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The Macroeconomic Impact of Foreign Exchange Intervention: Some Cross-country Empirical Findings

by Zhongxia Jin, Haobin Wang, and Yue Zhao

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Macroeconomic Impact of Foreign Exchange Intervention: Some Cross-country Empirical Findings

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Abstract

Based on VAR analyses across 26 countries, we show that, although foreign exchange intervention (FXI) is effective in stabilizing the nominal exchange rate in the short run, its impacts on the real exchange rate are less significant: Limitations on nominal exchange rate flexibility may induce adjustments to the real exchange rate through domestic prices. We find that countries that intervene more heavily in response to external shocks experience greater general and asset price volatility, which is not conducive to countering the impact of external shocks. We show that China's macroeconomic responses to external shocks are broadly consistent with international experiences among intervening countries. The simple methodological framework adopted in this paper is meant to examine a broad set of macroeconomic variables and bears limitations; our findings serve to motivate more structural analysis on FXI's macroeconomic impacts going forward.

JEL Classification Numbers: E42, E58, F31, F40

Keywords: foreign exchange intervention, exchange rate, Chinese economy, inflation

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I. INTRODUCTION[1]

In this paper, we focus on examining the macroeconomic consequences of foreign exchange intervention (FXI) and exchange rate rigidity in the hopes of gathering some insights for the choice of exchange rate system.

Mainstream views regarding the optimal choice of exchange rate policies have evolved over time, and the issue still remains a matter of significant debate. In the early 1990s, a fixed exchange rate (pegged to the US dollar or German mark) was a popular option for developing countries, especially those transitioning toward market economies. However, the capital account crises and exchange rate collapse that took place in the late 1990s revealed the vulnerability of a fixed exchange rate and resulted in the wide perception that simple pegs might be too risky and that a country should either adopt a hard peg via monetary unions or currency boards or use a free-floating exchange rate without government intervention (Gosh and Ostry, 2009).

The collapse of the Argentine peso in 2002 once again shifted mainstream views with regard to the optimal choice of an exchange rate regime by raising new doubts about the viability of hard pegs. Discussions about the merits of an intermediate exchange rate regime followed suit. Yi and Tang (2001) propose an expanded version of the "impossible trinity" and show that a country does not have to fully give up any one of the trinity conditions (i.e., a free-floating exchange rate, free capital mobility, or monetary independence). The authors argue that it is possible to achieve a combination of the three conditions proportionately. Their proposal suggests that an exchange rate regime does not necessarily have to be a clean float or a hard peg, but in practice, can be an intermediate regime that lies in between the two.

Hussain et al. (2005) find that exchange rate regimes across countries have not exhibited an obvious tendency to evolve toward either a clean float or a hard peg. Instead, intermediate regimes have demonstrated greater sustainability over time. They also find that the merits of a free-floating regime tend to become more prominent as an economy matures. In the early stage of economic development, a fixed exchange rate has the benefit of serving as a nominal anchor that keeps inflation in check. However, as an economy matures and its policy credibility improves, the price-stabilizing function of a fixed exchange rate becomes less important. A free-floating regime, on the other hand, appears more beneficial as mature economies with a free-floating exchange rate tend to achieve superior economic performance. The 2009 IMF review of exchange rate regimes similarly points out that the appropriate choice of exchange rate regime should depend on country-specific contexts: A rigid exchange rate regime helps anchor inflation expectations and sustain economic output, but it simultaneously puts greater constraints on macroeconomic policies, increases

[1] This work is the English version of a selected chapter from a research project sponsored by the China Finance 40 Forum (CF40). The work has benefited from comments and valuable discussions with participants at CF40's biweekly round table discussion, as well as Helge Berger, Udaibir Saran Das, Russell Green, Shakill Hassan, Henry Hoyle, Deniz Igan, Phakawa Jeasakul, Gunes Kamber, Martin Kaufman, Rui Mano, Francisco Roldan, Masashi Saito, Ryan Wu, and Jun Zhu. We would also like to thank Peichu Xie for his valuable contributions to early discussions on the empirical methodology, Shuhan Jin from the University of Chicago for her research assistance in this project, and Erin Yiu for editorial assistance.

vulnerability to crises, and impedes macroeconomic adjustments against external shocks (Ostry and Gosh, 2009).

More recently, especially after the global financial crisis and the subsequent massive scale of unconventional monetary easing, economies have increased the use of capital controls and FXI to manage the heightened volatility of exchange rates and capital flows. Some studies have provided a theoretical justification for the use of sterilized FXI, even for economies that adopt inflation-targeting (IT) regimes (Alla et al., 2017; Benes et al., 2013; Cavallino, 2019; Ostry et al., 2015). Another large body of empirical studies has analyzed the effectiveness of FXI in stabilizing the exchange rate (e.g., Adler et al., 2015; Blanchard et al., 2015 and 2016; Daude et al., 2014; Fratzscher et al., 2015).

Despite the potential merits of using FXI,[2] most studies do recognize that FXI is not a free lunch and should be used only under very rare circumstances. Recent literature, however, has paid less attention to the potential costs associated with FXI.[3] Although China has significantly reduced its intervention in the foreign exchange market in recent years, it remains important to understand the macroeconomic consequences of FXI to gather insights that may help with China's macroeconomic management.

We set out to investigate both the effectiveness and potential consequences of FXI by drawing from international experiences and the China-specific context. Based on VAR analyses across 26 countries, we show that while FXI is effective in mitigating nominal exchange rate fluctuations in the short run, its impact on the real exchange rate is less significant. Our results suggest that while FXI can limit adjustments of the nominal exchange rate, it simultaneously induces the real exchange rate to adjust through domestic prices, which may not be conducive to countering the impacts of external shocks. Specifically, we find that in the face of external financial shocks, countries with more intensive use of FXI experience greater general and asset price volatility. We further examine China's macroeconomic responses to external shocks over the past decades and find that they are broadly consistent with international experiences among intervening countries.

The simple methodological framework adopted in this paper is meant to examine a broad set of macroeconomic variables and bears limitations; our findings serve to motivate more structural analysis on FXI's macroeconomic impacts in the future.

The rest of the paper is organized as follows. Section II presents our empirical methodology and datasets, Section III presents our cross-country and China-specific empirical results, Section IV concludes the paper.

II. EMPIRICAL METHODOLOGY

A key challenge in estimating the macroeconomic impacts of FXI arises from the endogenous nature of FXI: FXI is often triggered by contemporaneous changes in

[2] Including a vast literature on the use of FXI for precautionary and mercantilist purposes (e.g., Aizenman and Lee, 2008; Jeanne and Ranciere, 2011; Ghosh et al., 2012).
[3] Adler and Mano (2016) is a recent work that examines the quasi-fiscal costs associated with FXI.

macroeconomic variables, such as the exchange rate, yet the implementation of FXI will in turn affect the same macroeconomic variables, making it difficult to identify the causal impact from FXI. Many studies have resorted to the use of either instrumental variables to identify the exogenous variations in FXI, or the use of high-frequency data and event-study techniques to resolve reverse causality. We adopt a methodology similar to that in Blanchard et al. (2015), which constructs a capital flow measure deemed exogenous from the perspective of individual economies and study whether exchange rates in countries with or without FXI exhibit different responses to the capital flow measure. We apply the methodology to investigate the impulse response of additional macroeconomic variables to FXI and compare the findings to a case study in the context of China.[4] Our reduced-form VAR is meant to capture how countries with varying degree of FXI differ in their macroeconomic responses broadly; further research can deploy more robust Structural Vector Autoregression (SVAR) to investigate the underlying transmission mechanisms.

The empirical results suggest that in the face of external shocks, FXI can mitigate nominal exchange rate fluctuations, but it has limited impact on the real exchange rate. Moreover, in the face of external shocks, countries with FXI experience greater general and asset prices volatility compared to countries with a free-floating exchange rate. The results suggest that although FXI may be effective in stabilizing the nominal exchange rate, the real exchange rate may achieve self-adjustments through domestic prices, yet the adjustment process likely bears painful domestic consequences. We find that the macroeconomic responses to external shocks in China are broadly consistent with international experiences among intervening countries.

To investigate the macroeconomic impacts of FXI, we conduct VAR analysis for a group of 26 countries individually. We follow Blanchard et al. (2015) and place the countries into two groups—namely, interveners and floaters—based on individual FXI responses to external financial shocks, which is the "VIX" in our case.[5] Hence, the exogenous shock used in our model can also be considered a global financial shock. Half of our sample countries are grouped as interveners while the other half are floaters. We use monthly data from 1990 to 2019 in our estimation.[6] The country-specific model takes the following form:

$$\left(I - A_1 L - \ldots - A_p L^p\right) \cdot Y_{j,t} = \epsilon_{j,t}$$

Specifically, L^p represents a lag operator of order p, $A_1 \ldots A_p$ are 6×6 parameter matrices, $Y_{j,t}$ represents the vector of exogenous and endogenous variables, defined as the following in the baseline specification:

[4] Blanchard et al. (2015) focus primarily on the impact of FXI on exchange rates; we extend their methodology to examine other macroeconomic variables. In addition, we use "VIX" as our exogenous variable, which correlates highly with the capital flow measure constructed in Blanchard et al. (2015) and has been shown to yield similar empirical results.

[5] As emphasized in Blanchard et al. (2015), the categorization is based on country responses to the specific choice of external shock only, which is the "VIX" in our case. In practice, countries may also intervene in response to other types of shocks such as country-specific shocks.

[6] Our sample is restricted, and we follow Blanchard et al. (2015) by excluding some country-specific periods of structural breaks related to changes in monetary and foreign exchange policies.

$$Y_{j,t} \equiv \left[ER_{j,t}\ FXI_{j,t}\ \ F_{j,t}\ STOCK_{j,t}\ T_{j,t}\ VIX_{j,t}\ \right]$$

Specifically, $ER_{j,t}$ denotes changes in the nominal exchange rate vis-à-vis the US dollar. $F_{j,t}$ is the inflation indicator, measured by the average growth of CPI and PPI. Throughout our estimations, we measure inflation as the average growth of CPI and PPI to capture the price responses in both the consumer and producer sectors.[7] $STOCK_{j,t}$ indicates the change in the stock market index, and $T_{j,t}$denotes short-term interest differentials vis-à-vis the US, which is meant to control for contemporaneous changes in monetary policy stance (unsterilized FXI). Lastly, $VIX_{j,t}$ denotes changes in the S&P 500 volatility index, which captures global financial conditions and serves as the exogenous variable in our model. We include additional variables, such as real exchange rate and real interest rate, in subsequent estimations of the model.[8] For comparability, we use bilateral real exchange rate (vis-à-vis the US dollar) as our real exchange rate variable. We also conduct robustness checks using real effective exchange rates.

$FXI_{j,t}$ indicates FXI, which is measured by changes in the stock of foreign reserves (normalized by quarterly GDP) in the benchmark specification.[9] An advantage of measuring FXI using the changes in the stock of foreign reserves is that such a proxy is consistently available across countries and typically spans a long period—namely, 1990-2019 in our baseline specification. But a disadvantage of such a proxy is that it is polluted by valuation changes and investment income flows, and it includes central bank operations vis-à-vis residents and non-residents that affect the level of foreign reserves but does not constitute FXI. To address such a concern, we re-estimate the baseline model and subsequent empirical tests using an alternative novel database of FXI (Adler et al., 2021) as a robustness check. The novel database compiles officially published and proxied FXI in both the spot and derivatives markets, covering the period from 2000 to 2020. For brevity, we report the estimation results using the simple measure in the main text while leaving the estimation results using the novel database in the appendix. To anticipate the results, both measures of FXI yield similar conclusions.

The baseline model is used to group our sample countries into interveners and floaters by estimating country-specific FXI responses to external shocks. We classify the countries based on the rankings of their cumulative FXI responses at a specified time horizon. Such a classification methodology is based solely on the statistically estimated FXI responses to external financial shocks. Some countries grouped as floaters might intervene strongly in the foreign exchange market, albeit in response to other types of shocks, and are therefore not reflected in our estimation.

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[7] Inclusion of PPI is important in the computation of the real interest rate, as it more accurately captures the real lending/borrowing cost in the business loan market, which in many countries takes up a significant share of the overall credit market.

[8] The number of lags for each individual VAR is based on Akaike information criteria.

[9] We choose not to include off-balance sheet items (derivatives) as they are not consistently available across countries and over time. Such items will be captured in the alternative FXI measure (Adler et al., 2021) that we use as a robustness check.

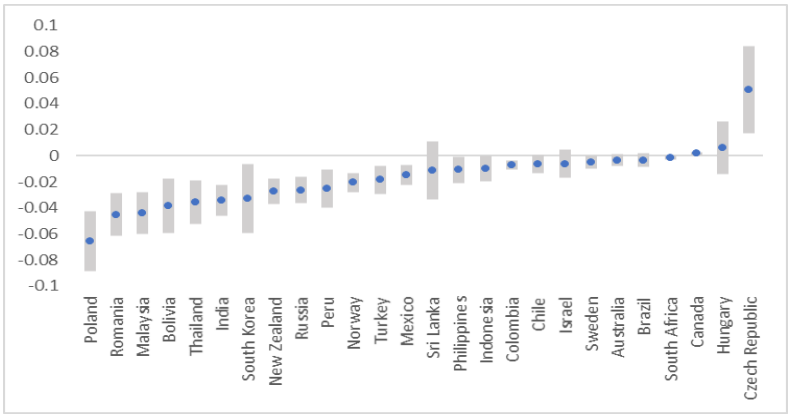
The data for nominal exchange rates and foreign reserves are from the IMF's International Financial Statistics (IFS). Data for inflation, interest rates, and stock market index are from Haver Analytics. Data for the "VIX" are from the Chicago Board Options Exchange.

III. CROSS-COUNTRY EMPIRICAL RESULTS

A. Responses of FXI and the nominal exchange rate

Figure 1 reports the cumulative impulse responses of FXI to an external financial shock at t=6. The external financial shock in all our reported results refers to a standard deviation increase in our exogenous variable (i.e., changes in the "VIX") and can be interpreted as a worsening of external financial conditions. The y-axis indicates percentage changes. The significant cross-sectional variations in FXI responses provide the basis for us to construct a *de-facto FXI regime classification* (Table 1) based on the rankings of their responses (i.e., whether their cumulative responses are smaller or larger than the median). FXI responses using alternative FXI measures (Adler et al., 2021) are presented in the Appendix (Figure A1).

Figure 1. Cumulative Responses of FXI to an External Shock (t=6)



Note: Cumulative impulse responses from individually estimated VAR models, at t=6. One standard deviation bands are reported.

Table 1. Categorization of De Facto Exchange Rate Regimes

De Facto Exchange Rate Regimes			
Interveners		**Floaters**	
Bolivia	Poland	Australia	Indonesia
India	Romania	Brazil	Israel
Malaysia	Russia	Canada	Philippines
Mexico	South Korea	Chile	South Africa
New Zealand	Thailand	Colombia	Sri Lanka
Norway	Turkey	Czech Republic	Sweden
Peru		Hungary	

Source: Blanchard et al. (2015) and author's calculation.

Our focus is on the cross-section of impulse response functions of domestic variables to the exogenous variable. We start by estimating country-by-country impulse response functions using the above VAR model. We then take the weighted average of country estimations for the group of floaters and group of interveners, respectively.[10] We compare the impulse response functions of key variables across the two groups.

Figure 2(a) reports the impulse response functions of changes in foreign reserves to one standard deviation shock to the exogenous variable. The solid lines represent the weighted average of individual impulse response functions for the two country groups. The dashed lines represent the associated confidence bands. The results show that foreign reserves among interveners (versus floaters) experience a larger decline in response to an external shock. The difference is significant, both economically and statistically.

Figure 2(b) reports the impulse response functions of the average nominal exchange rate to an exogenous shock. A positive value indicates a depreciation vis-à-vis the US dollar. The results show that the nominal exchange rates of floaters experience a larger depreciation than those of the interveners in response to an external shock.[11] Again, the difference is economically and statistically significant. The empirical results are broadly consistent with those of Blanchard et al. (2015).

[10] The weights are inversely proportional to the standard deviation of each impulse response.
[11] A positive value implies depreciation.

Figure 2. Responses of Foreign Reserves and Exchange Rates to External Shock

Figure 2a. FXI IRF: Interveners vs. Floaters

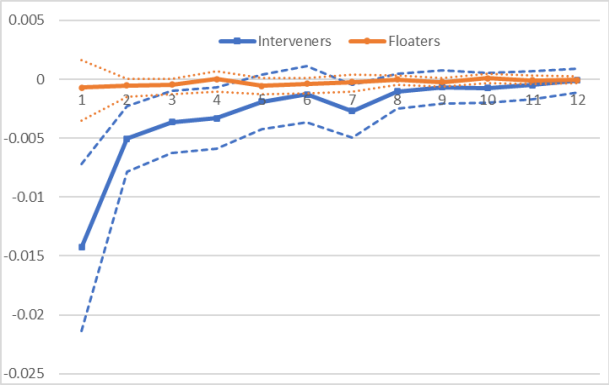
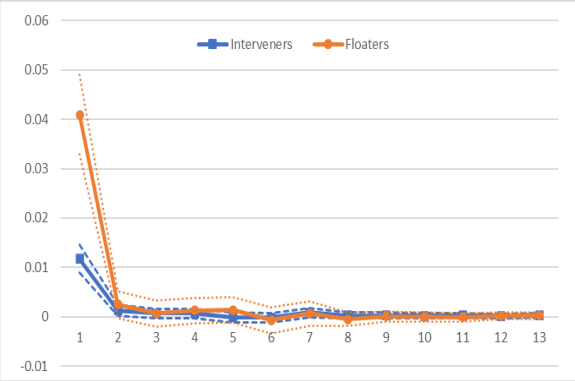


Figure 2b. Nominal Exchange Rate IRF: Interveners vs. Floaters



Note: The figure reports impulse response functions to a one standard deviation shock to the exogenous variable. Solid and dashed lines represent the weighted average of impulse responses and their (60 percent) confidence bands respectively, with weights that are inversely proportional to the standard deviation of each impulse response. The x-axis indicates number of months while the y-axis indicates percentage changes.

The results in Figure 1 suggest that FXI is effective in mitigating the nominal exchange rate fluctuations in the face of an external financial shock. Estimation results using the alternative novel FXI database yield similar results (see Figure A2 in the Appendix).

B. Responses of the real exchange rate

Figure 3 compares the impulse response functions of real exchange rates between the two groups of countries. Although the extent of depreciation remains different across the two groups and is still larger for the floaters, they become economically smaller and statistically less significant (versus Figure 2b). The results suggest that FXI is less effective in stabilizing the bilateral real exchange rate (versus the nominal exchange rate) in the face of an external shock. The result is robust to alternative measures of FXI (see Figure A3 in the Appendix). We also conduct a robustness check using real effective exchange rates, but the findings in Figure 3 still hold.

While the result in Figure 3 suggests that real exchange rates among interveners can still manage to adjust despite the presence of FXI that limits nominal exchange rate flexibility, such external adjustments are likely less desirable than those of the floaters for the following reasons. First, adjustments of the real exchange rate through falling domestic prices can be painful as it amplifies the deflationary pressure that may result from external shocks. Second, real exchange rate depreciation through falling domestic prices may not fully release depreciation pressure due to potential downward price rigidities: Domestic prices may not adjust flexibly in response to external shocks. As both Figure 3 and Figure A3 show, real exchange rates depreciate to a lesser extent among interveners (vs. floaters) in response to the external shock.

Figure 4a further compares the impulse response functions of the nominal exchange rate and the real exchange rate among the group of interveners. Real exchange rates experience greater depreciation than nominal exchange rates in response to an external shock, suggesting that, although the nominal exchange rate may be kept stable through FXI, the real exchange rate could still adjust through falling domestic prices. One possible interpretation of the observation is that FXI, in practice, may not always be fully sterilized, especially in the short run, thereby resulting in a change of monetary stance that may affect relative prices. Another possibility is that external financial shocks are contractionary in nature and may cause deflationary pressure domestically, and limitations on exchange rate flexibility impedes external adjustments that would counter the deflationary pressure of the shock.

In contrast, Figure 4b shows that for the group of floaters, nominal and real exchange rates exhibit relatively similar responses to external shocks, suggesting that external shocks among floaters are not accompanied by significant changes in relative prices. One way to interpret such an observation is that nominal exchange rate depreciation helps facilitate external adjustments and serve to counter the deflationary pressure that may result from the external shock.

Figure 3. Responses of Real Exchange Rates

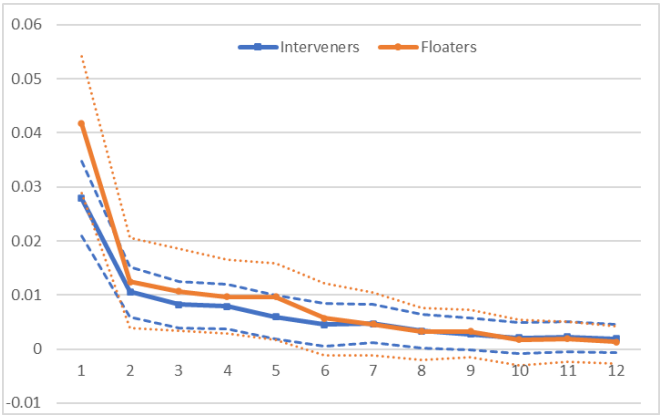


Figure 4. Comparing the Responses of Nominal and Real Exchange Rates

Figure 4a. Interveners IRF: Nominal vs. Real Exchange Rate

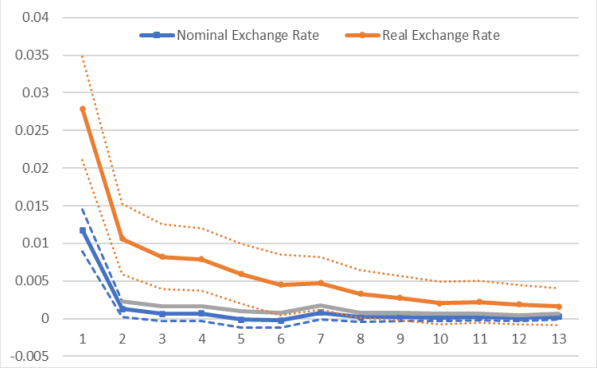
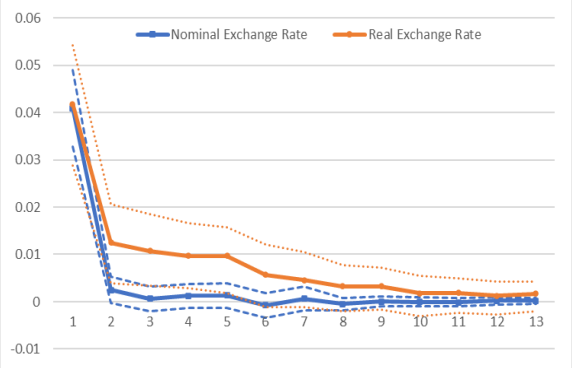


Figure 4b. Floaters IRF: Nominal vs. Real Exchange Rate

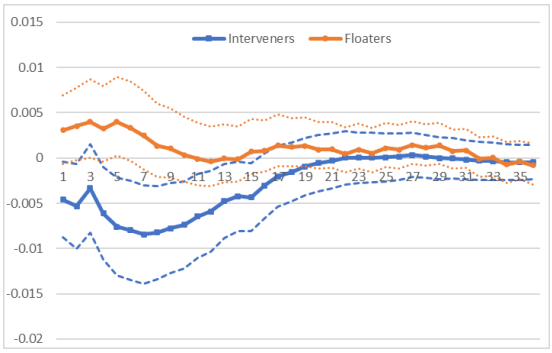


C. Responses of inflation

Figure 4a suggests that, although FXI may stabilize nominal exchange rates, real exchange rates may achieve adjustments through changes in relative prices. Figure 5 reports the inflation[12] responses to external shocks for the two country groups. The results show that interveners experience greater deflationary pressure in the aftermath of an external shock, consistent with the findings in Figure 4a.

[12] Average year-over-year growth rate of CPI and PPI.

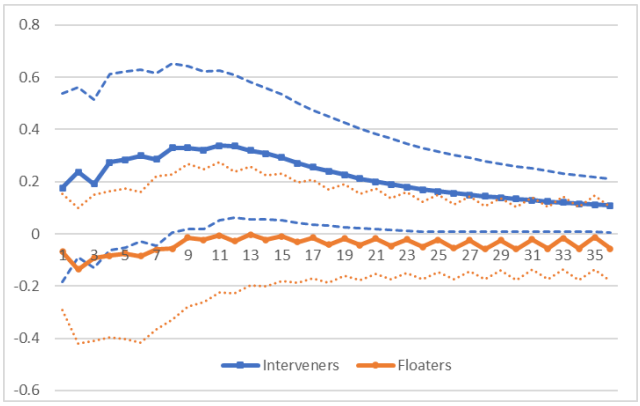
Figure 5. Responses of Inflation



D. Responses of real interest rate

The impact of FXI on prices may also translate into an impact on the real interest rate. We test real interest rate responses to external shocks by adding a real interest rate variable to the baseline model. Figure 6 compares the average impulse response functions of real interest rates between floaters and interveners. The results show that in response to an external shock, average real interest rates among the floaters remain relatively unchanged but rise among the interveners. Rising real interest rates may amplify the impact of external shocks, aggravate the repayment burden of debtors, and further exacerbate domestic deflationary pressure. Although the differences across the two groups are not statistically significant, estimation results using alternative FXI measures similarly show that the average real interest rate among interveners rises persistently in response to external shocks (see Figure A4 in the Appendix).

Figure 6. Response of Real Interest Rates



E. Response of asset prices

Figure 7 compares the average impulse response functions of stock and housing prices to external shocks across the two country groups. The results show that stock prices generally fall in response to an external shock, consistent with findings in the global financial cycle (GFC) literature, but the average decline is larger among interveners. A robustness check using alternative FXI measures yields similar findings, which are both economically and statistically significant (see Figure A5 in the Appendix). The reactions of housing prices to external shocks are more mixed but also appear larger among interveners. Although FXI is often relied upon as a policy tool to reduce market volatility, we find no evidence that FXI can mitigate domestic asset price volatility.

Indeed, to the extent that FXI is effective in stabilizing the nominal exchange rate, it also constrains the role of the exchange rate as a "shock absorber," and may amplify the impact of external shocks on domestic asset prices. For instance, although FXI may mitigate nominal exchange rate depreciation in response to external shocks, it prevents depreciation expectations from being reflected in market prices in a timely manner and prolongs arbitrage opportunities, which may accelerate capital outflows and increase market volatility. Another possibility is that, to the extent that FXI contributes to rising real interest rates, as shown in Figure 6, it increases the opportunity costs of investing in the stock and housing markets, and may trigger downward pressure on stock and housing prices.

Of course, asset price dynamics are inherently complicated and can be driven by many other factors, further research is needed to investigate the precise role of FXI in influencing asset prices. The upshot is that we find no evidence that FXI can mitigate asset price volatility. To the contrary, our results suggest that FXI may actually result in greater asset price volatility.

Figure 7. Response of Asset Prices

Figure 7a. Stock Price IRF: Floaters vs. Interveners

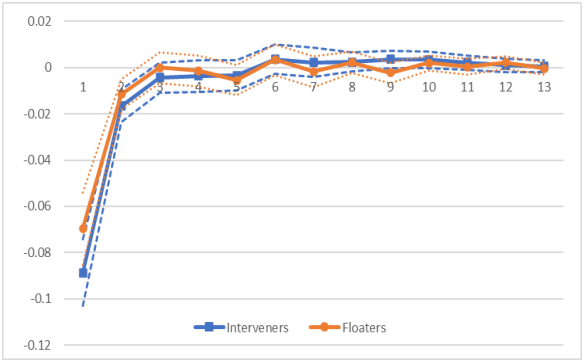
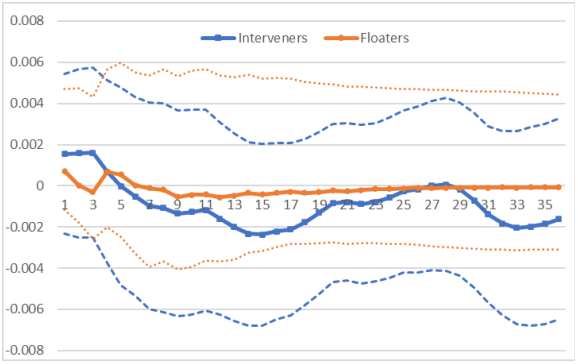


Figure 7b. Housing Price IRF: Floaters vs. Interveners



Note: The figure reports impulse response functions to a one standard deviation shock to the exogenous variable. Solid and dashed lines represent the weighted average of impulse responses and their (60 percent) confidence bands respectively, with weights that are inversely proportional to the standard deviation of each impulse response. The x-axis indicates number of months while the y-axis indicates percentage changes.

F. Transmission of FXI

The empirical results presented herein show that differences exist between the two groups' macroeconomic responses to external shocks, suggesting that FXI can potentially generate macroeconomic impacts. We briefly discuss and review the transmission of FXI from a theoretical perspective.

FXI can generate macroeconomic impacts via many channels. FXI that is not fully sterilized entails a change in monetary stance and can subsequently affect exchange rate and domestic prices. FXI aimed at countering depreciation pressure, for instance, consists of selling foreign currencies and buying domestic currencies, which can be considered a reduction in the central bank's balance sheet. Without complete sterilization, the reduced balance sheet will result in a tightening of the money supply, contributing to deflationary pressure through falling general prices, rising real interest rates, and potentially falling asset prices.

Even with complete sterilization, FXI may still generate macroeconomic impacts. The literature on the transmission mechanism of sterilized FXI is vast and rich, and most notably includes works on the portfolio balance channel. The portfolio balance channel (Henderson and Rogoff, 1982; Kouri, 1982; Branson and Henderson, 1985) predicates primarily on the imperfect substitutability between domestic and foreign assets so that any changes in asset composition could affect risk premia. Recent works have advanced the portfolio balance theory using micro-founded frameworks to model the underlying financial friction (Gabaix and Maggiori, 2015; Chang and Velasco, 2017; Cavallino, 2019; Fanelli and Straub, 2020). Sterilized FXI may also generate macroeconomic impacts via the signaling channel by revealing the central bank's policy intentions, thereby influencing market expectations.[13]

G. Direct costs of FXI

The empirical results presented herein suggest that while interveners experience less nominal exchange rate volatility in response to external shocks, they bear the consequence of additional adjustments in domestic general and asset prices. Such macroeconomic consequences can be costly but may be overlooked or underestimated as they may not be directly observable.

FXI can also incur more direct costs, including the buildup of external imbalances, loss of foreign reserves, suppression of external investment returns, underdevelopment of the foreign exchange market, and conflicting goals between monetary policy and exchange rate policy, which we briefly discuss next.

FXI may impede timely adjustments of the balance of payments in response to negative external shocks. FXI that attempts to counter depreciation pressure can slow the adjustments of the balance of payments. The IMF's External Balance Assessment (EBA) conducts an

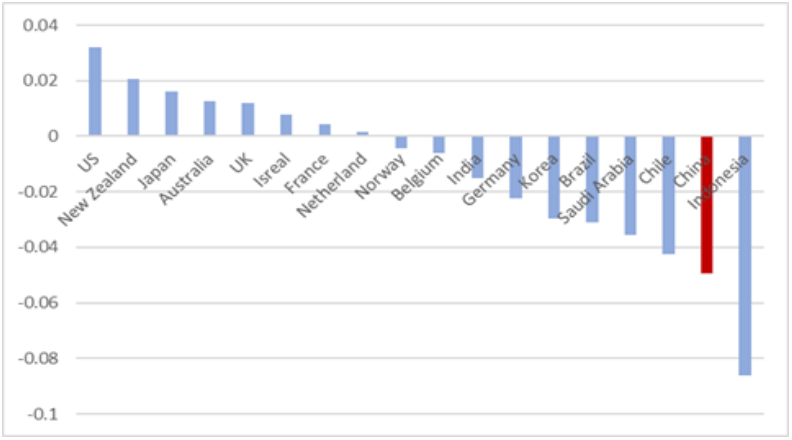
[13] Canales-Kriljenko et al. (2003), Adler and Tova (2011), and Mohanty (2013) are examples of related work.

empirical analysis and finds that FXI results in a buildup of external imbalances, especially in countries with capital account restrictions[14] (Phillips et al., 2013).

FXI could also accelerate the depletion of foreign reserves. Figure 2a shows that in the face of external shocks, interveners suffer a much larger decline in foreign reserves compared to floaters, with a difference in FXI of close to 1.5 percent of quarterly GDP.

FXI also incurs quasi-fiscal costs that may arise from the economic opportunity costs of holding reserve assets. Sustained FXI could inculcate a long-term dependence on reserve accumulation, a large portion of which is typically invested in low-return asset classes such as sovereign bonds, suppressing the net external investment returns of a country. Adler and Mano (2016) introduce a measurement for the marginal and total costs associated with foreign reserve accumulation and show that the fiscal costs of sustained FX intervention are non-negligible across a large set of countries. Moreover, reserve accumulation crowds out the private sector's external investment, which could hamper the efficient allocation of outbound capital. Figure 8 shows that China's average net external return from 2000 to 2018 fell in the negative region,[15] lagging behind many other emerging market economies.

Figure 8. Cross-country Average Net External Investment Returns (2000-2018)



Source: Das et al. (2020)[16]

FXI can also inhibit the development of foreign exchange derivatives markets. FXI, in practice, may not always involve direct purchases and sales in the spot market, but may alternatively take place in the derivatives markets with policy measures such as requiring payment of foreign exchange risk reserves. Intervention in the derivatives market serves the purpose of countering depreciation or appreciation pressure without directly tapping foreign

[14] Their results show that for countries at the 75th percentile and 90th percentile, every 1 percent increase (as a share of GDP) in foreign reserve purchases (sales) will increase current account surplus (deficit) by 0.19 percent and 0.38 percent respectively.

[15] One reason China's net external investment return has persistently remained in the negative region is that China's overall economic growth exceeds the average external growth, hence average domestic investment returns are generally higher than external investment returns.

[16] Das et al. (2020) estimate external investment returns using the IMF's cross-border investment stock and flow data, see Gourinchas and Rey (2007) for more details regarding the methodology.

reserve assets. An important side effect of FXI in the derivatives market is that the distorted price or additional cost of hedging as a result of intervention policies may drive away investors who have real hedging needs, thereby creating market barriers to risk-management tools. Such intervention policies contradict a sustainable market-based approach to risk management and can result in underdevelopment of the derivatives market. Hofman et al. (2020) find that the case for FXI appears strongest in countries with severe currency mismatch and underdeveloped markets. Their findings suggest that sustained use of FXI may entrench adverse initial conditions such as an underdeveloped market, giving rise to a negative policy-induced feedback loop.

Another costly consequence of FXI is that it can put the central bank in a dilemma by creating conflicting goals between inflation and exchange rate targets. An important mandate of the central bank is to maintain price stability, but inflation targets may be compromised if the central bank simultaneously attempts to achieve an exchange rate target. Granted, there are circumstances under which inflation targets are compatible with exchange rate targets. For example, when a country tries to combat deflationary pressure, FXI that sells domestic currencies in exchange for foreign currencies helps ramp up inflation. Similarly, when a country experiences inflationary pressure, FXI that sells foreign currencies in exchange for domestic currencies helps rein in inflation. However, under many circumstances in practice, the objectives of FXI often conflict with inflation targets. For instance, countries often resort to FXI under a crisis scenario with a rising current account deficit, capital outflows, exchange rate depreciation, and deflation. FXI that involves reserve sales may reinforce the deflationary pressure if no immediate and complete sterilization policies are in place. On the other hand, reserve accumulation typically takes place under a rising current account surplus, capital inflows, appreciation pressure, and inflation; hence, FXI that is not fully sterilized could further fuel inflation.

H. The Case of China

We use the VAR model to study the impulse responses of China's macroeconomic variables to external shocks. As with the cross-country analysis, we estimate the model with monthly data from 1990 to 2018.[17] Our results suggest that China's macroeconomic responses to external shocks are broadly consistent with international experiences among interveners.

Figure 9a reports FXI's impulse response function to an external shock. The results show that over the past three decades, foreign reserves did fall in response to external shocks, indicating the presence of FXI in China during the period. Figure 9b reports the impulse response function of the nominal exchange rate, which exhibits a lagged and relatively small depreciation in response to external shocks.

[17] We transform the data to three-month moving averages in order to smooth out the impulse response functions.

Figure 9. Response of FXI and Nominal Exchange Rate to External Shocks

Figure 9a. China: FXI IRF

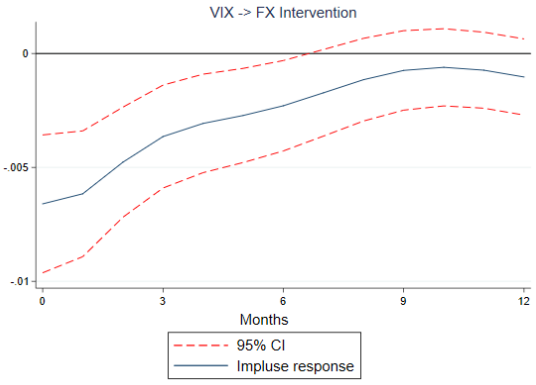


Figure 9b. China: Nominal Exchange Rate IRF

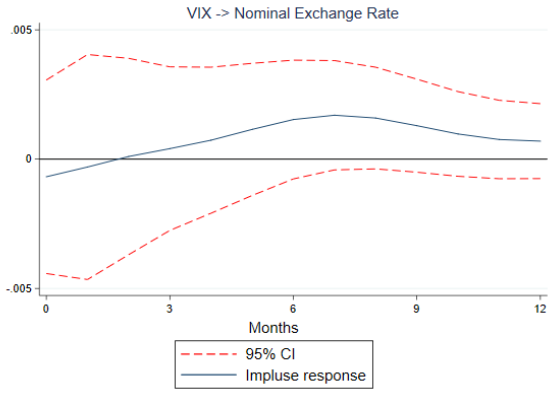


Figure 10a reports the impulse response functions of the real exchange rate to external shocks. The result suggests that, although FXI in China limits nominal exchange rate adjustments in response to external shocks, it induces the real exchange rate to adjust through domestic prices: The real exchange rate depreciates quite significantly against external shocks. Adjustments to the real exchange rate, particularly through declining domestic prices, are unintended consequences of restricting the nominal exchange rate flexibility and can be costly to the macroeconomy. Figure 10b confirms that external shocks induce deflationary pressure domestically, resembling the observations among interveners.

Figure 10. Response of Real Exchange Rate and Inflation Rate to an External Shock

Figure 10a. China: Real Exchange Rate IRF

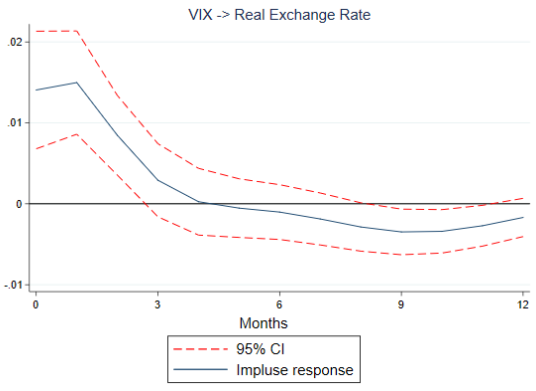


Figure 10b. China: Inflation IRF

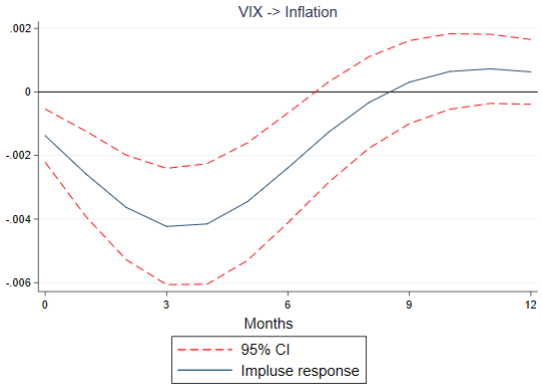


Figure 11 reports the impulse response function of the real interest rate to external shocks. The real interest rate rises in response to external shocks, which could amplify the domestic impact of external shocks as it raises the real cost of borrowing and is contractionary in nature.

Figure 11. Response of the Real Interest Rate to External Shocks

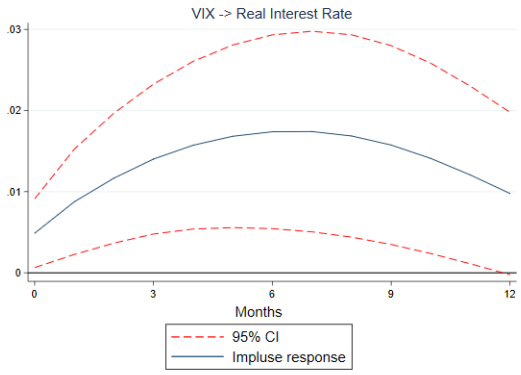


Figure 12 reports the impulse response functions of stock and housing prices to external shocks. Consistent with international experience, stock and housing prices in China fall in response to external shocks, with a magnitude that is closer to that of the interveners (Figure 7a).

Figure 12. Response of Stock and Housing Prices to External Shocks

Figure 12a. China: Stock Price IRF

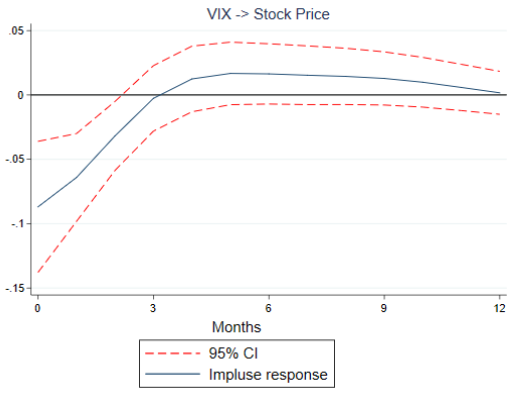
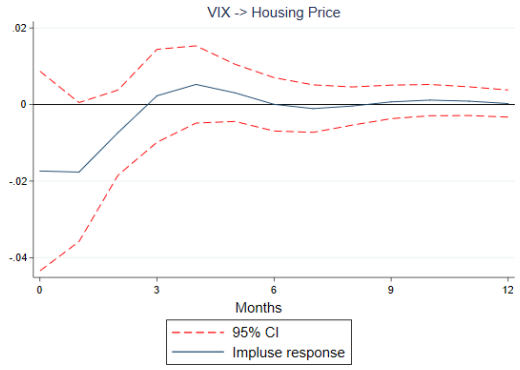


Figure 12b. China: Housing Price IRF



These results show that, over the past three decades, external shocks to China were generally followed by FXI. Moreover, external shocks were accompanied by relatively mild nominal exchange rate fluctuations, deflationary pressure, real exchange rate depreciation, rising real interest rates, and falling asset prices, similar to the experiences of other interveners.

However, the estimated responses to external shocks are only empirically associated with FXI; we have yet to examine whether FXI has any causal relationship with the relevant macroeconomic variables. To this end, Figure 13 reports a Granger causality test that includes our variables of interest. The results show that FXI can Granger-cause real exchange rate, general prices, the real interest rate, and asset prices. Drawing from our cross-country empirical evidence, our results suggest that FXI is likely a contributing factor behind China's exhibited macroeconomic adjustments in response to external shocks.

Figure 13. FXI's Impact in China: Granger Causality Test

Granger causality Wald tests				
Equation	Excluded	chi2	df	Prob>chi2
ER	FXI	5.751	2	0.056
F	FXI	11.24	2	0.004
STOCK	FXI	5.541	2	0.063
rir	FXI	7.423	2	0.024
T	FXI	0.0118	2	0.994

Note: ER, FXI, F, STOCK, rir, and T refer to the corresponding variables for exchange rate, FXI, inflation, asset price changes, real interest rate, and short-term interest differential.

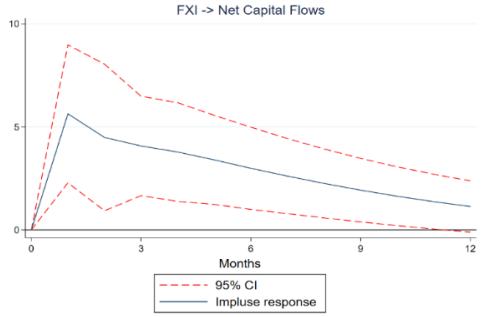
Can foreign exchange intervention stem capital outflows? FXI is often used as a policy instrument to counter capital outflow pressure when market volatility heightens, but the effectiveness of such policy measures remains a matter of significant debate. We conduct a VAR analysis with three endogenous variables (i.e., net capital outflows, US–China interest rate differentials, and changes in foreign reserves) and an exogenous variable (i.e., changes in the "VIX") to investigate the impact of FXI on capital outflows. Figure 14 reports the Granger causality test among the endogenous variables. The results show that FXI can Granger-cause net capital flows. However, rather than stemming capital outflows, capital outflows respond positively to FXI after the external shock hits (Figure 15), suggesting that FXI may have actually accelerated capital outflows. In sum, we find no evidence that FXI has helped stem capital outflows in China over the sample period.

Figure 14. FXI's Impact on China's Capital Flows: Granger Causality Test

Granger causality Wald tests				
Equation	Excluded	chi2	df	Prob>chi2
capital flow net	FXI	6.618	2	0.037
capital flow net	T	3.446	2	0.179
FXI	capital flow net	23.09	2	0
FXI	T	13.73	2	0.001
T	capital flow net	0.27	2	0.874
T	FXI	1.768	2	0.413

Note: capital flow net, FXI, and T refer to the corresponding variables for net capital outflows, FXI, and short-term interest rate differentials.

Figure 15. FXI's Impact on China's Capital Flows



Our results suggest that, over the past three decades, FXI in China has played a role in smoothing out nominal exchange rate fluctuations against external financial shocks, which may have helped alleviate market panic to a certain extent when volatility heightened. Yet it may have simultaneously caused unintended domestic macroeconomic consequences that could impair adjustments against external shocks. For example, the fact that the real exchange rate adjusts more flexibly than the nominal exchange rate suggests that limitations on the nominal exchange rate may induce greater general and asset price volatility domestically in response to external shocks. The macroeconomic consequences of FXI in China are broadly consistent with those among other countries with the active use of FXI.

Sterilization policies themselves are not without costs. Our estimations controlled for the central bank's sterilization policies, without which the impact of FXI could be even stronger. If the central bank sterilizes by issuing central bank notes, it has to bear the interest rate charges on central bank notes. If the central bank raises the reserve requirement ratio, the cost is effectively passed on to the commercial banks, which may in turn raise the lending cost to borrowers. If the commercial banks respond to the higher reserve requirement ratio by shifting businesses off their balance sheets or to the non-bank sector, they will create shadow banking businesses and increase financial stability risks. Further research is needed to empirically confirm the identified transmission channels of sterilization policies.

IV. CONCLUSION

Based on cross-country VAR analyses, we find that, although FXI is effective in mitigating nominal exchange rate fluctuations, it has limited impacts on the real exchange rate. We find that real exchange rates among intervening countries adjust more flexibly than nominal exchange rates do, suggesting that the stability of the nominal exchange rate may be achieved at the expense of greater domestic volatility. Both our cross-country analysis and a representative single-country case analysis show that in the face of external financial shocks, FXI may result in greater general and asset price volatility, which are unintended domestic consequences. China's macroeconomic responses to external shocks over the past three decades are broadly consistent with international experiences among intervening countries. The reduced-form VAR used in this paper bears methodological limitations; future research can examine the macroeconomic transmissions of FXI more structurally. Considering that the balance of payments is one of the most critical macroeconomic equilibrium relationships, there are reasons to believe that the costs of external imbalances may have been underestimated in intervening countries. A flexible exchange rate is critical in cushioning external shocks without causing unintended and potentially costly domestic consequences. Greater exchange rate flexibility could also help avoid conflicting monetary policy goals and enhance central bank credibility, which are important in ensuring greater independence in designing and implementing domestic macroeconomic policies.

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APPENDIX

The appendix presents cross-country empirical results using the novel dataset of FXI from Adler et al. (2021). The novel database compiles officially published and proxied FXI in both the spot and derivatives markets, covering the period from 2000 to 2020.

Figure A1. Cumulative Responses of FXI to an External Shock (t=6)

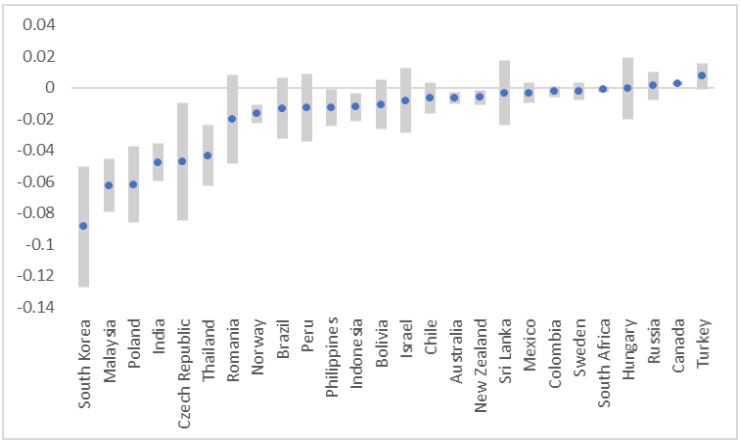

Figure A2. Responses of Foreign Reserves and Exchange Rates to External Shock

Figure A2a. FXI IRF: Interveners vs. Floaters

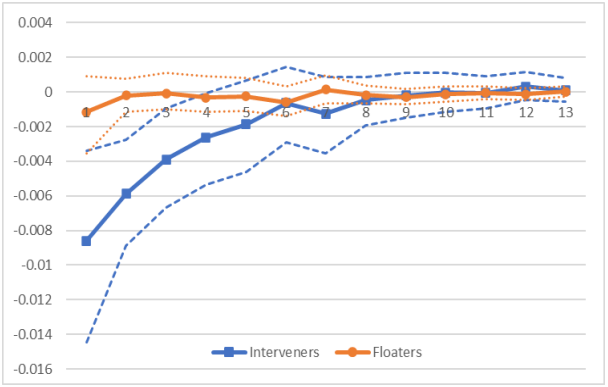

Figure A2b. Nominal Exchange Rate IRF: Interveners vs. Floaters

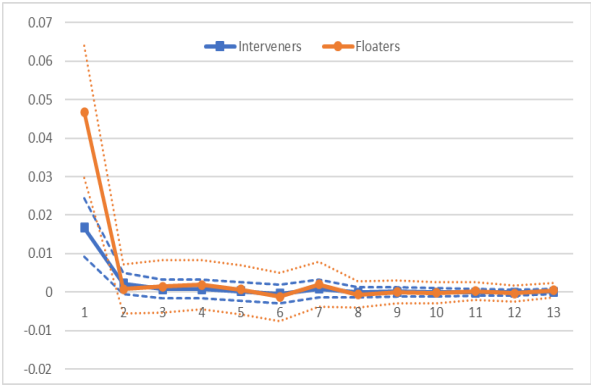

Figure A3. Responses of Real Exchange Rates

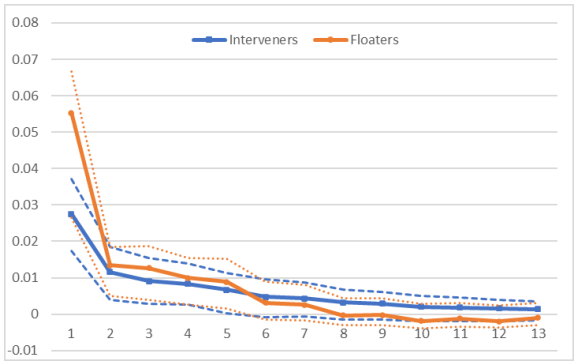

Figure A4. Response of Real Interest Rates

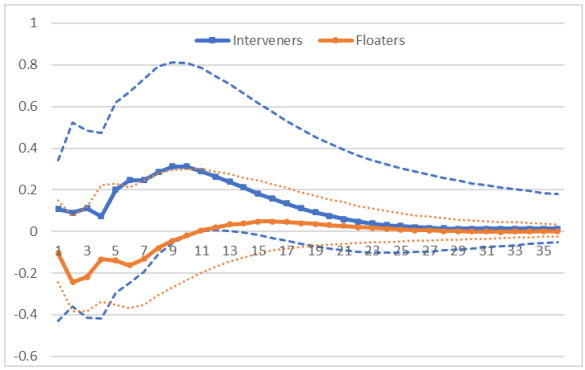

Figure A5. Response of Asset Prices

Figure A5a. Stock Price IRF: Floaters vs. Interveners

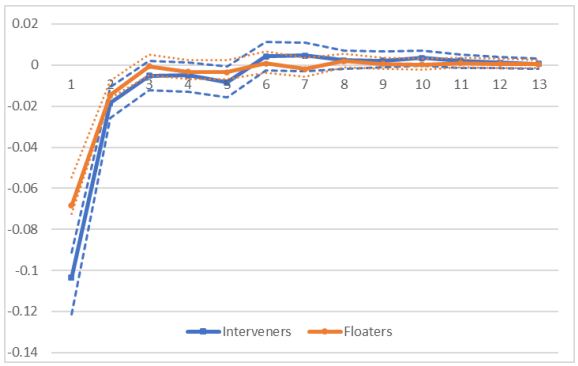

Figure A5b. Housing Price IRF: Floaters vs. Interveners