2020). The disease outbreak channel of exchange rate return predictability: Evidence from COVID-19. *Emerging Markets Finance and Trade*, *56*(10), 2277-2297.

33. Kalemli-Özcan, Ṣ. (2019). US Monetary Policy and International Risk Spillovers. NBER Working Paper 26297. https://www.nber.org/papers/w26297.

34. Maćkowiak, B. (2007). External shocks, US monetary policy and macroeconomic fluctuations in emerging markets. *Journal of monetary economics*, *54*(8), 2512-2520.

35. Mdaghri, A. A., Raghibi, A., Thanh, C. N., & Oubdi, L. (2020). Stock market liquidity, the great lockdown and the COVID-19 global pandemic nexus in MENA countries. *Review of Behavioral Finance*, *13*(1), 51-68.

36. Obstfeld, M. (2021). Trilemmas and tradeoffs: living with financial globalization. In *The Asian Monetary Policy Forum: Insights for Central Banking* (pp. 16-84).

37. Obstfeld, M., & Rogoff, K. (2002). Global implications of self-oriented national monetary rules. *The Quarterly journal of economics*, *117*(2), 503-535.

38. Obstfeld, M., & Rogoff, K. (2000). New directions for stochastic open economy models. *Journal of international economics*, *50*(1), 117-153.

39. OECD Weekly Tracker of Economic Activity (2021). Available at https://www.oecd.org/economy/weekly-tracker-of-gdp-growth/.

40. Our World in Data (2021). Available at https://ourworldindata.org/.

41. Rey, H. (2015). Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence. NBER Working Paper 21162. https://www.nber.org/papers/w21162.

42. Rey, H. (2016). International channels of transmission of monetary policy and the Mundellian trilemma. *IMF Economic Review*, *64*(1), 6-35.

43. Ristiniemi, A., & de Rezende, R. B. (2018). A shadow rate without a lower bound constraint. Riksbank Research Paper Series 178. https://dx.doi.org/10.2139/ssrn.3263500.

44. Summers, J., Cheng, H. Y., Lin, H. H., Barnard, L. T., Kvalsvig, A., Wilson, N., & Baker, M. G. (2020). Potential lessons from the Taiwan and New Zealand health responses to the COVID-19 pandemic. *The Lancet Regional Health-Western Pacific*, *4*, 100044.

45. Tillmann, P., Kim, G. Y., & Park, H. (2019). The spillover effects of US monetary policy on emerging market economies. *International Journal of Finance & Economics*, *24*(3), 1313-1332.

46. Vidya, C. T., & Prabheesh, K. P. (2020). Implications of COVID-19 pandemic on the global trade networks. *Emerging Markets Finance and Trade*, *56*(10), 2408-2421.

Table 1 - Country-Specific Reaction of Exchange Rates to U.S. Monetary Policy

Country	Advanced	Reaction to Federal Funds Rate in 2019						Reaction to Federal Funds Rate in 2020					
		Median	Credible Interval					Median	Credible Interval				
United States	1	-44.4	[	-69.6	,	-29.9	]	-6.8	[	-40.4	,	14.3	]
Argentina	0	180.9	[	116.5	,	267.4	]	-5.6	[	-47.8	,	38.7	]
Australia	1	38.2	[	24.3	,	58.4	]	47.4	[	-5.2	,	105.4	]
Brazil	0	-12.7	[	-82.6	,	38.0	]	-20.5	[	-44.7	,	8.0	]
Canada	1	39.4	[	18.7	,	68.8	]	6.9	[	-3.8	,	22.6	]
China	0	39.6	[	19.9	,	68.0	]	31.5	[	10.9	,	62.3	]
Colombia	0	154.6	[	68.8	,	336.9	]	8.7	[	-12.6	,	36.4	]
Czechia	1	58.1	[	39.0	,	89.1	]	10.1	[	-11.1	,	35.9	]
Denmark	1	44.7	[	27.5	,	73.7	]	25.1	[	-3.5	,	64.2	]
Euro Area	1	39.6	[	21.8	,	63.6	]	24.2	[	-11.6	,	76.1	]
Iceland	1	137.9	[	92.1	,	211.7	]	12.0	[	-11.3	,	46.5	]
India	0	-87.0	[	-408.9	,	0.8	]	6.1	[	-5.4	,	25.2	]
Indonesia	0	45.6	[	12.2	,	78.1	]	-2.9	[	-11.5	,	11.9	]
Israel	1	70.7	[	47.0	,	111.1	]	-0.3	[	-11.1	,	14.1	]
Korea	1	33.5	[	12.5	,	66.4	]	19.5	[	-0.4	,	43.9	]
Mexico	0	49.7	[	10.4	,	107.6	]	0.4	[	-32.0	,	48.4	]
New Zealand	1	31.2	[	13.5	,	60.1	]	76.9	[	38.5	,	148.0	]
Norway	1	115.9	[	28.2	,	379.7	]	18.3	[	-9.2	,	58.3	]
Romania	0	26.0	[	5.4	,	45.6	]	18.8	[	-5.3	,	48.3	]
Russia	0	130.8	[	90.2	,	195.0	]	-49.4	[	-90.8	,	-20.3	]
South Africa	0	144.6	[	96.6	,	218.7	]	-21.0	[	-58.4	,	17.3	]
Sweden	1	45.4	[	25.5	,	80.5	]	7.5	[	-29.0	,	42.2	]
Turkey	0	30.4	[	-362.1	,	214.3	]	114.9	[	-58.6	,	681.9	]
United Kingdom	1	90.1	[	53.7	,	152.1	]	16.6	[	-5.8	,	49.5	]
Average	0.5	58.5	[	-4.1	,	123.2	]	14.1	[	-19.2	,	70.0	]
Advanced	1	53.9	[	25.7	,	106.6	]	19.8	[	-8.0	,	55.5	]
Emerging	0	63.9	[	-39.4	,	142.8	]	7.4	[	-32.4	,	87.1	]

Source: Own calculations using data from Bank for International Settlements (2021a,2021b), Federal Reserve Economic Data (2021) and OECD Weekly Tracker of Economic Activity (2021).
Notes: Reaction to Federal Funds Rate shows the cumulative impulse response of country-specific exchange rates (constructed as appreciation of local currencies) to a negative shock on Federal Funds Rate after 52 weeks. Advanced takes a value of 1 if the country is an advanced economy and takes a value of 0 if the country is an emerging market. The summary results for advanced economies and emerging markets at the bottom of the table represent the corresponding average values.

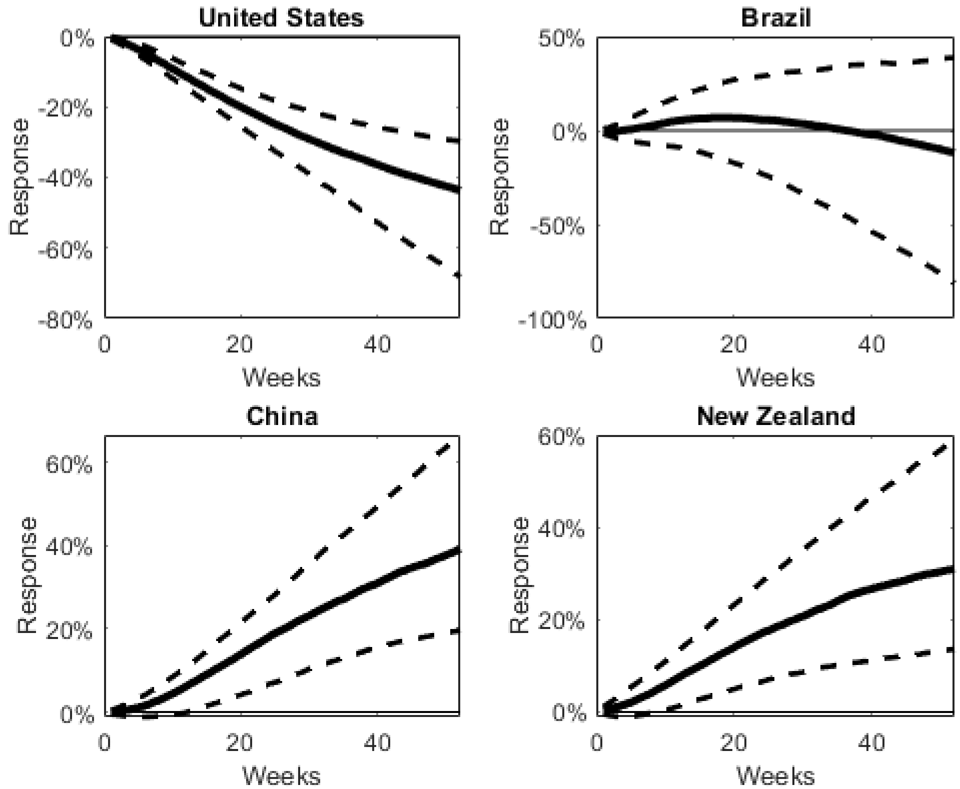
Table 2 - Contribution of U.S. Monetary Policy to Country-Specific Exchange Rates

Country	Advanced	% Contribution of Federal Funds Rate in 2019		% Contribution of Federal Funds Rate in 2020	
		Median	Credible Interval	Median	Credible Interval
United States	1	57.3	[37.5 , 74.2]	7.4	[2.3 , 18.8]
Argentina	0	46.4	[28.3 , 64.2]	4.9	[1.4 , 11.8]
Australia	1	41.9	[21.0 , 59.9]	18.3	[4.9 , 42.7]
Brazil	0	10.0	[3.3 , 25.3]	16.4	[6.6 , 31.5]
Canada	1	26.3	[6.8 , 49.7]	11.9	[5.6 , 23.0]
China	0	34.5	[12.2 , 60.1]	12.5	[2.8 , 28.4]
Colombia	0	23.5	[7.3 , 48.7]	14.0	[7.0 , 23.3]
Czechia	1	50.1	[31.6 , 69.0]	14.9	[6.8 , 26.5]
Denmark	1	29.1	[7.8 , 55.1]	4.7	[0.9 , 15.9]
Euro Area	1	33.3	[10.9 , 56.0]	5.0	[1.1 , 15.5]
Iceland	1	63.6	[42.9 , 78.7]	6.3	[2.2 , 16.3]
India	0	19.2	[5.6 , 43.5]	15.8	[7.9 , 28.0]
Indonesia	0	33.1	[9.6 , 58.5]	11.0	[5.8 , 19.9]
Israel	1	51.4	[21.4 , 70.7]	6.6	[2.0 , 15.1]
Korea	1	16.9	[4.7 , 38.6]	9.3	[3.2 , 22.8]
Mexico	0	19.6	[6.2 , 39.1]	17.2	[8.2 , 31.4]
New Zealand	1	15.3	[4.7 , 34.7]	27.5	[9.1 , 49.1]
Norway	1	15.6	[3.3 , 41.0]	14.1	[7.0 , 25.9]
Romania	0	13.9	[3.3 , 32.9]	6.4	[2.4 , 16.5]
Russia	0	63.5	[46.6 , 79.2]	19.2	[10.6 , 32.1]
South Africa	0	60.1	[40.3 , 75.6]	13.1	[5.5 , 26.9]
Sweden	1	28.4	[9.3 , 51.5]	4.5	[1.3 , 13.1]
Turkey	0	12.5	[2.9 , 35.6]	4.7	[1.0 , 15.9]
United Kingdom	1	55.0	[29.5 , 74.6]	5.9	[1.7 , 16.4]
Average	0.5	34.2	[16.5 , 54.9]	11.3	[4.5 , 23.6]
Advanced	1	37.2	[17.8 , 58.0]	10.5	[3.7 , 23.2]
Emerging	0	30.6	[15.1 , 51.2]	12.3	[5.4 , 24.2]

Source: Own calculations using data from Bank for International Settlements (2021a,2021b), Federal Reserve Economic Data (2021) and OECD Weekly Tracker of Economic Activity (2021).

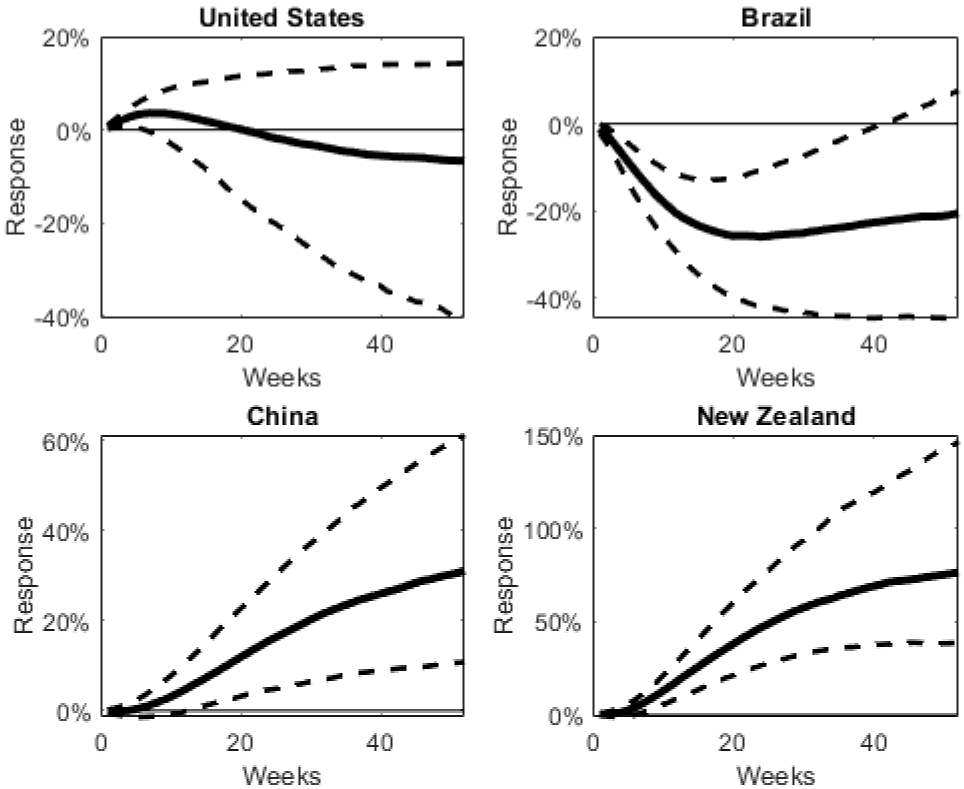
Notes: Contribution of Federal Funds Rate shows the part of exchange rate volatility explained by Federal Funds Rate based on forecast error variance decomposition after 52 weeks. Advanced takes a value of 1 if the country is an advanced economy and takes a value of 0 if the country is an emerging market. The summary results for advanced economies and emerging markets at the bottom of the table represent the corresponding average values.

Figure 1 – Cumulative Impulse Responses of Exchange Rates to a Negative Shock on the U.S. Policy Rate in 2019



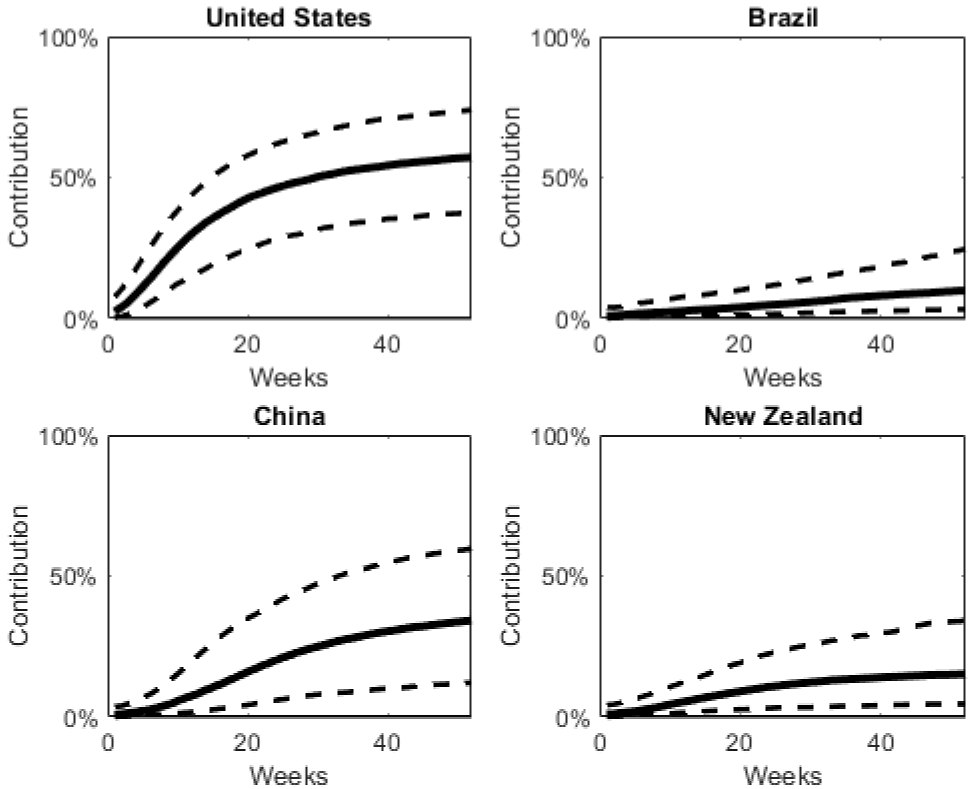
Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the cumulative impulse responses of exchange rates in percentage terms (constructed as appreciation of currencies) following a negative 1% shock to the U.S. policy rate.

Figure 2 – Cumulative Impulse Responses of Exchange Rates to a Negative Shock on the U.S. Policy Rate in 2020



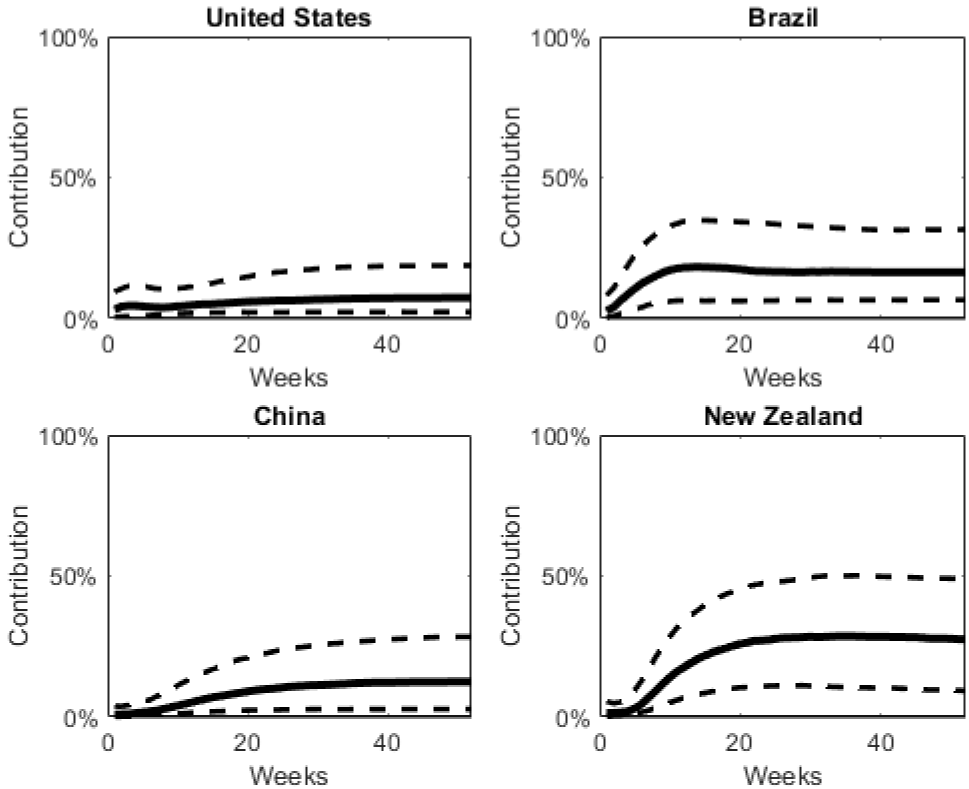
Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the cumulative impulse responses of exchange rates in percentage terms (constructed as appreciation of currencies) following a negative 1% shock to the U.S. policy rate.

Figure 3 – Contribution of Federal Funds Rate to the Exchange Rate Volatility in 2019



Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the contribution of federal funds rate to the forecast error variance decomposition of the exchange rate in percentage terms.

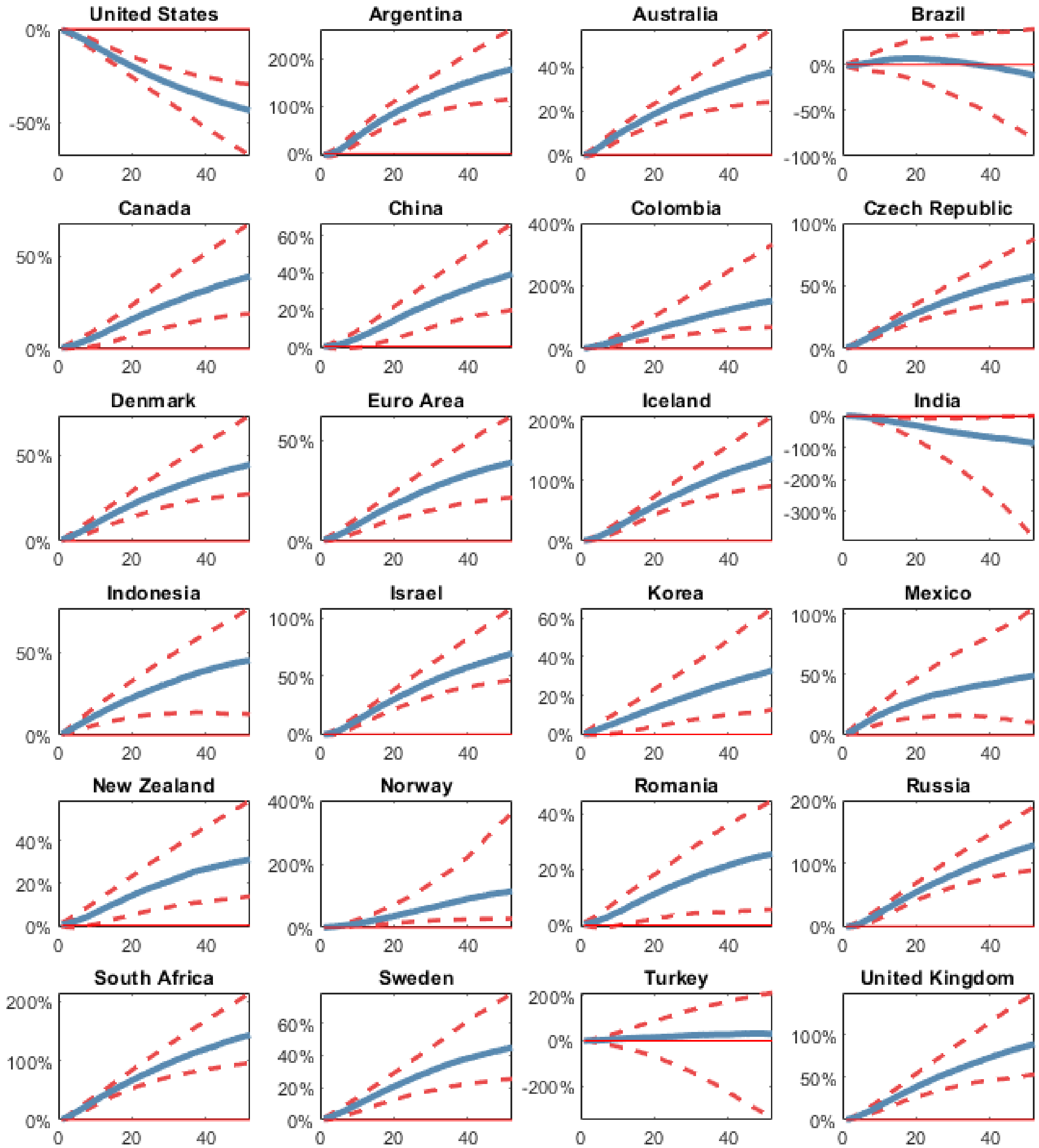
Figure 4 – Contribution of Federal Funds Rate to the Exchange Rate Volatility in 2020



Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the contribution of federal funds rate to the forecast error variance decomposition of the exchange rate in percentage terms.

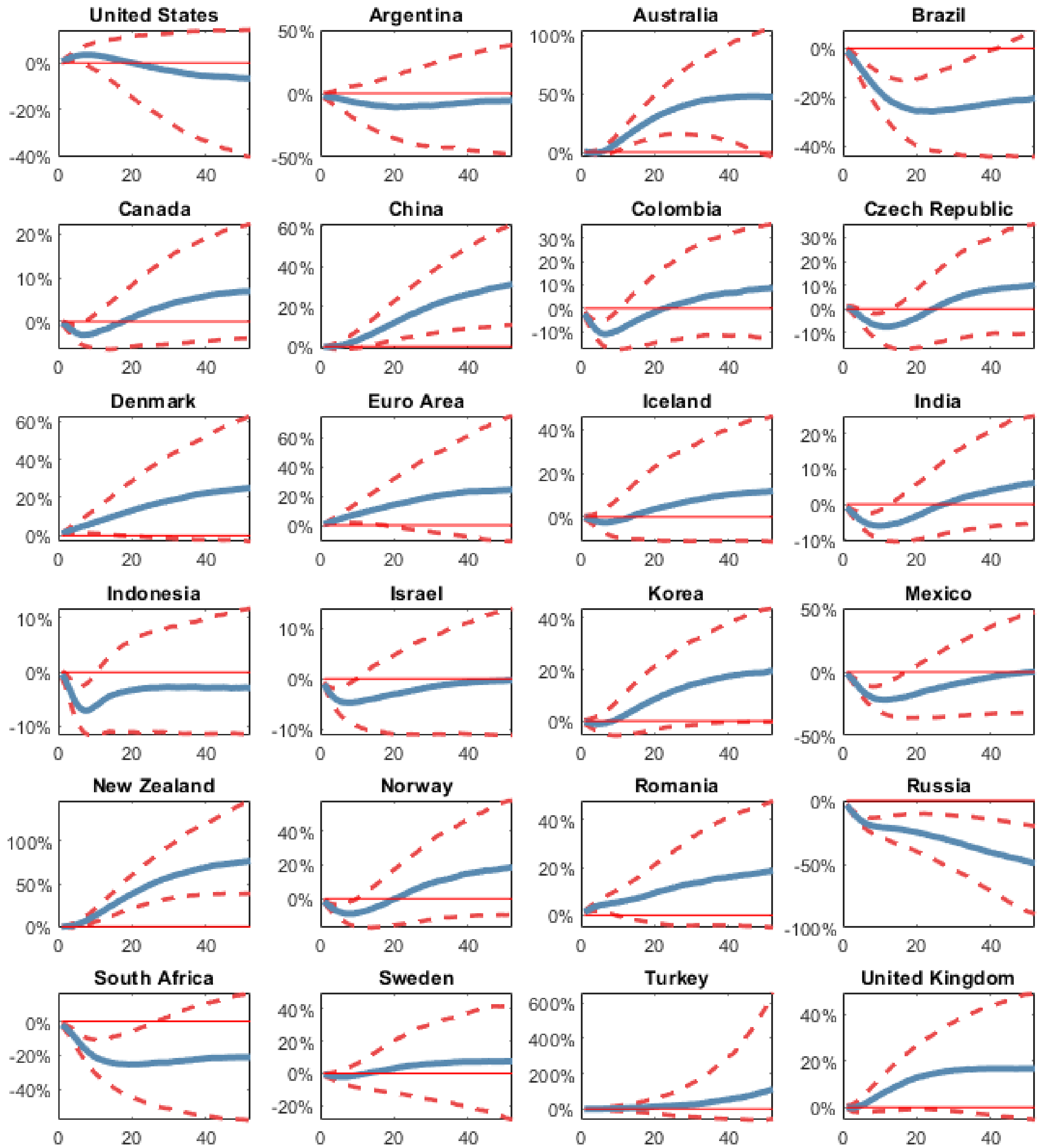
Online Supplemental Appendix

Figure A.1 – Cumulative Impulse Responses of Exchange Rates to a Negative Shock on the U.S. Policy Rate in 2019



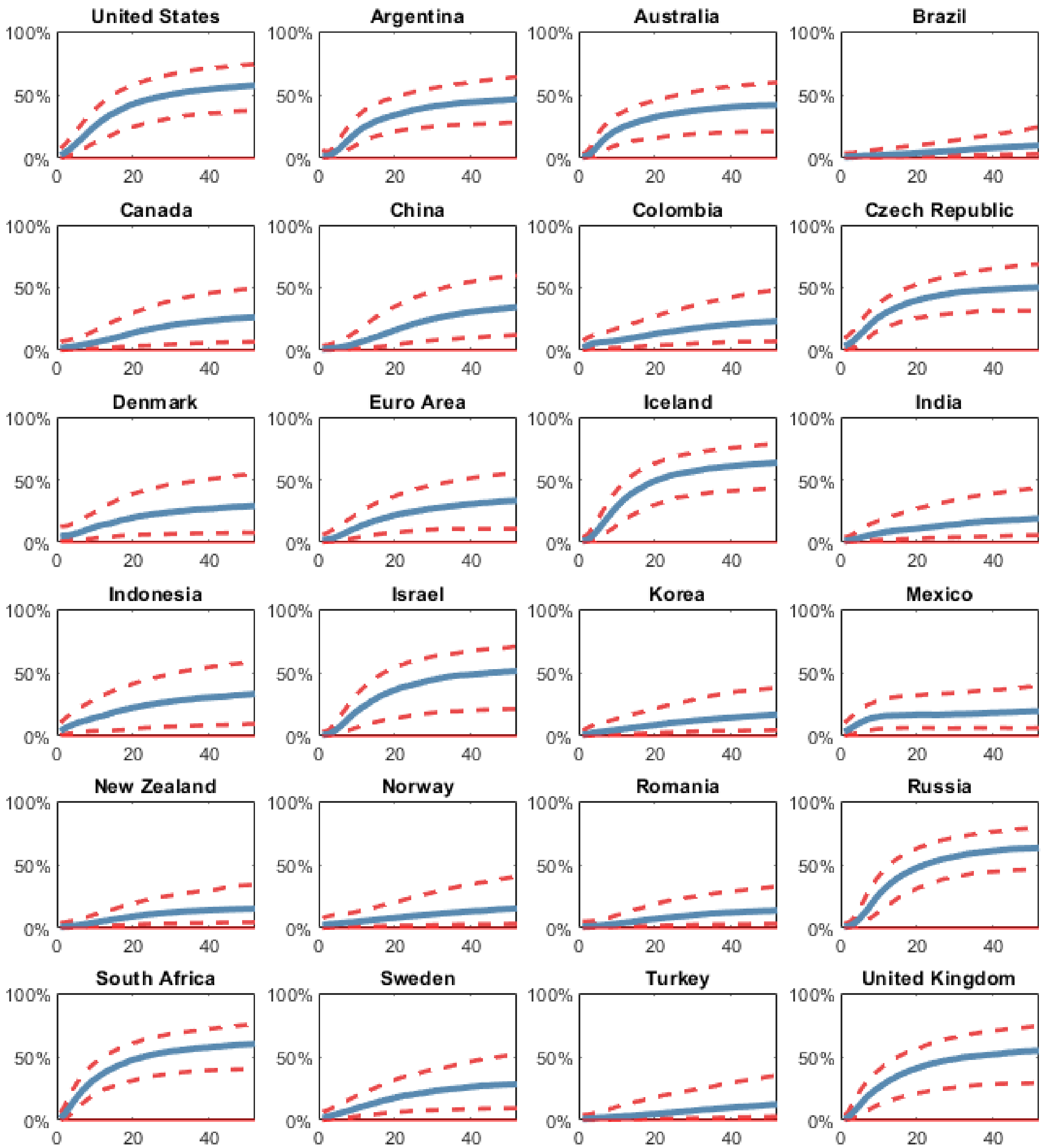
Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the cumulative impulse responses of exchange rates in percentage terms (constructed as appreciation of currencies) following a negative 1% shock to the U.S. policy rate. The horizontal axes represent weeks.

Figure A.2 – Cumulative Impulse Responses of Exchange Rates to a Negative Shock on the U.S. Policy Rate in 2020



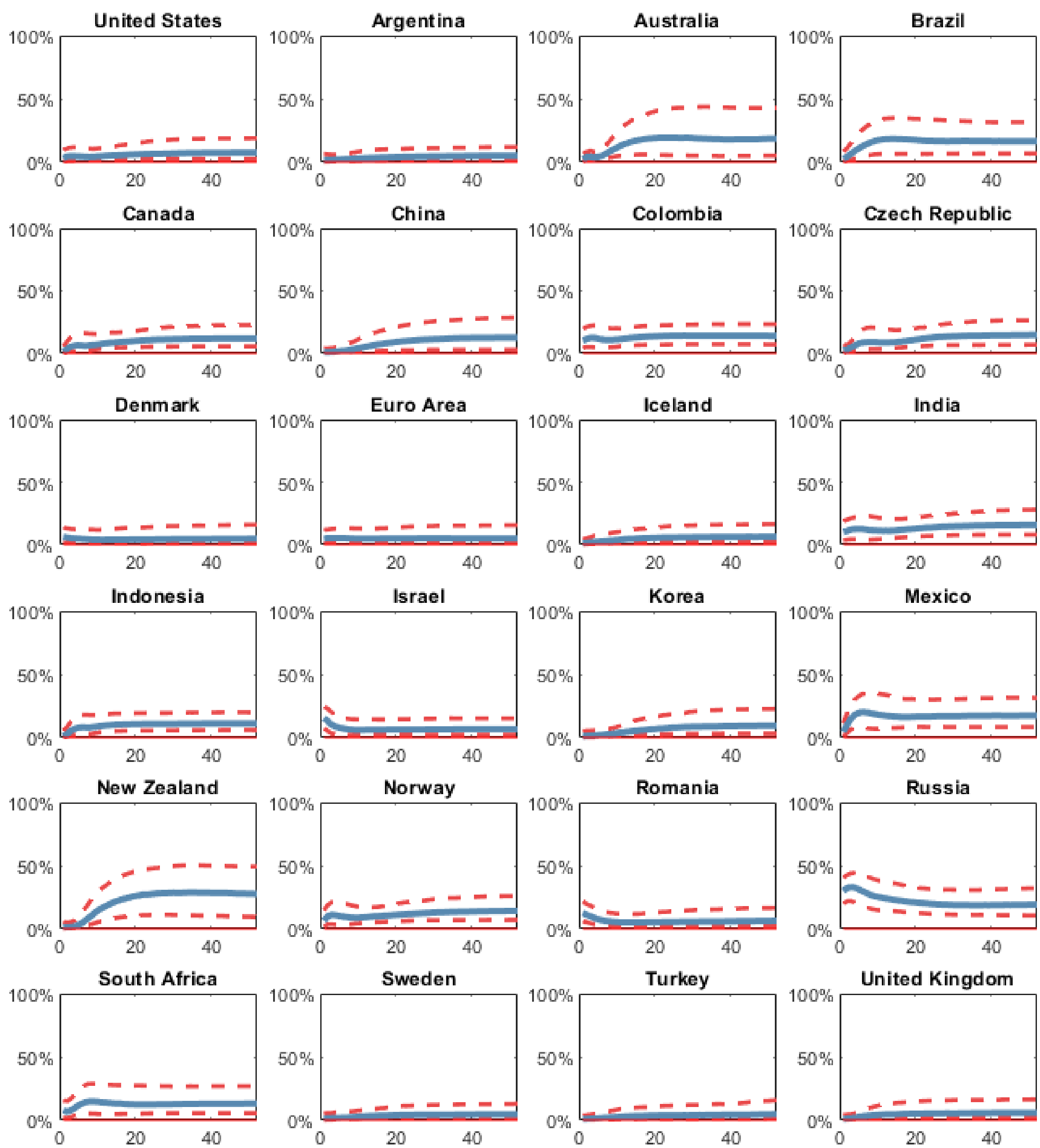
Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the cumulative impulse responses of exchange rates in percentage terms (constructed as appreciation of currencies) following a negative 1% shock to the U.S. policy rate. The horizontal axes represent weeks.

Figure A.3 – Contribution of Federal Funds Rate to the Exchange Rate Volatility in 2019



Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the contribution of federal funds rate to the forecast error variance decomposition of the exchange rate in percentage terms. The horizontal axes represent weeks.

Figure A.4 – Contribution of Federal Funds Rate to the Exchange Rate Volatility in 2020



Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals. The vertical axes represent the contribution of federal funds rate to the forecast error variance decomposition of the exchange rate in percentage terms. The horizontal axes represent weeks.