International spillovers of US unconventional monetary policy to emerging market economies

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Title: International spillovers of US unconventional monetary policy to emerging market economies

Abstract

This paper analyses whether US unconventional monetary policy (UMP) shocks contribute to the global financial and macroeconomic conditions in EMEs. Using global VAR models, we assessed the possible effects of US UMP on financial and macroeconomic conditions in EMEs and documented the credit channels through which potential spillovers occur, focusing on cross-border portfolio flows. We found that US UMP leads to an increase in bond outflows, in turn, the rise of inflows to EMEs results in a significant response by financial variables, indicating that US UMP generates sizable spillovers by financial terms in EMEs. While these results represent commonalities within a country, there is evidence of cross-country heterogeneity. The magnitude of spillovers depends on the EMEs' trade integration, exchange rate regime, and financial market development. The results of this thesis suggest that EMEs' policymakers could mitigate their financial vulnerability to US UMP by fostering flexibility of exchange rates as well as domestic financial market development, while such policy might reduce long-run growth.

Key words:

International spillovers, US unconventional monetary policy, emerging market economies, global VAR, portfolio flows, financial vulnerability

Title

International spillovers of US unconventional monetary policy

to emerging market economies

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Declaration

I declare that this thesis is a record of the original work of PhD. program carried out by myself under the supervision of Professor Rob Dixon and Doctor Zhichao Zhang at the University of Durham, United Kingdom.

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Chapter 1. Introduction

1.1 Pre-crisis FED conventional monetary policy

In the decades prior to 2008 financial crisis, the Federal Reserve's Federal Open Market Committee (FOMC) adjusted the level of interest rates to match economic conditions by changing the federal funds rate (Hogan, 2021), which is the interest rate on overnight bank borrowing and the benchmark interest rate for asset pricing. Although the influence may differ from each other, short-term interest rates are closely related. The arbitrage behaviour of financial institutions puts a particular short-term interest rate under pressure in the opposite direction when it is higher or lower, which in turn causes most short-term returns to converge (Hogan, 2021).

In addition to FFR adjustment, the Fed also adjusted the level of reserves mainly through the New York Fed buying and selling relatively small amounts of treasury bonds, known as Open Market Operations (Hummel, 2017). This is a typical practice under the traditional framework, that is, to adjust the level of reserves through open market operations and to achieve interest rate policy with scare reserves.

Moreover, the level of reserves is also adjusted by the discount rate at which commercial banks and other depository institutions could borrow from the Federal Reserve Bank in their region (Hess and Shelton, 2016). The Federal Reserve Bank offers depository institutions three discount windows: primary credit, secondary credit, and seasonal credit, each with different interest rates, but all of which are completely safe. The existence of a discount rate sets a ceiling on the lending rate within a certain range, because the Federal Reserve Bank lends at the discount rate, so no one will borrow money at an interest rate higher than the discount rate and take more risks, as shown in Figure 1.1.

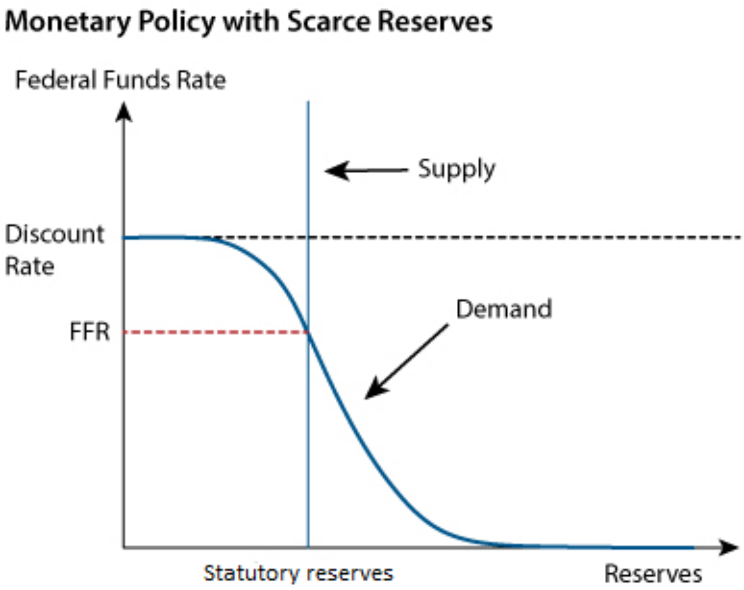


Figure 1. 1 FED monetary policy with scarce reserves

Since the Fed does not pay interest on reserves, statutory and excess reserves can be considered a hidden tax (Williamson, 2019). And banks are more willing to lend these reserves or use them for other investments to earn interest. Therefore, under the traditional framework, banks would minimize excess reserves while maintaining statutory reserves. Because reserves are relatively scarce, banks borrow in the federal funds market to ensure that they meet the requirements of the statutory reserve ratio. Thus, the reserve ratio is approximately equal to the statutory reserve ratio, and the currency multiplier is approximately equal to the reciprocal of the statutory reserve ratio.

The reduction in short-term interest rate improved the financial liquidity condition and slow down the decline of economic growth a litter bit, however, in the time of the financial crisis, they soon became ineffective (Ahmed and Zlate, 2013, 2014). This was mainly due to two aspects. On one hand, the economic shock was so powerful that short-term interest rates were quickly closed to the zero-lower bond (ZLB), making further cut in policy rates impossible. On the other hand, the transmission channel of monetary policy was seriously impaired, which made conventional monetary policy actions largely ineffective. Under these circumstances, Fed needed to reduce the short-term nominal interest rate even further than in normal conditions. Therefore, Fed had introduced unconventional monetary policy (UMP) for direct liquidity stimulation.

1.2 Post-crisis FED unconventional monetary policy

Since the outbreak of the financial crisis in 2008, the Fed had made many attempts to build an interest rate corridor system, and implied unconventional monetary policy through the interest rate corridor system (Williamson, 2019), thereby bringing the US out of the crisis.

The quantitative easing (QE) programs of Federal Reserve was one of the highly profiled examples of UMP. As the crisis erupted, Federal Reserve intervened to fix the financial markets liquidity and the economic growth by initiating large-scale asset purchase programs (Chen et al., 2016) (figure 1.2). The Federal Reserve used several rounds of QEs to get the economy back on track, which lead to a sharp growing in its balance sheet by purchasing government bonds and mortgage-backed securities (Ahmed and Zlate, 2013, 2014; Bowman et al., 2014, 2015). It was proposed that the LSAPs should be able to lower the cost of money and raise inflation expectations, thus enhancing the market liquidity and stimulating economic growth and price stabilisation.

Source from: The Federal Reserve

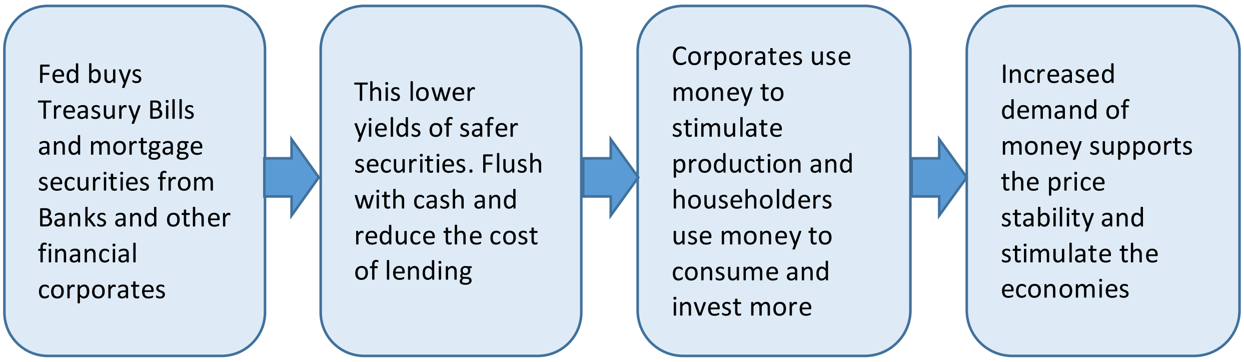


Figure 1. 2 US QE (large-scale asset purchases)

The three rounds of LSAP programs that ended in October 2014 had raised 4.5 trillion in the market. The first round QE program (QE1) started in late November 2008. The Federal Reserve announced a purchase of 600 billion in bank debt, mortgage-backed securities, and treasury notes. By March 2009, the number increased to 1.75 trillion in total, and a peak of 2.1 trillion had been reached in June 2010. By 2012, the Federal Reserve's holdings started falling natural and they kept holdings at 2.054 trillion for QE1. The second round of QE program (QE2) started between November 2010 and December 2012. The Federal Reserve planned to purchase 600 billion of treasury securities whose remaining maturity ranges from six to 30 years. In September 2012, the Federal Reserve decided to launch QE3 program, which promised to increase its holdings of open-ended bond purchasing program of agency mortgage-backed securities as well as long-term treasury securities in a speed of 40 billion per month until announcing tapering off in early 2014. And since then, the balance sheet of Fed had remained expansionary.

In times of crisis, large reserves must be injected to maintain financial market stability, and it is impossible to maintain a low inflation rate by injecting large reserves through QEs under the traditional framework (Hogan, 2021). Therefore, the Fed introduced three new tools that help better explore the effects of expansionary balance sheet without undermining the price and financial stability.

The Fed's first innovative tool is the IOR (Interest on Reserves) which was enacted by Congress in 2006 (Hess and Shelton, 2016). In response to the crisis, the Federal Reserve brought forward the IOR, originally scheduled for 2011, to October 2008 and began paying interest on statutory reserves (IORR) and excess reserves (IOER). This move effectively changes the implicit tax nature of statutory reserves (Hess and Shelton, 2016). Although the FFR is still lower than the IOER, the IOER supports the conditions for a large expansion of the Fed's balance sheet and keeps the FFR slightly above 0 to maintain the vitality of the interbank market (Hess and Shelton, 2016). This measure increased the level of excess reserves from zero before the summer of 2008 to approximately $2.7 trillion in August 2014, partially offsetting inflationary pressures from QE's large reserve injections.

Since IOER provides safe, risk-free investment options for banks holding reserves, and banks do not provide reserves to the market at interest rates lower than IOER, then IOER in fact imposes certain restrictions on FFRs (Hogan, 2021). Arbitrage plays a key role in achieving FFR targets (Hogan, 2021): if FFR is much lower than IOER, banks have an incentive to borrow in the federal funds market and deposit these reserves with the Fed, which will put upward pressure on FFR, narrowing the FFR-IOER spread. In order to implement interest rate policy, the Fed mainly adjusts the FFR to the target range set by the FOMC by adjusting the IOER. However, not every financial institution can hold reserves in the Fed. Therefore, although IOER has a somewhat limiting effect on FFR, IOER is generally higher than FFR (Hogan, 2021).

The Fed's second innovative tool is the Overnight Reverse Repurchase Agreement (ON RRP) issued in September 2014 (Hogan, 2021). When an institution uses ON RRP, it deposits excess reserves overnight and earns interest from Fed (Hogan, 2021). This is similar to the consumer buying a certificate of deposit to hold for a specified period of time and receiving interest at the time of exchange. The emergence of ON RRP sets a lower bound on interest rates (Hogan, 2021), as more financial institutions can participate in ON RRP. Financial institutions use the ON RPP rate to arbitrage other short-term interest rates (Hogan, 2021). Since ON RPP is an open, safe, and risk-free investment option for the vast majority of financial institutions, these financial institutions will not lend funds at a lower rate than the ON RRP. Therefore, the FFR will not be lower than the ON RRP rate, and the ON RRP rate provides a lower bound for FFR.

In terms of lending rates in the interest rate corridor (Williamson, 2019), the Fed continues to use the discount rate as a tool. If FFR is set in the middle of a corridor consisting of the discount rate as the upper limit and the IOER and ON RRP rates as the lower bound, then the Fed's monetary policy framework is a standard symmetrical interest rate corridor system. And after the Fed injected excess reserves through QE, the interest rate corridor system actually entered the state of a floor system (Hogan, 2021). After the crisis, the Fed set the interest rate target range, simply by adjusting the IOER and ON RRP rates, so that the market rate can reach the target range without changing the level of reserves. the interest rate corridor system ultimately helped anchor FFR around the interest rate set by the FOMC, as shown in Figure 1.3.

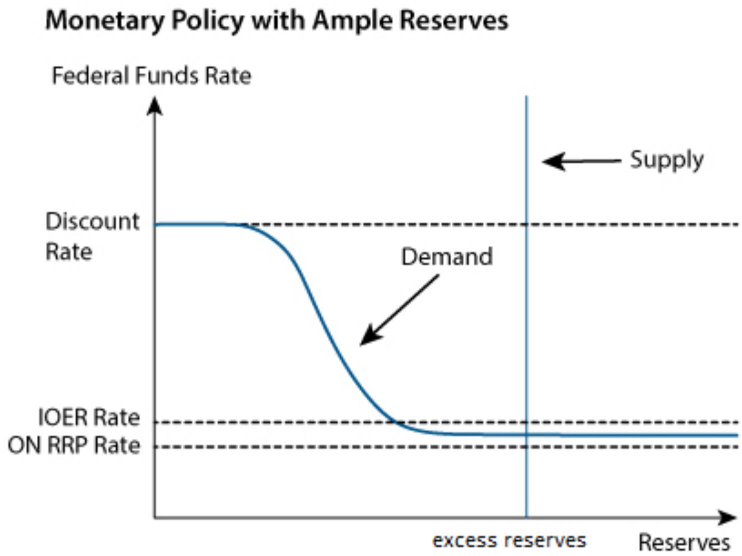
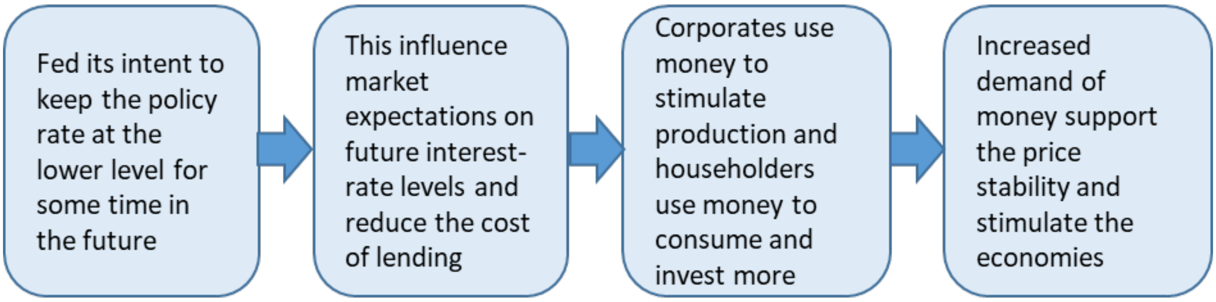


Figure 1. 3 Monetary Policy with Ample Reserves

Additionally, forward guidance (FG) announced by the Federal Reserve had been adopted as a natural complement, which was designed to influence market expectations on future interest-rate levels (Jordan and Luther, 2019). When the Federal Reserve was constrained by the zero lower bound in its capacity to reduce the short-term rate, FG (Figure 1.4) became a way to communicate its intention to keep the policy rate at the current level for some time in the future. Thus, FG implies a willingness to tolerate higher future inflation even at a low short term interest rate. Importantly, it is expected that FG would help better explore the effects of balance sheet expansion without undermining the price and financial stability.



Source from: The Federal Reserve

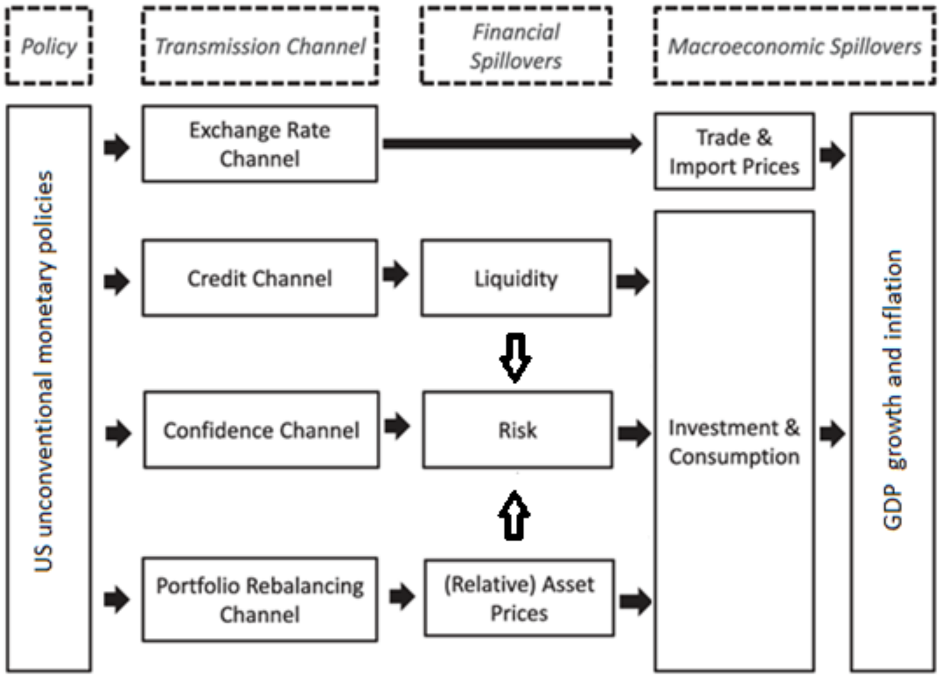
Figure 1. 4 Forward Guidance (FG)

1.3 Monetary policy transmission mechanism

The domestic effects of UMP transfer much through the same channels as the conventional policy domestically (Ahmed and Zlate, 2013; Figure 1.5). In times of crisis, large reserves have been injected to maintain financial market stability, so the inflation rate raised as a result of an increasing in money supply under the traditional framework. As stated by fisher effect theory (Eq 1), the real interest rate equals the nominal interest rate minus the expected inflation rate. Therefore, FED could actually lower real interest rates which are the combined result of rising inflation and constant nominal interest rates (Hogan, 2021). And lower real interest rates encourage investors to take more risks and bring the yields on assets down to match the short-term interest rate (Hogan, 2021). However, in a long-term view, as the spreads among assets decrease, investors will be seeking for riskier assets and eventually shift investment abroad (Hogan, 2021).

$$i_r \approx i_n - \pi \qquad \text{Eq. 1}$$

where i_r stands for real interest rate, i_n is the nominal interest rate and π states for inflation



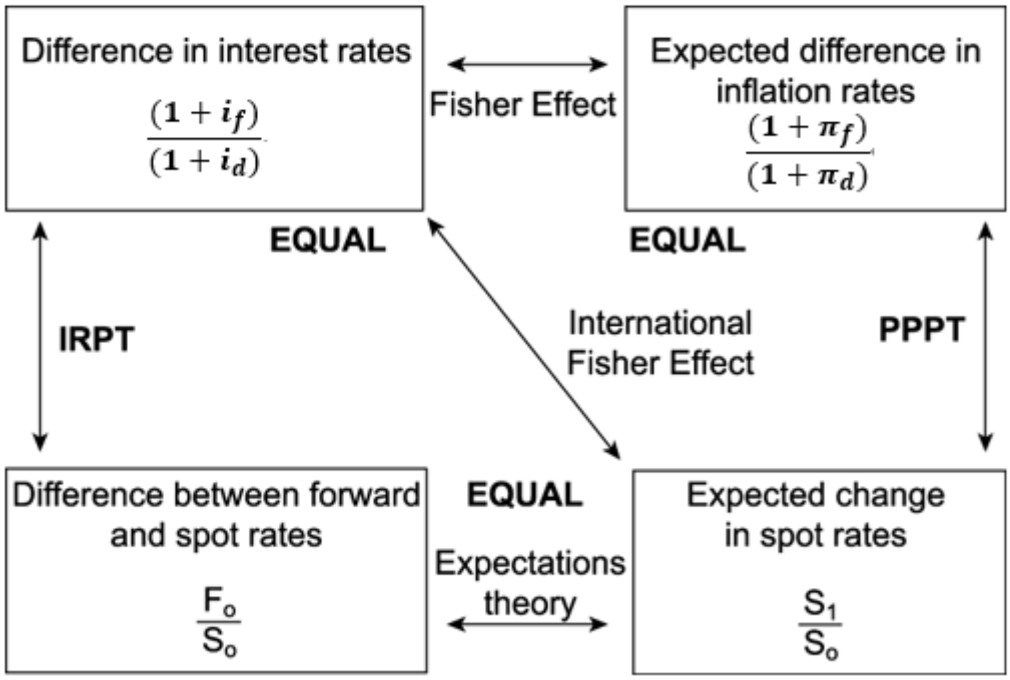
Source from: Ahmed and Zlate, 2013

Figure 1. 5 monetary policy transmission mechanism

Similarly, central banks of major advanced countries also adopted unconventional monetary policy to escape from a low interest rates trap and a depreciation of exchange rate to keep financial system alive (Punz and Chantapacdepong, 2019). As indicated by international fisher effects and purchase power parity theory (Figure1.6), the long-term change in exchange rate is rough the difference between two inflation expectations when real interest rates were close to ZLB (Punz and Chantapacdepong, 2019; Eq.2). This increased amount of inflation difference should cause the currency in the country with a higher interest rate to depreciate against a country with lower interest rates in a long-term view.

$$S_1 - S_0 \approx i_f - i_d \approx \pi_f - \pi_d \qquad \text{Eq. 2}$$

where S_1 stands for expected exchange rate, S_0 stands for spot exchange rate, i_f is the foreign nominal interest rate, i_d is the domestic nominal interest rate, π_f is the expected foreign inflation rate and π_d is the expected domestic inflation rate.



Source from: Punz and Chantapacdepong, 2019.

Figure 1. 6 monetary policy transmission theories

In contrast, the international spillovers to Emerging Market Economies (EMEs) appear to be more complex (Bowman et al., 2015), and that is why EMEs concerned more vulnerable in terms of increasing in interest rate risk, inflation risk and exchange rate risk (Bowman et al., 2015).

In a short-term view, the increasing in interest rate differentials between US and EMEs encouraged vulnerable capital flows to EMEs, seeking for higher returns (Bernanke, 2017). Meanwhile, the Gross Domestic Product (GDP) of EMEs increases duo to the increasing exports demand which makes aggregate demand outpacing the growth of the supply, and thus leading to increases the output gap and inflation (Bowman et al., 2015). The result is that the nominal interest rates have suffered an upward pressure due to the rise of inflation rates in a short run (Bowman et al., 2015), causing interest rate risk as indicated by fisher effect theory (Gagnon et al., 2011; Eq.3). At the meantime, the rise in inflation leads to the depreciation of EMEs' currency and reduce the long-term growth, according to the purchasing power parity theory (Rogers et al., 2014, 2018; Eq.4).

$F_1 - S_0 \approx i_f - i_d$ Eq. 3

$S_1 - S_0 \approx \pi_f - \pi_d$ Eq. 4

Where F_1 stands for forward exchange rate, S_1 stands for expected exchange rate, S_0 stands for spot exchange rate, i_f is the foreign nominal interest rate, i_d is the domestic nominal interest rate, π_f is the expected foreign inflation rate and π_d is the expected domestic inflation rate.

1.4 Key contributions

Although, the spillover effects of US UMP to EMEs have been intensively studied, the findings have been found highly heterogeneous across EMEs which underscore the debate on the determinants and consequences of cross-border capital flows (Ouerk, 2023). Some believe, this heterogeneity should be explained by differences in the strength of transmission channels (Lim, Mohapatra, and Stocker, 2014). While others think variation in shock identifying process (Bowman, Londoño, and Sapriza, 2014, 2015) and EMEs' domestic powers should be reasons for heterogeneity (Fischer, 2015; Gagnon et al., 2017). We contribute to this debate by, firstly, assessing the effects of US UMP on cross-board portfolio flows and the role of portfolio flows in the transmission of US UMP to EMEs. We also contribute to this debate by assessing the effects of US UMP on financial and macroeconomic factors to EMEs in a Global VAR model. And finally, we contribute to this debate by testing the domestic factors which may be the determinants of international spillovers as a supplement to Global VAR study.

This thesis is related to and contributes to pervious literature in three aspects. Firstly, this thesis is related to literature investigating the effects of US monetary policy shocks on other countries' equity and bond markets, capital flows, and exchange rates, typically using high frequency data based bilateral model methods (Ahmed and Zlate, 2013, 2014; Beirne and Fratzscher, 2013; Fratzscher et al., 2014; Manova, 2013; Rogers et al., 2014). Although this literature (Ahmed and Zlate, 2013, 2014; Gurkaynak and Wright, 2011; Fratzscher et al., 2016) argued that portfolio flows from US to EMEs is the main channel through which UMP shocks transferred, this literature provides limited evidence to policymakers regarding move of real capital flows. Since most of the results are based on the analysis on regression among various yields curve, exchange rate changes, and UMP announcements, this literature only captures the near-term effects. Moreover, literature (such as Ahmed and Zlate, 2013, 2014; Gurkaynak and Wright, 2011; Fratzscher et al., 2016) investigating the international spillovers from US UMP is mostly based on the bilateral models which do not account for the multilateral nature of interdependency, thus offers limited evidence to policymakers who were seeking advice for policy makings in response to US UMP in a global perspective.

In contrast, in chapter 3, we study whether the portfolio flows are driven significantly by US UMP through a dynamic panel data (DPD) analysis. While dynamic panel data (DPD) analysis allows us capturing the near-term effects, we can study the long-term effects through lagged terms. Moreover, we advanced research by investigating the role of portfolio flows in US UMP shocks transmission and the interaction between financial and macroeconomic variables through a multilateral Global VAR model.

Secondly, inspired by the improvement and integration in the globalized standards of databases collection, a variety of indicators have been used to measure the international spillovers of US UMP at high frequency (Fratzscher et al., 2013; Lim et al., 2014; Dahlhaus and Vasishtha, 2014; Bowman et al., 2015; Fratzscher et al., 2016). They identify various interest rates indicators for US UMP and examine the financial spillovers from US to foreign interest rates (Lim et al., 2014; Dahlhaus and Vasishtha, 2014). While interest rates play an important role in the transmission of US UMP shocks, subjects at low frequency such as gross domestic production growth and inflation are variables of interest to policymakers who need to setup macro-policies. Chen (et al., 2016) and Ouerk (2023) do count for multilateral nature and identify various UMP shocks to interest rate and exchange rate along with GDP growth and inflation with Global VAR model, but fail to investigate the interdependency among several countries.

In contrast, in chapter 4, we take into account the interaction between financial and macroeconomic variables through a multilateral Global VAR model. And We also try to explore whether different ways of UMP shock identifications that related with portoflio inflows have different impacts on financial and macroeconomic factors and whether the co-movements exist between countries.

Finally, this thesis adds to the quickly expanding literature on implement of Global VAR models on modelling international spillovers to EMEs (Chudik and Fratzscher, 2011; Favero, 2013; Konstantakis and Michaelides, 2014; Konstantakis et al, 2015; Georgiadis, 2015). While the Global VAR model do account for modelling interdependent among economics, they provided limited evidence in explaining the international spillovers of US UMP as most of them focus on conventional monetary policy. Exceptions are Chen et al. (2016) and Anaya et al. (2017), they studied the spillovers though a Global VAR model that includes a huge variety of macroeconomic variables and US unconventional monetary policy indicators, and the international spillovers are explained through various interpretation of impulse response functions. However, they provided limited access to heterogeneities of international spillovers.

In contrast, in chapter 5, we follow Georgiadis (2015), Chen et al. (2016) and Anaya et al. (2017) to measure international spillovers of US UMP by GDP output and policy rate to EMEs while try to figure out some determinants of the heterogeneities through standard panel data analysis.

1.5 Structure of thesis and key findings

The rest of this thesis are organized as follows. In chapter 2, we discuss the recent development in modelling macroeconomic interdependencies. We mainly focus on the introduction of the global vector auto regression (GVAR) model. Chapter 2 consists of several parts, including how could the GVAR model solve the curse of dimensionality issue and cross-sectional dynamic heterogeneities, GVAR in global financial and macroeconomic applications, general model specifications and the essential tests for a stable GVAR estimations.

In chapter 3, we contribute to the debate of international spillovers of US UMP shocks by assessing the effects of US UMP on bilateral portfolio flows and the role of portfolio flows in the transmission of US UMP shocks to financial and macroeconomic conditions in EMEs. Our approach consists of two hypotheses in accordance with a logical sequence. Only if the first hypothesis is tested valid, we will continue testing the second hypothesis. First hypothesis: US UMP impact portfolio outflows from US, and in turn, portfolio inflows to EMEs. Second hypothesis: US UMP impact the financial and macroeconomic conditions of EMEs via portfolio inflows.

The key findings of this chapter are: We firstly find that both portfolio flows and bond flows toward EMEs appear to be significantly driven by US UMP while we find no evidence that the equity inflows to EMEs are driven by US UMP. Moreover, we find that the expansionary monetary policy of US has a negative effect on portfolio and bond inflows to EMEs in short-term while a positive sign is indicated by lagged terms in our DPD models. These are in line with the theory, lowers real interest rates do encourage investors to take more risks and bring the yield on assets down to match the short-term interest rate (Hogan, 2021). While, in a long-term view, as the spreads among assets decrease, investors will be seeking for riskier assets and eventually shift investment abroad (Hogan, 2021). Secondly, in our GVAR model, we find that US UMP which leading to an increase in bond outflows, in turn, the rise of bond inflows to EMEs results in a significant response by financial variables, proving that US UMP is a key driver of the financial and macroeconomic conditions in EMEs (Ouerk, 2023). While there is evidence of cross-country heterogeneity, these results represent general common trends especially in the case of bond inflows. We find similar shapes between the individual impulse response plot in EMEs. Which might be explained as US UMP contribute to the raise of the global financial cycle (Dées and Galesi, 2021; Inoue and Okimoto, 2022).

In Chapter 4, we rely on the estimation of GVAR framework, trying to explore the macroeconomic interdependencies and cross-sectional heterogeneities among EMEs. Our results show that, firstly, consistent with previous studies (Bowman et al., 2014; Bowman et al., 2015; Jordan, 2016; Fratzscher et al., 2016; Chen et al., 2016; Georgios, 2016; Garratt, Lee and Shields, 2016), it is clear that US UMP measures tend to have a greater impact on global financial conditions in EMEs. Because US UMP leads to an increase in bond outflows, in turn, the rise of inflows to EMEs, and results in a significant response by financial variables (Hallam, 2022). Secondly, the impulse response results show that US corporate spread shocks have greater domestic effects than domestic term spread shocks. That is purchasing US treasuries to lower the term spread may be a weak tool and reducing risk premium by allowing indirect liquidity for bank section generates much more effects persuading GDP growth as well as a short-term appreciation of domestic currency (Inoue and Okimoto, 2022). While, for EMEs, there are no significant difference between two shocks. Finally, although GDP responses have been diversified among EMEs, we do find an expected co-movement between exchange rate responses, monetary policy and inflations (Punz and Chantapacdepong, 2019) which may partly explain the divergence in financial structure as well as optimal objectives of central bank in responses of output growth, inflation growth, exchange rate stability and credit growth (Inoue and Okimoto, 2022).

In chapter 5, we conduct a discussion on the determinants of international spillovers of US unconventional monetary policy on emerging market economies. Taking advantage of panel model, we regress the point estimations of impulse responses of EMEs' monetary policy and GDP from GVAR on a variety of country specific factors. And we figure out that exchange rate liberalization and trade openness are important determinates for EMEs to effectively control the external shocks from US unconventional monetary policy.

In chapter 6, we provide an overall summary of the thesis. In this final chapter, research findings scattered in earlier chapters are brought together to give an integral picture of the whole thesis. Limitations of the present research and possible avenues for future research are also suggested.

Chapter 2 The global vector auto regression (GVAR) framework

2.1 Recent development in modelling country interdependencies on macro-level

Over the past decade, there has been considerable improvement and integration in the globalized standards of databases collection, eg. IMF, BIS, OECD and substantial efforts to create detailed and comparable data in macro-level. This allows empirical studies to model low frequency macro-level data of EMEs into a panel dimension which were previously hardly achieved due to the data omission (Koop and Korobilis, 2016).

Along with the increasing data availability, there has also been a significant change in the interdependencies among regions and countries (Inoue and Okimoto, 2022). Terms like 'globalization' and 'regionalization' have become part of discussions. As a result, economies can barely be treated independently. In fact, domestic shocks can quickly spread across borders, and international spillovers are detected with substantial heterogeneities. The issue of globalization with persistent heterogeneities is of interest for policymakers who are willing to understand and monitor both domestic and foreign responses, to study how foreign or global shocks are transmitted, to understand the potential sources of heterogeneities and to provide policymakers with valuable advice (Inoue and Okimoto, 2022).

Panel VARs seem to be particularly suitable in addressing 'globalization' issues in macroeconomics level for small open economies (SOE). Panel VARs can capture dynamic interdependencies between two countries, to easily incorporate time variations in the coefficients and in the variance of the shocks, and to account for cross-sectional dynamic heterogeneities (Fratzscher et al., 2016; Chudik and Pesaran, 2016). Panel VARs are built with the same logic of standard VARs. However, by adding a cross-sectional dimension, they are a much more powerful tool to address interesting policy questions such as the transmission of monetary shocks to EMEs. And panel VARs can be used to explain the interdependencies issues that do not require specification of the entire structure of the economy (Fratzscher et al., 2016; Chudik and Pesaran, 2016).

2.2 Relation between Panel VARs and Global Vector Auto Regressions (Global VARs)

While, panel VARs may become inconsistent under two circumstances (Chudik and Pesaran, 2016). One is that the large samples involving in panel VARs typically makes the curse of dimensionality an issue. The common feature of this problem is that panel VARs may lack of freedom where either the time dimension of the panel is short or too many parameters are estimated simultaneously. Therefore, most panel VAR studies based on large numbers of samples, limited numbers of variables or typically high frequency data. Moreover, the cross-sectional heterogeneity and series correlations in long-term may lead to inconsistent estimation across units (Koop and Korobilis, 2016). When the time dimensionality increases, the available data become sparse because of rapid increase in the volume of the sampling space. To solve these dimensionality issues, the Global VAR presents some shrinkage approaches without compromising too much on the structure and on the ability to address interesting economic questions (Chudik and Pesaran, 2016).

Pesaran (Chudik and Pesaran, 2010) introduces the estimation for Global VAR (p, q) model as a two-step procedure. In the first step, small-scale country-specific models are estimated conditional on the rest of the observations. These individual country models are represented as VARX models which consist with both domestic variables, weighted cross-section averages of foreign variables and global factors. This approach solves the curse of dimensionality issue by tearing the blocks down and estimates as many parameters as possible in a single country-specific model. As both the parameters and weighting matrix are already known, it allows the maximize number of variables that could integrated into the Global VAR system. Moreover, to remedy autocorrelation issue, Chudik and Pesaran (2010) impose the error correction approach by exploring cointegration relationship among variables in the VARX model thus limits the series correlation for individual models as well as the whole system.

And most importantly, instead of putting a symmetric restriction in panel VARs, there is a great flexibility in variable selection and interdependency construction for Global VAR model. The Global VAR model considers three ways of modelling interdependency among countries (Chudik and Pesaran, 2016). Firstly, one of the key assumptions of the Global VAR modelling approach is the weak exogeneity assumption. The basic idea of weak exogeneity assumptions is that by conditioning the country-specific models on weakly exogenous current and lagging values of foreign variables, it is considerable to capture the degree of correlation on the system wide shocks across countries. These residual interdependencies could provide evidence for identifying monetary policy spillovers of the controlled section to other blocs. The average pairwise cross-section correlations for the levels and first differences of the endogenous variables of the model, as well as those of the associated residuals over the selected estimation period could be used to explain the effectiveness of cross-section correlation of the domestic variables to their foreign counterparts in the Global VAR model

(Chudik and Pesaran, 2016). Secondly, the variables of each country may affect by common global exogenous variables such as oil prices and volatility index, allowing to capture the global common shock, such as business cycle shock and global financial shock (Chudik and Smith, 2013). Furthermore, by including these global variables endogenously in at least one of the country-specific models, we can identify the spillover effects of specific domestic shocks to the global block (Chudik and Smith, 2013). Finally, the interdependency is reflected in the Global VAR's error covariance matrix. This allows the i^{th} country being affected by the current shock received by thej^{th} country and being able to capture the degree of correlation on the endogenous shocks of specific countries system widely. Thanks to the Global VAR MATLAB toolbox developed by Smith and Galesi (2014), we can conduct our Global VAR estimations in a simple yet effective interface and enjoy various flexibility with the built-in programs.

2.3 GVAR applications: up-to-date

GVAR was first proposed for studies aftermath of Asia financial crisis to quantify the losses of major financial institutions on macroeconomic level, but soon extended to other applications on international transmission of various shocks and global financial studies (Chudik and Pesaran, 2016). There have been numerous applications of the GVAR modelling that are related with our study, including the modelling of credit risk with a global perspective (Ouerk, 2023; Dées and Galesi, 2021) and the modelling of various shocks from US and European Central Bank (ECB)'s monetary policy on global macroeconomic (Hallam, 2022; Inoue and Okimoto, 2022). Some of the latest literature provides useful recommends for our research.

Firstly, the complex global network would lead to biased results. As indicated in Dées and Galesi (2021), macro-financial spillovers by US monetary policy shocks could be reinforced by the complex network of interactions across countries, and the result were roughly double the direct impacts of US monetary policy shocks in shaping the Global Financial Cycle. It's obvious that the real spillovers of US monetary policy shocks are misconducted (Dées and Galesi, 2021). And this is the very reason why we decided to include only US and EMEs in the GVAR model. We want to reduce the potential impacts of the monetary policy of other major countries which may lead to biased results.

Secondly, focusing on cross-border portfolio flows would most likely yield useful results. Recent studies (Ouerk, 2023; Inoue and Okimoto, 2022; and Dées and Galesi, 2021) find that the rise of inflows to EMEs results in a significant response by financial variables, proving that cross-border portfolio flows is an important channel through with UMP shocks of major economies were transferred to the financial conditions in EMEs. And we contribute to this debate by assessing the effects of US UMP on bilateral portfolio flows and the role of portfolio flows in the transmission of US UMP to financial and macroeconomic conditions in EMEs.

And finally, global variable must be used as endogenous variable of US, otherwise the spillovers of US monetary policy to EMEs will be weakened, and thus conducting incorrect results. As shown in Hallam (2022), the US policy rate shock does not have the expected contractionary effect, as this is partially taken over by the global financial risk shock which is modelled as exogenous variable of US in the GVAR model. And they suggested that EMEs became more sensitive to global financial shocks over time. Be aware of this, we decided to treat VIX as an endogenous variable of US while as a global variable for EMEs.

2.4 GVAR model specification: generalized process

2.4.1. Construction of foreign variable matrix

Since the Global VAR model system is too large, coefficients can hardly be estimated simultaneously in one uniformed system for a certain sample length. Therefore, a flexible method is used for analysis without compromising too much on the panel VARs structure. Considering $N+1$ economies, indexed by i = 0, 1, 2, . . ., N, the vectors of country-specific variables and foreign variables can be presented as Eq.5,

$$x_t = (x'_{0t}, x'_{1t}, \dots, x'_{Nt})' \qquad \text{Eq. 5}$$

For the i^{th} economy, the country-specific variable vector x_{it} contains $k_i \times 1$ domestic variables. Stacking the vectors of country-specific variables, a VAR model of x_t ($k \times 1$ matrix) obviously would contain ways too many parameters to be estimable. Rather than simultaneously letting foreign variables enter the set of equations for country i, the Global VAR model allows a new vector (x_{it}^*) serving the role of foreign counterpart variables in individual country-specific VECMX (p_i^*, q_i^*) model, where x_{it} and x_{it}^* are related by a weighting matrix $\overline{W_i}$ ($k_i^* \times k$) shown below (Eq.6). The number of foreign variables does not necessary as same as the domestic ones.

$$x_{it}^* = \overline{W_i} * x_t \qquad \text{Eq. 6}$$

The weighting matrix $\overline{W}$ that links x_{it} and x_{it}^* can be typically constructed using either real intra-country data or pre-determinate weights (eg. the share of country j in the trade of country$i$). The weighting matrix are computed in various ways since it serves as a proxy for the unobserved correlations between domestic and foreign variables. The weighting matrix is subject to the following restrictions (Eq.7).

$$x^*_{lit} = \sum_{j=0}^{N} \omega_{lij}\, x_{ljt}, \qquad l = 1,2,\dots,k^*_i$$

$\sum_{j=0}^{N} \omega_{lij} = 1$, (Real data generated case) Eq. 7

For illustration propose, we consider a simple model of three countries with a weighting matrix represented for the share of country j in the trade of country i. The domestic and foreign variable vectors could contain, for example, the following variables (Eq.8):

$$x_t = \begin{pmatrix} y_{0t} \\ p_{0t} \\ y_{1t} \\ p_{1t} \\ y_{2t} \\ p_{2t} \end{pmatrix} \qquad x^*_t = \begin{pmatrix} y^*_{0t} \\ p^*_{0t} \\ y^*_{1t} \\ p^*_{1t} \\ y^*_{2t} \\ p^*_{2t} \end{pmatrix}$$

Eq. 8

Where x_{it} and x^*_{it} are linked by a stacking weight matric $\overline{w}_i(k^*_i \times k)$, (Eq.9)

$$\overline{W} = \begin{pmatrix} \overline{w}_0 \\ \overline{w}_1 \\ \overline{w}_2 \end{pmatrix} = \begin{pmatrix} 0 & 0 & w_{01} & 0 & w_{02} & 0 \\ 0 & 0 & 0 & w_{01} & 0 & w_{02} \\ w_{10} & 0 & 0 & 0 & w_{12} & 0 \\ 0 & w_{10} & 0 & 0 & 0 & w_{12} \\ w_{20} & 0 & w_{21} & 0 & 0 & 0 \\ 0 & w_{20} & 0 & w_{21} & 0 & 0 \end{pmatrix}$$

$$where\ \ w_{01} + w_{02} = 1 \qquad w_{10} + w_{12} = 1 \qquad w_{20} + w_{21} = 1$$ Eq. 9

And here blow (Eq.10) is an example how the foreign variable y^*_{it} (the counterpart) is constructed.

$y_{0t}^{*} = w_{01}y_{1t} + w_{02}y_{2t}$ $\qquad$ $y_{1t}^{*} = w_{11}y_{0t} + w_{12}y_{2t}$ $\qquad$ $y_{2t}^{*} = w_{20}y_{0t} + w_{21}y_{1t}$

Eq. 10

2.4.2 Construction of individual country specific VARX

The individual country specific VARX (p_i^*,q_i^*) model can be structured as Eq.11, allowing for points estimation of the international transmission mechanisms.

$$x_{it} = a_{i0} + a_{i1} * t + \sum_{s=1}^{p_i} \Phi_{is} x_{i\,t-s} + \sum_{s=1}^{q_i} \Lambda_{is} x_{it-s}^{*} + \sum_{s=0}^{r_i} \gamma_{is} d_{t-s} + \varepsilon_{it} \qquad \text{Eq. 11}$$

where $d_{t-s}$is the observed global factors ($r\times1$), and $\varepsilon_{it}^{iid} \sim (0, \sum_i)$.

As is standard in time-series analysis a_{i1} are restricted whenever the possibility of common trend being present in the model considered. The foreign variables need to fulfil weak exogeneity assumption that the domestic variables are affected by current and lagging values of foreign variables while the domestic variables are not capable to explain the exogeneities. It is considerable to capture the degree of correlation of the system, thus reflecting corresponding interdependency between the domestic and foreign counterparts.

Moreover, considering real data usually are not integrated at $I(0)$ process and has series autocorrelation, the individual country-specific VARX (p_i^*,q_i^*) model may be rewritten in error-correction representation as Eq.12 if cointegration relations do exist.

$$\Delta x_{it} = a_{i0} + a_{i1} * t + \prod * \tilde{z}_{i\,t-1} + \sum_{s=1}^{p_{i-1}} \Psi_{is} \Delta z_{i\,t-s} + \Gamma_i * \Delta x_{it}^{*} + \sum_{s=0}^{r_{i-1}} \gamma_{is} \Delta d_{t-s} + \varepsilon_{it}$$

Eq. 12

where $z_{it} = (x'_{it}\ \ x^{*\prime}_{it})'$, $\tilde{z}_{it} = (x'_{it}\ \ x^{*\prime}_{it}\ \ d_t')'$, and x^*_{it} and d_t serve the role as the long-run forcing for x_{it}.

Testing for the number of co-integrating relations is conducted using Johansen's trace and maximum eigenvalue test statistics as set out in Chudlk and Pesaran (2016) for models with weakly exogenous $I(1)$ regressors. identifying the number of co-integrating vectors is important since misspecification of the rank for the co-integrating space can have a severe impact on the performance of the GVAR model, with adverse implications for stability, persistence profiles, and impulse responses. Once the number of co-integrating vectors is determined, it is possible to proceed with the identification of long-run structural relations and, if desired, to impose over-identifying (signal) restrictions in further. These restrictions can then be tested using the log-likelihood ratio test statistics for structure stability and persistence profiles.

The error-correction properties of the model for country i are determined by $\boldsymbol{\Pi}_i$ (Eq.13), where the vector can be decomposed as $\boldsymbol{\Pi}_i = \boldsymbol{\alpha}_i * \boldsymbol{\beta}_i$. $\boldsymbol{\alpha}_i$ is a matrix measuring the speeds-of-adjustment to equilibrium, and $\boldsymbol{\beta}_i$ is a matrix of long-run coefficient for capturing the degree of correlation of the system though the decomposition is not unique.

$$\boldsymbol{\Pi}_i = (I_{k_i} - \boldsymbol{\Phi}_{i1}, -\boldsymbol{\Lambda}_{i0} - \boldsymbol{\Lambda}_{i1}, -\boldsymbol{\gamma}_{i0} - \boldsymbol{\gamma}_{i1}) \qquad \text{Eq. 13}$$

The VECMX can be estimated for each economy with the ordinary least squares (OLS) or rank reduced approach. And the solution can be used as is usually demonstrated within standard two-country VAR model.

2.4.3 Solve the Global VAR

In the second step, individual country VARX models are stacked and estimated simultaneously as Global VAR model through $z_{it} = (x'_{it} \ \ x^{*}_{it}{}')'$(Chudik and Pesaran, 2016). For example, the Global VAR (1,1) model is presented as Eq. 14:

$$A_i z_{it} = a_{i0} + a_{i1} * t + B_i * z_{i\,t-1} + \sum_{s=0}^{r_i} \boldsymbol{\gamma}_{is} d_{t-s} + \varepsilon_{it} \qquad \text{Eq. 14}$$

Where

$A_i = (I_{k_i}, -\boldsymbol{\Lambda}_{i0})$ and $B_i = (\boldsymbol{\Phi}_{i1}, \boldsymbol{\Lambda}_{i1})$ both size are $k_{\,i} \times (k_{\,i} + k_i^*)$

The structural aggregation weighting matrix W_i $(k_{\,i} + k_i^*) \times k_{\,i}$)which links individual country-specific model with the global one can be readily seen (Eq.15). W_i are the stacked version of individual weighting matrix $\overline{w}_i$ and identity matrix.

$$z_{it} = (x_{it}, x_{it}^*) = \begin{pmatrix} \mathbf{1} \times x_{it} \\ \overline{w}_i \times x_{it} \end{pmatrix} = (\mathbf{1}, \overline{w}_i) x_{it} = \ W_i x_{it} \qquad \text{Eq. 15}$$

Thus, stacking across all VARX equations, the resultant stacked system may be rewritten as Eq.16, where $G_i = A_i W_i$ and $H_i = B_i W_i$.

$$G * x_t = a_{i0} + a_{i1} * t + H * x_{t-1} + \sum_{s=0}^{r_i} \boldsymbol{\gamma}_{is} d_{t-s} + \varepsilon_t \qquad \text{Eq. 16}$$

In general, the matrix G is expected to be of full rank $(k \times k)$ and therefore can be restructured as Eq.17, by multiply inverse matrix G^{-1} on both side, which is the solution of standard

Global VAR model. It is important that the overall number of cointegrating relationships in the Global VAR model cannot exceed the total number of long-run relations in the underlying country-specific models, otherwise individual country-specific models cannot be consistently estimated.

$$x_t = G^{-1} * a_{i0} + G^{-1} * a_{i1} * t + G^{-1} * H * x_{t-1} + G^{-1} * \sum_{s=0}^{r_i} \boldsymbol{\gamma}_{is} d_{t-s} + G^{-1} * \varepsilon_t \quad \text{Eq. 17}$$

2.5 Essential tests

To ensure the stability of the Global VAR system, several tests are carrying out. As even the individual country-specific model is stable, there might be possible that the Global VAR model has at least one eigenvalue that lies above the unit circle in the presence of unit roots, and lead to inconsistent estimation.

So firstly, we carry out unit root tests for domestic, foreign, and global variables. The augmented Dickey–Fuller (ADF) and the weighted-symmetric Dickey–Fuller (WSDF) unit root tests should be conducted for all variables. The two tests produce broadly similar results. If most of the variables are integrated at $\mathrm{I}(1)$ process, we can conduct test Trace and Johansen max eigenvalue test, identifying potential cointegration relations in individual models.

Moreover, we m test weak exogeneity condition as it was the key assumption obtaining a stable Global VAR system. The ideally condition are that all external variables are weak exogenous variables, that is, they will have long-term effects on other variables in the model while domestic variables in the model have no long-term feedback on them. To further examine the cointegration space is indeed the $I(0)$ space, and we carry out persistence profiles for a shock response test on the cointegration relationship. If the impulse response function after applying system shock is soon close to zero, we know the cointegration relations and the system are stable. It should be highlighted that the Global VAR model performs the above statistical tests on all countries or regions included otherwise the further process, such as generalized impulse response function (GIRFs), orthogonalized impulse response function (OIRFs) and forecast error variance decomposition (FEVD), cannot provide consistent and effective estimations.

Moreover, the cross-sectional heterogeneity and series correlations may lead to inconsistent estimation across units. When the time dimensionality increases, the available data become sparse because of rapid increase in the volume of the sampling space. We conduct series correlations test conditional on null hypothesis that there are no series correlations in the residuals. Moreover, overidentify signal restriction upon certain variables are important in Global VAR model as it not only determinate the shocks identification and substantial transmission channel, but also related with the error-correction properties. Thus, different signal restrictions with specific assumptions may have great impact on the heterogeneity responses of EMEs to US UMP.

Chapter 3 International spillovers of US unconventional monetary policy to emerging market economies: The role of portfolio inflow

3.1 Introduction

Recent studies (Kim and Shin, 2021; Ge and Zhang, 2022) point out that the offshore bond issuance has become a key transmission channel of global financial conditions to EMEs. Because more emerging country bonds entered international markets, and the cumulative inflows into mutual funds dedicated to EME bonds rose at a dramatic rate aftermath 2008. Meanwhile, gross bond inflows from US to EMEs continue to rise and reach about 247.04 billion in mid-2018, about three times of pre-crisis level.

While cumulative inflows into mutual funds facilitate the absorption of large and volatile capital flows, EMEs can still be vulnerable to US monetary policy as large amounts of debt are US dollar denominated (Ahmed and Zlate, 2013, 2014; Punz and Chantapacdepong, 2019). Moreover, as argued in Gurkaynak and Wright (2011) and Fratzscher et al. (2016), portfolio flows from US to EMEs is the main channel through which UMP shocks transferred, especially the portfolio rebalance part. They share the commons that the US UMP had shift investors' preference to investment opportunities in EMEs. And this raised issues, such as the large portfolio inflows, currency appreciation pressure, and deflation pressures on emerging economies, especially the ones whose currencies are pegged to the dollar (Gurkaynak and Wright, 2011; Fratzscher et al., 2016).

Moreover, empirical analysis of the tapering episode of US UMP (Dahlhaus and Vasishtha, 2014; Anaya et al., 2017), in which the adjustment of expectations of a normalization of UMP could have substantial repercussions for portfolio inflows to EMEs. However, this literature (Dahlhaus and Vasishtha, 2014; Anaya et al., 2017) provides weak evidence that portfolio inflows to EMEs is the main channel through which UMP shocks transferred. Because most of the results are based on the analysis on interest rate transmission among various yields curve, exchange rate changes, interest rate indicators, and announcements rather than the changes in portfolio inflows. Although interest rates play an important role in the transmission of US unconventional monetary policy shocks, policymakers are more willing to focus on the responses of real activity and inflation that could give macro-policy advice (Anaya et al., 2017).

Furthermore, this literature examines international spillovers from US UMP to EMEs through either high-frequency data on fund flows or international portfolio flows as measured in the balance of payments (BoP) and yields different results (Hummel, 2017). It is thus no surprise that the magnitude and dynamic behavior between two data sources differs significantly as they are conceptually different from international portfolio flows and are subject to various sampling issues. And most importantly, this literature investigates the international spillovers from US UMP via the bilateral models which do not account for the multilateral nature of interdependency, thus offers limited evidence to policymakers (Anaya et al., 2017).

We contribute to this debate by assessing the effects of US UMP on bilateral portfolio flows and the role of portfolio flows in the transmission of US UMP to financial and macroeconomic conditions in EMEs. Our approach consists of two hypotheses in accordance with a logical sequence. Only if the first hypothesis is tested valid, we will continue testing the second hypothesis. First hypothesis: US UMP impact portfolio outflows from US and, in turn, portfolio inflows to EMEs. Second hypothesis: US UMP impact the financial and macroeconomic conditions of EMEs via portfolio flows.

We employ quarter data from 2008Q3 to 2018Q2 as the quick rose of EMEs bond inflows can be tracked back to Global Finance Crisis (GFC) period. The portfolio inflows data are estimated based on Federal Reserves' Treasury International Portfolio Reporting System (TIC). We track the monthly transaction data (SLT survey) back to 1970s and cumulate the amount within which 32 missing points are omitted for Saudi Arabia. The cumulation of transactions scaled by receiver's GDP are used as gross portfolio inflows and gross bond inflows from US to EMEs, respectively. Other databases we rely on are Federal Reserve Bank of St. Louis database, Bank for International Settlements (BIS), the International Financial Statistics (IFS) and the Organisation for Economic Co-operation and Development (OECD).

The key findings of this chapter are: We firstly find that both portfolio flows and bond flows toward EMEs appear to be significantly driven by US unconventional monetary policy while we find no evidence that the equity inflows to EMEs are driven by US UMP. Moreover, we find that the expansionary monetary policy of US has a negative effect on portfolio and bond inflows to EMEs in short-term while a positive sign is indicated by lagged terms in our DPD models. These are in line with the theory, lowers real interest rates do encourage investors to take more risks and bring the yield on assets down to match the short-term interest rate in the short term (Hogan, 2021). While, in a long-term view, as the spreads among assets decrease, investors will be seeking for riskier assets and eventually shift investment abroad (Hogan, 2021). Secondly, in our GVAR model, we find that US UMP which leading to an increase in bond outflows, in turn, the rise of bond inflows to EMEs results in a significant response by financial variables, proving that US UMP is a key driver of the financial and macroeconomic conditions in EMEs. While there is evidence of cross-country heterogeneity, these results represent general common trends especially in the case of bond inflows. We find similar shapes between the individual impulse response plot. Which might be explained as US UMP contribute to the raise of the global financial cycle in Ouerk (2023), Dées and Galesi (2021) and Inoue and Okimoto (2022).

The rest of this study is structured as follows: Section 3.2 provides the literatures related to this study. Section 3.3 presents the empirical model used. Section 3.4 and 3.5 attempts to quantify the relative importance of portfolio flows in transferring US UMP shocks and other determinants that stimulate portfolio flows toward EMEs. And 3.6 provided a summary of the key findings.

3.2 Literature reviews

Previous literature identifies few main channels through which US UMP affects economic activity and prices in helping explain the high vulnerability of portfolio flows to EMEs. This related strand of literature (Chen et al., 2014, Fratzscher, 2012; Fratzscher et al., 2012; Fratzscher et al., 2013; Ahmed and Zlate, 2013, 2014; Georgiadis, 2015; Anaya et al., 2017) finds that changes in US UMP can transfer through credit and portfolio rebalance channels because of vulnerability arising in financial markets and most notably bond purchases. This may have large international spillover effects on various yield spreads between US and EMEs (Ahmed and Zlate, 2013, 2014; Kiendrebeogo, 2016). Because of a greater deepening of global financial integration in EMEs as well as the increasing interest rate differentials between US and EMEs, US investors shift the portfolio flows to EMEs, seeking for higher returns, and therefore causing international issues, such as 'hot money' and global inflation pressures (Gagnon et al., 2011; Rogers et al., 2014, 2018; Chen et al., 2014).

Ahmed and Zlate (2013, 2014) examine the effects of US UMP on net private capital inflows to emerging market economies since 2002. They find positive effects of US UMP to EMEs inflows, especially portfolio inflows. While net private capital inflows are mainly affected by the global risk appetite, GDP growth rate and interest rate differentials between emerging market economies and advanced economies are also statistically and economically important determinants. Ahmed and Zlate (2013, 2014) also find significant changes in the investment behaviour of net capital inflows from the period before the global financial crisis to the post-crisis period. Great increasing in portfolio inflows partly explained by the greater sensitivity of such flows to interest rate differentials since the crisis.

Fratzscher et al. (2013) find portfolio flows are affected positively by UMP shocks since 2007. They exam the unconventional monetary policy effects in boosting bond and equity prices, particularly in yields of government bonds. Similarly, Cho and Rhee (2013) show the portfolio fluctuation is driven by portfolio rebalancing as investors seek for higher yields and risk diversification. And they also show that the heterogenous responses may related with tighter monetary controls which have been introduced by several EMEs in recent years, such as exchange rate control and foreign reserve controls in China and Brazil. While these capital control have a dampening impact on total portfolio inflows, controls upon 'hot money' are less efficient for EMEs to avoid excessive volatility and negative spillovers (Cho and Rhee, 2013).

Moreover, recent studies figure out that the US UMP can influence real interest rates through the confidence channel or so call 'news' (Bauer and Rudebusch, 2013, 2014; Bauer and Neely, 2014; Georgiadis, 2015). For instance, after the financial crisis, Federal Reserve induce the public to expect a higher price level in the future while they keep the real interest rate at a lower level for a long time. Since long-term rates are prima facie averages of expected short-term rates, the expectation channel would tend to flatten entire yield curve when policymakers commit to put real interest rate at zero-lower bound (Bauer and Neely, 2014). This may lead to capital outflow toward EMEs where the yield is higher. While, as the short-term rate at the zero-lower bound for long enough, it also prevent inflation expectations from falling, which would otherwise raise real interest rates and attract capitals back to US (Bauer and Neely, 2014).

Additionally, another most obvious channel in transferring monetary shocks is the exchange rate channel. The exchange rate depreciates in EMEs who have generally adopt tighten monetary policy to defend the value of their currencies under lifted inflation. As the financial conditions are in general better than US, EMEs could attract more investment abroad seeking for higher risks and returns and thus lead to inflation pressure. EMEs lower the value of their currencies in order to maintain competitive advantage in international trade and of helping economies to moderate external shocks (Georgiadis, 2015; Fratzsche, et al, 2012; Fratzscher et al, 2014; Fratzscher et al, 2016). But, another explanation for this finding suggests that the flexible exchange rate depreciating in line with the US dollar in response to a monetary policy easing would probably lead to a capital flow reversal in long-term if the gains from home currency depreciation are relatively small to the loses (Georgiadis, 2015; Fratzscher et al, 2016). Moreover, Fratzscher et al (2016) find the moving of capital follow reflect the need of portfolio reallocation as well as the evaluate of risk premia in financial market through the direct impact in driving the capital moves are little. And countries with more independence on monetary policy were less affected by the UMP shocks.

Overall, these transmission channels have intensively discussed in literature underline the role of US UMP in explaining the movement in portfolio inflows in EMEs. Taking advantage of analysing the high-frequency dataset, this literature finds that a large raise in portfolio inflows in EMEs are driven by interest rate shocks in US (Lim, Mohapatra, and Stocker, 2014) as well as changes to global liquidity and risk aversion both during the crisis and in the recovery (Fratzscher et al, 2016). However, this literature considers total capital flows instead of bilateral inflows with very few exceptions such as Fratzscher et al (2016). Therefore, failing to identify and separate the effects of US UMP shocks from the global ones.

Moreover, these effects have been highly heterogeneous across countries, with a large part of this heterogeneity being explained by differences in the strength of transmission channels. Lim, Mohapatra, and Stocker (2014) conducted comprehensive research exploring different responses of EMEs capital inflows on UMP through three transmission channels, namely credit, portfolio balancing, and confidence channels, through which the effects of US UMP on gross portfolio flows transfer to EMEs. They find that US UMP seem to result in sharp rising in prices of bond and equity markets domestically and globally, with some variation across markets. Moreover, portfolio flows tend to be more sensitive than FDI to relevant shocks measured, but only a small response has been found on net portfolio flows to US UMP shocks (Lim, Mohapatra, and Stocker, 2014).

The limits of this literature are that the evidence response variously to the different measures of portfolio flows used in the literature. This distinction is important because the drivers may differ crucially depending on the specific concepts and data that are analysed. For example, portfolio inflows to EMEs' market by non-residents and outward investment by the residents may double counted in different data standards. The type of portfolio flows also vary across components, like portfolio flows, FDI, equity flows, bond flows and banking flows (Fratzscher et al 2013; Bertaut and Judson, 2014; Kiendrebeogo, 2016; Anaya et al., 2017). Other factors, such as difference among institutional factors, and indicators used approx. for US UMP shocks may also lead to different results (Ahmed and Zlate, 2013, 2014; Fratzscher et al., 2016).

These issues have been intensively discussed in cross-country VAR frameworks in exploring the determinants of international portfolio flows (Fratzscher et al., 2013; Lim et al., 2014; Dahlhaus and Vasishtha, 2014; Bowman et al., 2015; Fratzscher et al., 2016). This literature discusses the explanatory power of various UMP shocks as the key driver for portfolio flows to EMEs. For example, Dahlhaus and Vasishtha (2014) examined the potential impact of US UMP shocks on portfolio inflows to 23 EMEs with the 'policy normalization shock' by the yield spreads of various US long-term bonds as well as the expectations of monetary policy. The result showed that while US UMP have substantial effects in driving portfolio flows to EMEs, the impact of US UMP on portfolio flows volume as a share of GDP is small comparing to previous studies such as Fratzscher et al. (2013) and Lim et al. (2014).

Similarly, Lombardi and Zhu (2014, 2018) proposed a new "shadow policy rate" as US UMP indicator for the simulation. And the result indicated that while the shadow policy rate tracks the real effective federal funds rate (FEER) very closely, the shadow policy rate has greater impact on portfolio inflows to EMEs than FEER. Moreover, Gambacorta et al. (2014) use the size of the Federal Reserve balance sheet as US monetary policy indicator. The UMP shock in portfolio flow channel is identified through a mixture of zero and sign restrictions, and result supports that portfolio flow is one of the main channels through which the international spillovers of US UMP shocks transferred to EMEs.

However, this literature provides limited evidence as them are based on bilateral regression among various yields curve, exchange rate changes, and QE announcements instead of real portfolio flows. Exceptions are Ahmed and Zlate (2013, 2014) who are focus on the relation between US UMP and real portfolio flows. The main findings in Ahmed and Zlate (2013, 2014) support that interest rate differentials between EMEs and US are important drivers of net private capital inflows which are greater sensitive to interest rate differentials since the crisis. Moreover, they create a dummy variable for QEs and find positive effects of QE announcements on EME portfolio flows. However, their study has clearly limitation as these inflows are computed from quarterly balance-of-payments data instead of bilateral inflows, thus failing to identify and separate the effects of US UMP from the global ones. Similarly, in Bruno and Shin (2015), US UMP are believed to be one of several important factors influencing portfolio inflows to EMEs.

The issues of Ahmed and Zlate (2013, 2014) is partially solved in Kiendrebeogo (2016). Kiendrebeogo (2016) empirically investigates the impact of US unconventional monetary policy on bilateral portfolio outflows to 98 developing economies and non-UMP advanced economies from 2007 to 2012. Bilateral inflows data are calculated from the Treasury International Portfolio Reporting System (TIC) of Federal Reserve. The combination of transaction data and US international portfolio investment survey data allow Kiendrebeogo (2016) to separate the effects of US UMP from the global ones by various types of bilateral portfolio outflows. The key finding is that US unconventional monetary policy are associated with increased net portfolio flows to developing countries as suggested in Ahmed and Zlate (2013, 2014). Furthermore, Kiendrebeogo (2016) implies a dummy for the event of QE tapering off, and the result shows that US unconventional monetary policy is likely to cause an inflow reversal between US from EMEs. However, Ahmed and Zlate (2013, 2014) and Kiendrebeogo (2016) only able to capture the near-term effect of US unconventional monetary policy on portfolio flows. And most importantly, like other literature who conduct a bilateral model study, they do not account for the multilateral nature of interdependency thus fail to investigate the role of portfolio flows in transmission UMP shocks.

In contrast, this study is related and contributes to literature of the spillover effects of US UMP in two aspects. I contribute to this literature by assessing the effects of US UMP on bilateral portfolio flows and the role of portfolio flows in the transmission of US UMP to financial and macroeconomic conditions in EMEs. Our approach consists of two hypotheses in accordance with a logical sequence. Only if the first hypothesis is tested valid, I will continue testing the second hypothesis.

First hypothesis: US UMP impact portfolio outflows from US and, in turn, portfolio inflows to EMEs.

Second hypothesis: US UMP impact the financial and macroeconomic conditions of EMEs via portfolio flows.

3.3. Methodology

3.3.1 Specification of individual country specific models

Though EMEs were affected by the US unconventional monetary policy in several ways, the volatile portfolio inflows play a key role in explaining the spillover effects related. The portfolio inflows not only created great pressure on foreign exchange rate (Gagnon, Raskin, Remache, Sack, 2011; Rogers et al., 2014; Chen et al., 2016) but also resulted in greater uncertainty in financial market conditions.

In this study, we use global vector autoregressive model (global VAR) to estimate the impact of US unconventional monetary policy to EMEs through portfolio flows and investigating the role of portfolio flows in explaining the spillover effects related. The specification of the country special model is presented as Eq.18:

$$x_{it} = a_{i0} + a_{i1} * t + \sum_{s=1}^{p_i} \mathbf{\Phi}_{is} x_{i\,t-s} + \sum_{s=0}^{q_i} \mathbf{\Lambda}_{is} x^{*}_{i\,t-s} + \sum_{s=0}^{r_i} \boldsymbol{\gamma}_{is} d_{t-s} + \varepsilon_{it}$$ Eq. 18

Where x_{it} contains short-term rate and gross portfolio inflows to EMEs. They are the variables of interest for our research questions. Following Georgiadis (2015), we also include the potentially non-stationary level variables real GDP and effective exchange rate in logarithm form in all models. Using logarithm form for real GDP and real effective exchange rate ensures scale stability of the model across all different specifications. The foreign counterparts of EMEs contains GDP growth, effective exchange rate and policy rate that are linked by specific weighting matrix. The weighting matrix used is fixed and calculated from intra-trade data (Appendix Table 3A.1).

We use Federal Reserve balance sheet as a suitable and consistent instrument to measure US unconventional monetary policy shocks stance over QE periods and aftermath (2008Q3 to 2018Q2) for two reasons. On the one hand the expansionary of balance sheet of the Federal Reserve was directly connected with QEs that immediately provided credit to intermediaries and key markets. On the other hand, the size of balance sheet is consistent over QE periods and aftermath. Therefore, by using the Federal Reserve balance sheet as the monetary policy component for US bloc, we can easily identify the unconventional monetary policy shocks through the change size of balance sheet.

While measuring the change of the balance sheet size captures exogenous innovations to international spillovers of US UMP, it also reflects the endogenous reaction of the Fed to financial market liquidity condition domestically. To identify an UMP shock through balance sheet and to distinguish one from risk averse channel, we add an exogenous variable, the volatility index (VIX), to the non-US model to capture financial market uncertainty across countries. While the VIX is treated as endogenous in the US model, which captures the reaction of financial channel to the unconventional monetary policy. And we also include portfolio outflows as share of GDP in the US model, capturing the potential effect of US unconventional monetary policy on portfolio outflows to EMEs. And we use GDP growth as the only foreign variable that affects the US block. We also put US as the first block in the Global VAR, as this ensures the weak exogenous condition of US to EMEs.

In sum, the following definition of endogenous and foreign variables is used for the GVAR model:

$$x_{US,t} = (GDP, EER, BALANCE\ SHEET, gross\ bond\ outflows, VIX)$$

$$x_{US,t}{}^{*} = (GDP)$$

$$x_{EMEs,t} = (GDP, EER, mp, gross\ bond\ inflows)$$

$$x_{EMEs,t}{}^{*} = (GDP, EER, mp)$$

$$d_{EMEs,t}{}^{*} = (VIX)$$

Where GDP=gross domestic product, EER=real effective exchange rate, mp=short-term interest rate, and VIX= CBOE volatility index

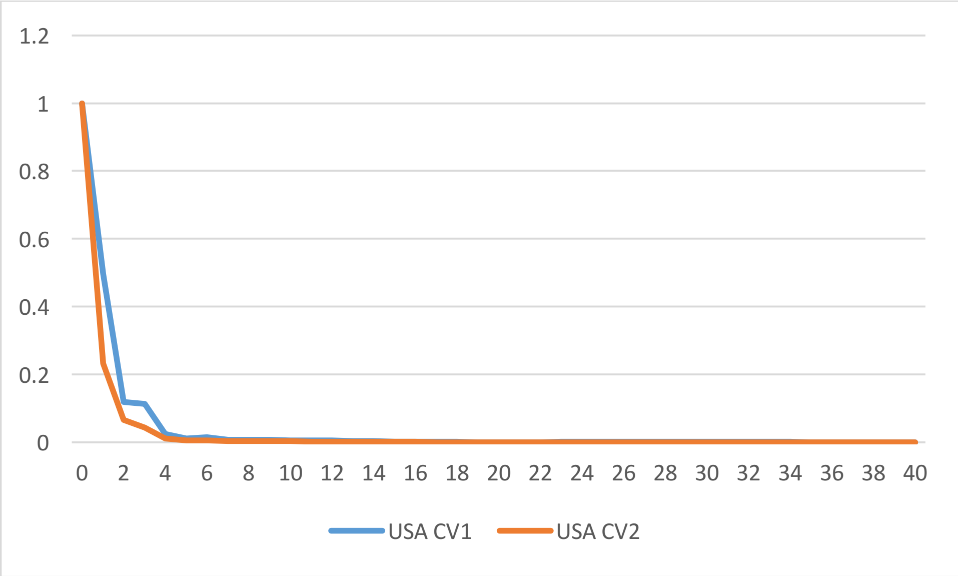
We conduct the augmented Dickey-Fuller (ADF) and the weighted-symmetric Dickey-Fuller (WSDF) unit root tests for all model variables. The two tests produce broadly similar results. At the 5 percent significance level, the unit root test shows most variables are integrated at

$I(1)$ process (Appendix Table 3A.2; 3A.3; 3A.4). This is important for identifying potential co-integration relations between domestic variables and foreign variables as error correction term, and this could improve long-term consistency (Appendix Table 3.5; 3.6). Given the natural of time series, adding additional restrictions are important for estimations of the long-run UMP shocks to reduce serial correlation and overidentification. We also conduct the serial correlation test and weak exogeneity test. The results are significant at 5% level. To identify UMP shocks through portfolio rebalancing channel, we put a positive sign for balance sheet as US UMP do enlarge the size of balance sheet while negative sign is imposed on VIX which reflect the attitude of increasing global risk averse affected by unconventional monetary policy (Table 3.1).

Table 3. 1 Overidentify restrictions

	GDP	EER	Balance sheet	VIX
UMP shocks			**>0**	**$\leq$0**

To ensure the stability of Global VAR model, we conduct eigenvalue stability test. All the eigenvalues reported are within or on unit cycle which means the individual models and Global VAR model we estimated are all stable. Moreover, we imply persistence profile (PP) test, capturing the effect of system-wide shocks to the cointegrating relations, and the result confirm that both cointegrating relations of US and other models are stable (Figure 3.1). Therefore, the models are ready to conduct general impulse response functions (GIRFs). This technic is mainly used to identify the proportion of the unanticipated changes of an endogenous variable that can be attributed to innovations in the variable itself and to other variables in the system.



Source from GVAR estimation

Figure 3 1 Persistence Profile for US

We also conduct simulations for US UMP indicators other than balance sheet, unfortunately, we cannot ensure that both bond and portfolio models are stable at the same time. Therefore, reports for other indicators are omitted.

3.3.2 Data

Data of gross portfolio flows are taken from the Treasury International Portfolio Reporting System (TIC). The TIC provides detailed records for monthly transactions in long-term securities between U.S. and foreign residents. The Federal funds rate is taken from Federal Reserve Bank of St. Louis Fred database. And data of non-US policy rate (short term interest rate) is taken from Bank for International Settlements. Other variables are collected from the International Financial Statistic (IFS), the World Development Indicator (WDI) and World Economic Outlook (WEO) database. The originally records of monthly data is converted to quarterly form by taking average value over 3 months to match the real GDP data which is available in quarterly form. The data set consists of quarterly data covering the period from 2008Q3 to 2018Q2 for ten emerging market economies of G20 group who are members of the diagnostic framework for development and efficiency of local currency bond markets. The selection of these 10 countries is mainly based on that these countries represent large proportion of the gross world product, as well as world trade, which highlight their importance in a global system. The country and variable list is shown in table 3.2 and table 3.3.

Table 3. 2 Variables included in the model, 2008Q3-2018Q2

Dependent Variables	**Definition**	**Source**
Gross bond flows	gross bond inflows from US to non-US countries, scaled by nominal GDP	The Treasury International Portfolio Reporting System (TIC).
Portfolio flows	Gross inflows from US to non-US countries, scaled by nominal GDP	The Treasury International Portfolio Reporting System (TIC).
Independent Variables	**Definition**	**Source**
Gross Domestic Product	ln(GDP/CPI)	Quarterly GDP, OECD (=2010 fixed USD); Data for China(=2015 Fixed USD) is from datastream
Effective Exchange Rate	Real effective exchange rate in logarithm form	Bank for International Settlements

Monetary policy indicator	Short term policy rates in percentage point	Bank for International Settlements
unconventional monetary indicators		
Balance sheet	Total Reserve Balances Maintained with Federal Reserve Banks	Federal Reserve Bank of St. Louis Fred database
MSA-FFR corporate spread	Moody's Seasoned Aaa Corporate Bond Yield minus Federal effective funds rate	Federal Reserve Bank of St. Louis Fred database
Term spreads	10-year bond rate minus FEFR	Federal Reserve Bank of St. Louis Fred database
Federal effective funds rate	Three-month effective Federal funds rate	Federal Reserve Bank of St. Louis Fred database
Wu-Xia shadow Federal Funds Rate	Estimation from December 16, 2008, to December 15, 2015	Federal Reserve Bank of Atlanta

Table 3. 3 Country Groups

Country Group	
Dominated	US
Non-BRICs emerging countries	Indonesia, Mexico, Argentina, Turkey, and Saudi Arabia.

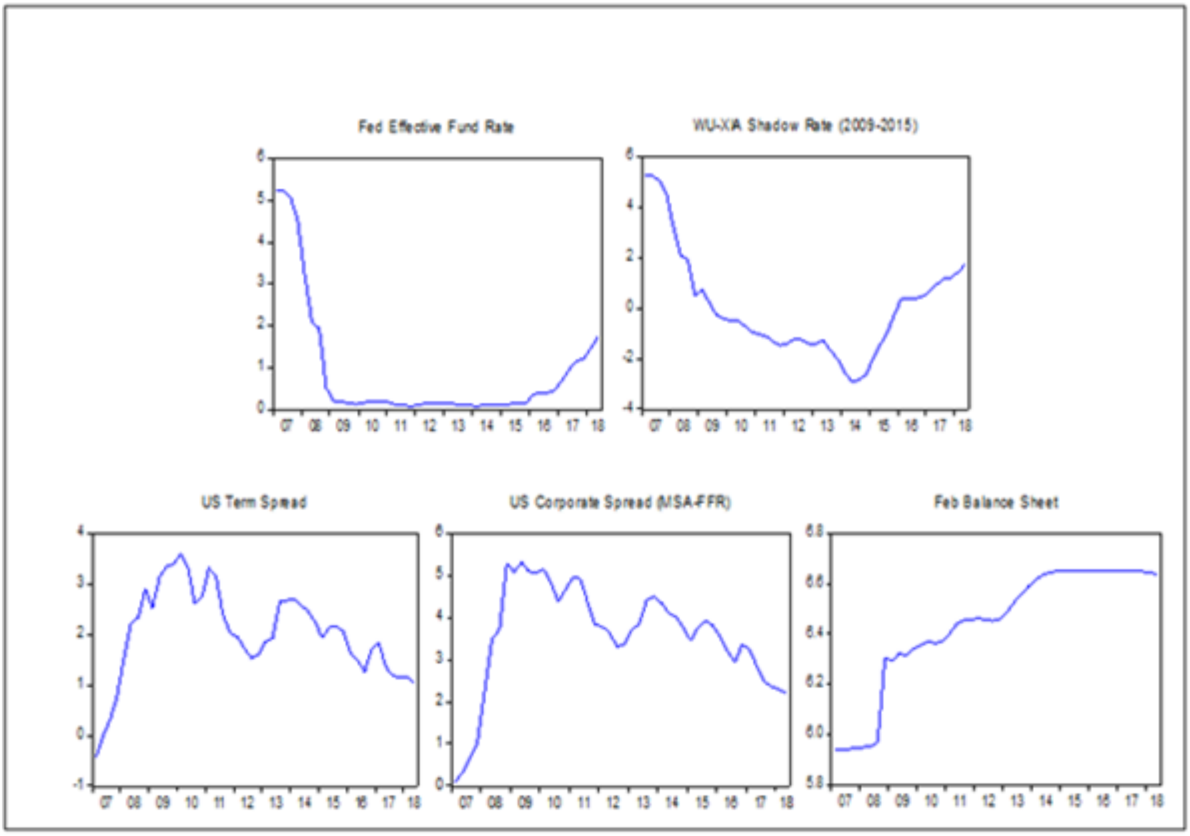
3.3.3 US unconventional monetary policy measurements

In general, US UMP aim at directly targeting the cost and availability of external finance to market, thus improving the position of financial liquidity (Ehrmann and Fratzscher, 2009). These sources of finance can be in the form of large asset purchase program with a clear expansionary on central bank balance sheet. Since the cost of external finance is generally at a premium over the short-term interest rate, large asset purchase program tends to reduce the spreads between various maturities of external finance, thus raising asset prices and inflation in the economy (Neely, 2010). The US UMP generate profound impact on the spreads between various forms of external finance in two ways: one from direct easing and the other from credit easing (Wongswan, 2009).

The idea of direct easing monetary policy is straightforward that the Federal Reserve expends its balance sheet by directly purchasing of long-term government bond in the relevant markets (Neely, 2010). As reduction in supply of long-term government bond, the price of bond increases and the yield to maturity reduces, thus reduce the return spread between long-term treasury bills and short-term treasury bills (Fratzscher et al., 2014). Because the interest rate of long-term government bonds serves as a risk-free rate for pricing other riskier assets, the yield spreads for other assets decline in parallel. Meanwhile, as long-term interest rates fall, this would create additional credit for householders, hence stimulate portfolio rebalance, short-term investments, and price stability (Beirne and Fratzscher, 2013; Manova, 2013; Rogers et al., 2014).

While direct credit easing is the policy that directly addresses liquidity problem and affect profit spreads in certain financial market through the purchase of commercial paper and asset-backed securities (Gagnon et al., 2011). When relative returns on assets become lower, investors seek opportunities elsewhere, shifting the portfolio flows to other assets such as corporate bonds and equities and therefore increasing their prices as well (Rogers et al., 2014; Chen et al., 2016). And Curdia and Woodford (2011) find that both conventional and unconventional monetary policy is likely to be ineffective when financial markets are sufficiently disrupted. They conduct analysis on an extension standard New Keynesian model regarding both unconventional monetary policies alongside normal interest rate policy, and they find that expansion on balance sheet by large asset purchases program of Fed has greater impact on financial market than interest rates.

While the size of the balance sheet is a suitable instrument to measure the unconventional monetary policy (Gambacorta, Hofmann, and Peersman, 2014; and Anaya, Hachula, and Offermanns, 2017), several measures have been proposed in the previous studies (Figure 3.2). Wu and Xia (2015) estimated the shadow rate with a latent factor extracted from a large panel of monetary and financial quantities. Moreover, Chen et al. (2014) and Chen et al. (2016) identified UMP shocks through yield spreads between long-term and shot-term securities such as treasury bills and corporate bonds. All these indicators have been used as approx. measurements for US UMP.

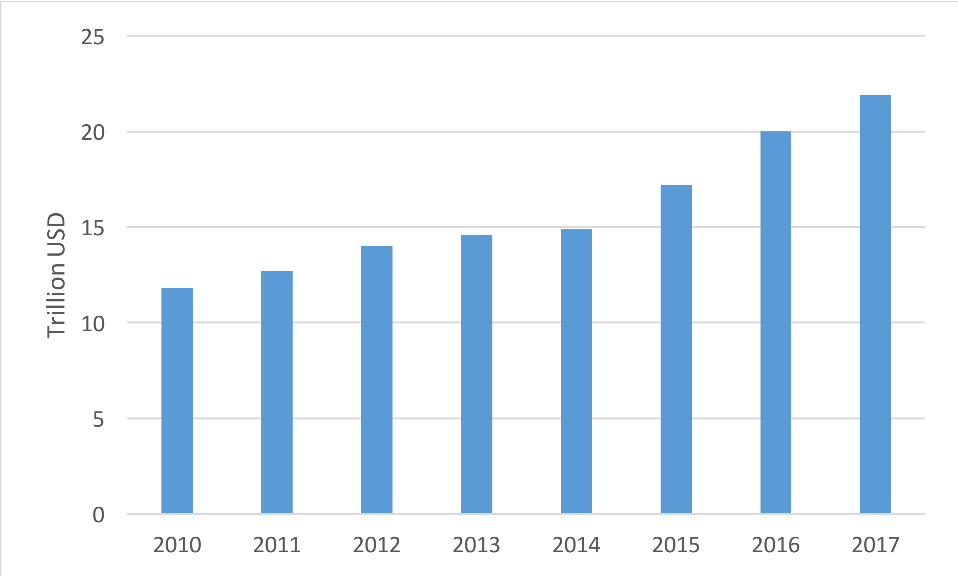


Source: Federal Reserve St. Louis Database. All scales are percentage except for Feb balance sheet series which are calculated in its logarithms.

Figure 3 2 US unconventional monetary policy indicators

3.3.4 Portfolio investments from US to EMEs

Global portfolio investments have seen large changes since the onset of the global financial crisis in 2008. The total value of these EMEs bonds securities count for more than 80% of global bond securities, rising from more than 10 trillion USD in 2010 to 21.9 trillion USD in 2017 (Figure.3.3). And the trend continues as the EMEs keep relying on external capital flows for financing and GDP simulation. As mentioned by IMF, the EMEs bond market growth continues among which most are dominated by BRICs. On one hand, it can be explained as the profit seeking theory. A combination of higher yield and greater supply dominated the process, attracting investors abroad. On the other hand, as the cost of capital is relatively higher domestically as a result of higher price, EMEs prefer to gain money abroad through quick expansion of bond markets.



Source: IMF 2018 staff note for the G20 IFAWG

Figure 3 3 Local Currency Bond Markets of EMEs

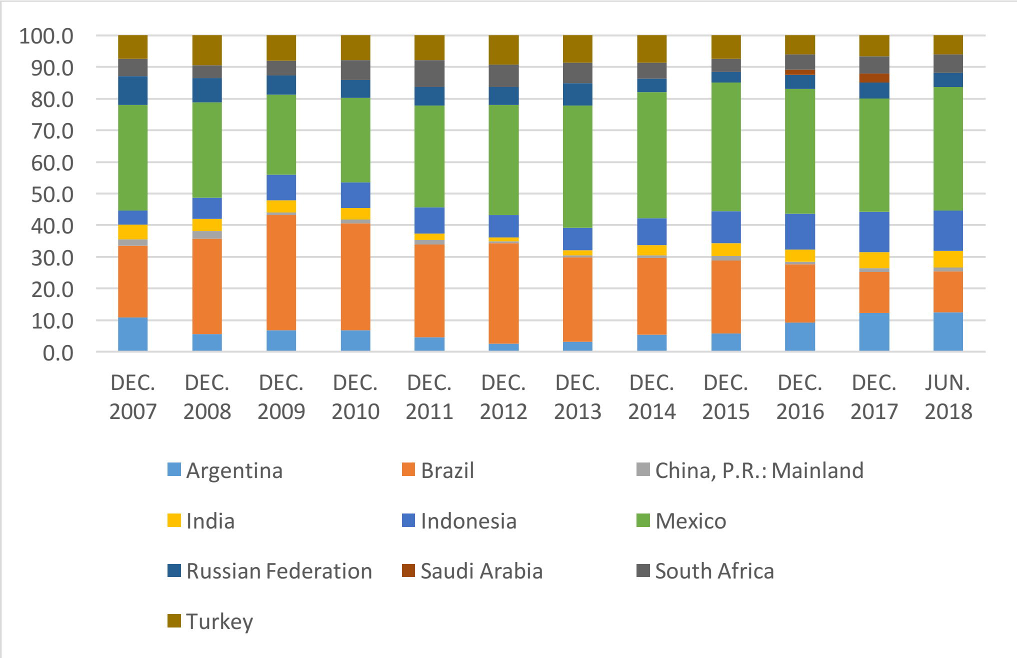
Additionally, gross portfolio inflows from US to EMEs increase considerably since 2008. In December 2009, both gross bond inflows and portolio inflows increase to 89.06 billion and 630.86 billion respectively (Figure 3.4). By the end of 2013, after several rounds of QEs by the Federal Reserve, gross bond inflows into the EMEs increase to 189.9 billion and gross portfolio flows is around 743.7 billion, respectively. And gross bond inflows continue to rise and reach about 247.04 billion in mid-2018.

Note: Gross bond inflows refers to the asset under management held by mutual funds in bond market. EMEs include 10 economies: Argentina, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, and Turkey.

Source: Coordinated Portfolio Investment Survey (CPIS), IMF.

Figure 3 4 US allocation to bond investments in EMEs, Dec 2007 – Jun 2018

In terms of individual receiver, Mexico is the largest recipient of gross bond inflows in our sample with an average of 34.61 per cent of total flows over 2007-2018 followed by Brazil with an average of 25.18 per cent. Other countries in the sample are all less than 10 per cent share of bond inflows ranking as Indonesia (8.76 per cent), Turkey (7.79 per cent), Argentina (7.17 per cent), Russia (5.76 per cent), South Africa (5.63per cent), India (3.51 per cent), China (1.21 per cent) and Saudi Arabia (0.37 per cent) (figure 3.5). This leads to another question, whether the geographical location affects the flow of funds.



Note: Total gross inflows refer to the sum of the EMEs include 10 economies receiving from US: Argentina, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, and Turkey.

Source: Coordinated Portfolio Investment Survey (CPIS), IMF.

Figure 3 5 Share of bond inflows from US

3.4 Bilateral models

3.4.1 Estimating dynamic panel model

To begin with, we firstly estimate the dynamic panel data model for the impact of US UMP on gross portfolio flows to EMEs. Then we employ a global VAR model to analyse the responses of portfolio inflows of EMEs on US UMP shocks, identified through signal restrictions on balance sheet and VIX. The specification of the dynamic panel model is presented as in Kiendrebeogo (2016):

$$Y_{i,t}^{US} = \alpha_1 Y_{i,t-1}^{US} + \beta_1 UMP_{i,t}^{US} + \beta_2 UMP_{i,t-1}^{US} + \beta_3 X_{it} + \beta_4 X_{it-1} + \varepsilon_{it} \qquad \text{Eq. 19}$$

The $Y_{i,t}^{US}$ is defined as the gross portfolio inflows of country i from US at year t. As YTM for long-term bond reduces, this would stimulate short-term investments and hence aggregate immediate demand of portfolio flows seeking for higher returns (higher policy rate spread) abroad (Beirne and Fratzscher, 2013; Fratzscher et al., 2014; Manova, 2013). This is referred as 'hot money' (Gagnon, Raskin, Remache, Sack, 2011; Rogers et al., 2014; Chen et al., 2014). UMP_i^{US} measures adoption of US unconventional monetary policy discussed in last section. While both current and lagged UMP_i^{US} are included in the regression, we are only look at the coefficients of lagged term. As the current portfolio inflows are determinate by past value of UMP_i^{US}.

Furthermore, as the individual country characteristics would also have effects on portfolio flows, we include a set of country characteristics in the dynamic panel data model. As is in Fratzscher, Lo Duca, and Straub (2013), Ahmed and Zlate (2013, 2014), Kiendrebeogo (2016) and Koepke (2019), two rather opposing forces have influenced the global portfolio investment. On the one hand, suffering from great losses, some investors have become risk averter who are more sensitive to credit and liquidity risks. In this environment, EMEs that enjoy strong GDP growth are seen as providing safer investment opportunities to investors. On the other hand, cyclical factors such as very low global interest rates and monetary easing condition may have made investors risk seekers. They prefer to take on additional risks by going beyond their traditional asset classes (eg. US treasury bills).

Be aware of this, we include the difference of GDP growth rate between US and EMEs as the macroeconomic factor which influence the mobility of portfolio flows. The idea is that a slower growth of GDP would limits the mobility of portfolio flows, and the future portfolio flows would move toward the countries who has a higher economic growth now. Besides, we include policy rate difference between US and EMEs in the estimation, as higher yields could attract investors abroad. Moreover, change in volatility index (VIX) in included as for controlling international risk averse. VIX is treated as strict exogenous variable in the regression. Additionally, to capture the unobservable country specific factors, fixed effect factors (μ_i and γ_t) are included in the error term$\varepsilon_{it} = \mu_i + \gamma_t + VIX + \epsilon_{it}$.

Descriptive statistics are summarized in table 3.4. where bond inflows and portfolio inflows are scaled by GDP, GDP growth differences are the logarithmic difference between EMEs and US GDPs, and policy rate differences stand for policy rate of EMEs minus FEER rate.

Table 3. 4 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Bond inflows	374	24.30	24.84	1.10	106.84
Portfolio inflows	374	28.16	26.63	1.52	111.54
GDP growth diff	400	0.34	2.00	-9.91	6.73
Policy rate diff	400	7.43	5.40	0.62	38.12
Balance sheet	400	3.20	0.27	1.82	3.44
FEER	400	0.37	0.47	.073	1.94
Wu-Xia	400	-0.58	1.26	-2.92	1.94
MSA-FFR	400	3.93	0.85	2.20	5.33
Term-spreads	400	2.22	0.70	1.04	3.60
vix	400	1.26	0.15	1.00	1.71

It is critical in choosing a proper estimation technique for two reasons. On the one hand, the fixed effect estimator and the first differences estimator with a lagged dependent variable may generate biased estimation when the time dimension is smaller than country dimension. While our datasets have a time dimension ($T = 40$) greater than country dimension (N=10), a natural question is whether the time dimension is big enough. Instead of the fixed effect estimator and the first differences estimator, we conduct estimation with least square dummy variable model, as the bias of LSDV estimator is sizeable for dynamic panel data models with $T \geq 20$ and minimum root mean square error (RMSE) criterion (Judson and Owen, 1999). Two LSDV models are considered. One with common time trend and random errors, another with both common time trend and individual effects. And lower RMSE indicates better results.

$$Y_{i,t}^{US} = \alpha_1 Y_{i,t-1}^{US} + \beta_1 UMP_{i,t}^{US} + \beta_2 UMP_{i,t-1}^{US} + \beta_3 X_{it} + \beta_4 X_{it-1} + \gamma_t + \varphi_{it} \qquad \text{Eq. 20}$$

$$Y_{i,t}^{US} = \alpha_1 Y_{i,t-1}^{US} + \beta_1 UMP_{i,t}^{US} + \beta_2 UMP_{i,t-1}^{US} + \beta_3 X_{it} + \beta_4 X_{it-1} + \mu_i + \gamma_t + \epsilon_{it} \qquad \text{Eq. 21}$$

On the other hand, the endogeneity problem may exist as the lagged dependent variable are potentially correlated with the error term as it contains time trend term, where $E(\varepsilon_{it}) \neq 0$ and $E(y_{it-1}\varepsilon_{it}) \neq 0$, thus lead to biased estimation of parameters in first difference estimations as $E(\Delta y_{it-1}\Delta\varepsilon_{it}) \neq 0$. Additionally, to conduct consistent result, the fixed effect estimator and the first differences estimator both rely on the strict exogeneity assumption of the Gauss–Markov theorem that $E(x_{it}\varepsilon_{it}) = 0$ and $E(x_{it-1}\varepsilon_{it}) = 0$. The failure of this assumption may lead to misconduct of independent parameters estimations. To solve the endogeneity problem, we conduct both difference GMM estimator and system GMM estimator with proper instrumental variable to address this problem and to provide precise and consistent estimation results (Judson and Owen, 1999; Kiendrebeogo, 2016). The Blundell–Bond system generalized method of moments (GMM) estimator solved this issue by exploiting the additional instruments along with the standard initial moment condition (Arellano,M.,and Bond, S., 1991). The instruments for difference GMM estimator are the lagged value of explanatory variables which are$Y_{i,t-2}^{US}$, $UMP_{i,t-2}^{US}$ and X_{it-2} while the system GMM-type instruments are $\Delta Y_{i,t-2}^{US}$.

Difference GMM estimator:

$$\Delta Y_{i,t}^{US} = \alpha_1 \Delta Y_{i,t-1}^{US} + \beta_1 \Delta UMP_{i,t}^{US} + \beta_2 \Delta UMP_{i,t-1}^{US} + \beta_3 \Delta X_{it} + \beta_4 \Delta X_{it-1} + \varepsilon_{it} - \varepsilon_{it-1}$$

Eq. 22

With $E(y_{it-2}\Delta\varepsilon_{it}) = 0, E(x_{it-2}\Delta\varepsilon_{it}) = 0$ and $E\left(UMP_{i,t-2}^{US}\Delta\varepsilon_{it}\right) = 0$

System GMM estimator:

$$\Delta Y_{i,t}^{US} = (\alpha_1 - 1)Y_{i,t-1}^{US} + \beta_1 \Delta UMP_{i,t}^{US} + (\beta_1 + \beta_2)UMP_{i,t-1}^{US} + \beta_3 \Delta X_{it} + (\beta_3 + \beta_4)X_{it-1} + \varepsilon_{it}$$

Eq. 23

With additional system GMM-type instruments $E(\Delta y_{it-2}\Delta\varepsilon_{it}) = 0$

We conduct autocorrelation test (AR1 and AR2 test) for difference GMM estimator to ensure the reliability of the results. The main purpose of the autocorrelation test is to test whether there is autocorrelation between residuals. If there is autocorrelation, it will lead to endogeneity problem and the difference GMM needs to select the more lagging y as its instrument variables. In other words, AR (2) test must be passed to ensure that instrument variables are valid, otherwise the system GMM is not able to be established. Moreover, overidentify test (Sargen test) is essential to ensure the effectiveness of instrument variables. The result of Sargon test is estimated under the null hypothesis that the residual term has the same variance if the number of instrument variables is greater than the number of required estimation parameters. If the P-value is significant at 5% level, the GMM estimator is robust but weaken by many instrumental variables.

3.4.2 Result

The model estimations are based on five UMP indicators, namely size of balance sheet, MSA-FFR, term spreads, FEER, and WU-xia's shadow rate. All indicators capture different aspects of US UMP. Table 3.5-3.14 show our LSDV regressions (one-way fixed model and two-way fixed model) as well as two GMM regressions where gross portfolio inflows and gross inflows of bond are the dependent variables. The difference GMM models pass the autocorrelation test as the P-value for AR2 is greater than 5%. Moreover, overidentify restrictions test (Sargen test) shows the GMM models are robust but weakened by many instruments as the p-value is statically significant at 5% level.

We highlight the results of Table 3.5 to 3.8 which adopt the size of Federal Reserve' balance sheet and MSA-FFR as indicators for US unconventional monetary policy. The size of Federal Reserve' balance sheet and MSA-FFR (the lagged terms) indicate that if financial condition in US begin to tighten, for example a significant downsizing of Federal Reserve' balance sheet and reducing in risk premia, it would be much difficult for EMEs to borrow money abroad as a cut of supply side. Meanwhile we estimate for the impacts of term spreads on portfolio inflows in EMEs (table 3.9 and 3.10). Although lacking significance, we find the coefficients for lagged term spreads are negative related with portfolio inflows which indicate that increasing in risk premia would potentially lead to a cut of portfolio flows to EMEs. And all other explanation variable remains same direction and significant level as other models.

Table 3. 5 Model: Bond inflow =f(balance sheet, GDP, Policy rate, VIX)

	(1) One-way fixed	(2) two-way fixed	(3) Diff-GMM	(4) Sys-GMM
L.y	1.01***	0.98***	0.97***	1.01***
	(0.00)	(0.01)	(0.01)	(0.00)
balance sheet	17.20*	15.56	-3.31***	-3.93***
	(10.17)	(9.46)	(0.69)	(0.81)
L.	-0.53	0.22	2.06***	2.11***
	(2.61)	(2.43)	(0.23)	(0.23)
GDP	-1.68***	-1.69***	-1.70***	-1.76***
	(0.03)	(0.03)	(0.13)	(0.10)
L.	0.16***	0.11***	0.09*	0.10**
	(0.03)	(0.03)	(0.05)	(0.04)
policy rate	-0.09***	-0.10***	-0.08***	-0.07***
	(0.03)	(0.03))	(0.03)	(0.03)
L.	0.05*	0.06*	0.03	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
vix	8.60***	8.34***	-1.10	-0.41
	(2.14)	(1.98)	(0.72)	(1.20)
constant	-64.77**	-61.12**	7.50***	7.59**
	(27.08)	(25.19)	(2.44)	(3.80)

N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.90	0.83		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.08	0.10
Hansen(p-value)			0.83	0.21

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Bond inflow is dependent variable, balance sheet is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 6 Model: portfolio inflow = *f* (balance sheet, GDP, Policy rate, VIX)

	(1)	(2)	(3)	(4)
	One-way fixed	two-way fixed	Diff-GMM	Sys-GMM
L.y	1.012***	0.98***	0.97***	1.01***
	(0.00)	(0.00)	(0.00)	(0.00)
balance sheet	16.59	14.99	-3.44***	-4.13***
	(10.29)	(9.61)	(0.73)	(0.75)
L. balance sheet	-0.177	0.61	2.15***	2.18***
	(2.64)	(2.47)	(0.25)	(0.25)
GDP	-1.75***	-1.76***	-1.77***	-1.83***
	(0.02)	(0.02)	(0.12)	(0.10)

L. GDP	0.16***	0.11***	0.09*	0.10**
	(0.02)	(0.02)	(0.04)	(0.04)
policy rate	-0.08***	-0.08***	-0.06**	-0.06**
	(0.03)	(0.02)	(0.02)	(0.02)
L. policy rate	0.04	0.04	0.02	0.01
	(0.03)	(0.03)	(0.02)	(0.02)
vix	9.07***	8.84***	-1.06	-0.43
	(2.16)	(2.01)	(0.73)	(1.20)
constant	-64.40**	-60.82**	7.69***	8.16**
	(27.41)	(25.61)	(2.54)	(3.61)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.91	0.84		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.09	0.10
Hansen(p-value)			0.87	0.21

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: portfolio inflow is dependent variable, balance sheet is the UMP indicator, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 7 Model: bond inflow = f (MSA-FFR, GDP, Policy rate, VIX)

	(1)	(2)	(3)	(4)
	One-way fixed	two-way fixed	Diff-GMM	Sys-GMM
L.y	1.01***	0.97***	0.97***	1.01***
	(0.00)	(0.00)	(0.00)	(0.00)
MSA-FFR	-18.14**	-17.64***	-0.30***	-0.12
	(7.02)	(6.57)	(0.11)	(0.10)
L.	30.38**	29.15**	0.50***	0.47***
	(12.87)	(11.96)	(0.11)	(0.11)
GDP	-1.68***	-1.69***	-1.69***	-1.75***
	(0.02)	(0.02)	(0.13)	(10.99)
L.	0.16***	0.10***	0.08*	0.09**
	(0.02)	(0.02)	(0.04)	(0.04)
policy rate	-0.09***	-0.09***	-0.10***	-0.10***
	(0.03)	(0.02)	(0.02)	(0.02)
L.	0.05*	0.05*	0.04*	0.04*
	(0.03)	(0.03)	(0.02)	(0.02)
vix	22.85***	21.98***	-1.29***	-0.68
	(7.60)	(7.06)	(0.48)	(0.78)
_cons	-56.86**	-53.67**	2.86***	0.62
	(23.34)	(21.71)	(0.28)	(0.86)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.89	0.83		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.17	0.20
Hansen(p-value)			0.64	0.08

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Bond inflow is dependent variable, MSA-FFR corporate spread is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 8 Model: portfolio inflow = f (MSA-FFR, GDP, Policy rate, VIX)

	(1) One-way fixed	(2) two-way fixed	(3) Diff-GMM	(4) Sys-GMM
L.y	1.01***	0.98***	0.97***	1.01***
	(0.00)	(0.00)	(0.00)	(0.00)
MSA-FFR	-18.09**	-17.68***	-0.31**	-0.10
	(7.10)	(6.62)	(0.12)	(0.11)
L.	30.10**	29.02**	0.52***	0.47***
	(13.03)	(12.16)	(0.11)	(0.12)
GDP	-1.75***	-1.76***	-1.76***	-1.82***
	(0.02)	(0.02)	(0.14)	(0.11)
L.	0.16***	0.11***	0.08*	0.10**
	(0.02)	(0.02)	(0.04)	(0.04)
policy rate	-0.08***	-0.08***	-0.09***	-0.09***
	(0.03)	(0.02)	(0.02)	(0.03)
L.	0.04	0.04	0.04	0.04
	(0.03)	(0.03)	(0.02)	(0.02)
vix	23.18***	22.420***	-1.29***	-0.68
	(7.70)	(7.18)	(0.49)	(0.80)
_cons	-56.63**	-53.47**	2.87***	0.63
	(23.63)	(22.08)	(0.27)	(0.94)

N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.91	0.84		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.18	0.21
Hansen(p-value)			0.69	0.08

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: portfolio inflow is dependent variable, MSA-FFR corporate spread is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 9 Model: bond inflow = f (Term-spread, GDP, Policy rate, VIX)

	(1) One-way fixed	(2) two-way fixed	(3) Diff-GMM	(4) Sys-GMM
L.y	1.01***	0.93***	0.96***	1.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Term-spread	3.92	3.51	0.26*	0.45***
	(2.42)	(2.25)	(0.15)	(0.14)
L.	-9.94***	-9.77***	-0.13	-0.19
	(3.55)	(3.29)	(0.13)	(0.14)
GDP	-1.76***	-1.69***	-1.69***	-1.75***
	(0.02)	(0.02)	(0.14)	(0.11)
L.	0.16***	0.10***	0.08*	0.09**

	(0.02)	(0.02)	(0.04)	(0.03)
policy rate	-0.09***	-0.09***	-0.11***	-0.11***
	(0.03)	(0.02)	(0.03)	(0.03)
L.	0.05*	0.05*	0.06**	0.06**
	(0.03)	(0.03)	(0.02)	(0.02)
vix	4.86***	4.77***	-1.16***	-0.27
	(1.75)	(1.63)	(0.43)	(0.78)
_cons	2.27	3.04	3.22***	0.91
	(2.28)	(2.14)	(0.26)	(0.80)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.89	0.83		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.21	0.29
Hansen(p-value)			0.05	0.06

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: bond inflow is dependent variable, term-spread is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 10 Model: portfolio inflow = f (Term-spread, GDP, Policy rate, VIX)

	(1)	(2)	(3)	(4)
	One-way fixed	two-way fixed	Diff-GMM	Sys-GMM

L.y	1.01***	0.98***	0.97***	1.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Term-spread	3.76	3.36	0.27*	0.50***
	(2.45)	(2.29)	(0.15)	(0.13)
L.	-9.96***	-9.84***	-0.14	-0.22
	(3.59)	(3.35)	(0.14)	(0.14)
GDP	-1.75***	-1.76***	-1.76***	-1.82***
	(0.02)	(0.02)	(0.14)	(0.11)
L.	0.16***	0.11***	0.08*	0.10**
	(0.02)	(0.02)	(0.04)	(0.03)
policy rate	-0.08***	-0.08***	-0.10***	-0.11***
	(0.03)	(0.02)	(0.03)	(0.03)
L.	0.04	0.04	0.05*	0.05*
	(0.03)	(0.03)	(0.02)	(0.02)
vix	5.38***	5.31***	-1.17***	-0.26
	(1.78)	(1.66)	(0.43)	(0.81)
_cons	1.95	2.97	3.28***	0.94
	(2.30)	(2.18)	(0.28)	(0.88)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.000	0.00
RMSE	0.91	0.84		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.22	0.30
Hansen(p-value)			0.61	0.05

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: portfolio inflow is dependent variable, term- spread is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

In table 3.11 and 3.12, we estimate the effect of FEER on gross bond inflows and gross portfolio inflows of EMEs. And we find the monetary easing conditional in US which is a decrease in FFER would lead to an increase in portfolio inflows to EMEs, especially the bond inflows. As shown by LSDV regressions, the lagged FEER is negatively associated with change of gross bond inflows of EMEs (the coefficient is about -5.5 with a significant level at 1%) which indicates a potential cut in FEER would lead to an increase in gross bond inflows to EMEs. Likewise, federal effective funds also have a statistically significant promotion impact on gross portfolio inflows about 5.5 percentage points for emerging market economies for percentage point drop in FEER. Both sets of coefficients estimate of gross bond flows and gross portfolio flows are statistically significant at 1% level. Our results also suggest that while lower federal effective funds are associated with an increase in gross bond inflows and gross portfolio inflows, FEER affect gross equity inflow in the same direction. However, the coefficient for the gross equity inflows is statistically insignificant and the results are not reported.

Table 3. 11 Model: Gross bond inflow =f(FEFR, GDP, Policy rate, VIX)

	(1)	(2)	(3)	(4)
	One-way fixed	two-way fixed	Diff-GMM	Sys-GMM
L.y	1.01***	0.98***	0.96***	1.01***

	(0.00)	(0.01)	(0.01)	(0.01)
FEER	1.95***	2.21***	1.99***	1.63***
	(0.50)	(0.47)	(0.13)	(0.15)
L.	-5.38***	-5.52***	-2.08***	-2.05***
	(1.32)	(1.23)	(0.14)	(0.15)
GDP	-1.68***	-1.69***	-1.70***	-1.76***
	(0.03)	(0.03)	(0.12)	(0.10)
L.	0.16***	0.11***	0.76**	0.10***
	(0.03)	(0.03)	(0.04)	(0.04)
policy rate	-0.09***	-0.10***	-0.09***	-0.08***
	(0.03)	(0.03)	(0.02)	(0.02)
L.	0.05*	0.06*	0.04*	0.03
	(0.03)	(0.03)	(0.02)	(0.03)
vix	6.46***	6.02***	0.55	1.65**
	(1.79)	(1.67)	(0.49)	(0.68)
_cons	-2.84*	-2.11	1.63***	-0.76
	(1.70)	(1.61)	(0.43)	(0.82)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.90	0.83		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.10	0.16
Sargen(p-value)			0.69	0.09

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: bond inflow is dependent variable, FEER is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 12 Model: portfolio inflow = f (FEFR, GDP, Policy rate, VIX)

	(1)	(2)	(3)	(4)
	One-way fixed	two-way fixed	Diff-GMM	Sys-GMM
L.y	1.01***	0.98***	0.97***	1.01***
	(0.00)	(0.01)	(0.01)	(0.01)
FEER	2.09***	2.37***	2.10***	1.70***
	(0.50)	(0.48)	(0.15)	(0.19)
L.	-5.50***	-5.68***	-2.19***	-2.11***
	(1.34)	(1.25)	(0.16)	(0.18)
GDP	-1.75***	-1.76***	-1.77***	-1.83***
	(0.03)	(0.03)	(0.12)	(0.11)
L.	0.17***	0.11***	0.08**	0.10***
	(0.02)	(0.03)	(0.04)	(0.04)
policy rate	-0.085***	-0.09***	-0.08***	-0.08***
	(0.03)	(0.03)	(0.02)	(0.02)
L.	0.04	0.05	0.03	0.02
	(0.03)	(0.03)	(0.02)	(0.03)
vix	6.83***	6.39***	0.62	1.77**
	(1.82)	(1.70)	(0.50)	(0.73)
_cons	-3.23*	-2.29	1.66***	-0.79
	(1.7185)	(1.6529)	(0.4469)	(0.9140)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00

RMSE	0.91	0.85		
AR1(p-value)			0.01	0.02
AR2(p-value)			0.10	0.16
Sargen(p-value)			0.75	0.09

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: portfolio inflow is dependent variable, FEER is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

The results of GMM models are similar to the LSDV models. As is shown in table 3.11 and 3.12, FEER have negative impacts on portfolio inflows which indicate that an easing in US monetary policy is associated with an increase in gross bond inflows and gross portfolio inflows into the EMEs. While the impact is smaller than the statistic model, the coefficients estimated are still statistically significant at 1% level.

We also test for the role of rest explanatory variables, such as economic growth difference, policy rate spreads and global risk averse in determining gross portfolio flows to EMEs. The results show the coefficients of lagged GDP growth difference and VIX index are positively associated with gross bond inflows and gross portfolio inflows. While policy rate difference seems to play a less important role in attracting external finance as only few of them has a significant positive coefficient. We also note that VIX has greater impact on the portfolio and bond inflows than FEER and GDP growth gaps between EMEs and US, which indicates that the investors are more risk seekers than risk averters. All coefficients estimate for VIX index and GDP growth gaps are also statistically significant at 1% level while both sets of coefficients estimate for policy rate spreads are not statistically significant as the ones of static models.

We also test the impact of Wu-Xia's shadow federal Rate (Table. 3.13 and table 3.14) on gross portfolio inflows into the EMEs. Likewise, GDP growth gaps, policy rate spreads between US and EMEs and VIX have stronger impact on both gross portfolio inflows and gross bond inflows as the coefficient is close to the one above and also statistically significant at 1% level. While the policy rate spreads only have near term impacts as the lagged value are not statistically significant. The coefficients of GDP growth gaps, policy rate spreads and VIX are close to the ones in FEER. While the directions are same, the coefficients of Wu-xia's shadow rate are much smaller than FEER in GMM estimators.

Table 3. 13 Model: Bond inflow =f(Wu-Xia, GDP, Policy rate, VIX)

	(1) One-way fixed	(2) two-way fixed	(3) Diff-GMM	(4) Sys-GMM
L.y	1.012***	0.98**	0.95***	1.01**
	(0.00)	(0.01	(0.01)	(0.01)
Wu-Xia	1.95***	2.21**	0.65***	0.38**
	(0.50)	(0.47)	(0.13)	(0.12)
L.	-5.38***	-5.52**	-0.55***	-0.37***
	(1.32)	(1.23	(0.13)	(0.11)
GDP	-1.68***	-1.69***	-1.67***	-1.74***

	(0.03)	(0.03)	(0.14)	(0.12)
L.	0.16***	0.11***	0.84	0.11**
	(0.03)	(0.03)	(0.05)	(0.05)
policy rate	-0.09***	-0.10***	-0.10***	-0.11***
	(0.03)	(0.03)	(0.02)	(0.03)
L.	0.05*	0.06*	0.04	0.04
	(0.03)	(0.03)	(0.02)	(0.03)
vix	6.46***	6.02***	-1.02***	0.44
	(1.79)	(1.67)	(0.34)	(0.71)
_cons	-2.84*	-2.11	4.01***	0.76
	(1.70)	(1.61)	(0.57)	(0.90)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.91	0.85		
AR1(p-value)			0.01	0.01
AR2(p-value)			0.12	0.25
Sargen(p-value)			0.56	0.02

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: bond inflow is dependent variable, WU-XIA's shadow rate is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

Table 3. 14 Model: portfolio inflows = *f* (Wu-Xia, GDP, Policy rate, VIX)

	(1)	(2)	(3)	(4)
	One-way fixed	two-way fixed	Diff-GMM	Sys-GMM
L.y	1.01***	0.98***	0.96***	1.01***
	(0.00)	(0.01)	(0.01)	(0.01)
Wu-Xia	2.09***	2.37***	0.67***	0.39***
	(0.50)	(0.48)	(0.13)	(0.13)
L.	-5.50***	-5.68***	-0.57***	-0.37***
	(1.34)	(1.25)	(0.12)	(0.12)
GDP	-1.75***	-1.76***	-1.74***	-1.81***
	(0.03)	(0.03)	(0.14)	(0.12)
L.	0.17***	0.11***	0.09*	0.11**
	(0.03)	(0.03)	(0.05)	(0.04)
policy rate	-0.08***	-0.09***	-0.09***	-0.11***
	(0.03)	(0.03)	(0.02)	(0.03)
L.	0.04	0.05	0.03	0.03
	(0.03)	(0.03)	(0.02)	(0.03)
vix	6.83***	6.39***	-1.01***	0.50
	(1.82)	(1.70)	(0.35)	(0.76)
_cons	-3.23*	-2.29	4.10***	0.82
	(1.72)	(1.65)	(0.60)	(1.01)
N	364	364	354	364
F(p-value)	0.00	0.00		
Chi2(p-value)			0.00	0.00
RMSE	0.91	0.85		
AR1(p-value)			0.02	0.02
AR2(p-value)			0.13	0.25
Hansen(p-value)			0.62	0.03

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: portfolio inflow is dependent variable, WU-XIA's shadow rate is the UMP indicator and independent variable, GDP and policy rate are independent variables, and VIX (volatility index) is treated as strict exogenous variable in the regression.

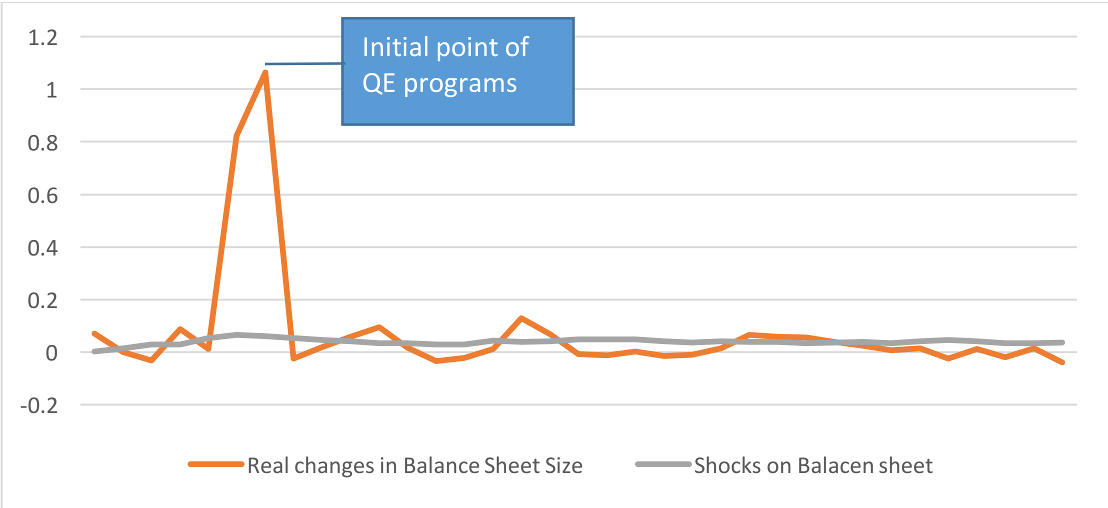
L.y stands for the lag value of dependent variable, and L. states for lag values of independent variables.

3.5 GVAR estimation

3.5.1 Domestic effects

In this part, we use global vector autoregressive model (global VAR) to estimate the international spillovers of US UMP shocks to EMEs by portfolio and bond flows. We firstly estimate domestic effects of UMP shocks through general impulse responses estimations of US domestic variables to one standard error positive shocks on balance sheet with pre-identified signal restrictions on balance sheet and VIX. We include following ordering of the endogenous variables in the US bloc: GDP (y), effective exchange rate (eer), a monetary policy indicator (mp), portfolio outflows (pf) and VIX index (vix). The generalized impulse responses functions are based on point estimations of country specific models for 40 periods through a bootstrap of 200 times (Georgiadis, 2015; 2016; Chen et al., 2016).

For a better interpretation of the identified US UMP shocks, we first examine the shock series that yields point estimation through the median impulse response function in the baseline model. This inspection allows us to know whether estimated innovations could reflect the real measures taken by the Federal Reserve during and after the financial crisis. Figures 3.6 shows the point estimation of unconventional monetary policy shocks on balance shee. The figure shows that the lines of estimated and real changes in balance size are in general similar sharp over the sample period expect the initial sparking of real changes in balance size. Therefore, we can conclude that the identified UMP shocks on balance sheet capture the most important feature of US unconventional monetary policy and, hence, is a good indication of the unconventional monetary policy stance for our sample period.



Source from: GVAR estimation and Federal Reserve Bank of St. Louis data base

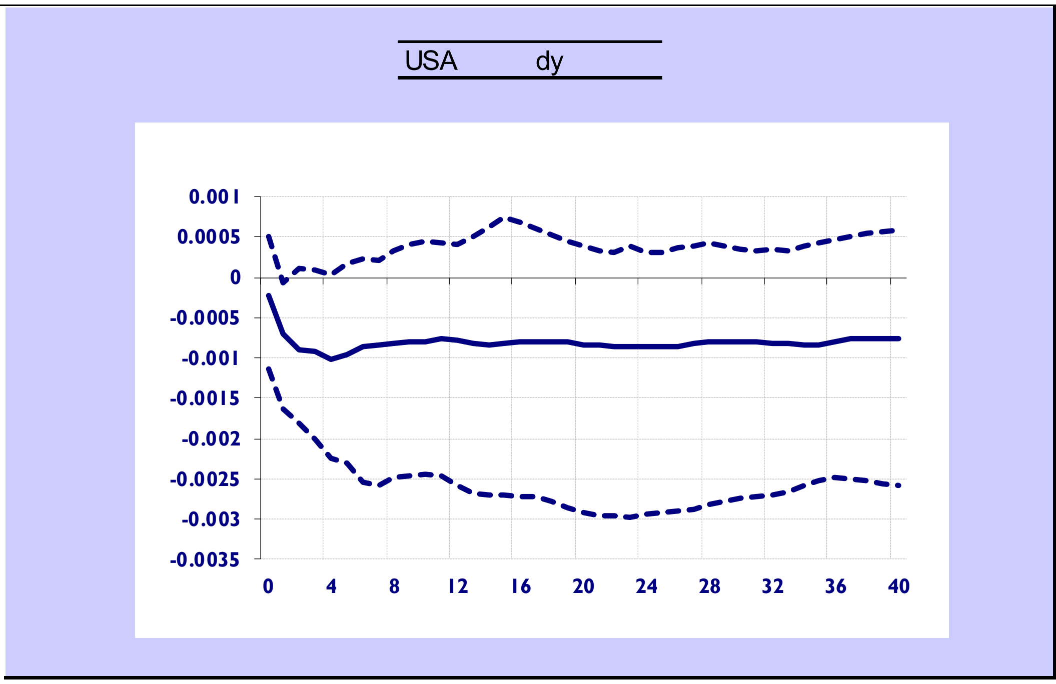
Figure 3 6 Point estimation of balance sheet shocks and real changes of balance size

Next, we look at domestic responses of the estimated GVARs to see how an expansionary UMP shock affects GDP growth, effective exchange rate, portfolio outflows, and VIX. The results for US responses to a one standard deviation positive shock on balance sheet are presented in figure 3.7 and figure 3.8. Both model show that the US GDP growth have a statistically significant and persistent response to a positive balance sheet shock. In the portfolio flow model, the initial response of GDP drops at first but soon become flatten and above. While in the bond flow, we find a persist positive response on GDP. This is in line with Ahmed and Zlate (2013, 2014) and Bowman et al. (2015) who suggest that the US QEs might not have only prevented US from deflation in short-term but also have contributed to stabilizing US economy in long-term recovering.

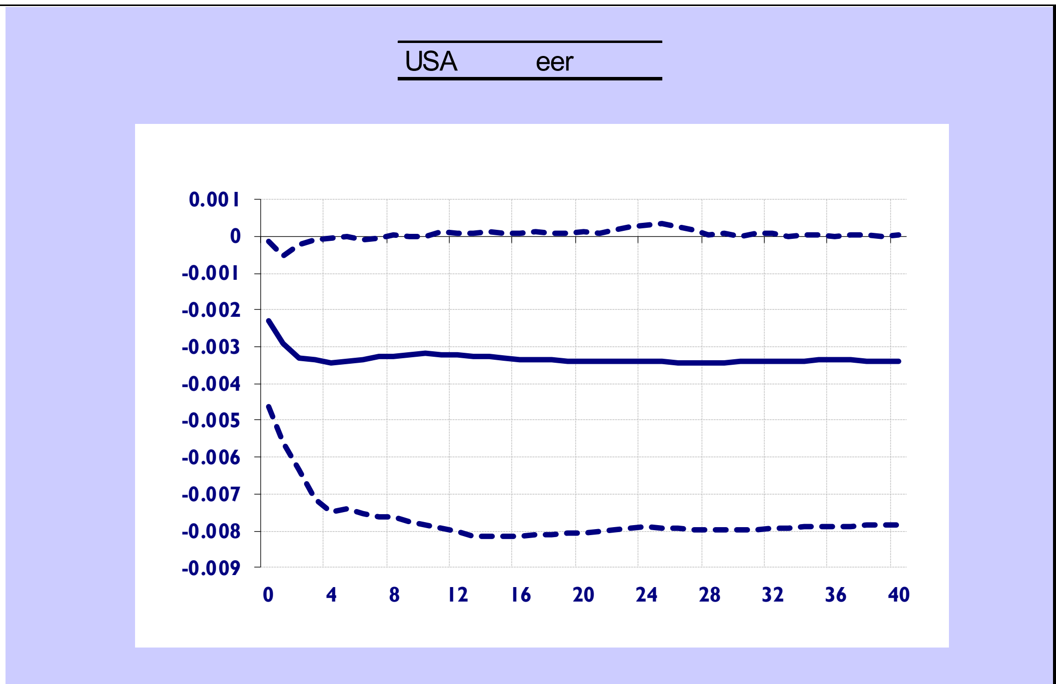
In addition to GDP, estimates based on the one standard deviation positive shocks on balance sheet suggest that different channels might be at play (Bowman et al., 2015). We find, in portfolio model, depreciation pressure on effective exchange rate as the responses of effective exchange rate stay negative over the period. The negative reader on effective exchange rate indicates that, under the traditional framework, as large reserves have been injected to maintain financial market stability, the inflation rate raised as a result of an increasing in money supply and currency deprecates follows. While, in bond model, we find a positive move on effective exchange rate which means the value of US dollars in relation to major currencies increases due to the risk seeking behaviours. And this reflects the expectation on currency appreciation with lower interest rate in the future.

Furthermore, as stated by fisher effect theory, the real interest rate equals the nominal interest rate minus the expected inflation rate. Therefore, FED actually lower real interest rates which are the combined result of rising inflation and constant nominal interest rates (Hogan, 2021). And lower real interest rates encourage investors to take more risks domestically and thus stops portfolio inflows from loss (Hogan, 2021). While the profit seeking behaviours through portfolio rebalancing channel dominant in short-term as bond outflows increase.

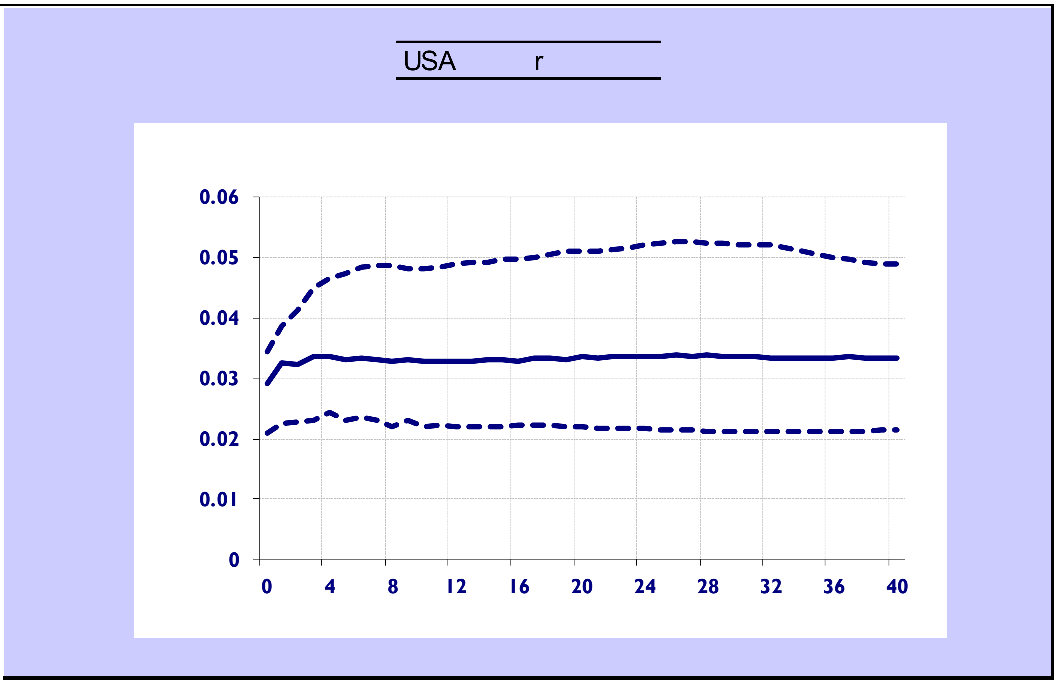
Moreover, we find an upward trend response on VIX, which because of an increase on demand side and a raise in volatility. Like any time, the price will move more vulnerable because demand drastically outpaces supply and investors are risk seekers.



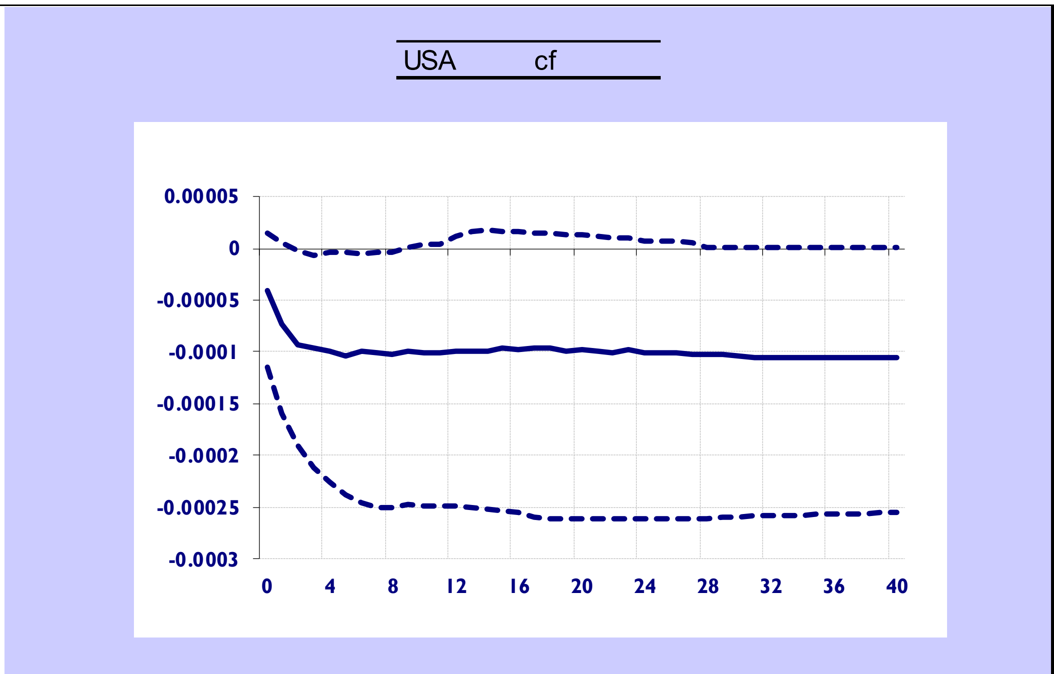
(a)Real GDP



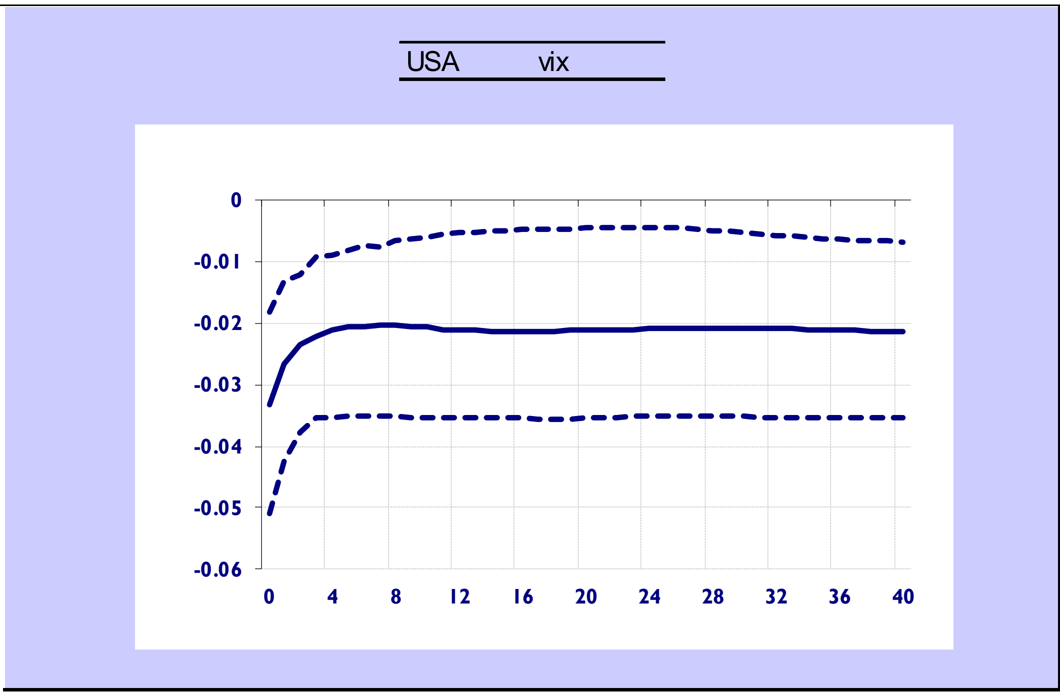
(b)Effective Exchange Rate



(c)Balance Sheet



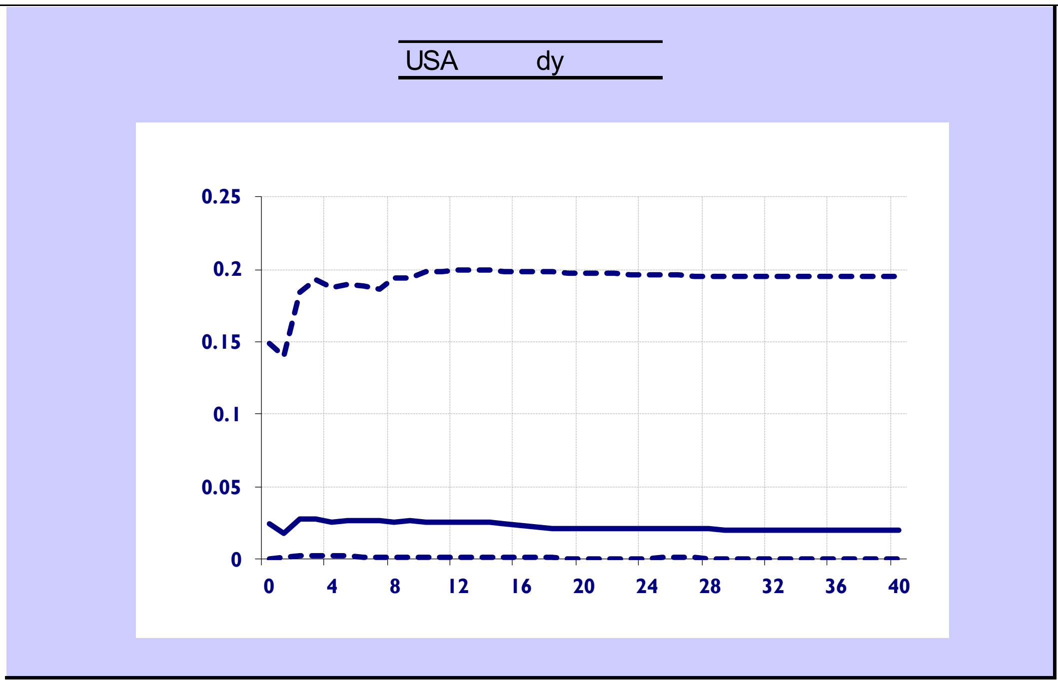
(d)Portfolio outflows



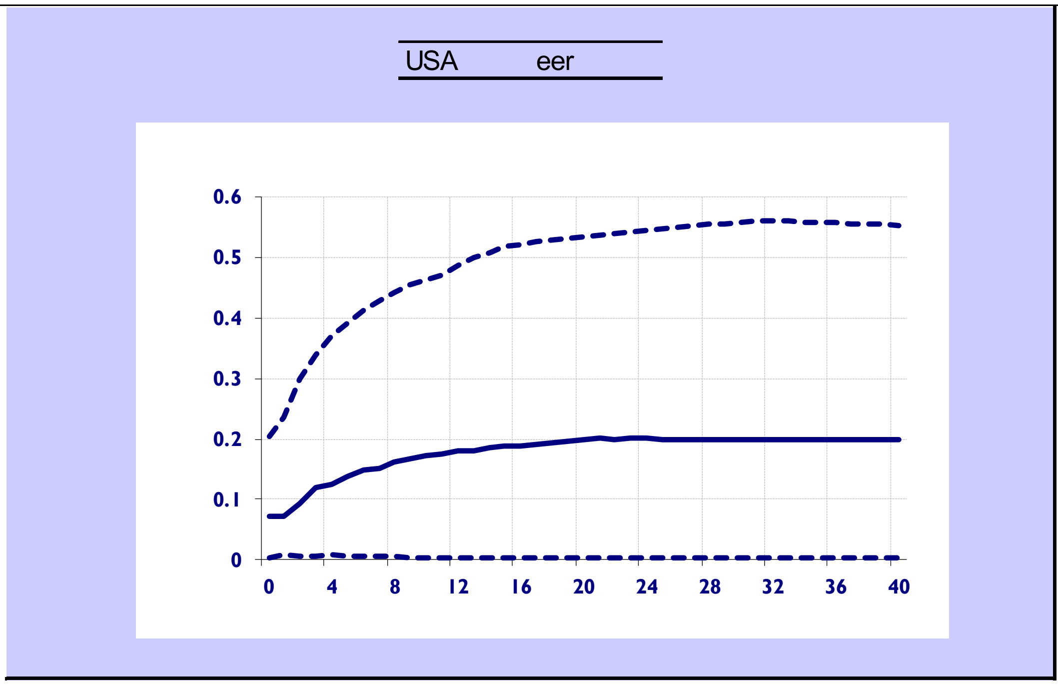
(e)VIX

Figure 3 7 Responses of US variables to US UMP shock: A positive shock on balance sheet

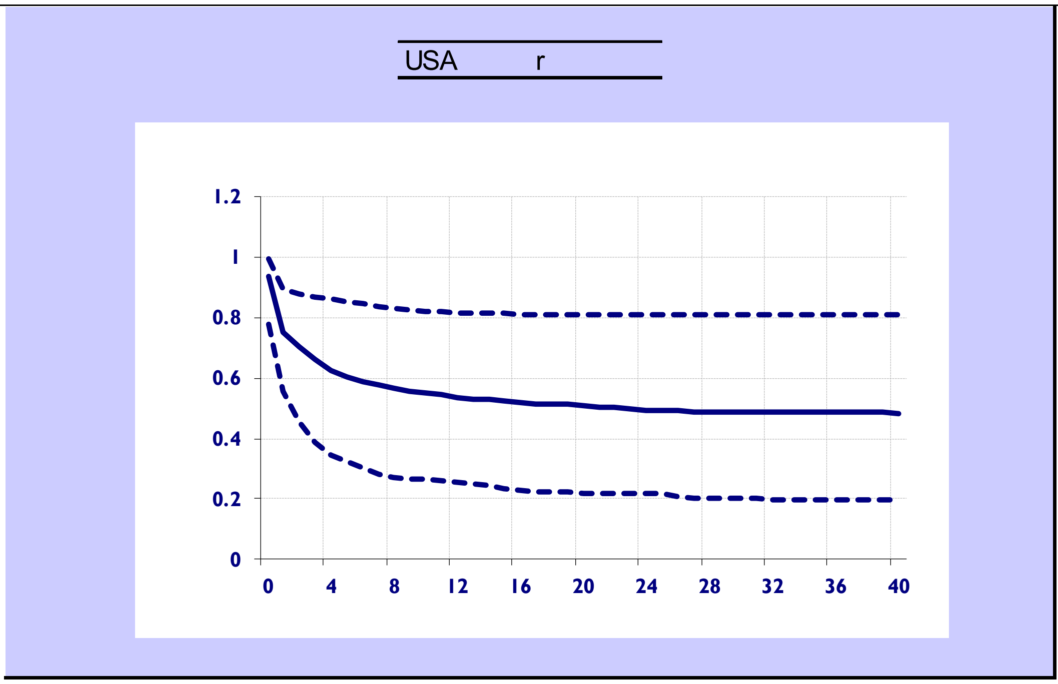
Note: All impulse responses estimations are cumulated impulse responses



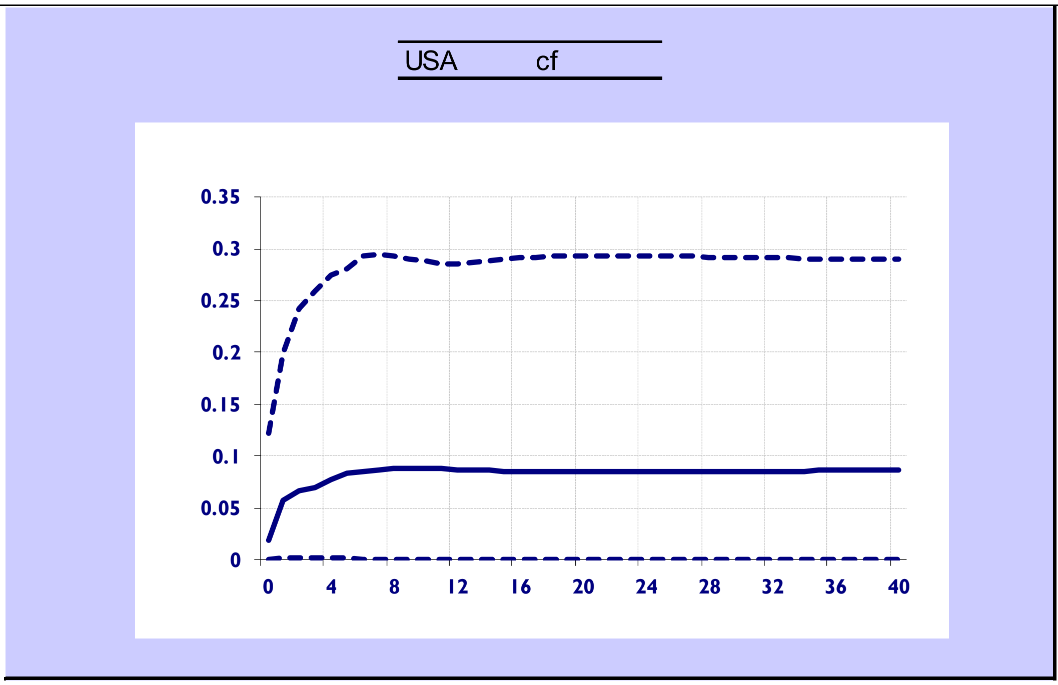
(a)Real GDP



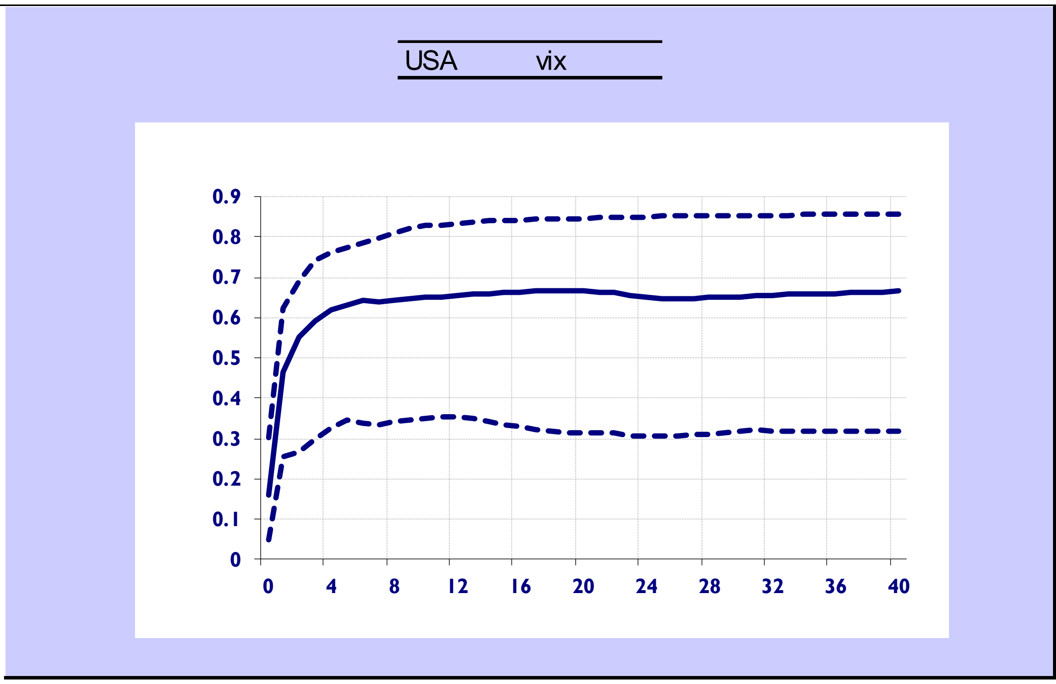
(b)Effective Exchange Rate



(c)Balance Sheet



(d)Bond outflows



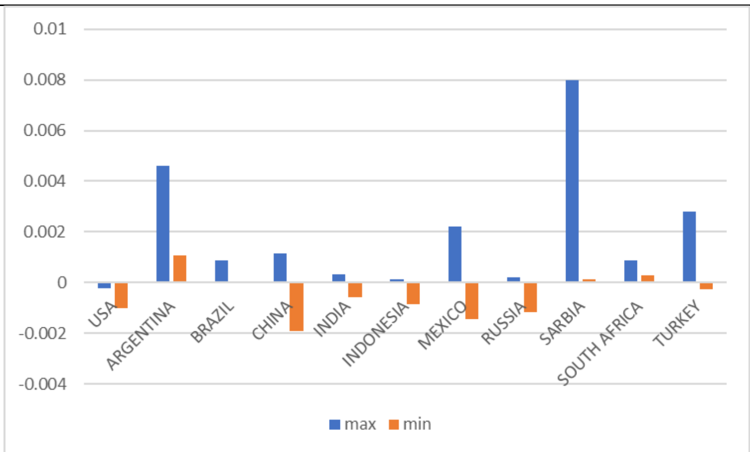
(e)VIX

Figure 3 8 Impulse responses of bond flows to US UMP shock: A positive shock on balance sheet

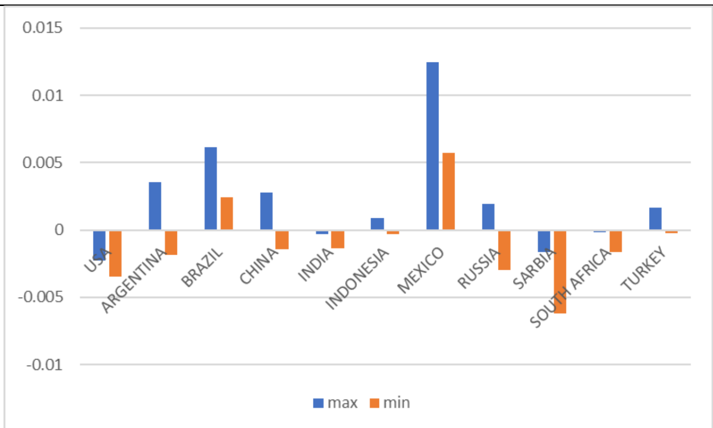
Note: All impulse responses estimations are cumulated impulse responses

3.5.2 Shock transmission to EMEs

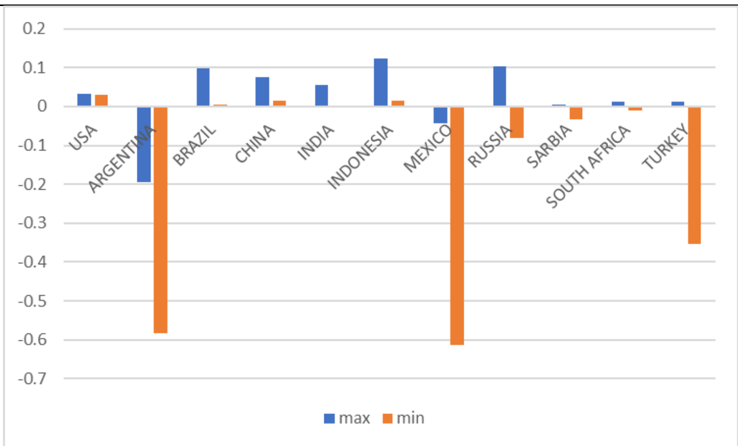
The results of GIFRs (*Figure 3.9 and Figure 3.10*) are clear that unconventional measures tend to have a great variety impacts on emerging economies which is consistent with previous studies (Bowman et al., 2014; Bowman et al., 2015; Jordan, 2016; Fratzscher et al., 2016; Chen et al., 2016; Georgios, 2016; Garratt et al., 2016). We find that initial impulse responses of EMEs' GDP growth to the positive shock on US balance sheet expansionary are mostly positive, which suggest that the US unconventional monetary policy might not have only prevented US from deflation but also have contributed to overheating EMEs' economies in short-term (Ahmed and Zlate, 2013, 2014; Bowman et al., 2015). Moreover, while in panel data models, the size of balance sheet positively drives the portfolio inflows to EMEs significantly at 5% level, the magnitude of international spillovers is small as we find limited impulse responses of portfolio flows to size of balance sheet expect for China and Saudi Arabia. And lastly, we find that it takes about four quarters on average for US variables to reach the peak of the impulse response while there is great difference among other EMEs' variables. These heterogeneous responses may be due to the difference in relative strength of shocks identification and transmission channels.



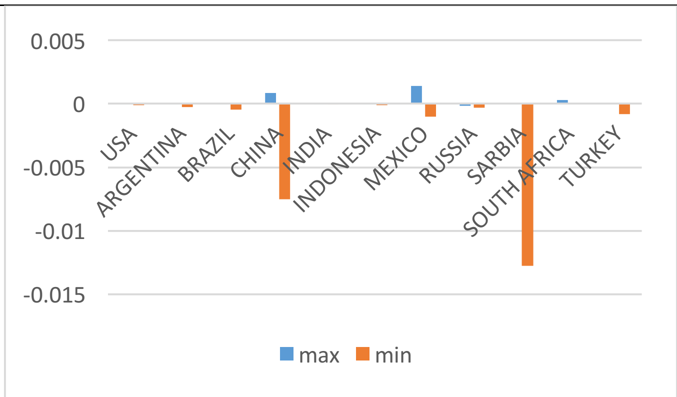
Real GDP



Effective Exchange Rate

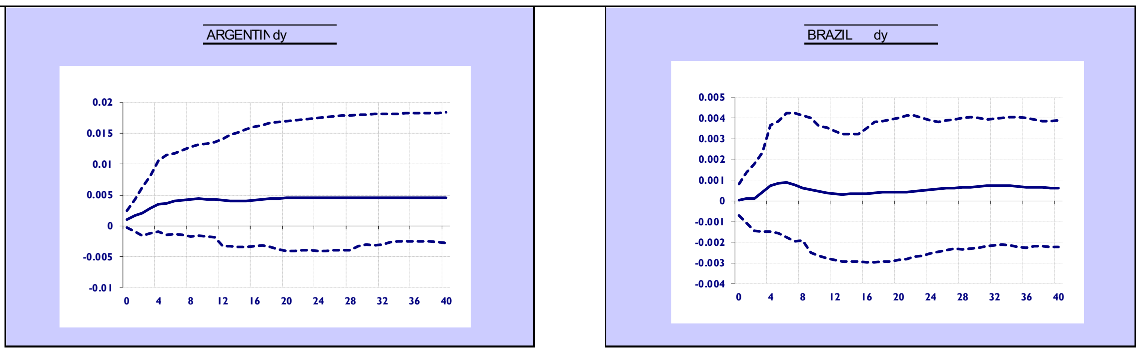


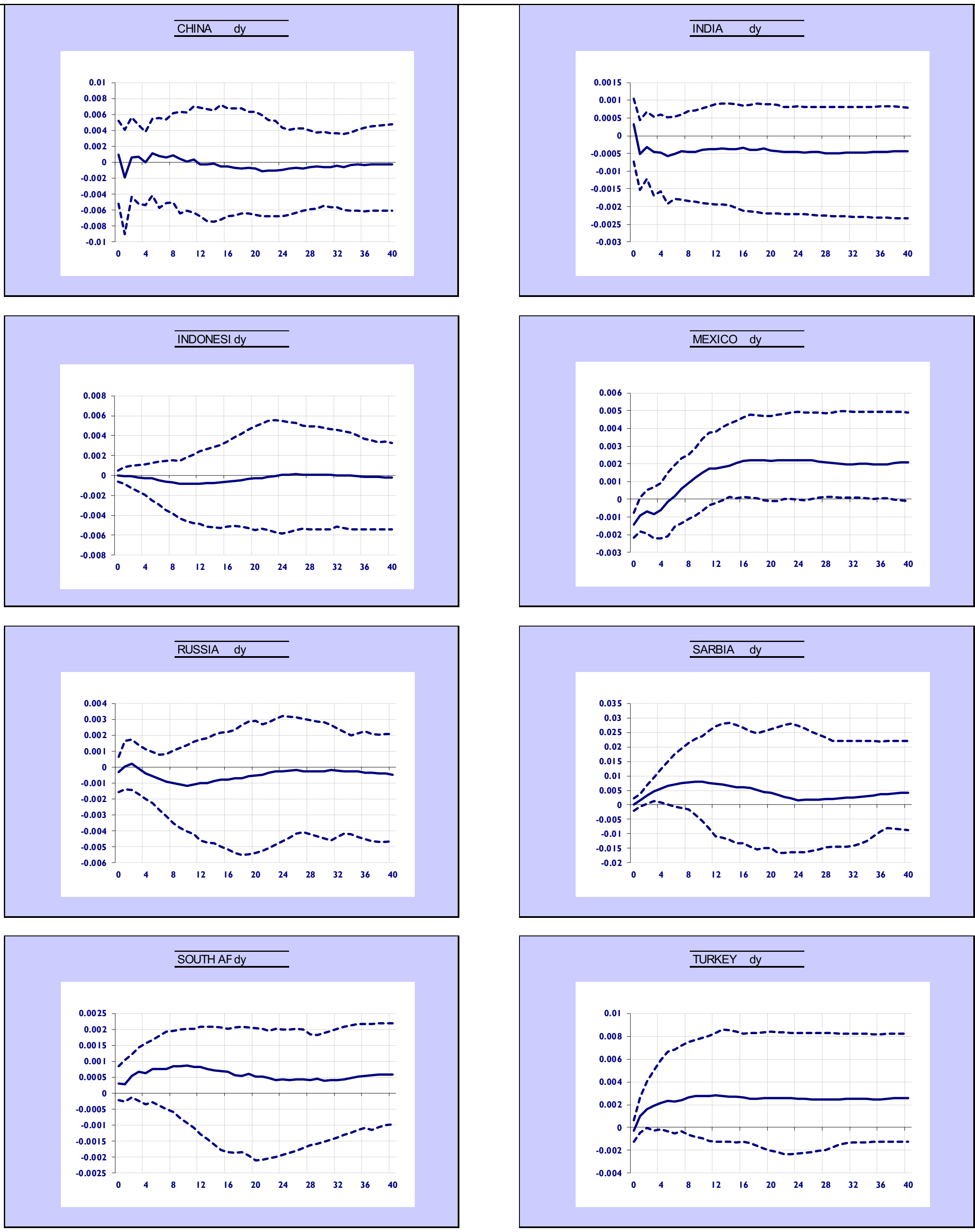
Monetary policy



Portfolio inflows

Figure 3 9 Impulse responses of EMEs to US UMP shock: A positive shock on balance sheet

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INDIA dy
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RUSSIA dy
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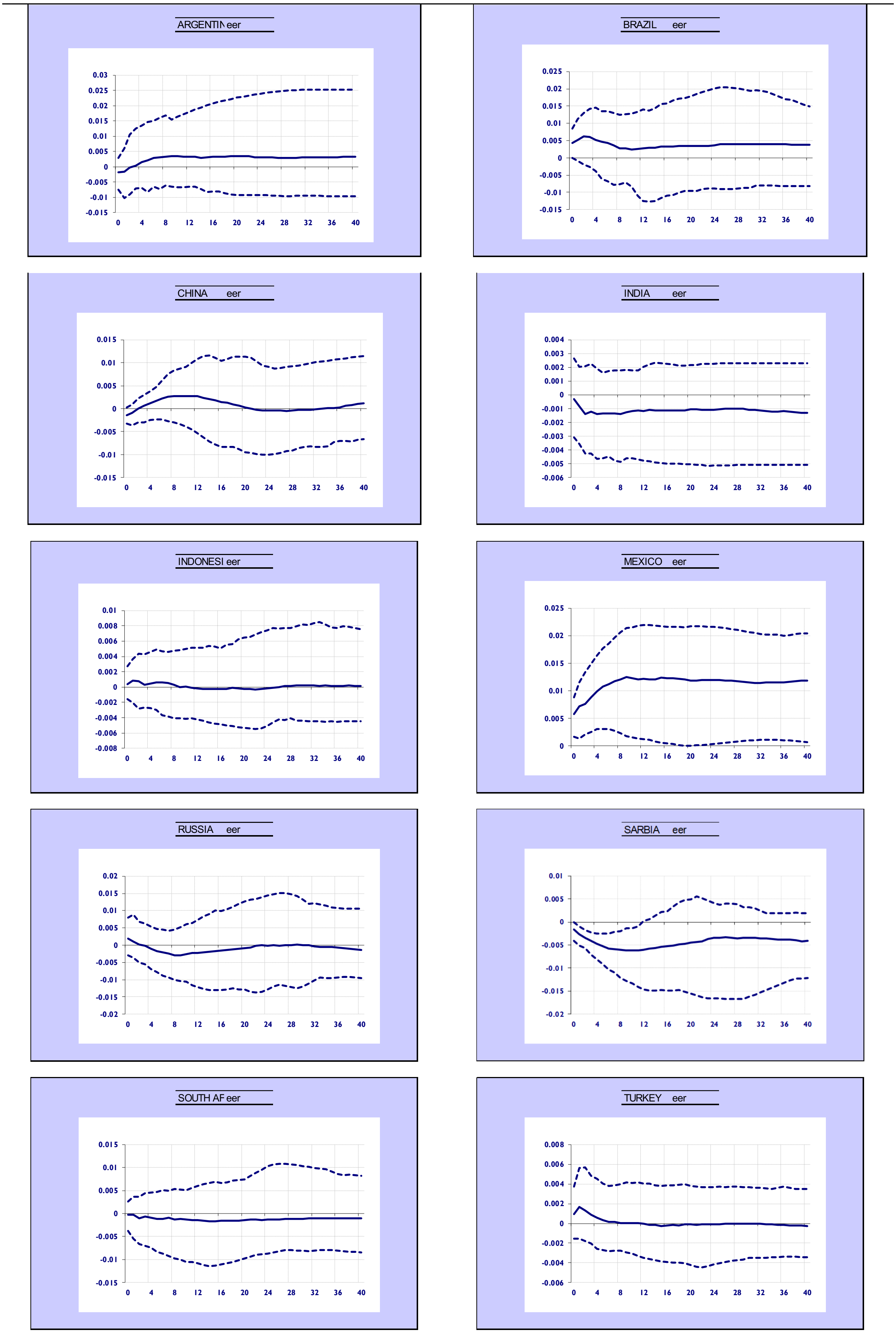
SOUTH AF dy
TURKEY dy

(a)Real GDP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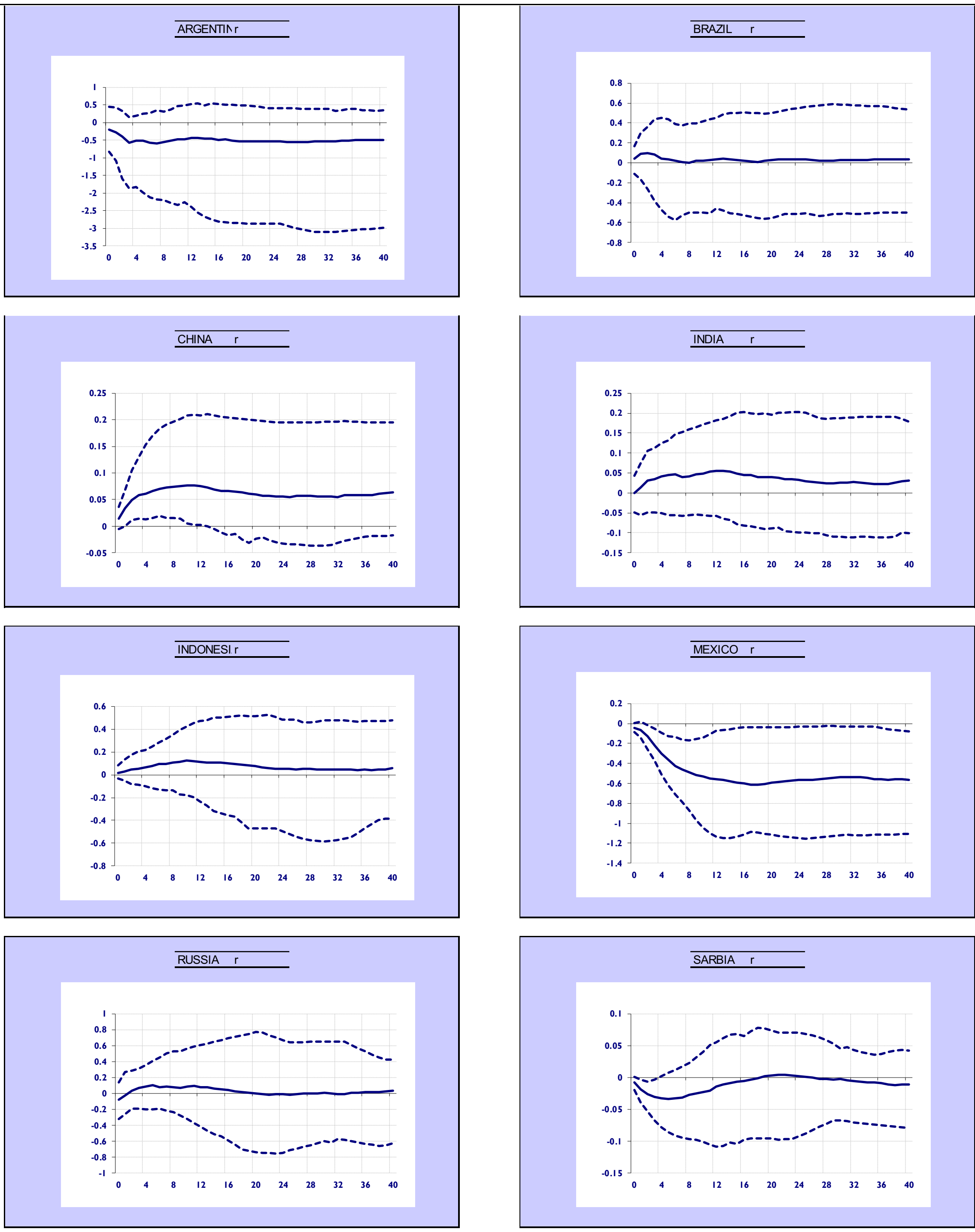
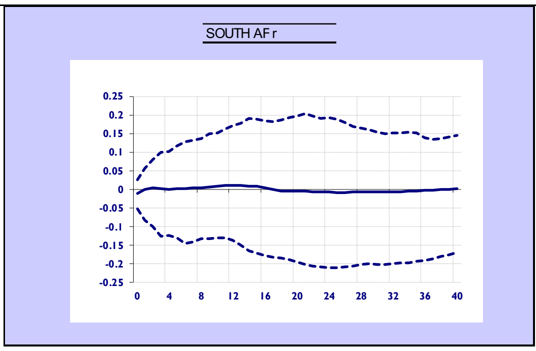
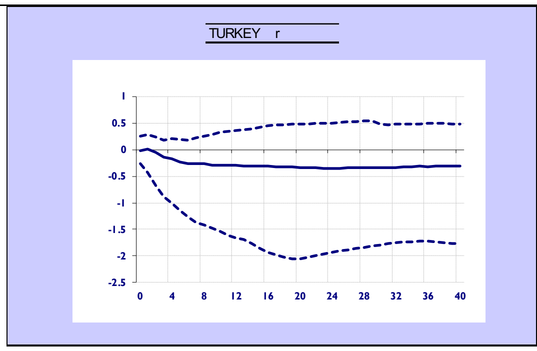
BRAZIL eer
CHINA eer
INDIA eer
INDONESI eer
MEXICO eer
RUSSIA eer
SARBIA eer
SOUTH AF eer
TURKEY eer
0 4 8 12 16 20 24 28 32 36 40

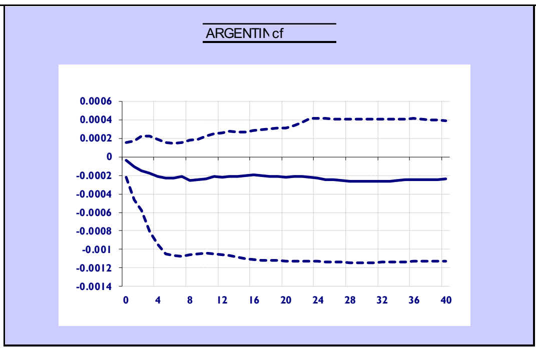
(b)Effective Exchange Rate

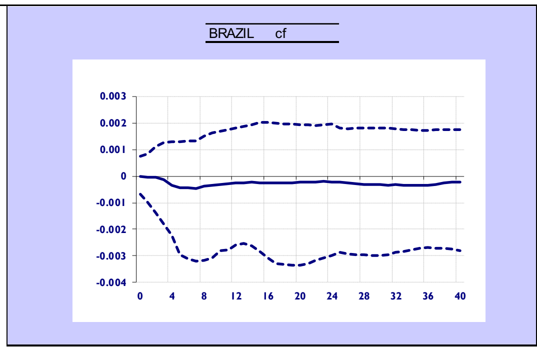


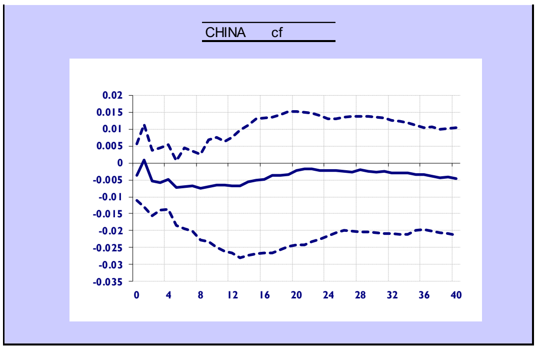


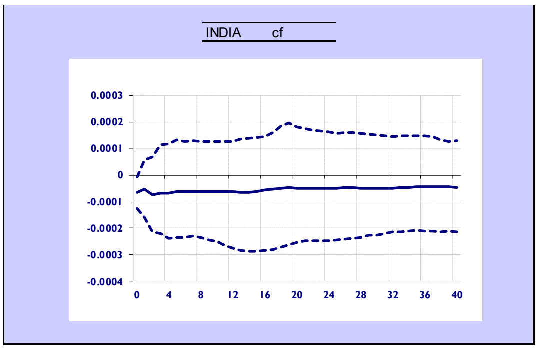


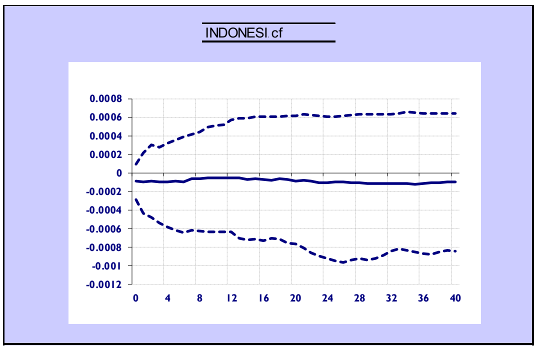
(c)Monetary policy

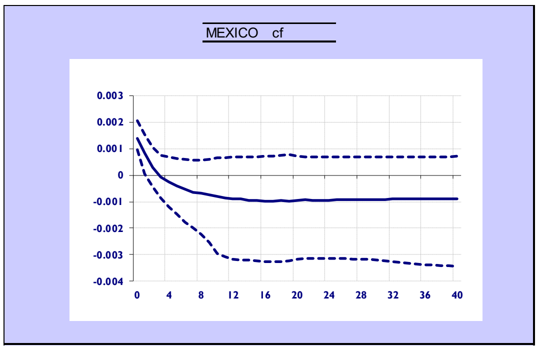


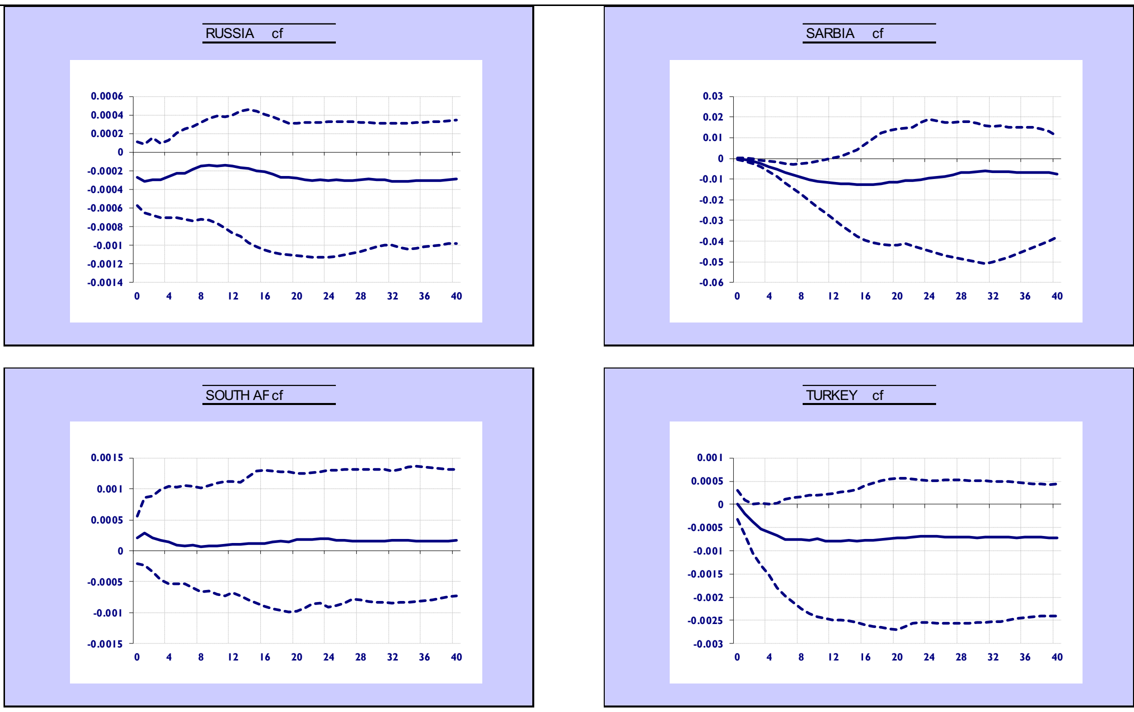












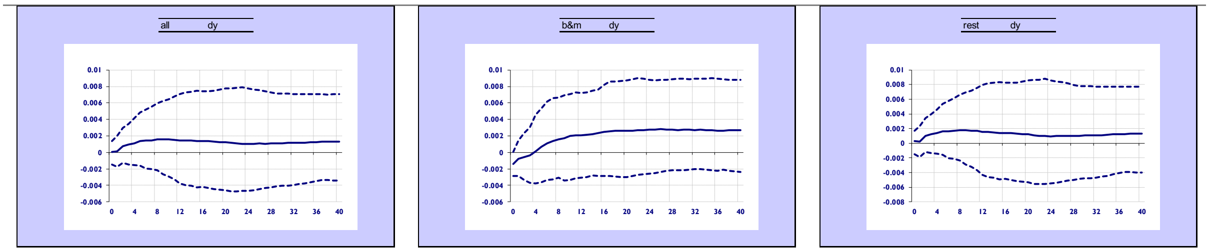
(d)Portfolio inflows

Figure 3 10 Impulse responses of EMEs to US UMP shock: A positive shock on balance sheet

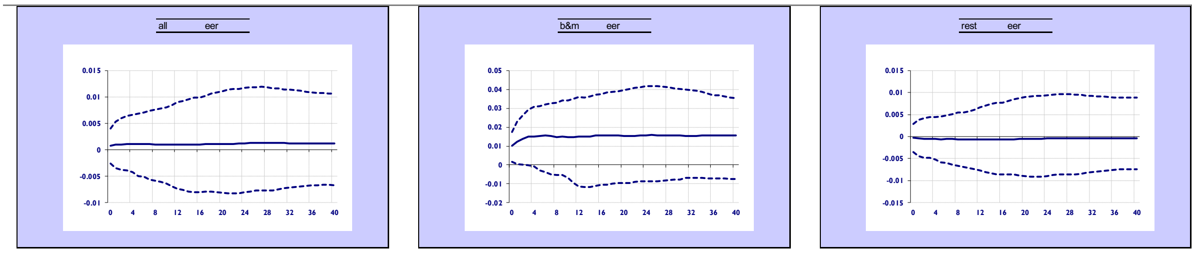
Note: All impulse responses estimations are cumulated impulse responses

Moreover, we examine the mean average impulse responses of EMEs to the balance sheet shocks in two groups: Brazil and Mexico vs. rest of EMEs (figure 3.11). The share of bond inflows from US to Brazil and Mexico count for more than half of the total gross inflows. The results of group comparison allow us to exploiting whether the heterogeneities of international spillovers the US unconventional monetary policy to EMEs are related with geographical difference. We find the mean average impulse estimates of two groups typically have a larger dispersion, with Brazil and Mexico response more vulnerable to US UMP shocks on GDP, exchange rate and policy rate, while the responses of portfolio flow between two group are close.

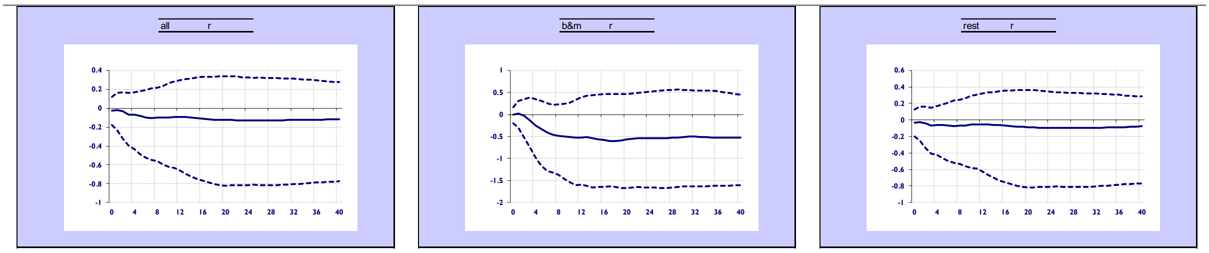
Overall	Brazil and Mexico	Rest EMEs



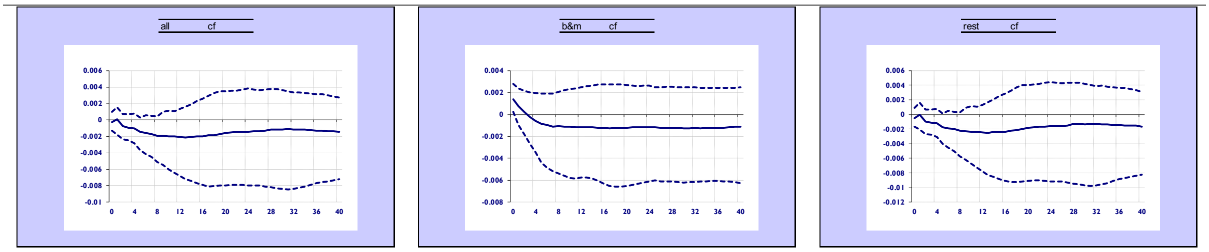
(a) real gdp



(b) effective exchange rate



(c) Monetary policy



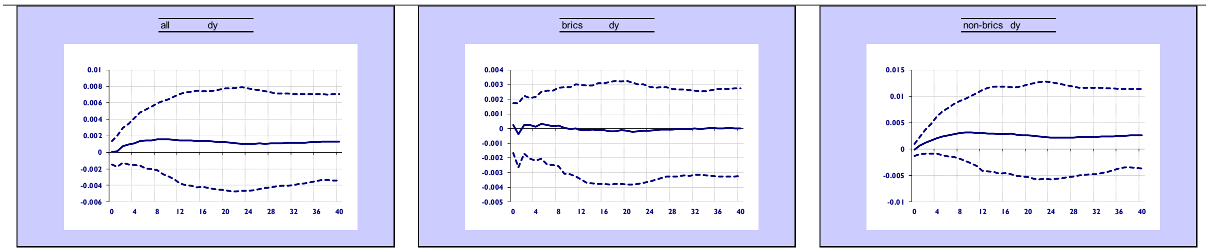
(d) portfolio inflows

Figure 3 11 Mean average responses of EMEs variables to A positive shock on US balance sheet

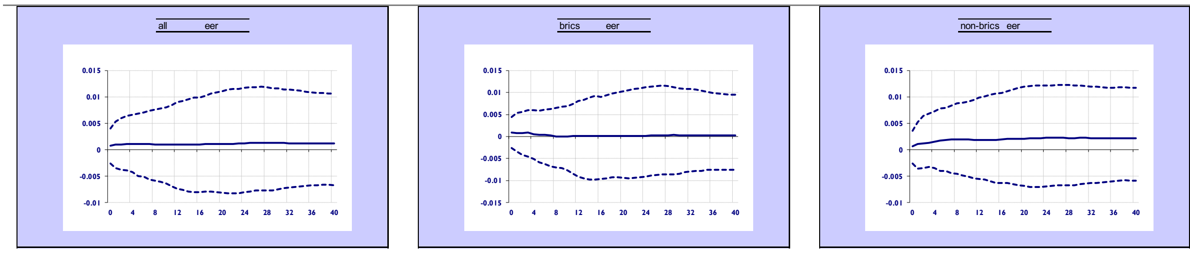
Note: All impulse responses estimations are cumulated impulse responses

And finally, we examine the mean average impulse responses of EMEs to the balance sheet shocks between BRICs and non-BRICs EMEs, where the former has stronger GDP and bond market growth than the later (figure 3.12). We find the mean average impulse response estimates of non-BRICs are more vulnerable to US UMP shocks than BRICs as the impulse responses of BRICs' GDP, monetary policy and exchange rate is smaller than the non-BRICs.

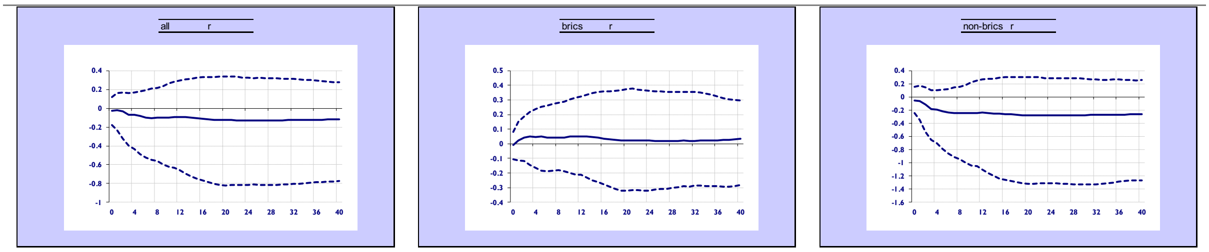
Overall	**BRICS**	**non- BRICS EMEs**



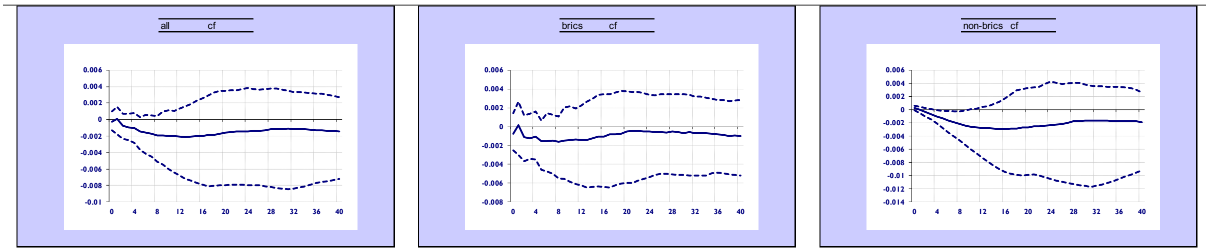
(a) real gdp



(b) effective exchange rate



(c) Monetary policy

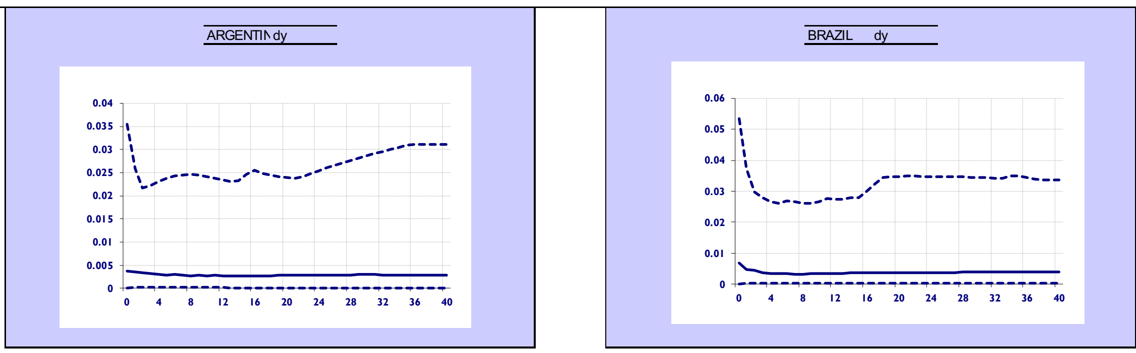


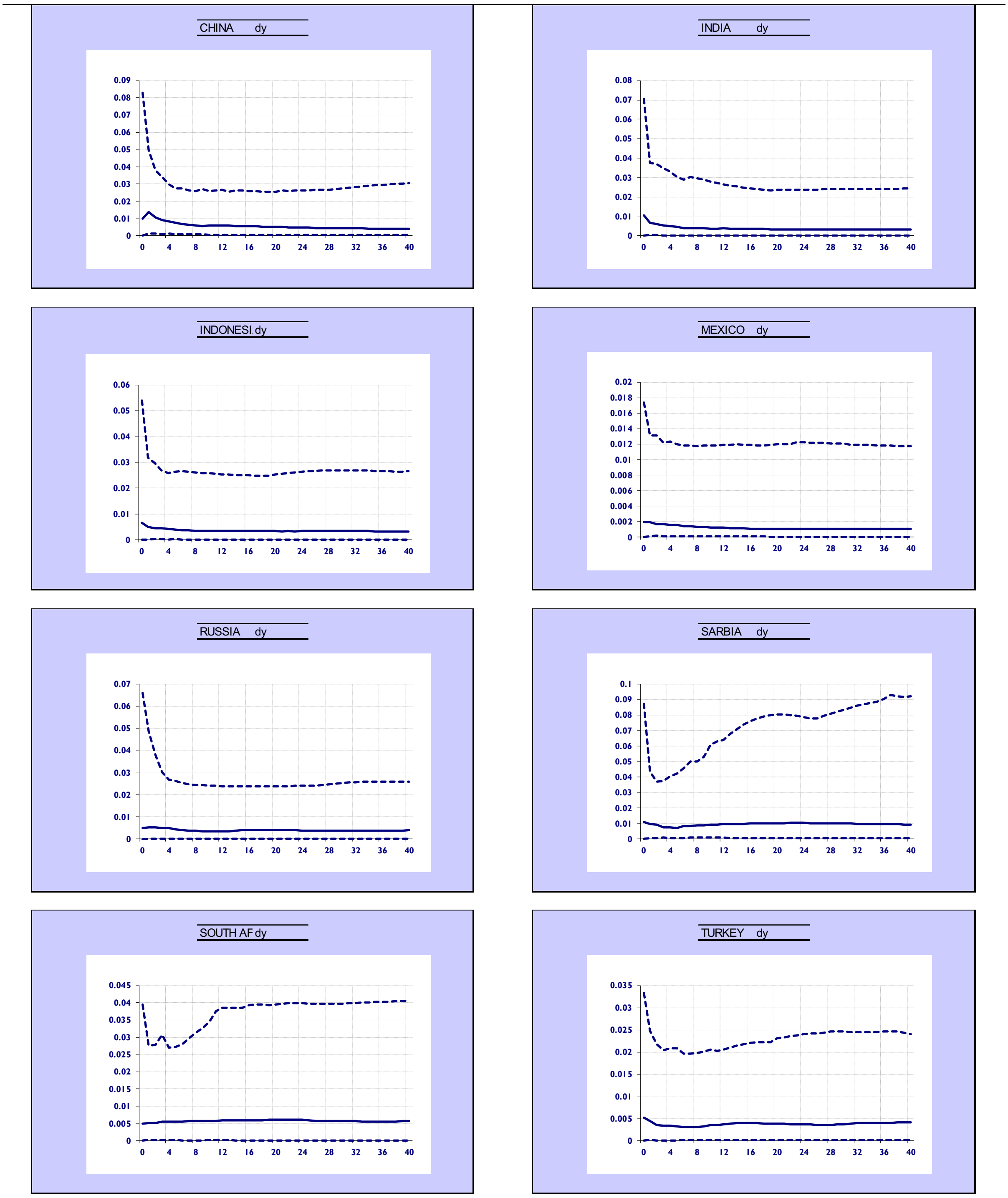
(d) portfolio inflows

Figure 3 12 Mean average responses of EMEs variables to A positive shock on US balance sheet (BRICs and non-BRICs)

Note: All impulse responses estimations are cumulated impulse responses

While in bond flow model, as presented in *Figure 3.13,* we find that impulse responses of EMEs' GDP growth to the positive shock on US balance sheet expansion are all positive, which suggest that the US UMP might not have only prevented US from deflation but also have contributed to overheating EMEs' economies in short-term (Ahmed and Zlate, 2013, 2014; Bowman et al., 2015). Moreover, we find while impulse responses among EMEs have large dispersion, there are common trend within the groups, proving that US UMP is a driver of the global financial conditions in EMEs. And lastly, we find that variables in bond flow model react faster than variables in portfolios.




CHINA dy
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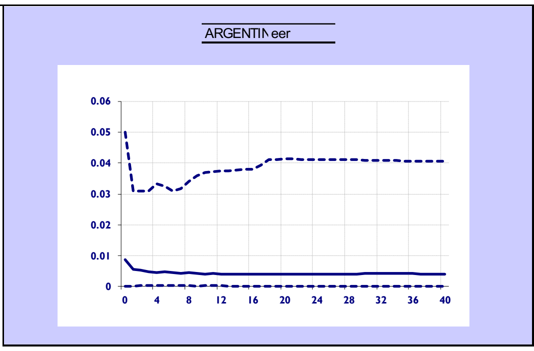
SOUTH AF dy
TURKEY dy

(a)Real GDP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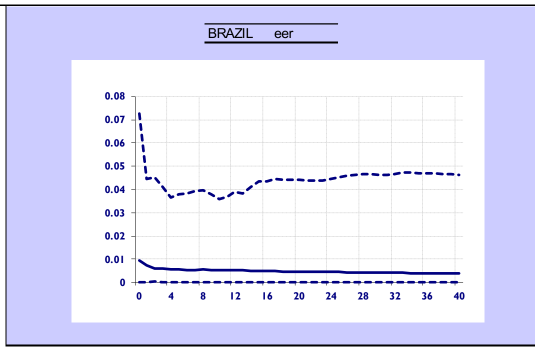
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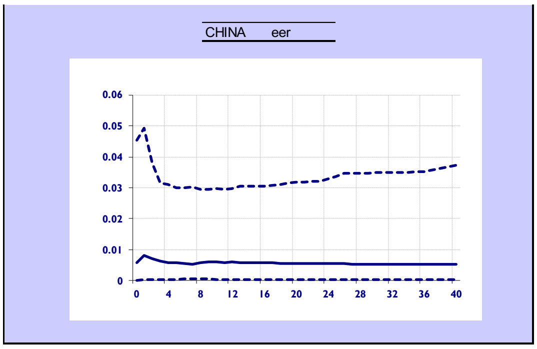
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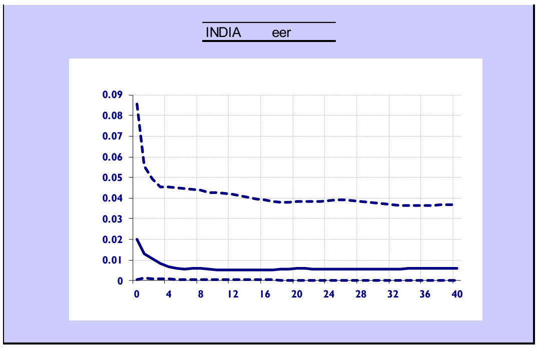
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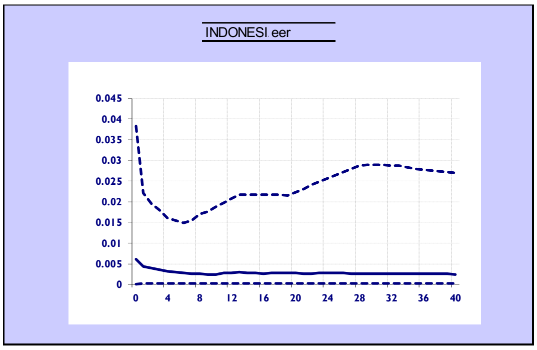
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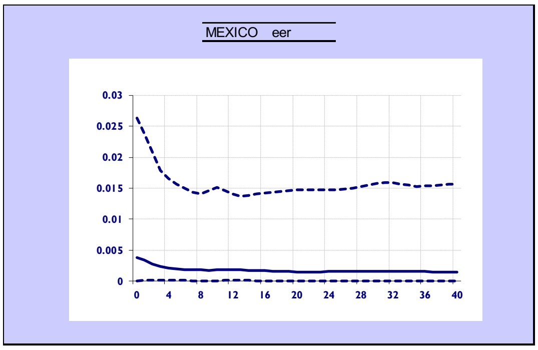
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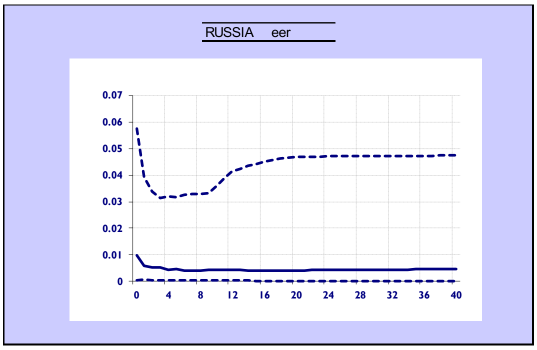
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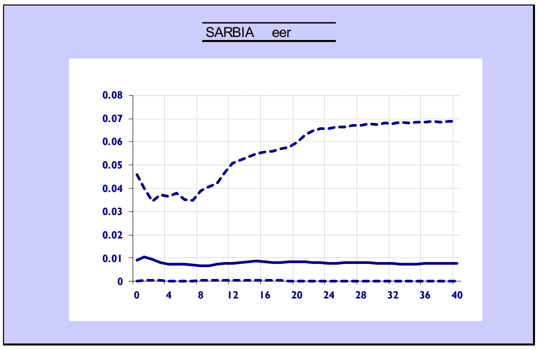
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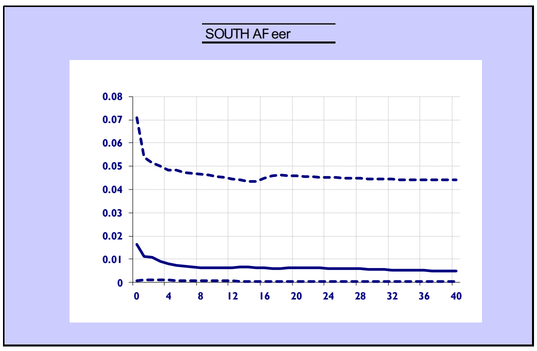
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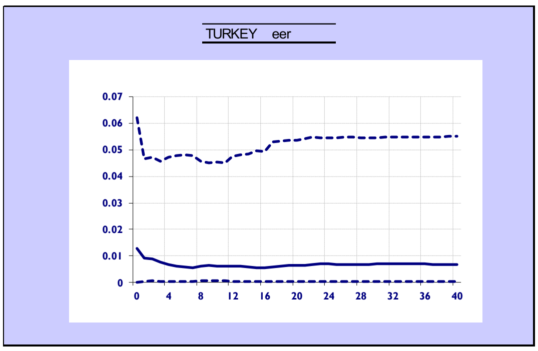
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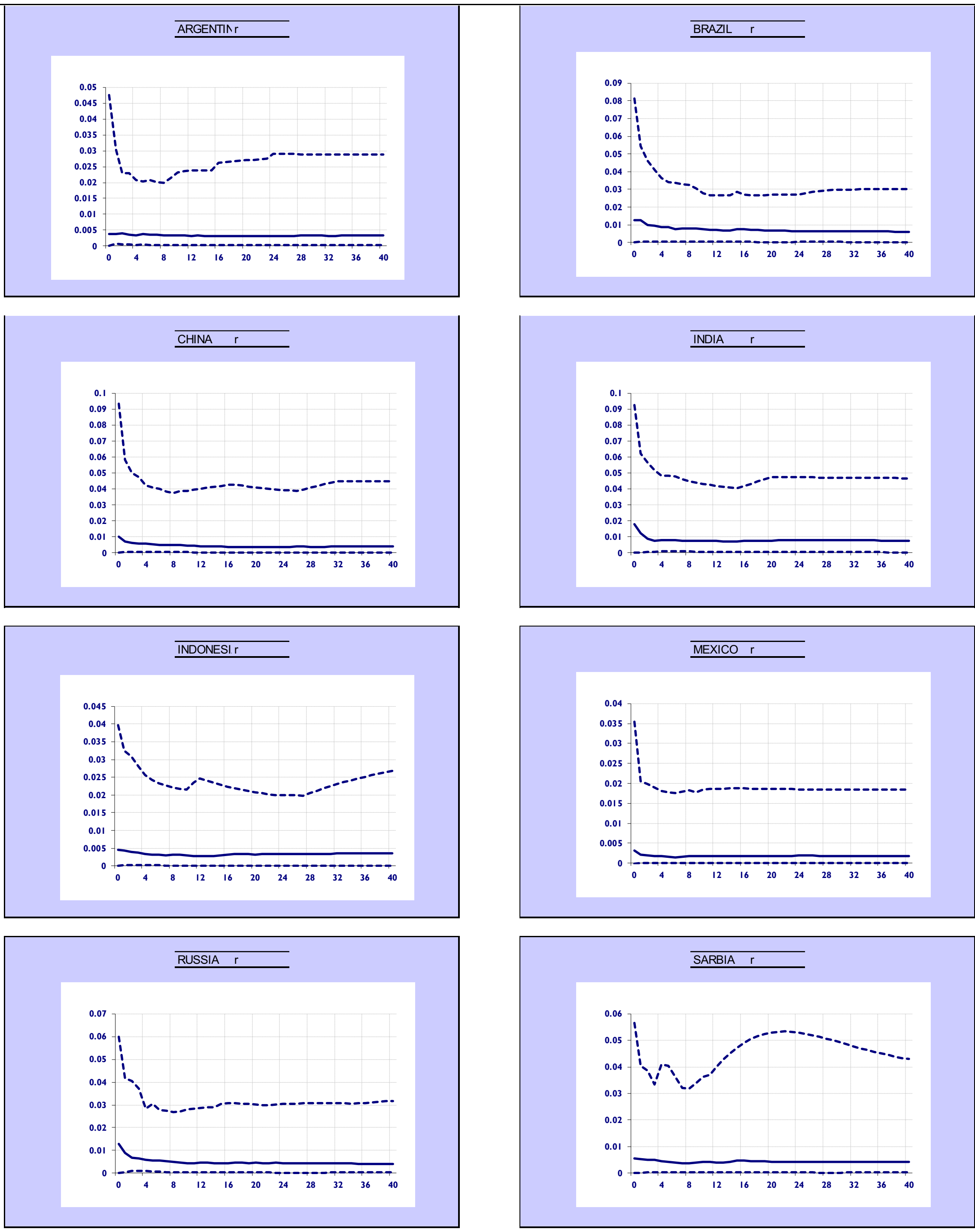
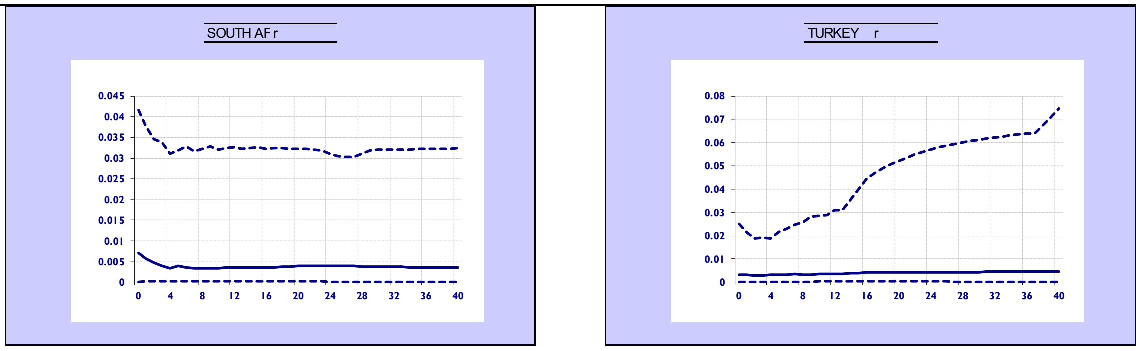
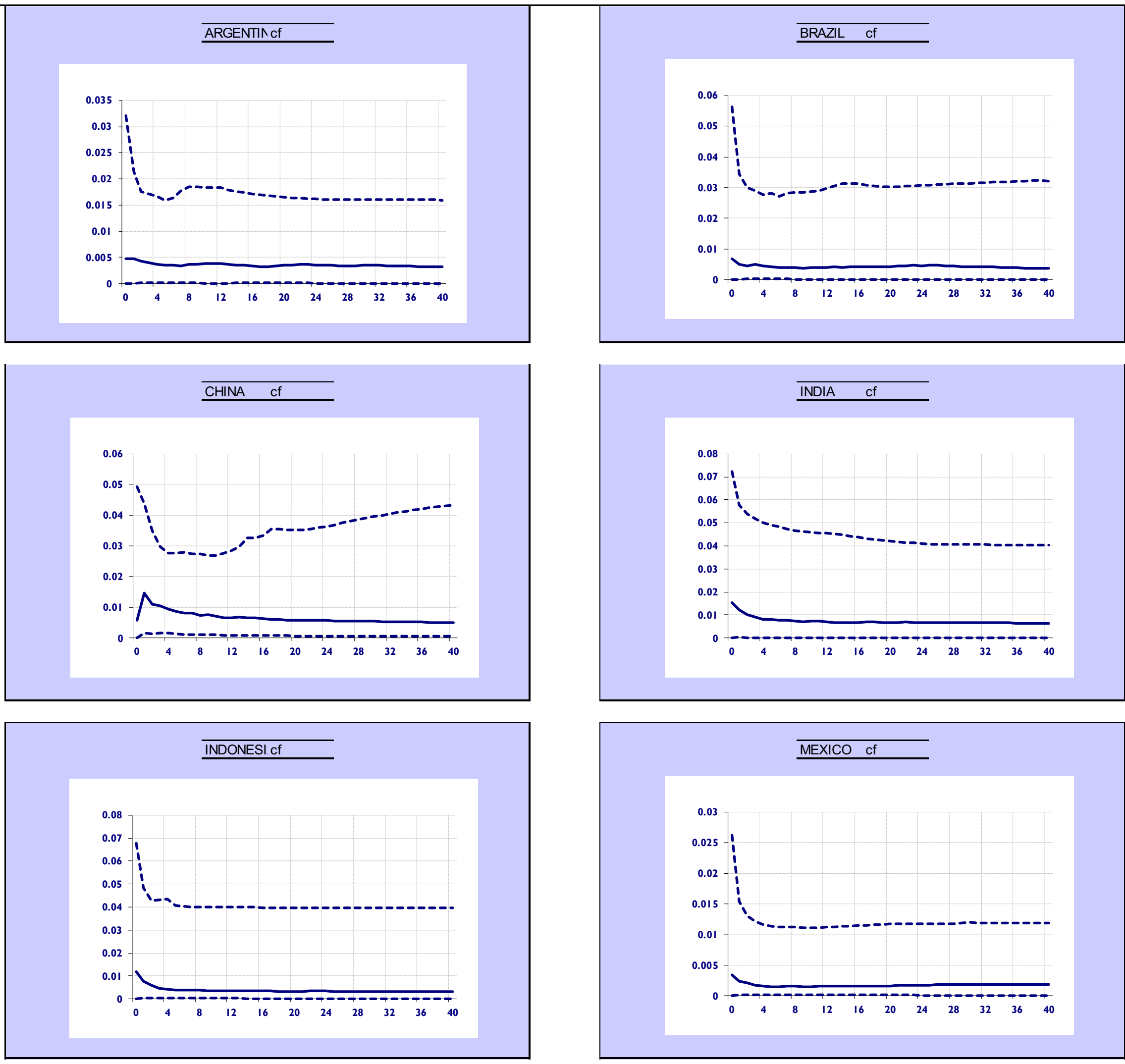
0 4 8 12 16 20 24 28 32 36 40

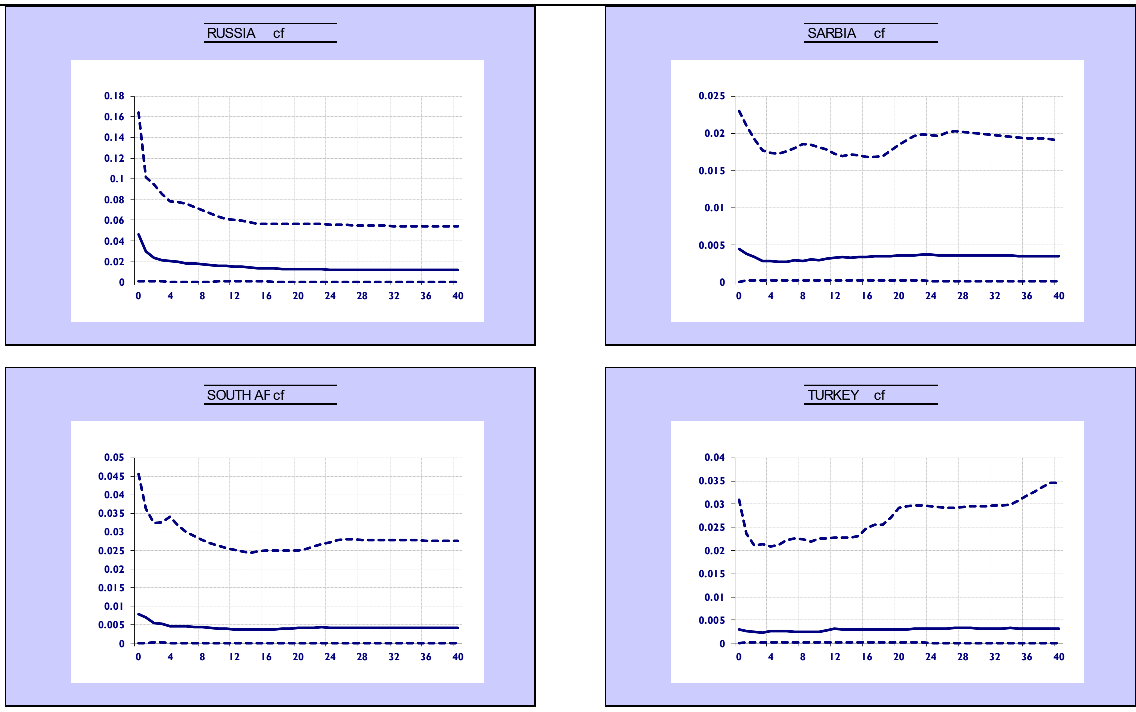
(b)Effective Exchange Rate





(c)Monetary policy





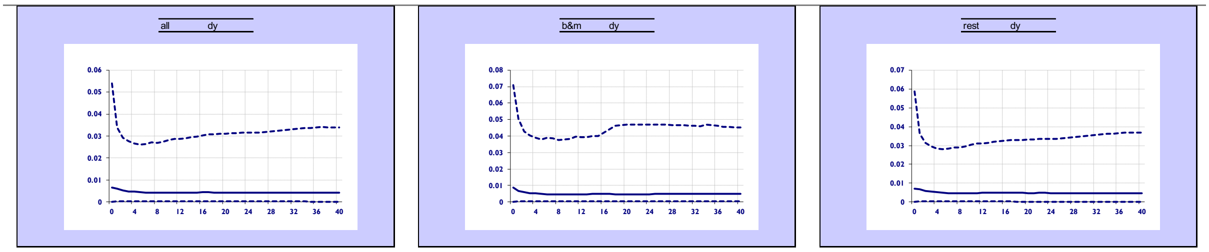
(d)Bond inflows

Figure 3 13 Impulse responses of EMEs to US UMP shock: bond flows

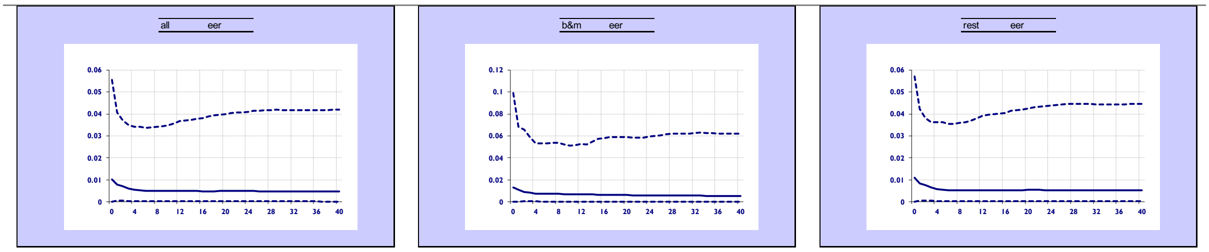
Note: All impulse responses estimations are cumulated impulse responses

Moreover, we examine the mean average impulse responses of EMEs to the balance sheet shocks by bond flows (figure 3.14). We find the mean average impulse estimates of two groups typically have a larger dispersion, with Brazil and Mexico response more vulnerable to US UMP shocks on GDP. Rest of EMEs response more vulnerable by exchange rate and policy rate, while the responses of bond flows between two group are close.

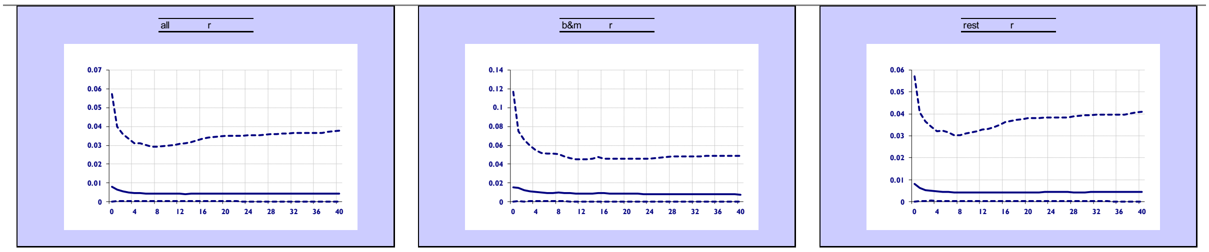
Overall	**Brazil and Mexico**	**Rest EMEs**



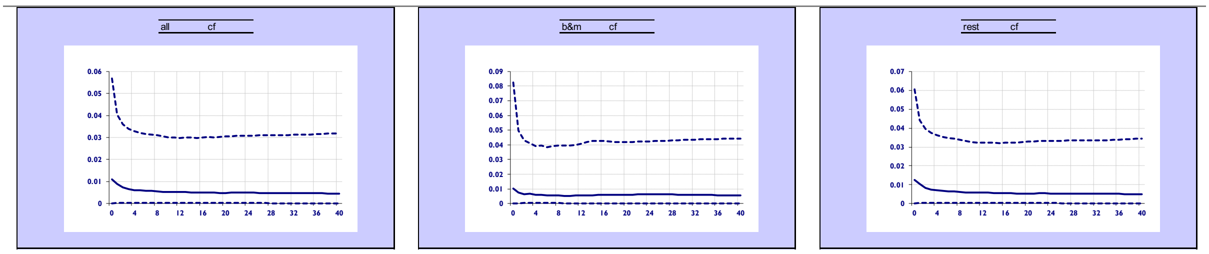
(a) real gdp



(b) effective exchange rate



(c) Monetary policy



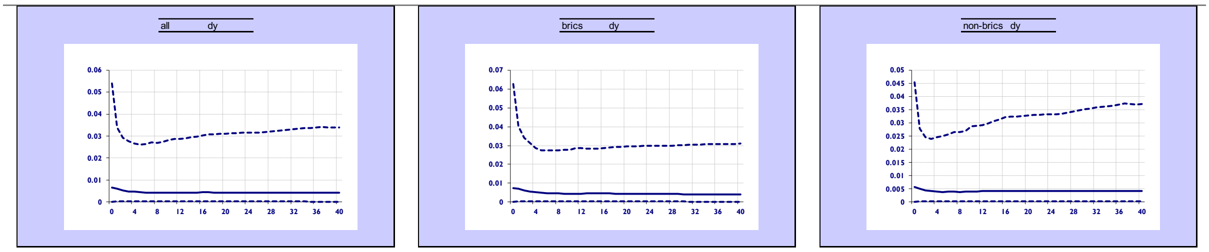
(d) Bond inflows

Figure 3 14 Mean average responses of EMEs variables to A positive shock on US balance sheet (bond flows)

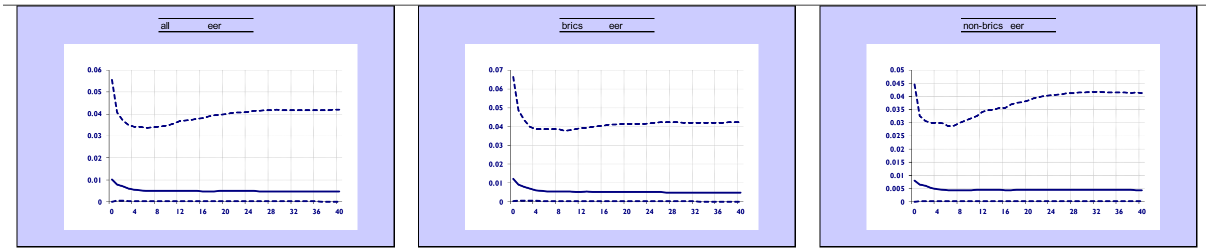
Note: All impulse responses estimations are cumulated impulse responses

And finally, we examine the mean average impulse responses of EMEs to the balance sheet shocks between BRICs and non-BRICs EMEs by bond inflows (figure 3.15). We find the mean average impulse responses of non-BRICs are more vulnerable to US UMP shocks than BRICs as the confidence interval of BRICs is smaller than the non-BRICs.

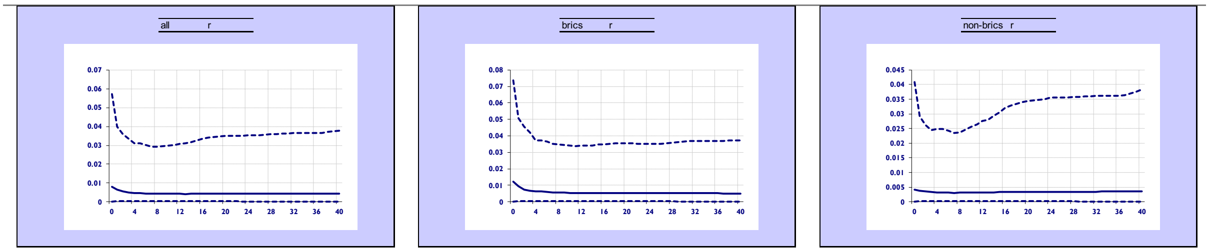
Overall	**BRICS**	**non- BRICS EMEs**



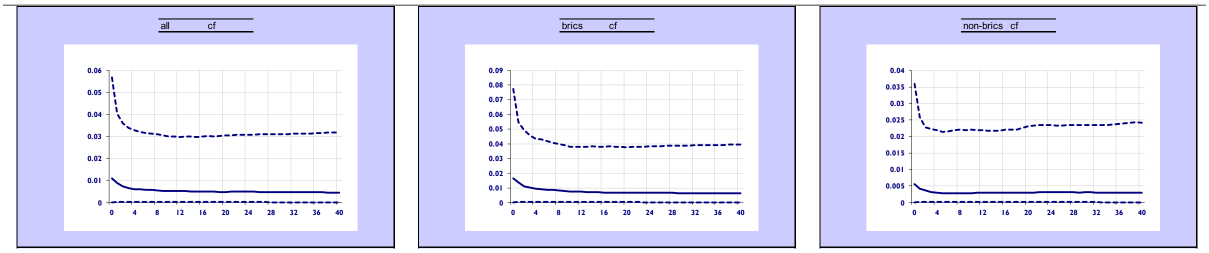
(a) real gdp



(b) effective exchange rate



(c) Monetary policy



(d) Bond inflows

Figure 3 15 Mean average responses of EMEs variables to A positive shock on US balance sheet (bond flows)

Note: All impulse responses estimations are cumulated impulse responses

3.6 Conclusion

This paper examines the implications of US unconventional monetary policy and its continued effects on emerging market portfolio inflows with an emphasis on quantifying the pushing effects in a dynamic panel data model while exploring the role of portfolio flows in shock transmissions through a GVAR model. We use US TIC Treasury data to extract changes of emerging market economies portfolio inflows that directly from US. A key advantage of extracting the magnitude of the monetary surprises directly from the TIC data is that we can directly estimate US investor long-term position and portfolio inflow changes to emerging market economies while easily controlling for a variety of push and pull factors. We quantify the distributional impact of US unconventional monetary policy on emerging-market portfolio inflow along with a consideration of emerging markets' experience between bond and portfolio inflow.

We find that both portfolio flows and bond flows toward EMEs appear to be significantly driven by US unconventional monetary policy while we find no evidence that the equity inflows to EMEs are driven by US UMP. Moreover, we find that the expansionary monetary policy of US has a negative effect on portfolio and bond inflows to EMEs in short-term while a positive sign is indicated in our DPD models. These are in line with the theory, lowers real interest rates do encourage investors to take more risks and bring the yield on assets down to match the short-term interest rate in the short term (Hogan, 2021). While, in a long-term view, as the spreads among assets decrease, investors will be seeking for riskier assets and eventually shift investment abroad (Hogan, 2021).

We also examine the role of portfolio and bond flows in transferring the international spillovers from US UMP to EMEs through a GVAR model. We find that US UMP which leading to an increase in bond outflows, in turn, the rise of bond inflows to EMEs results in a significant and statuary response by financial variables (either exchange rate or interest rate), proving that US UMP is a key driver of the global financial conditions in EMEs as in Ouerk (2023). This may reflect the transmission of international spillovers of US UMP work much through the same channels as the conventional policy (Ahmed and Zlate, 2013, 2014; Bowman et al., 2015).

We find that while there is evidence of cross-country heterogeneity, these results represent general common trends especially in the case of bond inflows. We find similar shapes between the individual impulse response plot. Which might be explained as US UMP contribute to the emergence of the global financial cycle by cross-board bond flows (Ouerk, 2023; Dées and Galesi, 2021; Inoue and Okimoto, 2022).

While responses by financial variables are significant, we find little evidence answering to what extent the macroeconomic factors such as inflation are affected by US UMP shocks. In a long-term view, as the spreads among assets decrease, investors will be seeking for riskier assets and eventually shift investment abroad (Hogan, 2021), which may lead to inflationary pressures and destabilisation of interest rate in EMEs. This is what we will discuss in chapter 4.

Chapter 4 International spillovers of US unconventional monetary policy on emerging market economies: exploring the heterogeneity among EMEs

4.1 Introduction

In chapter 3, we started with the question of measuring the international spillovers of US UMP to EMEs by bond and portfolio inflows, estimating a Global VAR model and a dynamic panel data (DPD) model. We find that both portfolio flows and bond flows toward EMEs appear to be significantly driven by US unconventional monetary policy while we find no evidence that the equity inflows to EMEs are driven by US UMP. Moreover, we find that the expansionary monetary policy of US has a negative effect on portfolio inflows to EMEs in short-term. This is in line with the theory, lowers real interest rates do encourage investors to take more risks in US financial market and bring the yield on assets down to match the short-term interest rate in the short term (Hogan, 2021), which may lead to deflationary pressures and destabilisation of interest rate in EMEs.

As presented in Bowman et al. (2015) and Ahmed and Zlate (2013, 2014), the US unconventional monetary policy had raised issues of the possible side-effects of unconventional measures in addition to the large capital inflows, such as currency appreciation pressure, and consumer and asset price inflation pressures, in emerging economies, especially the ones whose currencies are pegged to the dollar. Given the dominance of the US economy and finance in global markets, the impact of the US UMP to the rest of the world, especially emerging economies, is not surprising. The normalization of

US UMP has also profound implications for global financial conditions and capital flows (Forbes et al., 2013; Fratzscher et al., 2014; Chen et al., 2016). And the associated growing importance of international spillovers of US UMP shocks on other economies has given impetus to academics, and policymakers alike to devote more efforts to understand the relevant transmission channels and spillovers in a global content (Georgiadis, 2015; Georgiadis, 2016). However, this literature mainly relies on studies of various yields of securities rather than real economic activities, thus offers limit efforts to guide policymakers in improving economic resilience to changes in external monetary policy. Moreover, this literature failed to explore heterogeneity issue of international spillovers from US UMP to EMEs.

Using global VAR models, we assessed the possible effects of US UMP on both financial and macroeconomic conditions in EMEs, focusing on inflationary pressure from credit shocks. Our study contributes to Global VAR-based literature in two ways. We take account the interaction between US UMP and financial and macroeconomic factors in EMEs (Georgiadis, 2015, 2016) through a multilateral Global VAR model. And We also try to explore whether different ways of UMP shock identifications that related with bond inflows have different impacts on financial and macroeconomic factors and whether the co-movements exist between countries (Ouerk, 2023; Dées and Galesi, 2021; Inoue and Okimoto, 2022). The sample and data remain same, which includes 10 emerging economies and quarterly data spanning from 2008Q3 to 2018Q2.

By theory, in a short-term view, the increasing in interest rate differentials between US and EMEs encouraged vulnerable capital flows to EMEs, seeking for higher returns (Bernanke, 2017). Meanwhile, the Gross Domestic Product (GDP) of EMEs increases duo to the increasing exports demand which makes aggregate demand outpacing the growth of the supply, and thus leading to increases the output gap and inflation (Bowman et al., 2015). The result is that the nominal interest rates have suffered an upward pressure due to the rise of inflation rates in a long run (Bowman et al., 2015), causing interest rate risk as indicated by fisher effect theory (Gagnon et al., 2011). At the meantime, the rise in inflation leads to the depreciation of EMEs' currency, according to the purchasing power parity theory (Rogers et al., 2014, 2018). Therefore, we expected that interest rate and inflation should move at same direction while exchange rate will do the opposite. And we expect a generally positive response of GDP to UMP shocks.

The key findings are that US UMP shocks tend to have a greater impact on many EMEs than on the US economy, which is consistent with previous literature (Bowman et al., 2014; Bowman et al., 2015; Jordan, 2016; Chen et al., 2016; Georgiadis, 2015, 2016; Garratt et al., 2016). Meanwhile, the impulse responses of US in corporate spreads model have been greater on GDP growth and real effective exchange rate than in term spread model domestically. This is consistent with Bowman et al. (2014) that purchasing US treasuries to lower the term spread may be a weak tool and reducing risk premium by allowing indirect liquidity for bank section generates much more effects stimulating GDP growth as well as an appreciation of domestic currency. Moreover, while the impulse responses of inflation, monetary policy and exchange rate have been diverse in the emerging economies, the direction of impulse responses are in general the same by two models which may partly explain the divergence in real and financial structure as well as optimal objectives of central bank in the responses to external financial shocks.

The rest of this study is structured as follow: Section 4.2 provides the literatures related to measuring the international spillovers of US unconventional monetary policy to EMEs. Section 4.3 presents details of the empirical model including model specification, the data, the shock identification process, and the essential test for ensuring the stability of our GVAR model. Section 4.4 and 4.5 attempts to quantify the magnitude of US unconventional monetary policy shocks to EMEs. And in section 4.6, we conduct a robustness check for Global VAR model to ensure whether the heterogenous responses are subject to the change of shock indicator. Finally, section 4.7 provides a summary of the key findings.

4.2 Literature reviews

So far, great number of empirical studies that based on the bilateral model methodology could give a certain answer that the international spillovers of US UMP to EMEs do exist and transmission channels through which the shocks transferred (Gurkaynak and Wright, 2011; Fratzscher et al., 2016). They share the commons idea that the US UMP had raised issues, such as the large capital inflows, currency appreciation pressure, and consumer and asset price inflation pressures, on emerging economies, especially the ones whose currencies are pegged to the dollar (Ahmed and Zlate, 2013, 2014; Bowman et al., 2014, 2015). And the recent studies also point out that advanced economies are more likely affect by US UMP through the exchange rate channel while effect channels vary among EMEs with substantial differences in the impulse responses to the US UMP shocks. (Bowman et al., 2014, 2015; Jordan, 2016). Moreover, the US UMP generate considerable international spillovers to EMEs, which are generally found to be larger than the domestic effects. The result also suggest that UMP had larger spillovers per unit of surprise than conventional policy.

This literature helps to clarify the channels through which spillovers of US UMP transfer to other economies, though most have focused on limited number of the small open economy (Fratzscher, LoDuca, and Straub, 2012). They argue that the responses to international spillovers of the US UMP depend on the channels of transmission as well as the relative strength of these channels. There have few distinguished and discussed stylized international spillover channels that include portfolio rebalancing channel, the exchange rate, and 'news' (Bauer and Neely 2014; Ostry and Ghosh, 2013; Ghosh et al., 2013; Claessens et al., 2013). Most of studies found that advanced economies are more likely affect through the international financial integration while effect channels vary among EMEs with substantial differences in the impulse responses to the US UMP shocks. (Claessens et al., 2013; Bowman et al., 2015; Jordan, 2016; Chen et al., 2016).

One of the main transmission channels of US unconventional monetary policy is the portfolio rebalancing channel, whereby, in a context of low yields and supply reduction of US long-term bonds, investors tend to shift their investments towards EMEs with higher expected returns and risks. Meanwhile, cyclical factors and structural factors works together to stimulate the capital inflows toward EMEs. Such factors are usually referred as 'push' and 'pull' factors in much of the empirical analysis (Koepke, R., 2019). Candidates include GDP growth, inflation, and exchange rate.

In addition to portfolio rebalancing channel, another most obvious channel of international spillover effects is the exchange rate channel (Fratzscher et al., 2014). The rebalancing of portfolio flows during the QE resulted in a depreciation of US dollar and therefore, creating appreciation pressure in EMEs, which not only lead to sharp rising in security prices of EMEs but also result in reduction of export competitiveness. In response of this, EMEs had generally adopt the tighten monetary policy to defend the value of their currencies. Indicators used in this literature were bilateral exchange rate or real effective exchange rate. Fratzscher (et al., 2012; Fratzscher et al., 2014) argue that the role of the exchange rate in the international spillovers depends highly on the exchange rate regime and related management policy.

For example, EMEs who suffer moderate external shocks on exchange rate may benefit from adoption of managed floating system. Moreover, a managed floating exchange rate that depreciates in response to an easing in the US monetary policy may also affects the magnitude of international spillovers caused by expenditure switching. However, managed floating exchange rates would be poor in response to an easing of the US unconventional monetary policy for economies who hold huge number of foreign reserves assets and run a fiscal surplus (Georgiadis, 2016; Fratzscher et al., 2012; Fratzscher et al., 2014; Fratzscher et al., 2016). But another explanation of this literature suggests that the flexible exchange rate depreciating in line with the US dollar in response to a monetary policy easing would probably lead to a current account reversal in long-term if the gains from home currency depreciation are relatively small to the loses (Fratzscher et al., 2016).

Alternatively, recent studies figure out that the US UMP can influence real long-term interest rates by affecting market expectations or so call 'news' (Bauer, and Rudebusch, 2013; Bauer, and Neely 2014; Ostry and Ghosh, 2013; Georgiadis, 2016). For instance, the central bank lowers the real interest rate if it could induce the public to expect a higher price level in the future. Since long-term rates are prima facie averages of expected short-term rates, the expectation channel would tend to flatten the entire yield curve when policymakers commit to stay at the lower bound. Moreover, a conditional commitment to keep the very short-term rate at the lower bound for long enough should also prevent inflation expectations from falling, which would otherwise raise real interest rates and curtail spending. In either case, because of temporary reductions in the domestic currency and borrowing cost against US dollar, demand for credit increases domestically and banks expand credit dramatically. Households and corporate sectors can gain from accumulation of debts that denominated by foreign currency to enjoy the currency appreciation against US dollar.

Moreover, implementation of a variety of UMP measures allows researchers measuring the international spillovers of US UMP through various transmission channels. Some papers were relying on event studies of the Federal reserve's large-scale assets purchase actions, focusing on identifying the spillovers transmission channels of monetary policy rather than the estimations of magnitude of international spillovers (Engel, 2016). Among studies who adopt an event study method, some of them (Fratzscher, LoDuca, and Straub, 2012; Fratzscher, LoDuca, and Straub, 2016) estimate international spillovers through actual asset purchases (such as LASP) channel while others, for example Bauer and Rudebusch (2013, 2014), Aizenman, Binici et al. (2014) and beirne and Neely (2014) focus on policy announcements. Most of them starts from the spillovers from US unconventional monetary policy to global financial markets (Hausman and Wongswan, 2011; Gurkaynak and Wright, 2011; Fratzscher et al., 2012; Rogers et al., 2014).

While others study the effects of US UMP shocks on other countries' equity and bond markets, capital flows, and exchange rates, using high frequency data based bilateral model methods (Craine and Martin, 2008; Ehrmann and Fratzscher, 2009; Wongswan, 2009; Neely, 2010; Hausman and Wongswan, 2011; Gurkaynak and Wright, 2012). Real interest rate related indicators implement in this literature. For example, Lim, Mohapatra, and Stocker (2014) conduct a study on the effects of US UMP on net financial inflows to EMEs by comparing yields of various securities. The study mainly examines transmission mechanism through liquidity, portfolio balancing, and confidence channels. The results show that US UMP had led to sharp rising in prices of bond and equity markets domestically and globally, with some variation across markets. Moreover, although portfolio (especially bond) flows tend to be more sensitive than FDI to relevant shocks measured, only small impacts on portfolio flows in EMEs have been detected.

However, the evidence from EMEs based studies suggest that the spillovers of US UMP on individual economies are various and they keep change over time. Some researchers believe such difference mainly depend on the type of shocks. For example, instead of policy announcements, Bowman et al. (2015) as well as Fratzscher, LoDuca, and Straub (2016) estimate international spillovers through actual asset purchases (such as LASP). The various methods of identifying the US UMP indicators, thus, lead to failure of bilateral model to capture the spillovers from US UMP that affect all economies. While other researchers believe such difference does not seem to result from a change in the type of shocks. For instance, Dahlhaus and Vasishtha (2014) and Lombardi and Zhu's (2014, 2018) believe the reason seems to be more structural, tied to the UMP indicators used.

Dahlhaus and Vasishtha (2014) examined the potential impact of US UMP on portfolio flows to 23 emerging market economies by using a vector autoregressive model. They defined 'policy normalization shock' as a shock that increases in the yield spread of US long-term bonds as well as the expectations of monetary policy, while leaving the policy rate unchanged. The result showed that Federal Reserve's UMP which stimulus liquidity and eventually decrease in interest rates could have substantial effects for capital flows to EMEs. However, the impact of this shock on portfolio flows is expected to be economically small comparing with previous studies (Gurkaynak and Wright, 2011; Fratzscher et al., 2013).

Similarly, Lombardi and Zhu's (2014, 2018) proposed a new "shadow policy rate" for the US economy, which represent the various features of US UMP. The shadow policy rate was measured separately by changes in term spreads of various maturities and asset purchases by the Federal Reserve during different QE periods. The results of structural vector autoregressive (VAR) models indicated that the shadow policy rate helps identify monetary policy shocks that better reflect the Federal Reserve's UMP measures. The simulation indicated that the shadow policy rate tracks the real effective federal funds rate very closely even when the ZLB becomes binding. Therefore, it provided a reasonable support for the view that the various international spillovers of US UMP on individual EMEs were tied to the unconventional monetary policy indicators used during the unconventional monetary policy period.

Ouerk (2023) and Dées and Galesi (2022) also investigated the effects of US UMP on sovereign yields, foreign exchange rates, and stock prices in emerging market economies, try to evaluate how these effects depend on country-specific characteristics. A strong response is found upon the asset prices of EMEs, mainly those of sovereign bonds, to US UMP announcements. However, the results also indicate that these responses were not outsized with respect to a model that considers each country's currency regime and vulnerability to US financial conditions.

Although previous literature yields valuable outcomes regarding the relation between US unconventional monetary policy and portfolio flows, it is necessary to treat macroeconomic activities seriously in econometric models as it is for good policymaking. In context of modelling complex macroeconomic interactions and exploring the heterogeneities of international spillovers of US UMP to EMEs, lots of Global VAR based studies have emerged (Ouerk, 2023; Dées and Galesi, 2022; Georgios 2015; Chen et al., 2016; Kempa and Khan, 2017). Global VAR approach has advanced the studies of international spillovers of US unconventional monetary policy. On one hand, it allows the entry of a large number of economies thus incorporating the fact that in the global economy more than one of these entities could have a predominant role, without neglecting the power over international trade and financial linkage. On the other hand, the Global VAR approach is capable of incorporating the macroeconomic variables that exist in low frequency data in recent studies (Georgios, 2016; Garratt et al., 2016; Chen et al., 2016).

Recent Global VAR studies of international spillovers of US UMP are mostly modelled by assessing the US UMP shocks identified in bilateral models (such as structural VAR, panel VAR or qual-VAR), considering the involvement of a large number of economies and low frequency data. The results from the mean impulse responses of different groups suggest that the magnitude of spillovers may depend on the receiving country's fundamentals, such as trade and financial integration, de jure financial openness, exchange rate regime, financial market development, labour market rigidities, industry structure, and participation in global value chains.

In paper of Georgiadis (2015; Georgiadis, 2016), a huge variety of macroeconomic variables had been tested though a Global VAR approach. The results pointed to weak evidence that flexible exchange rate regimes help shield bond yields from foreign monetary policy shocks which is in line with the findings of Chen, Griffoli and Sahay (2014). Georgiadis (2016) also suggested that policymakers of EMEs could prevent international spillovers of US monetary policy by enhancing trade integration, domestic financial market development, increasing the flexibility of exchange rates, and reducing frictions in labour markets though these non-monetary measurements are likely to reduce long-run growth of domestic economy.

Chen et al. (2016) advanced the research by estimating a global vector error-correcting model, which not only allow the incorporation of the complex interdependencies but the entry of long-term's adjustment through the error correction term, persuading a stable model that represent the real-world activities. Their paper use Lombardi and Zhu's (2014, 2018) shadow rate as the shock source and found weak evidence that US unconventional policy have persistent effects on emerging market economies' GDP growth, inflation pressure, increase in equity prices, appreciation of exchange rates and decline in foreign reserves.

Besides, Chen et al. (2016) studies the impact of US UMP through an interest rate channel on both the emerging and advanced economies. The macroeconomic interaction is modelled through a global vector error correction model (GVECM) along with two types of shocks delivery from US UMP. One is the US term spread, which is simply the difference between 10-year and 3-month treasury bill. The other is corporate spreads, which is defined as yields of BofA Merrill Lynch US Corporate AAA bonds minus the federal funds rate. The estimated spillovers of US UMP are sizeable and vary across economies. Chen et al. (2016) also finds that the spillover effects to EMEs are generally larger than those found for the US and other advanced economies. The estimates suggest that US monetary policy spillovers contributed to a great increase in asset price and currency appreciation in Brazil, China, and some other EMEs around 2010 and 2011, which is coherent with previous studies. But the response to reduce the US corporate spread and lower the US term spread tend to be diverse among emerging market economies.

Moreover, Ouerk (2023), Inoue and Okimoto (2022) and Dées and Galesi (2021) find that the rise of inflows to EMEs results in a significant response by financial variables, proving that cross-border portfolio flows is an important channel through with UMP shocks of major economies were transferred to the financial conditions in EMEs. And we contribute to this debate by assessing the effects of US UMP on bilateral portfolio flows and the role of portfolio flows in the transmission of US UMP to financial and macroeconomic conditions in EMEs.

We also contributes to previous literature in two aspects. On the one hand, as the data span increase, we can distinguish and separate the effects from EMEs to advanced economies for various indicators of US UMP. On the other hand, we also study the role of US UMP shocks through a Global VAR model which account for the multilateral nature of interdependency and allow us to investigate the impact of US UMP shocks by credit shocks.

4.3 Methodology

4.3.1 Model specification

Like standard Global VAR process developed by Pesaran (Chudik and Pesaran, 2010; Chudik and Pesaran, 2016; Chen et al., 2016), the estimation for Global VAR (p, q) model can be briefly summarized as a two-step procedure. In the first step, small-scale country-specific models are estimated conditional on the rest of the observations. These individual country models are represented as augmented VECM models (denoted as VECMX) which consist with both domestic variables, weighted cross-section averages of foreign variables and global factors.

For the i^{th} economy, the country-specific variable vector x_{it} contains $k_i \times 1$ domestic variables. Stacking the vectors of country-specific variables, a VAR model in x_t obviously would contain ways too many parameters to be estimable unless the number of samples is siginificantly larger than the number of observations. For country i, stead of estimating vectors of foreign variables (x_{-it}) directly enter equations, the Global VAR model creates a foreign vector (x_{it}^*) serving the role of correlation variables in individual country specific VECMX (p_i^*,q_i^*) model and bunding into Global VAR system. x_{it} and x_{it}^* are linked by a fixed weighting matrix $\bar{W}$ ($\mathrm{k} \times k_i^*$) typically constructed using the average value of intra-country data between 2008 and 2009, maintaining a relative consistent of interdependency and the unobserved common effects across economies over time.

The country-specific VARX (p_i^*,q_i^*) models are rewritten in error-correction representation as follow, where for US block the global variable is treaded as endogenous variable and is included in identifying the co-integration relations. While for non-US blocks, the global common variable d_t is treated as strictly exogenous variable. Only the x_{it}^* serve the role as the long run forcing for x_{it}.

$$\Delta x_{0t} = a_{00} + a_{01} * t + \prod \tilde{z}_{i\,t-1} + \sum_{s=1}^{p_{i-1}} \Psi_{is} \Delta z_{i\,t-s} + \Gamma_i * \Delta x_{it}^* + \sum_{s=0}^{r_i - 1} \gamma_{is} \Delta d_{t-s} + \varepsilon_{it}$$

Eq. 24

$$\Delta x_{it} = a_{i0} + a_{i1} * t + \Phi_{i0} z_{i\,t} + \Psi_{i1} \Delta z_{i\,t-1} + \Gamma_i * \Delta x_{it}^* + \sum_{s=0}^{r_{i-1}} \gamma_{is} \Delta d_{t-s} + (\gamma_{i0} - \gamma_{i1}) d_{t-1} + \varepsilon_{it}$$

Eq. 25

where d_{t-s} is the observed global factors ($m \times 1$), $z_{it} = (x'_{it}\ x^{*\prime}_{it})'$, $\tilde{z}_{it} = (x'_{it}\ x^{*\prime}_{it}\ d_t')'$ and $\varepsilon_{it}^{iid} \sim (0, \sum_i)$.

Moreover, testing for the number of co-integrating relations is conducted using Johansen's trace and maximum eigenvalue test statistics as set out in Pesaran et al. (2000) for models with weakly exogenous I (1) regressors. Selecting the number of co-integrating vectors is important since misspecification of the rank of the co-integrating space can have a severe impact on the performance of the resulting GVAR model, with adverse implications for stability, persistence profiles, and impulse responses. The max rank for US block is $(k_{us} + k_{us}^* + m) \times k_{us}$, where k_{us} is the number of endogenous variables, k_{us}^* is the number of corresponding foreign weak exogenous variables, and m is the number of common global variables that is treated as the endogenous variables. Therefore, the potential number of co-integrations in US block is $0 \leq r_{us} < k_{us} + k_{us}^* + m$. While in other blocks, as the global variables are treated as strictly exogenous variables, the total number of co-integrations is$0 \leq r_i < k_i + k_i^*$, where k_i is the number of endogenous variables, k_i^* is the number of corresponding foreign weak exogenous variables. The VECMX models are estimated with rank reduced approach.

While, in the second step, individual country VARX models are integrated and estimated simultaneously as Global VAR model (Chudik and Pesaran, 2016). Considering a GVAR (1,1) model with global term treat as endogenous in country model

$$x_{it} = a_{i0} + a_{i1}t + \phi_i x i_{t-1} + \Lambda_{i0} x i_t^* + \Lambda_{i1} x i_{t-1}^* + \varepsilon_{it} \qquad \text{Eq. 26}$$

$Az_{it} = a_0 + a_1 t + Bz_{it-1} + \varepsilon_{it}$ Eq. 27

Where $z_{it} = (x_{it}, x_{it}^*)$, $\mathrm{A} = (I_i, -\boldsymbol{\Lambda}_{i0})$ and $\mathrm{B} = (\boldsymbol{\Phi}_i, \boldsymbol{\Lambda}_{i1})$

From $x_{lit}^* = \sum_{j=0}^{N} \omega_{lij}\, x_{ljt}$, the structural aggregation weighting matrix W_i which links individual country-specific model with the global one can be readily seen.

$$z_{it} = W_i * x_t \qquad \text{Eq. 28}$$

Thus, stacking across all VARX equations, the resultant stacked system may be rewritten as

$Gx_t = a_0 + a_0 t + Hx_{t-1} + \varepsilon_t$ Eq. 29

where $G_i = A_i * W_i$ and $H_i = B_i * W_i$.

In general, the matrix G is expected to be of full rank and therefore GVAR (1,1) can be restructured as below by multiply inverse matrix G^{-1} on both sides, which is the solution of standard GVAR model. However, in our case the matrix G is not positively defined, as the US block are not entering symmetrically. Instead of multiplying G^{-1} on both sides, we adopt the approach to estimate a simple covariance matrix with block diagonal. The estimations are under bootstrap for 200 times, ensuing the stability of GVAR.

$x_t = b_0 + b_0 t + F \times x_{t-1} + \epsilon_t$ Eq. 30

Where $F = G^{-1}H$ and $\epsilon_t = G^{-1}\varepsilon_t$

4.3.2 Data description

This paper adopts a Global VAR analysis approach to modelling the international spillovers of UMP to EMEs. The variables (table 4.1) examined includes real GDP growth (y), the CPI inflation rate (p), a monetary policy indicator (mp), and real effective exchange rate (eer), which is consistent with most studies in international spillovers of US UMP through Global VAR model. For the US block, the same set of domestic variables are included as in the other economies, but only the non-US real GDP growth as a foreign variable.

Table 4. 1 Detailed Data Description

Variables	Description	Source	Notes
GDP(y)	ln(GDP/CPI)	IMF IFS, national data.	change in GDP; all at 2010 price (Billions of US dollars).
CPI inflation$(\boldsymbol{p})$	logarithm form	BIS	change in consumer price index.
Monetary policy indicator (mp)	Represent for conventional monetary policy	BIS	Short-term policy rate
Corporate spreads (mp)	unconventional monetary policy indicator (A)		Moody's Seasoned Aaa Corporate Bond Yield minus Federal effective funds rate
Term spreads (mp)	unconventional monetary policy indicator (B)		the US term spread between the 10-year and three-

			month Treasury yields
Real Effective Exchange Rate (eer)	logarithm form	BIS	change in Effective Exchange Rate; Real (CPI-based), Broad Indices; 2010=100.
VIX (vix)	logarithm form	CBOE	Change in Volatility Index.

The sample period is from 2008Q3 to 2018Q2, allowing for more observations in QE periods and aftermath. Moreover, capital flows to emerging countries in the short run are mostly determined by global risk appetite. Therefore, the CBOE Volatility Index (VIX) is adopted as approx. form of global risk appetite measurement in a quarterly based.

$$x_{US,t} = (y, eer, mp, \mathrm{p}, VIX)$$

$$x_{US,t}{}^{*} = (y^{*})$$

$$x_{EMEs,t} = (y, eer, mp, \mathrm{p})$$

$$x_{EMEs,t}{}^{*} = (y^{*}, eer^{*}mp^{*}p^{*})$$

$$d_{EMEs,t}{}^{*} = (VIX)$$

Where y stands for GDP, eer stand for real effective exchange rate, mp stand for monetary policy, and p stands for CPI.

The weighting matrix $\overline{W}$ ($k_{\ i} \times k_i^*$) that links $x_{\ it}$ and x_{it}^* is typically constructed as the intra-links between domestic and foreign blocs. Considering the complexity of interdependency with other economies, the weighting matrix can be computed in various ways since it serves as a proxy for the unobserved common effects across the economies. But here in this study, we use the same fixed intra-country weight matrix as in last chapter, which is primary calculated by the intra-country trade data between country j and country i.

We use credit shock indicators that tested in Chudik and Fratzscher (2011) and Ahmed and Zlate (2013, 2014) and Bowman et al. (2014, 2015). Two monetary policy “indicators” are: corporate spreads between the Moody's Seasoned Aaa Corporate Bond Yield and federal effective funds rate and the US term spreads between the ten-year and three-month Treasury yields. For EMEs, we use the policy interest rates as the conventional monetary policy indicators. We estimate two different Global VAR models, one with the US corporate spread as the indicator for the US UMP shocks, the other with the US term spread. Admittedly, the term spreads and corporate spreads may reflect information beyond that captured by US UMP in short-term expectation. At the zero-lower bound, the two spreads continue to reflect the immediate objectives of US UMP measures, namely, to reduce longer-term treasury yields, lows borrowing costs for corporates and households and restore credit liquidity through financial system.

International Monetary Fund (IMF)-IFS database is the primary sources of this study. The IFS database is the most comprehensive and comparable source of Marco-economic statistics for many countries. Nevertheless, there are several issues with the compilation of the statistics, as substantial country differences in terms of time period coverage, and missing, unreported or misreported data, in particular for developing countries. Therefore, we also include Bank for International Settlements (BIS) database along with World Bank and CBOE as our sources for testing.

4.3.2 Basic test for Global VAR

We conduct some basic tests for two Global VAR models (Table 4.2 and appendix table 4.1-4.9). we first conduct the augmented Dickey–Fuller (ADF) and the weighted-symmetric Dickey–Fuller (WSDF) unit root tests for all model variables. The two tests produce broadly similar results. At the 5% significance level, we find that in most economies, the domestic variables are tested to be integrated of order 1 with the exception of some variables being tested to be I (0) or near I (1). Most foreign variables are tested to be I (1), so is the global factor VIX. We also do Trace and Johansen max eigenvalue test for co-integration identification with auto selected lag orders. We also do the weak exogeneity and autocorrelation tests as they the key assumption of Global VAR and the p-value is significant at 5% level. And finally, we impose signal restriction on VIX and term spread ensuring the shocks are transfer through selected UMP indicators rather than risk averse while leave corporate spreads model unrestricted.

Table 4. 2 Overidentify restrictions

	GDP	**EER**	**Monetary policy**	**VIX**
UMP shocks (corporate spread)				≤0
UMP shocks (term spread)			<0	≤0

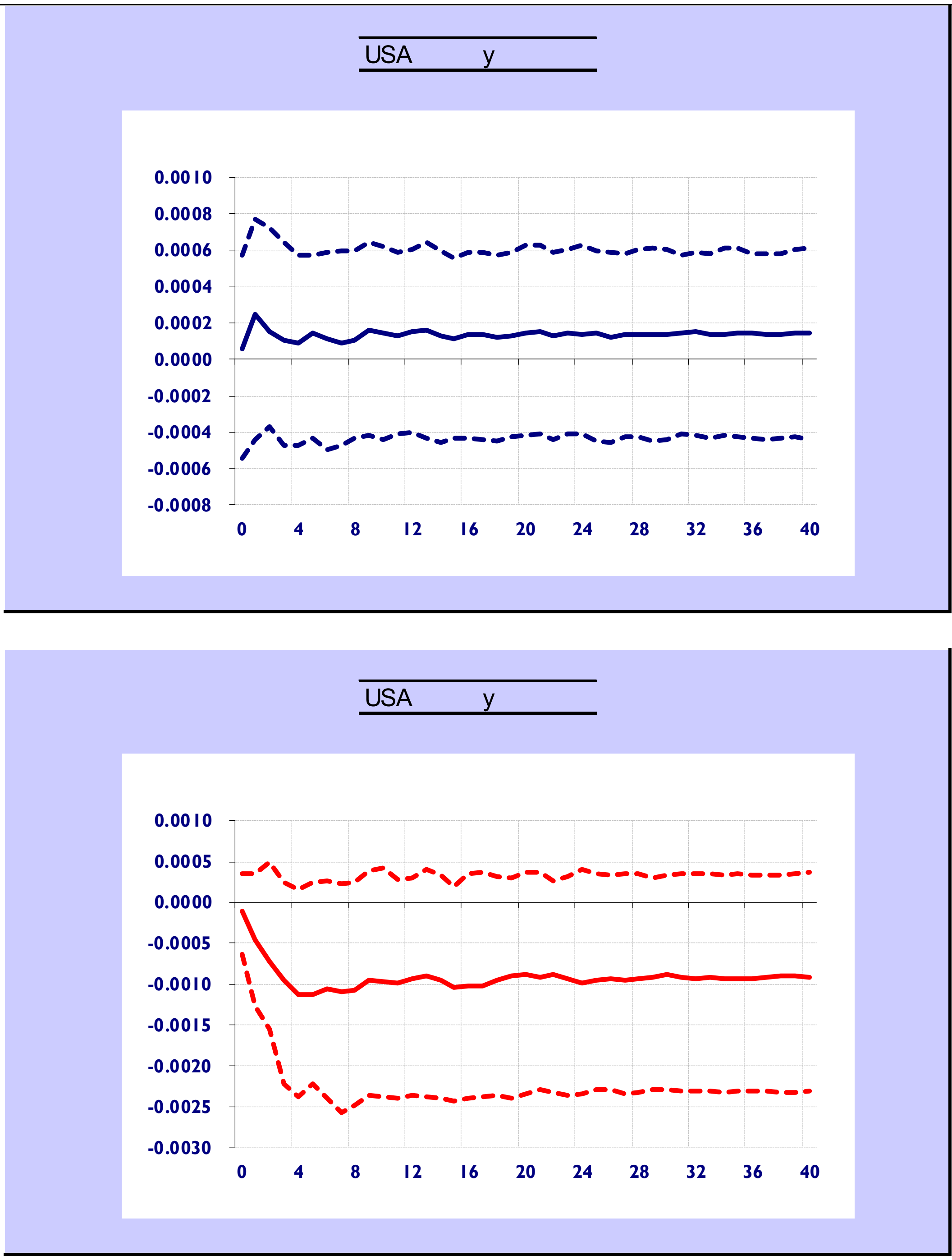
4.4 US unconventional monetary policy's domestic effects

In this part, we use global VAR model to estimate domestic effects of US UMP Shocks. We collect the general impulse responses estimation of US domestic variables to one standard deviation negative shocks on US UMP with the following ordering of the endogenous variables in the US bloc: GDP (y), effective exchange rate (eer), a monetary policy indicator (mp), inflations (p) and VIX index (vix). The generalized impulse responses functions are based on point estimation for 40 periods through a bootstrap of 200 times (Georgiadis, 2015; 2016; Chen et al., 2016).

We firstly examine the efficiency of the Global VAR model through the median impulse response functions of US monetary policy for a better interpretation of the identified US UMP shocks. This inspection allows us to know whether estimated shocks could correctly reflect the expansionary features taken by the Federal Reserve during and after the financial crisis. Figure 4.1 (Panel c) shows the point estimations of one negative deviation of corporate spreads (86.3 basis point) and term spreads (71.4 basis point) shocks. The plots indicate that that US UMP shocks have a statistically significant and persistent negative response to both corporate spread shocks and term spread shocks. This is in line with our signal restriction that the corporate spread shocks and term spread shocks should indicate an expansionary condition on US monetary policy with the former represents an increase in aggregate demand and financial volatility while the later reflects a decrease in short-term real interest rate (Hogan, 2021).

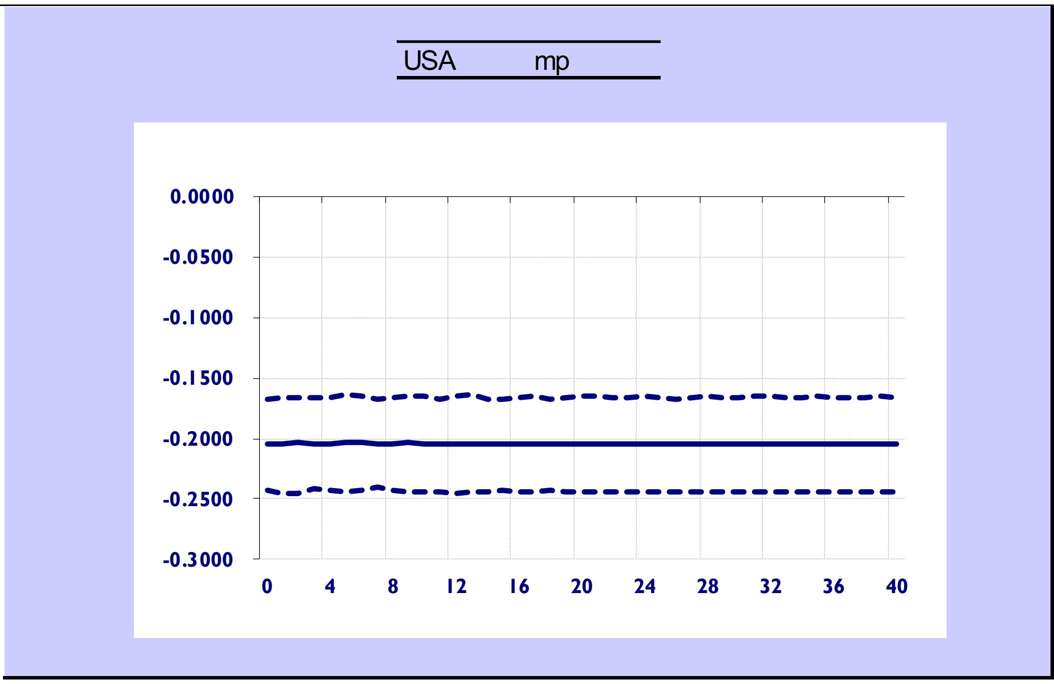
Secondly, impulse responses of other variables suggest that different channels might be at play. While the term spread reduction typically has negative statistically significant effects on US inflation, it does help slowing down the decline as the line becomes smooth in long term. A reduction in output growth is correspond to lower inflation, and exchange rate reduction is statistically significant but soon become level after four quarters. These suggests that a decline in the US term spread may be granted as overall negatively by markets as the liquidity supply is outpace aggregate demand.

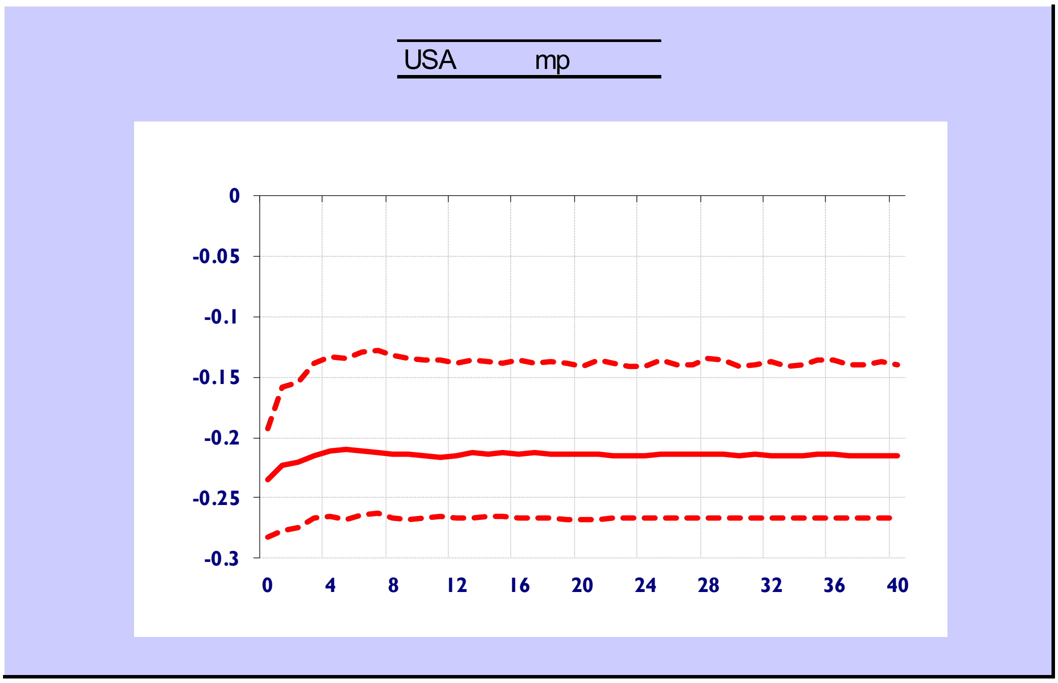
Meanwhile, lowering the corporate spread has a positive impact on real GDP growth over time, and it appreciates the US dollar in short run. While a cut in the US corporate spread consistently boosts real efficient exchange rate, a growth in inflation has been found. Consistent with the findings in previous studies (Chudik and Fratzscher, 2011; Ahmed and Zlate, 2013, 2014; Bowman et al., 2014, 2015; Fratzscher et al., 2016), it is apparent that a negative shock on corporate spreads is a sign that the aggregate demand is outpace aggregate supply, and thus support price stabilization and currency appreciation.


USA y
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
-0.0002
-0.0004
-0.0006
-0.0008
0 4 8 12 16 20 24 28 32 36 40
USA y
0.0010
0.0005
0.0000
-0.0005
-0.0010
-0.0015
-0.0020
-0.0025
-0.0030
0 4 8 12 16 20 24 28 32 36 40

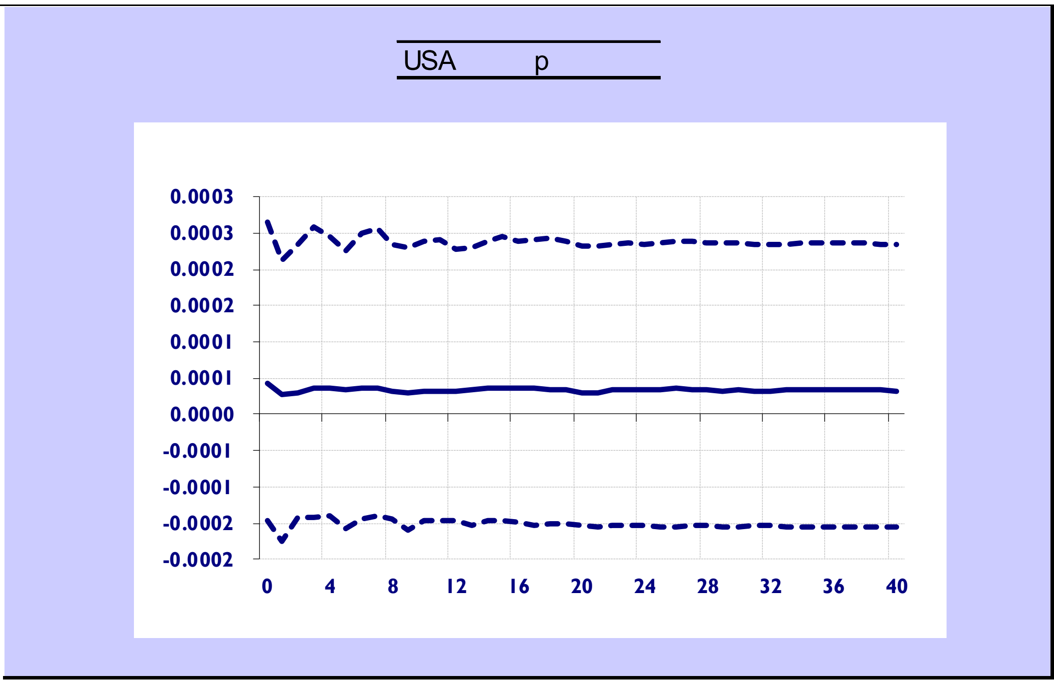
(a) real gdp

(b) effective exchange rate

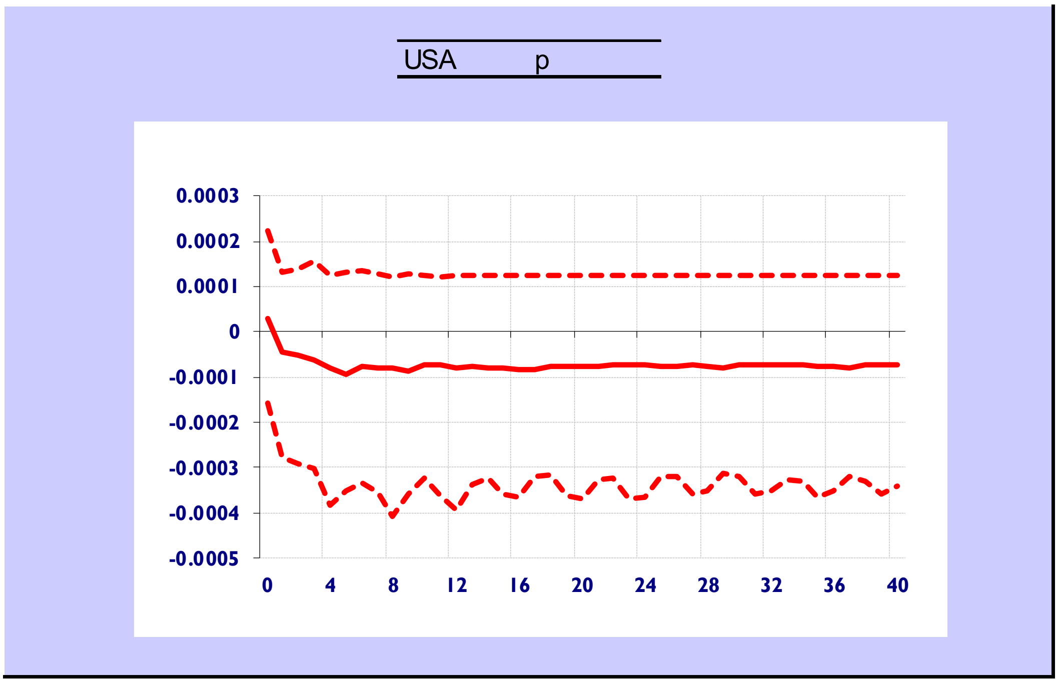




(c) monetary policy

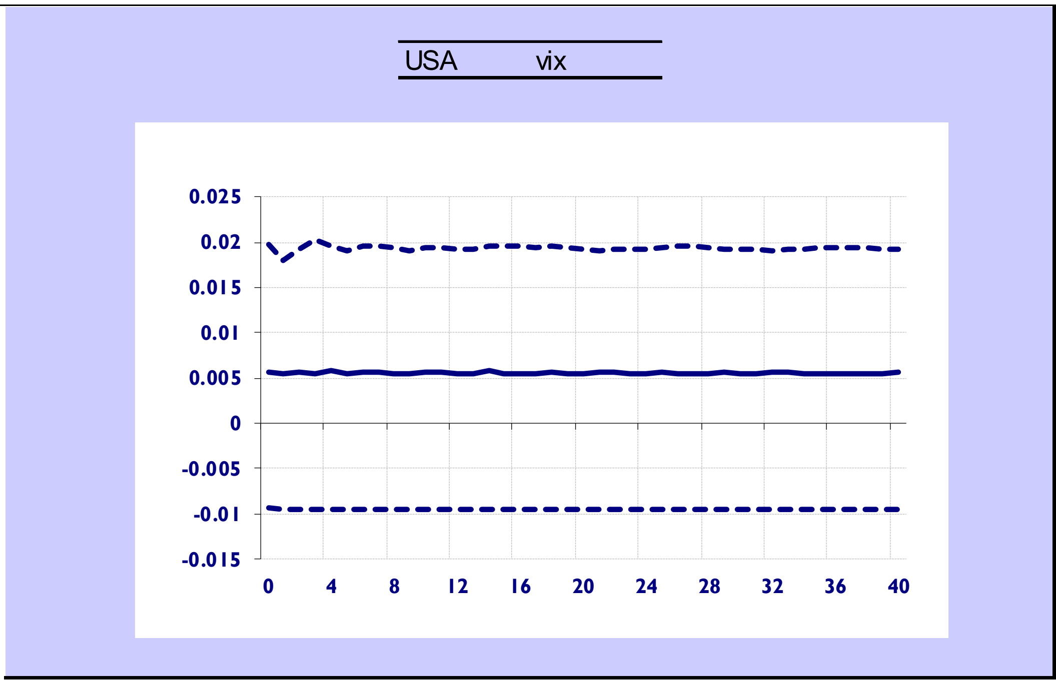


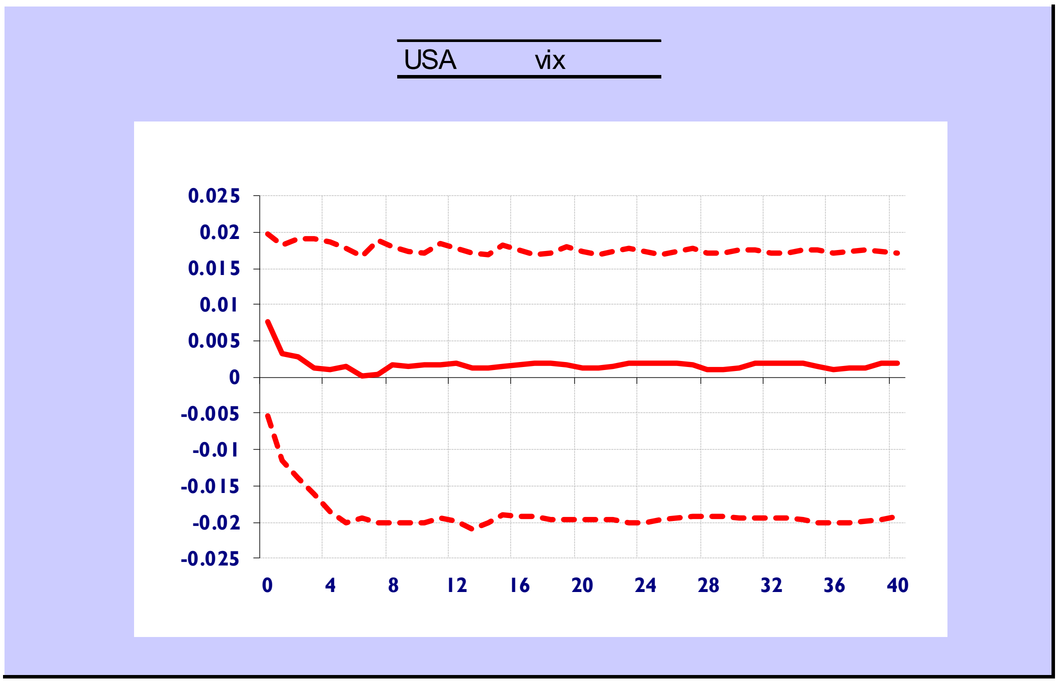
USA p
0.0003
0.0003
0.0002
0.0002
0.0001
0.0001
0.0000
-0.0001
-0.0001
-0.0002
-0.0002
0 4 8 12 16 20 24 28 32 36 40



USA p
0.0003
0.0002
0.0001
0
-0.0001
-0.0002
-0.0003
-0.0004
-0.0005
0 4 8 12 16 20 24 28 32 36 40

(d) inflation





(e) VIX

Median estimates
Upper/lower bounds

Median estimates
Upper/lower bounds

corporate spread shocks

Term spread shocks

Two sets of impulse responses for the US economy. One set refers to responses to a one-standard deviation (86.3. basis points) reduction in the US corporate spreads, the other to a one-standard-deviation cut in the US term spreads of 71.4 basis points.

Figure 4 1 Impulse responses to US corporate spread and term spreads shocks: United States

Finally, the impulse responses are greater by corporate spreads rather than by term spread. This is consistent with Blinder (2012) that purchasing US Treasuries to lower the term spread may be a weak tool. And reducing risk premium by allowing indirect liquidity for credit section generates much more effects persuading domestic GDP growth as well as a short-term appreciation of domestic currency (Inoue and Okimoto, 2022).

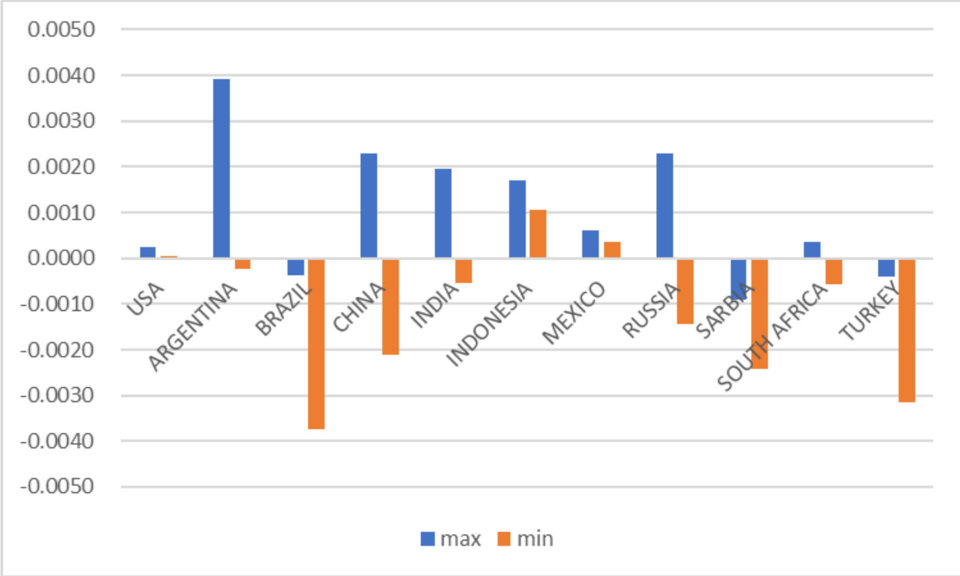
4.5 International spillovers of US unconventional monetary policy

In this section we examine the impulse responses of EMEs to US unconventional monetary shocks individually and in groups. The results from this section allow us to exploiting the heterogeneities of international spillovers the US unconventional monetary policy to EMEs. The mean average impulse responses analysis approach is presented in Anaya, Hachula and Offermanns (2017) for exploringthe heterogeneity issues in groups.

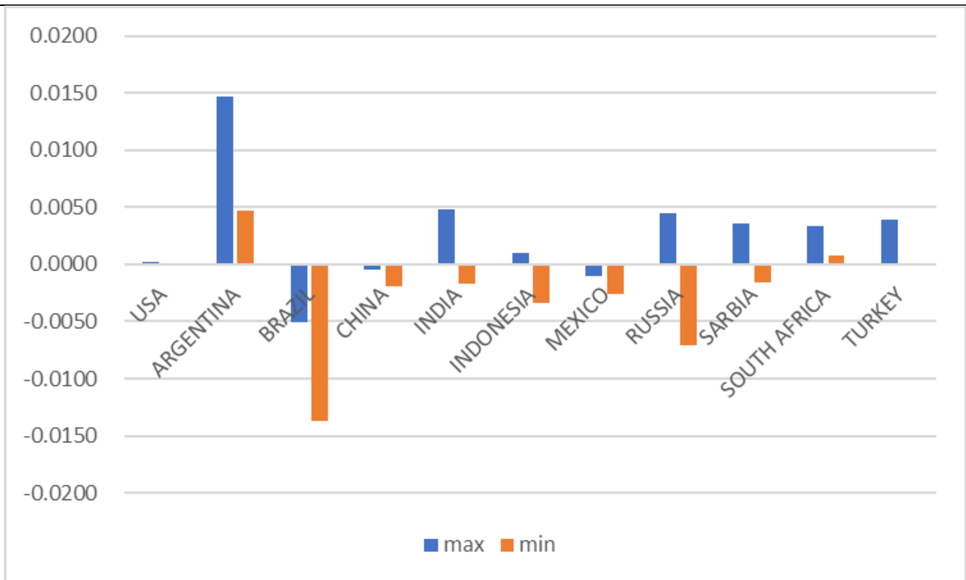
The individual result for US corporate spread shocks and term spread shocks are presented separately (Figure4.2, figure 4.3, figure 4.4 and figure 4.5). We see that the response of GDP to both UMP shocks is generally positive and significant. While the response of the price index, exchange rate and interest rate are weaker and less persistent, the relationship between price factors, interest rates and exchange rates correspond to the theoretical state in Chapter 1 section 3. In a short-term view, the increasing in interest rate differentials between US and EMEs encouraged vulnerable capital flows to EMEs, seeking for higher returns (Bernanke, 2017). Meanwhile, the Gross Domestic Product (GDP) of EMEs increases duo to the increasing exports demand which makes aggregate demand outpacing the growth of the supply, and thus leading to increases the output gap and inflation (Bowman et al., 2015). The result is that the nominal interest rates have suffered an upward pressure due to the rise of inflation rates in a long run (Bowman et al., 2015), causing interest rate risk as indicated by fisher effect theory (Gagnon et al., 2011). At the meantime, the rise in inflation leads to the depreciation of EMEs' currency, according to the purchasing power parity theory (Rogers et al., 2014, 2018).

Moreover, we find that UMP shocks tend to have different effects among EMEs. While the way a country response to two UMP shocks is in general the same, which might indicate that the heterogeneity issue is caused by EMEs' domestic powers rather than the identification of UMP shocks (Gagnon et al., 2017). And, we find US unconventional policy shocks have greater impact on financial variables rather than exchange rate and GDP, proving that US UMP is a driver of the financial conditions in EMEs (Ouerk, 2023).

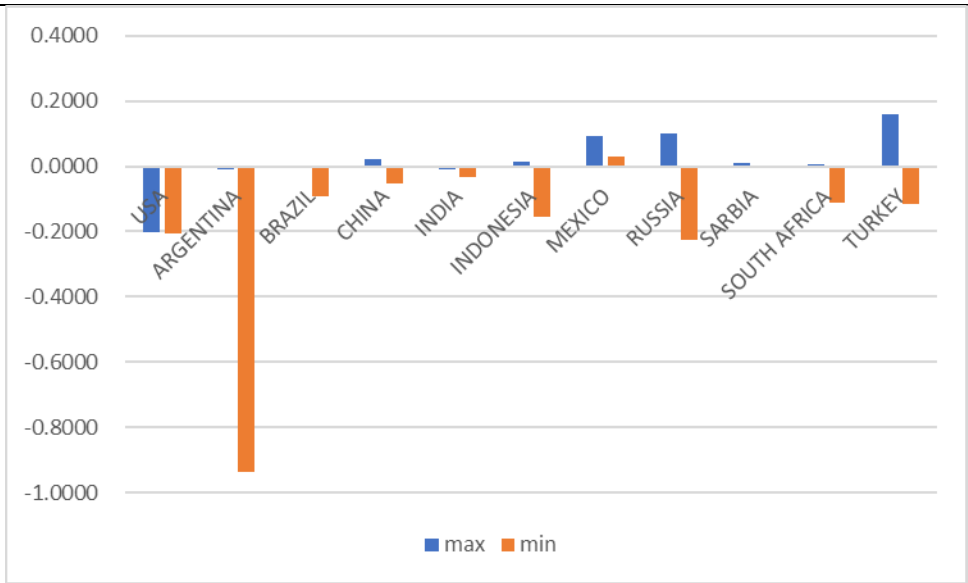
Lastly, we found that the response changes periodically, decreasing one after the other. We find that the total spillover was cyclical at every two years roughly. And, we find that the net spillover of all four variables of EMEs is negative, that is, US has transferred its own risk to EMEs.



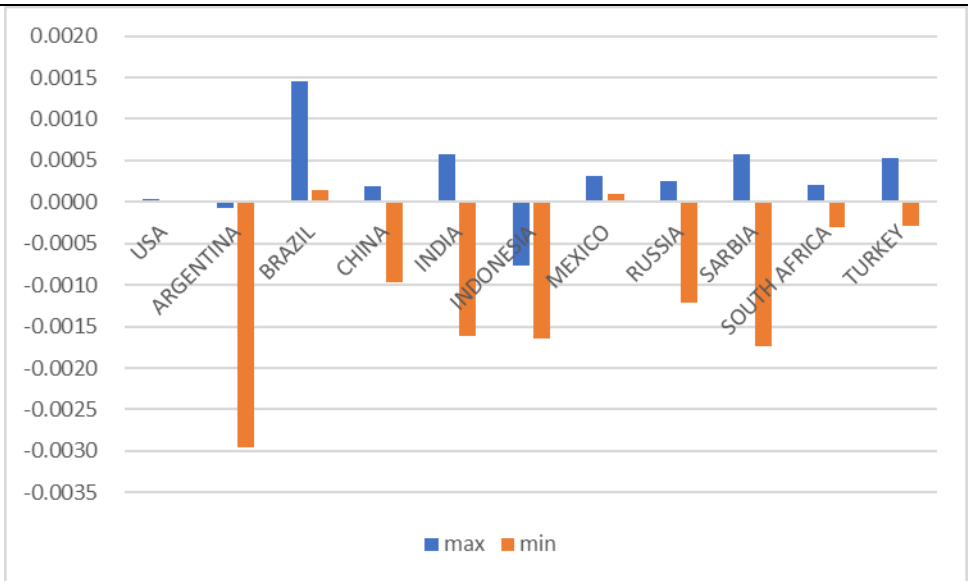
(a) real gdp



(b) effective exchange rate

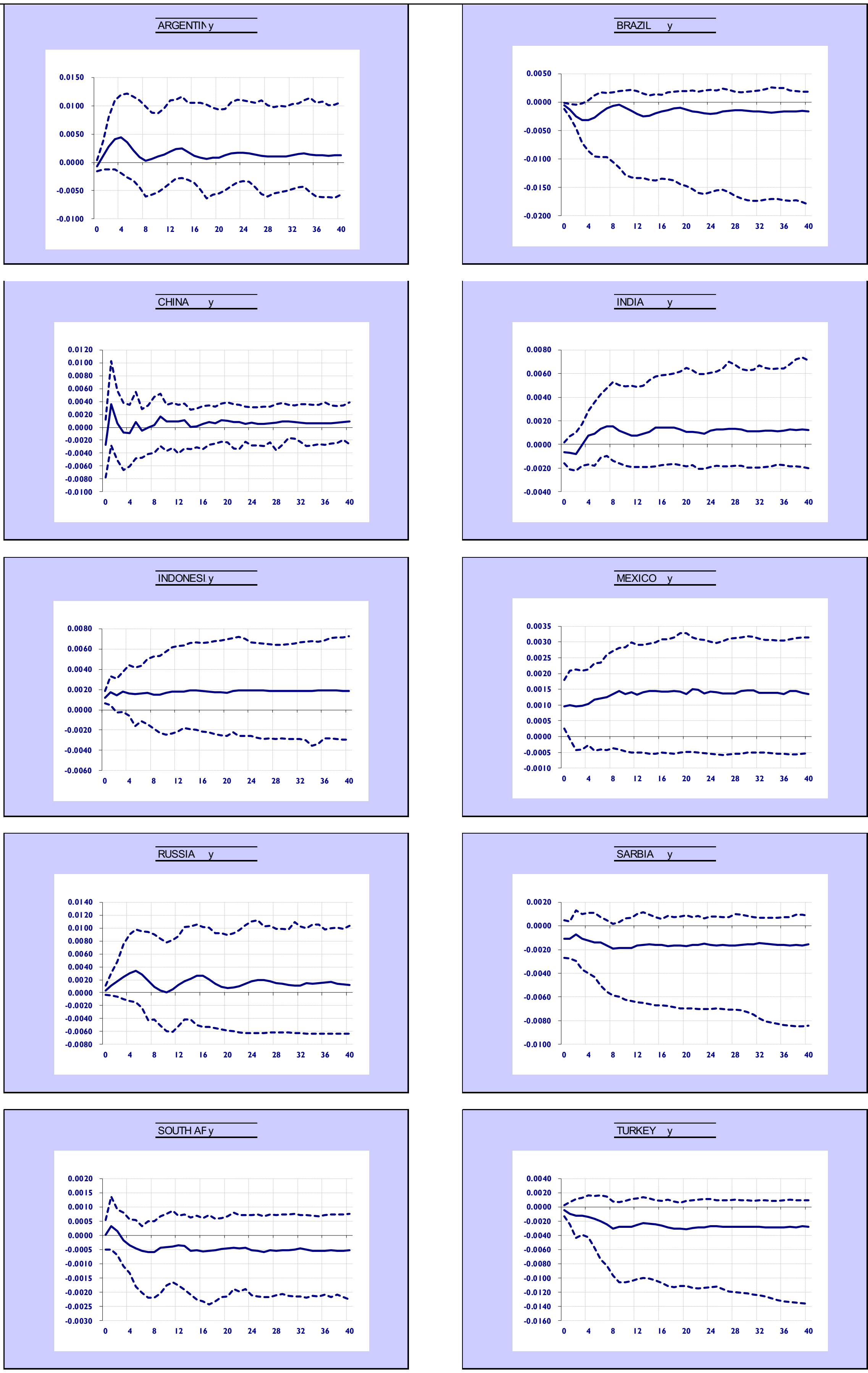


(c) monetary policy

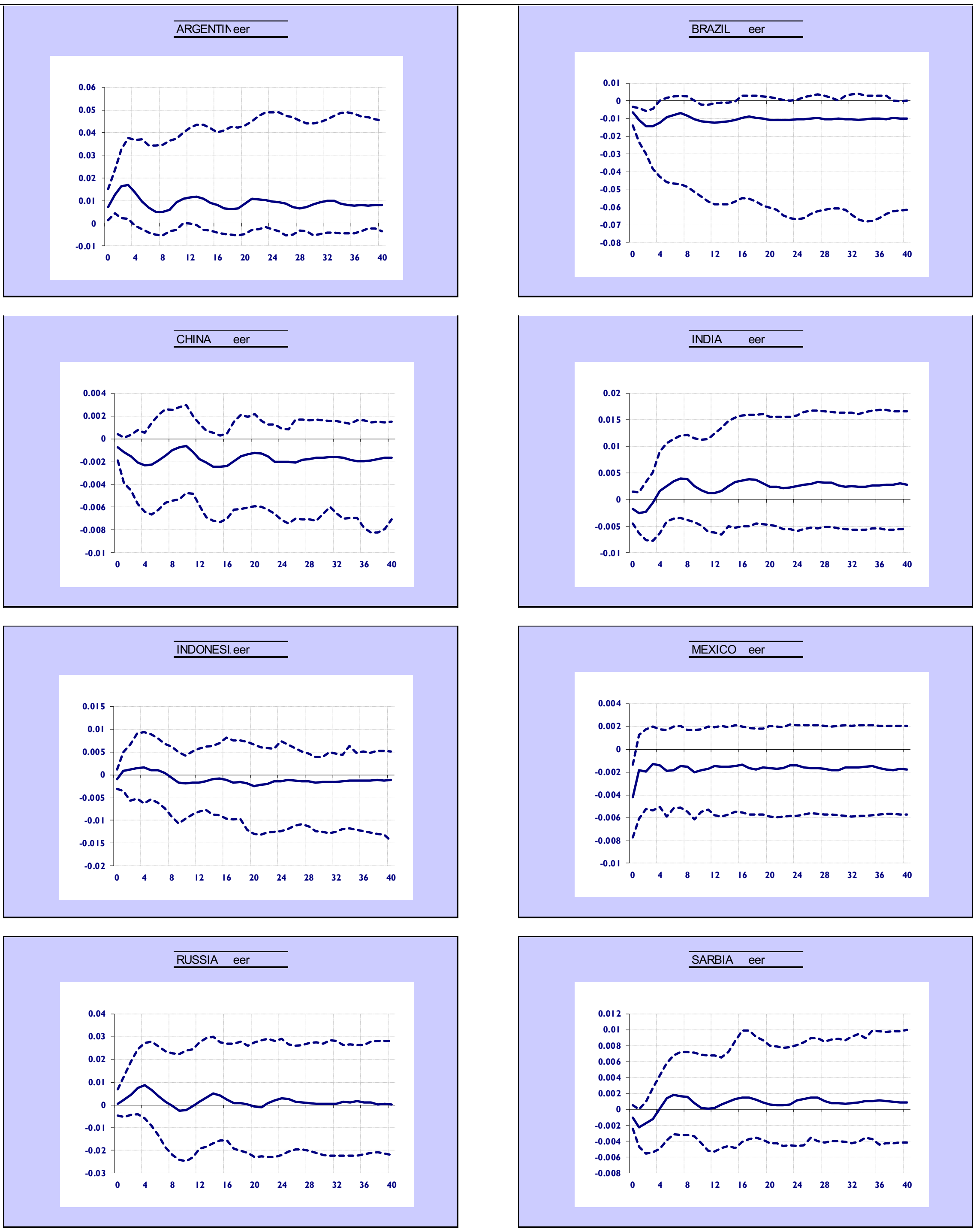


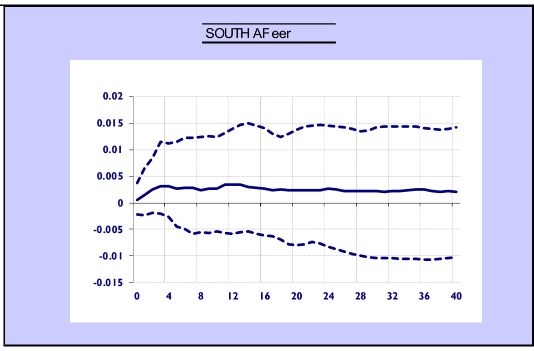
(d) inflation

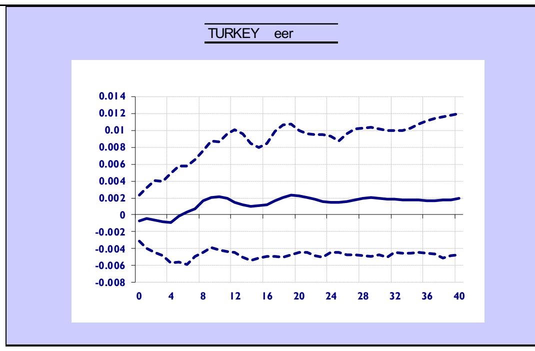
Figure 4 2 Individual responses to US corporate spread shocks


ARGENTIN y
BRAZIL y
CHINA y
INDIA y
INDONESI y
MEXICO y
RUSSIA y
SARBIA y
SOUTH AF y
TURKEY y

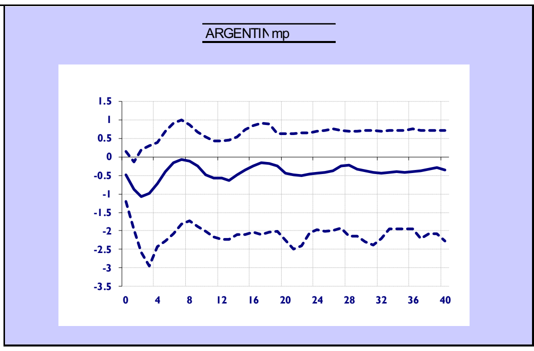
(a)Real GDP

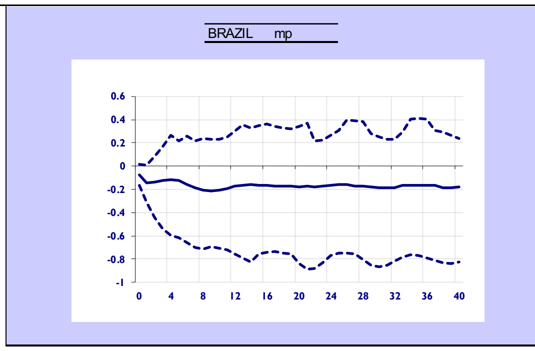

ARGENTIN eer
BRAZIL eer
CHINA eer
INDIA eer
INDONESI eer
MEXICO eer
RUSSIA eer
SARBIA eer

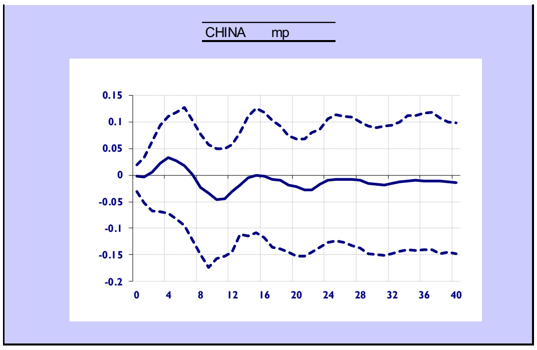


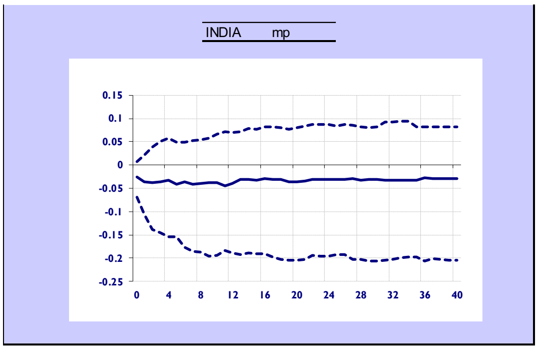


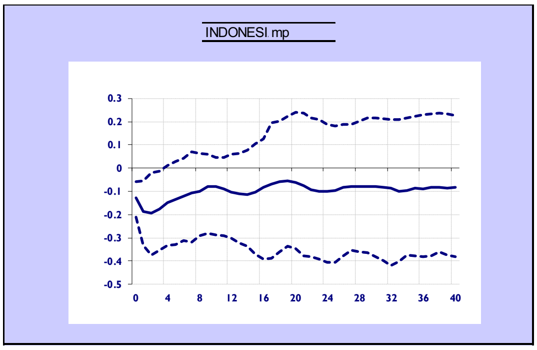
(b)Effective Exchange Rate

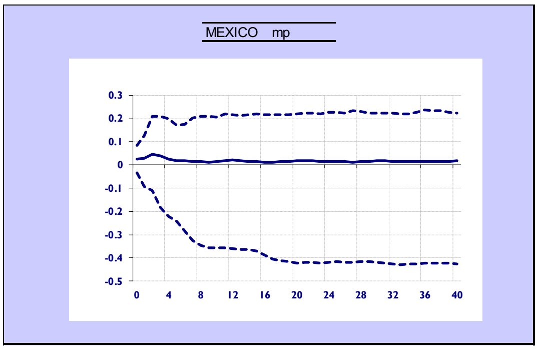


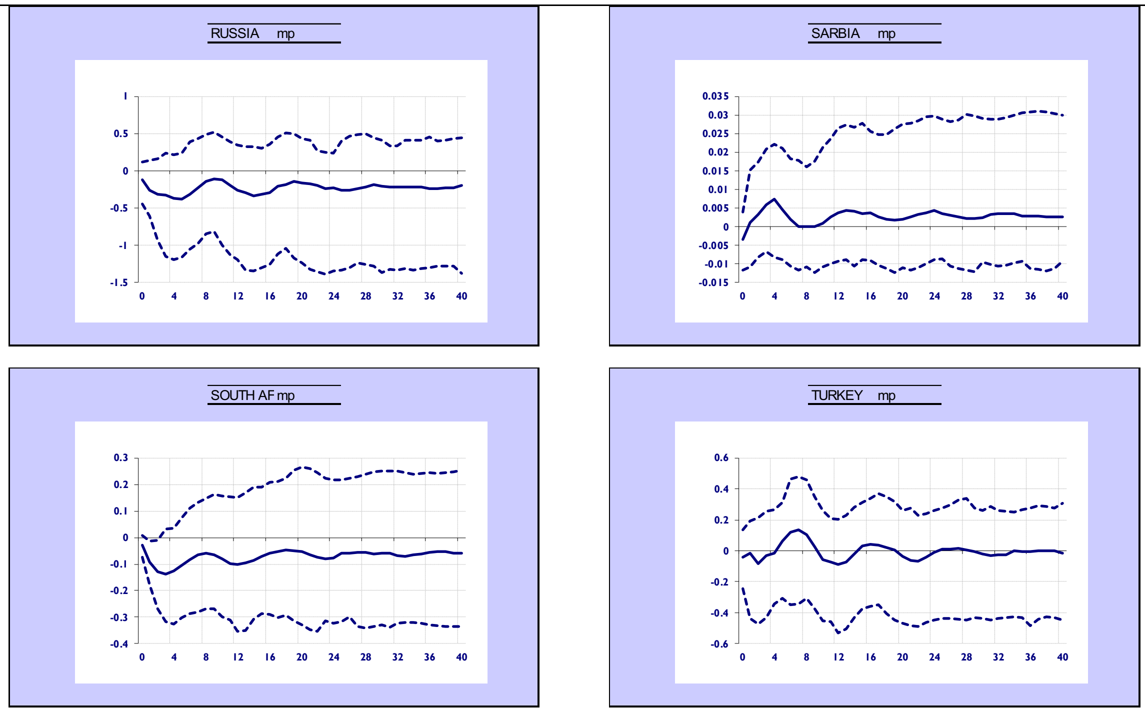




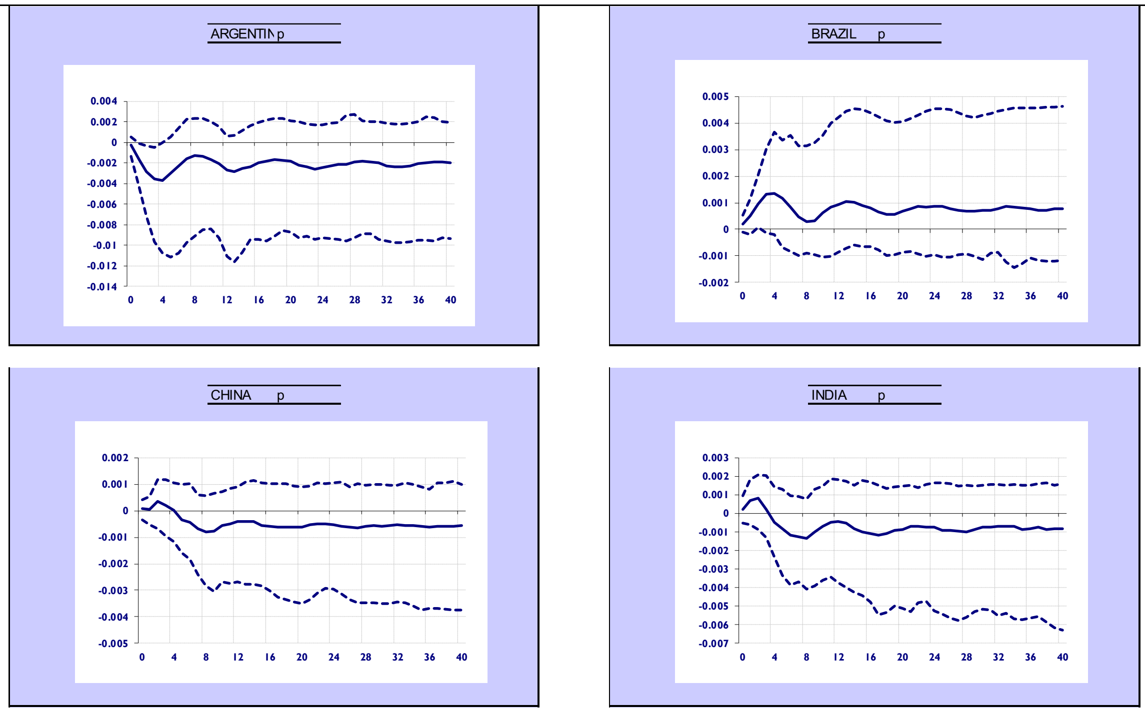


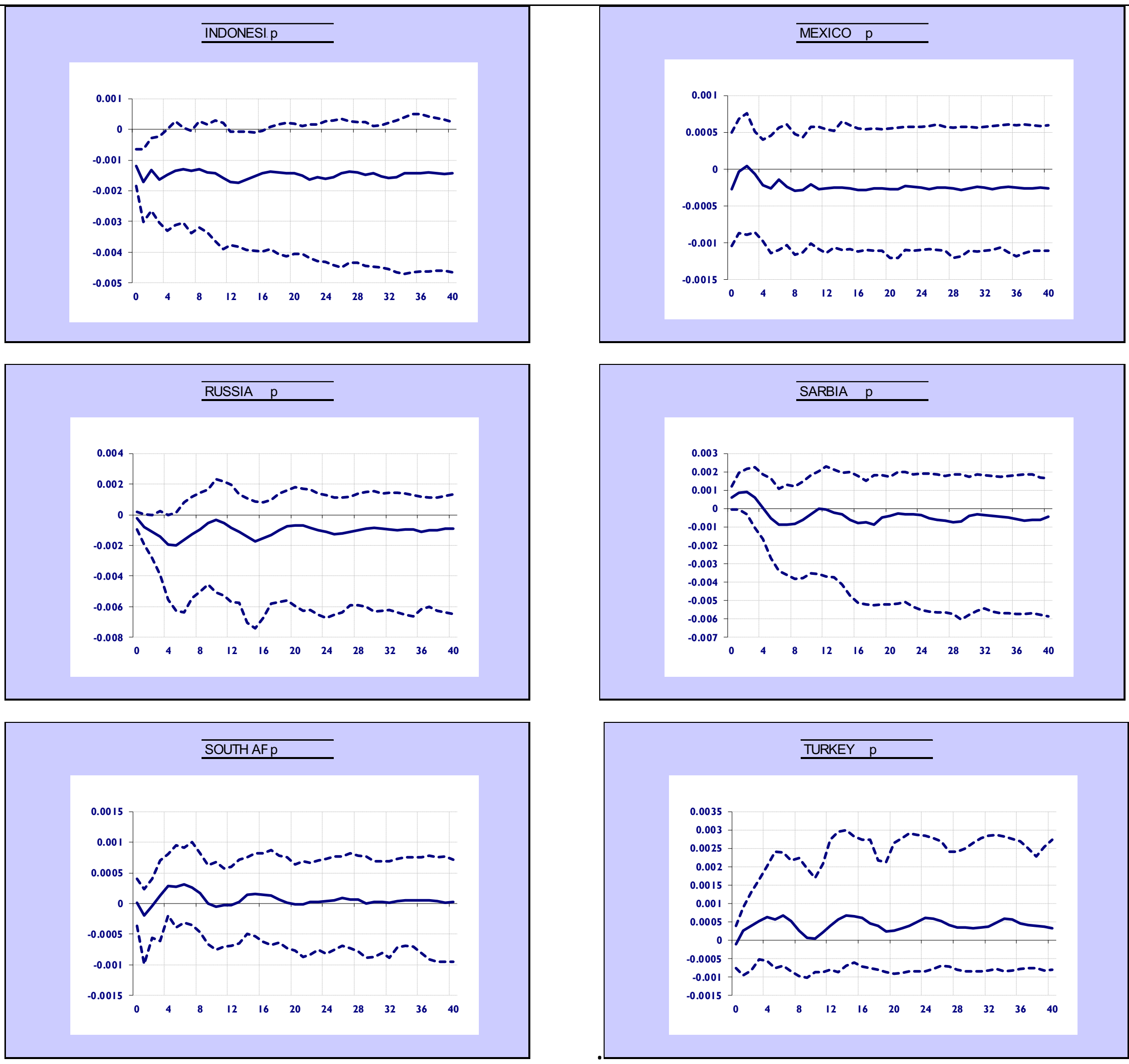






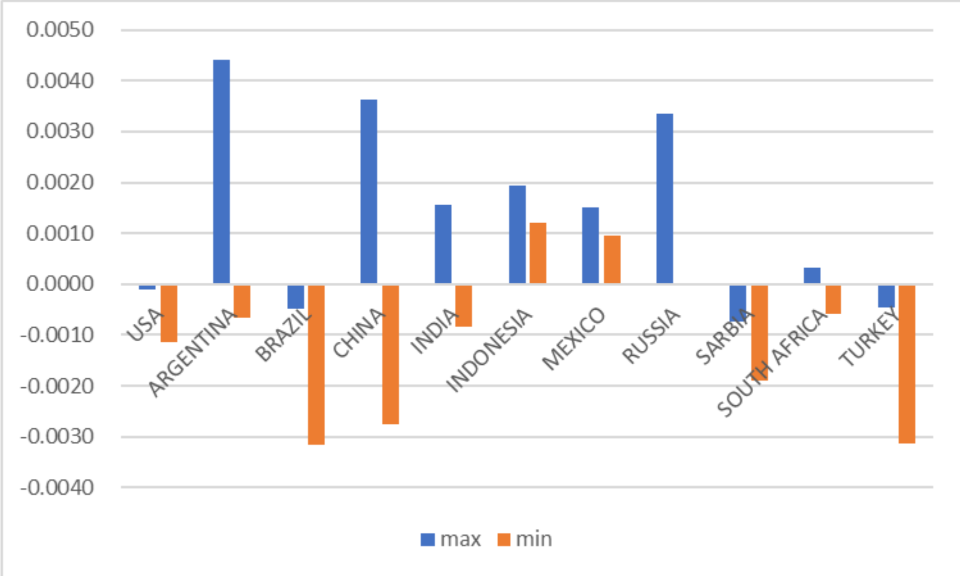
(c)Monetary policy



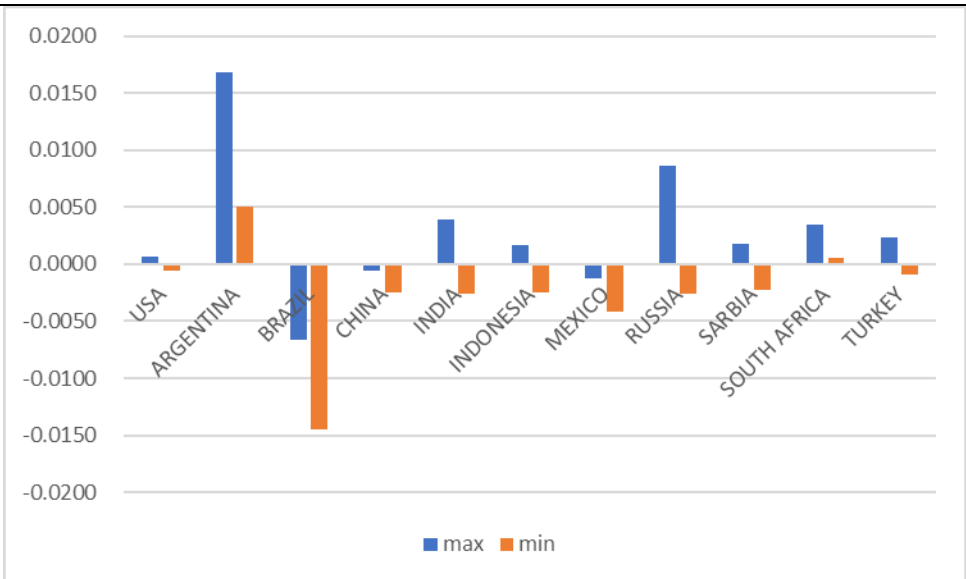


(d) inflation

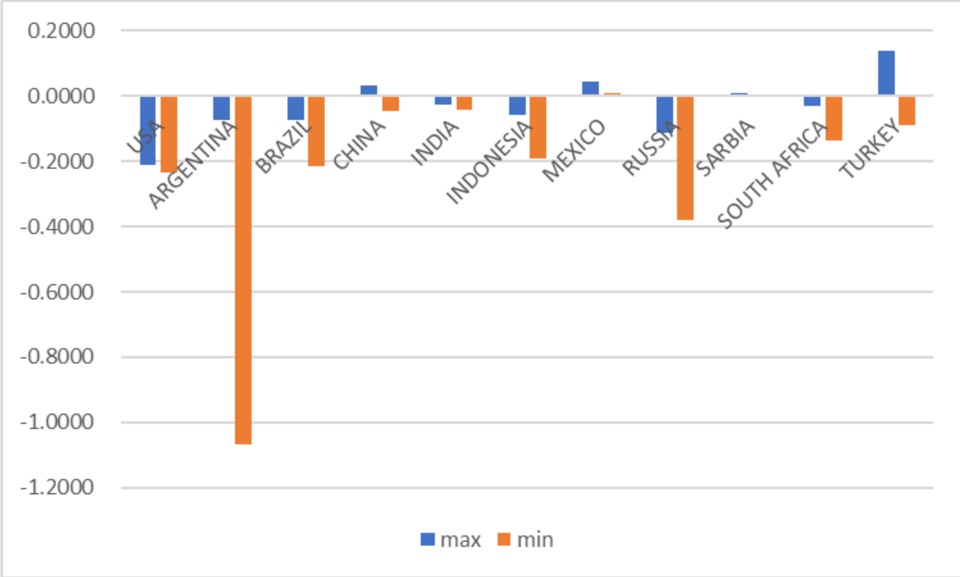
Figure 4 3 Individual responses to US corporate spread shocks (individual plot)



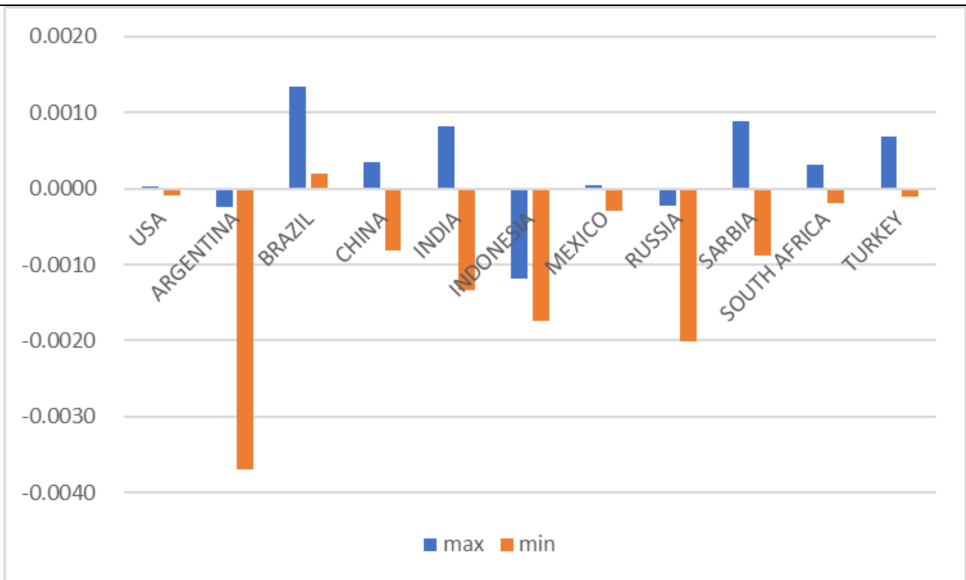
(a) real gdp



(b)effective exchange rate

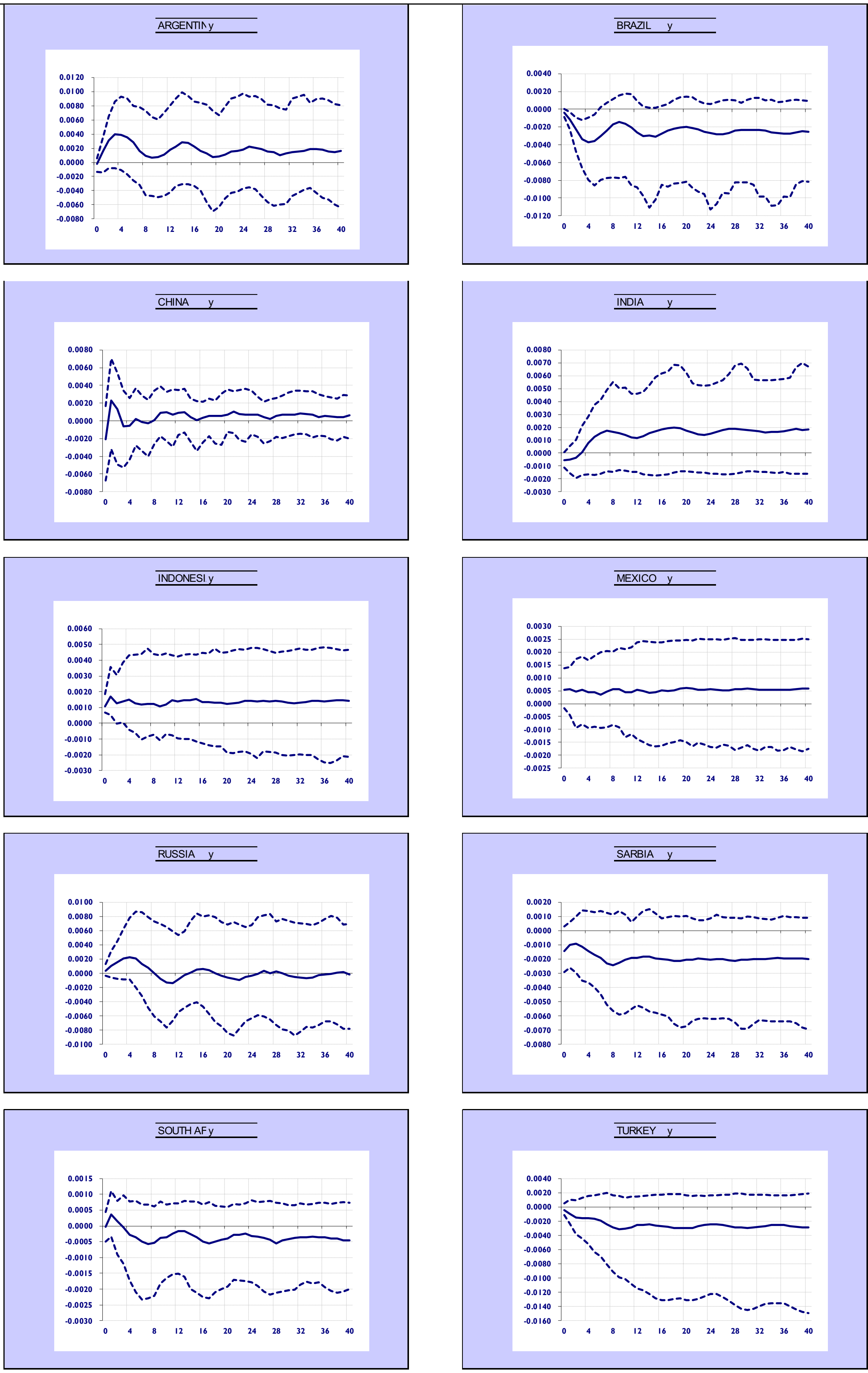


(c) monetary policy

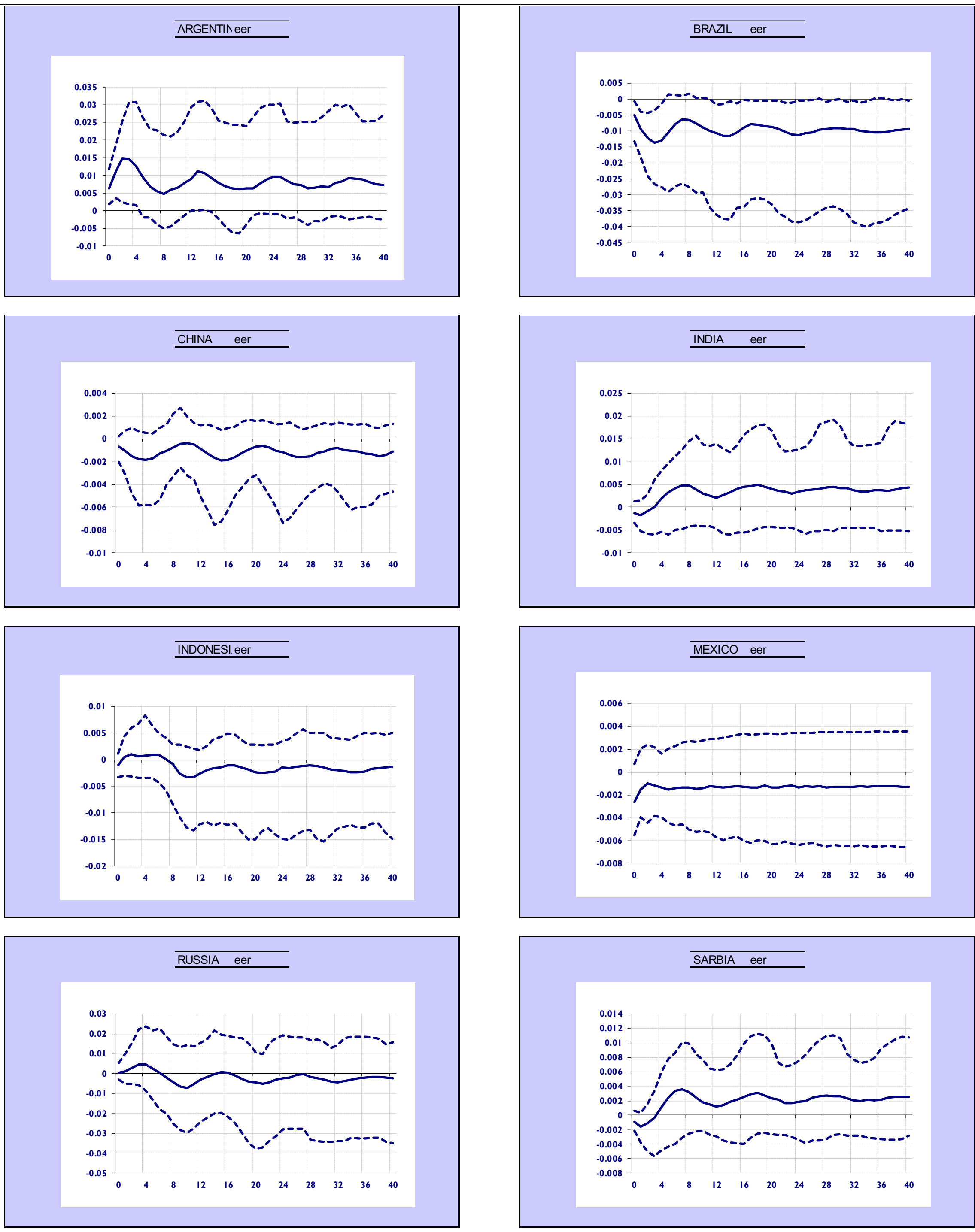


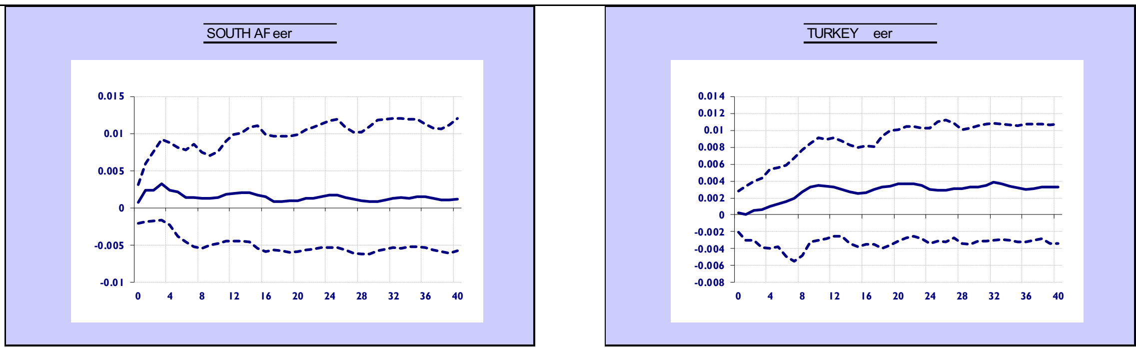
(d) inflation

Figure 4 4 Individual responses to US term spread shocks

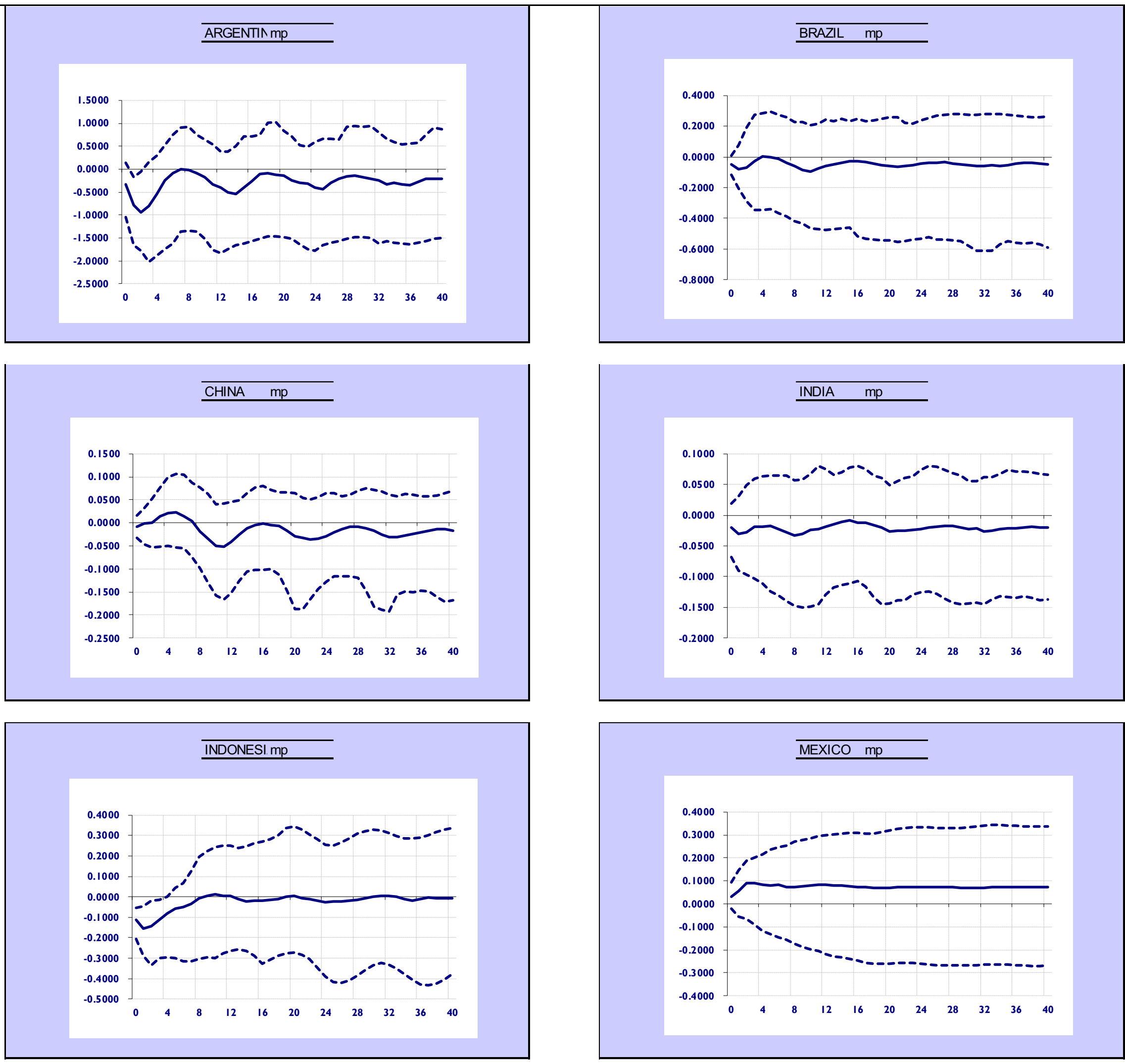

ARGENTIN y
BRAZIL y
CHINA y
INDIA y
INDONESI y
MEXICO y
RUSSIA y
SARBIA y
SOUTH AF y
TURKEY y

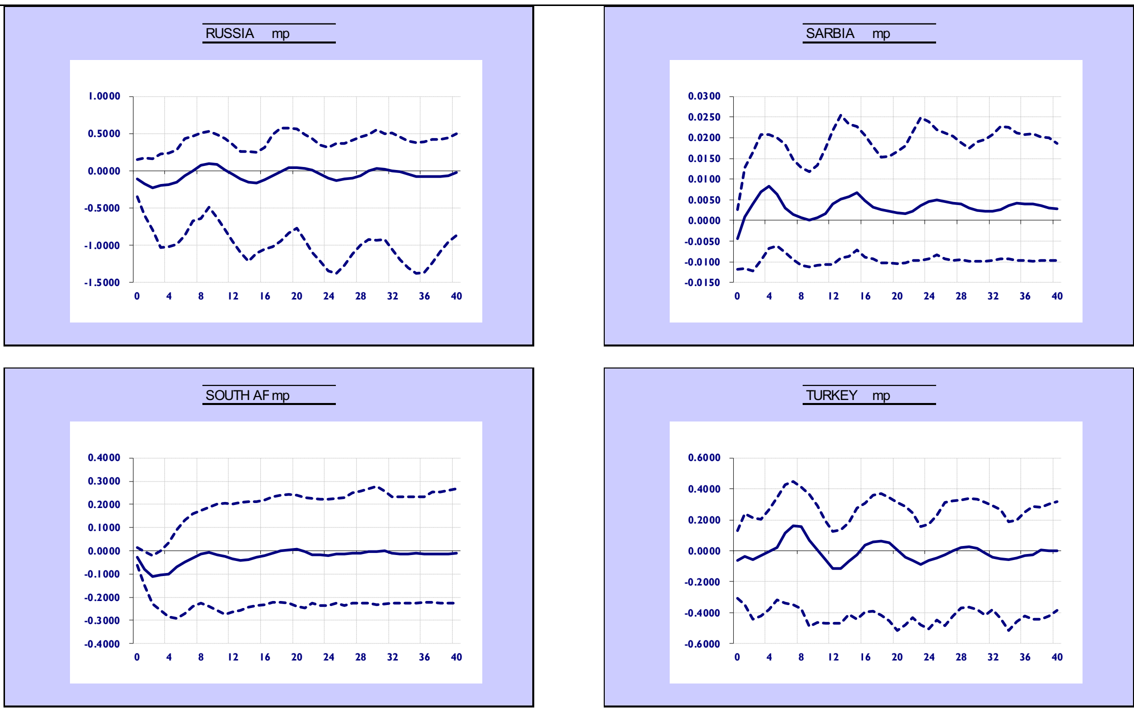
(a)Real GDP


ARGENTIN eer
BRAZIL eer
CHINA eer
INDIA eer
INDONESI eer
MEXICO eer
RUSSIA eer
SARBIA eer

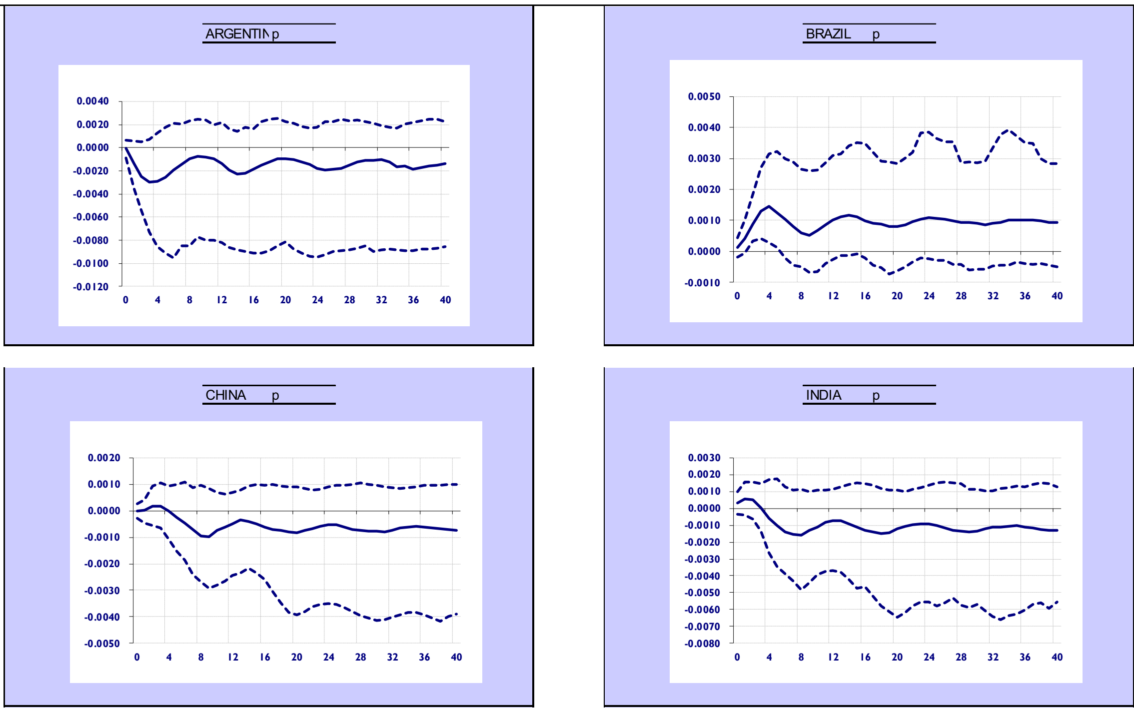


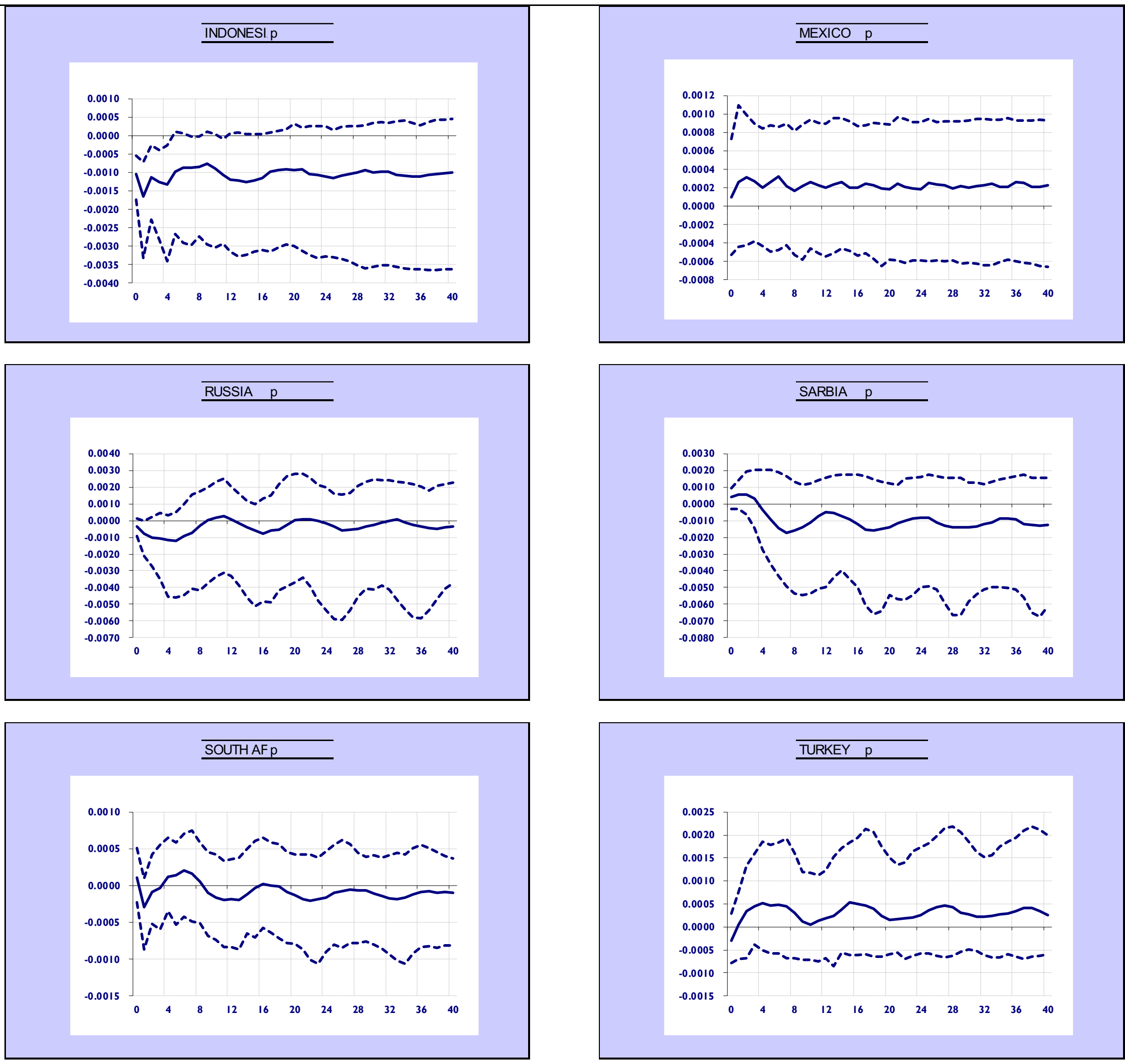
(b)Effective Exchange Rate





(c)Monetary policy

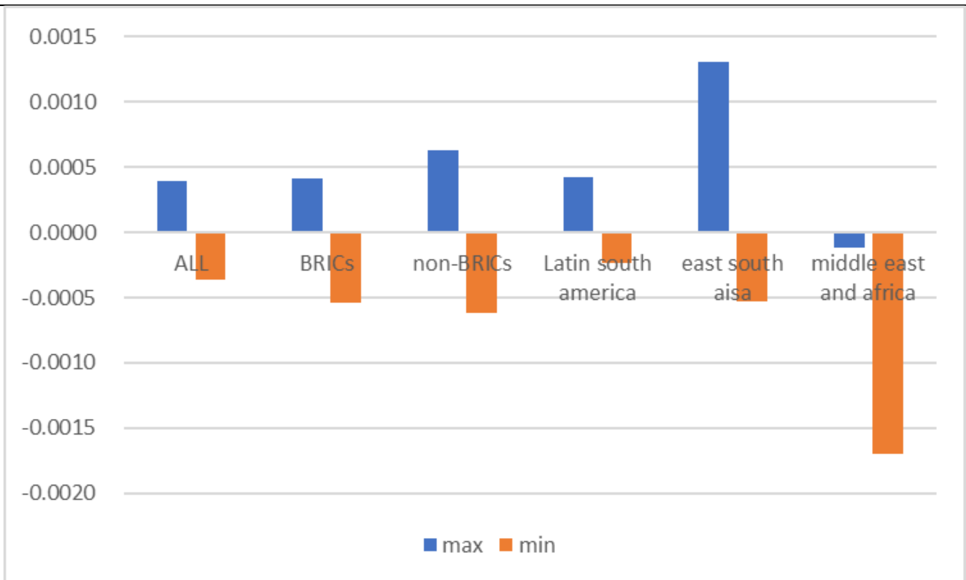




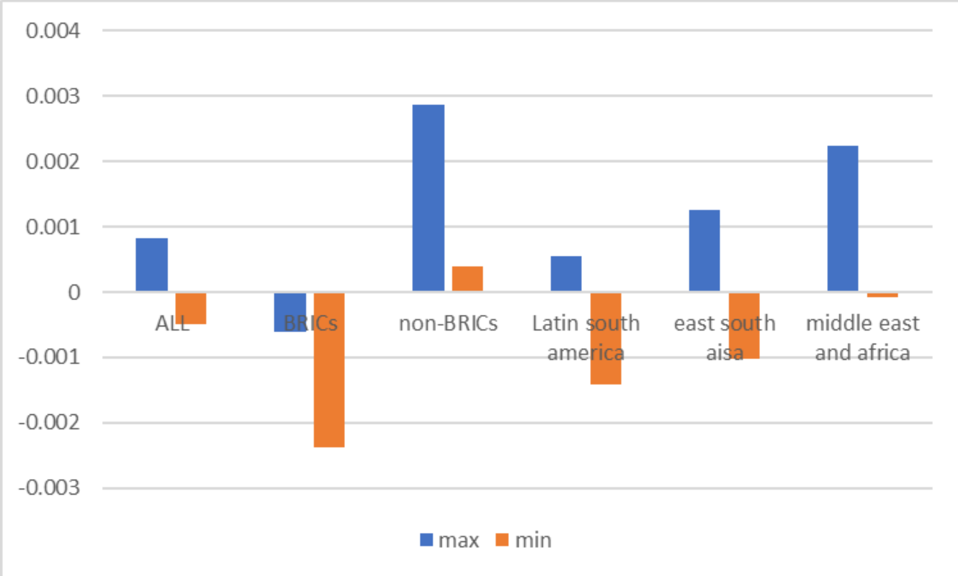
(d) inflation

Figure 4 5 Individual responses to US term spread shocks (individual plot)

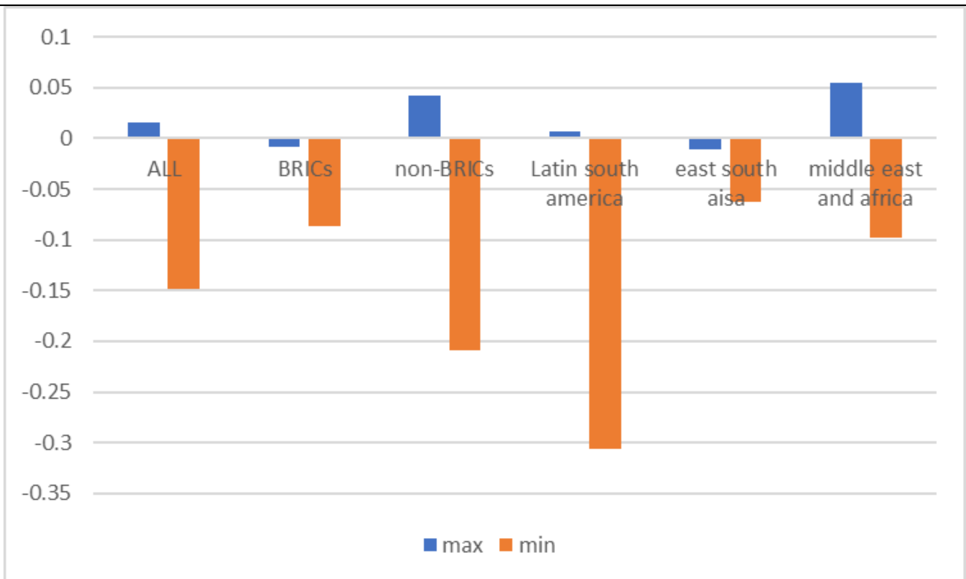
While figure 4.6 show the group mean responses of EMEs for the corporate spreads model after a negative UMP shock in the US block and the subsequent increase in global risk appetite, figure 4.7 show the mean responses of all the EMEs by the term spread model. Firstly, we find several strong co-movements among GDP growth, monetary policy, and inflation, but various in effective exchange rate, proving that US UMP is a driver of the global financial and macroeconomic conditions in EMEs. Secondly, the medium estimates of difference groups typically have a larger dispersion in inflation and effective exchange rate, possibly reflecting heterogeneities in their chooses for whether to keep interest rates stable or maintain inflation targeted (Georgios, 2016; Garratt et al., 2016). And finally, we find a much stronger co-movements between EMEs' inflation and monetary policy, which indicates that the strong positive expansionary shocks of unconventional monetary policy may relate with not only financial market integration but also the trade openness giving a weak financial development in EMEs (Bhattarai et al., 2015).



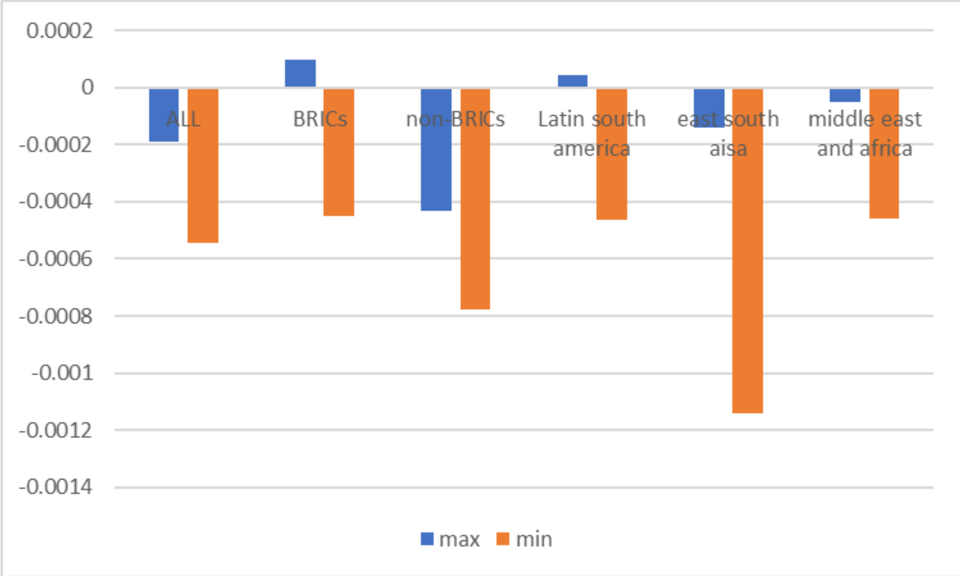
(a) real gdp



(b)effective exchange rate

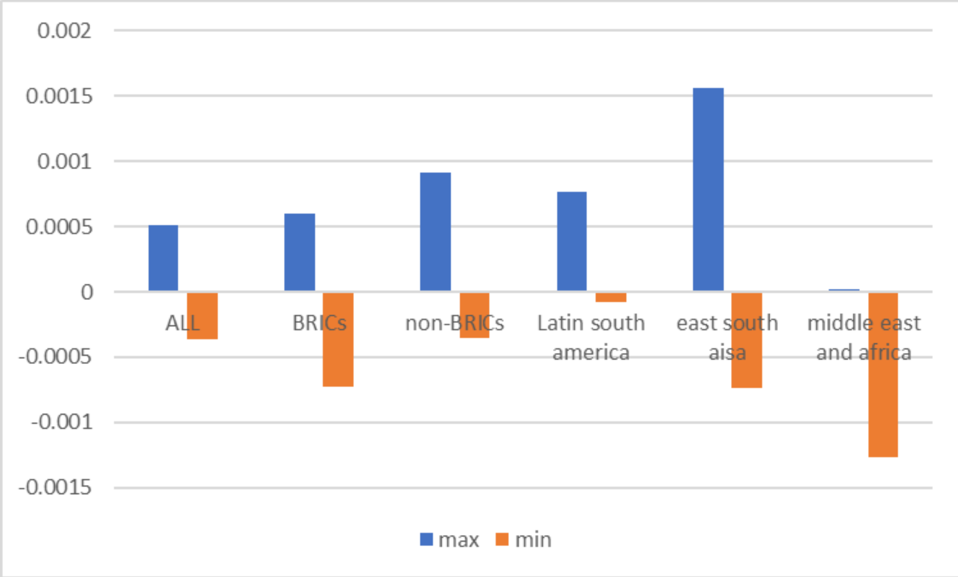


(c) monetary policy

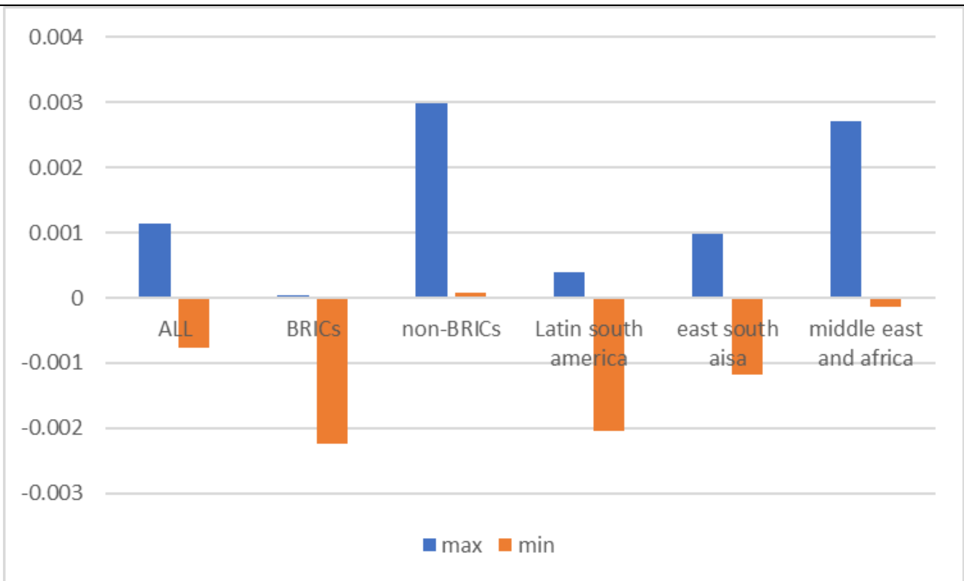


(d) inflation

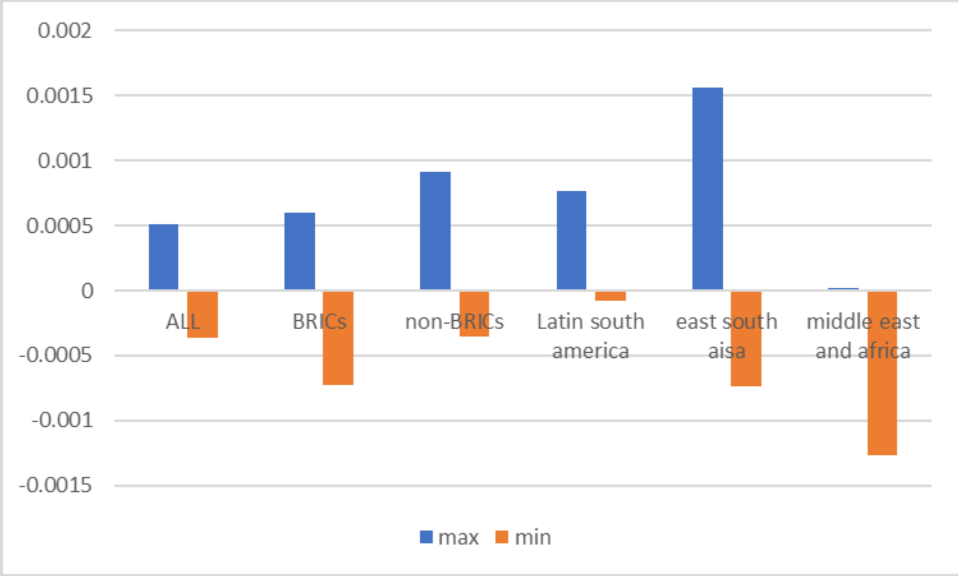
Figure 4 6 Mean responses to US corporate spread shocks



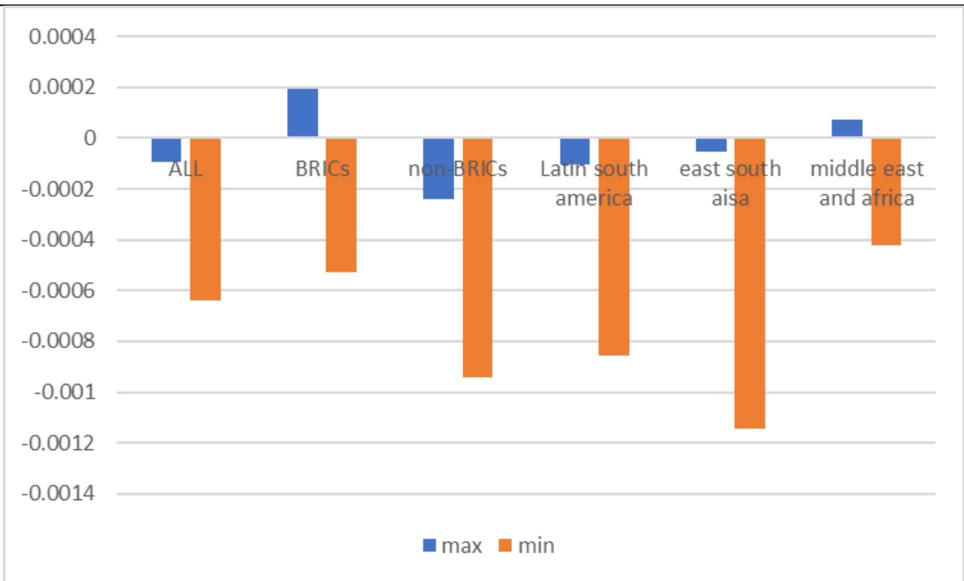
(a) real gdp



(b)effective exchange rate



(c) monetary policy



(d) inflation

Figure 4 7 Mean responses to US term spread shocks

4.6 Robustness check

To further confirm whether the heterogenous responses are not related to the change of shock indicators, our robustness test includes interest rate of US 10-year treasury yields as the UMP shock indicator in US block. US 10-year treasury yields is the parallel interest rates for FFR. The interest rate of US 10-year treasury yields rate is not only used for pricing a risk-free asset but also an indicator of the short-term liquidity condition. The signal restriction for identifying expansionary measures on US UMP remain negatively restricted. The following definition of endogenous and foreign variables are used.

$$x_{US,t} = (y, eer, 10yrbond, \mathrm{p}, VIX)$$

$$x_{US,t}{}^{*} = (y^{*})$$

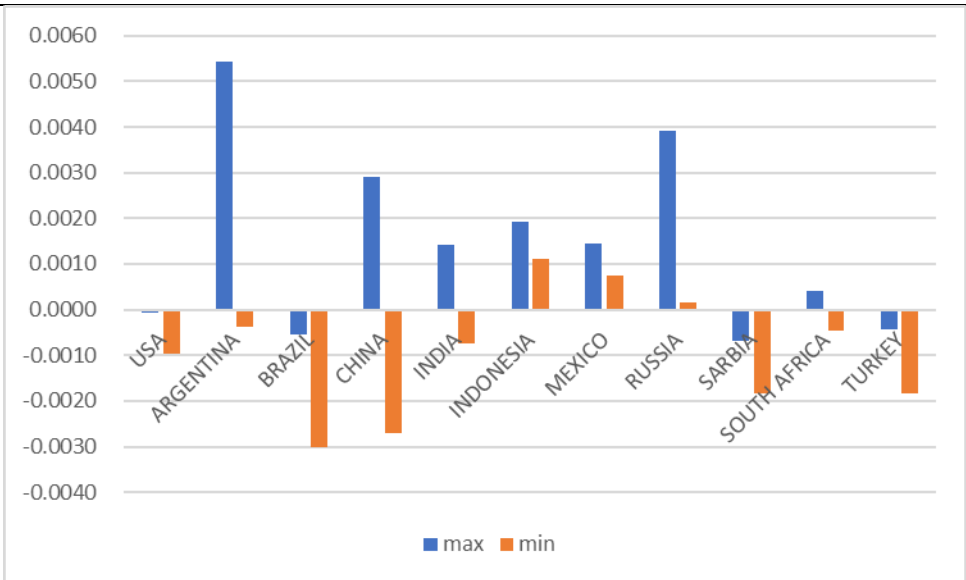
$$x_{EMEs,t} = (y, eer, mp, \mathrm{p})$$

$$x_{EMEs,t}{}^{*} = (y^{*}, eer^{*}, mp^{*}, p^{*})$$

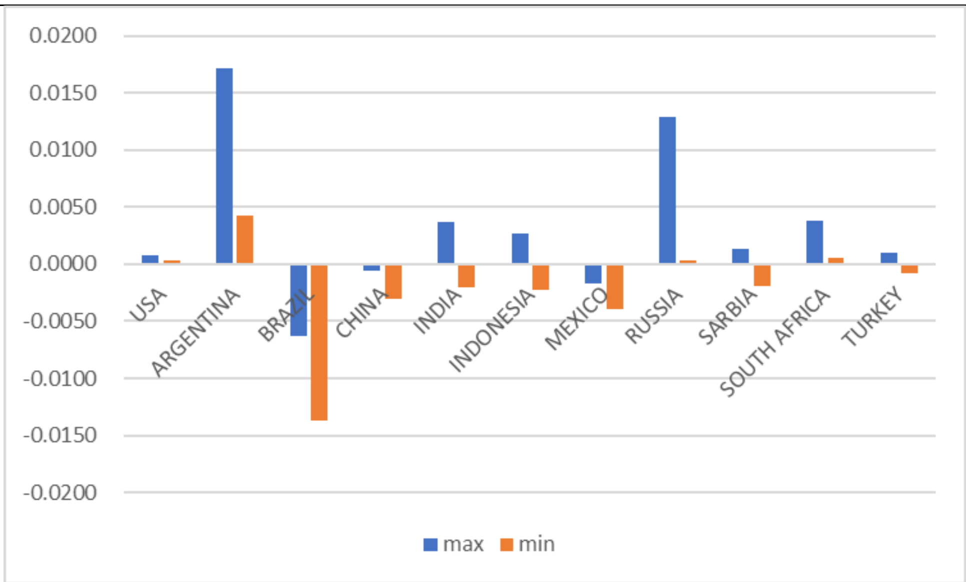
$$d_{EMEs,t}{}^{*} = (VIX)$$

The individual result for US 10-year treasury yield shocks is presented in figure 4.8 and figure 4.9. We find that there has no significant difference from baseline results. And we find co-movements in the landscape of the three models.

We also compare the medium estimates of all groups (figure 4.10), and we find that the BRICs typically has a much smaller dispersion in general which are same as the term-spreads model and corporate spreads model. In contrast, medium estimates tend to have larger dispersions for non-BRICs group. Moreover, we find that the impulse response of GDP to 10-year treasury yield shocks are greater than term spread and corporate spreads. Furthermore, we find consistent evidence that the independency of EMES' monetary authority is compromised by US unconventional monetary policy shocks. As direction of impulse responses of monetary policy of EMEs to 10-year treasury yield shocks are as same to as the ones we find for term spread shock model and corporate spreads shocks model.

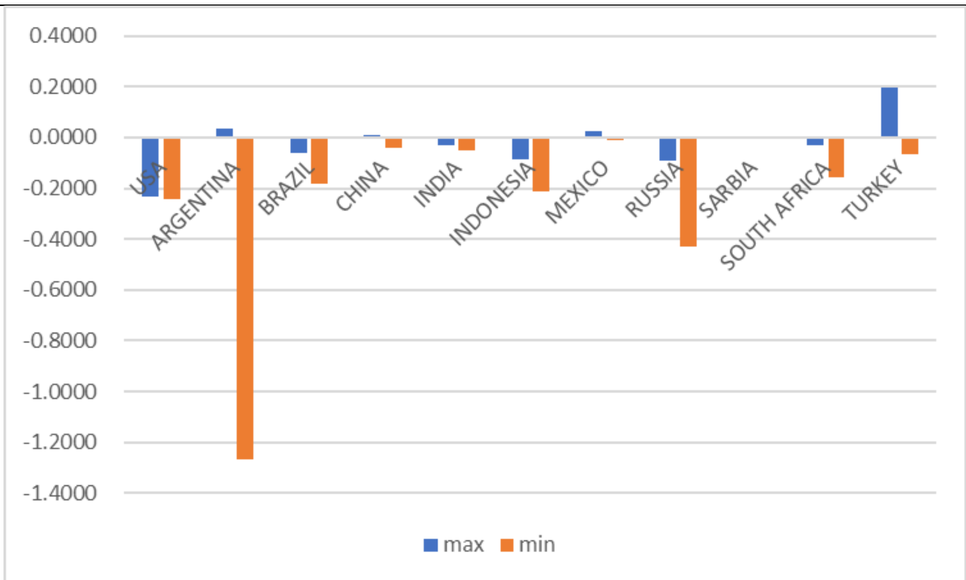


(a) real gdp

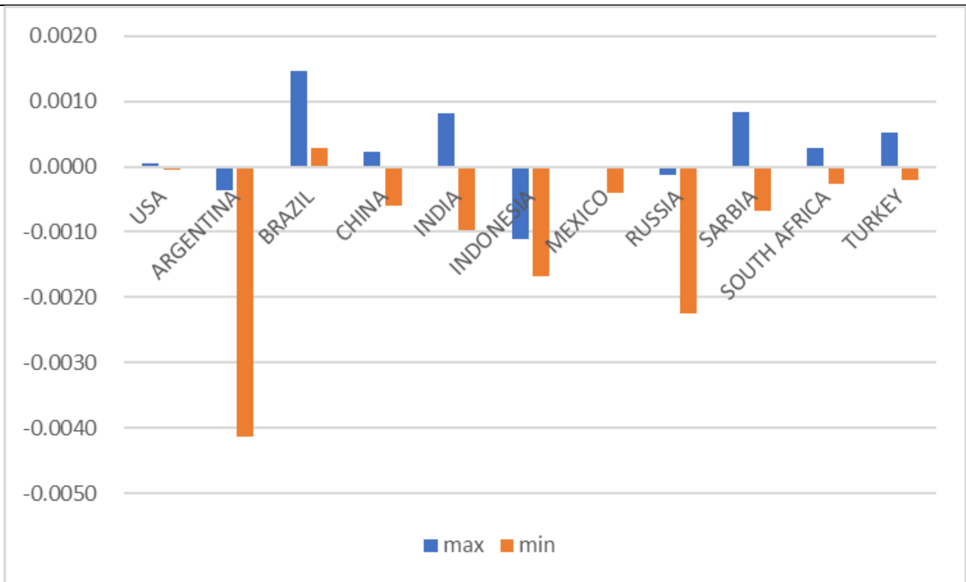


(b)

effective exchange rate

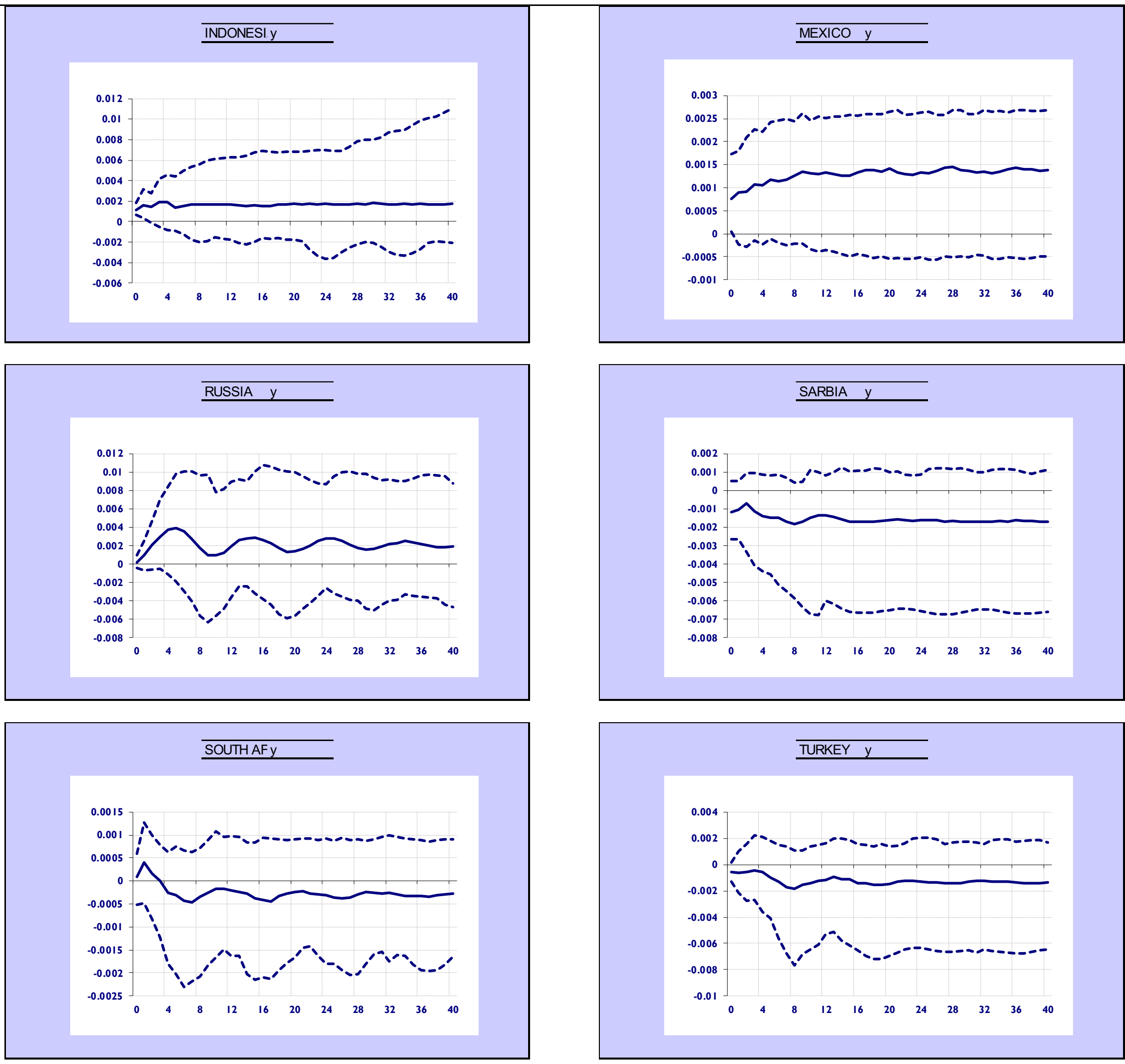


(c) monetary policy



(d) inflation

Figure 4 8 Impulse responses to US 10-year bond shocks: EMEs


INDONESI y
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0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
0 4 8 12 16 20 24 28 32 36 40
MEXICO y
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
-0.0005
-0.001
0 4 8 12 16 20 24 28 32 36 40
RUSSIA y
0.012
0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.008
0 4 8 12 16 20 24 28 32 36 40
SARBIA y
0.002
0.001
0
-0.001
-0.002
-0.003
-0.004
-0.005
-0.006
-0.007
-0.008
0 4 8 12 16 20 24 28 32 36 40
SOUTH AF y
0.0015
0.001
0.0005
0
-0.0005
-0.001
-0.0015
-0.002
-0.0025
0 4 8 12 16 20 24 28 32 36 40
TURKEY y
0.004
0.002
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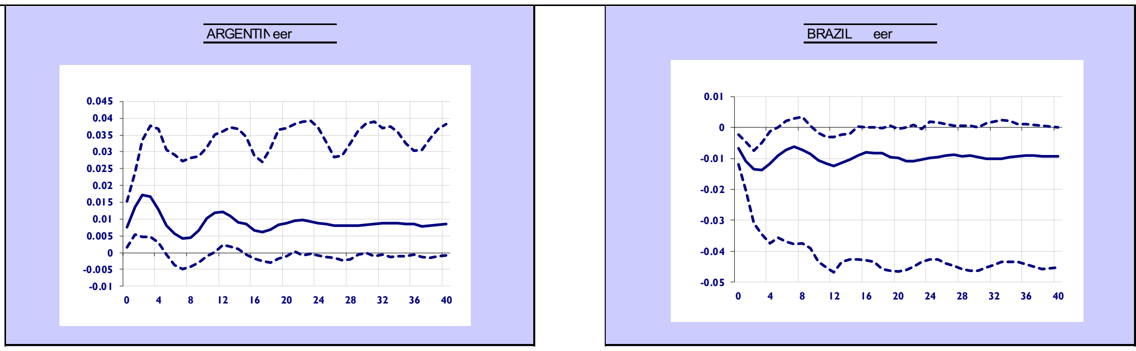
-0.002
-0.004
-0.006
-0.008
-0.01
0 4 8 12 16 20 24 28 32 36 40

(a)Real GDP


ARGENTIN eer
0.045
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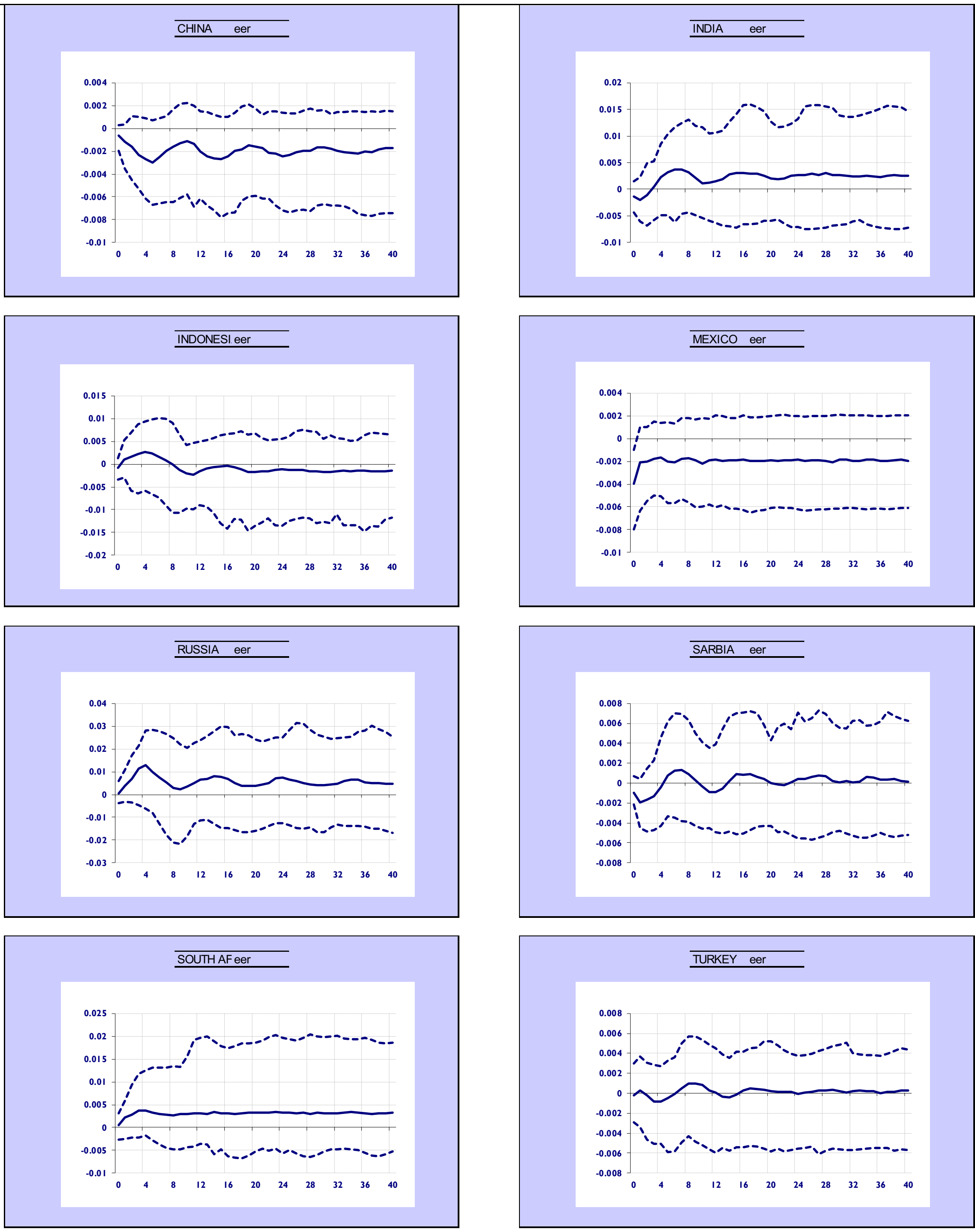
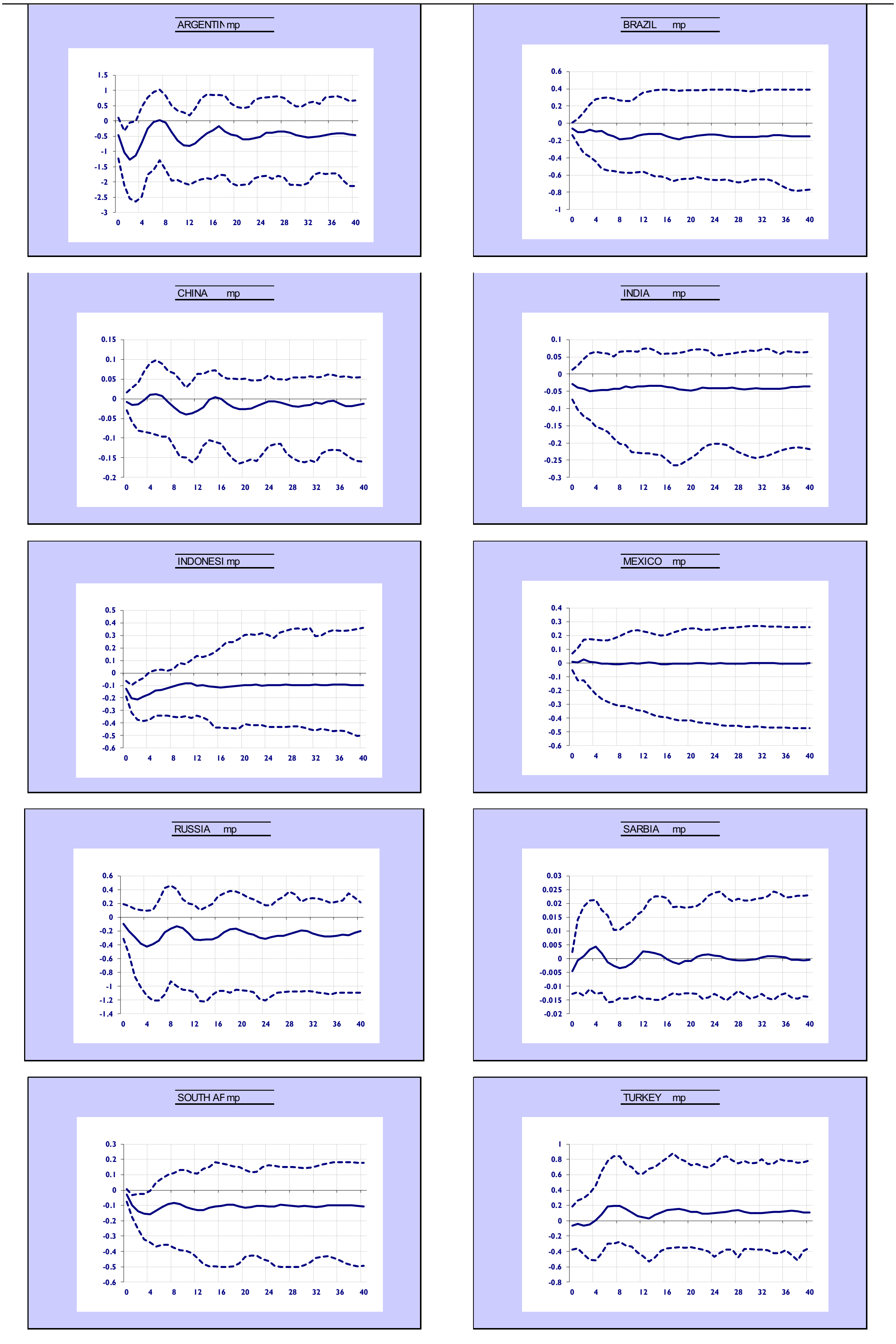
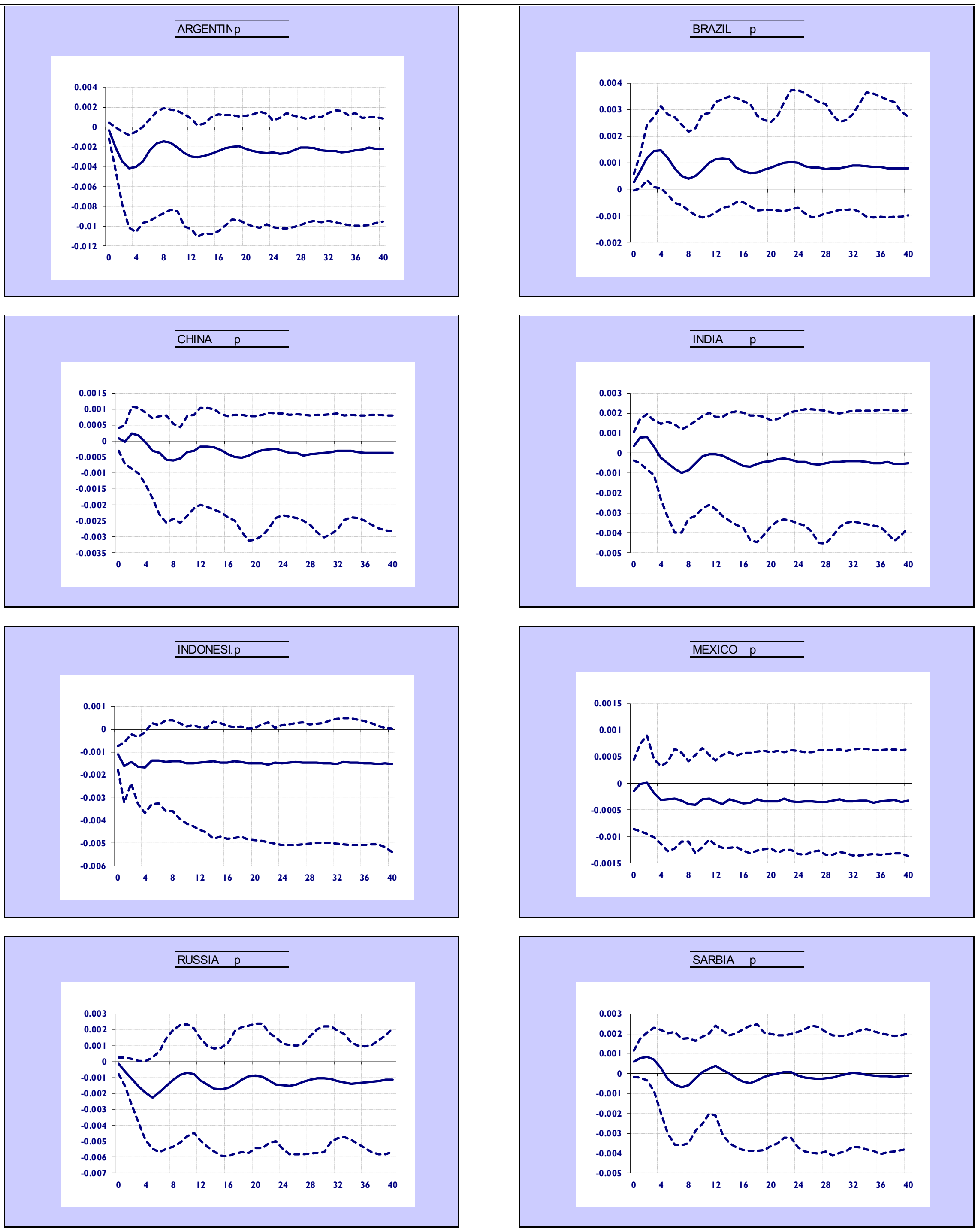
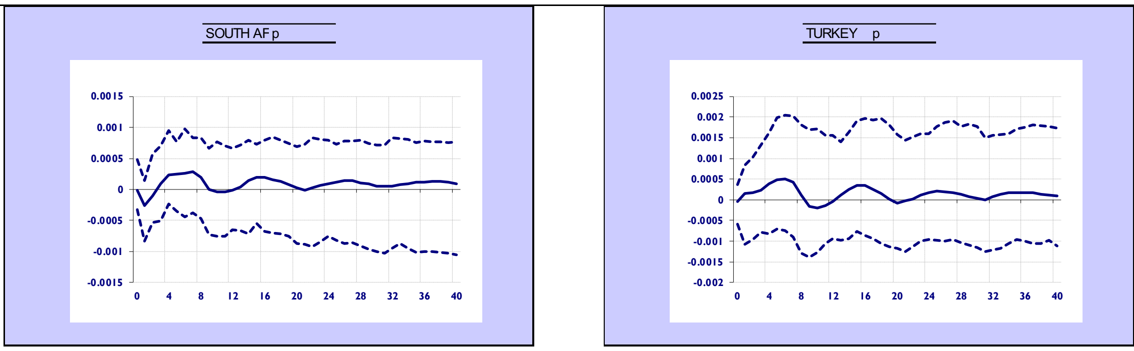


(b)Effective Exchange Rate


ARGENTIN mp
BRAZIL mp
CHINA mp
INDIA mp
INDONESI mp
MEXICO mp
RUSSIA mp
SARBIA mp
SOUTH AF mp
TURKEY mp

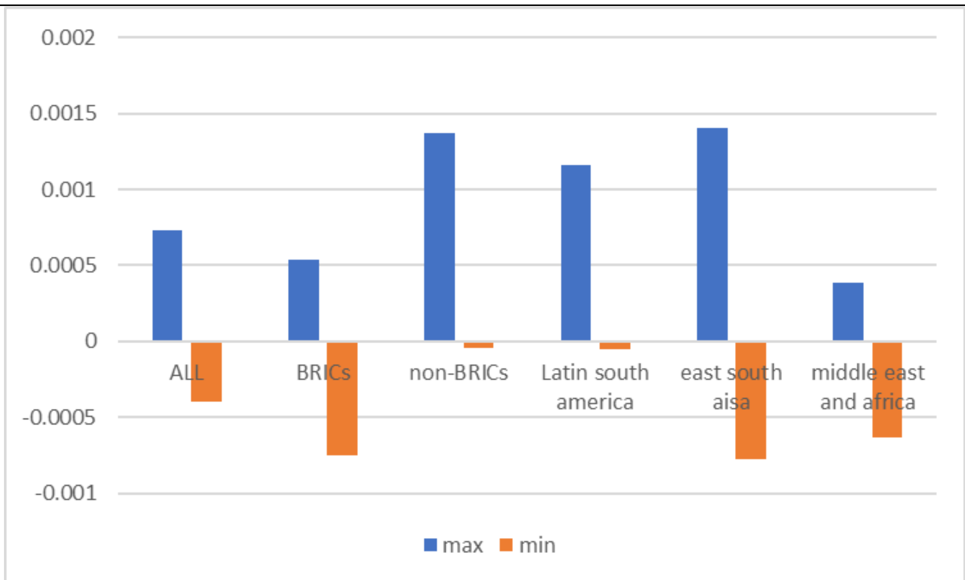
(c)Monetary policy



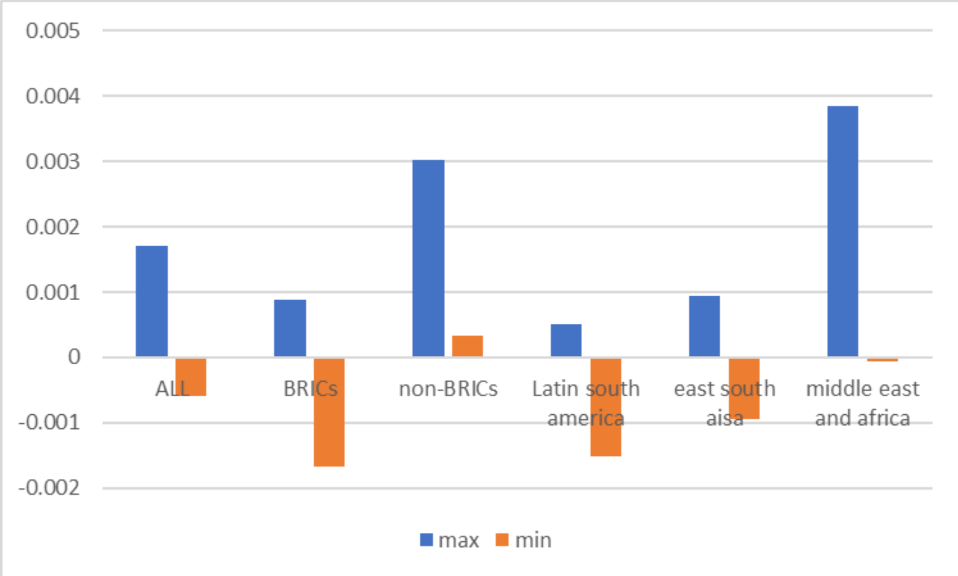


(d) inflation

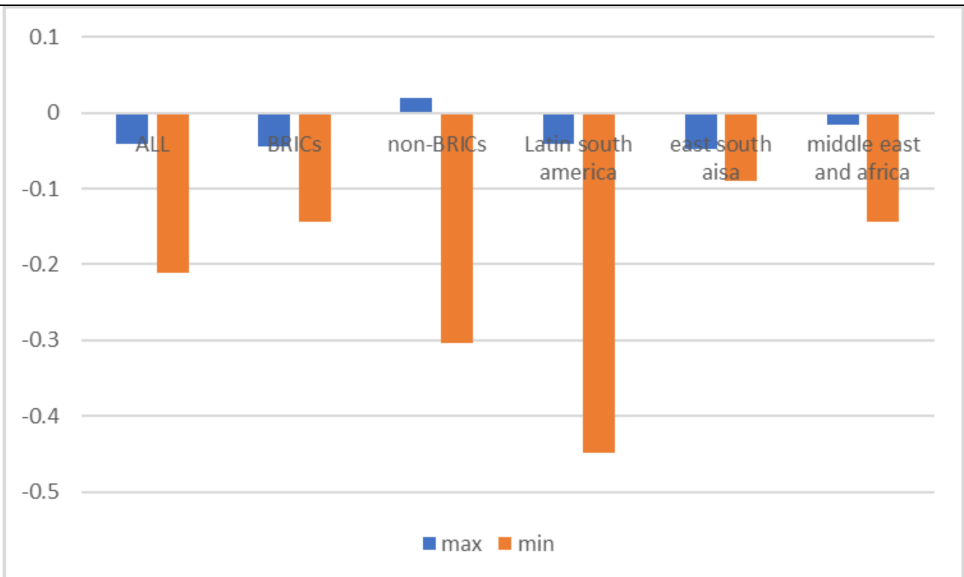
Figure 4 9 Impulse responses to US 10-year bond shocks: EMEs (individual plot)



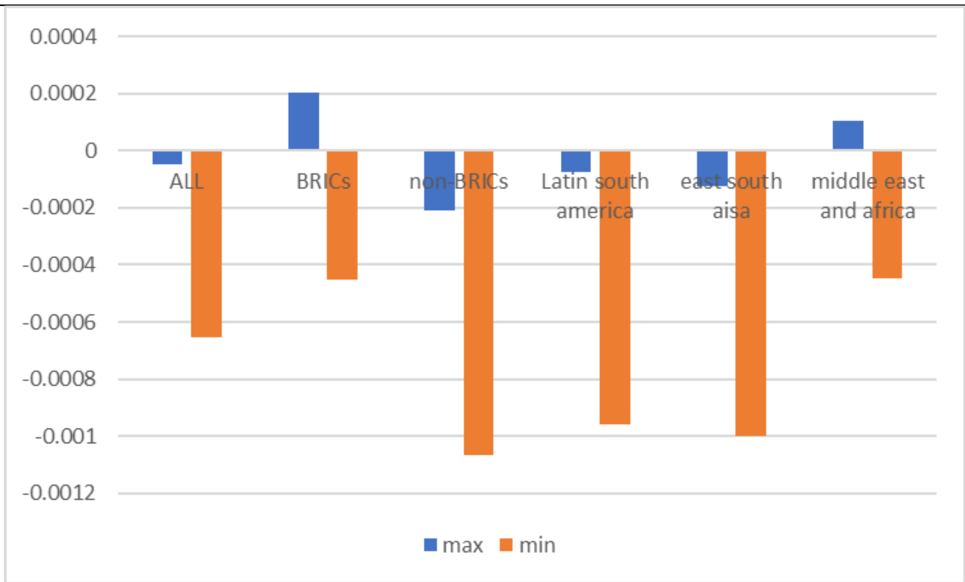
(a) real gdp



(b)effective exchange rate



(c) monetary policy



(d) inflation

Figure 4 10 Mean responses to US 10-year bond shock: EMEs

4.7 Conclusion

In this paper, we examine the international spillover effects of US UMP to EMEs in a Global VAR model. We advanced the knowledge of current literature by estimating a Global VAR model with moderate sample size and low frequency quarterly data. And our results show that, firstly, consistent with previous studies (Bowman et al., 2014; Bowman et al., 2015; Jordan, 2016; Fratzscher et al., 2016; Chen et al., 2016; Georgios, 2016; Garratt, Lee and Shields, 2016), it is clear that US UMP measures tend to have a greater impact on global financial conditions in EMEs as US UMP leads to an increase in credit conditions, in another word, the rise of inflows to EMEs results in a significant response by financial variables (Hallam, 2022).

Secondly, the impulse response results show that US corporate spread shocks have greater domestic effects than domestic term spread shocks. That is purchasing US Treasuries to lower the term spread may be a weak tool and reducing risk premium by allowing indirect liquidity for bank section generates much more effects persuading GDP growth as well as a short-term appreciation of domestic currency (Inoue and Okimoto, 2022).

Moreover, although exchange rate responses have been diversified among EMEs, we do find a co-movement between exchange rate responses, monetary policy and inflations (Punz and Chantapacdepong, 2019) which may partly explain the divergence in financial structure as well as optimal objectives of central bank in responses of output growth, inflation growth, exchange rate stability and credit growth (Inoue and Okimoto, 2022).

While our study does account for the multilateral nature of cross-country interlinkages, further works are needed for understanding the determinants of the heterogeneous international spillovers. As the impulse responses have been diverse in the emerging economies, which may partly explain the divergence in real and financial structure as well as optimal objectives of central bank in the responses of GDP growth and financial stability. Moreover, we find strong spillovers on domestic monetary policy in EMEs which lead to a natural question of whether such effects are the result of international trade and financial integration. We will discuss the determinants of the heterogeneous international spillovers to EMEs in chapter 5.

Chapter 5 International spillovers of US unconventional monetary policy on emerging market economies: The role of country specific characteristics

5.1 Introduction

Given the dominance of the US economy in global markets, the impact of the US UMP to the rest of the world, especially emerging economies, is not surprising. Despite of variation in shock identifying process, other studies argue difference of international spillovers on asset prices and capital flows was possibly affected by EMEs' domestic powers (Fischer, 2015; Bowman, Londoño, and Sapriza, 2014, 2015; Gagnon et al., 2017). Better fundamentals (such as lower government deficit, huge foreign reserves, and more liquidity markets) could probably help reduce the effects of US UMP shocks in long-term position.

However, there have litter weak evidence supporting this view. For instance, Fratzscher, LoDuca and Straub (2012) find no evidence that foreign exchange reserves (FRX) or capital account policy helped contain spillovers, while Chen, Griffoli and Sahay (2014) point to weak evidence that flexible exchange rate regimes help shield bond yields from foreign monetary policy shocks.

Moreover, it is beneficial to EMEs' macro-economic and macro-financial stability under trade openness and financial integration by exchange rate control and foreign reserve controls. EMEs can improve the inspection power over the exchange rate stability if it speeds up the establishment of a multi-currency operation to diversifying the impacts of US dollars on international trade and portfolio investment (Jenkins and Zelenbaba, 2012; Adam, Subacchi and Vines, 2013). Meanwhile Cho and Rhee (2013) show that tighter monetary controls have been introduced by several EMEs in recent years, such as exchange rate control and foreign reserve controls. While these capital control have a dampening impact on total and portfolio inflows, controls upon 'hot money' are less efficient for EMEs to avoid excessive volatility and negative spillovers.

In this study, we continue work of Chapter 4, trying to find out whether the heterogeneity spillovers of US UMP shocks to EMEs' monetary policy is possibly affected by EME' domestic powers. As the heterogeneity responses of inflation, monetary policy and exchange rate may partly explain the divergence in real and financial structure as well as optimal objectives of economic growth and financial stability. We find that the exchange rate stability, trade openness, economic structure and financial depth are important determinants of international spillovers of US UMP shocks to EMEs' financial stability.

The rest of this study is structured as follow: Section 5.2 provides the literatures related to explaining the heterogeneity international spillovers of US UMP to EMEs. Section 5.3 presents details of the empirical model and the data we used in this study. Section 5.4 presents the result of this study. The result is presented in two parts. First, we analysis whether international spillovers to EMEs' monetary policy was possibly affected by their domestic powers, like trade openness, exchange rate regime and financial integration, in a simple linear panel model. Second, we analysis the interaction between trade openness, trade structural, exchange rate regime and financial integration in non-linearity models. And in section 5.5, we conduct a robustness check to further confirm whetehr the heterogenous responses came are subject to the change of shock indicators. Finally, section 5.6 provides a summary of the key findings.

5.2 literature reviews

5.2.1 Discussion of heterogeneity responses

A related strand of literature believes US unconventional monetary policy shocks have generated heterogeneous international spillovers across countries (Chen et al., 2016; Anaya et al., 2017). This literature shares the commons that the US unconventional monetary policy had raised issues, such as the large capital inflows, currency appreciation pressure, and consumer and asset price inflation pressures, on emerging economies, especially the ones whose currencies are pegged to the dollar (Ahmed and Zlate, 2013, 2014; Bowman et al., 2014, 2015; Xu and La, 2017). And the recent studies also point out that advanced economies are more likely affect by US unconventional policy through the exchange rate channel while effect channels vary among EMEs with substantial differences in the impulse responses to the US unconventional monetary policy shocks (Bowman et al., 2014, 2015; Jordan, 2016). Moreover, the US unconventional monetary policy generate considerable international spillovers to EMEs, which are generally found to be larger than the domestic effects. While great amount of bilateral model studies the transmission mechanism of US UMP shocks (Gurkaynak and Wright, 2011; Fratzscher et al., 2016), few evidence are given in explaining the heterogeneity of international spillovers of US unconventional policy on emerging market economies.

Some researchers believe that such difference mainly depend on interpretation of transmission channel. Most of them starts from credit channel where the international spillovers from US unconventional monetary policy transfer to global financial markets (Hausman and Wongswan, 2011; Gurkaynak and Wright, 2011; Fratzscher et al., 2012; Rogers et al., 2014). While some literature, for example, Aizenman, Binici et al. (2014) and Bauer and Neely (2014), estimates international spillovers through actual asset purchases (such as LASP) and QE announcements, other literature researches the potential impact of US unconventional monetary policy through the transmission of real interest rate. For example, Dahlhaus and Vasishtha (2014) examined the potential impact of US unconventional monetary policy by defining 'policy normalization shock' as a shock that increases in the yield spread of US long-term bonds in addition to the policy rate spread. Moreover, Gurkaynak and Wright (2011), and Fratzscher et al. (2014) give a certain answer that US unconventional monetary policy have substantial effects for capital flows to emerging market economies, and magnitude of shock impacts depends on the type of the credit shocks. Another example is Lombardi and Zhu's (2014, 2018) who propose a new "shadow policy rate" to explain heterogeneous international spillovers through various maturities and asset purchases during different unconventional monetary policy period.

Other studies argue difference of international spillovers on asset prices and capital flows was possibly affected by EME' domestic powers (Bowman, Londoño, and Sapriza, 2014, 2015; Gagnon et al., 2017). The assumption of this literature is that better fundamentals (such as lower government deficit, huge foreign reserves, and more liquid markets) could probably help reduce the effects of US monetary policy shocks in long-term position and several possible extensions are made in exploring the heterogeneities of international spillovers the US unconventional monetary policy to EMEs by including other fundamentals variables of EMEs (such as government deficit, public debt, foreign reserves). However, there have litter weak evidence supporting this view.

For instance, Chen, Griffoli and Sahay (2014) point to weak evidence that flexible exchange rate regimes help shield bond yields from foreign monetary policy shocks. They argue that financial market development may affect the magnitude of spillovers from the US unconventional monetary policy. Economies with less financial openness tend to be riskier, giving rise to vulnerability in equity price in response to the greater capital inflows which is led by the US unconventional monetary policy, and thereby to deepen domestic inflation target as well as short-term interest rate and decline in foreign reserves. Bowman et al. (2015) also investigated how country-specific characteristics affect the magnitude of spillovers from the US unconventional monetary policy with respect to a model that take account each country's currency regime and vulnerability to US financial conditions. However, the result indicate that these responses were not outsized the baseline models. Fratzscher, LoDuca and Straub (2012) find no evidence that foreign exchange reserves (FRX) or capital account policy helped contain spillovers. In Fratzscher, Lo Duca and Straub (2013), the portfolio rebalance has been examined as it is the main transmission channels of US UMP shocks. The result indicates that UMP shocks are firstly boosting bond and equity prices and then led to the appreciation of the US dollar. Furthermore, they find the UMP shocks through portfolio rebalance channel are in the opposite direction, magnifying vulnerability in financial market. Furthermore, for EMEs with highly monetary interdependency, the spillover effects of UMP shock to EMEs did not necessarily shield by either imposing capital control or managing the exchange rate floating.

Besides, some researchers (Ahmed and Zlate, 2013, 2014; Lim, Mohapatra, and Stocker, 2014) argue that the responses to international spillovers of the US unconventional monetary policy depend on the relative strength of these channels. Ahmed and Zlate (2013, 2014) examine the effects of unconventional monetary policy on net private capital inflows to emerging market economies since 2002. They find that the net private capital inflows are mainly affected by GDP growth rate between emerging market economies and advanced economies. And Lim, Mohapatra, and Stocker (2014) conduct a study on the effects of US unconventional monetary policy on net financial inflows to emerging market economies. Two studies mainly examine transmission mechanism through liquidity, portfolio balancing, and confidence channels and they find that US unconventional monetary policy seem to result in sharp rising in prices of bond and equity markets domestically and globally, with some variation across security segments. Moreover, although portfolio flows seem to be a strong transmission channel for US unconventional monetary policy shocks, they found small impact on capital flows in emerging countries which may because EMEs' financial market are under development.

Additionally, some researchers believe such difference does not seem to result from a change in the type of shocks transmission but the way in model specification. The various methods of identifying the unconventional monetary policy shocks, thus, lead to failure of bilateral model to capture the spillovers from US unconventional monetary policy that affect all economies. In papers of Georgios (2015) and Chen (et al. 2016), they believe previous studies do not account for the multilateral nature of cross-country interlinkages, thus fail to explore the heterogeneities in the spillovers and provide limited efforts to guide policymakers in improving real activities (such as GDP and inflation) to changes in external monetary policy.

There are quickly expanding literature of modelling international spillovers of US unconventional monetary policy on emerging market economies through multilateral models (Curdia and Woodford, 2011; Anaya, Hachula, and Offermanns, 2017). The former is based on a multi-country New Keynesian dynamic stochastic general equilibrium model while the latter solve the question using GVAR approach. Both approaches do account for modelling interdependent among economics, however, this literature yields limited evidence in explaining the heterogeneities among EMEs.

In context of exploring the heterogeneities of international spillovers of US unconventional monetary policy to EMEs, the need for modelling macroeconomic interactions has led to studies of multilateral models. Global Vector Aggression model (Chudik and Fratzscher, 2011; Favero, 2013; Konstantakis and Michaelides, 2014; Konstantakis et al., 2015; Georgios 2015; Chen et al., 2016). Global VAR model has been thought advancing the studies of international spillovers of US unconventional monetary policy. On one hand, Global VAR approach allows the entry of a large number of economies and to model the dynamics of several economies jointly. On the other hand, the Global VAR approach can incorporate the complex interdependencies that exist between the various economies without neglecting the channels of real activities (Georgios, 2016; Garratt, Lee and Shields, 2016; Chen et al., 2016; Kempa and

Khan, 2017), which allows for testing a huge variety of macroeconomic variables that might lead to the answer of heterogeneity. For example, in paper of Chudik and Fratzscher (2011), and Georgiadis (2015; Georgiadis, 2016), a huge variety of macroeconomic variables had been tested. The results pointed to weak evidence that flexible exchange rate regimes help shield bond yields from foreign monetary policy shocks which is in line with the findings of Chen, Griffoli and Sahay (2014). Georgiadis (2016) also suggested that policymakers of EMEs could prevent international spillovers of US UMP shocks on output by enhancing trade integration, domestic financial market development, increasing the flexibility of exchange rates, and reducing frictions in labour markets though these non-monetary measurements are likely to reduce long-run growth of domestic economy.

Although most works focus on international spillovers of US UMP shocks to EMEs' output, we argued that US UMP shocks have greater impact on financial conditions than output of EMEs. We follow Georgiadis (2015), Chen et al. (2016) and Anaya et al. (2017) to measure international spillovers from US UMP to EMEs monetary autonomy through Global VAR study firstly. While we try to figure out some country specific characters that are determinants of the heterogeneities by panel data model which could lead to valuable suggestions toward financial stabilization of EMEs.

5.2.2 Stylized facts

Firstly, there exists considerable evidence showing that trade and financial integration is a crucial determinant of interntional spillovers in EMEs (Engel and Wang, 2011; Engel, 2016). On the one hand, the more integrated in global trade and financial activities makes EMEs more exposed than others to changes in the US monetary policy, especially the short-term interest rate and US dollar depreciation (Neely, 2010; Hausman and Wongswan, 2011). It has also highlighted that EMEs with strong surpluses faces fewer challenges from unconventional monetary policy shocks, while other with higher openness and strong financial linkages with US are more likely to be affected (Loh, 2014). As international trade stands for a larger share of the EMEs economy, the loss from the US dollar depreciation can be offset by a pure expenditure-shifting effect stimulating the exports of EMEs (Corsetti et al., 2010a; Corsetti et al., 2010b). On the other hand, in response to an easing in the US monetary policy, an expansion in capital outflows of the US could lead to an overheat in EMES' finanical market in short-term (Cavallo and Frankel, 2008). But it would also raise the expectation of a capital account reversal occurring in long-term, namely sudden stop of capital inflows (Bowman et al, 2015; Jordan, 2016). Moreover, to the extent that the expenditures switching effect associated with a rise in exports to the US, an appreciation of the US dollar outweighs the expenditure-reducing effect associated with the rise in global interest rates. Thus, economies that are more integrated in global trade should display smaller spillovers (Bowman et al., 2015; Jordan, 2016).

Second, factors related with financial development are also crucial determinants of interntional spillovers in EMEs, as the US unconventional monetary policy generate profound impact on the credit channel (Wongswan, 2009; Neely, 2010). On one hand, it can be explained through the profit seeking theory (Ehrmann and Fratzscher, 2009; Beirne and Fratzscher, 2013). The idea is straightforward that the Federal Reserve expends its balance sheet by directly purchasing of long-term government bond in the relevant markets, thus reducing the return spread between long-term treasury bills and short-term treasury bills (Beirne and Fratzscher, 2013; Fratzscher et al., 2014; Manova, 2013; Rogers et al., 2014). For EMEs, a combination of higher yields and greater supply dominated the process, attracting investors abroad and stimulating the GDP growth. On the other hand, while efficient credit growth facilitates the absorption of large and volatile capital flows, EMEs can be vulnerable to US dollar appreciation as large amounts of debt are US dollar denominated (Punz and Chantapacdepong, 2019). These inflows are mostly denominated in US dollars, which could make the countries concerned more vulnerable in terms of increasing in interest rate risk, and exchange rate risk. As suggested by Wright (2011), even though capital controls may be effective in the short run confrontation, these countries would be suffering a great lose when US dollar starting appreciation as they have large amounts of US dollar-denominated debt.

Chen, Griffoli and Sahay (2014) also argue that financial market development may affect the magnitude of spillovers from the US conventional monetary policy. On the one hand, economies with less financial openness tend to be more leveraged, giving rise to pronounced effects in equity price in response to the greater capital inflows which is led by the financial easing of the US monetary policy. However, the weak position of financial markets may also raise the issue to withstand capital outflows, and thereby to preserve domestic inflation target as well as short-term interest rate (Miyajima et al., 2014; Chen et al., 2014). To the extent that domestic interest rates decrease in line with those in the US. For example, EMEs that feature as export leading are more sensitive to the changes in short-term interest rate which responses to the US unconventional monetary policy (Fratzscher et al., 2016).

Another determinant of international spillover effects is the exchange rate regime of EMEs who had generally adopt the tighten monetary policy to defend the value of their currencies (Georgiadis, 2016). The role of the exchange rate in the international spillovers depends highly on the exchange rate regime and related management policy (Georgiadis, 2016). For example, managed floating exchange rates could help economies to moderate external shocks, by reducing the risk of current account reversals in response to an easing of the US unconventional monetary policy and by quickly responding to the impacts, while it would be poor for economies hold huge number of foreign reserves assets and run a fiscal surplus (Fratzscher, et al, 2014). Moreover, a managed floating exchange rate that depreciates in response to an easing in the US monetary policy may also help to reduce spillovers caused by expenditure switching (Fratzscher et al., 2016). By depreciating relative to the US dollar, the production competitiveness of EMEs in international trading changes. But another explanation for this finding suggests that the flexible exchange rate depreciating in line with the US dollar in response to a monetary policy easing would probably lead to a current account reversal in long-term if the gains from home currency depreciation are relatively small to the loses (Georgiadis, 2016; Fratzscher et al., 2016).

Additionally, foreign exchange reserve is considered as a precautionary saving of EMEs against the risks of financial openness, namely sudden stops of capital flows and contagious financial crises (Aizenman and Lee, 2008). EMEs' central banks can use foreign exchange reserves for intervention in non-crisis times. In a country with highly developed financial markets, it can use open-market operations, intervention in the forward exchange market, and direct operations in foreign exchange reserve to defend an exchange parity (Obstfeld et al., 2005). But a government attempting to keep its currency from depreciating may find its foreign reserve exhausted and its borrowing approaching a limit (Obstfeld et al., 2005). Thus, suffering greater shocks. Intervention can also act as a tool against deflation or a respond to terms of trade shocks, both by mitigating nominal appreciation, and by expanding the money supply.

However, some economists think that massive foreign exchange reserve are bad for EMEs, as it increases balance sheet exposure to external interest rate shocks, especially the one initialized from US unconventional monetary policy (Aizenman and Lee, 2008; Fratzscher et al., 2014). The current volatility in foreign exchange markets and capital flows root on the uncertainty regarding the timing and pace of US unconventional monetary policy. Although increasing foreign exchange reserve may indeed protect a country from domestic crises, the accumulation increases the instability of the international financial system and might become more sensitive to the monetary policy shocks from the reserve currency country (Fratzscher et al., 2014).

And finally, as discussed in Georgiadis (2016), economies characterised by fewer rigidities, market imperfections and informational asymmetries as summarised by measures of institutional quality should be able to adjust more efficiently to shocks, giving rise to larger spillovers from US monetary policy. However, these are usually not the case for EMEs which are featured as underdevelopment financial markets and less competitive in financial system.

5.3 Methodology

To begin with, we estimate the general impulse responses to one negative shocks in corporate spreads by Global VAR model which has been done in chapter 4. The country-specific models are estimated in last chapter with the following ordering of the endogenous variables: real GDP growth (y), the CPI inflation rate (p), a monetary policy indicator (mp), nominal effective exchange rate (eer), and VIX index (vix).

We decide to use medium estimation of impulse responses of EMEs' interest rate as the dependent variable ($\epsilon_{mp\ i,t+1}$) in this study as US UMP shocks have greater impacts on interest rate in EMEs and thus lead to instability of monetary autonomy (Hallam, 2022). EMEs are more likely exposed to changes in the monetary policy, especially through short-term portfolio rebalancing and repricing channel. And Hallam (2022) suggested that EMEs became more sensitive to global financial shocks over time. We also made a model about output as a supplement.

To investigate the underlying domestic determinants of international spillovers, we assume the impact of unconventional monetary policy shock to EMEs' monetary policy one-step ahead is determined by the following panel data regression:

$$\epsilon_{\widehat{mp\ i,t+1}} = \alpha_0 + \sum_{i=1}^{p} \alpha_i * X_{it} + u_t \qquad \text{Eq. 31}$$

X_i measure various of explanation factors on a set of country specific variables (table 5.1).

Table 5 1 Candidate determinants of output spillovers from US unconventional monetary policy

Group	Name	Label	Define
trade and financial openness	Trade openness	X1	Trade integration (% of GDP)
	Financial Integration	X2	Total debt service (% of GNI)
	Financial Openness	X3	KAOOPEN index
economic structure	Trade Structure	X4	Manufacturing values add in GDP%
	Financial depth	X5	Domestic credit to private sector (% of GDP)
vulnerable	Exchange rate regime	X6	Stability index
	Current account balance (% of GDP)	X7	Trade surplus
	Total reserves minus gold	X8	logarithm form

We now discuss in more detail the motivation for considering the country characteristics in X_i. To investigate the underlying domestic determinants of international spillovers, we identified the impact of unconventional monetary policy shock to EMEs' short-term interest rate is determined by three aspects: trade and financial openness, economic structure, and vulnerabilities.

Firstly, there exists considerable evidence showing that trade and financial integration is a crucial determinant of interntional spillovers in EMEs (Corsetti et al., 2010a; Corsetti et al., 2010b; Engel and Wang, 2011; Engel, 2016). On the one hand, the more integrated in global trade and financial activities makes EMEs more exposed than others to changes in the US monetary policy, especially the short-term interest rate and US dollar depreciation (Neely, 2010; Hausman and Wongswan, 2011). As international trade stands for a larger share of the EMEs economy, the loss from the US dollar depreciation can be offset by a pure expenditure-shifting effect stimulating the exports of EMEs (Loh, 2014).

Based on these reasons, we measure the trade openness and financial integration as X1 and X2. The trade openness (Engel, 2016) is a widely used indicator that measure of the extent to which EMEs are engaged in the global trading system. It is measured by the ratio between the sum of total trade and gross domestic product (GDP). While higher the ratios may lead to great exposed than others to changes in the US unconventional monetary policy, we assume the effects to EMEs should be less vulnerable as most EMEs are with strong surpluses. While the financial integration (Engel, 2016) is measured by the term total debt service to income ratio which refers to a debt service measurement that is already spent on housing-related and other similar payments. A higher financial integration should link with a higher response of monetary policy to UMP. Moreover, we adopt the KAOPEN index (X3) (Chinn and Ito, 2006) as an indicator for financial integration. The index is a score that range from zero to one with one stand for fully integrated, and the sign of the effects should be positive.

Second, to the extent if EMEs have a large share of manufacture output accounted for by industries which is less sensitive to the interest-rate shocks should dampening the responses of interest rate to US unconventional monetary policy (Georgiadis, 2015). Therefore, we use the manufacturing value adding to GDP ratios (X4) to represent the economic structure, as higher ratios imply that EMEs is focus on manufacture side rather than service sized and are less likely be affected by exchange rate. Moreover, financial depth (X5) may also affect the magnitude of spillovers from US unconventional monetary policy though the result may various (Georgiadis, 2015). The deeper financial development should increase the use of leverage, thus leading to more pronounced credit channel effects in response to UMP (Georgiadis, 2015). Considering this, we conduct the financial depth variable as the total credit growth to non-financial sectors that deeper the financial competitive is more efficient in delivery shocks.

Finally, most important determinant of international spillover effects is the exchange rate regime (X6) of EMEs. As suggested by Wright (2011), even though tighten foreign exchange regime and capital controls may be effective in avoiding the parallel decline between US and EMEs interest rate, such fundamentals position would become weaker when short-term interest rates quickly close or approach zero. Therefore, we assume only by liberalising the exchange rate regime, the effects of UMP to EMEs' short-term interest rate would be reduced. It has also highlighted that EMEs with strong surpluses (X7) faces fewer challenges from unconventional monetary policy shocks (Wright, 2011), while other with higher openness and strong financial linkages with US are more likely to be affected (Loh, 2014).

Then we imply a current account balance to GDP ratio to stand for trade surpluses. And holdings of foreign reserves (X8) may have weak effect absorbing shocks (Hallam, 2022).

In addition to linear estimation, we consider an investigation into the role of interactions between trade openness, trade structural, exchange rate regime and financial integration as in Eq.32.

$$\widehat{\epsilon_{mp,t+1}} = \alpha_0 + \sum_{i=1}^{p} \alpha_i * X_i + \Psi * X_k * X_j + u_t \qquad \text{Eq. 32}$$

Where X_j is fixed factor, while X_k are the interaction term.

The tested hypotheses between these characteristics are:

1) Higher manufacture ratios reduce spillovers if economies are highly integrated in global trade (Trade structure×X_j , X_j: trade openness)

2) Enhancing trade openness amplifies spillovers if the economy is manufacturing oriented (Trade openness ×X_j , X_j: Trade structure)

3) Trade openness amplifies spillovers if the exchange rate regime is managed (Trade integration ×X_j , X_j: Exchange rate stability)

4) Liberalising the exchange rate regime reduces spillovers in economies integrated in trade (Exchange rate stability×X_j , X_j: Trade integration)

5) Spillovers in financially integrated economies are reduced if the exchange rate regime is more flexible (Financial depth×X_j , X_j: Exchange rate stability)

6) Liberalising the exchange rate regime reduces spillovers in more financially integrated economies (Exchange rate stability×X_j, X_j: Financial depth)

International Monetary Fund (IMF)-IFS data and Bank for International Settlements (BIS) database were primary sources of this study along with World Bank and CBOE. The IFS database is the most comprehensive and comparable source of Marco-economic statistics for many countries. Nevertheless, there are several issues with the compilation of the statistics, as substantial country differences in terms of time coverage, and missing, unreported or misreported data, in particular for developing countries.

5.4 Baseline results

Following the work of Georgiadis (2016), we adopt a general-to-specific approach, starting with small numbers of determinants. The results are presented in table 5.2 and table 5.3. The first thing we notice is only few coefficient estimates are statistically significant at conventional significance levels in the GDP model (column (7)) while most coefficient estimates are significant in interest model (column (7)). Financial depth and exchange rate stability are significant determinants of international spillovers from US unconventional monetary policy by both GDP output and interest rate models but playing the opposite role. Maintaining a stable exchange rate would benefit output but not conducive to interest rate stability. While enhancing financial depth puts pressure on rising interest rates, it will hurt output.

Other factors significantly affect the magnitude of international spillovers by interest rate at conventional significance levels except financial integration. We find a strong negative effect from exchange rate regimes, which indeed means that higher exchange rate flexibility conducts in a significant reduction in short-term interest rate of EMEs to UMP shocks.

Moreover, we find a negative effect for trade openness as well. While this is because the trade structure is manufactured leaded, another reason might be EMEs in general have a trade surplus that EMEs with strong surpluses faces fewer challenges from unconventional monetary policy shocks. We also notice that higher financial depth could lead to an increase in impulse response of emerging markets economies from international spillovers of US unconventional monetary policy. This is in line with evidence that EMEs that are more integrated into financial market would be easier affected by US unconventional monetary policy shocks. Furthermore, greater trade surplus has a negative relation with spillovers, but the coefficients are relevantly small and insignificant. And increasing foreign exchange reserves do help EMEs to absorb the spillovers from US monetary policy significantly.

Table 5 2 Determinants of spillovers: GDP output-corporate spread shock

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x1	-0.0032	0.0153**	0.0035	-0.0034	0.0116*	0.0117*	0.0115*
	(0.0021)	(0.0061)	(0.0025)	(0.0021)	(0.0060)	(0.0061)	(0.0061)
x2	-0.0062	-0.0048	-0.0070	-0.0059	-0.0061	-0.0064	-0.0052
	(0.0065)	(0.0062)	(0.0060)	(0.0065)	(0.0060)	(0.0060)	(0.0062)
x4	-0.0099	0.0386**	-0.0095	-0.0093	0.0154	0.0139	0.0107
	(0.0090)	(0.0173)	(0.0083)	(0.0090)	(0.0188)	(0.0191)	(0.0205)
X5	-0.0017	-0.0036***	-0.0038***	-0.0015	-0.0043***	-0.0045***	-0.0042***
	(0.0012)	(0.0013)	(0.0012)	(0.0012)	(0.0013)	(0.0013)	(0.0015)

X6	0.2128**	0.2061***	1.3417***	0.2844**	1.0867***	1.1134***	1.1288***
	(0.0823)	(0.0780)	(0.2935)	(0.1210)	(0.3390)	(0.3446)	(0.3471)
x1*x4		-0.0010***			-0.0005	-0.0005	-0.0005
		(0.0003)			(0.0004)	(0.0004)	(0.0004)
x1*x6			-0.0284***		-0.0220***	-0.0238***	-0.0228**
			(0.0071)		(0.0083)	(0.0090)	(0.0091)
X5*X6				-0.0014		0.0009	0.0007
				(0.0018)		(0.0018)	(0.0018)
X7							-0.0040
							(0.0060)
X8							-0.0478
							(0.0642)
_cons	0.3980**	-0.3615	0.2647	0.3914**	-0.0973	-0.0837	1.1648
	(0.1782)	(0.2900)	(0.1675)	(0.1788)	(0.2969)	(0.2994)	(1.7240)
N	97	97	97	97	97	97	97
F	3.3743	4.8590	5.9571	2.9091	5.4882	4.7911	3.8835
r2	0.1689	0.2623	0.3036	0.1755	0.3217	0.3239	0.3324

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent series are point estimations of impulse response of GDP to US corporate spread shock. X1=trade openness, X2=financial integration, X4=trade structure, X5=financial depth, X6=exchange rate regime X7=current account balance X8=total reserve minus gold. Financial openness (X3) is omitted as shown collinearity.

Table 5 3 Determinants of spillovers: interest rate-corporate spread shock

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x1	-0.0051*	-0.0362***	-0.0164***	-0.0035	-0.0300***	-0.0288***	-0.0296***
	(0.0026)	(0.0074)	(0.0030)	(0.0023)	(0.0070)	(0.0065)	(0.0062)
x2	0.0073	0.0049	0.0086	0.0049	0.0070	0.0045	0.0077
	(0.0083)	(0.0075)	(0.0071)	(0.0073)	(0.0070)	(0.0064)	(0.0063)
x4	0.0095	-0.0719***	0.0088	0.0052	-0.0334	-0.0461**	-0.0592***
	(0.0115)	(0.0210)	(0.0098)	(0.0101)	(0.0220)	(0.0204)	(0.0207)
X5	0.0010	0.0042***	0.0045***	-0.0005	0.0054***	0.0035**	0.0046***
	(0.0015)	(0.0016)	(0.0015)	(0.0014)	(0.0015)	(0.0014)	(0.0015)
X6	-0.4665***	-0.4553***	-2.3484***	-0.9704***	-1.9174***	-1.6919***	-1.6457***
	(0.1049)	(0.0948)	(0.3477)	(0.1350)	(0.3960)	(0.3672)	(0.3508)
x1*x4		0.0017***			0.0009**	0.0011***	0.0012***
		(0.0004)			(0.0004)	(0.0004)	(0.0004)
x1*x6			0.0473***		0.0366***	0.0213**	0.0246***
			(0.0084)		(0.0097)	(0.0096)	(0.0092)
X5*X6				0.0101***		0.0077***	0.0071***
				(0.0020)		(0.0019)	(0.0019)
X7							-0.0108*
							(0.0060)

X8							-0.1697**
							(0.0649)
_cons	0.0698	1.3426***	0.2920	0.1160	0.9039**	1.0187***	5.4664***
	(0.2273)	(0.3524)	(0.1984)	(0.1994)	(0.3468)	(0.3191)	(1.7423)
N	97	97	97	97	97	97	97
F	5.8549	9.2698	11.8973	10.6787	11.2858	13.8081	13.1159
r2	0.2607	0.4042	0.4654	0.4386	0.4938	0.5800	0.6271

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent series are point estimations of impulse response of interest rate to US corporate spread shock. X1=trade openness, X2=financial integration, X4=trade structure, X5=financial depth, X6=exchange rate regime X7=current account balance X8=total reserve minus gold. Financial openness (X3) is omitted as shown collinearity.

We also analysis the interaction between trade openness, trade structural, exchange rate regime and financial integration in non-linearity models. The hypotheses and the corresponding results are reported in table 5.4. Since these results are estimated through simple Z-score, the numbers might not be very precisely. The results suggest that there is non-linearity in the system among variables and in their association with the spillovers from US unconventional monetary policy. It is interesting to note that, trade integration dampens spillovers in emerging markets economies if the manufacture count for a high share in total trade and if they adopt a tight policy for the management the exchange rate. The results in Table 5.4 also suggest that exchange rate stability plays a key role in containing the spillovers from US unconventional monetary policy. Exchange rate regime liberalisation reduces spillovers by intereat rate if they have a high level of trade integration and financial depth.

While, for those who need to maximizing output, exchange rate stabilization is more important, as the exchange rate volatility affects both the price and production costs of exports as implied by global value chains, and thus lead to negative impact on output (Adler, Meleshchuk and Buitron, 2023.).

Table 5 4 non-linearity in the determinants of spillovers: response to US corporate spread shock

Hypotheses		GDP output	Interest rate
		$\hat{\alpha}_k + \widehat{\Psi} * X_k$	$\hat{\alpha}_k + \widehat{\Psi} * X_k$
H1	At min(z)	0.01	-0.03
	At P^{25}	0.03	-0.01
	At P^{75}	0.04	0.00
	At max(z)	0.06	0.03
H2	At min(z)	0.01	-0.06
	At P^{25}	1.12	1.80
	At P^{75}	1.71	2.78
	At max(z)	2.74	4.49
H3	At min(z)	0.01	-0.03
	At P^{25}	0.02	-0.02
	At P^{75}	0.02	-0.01
	At max(z)	0.04	0.02
H4	At min(z)	1.13	1.65

	At P^{25}	2.25	3.51
	At P^{75}	2.84	4.49
	At max(z)	3.86	6.19
H5	At min(z)	-0.01	0.00
	At P^{25}	0.00	0.01
	At P^{75}	0.00	0.01
	At max(z)	0.00	0.01
H6	At min(z)	0.91	1.65
	At P^{25}	1.04	1.99
	At P^{75}	1.08	2.31
	At max(z)	1.13	3.24

Notes: The table reports estimate of the marginal effects of interacted candidate determinants of the spillovers from US monetary policy evaluated at different values of the interacting variable xj and the corresponding level of significance. Specifically, the marginal effects are reported at the maximum and the minimum values as well as at the 75% and 25% percentile of the distribution of the interacting variable.

5.5 Robustness check

We also conduct robustness check for US term spread shocks (table 5.5, 5.6, 5.7) and long-term bond rate shocks (table 5.8, 5.9, 5.10). As demonstrated by results, we find that the determinants are able to robustly stabilize the system with same direction of powers on most variables and interaction terms. And we do not find significant difference between three models. Furthermore, we include explanatory variables in the model, and we find that keeping a trade surplus and holding a higher foreign exchange reserves will reduce financial spillovers of EMEs.

Table 5 5 Determinants of spillovers: GDP output-term spread shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x1	-0.0028	0.0144**	0.0050*	-0.0029	0.0095	0.0098	0.0093
	(0.0023)	(0.0068)	(0.0028)	(0.0023)	(0.0067)	(0.0066)	(0.0066)
x2	-0.0036	-0.0023	-0.0045	-0.0034	-0.0040	-0.0047	-0.0025
	(0.0072)	(0.0069)	(0.0065)	(0.0072)	(0.0066)	(0.0066)	(0.0067)
x4	-0.0115	0.0336*	-0.0110	-0.0111	0.0027	-0.0009	-0.0068
	(0.0099)	(0.0195)	(0.0091)	(0.0100)	(0.0208)	(0.0210)	(0.0222)
X5	0.0003	-0.0014	-0.0021	0.0005	-0.0024*	-0.0029*	-0.0024
	(0.0013)	(0.0014)	(0.0013)	(0.0014)	(0.0014)	(0.0015)	(0.0016)
X6	0.3201***	0.3139***	1.6256***	0.3635***	1.4853***	1.5498***	1.5794***
	(0.0909)	(0.0877)	(0.3211)	(0.1340)	(0.3745)	(0.3783)	(0.3762)
x1*x4		-0.0009***			-0.0003	-0.0002	-0.0002
		(0.0004)			(0.0004)	(0.0004)	(0.0004)
x1*x6			-0.0328***		-0.0293***	-0.0337***	-0.0318***
			(0.0078)		(0.0091)	(0.0099)	(0.0099)
X5*X6				-0.0009		0.0022	0.0017
				(0.0020)		(0.0020)	(0.0020)
X7							-0.0079
							(0.0064)
X8							-0.0886
							(0.0696)
_cons	0.2525	-0.4523	0.0984	0.2485	-0.1008	-0.0679	2.2461
.0	(0.1968)	(0.3262)	(0.1832)	(0.1980)	(0.3280)	(0.3287)	(1.8685)
N	97	97	97	97	97	97	97

F	3.5192	4.3245	6.4760	2.9370	5.5964	5.0716	4.4172
r2	0.1749	0.2404	0.3215	0.1769	0.3260	0.3365	0.3616

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent series are point estimations of impulse response of GDP to US term spread shock. X1=trade openness, X2=financial integration, X4=trade structure, X5=financial depth, X6=exchange rate regime X7=current account balance X8=total reserve minus gold. Financial openness (X3) is omitted as shown collinearity.

Table 5 6 Determinants of spillovers: interest rate-term spread shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x1	-0.0057**	-0.0291***	-0.0168***	-0.0040*	-0.0219***	-0.0207***	-0.0213***
	(0.0026)	(0.0078)	(0.0030)	(0.0023)	(0.0072)	(0.0066)	(0.0064)
x2	0.0035	0.0017	0.0048	0.0010	0.0042	0.0015	0.0039
	(0.0083)	(0.0079)	(0.0071)	(0.0071)	(0.0072)	(0.0065)	(0.0065)
x4	0.0080	-0.0535**	0.0073	0.0034	-0.0084	-0.0221	-0.0366*
	(0.0115)	(0.0221)	(0.0098)	(0.0098)	(0.0226)	(0.0208)	(0.0213)
X5	-0.0008	0.0016	0.0026*	-0.0025*	0.0029*	0.0009	0.0022
	(0.0015)	(0.0016)	(0.0015)	(0.0013)	(0.0015)	(0.0015)	(0.0016)
X6	-0.5434***	-0.5350***	-2.4095***	-1.0835***	-2.2485***	-2.0070***	-1.9685***
	(0.1050)	(0.0996)	(0.3490)	(0.1319)	(0.4070)	(0.3741)	(0.3615)
x1*x4		0.0013***			0.0003	0.0005	0.0006
		(0.0004)			(0.0004)	(0.0004)	(0.0004)
x1*x6			0.0469***		0.0429***	0.0266***	0.0296***
			(0.0085)		(0.0099)	(0.0098)	(0.0095)
X5*X6				0.0109***		0.0082***	0.0079***

				(0.0019)		(0.0019)	(0.0019)
X7							-0.0075
							(0.0062)
X8							-0.1709**
							(0.0669)
_cons	0.2150	1.1781***	0.4354**	0.2646	0.6640*	0.7870**	5.2760***
	(0.2274)	(0.3703)	(0.1992)	(0.1948)	(0.3564)	(0.3251)	(1.7952)
N	97	97	97	97	97	97	97
F	6.7133	7.9225	12.6956	12.8502	10.9145	13.8401	12.6736
r2	0.2880	0.3670	0.4816	0.4846	0.4854	0.5805	0.6190

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent series are point estimations of impulse response of interest rate to US term spread shock. X1=trade openness, X2=financial integration, X4=trade structure, X5=financial depth, X6=exchange rate regime X7=current account balance X8=total reserve minus gold. Financial openness (X3) is omitted as shown collinearity.

Table 5 7 non-linearity in the determinants of spillovers: response to US term spread shock

Hypotheses		GDP output	Interest rate
		$\hat{\alpha}_k + \hat{\Psi} * DP_j$	$\hat{\alpha}_k + \hat{\Psi} * DP_j$
H1	At min(z)	0.00	-0.02
	At P^{25}	0.03	-0.01
	At P^{75}	0.03	0.00
	At max(z)	0.05	0.01
H2	At min(z)	0.00	-0.04
	At P^{25}	1.32	1.01
	At P^{75}	2.01	1.56

	At max(z)	3.19	2.52
H3	At min(z)	0.01	-0.02
	At P^{25}	0.02	-0.02
	At P^{75}	0.03	-0.01
	At max(z)	0.05	0.01
H4	At min(z)	1.58	2.01
	At P^{25}	2.87	3.06
	At P^{75}	3.55	3.61
	At max(z)	4.73	4.56
H5	At min(z)	0.00	0.00
	At P^{25}	0.00	0.00
	At P^{75}	0.00	0.01
	At max(z)	0.00	0.01
H6	At min(z)	1.44	2.01
	At P^{25}	1.52	2.29
	At P^{75}	1.55	2.55
	At max(z)	1.58	3.30

Notes: The table reports estimate of the marginal effects of interacted candidate determinants of the spillovers from US monetary policy evaluated at different values of the interacting variable xj and the corresponding level of significance. Specifically, the marginal effects are reported at the maximum and the minimum values as well as at the 75% and 25% percentile of the distribution of the interacting variable.

Table 5 8 Determinants of spillovers: GDP output-10-year bond shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x1	-0.0021	0.0127*	0.0057**	-0.0025	0.0074	0.0074	0.0069

	(0.0022)	(0.0068)	(0.0027)	(0.0023)	(0.0066)	(0.0066)	(0.0065)
x2	-0.0038	-0.0027	-0.0047	-0.0032	-0.0045	-0.0046	-0.0023
	(0.0071)	(0.0069)	(0.0065)	(0.0071)	(0.0065)	(0.0066)	(0.0067)
x4	-0.0080	0.0310	-0.0075	-0.0069	-0.0021	-0.0027	-0.0115
	(0.0098)	(0.0195)	(0.0089)	(0.0098)	(0.0206)	(0.0210)	(0.0219)
X5	0.0018	0.0003	-0.0006	0.0022	-0.0007	-0.0008	-0.0000
	(0.0013)	(0.0014)	(0.0013)	(0.0013)	(0.0014)	(0.0015)	(0.0016)
X6	0.3519***	0.3466***	1.6581***	0.4777***	1.6037***	1.6139***	1.6477***
	(0.0899)	(0.0877)	(0.3167)	(0.1313)	(0.3705)	(0.3771)	(0.3718)
x1_x4		-0.0008**			-0.0001	-0.0001	-0.0000
		(0.0004)			(0.0004)	(0.0004)	(0.0004)
x1_x6			-0.0328***		-0.0315***	-0.0322***	-0.0298***
			(0.0077)		(0.0090)	(0.0099)	(0.0098)
X5_X6				-0.0025		0.0003	-0.0001
				(0.0019)		(0.0019)	(0.0020)
X7							-0.0082
							(0.0064)
X8							-0.1178*
							(0.0688)
_cons	0.0811	-0.5276	-0.0731	0.0695	-0.1504	-0.1452	2.9390
	(0.1946)	(0.3259)	(0.1808)	(0.1940)	(0.3245)	(0.3277)	(1.8465)
N	97	97	97	97	97	97	97
F	3.9627	4.3524	7.0245	3.6158	5.9654	5.1614	4.7083
r2	0.1927	0.2415	0.3395	0.2092	0.3402	0.3404	0.3764

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent series are point estimations of impulse response of GDP to US 10-year bond shocks. X1=trade openness, X2=financial integration, X4=trade structure, X5=financial depth, X6=exchange rate regime X7=current account balance X8=total reserve minus gold. Financial openness (X3) is omitted as shown collinearity.

Table 5 9 Determinants of spillovers: interest rate-10-year bond shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x1	-0.0061*	-0.0349***	-0.0191***	-0.0041	-0.0266***	-0.0251***	-0.0256***
	(0.0034)	(0.0100)	(0.0040)	(0.0030)	(0.0096)	(0.0088)	(0.0083)
x2	0.0020	-0.0002	0.0035	-0.0010	0.0027	-0.0006	0.0012
	(0.0106)	(0.0102)	(0.0094)	(0.0093)	(0.0095)	(0.0088)	(0.0085)
x4	0.0111	-0.0642**	0.0102	0.0055	-0.0128	-0.0296	-0.0604**
	(0.0147)	(0.0285)	(0.0130)	(0.0129)	(0.0299)	(0.0279)	(0.0279)
X5	0.0002	0.0031	0.0042**	-0.0018	0.0047**	0.0022	0.0051**
	(0.0020)	(0.0021)	(0.0019)	(0.0018)	(0.0020)	(0.0020)	(0.0021)
X6	-0.6966***	-0.6863***	-2.8769***	-1.3481***	-2.6415***	-2.3432***	-2.3000***
	(0.1348)	(0.1287)	(0.4624)	(0.1731)	(0.5388)	(0.5024)	(0.4726)
x1_x4		0.0016***			0.0005	0.0008	0.0009*
		(0.0005)			(0.0006)	(0.0005)	(0.0005)
x1_x6			0.0548***		0.0489***	0.0288**	0.0336***
			(0.0112)		(0.0131)	(0.0132)	(0.0125)
X5_X6				0.0131***		0.0102***	0.0102***
				(0.0025)		(0.0026)	(0.0025)

X7							-0.0025
							(0.0081)
X8							-0.3098***
							(0.0875)
_cons	0.1712	1.3493***	0.4286	0.2310	0.7626	0.9146**	9.0942***
	(0.2920)	(0.4783)	(0.2639)	(0.2557)	(0.4718)	(0.4366)	(2.3472)
N	97	97	97	97	97	97	97
F	6.5191	7.4982	10.8954	11.4993	9.4126	11.6157	11.7851
r2	0.2820	0.3543	0.4436	0.4569	0.4486	0.5374	0.6017

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent series are point estimations of impulse response of interest rate to US 10-year bond shocks. X1=trade openness, X2=financial integration, X4=trade structure, X5=financial depth, X6=exchange rate regime X7=current account balance X8=total reserve minus gold. Financial openness (X3) is omitted as shown collinearity.

Table 5 10 non-linearity in the determinants of spillovers: response to US 10-year bond shocks

Hypotheses		GDP output	Interest rate
		$\hat{\alpha}_k + \hat{\Psi} * DP_j$	$\hat{\alpha}_k + \hat{\Psi} * DP_j$
H1	At min(z)	0.01	-0.03
	At P^{25}	0.02	-0.01
	At P^{75}	0.02	-0.01
	At max(z)	0.04	0.01
H2	At min(z)	-0.01	-0.06
	At P^{25}	1.26	1.26

	At P^{75}	1.93	1.96
	At max(z)	3.09	3.17
H3	At min(z)	0.01	-0.03
	At P^{25}	0.01	-0.02
	At P^{75}	0.02	-0.01
	At max(z)	0.04	0.01
H4	At min(z)	1.61	-2.30
	At P^{25}	2.88	-0.97
	At P^{75}	3.55	-0.28
	At max(z)	4.71	0.93
H5	At min(z)	0.00	0.01
	At P^{25}	0.00	0.01
	At P^{75}	0.00	0.01
	At max(z)	0.00	0.02
H6	At min(z)	1.61	-2.30
	At P^{25}	1.62	-1.95
	At P^{75}	1.63	-1.63
	At max(z)	1.66	-0.69

Notes: The table reports estimate of the marginal effects of interacted candidate determinants of the spillovers from US monetary policy evaluated at different values of the interacting variable xj and the corresponding level of significance. Specifically, the marginal effects are reported at the maximum and the minimum values as well as at the 75% and 25% percentile of the distribution of the interacting variable.

5.6 Conclusion

We find that in line with existing literature, the magnitude of spillovers depends on a few country characteristics. We find that trade openness, exchange rates stability, and financial depth are important determinants of international spillovers from US unconventional monetary policy to EMEs. Which means higher trade openness, industry structure and more liberalised exchange rate regime would reduce the spillovers from US unconventional monetary policy to EMEs. It is also noticed that higher financial depth could make emerging markets economies more exposed to international spillovers of US unconventional monetary policy. Furthermore, we find that holding a trade surplus and keeping a higher foreign exchange reserves will reduce spillovers of US UMP shocks by interest rate in EMEs, while shocks by GDP output are less affected.

Meanwhile our non-linear model shows various results which are valuable for policymakers. Some results suggest that trade integration dampens spillovers if their industry structure is tilted towards manufacturing goods and allow only less flexibility exchange rate regimes. Also, exchange rate liberalisation tends to magnify spillovers if EMEs are less integrated in global trade and lower in financial depth. And higher financial integration is associated with larger spillovers if managed exchange rate.

In general, in the current process of global economic and financial integration, no matter whether it is the maximization of output or the stabilization of interest rates, maintaining the stability of the exchange rate is the top priority for EMEs.

Chapter 6 Summary, future research, and political suggestions

6.1 Summary

The spillover effects of US UMP to EMEs which buffeted financial markets through bond flows are intensively tested (Ouerk, 2023). We contribute to this debate by, firstly, assessing the effects of US UMP on cross-board portfolio flows and the role of portfolio flows in the transmission of US UMP to EMEs. We also contribute to this debate by assessing the effects of US UMP on financial and macroeconomic factors to EMEs in a Global VAR model. And finally, we contribute to this debate by testing the domestic factors which may be the determinants of international spillovers as a supplement to Global VAR study.

In chapter 3, we study whether the portfolio flows are driven significantly by US UMP through a dynamic panel data (DPD) analysis. While dynamic panel data (DPD) analysis allows us capturing the near-term effects, we can study the long-term effects through lagged terms. Moreover, we advanced research by investigating the role of portfolio flows in US UMP shocks transmission and the interaction between financial and macroeconomic variables through a multilateral Global VAR model.

The key findings of this chapter are: We firstly find that both portfolio flows and bond flows toward EMEs appear to be significantly driven by US unconventional monetary policy while we find no evidence that the equity inflows to EMEs are driven by US UMP. Moreover, we find that the expansionary monetary policy of US has a negative effect on portfolio and bond inflows to EMEs in short-term while a positive sign is indicated in our DPD models. These are in line with the theory, lowers real interest rates do encourage investors to take more risks and bring the yield on assets down to match the short-term interest rate in the short term (Hogan, 2021). While, in a long-term view, as the spreads among assets decrease, investors will be seeking for riskier assets and eventually shift investment abroad (Hogan, 2021). Secondly, in our GVAR model, we find that US UMP which leading to an increase in bond outflows, in turn, the rise of bond inflows to EMEs results in a significant response by financial variables (either interest rate or exchange rate), proving that US UMP is a key driver of the financial and macroeconomic conditions in EMEs. While there is evidence of cross-country heterogeneity, these results represent general common trends especially in the case of bond inflows. We find similar shapes between the individual impulse response plot. Which might be explained as US UMP contribute to the emergence of the global financial cycle in Ouerk (2023), Dées and Galesi (2021) and Inoue and Okimoto (2022).

In Chapter 4, we rely on the estimation of GVAR framework, trying to explore the macroeconomic interdependencies and cross-sectional heterogeneities among EMEs. Our results show that, firstly, consistent with previous studies (Bowman et al., 2014; Bowman et al., 2015; Jordan, 2016; Fratzscher et al., 2016; Chen et al., 2016; Georgios, 2016; Garratt, Lee and Shields, 2016), it is clear that US UMP measures tend to have a greater impact on global financial conditions in EMEs as US UMP leads to an increase in bond outflows, in turn, the rise of inflows to EMEs results in a significant response by financial variables (Hallam, 2022). Secondly, the impulse response results show that US corporate spread shocks have greater domestic effects than domestic term spread shocks. That is purchasing US Treasuries to lower the term spread may be a weak tool and reducing risk premium by allowing indirect liquidity for bank section generates much more effects persuading GDP growth as well as a short-term appreciation of domestic currency (Inoue and Okimoto, 2022). Finally, although exchange rate responses have been diversified among EMEs, we do find a co-movement between exchange rate responses, monetary policy and inflations (Punz and Chantapacdepong, 2019) which may partly explain the divergence in financial structure as well as optimal objectives of central bank in responses of output growth, inflation growth, exchange rate stability and credit growth (Inoue and Okimoto, 2022).

In chapter 5, we follow Georgiadis (2015), Chen et al. (2016) and Anaya et al. (2017) to measure international spillovers of US UMP on output and interest rate to EMEs while try to figure out some determinants of the heterogeneities through standard panel data analysis. The key finding is what in the current process of global economic and financial integration, no matter whether it is the maximization of output or the stabilization of interest rates, maintaining the stability of the exchange rate is the top priority for EMEs. Moreover, the result suggest that policymakers could mitigate their financial vulnerability to US UMP by fostering flexibility of exchange rates as well as domestic financial market development, while such policy might reduce long-run growth.

6.2 Policy Implications of the Research

Based on our findings, the priority for EMEs is to establish an early-warning mechanism for exchange rate stability in response to international spllovers of US UMP shocks. It is beneficial to EMEs' macro-economic and global financial stability under trade openness and financial integration by stabilizing the exchange rate. EMEs can improve the inspection power over the exchange rate stability if it speeds up the establishment of a multi-currency operation to diversifying the impacts of US dollars on international trade and portfolio investment (Jenkins and Zelenbaba, 2012; Adam, Subacchi and Vines, 2013).

To achieve the desired goal of stabilizing the exchange rate, we believe the multi-currency system can be conducive if the international currency's status is symmetric. Yet the primacy of the dollar is no longer to be taken for granted, searching for a new global reserve currency system to supplant the dominance of the dollar is not an easy work for bilateral currency operation. Taking the Euro as an example, though euro is one of the popular currencies used in international settlements, it is still a young international currency compared with US dollars. The share of euro in international settlement is about 34% while US dollars count for over 40%, which make the euro a weaker competitor to the dollar. Therefore, establishment of multi-currency system would be much ideal for EMEs to offset the uncertainty delivered by US on international trade.

While a stabilization of the exchange rate can improve the position in international trade, increasing international trade integration and competition can enhance the stability of exchange rate. While low prices gave EMEs competitive advantage in short term position, the devaluation of local currency would make enterprises lack the incentive to improve product quality and core competitiveness in a long-term international trade. Adam, Subacchi and Vines (2013) argue that only if the products had sufficient advantages, exports could be no longer the passive bearers of exchange rate fluctuations and transferring exchange rate risks into controllable floating.

Finally, though higher financial integration is associated with larger spillovers if managed exchange rate stability, we argue that it is still necessary for EMEs to persuading liberation of capital market for two reasons. First, capital market liberalization is one of the most important aspects of globalization and EMEs' growth that cannot be ignored (Cui, 2012). Over the last decades, the global economy has witnessed a greater deepening of trade and financial integration. An increasing number of firms have joined the trend of cross-border M&As, FDIs and portfolio investment through the increasing financial openness in EMEs (Obstfeld, Shambaugh and Alan, 2005). Most FDIs and cross-border M&As promote EMEs' economic development sustainably. Therefore, it is essential for EMEs to development a liberalized capital market to attract cross-border investment. Second, liberalizing capital market can be the incentive to improve product quality and core competitiveness of EMEs. Capital market liberalization is a two-way benefit. While receiving investment, EMEs can also obtain technological upgrading and innovation through FDIs and cross-border M&As, and thus enhancing the competitive position in globalization.

6.3 Future research

While our study does account for the multilateral nature through GVAR modelling, there still needs improvement for understand the determinants of the heterogeneities in the spillovers as shock identification process is not unique.

Firstly, there are still many alternative variables can be tested in the future. For example, when identifying the shocks through portfolio channel, we could use variables that capture the spillovers of US unconventional monetary policy of lowering the long-term yields and temporal rebalancing toward higher risk EMEs. While yield spreads is the common variable, there are multiple indicators represent for yield spreads, such as yield to maturity (YTM), policy rate, 10-year bond rate and so on (Neely, 2010).

Secondly, the weighting matrix could be identified in various ways since it serves as a proxy for the unobserved common effects across the economies, thus for example, we could impose a time-vary weight matrix instead of the fixed one.

Finally, we were likely to get different results if including additional explanatory variables and dummy variables from bilateral models such as bilateral distance to the US, bilateral trade with the US and bilateral financial integration with the US.

Appendix

Appendix Table 3. 1 Weight Matrix (fixed weights: trade average between 2009 and 2011)

Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
USA	0.00	0.22	0.40	0.37	0.16	0.16	0.87	0.14	0.34	0.20	0.24
ARGENTINA	0.01	0.00	0.17	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.01
BRAZIL	0.03	0.52	0.00	0.13	0.03	0.04	0.02	0.08	0.08	0.05	0.02
CHINA	0.44	0.17	0.27	0.00	0.35	0.54	0.10	0.61	0.32	0.36	0.27
INDIA	0.04	0.01	0.04	0.07	0.00	0.12	0.00	0.03	0.13	0.11	0.05
INDONESIA	0.02	0.01	0.01	0.07	0.09	0.00	0.00	0.01	0.03	0.03	0.02
MEXICO	0.37	0.05	0.04	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00
RUSSIA	0.02	0.01	0.02	0.09	0.04	0.01	0.00	0.00	0.01	0.00	0.30
SARBIA	0.05	0.00	0.03	0.18	0.28	0.08	0.00	0.00	0.00	0.20	0.07
SOUTH AFRICA	0.01	0.00	0.01	0.04	0.02	0.01	0.00	0.01	0.01	0.00	0.01
TURKEY	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.10	0.06	0.02	0.00

Note: the sum of each row may not equal to 1 as the numbers are rounded.

Appendix Table 3. 2 Unit Root Tests for the Domestic Variables at the 5% Significance Level

Domestic Variables	**Statistic**	**Critical Value**	**USA**	**ARGENTINA**	**BRAZIL**	**CHINA**	**INDIA**	**INDONESIA**	**MEXICO**	**RUSSIA**	**SARBIA**	**SOUTH AFRICA**	**TURKEY**
y (with trend)	ADF	-3.45	-1.99	-0.06	-3.12	-2.42	-0.77	-2.15	-2.08	-2.08	-0.96	-2.33	-0.44
y (with trend)	WS	-3.24	-1.93	-0.41	-2.67	-2.70	-1.88	-1.65	-3.43	-2.28	-1.08	-2.74	-1.27
y (no trend)	ADF	-2.89	-0.87	3.68	0.49	0.22	0.64	-2.18	1.09	0.10	-2.57	1.25	1.80
y (no trend)	WS	-2.55	-1.31	1.23	0.42	1.69	-0.60	-0.82	0.71	0.57	0.11	0.83	1.17
Dy	ADF	-2.89	-3.37	-2.33	-2.24	-4.55	-1.97	-4.46	-5.98	-5.02	-5.66	-3.52	-4.72
Dy	WS	-2.55	-3.56	-2.53	-2.57	0.93	-1.73	-4.74	-2.47	-3.04	-5.80	-3.09	-3.73
DDy	ADF	-2.89	-9.40	-3.96	-4.73	-4.38	-6.84	-5.85	-5.59	-4.85	-7.80	-4.48	-5.65
DDy	WS	-2.55	-9.59	-3.83	-2.96	-3.90	-2.72	-6.34	-3.10	-4.47	-4.73	-3.33	-5.14
r (with trend)	ADF	-3.45	-1.48	-2.31	-2.16	-2.50	-2.57	-2.45	0.28	-2.80	1.31	-2.31	-2.53
r (with trend)	WS	-3.24	-0.06	-2.27	-2.66	-2.39	-2.57	-2.62	-1.19	-2.72	-2.15	-0.76	-0.21
r (no trend)	ADF	-2.89	-2.64	-0.51	-2.53	-1.21	-2.92	-2.20	0.33	-2.82	1.90	-1.23	-2.25
r (no trend)	WS	-2.55	1.65	-0.76	-2.69	-0.84	-2.91	-2.07	-1.22	-2.74	-0.15	-0.32	-0.21

Dr	ADF	-2.89	-4.03	-4.23	-3.35	-2.72	-5.03	-3.08	-2.26	-5.14	-0.19	-6.44	-2.33
Dr	WS	-2.55	-0.61	-4.51	-3.60	-1.39	-0.67	-2.83	-1.51	-5.31	-1.23	-1.65	-1.71
DDr	ADF	-2.89	-5.58	-5.34	-3.45	-6.69	-5.92	-4.93	-4.67	-7.91	-7.75	-5.79	-4.17
DDr	WS	-2.55	-1.26	-5.56	-3.91	-2.18	-2.82	-5.37	-4.10	-8.04	1.51	-4.51	-4.54
eer (with trend)	ADF	-3.45	-2.94	-0.61	-3.43	-1.75	-1.52	-2.87	-2.08	-2.45	-3.05	-3.61	-1.49
eer (with trend)	WS	-3.24	-2.02	-0.83	-2.62	-2.14	-1.89	-2.60	-2.21	-2.62	-2.18	-2.69	-2.16
eer (no trend)	ADF	-2.89	-0.41	2.17	-0.89	-1.00	-1.13	-0.62	0.58	-0.71	-0.55	-0.97	1.65
eer (no trend)	WS	-2.55	-0.84	1.30	-1.00	-0.66	-0.57	-0.81	0.17	-0.71	-0.99	-1.03	1.58
Deer	ADF	-2.89	-3.75	-3.73	-3.39	-4.02	-4.05	-3.06	-5.80	-2.71	-4.35	-3.28	-3.32
Deer	WS	-2.55	-4.02	-3.98	-3.72	-4.35	-4.30	-3.33	-3.59	-2.95	-4.68	-3.46	-3.59
DDeer	ADF	-2.89	-5.51	-6.34	-7.09	-6.43	-5.79	-10.16	-8.18	-10.39	-5.64	-8.00	-6.08
DDeer	WS	-2.55	-5.22	-6.39	-4.61	-6.41	-6.23	-7.08	-5.64	-10.79	-5.89	-5.60	-5.12

pf (with trend)	ADF	-3.45	-3.61	-2.27	-3.33	-3.18	-3.52	-3.78	-6.25	-2.97	-0.83	-1.76	-0.84
pf (with trend)	WS	-3.24	-3.43	-2.10	-2.61	-2.84	-3.36	-3.04	-3.21	-2.09	-1.21	-1.91	-1.49
pf (no trend)	ADF	-2.89	1.08	1.20	1.75	-1.57	0.86	0.42	-0.02	-0.06	0.45	-1.87	-0.09
pf (no trend)	WS	-2.55	0.69	0.42	0.71	-1.82	0.79	0.11	1.40	1.66	-0.28	0.39	-0.75
Dpf	ADF	-2.89	-3.04	-2.97	-2.11	-1.39	-2.88	-1.91	-6.36	-4.42	-1.38	-2.83	-4.22
Dpf	WS	-2.55	-3.15	-3.28	-2.25	-1.25	-3.23	-2.10	-4.12	-3.51	-1.58	-3.00	-2.97
DDpf	ADF	-2.89	-4.08	-3.86	-4.45	-3.80	-3.95	-6.74	-5.93	-4.65	-5.12	-5.51	-5.65
DDpf	WS	-2.55	-3.45	-2.90	-2.89	-3.83	-4.22	-6.83	-5.80	-4.16	-5.44	-5.83	-5.38

y=GDP, r=short-term interest rate, eer=real effective exchange rate, cf=portfolio inflows

Appendix Table 3. 3 Unit Root Tests for the global Variables at the 5% Significance Level

Global Variables	Test	Critical Value	Statistic
vix (with trend)	ADF	-3.45	-3.54
vix (with trend)	WS	-3.24	-3.60
vix (no trend)	ADF	-2.89	-2.93
vix (no trend)	WS	-2.55	-1.16
Dvix	ADF	-2.89	-4.43
Dvix	WS	-2.55	-4.90
DDvix	ADF	-2.89	-6.28
Dvix	WS	-2.55	-5.82

Appendix Table 3. 4 Unit Root Tests for the Foreign Variables at the 5% Significance Level

Foreign Variables	Statistic	Critical Value	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
ys (with trend)	ADF	-3.45	-3.01	-5.19	-1.53	-2.78	-1.98	-2.30	-2.74	-1.93	-2.93	-2.03	-3.34
ys (with trend)	WS	-3.24	-2.90	-3.78	-1.86	-1.69	0.12	-1.74	-2.66	-1.57	-4.13	-1.01	-3.66
ys (no trend)	ADF	-2.89	-2.84	-0.67	0.12	1.21	-4.69	-0.75	-0.58	-1.19	-0.49	-2.20	-1.93
ys (no trend)	WS	-2.55	-0.51	-1.50	-0.50	0.40	3.13	1.10	-0.97	0.79	0.50	0.71	-2.29
Dys	ADF	-2.89	-1.94	-1.68	-1.35	-4.35	-2.75	-1.97	-3.34	-2.19	-2.01	-2.34	-1.97
Dys	WS	-2.55	-2.20	-3.25	-1.79	-3.91	-3.01	-0.91	-4.01	-0.47	-1.86	-1.94	-1.66
DDys	ADF	-2.89	-6.41	-3.59	-3.65	-5.70	-8.56	-4.81	-4.26	-182.17	-4.23	-7.35	-5.53
DDys	WS	-2.55	-3.86	-2.21	-3.94	-4.17	-5.23	-3.45	-4.03	-186.33	-3.42	-4.43	-3.89
rs (with trend)	ADF	-3.45	-0.84	-2.27	-2.55	-2.81	-2.18	-3.18	-1.86	-3.18	-3.46	-3.37	-2.74

rs (with trend)	WS	-3.24	-1.55	-2.79	-2.35	-2.93	-1.22	-2.64	-0.62	-3.00	-3.61	-2.61	-2.47
rs (no trend)	ADF	-2.89	-1.01	-2.60	-0.63	-2.61	-2.03	-3.18	-2.29	-3.22	-3.47	-2.32	-2.79
rs (no trend)	WS	-2.55	-1.01	-2.83	-0.95	-2.85	-0.46	-2.43	0.54	-2.90	-3.71	-2.06	-2.39
Drs	ADF	-2.89	-5.59	-3.55	-4.16	-2.67	-3.75	-3.42	-3.26	-3.03	-3.11	-3.76	-4.88
Drs	WS	-2.55	-0.66	-3.80	-4.43	-1.98	0.26	-0.73	-2.44	-0.61	-1.28	-0.61	-5.18
DDrs	ADF	-2.89	-3.98	-3.47	-5.26	-7.21	-4.19	-5.96	-5.00	-3.75	-3.40	-5.74	-8.07
DDrs	WS	-2.55	-1.51	-3.92	-5.53	-7.43	-1.22	-3.01	-3.41	-3.07	-3.55	-3.32	-8.41
eers (with trend)	ADF	-3.45	-1.39	-3.41	-3.07	-2.78	-3.70	-2.02	-2.97	-0.96	-2.55	-2.97	-2.77
eers (with trend)	WS	-3.24	-1.84	-2.63	-3.32	-3.02	-3.21	-2.26	-2.07	-1.66	-2.50	-2.60	-3.04
eers (no trend)	ADF	-2.89	-0.09	-0.91	0.73	-0.87	-1.41	-1.40	-0.46	-1.25	-2.42	-1.80	-0.88

eers (no trend)	WS	-2.55	-0.12	-1.08	0.98	-0.65	-1.79	-1.75	-0.88	-1.68	-1.75	-2.16	-0.33
Deers	ADF	-2.89	-4.67	-3.35	-4.72	-4.60	-5.23	-4.76	-3.91	-4.64	-4.44	-4.64	-6.02
Deers	WS	-2.55	-3.64	-3.70	-5.19	-4.89	-5.62	-5.12	-4.20	-4.98	-4.80	-5.00	-6.34
DDeers	ADF	-2.89	-7.83	-7.13	-5.45	-6.70	-5.88	-6.37	-5.61	-6.40	-5.95	-5.87	-5.36
DDeers	WS	-2.55	-6.77	-5.28	-5.70	-6.97	-6.29	-6.56	-5.40	-6.88	-6.26	-6.15	-5.14

Appendix Table 3. 5 Cointegration Results

Detailed Cointegration Results for the Trace Statistic at the 5% Significance Level											
Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
# endogenous variables	5	4	4	4	4	4	4	4	4	4	4
# foreign (star) variables	1	4	4	4	4	4	4	4	4	4	4
r=0	133.77	122.88	124.78	143.78	125.77	135.74	167.04	123.67	132.88	131.38	121.45
r=1	78.29	72.19	73.03	88.61	69.88	84.36	100.26	63.67	71.89	61.37	78.23
r=2	38.74	37.93	38.35	41.13	37.46	41.61	51.22	31.90	43.76	26.86	43.19
r=3	17.36	13.77	15.72	15.13	13.76	15.76	23.96	8.75	19.45	10.96	19.23
r=4	5.36										
Critical Values for Trace Statistic at the 5% Significance Level (MacKinnon, Haug, Michelis, 1999)											

Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
# endogenous variables	5	4	4	4	4	4	4	4	4	4	4
# foreign (star) variables	1	4	4	4	4	4	4	4	4	4	4
r=0	100.29	100.96	100.96	100.96	100.96	100.96	100.96	100.96	100.96	100.96	100.96
r=1	73.31	71.56	71.56	71.56	71.56	71.56	71.56	71.56	71.56	71.56	71.56
r=2	50.25	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9	45.9
r=3	31.05	23.63	23.63	23.63	23.63	23.63	23.63	23.63	23.63	23.63	23.63
r=4	15.46										

Appendix Table 3. 6 VARX* Order of Individual Models (p: lag order of domestic variables, q: lag order of foreign variables) and numbers of cointegrating relations

	p	q	# Cointegrating relations
USA	1	1	2
ARGENTINA	2	1	2
BRAZIL	2	1	2
CHINA	2	1	2
INDIA	2	1	1
INDONESIA	2	1	2
MEXICO	2	1	4
RUSSIA	1	1	1
SAUDI ARABIA	2	1	2
SOUTH AFRICA	2	1	1
TURKEY	1	1	2

Appendix Table 4. 1 Unit Root Tests for the Domestic Variables at the 5% Significance Level (Corporate spread)

Domestic Variables	**Statistic**	**Critical Value**	**USA**	**ARGENTINA**	**BRAZIL**	**CHINA**	**INDIA**	**INDONESIA**	**MEXICO**	**RUSSIA**	**SARBIA**	**SOUTH AFRICA**	**TURKEY**
y (with trend)	ADF	-3.45	-1.99	-0.06	-3.12	-2.42	-0.77	-2.15	-2.08	-2.08	-0.96	-2.33	-0.44
y (with trend)	WS	-3.24	-1.93	-0.41	-2.67	-2.70	-1.88	-1.65	-3.43	-2.28	-1.08	-2.74	-1.27
y (no trend)	ADF	-2.89	-0.87	3.68	0.49	0.22	0.64	-2.18	1.09	0.10	-2.57	1.25	1.80
y (no trend)	WS	-2.55	-1.31	1.23	0.42	1.69	-0.60	-0.82	0.71	0.57	0.11	0.83	1.17
Dy	ADF	-2.89	-3.37	-2.33	-2.24	-4.55	-1.97	-4.46	-5.98	-5.02	-5.66	-3.52	-4.72
Dy	WS	-2.55	-3.56	-2.53	-2.57	0.93	-1.73	-4.74	-2.47	-3.04	-5.80	-3.09	-3.73
DDy	ADF	-2.89	-9.40	-3.96	-4.73	-4.38	-6.84	-5.85	-5.59	-4.85	-7.80	-4.48	-5.65
DDy	WS	-2.55	-9.59	-3.83	-2.96	-3.90	-2.72	-6.34	-3.10	-4.47	-4.73	-3.33	-5.14
p (with trend)	ADF	-3.45	-4.35	-0.11	-3.16	-2.83	-1.64	-1.74	-2.25	-2.58	-1.29	-3.01	1.39
p (with trend)	WS	-3.24	-4.65	-0.03	-3.11	-2.91	-1.94	-1.64	-3.23	-3.04	-0.25	-4.08	-0.07
p (no trend)	ADF	-2.89	-4.41	2.93	-0.33	-3.74	-4.55	-0.39	1.01	-0.57	-3.29	-0.02	2.45
p (no trend)	WS	-2.55	-4.66	0.76	-0.14	-1.54	-0.95	0.89	0.73	0.72	1.49	0.07	1.62

Dp	ADF	-2.89	-6.22	-2.20	-2.09	-2.46	-7.14	-4.46	-2.27	-4.66	-2.89	-2.81	-0.79
Dp	WS	-2.55	-6.64	-2.17	-2.35	-1.97	-5.49	-4.52	-2.48	-4.36	-3.08	-3.82	-1.27
DDp	ADF	-2.89	-7.64	-5.46	-9.54	-4.59	-5.58	-5.88	-6.49	-6.22	-6.74	-11.27	-6.21
DDp	WS	-2.55	-5.66	-5.79	-9.99	-3.24	-2.23	-6.40	-5.67	-6.54	-6.96	-11.40	-6.75
mp (with trend)	ADF	-3.45	-2.86	-2.31	-2.16	-2.50	-2.57	-2.45	0.28	-2.80	1.31	-2.31	-2.53
mp (with trend)	WS	-3.24	-2.38	-2.27	-2.66	-2.39	-2.57	-2.62	-1.19	-2.72	-2.15	-0.76	-0.21
mp (no trend)	ADF	-2.89	-0.41	-0.51	-2.53	-1.21	-2.92	-2.20	0.33	-2.82	1.90	-1.23	-2.25
mp (no trend)	WS	-2.55	-1.05	-0.76	-2.69	-0.84	-2.91	-2.07	-1.22	-2.74	-0.15	-0.32	-0.21
Dmp	ADF	-2.89	-4.88	-4.23	-3.35	-2.72	-5.03	-3.08	-2.26	-5.14	-0.19	-6.44	-2.33
Dmp	WS	-2.55	-3.12	-4.51	-3.60	-1.39	-0.67	-2.83	-1.51	-5.31	-1.23	-1.65	-1.71
DDmp	ADF	-2.89	-6.37	-5.34	-3.45	-6.69	-5.92	-4.93	-4.67	-7.91	-7.75	-5.79	-4.17
DDmp	WS	-2.55	-4.62	-5.56	-3.91	-2.18	-2.82	-5.37	-4.10	-8.04	1.51	-4.51	-4.54

eer (with trend)	ADF	-3.45	-2.94	-0.61	-3.43	-1.75	-1.52	-2.87	-2.08	-2.45	-3.05	-3.61	-1.49
eer (with trend)	WS	-3.24	-2.02	-0.83	-2.62	-2.14	-1.89	-2.60	-2.21	-2.62	-2.18	-2.69	-2.16
eer (no trend)	ADF	-2.89	-0.41	2.17	-0.89	-1.00	-1.13	-0.62	0.58	-0.71	-0.55	-0.97	1.65
eer (no trend)	WS	-2.55	-0.84	1.30	-1.00	-0.66	-0.57	-0.81	0.17	-0.71	-0.99	-1.03	1.58
Deer	ADF	-2.89	-3.75	-3.73	-3.39	-4.02	-4.05	-3.06	-5.80	-2.71	-4.35	-3.28	-3.32
Deer	WS	-2.55	-4.02	-3.98	-3.72	-4.35	-4.30	-3.33	-3.59	-2.95	-4.68	-3.46	-3.59
DDeer	ADF	-2.89	-5.51	-6.34	-7.09	-6.43	-5.79	-10.16	-8.18	-10.39	-5.64	-8.00	-6.08
DDeer	WS	-2.55	-5.22	-6.39	-4.61	-6.41	-6.23	-7.08	-5.64	-10.79	-5.89	-5.60	-5.12

y=GDP, r=short-term interest rate, eer=effective exchange rate, cf=portfolio inflows

Appendix Table 4. 2Unit Root Tests for the global Variables at the 5% Significance Level

Global Variables	Test	Critical Value	Statistic
vix (with trend)	ADF	-3.45	-3.54
vix (with trend)	WS	-3.24	-3.60
vix (no trend)	ADF	-2.89	-2.93
vix (no trend)	WS	-2.55	-1.16
Dvix	ADF	-2.89	-4.43
Dvix	WS	-2.55	-4.90
DDvix	ADF	-2.89	-6.28
Dvix	WS	-2.55	-5.82

Appendix Table 4. 3 Unit Root Tests for the foreign Variables at the 5% Significance Level: Corporate spread

Foreign Variables	Statistic	Critical Value	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
ys (with trend)	ADF	-3.04	-5.18	-1.56	-2.45	-1.31	-2.33	-2.76	-1.83	-2.94	-1.64	-3.88	-3.04
ys (with trend)	WS	-2.86	-3.79	-1.88	-1.69	-1.17	-1.46	-2.72	-1.56	-4.40	-1.13	-3.94	-2.86
ys (no trend)	ADF	-3.26	-0.45	0.63	1.03	-2.42	-1.05	-0.84	-1.34	-0.33	-2.48	-0.75	-3.26
ys (no trend)	WS	-0.67	-1.33	-0.10	0.23	0.43	1.00	-1.21	0.63	0.47	0.40	-0.98	-0.67
Dys	ADF	-1.98	-1.95	-1.59	-4.46	-3.15	-1.97	-3.48	-1.97	-2.08	-2.28	-2.44	-1.98
Dys	WS	-2.17	-3.23	-3.03	-4.03	-2.60	-1.16	-4.10	-0.67	-2.03	-2.13	-2.77	-2.17
DDys	ADF	-6.50	-3.62	-3.69	-6.16	-8.65	-5.36	-4.27	-4.05	-4.36	-7.28	-5.10	-6.50
DDys	WS	-3.77	-2.19	-3.88	-4.61	-5.17	-3.79	-4.03	-3.35	-3.45	-4.36	-3.46	-3.77
ps (with trend)	ADF	-3.36	-3.62	-0.25	-1.70	-1.52	-2.50	-4.27	-3.90	-2.25	-2.56	-2.61	-3.36
ps (with trend)	WS	-3.17	-4.09	-0.16	-2.41	-2.00	-2.66	-4.66	-3.91	-2.67	-2.67	-3.17	-3.17
ps (no trend)	ADF	-2.87	-1.08	2.90	-1.60	-3.22	-3.75	-1.15	-2.38	-3.04	-3.11	-1.25	-2.87
ps (no trend)	WS	-1.16	-0.87	0.18	0.48	-0.45	-1.28	0.71	-1.28	-1.24	-0.81	-0.47	-1.16

Dps	ADF	-2.45	-2.74	-2.45	-3.20	-1.72	-2.56	-5.42	-3.37	-3.22	-3.13	-1.91	-2.45
Dps	WS	-1.93	-2.84	-1.80	-3.48	-2.06	-2.22	-5.89	-1.99	-2.30	-2.92	-2.41	-1.93
DDps	ADF	-3.96	-7.26	-6.12	-6.06	-7.05	-4.36	-6.59	-4.37	-4.27	-3.83	-7.58	-3.96
DDps	WS	-2.21	-7.80	-6.55	-6.47	-7.47	-2.73	-5.76	-2.73	-2.74	-2.84	-8.03	-2.21
mps (with trend)	ADF	-0.78	-2.25	-2.38	-2.67	-2.38	-3.31	-2.63	-3.23	-3.37	-3.44	-2.69	-0.78
mps (with trend)	WS	-1.47	-2.69	-2.29	-1.75	-1.05	-2.67	-2.44	-3.02	-3.55	-2.53	-2.50	-1.47
mps (no trend)	ADF	-0.87	-2.39	-1.05	-2.72	-1.91	-2.55	-0.52	-3.19	-2.73	-3.45	-2.74	-0.87
mps (no trend)	WS	-1.07	-2.69	-1.39	-2.50	0.36	-1.39	-1.03	-1.93	-2.79	-2.55	-2.28	-1.07
Dmps	ADF	-5.69	-3.80	-4.05	-3.48	-4.37	-3.51	-4.54	-2.96	-3.05	-3.62	-5.07	-5.69
Dmps	WS	-0.73	-3.67	-4.33	-3.50	-0.76	-0.84	-3.46	-1.08	-2.04	-1.27	-5.35	-0.73
DDmps	ADF	-3.73	-4.50	-5.26	-7.26	-7.01	-6.18	-6.11	-3.81	-3.85	-5.30	-8.12	-3.73
DDmps	WS	-1.64	-4.32	-5.45	-7.57	-4.70	-3.00	-4.81	-3.50	-4.17	-4.11	-8.39	-1.64

Appendix Table 4. 4 Cointegration Results: Corporate spread

Detailed Cointegration Results for the Trace Statistic at the 5% Significance Level

Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
# endogenous variables	5	4	4	4	4	4	4	4	4	4	4
# foreign (star) variables	1	5	5	5	5	5	5	5	5	5	5
r=0	94.65	162.67	172.78	170.60	151.32	202.22	205.12	119.24	155.16	154.41	139.47
r=1	61.00	91.55	91.94	104.58	96.27	122.60	130.02	82.47	80.94	80.17	79.07
r=2	35.78	48.83	48.28	64.18	45.50	65.32	61.68	47.89	46.53	35.11	40.58
r=3	18.05	21.69	19.82	30.98	18.86	27.76	22.36	18.62	17.77	11.82	18.22
r=4	4.97										

Critical Values for Trace Statistic at the 5% Significance Level (MacKinnon, Haug, Michelis, 1999)

Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
# endogenous variables	5	4	4	4	4	4	4	4	4	4	4
# foreign (star) variables	1	5	5	5	5	5	5	5	5	5	5
r=0	100.29	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03
r=1	73.31	78.52	78.52	78.52	78.52	78.52	78.52	78.52	78.52	78.52	78.52
r=2	50.25	50.72	50.72	50.72	50.72	50.72	50.72	50.72	50.72	50.72	50.72
r=3	31.05	26.24	26.24	26.24	26.24	26.24	26.24	26.24	26.24	26.24	26.24
r=4	15.46										

Appendix Table 4. 5 VARX* Order of Individual Models (p: lag order of domestic variables, q: lag order of foreign variables) and numbers of cointegrating relations: Corporate spreads

	p	q	# Cointegrating relations
USA	1	1	0
ARGENTINA	2	1	2
BRAZIL	2	1	2
CHINA	2	1	4
INDIA	2	1	2
INDONESIA	2	1	4
MEXICO	2	1	3
RUSSIA	2	1	2
SAUDI ARABIA	2	1	2
SOUTH AFRICA	2	1	2
TURKEY	2	1	2

Appendix Table 4. 6 Unit Root Tests for the Domestic Variables at the 5% Significance Level: term spread

Domestic Variables	Statistic	Critical Value	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
y (with trend)	ADF	-3.45	-1.99	-0.06	-3.12	-2.42	-0.77	-2.15	-2.08	-2.08	-0.96	-2.33	-0.44
y (with trend)	WS	-3.24	-1.93	-0.41	-2.67	-2.70	-1.88	-1.65	-3.43	-2.28	-1.08	-2.74	-1.27
y (no trend)	ADF	-2.89	-0.87	3.68	0.49	0.22	0.64	-2.18	1.09	0.10	-2.57	1.25	1.80
y (no trend)	WS	-2.55	-1.31	1.23	0.42	1.69	-0.60	-0.82	0.71	0.57	0.11	0.83	1.17
Dy	ADF	-2.89	-3.37	-2.33	-2.24	-4.55	-1.97	-4.46	-5.98	-5.02	-5.66	-3.52	-4.72
Dy	WS	-2.55	-3.56	-2.53	-2.57	0.93	-1.73	-4.74	-2.47	-3.04	-5.80	-3.09	-3.73
DDy	ADF	-2.89	-9.40	-3.96	-4.73	-4.38	-6.84	-5.85	-5.59	-4.85	-7.80	-4.48	-5.65
DDy	WS	-2.55	-9.59	-3.83	-2.96	-3.90	-2.72	-6.34	-3.10	-4.47	-4.73	-3.33	-5.14
p (with trend)	ADF	-3.45	-4.35	-0.11	-3.16	-2.83	-1.64	-1.74	-2.25	-2.58	-1.29	-3.01	1.39
p (with trend)	WS	-3.24	-4.65	-0.03	-3.11	-2.91	-1.94	-1.64	-3.23	-3.04	-0.25	-4.08	-0.07
p (no trend)	ADF	-2.89	-4.41	2.93	-0.33	-3.74	-4.55	-0.39	1.01	-0.57	-3.29	-0.02	2.45
p (no trend)	WS	-2.55	-4.66	0.76	-0.14	-1.54	-0.95	0.89	0.73	0.72	1.49	0.07	1.62

Dp	ADF	-2.89	-6.22	-2.20	-2.09	-2.46	-7.14	-4.46	-2.27	-4.66	-2.89	-2.81	-0.79
Dp	WS	-2.55	-6.64	-2.17	-2.35	-1.97	-5.49	-4.52	-2.48	-4.36	-3.08	-3.82	-1.27
DDp	ADF	-2.89	-7.64	-5.46	-9.54	-4.59	-5.58	-5.88	-6.49	-6.22	-6.74	-11.27	-6.21
DDp	WS	-2.55	-5.66	-5.79	-9.99	-3.24	-2.23	-6.40	-5.67	-6.54	-6.96	-11.40	-6.75
mp (with trend)	ADF	-3.45	-2.37	-2.31	-2.16	-2.50	-2.57	-2.45	0.28	-2.80	1.31	-2.31	-2.53
mp (with trend)	WS	-3.24	-2.58	-2.27	-2.66	-2.39	-2.57	-2.62	-1.19	-2.72	-2.15	-0.76	-0.21
mp (no trend)	ADF	-2.89	-1.10	-0.51	-2.53	-1.21	-2.92	-2.20	0.33	-2.82	1.90	-1.23	-2.25
mp (no trend)	WS	-2.55	-1.41	-0.76	-2.69	-0.84	-2.91	-2.07	-1.22	-2.74	-0.15	-0.32	-0.21
Dmp	ADF	-2.89	-4.16	-4.23	-3.35	-2.72	-5.03	-3.08	-2.26	-5.14	-0.19	-6.44	-2.33
Dmp	WS	-2.55	-3.60	-4.51	-3.60	-1.39	-0.67	-2.83	-1.51	-5.31	-1.23	-1.65	-1.71
DDmp	ADF	-2.89	-6.03	-5.34	-3.45	-6.69	-5.92	-4.93	-4.67	-7.91	-7.75	-5.79	-4.17
DDmp	WS	-2.55	-6.34	-5.56	-3.91	-2.18	-2.82	-5.37	-4.10	-8.04	1.51	-4.51	-4.54
eer (with trend)	ADF	-3.45	-2.94	-0.61	-3.43	-1.75	-1.52	-2.87	-2.08	-2.45	-3.05	-3.61	-1.49
eer (with trend)	WS	-3.24	-2.02	-0.83	-2.62	-2.14	-1.89	-2.60	-2.21	-2.62	-2.18	-2.69	-2.16
eer (no trend)	ADF	-2.89	-0.41	2.17	-0.89	-1.00	-1.13	-0.62	0.58	-0.71	-0.55	-0.97	1.65

eer (no trend)	WS	-2.55	-0.84	1.30	-1.00	-0.66	-0.57	-0.81	0.17	-0.71	-0.99	-1.03	1.58
Deer	ADF	-2.89	-3.75	-3.73	-3.39	-4.02	-4.05	-3.06	-5.80	-2.71	-4.35	-3.28	-3.32
Deer	WS	-2.55	-4.02	-3.98	-3.72	-4.35	-4.30	-3.33	-3.59	-2.95	-4.68	-3.46	-3.59
DDeer	ADF	-2.89	-5.51	-6.34	-7.09	-6.43	-5.79	-10.16	-8.18	-10.39	-5.64	-8.00	-6.08
DDeer	WS	-2.55	-5.22	-6.39	-4.61	-6.41	-6.23	-7.08	-5.64	-10.79	-5.89	-5.60	-5.12

y=GDP, r=short-term interest rate, eer=effective exchange rate, cf=portfolio inflows

Appendix Table 4. 7 Unit Root Tests for the foreign Variables at the 5% Significance Level: term spread

Foreign Variables	Statistic	Critical Value	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
ys (with trend)	ADF	-3.04	-5.18	-1.56	-2.45	-1.31	-2.33	-2.76	-1.83	-2.94	-1.64	-3.88	-3.04
ys (with trend)	WS	-2.86	-3.79	-1.88	-1.69	-1.17	-1.46	-2.72	-1.56	-4.40	-1.13	-3.94	-2.86
ys (no trend)	ADF	-3.26	-0.45	0.63	1.03	-2.42	-1.05	-0.84	-1.34	-0.33	-2.48	-0.75	-3.26
ys (no trend)	WS	-0.67	-1.33	-0.10	0.23	0.43	1.00	-1.21	0.63	0.47	0.40	-0.98	-0.67
Dys	ADF	-1.98	-1.95	-1.59	-4.46	-3.15	-1.97	-3.48	-1.97	-2.08	-2.28	-2.44	-1.98
Dys	WS	-2.17	-3.23	-3.03	-4.03	-2.60	-1.16	-4.10	-0.67	-2.03	-2.13	-2.77	-2.17
DDys	ADF	-6.50	-3.62	-3.69	-6.16	-8.65	-5.36	-4.27	-4.05	-4.36	-7.28	-5.10	-6.50
DDys	WS	-3.77	-2.19	-3.88	-4.61	-5.17	-3.79	-4.03	-3.35	-3.45	-4.36	-3.46	-3.77
ps (with trend)	ADF	-3.36	-3.62	-0.25	-1.70	-1.52	-2.50	-4.27	-3.90	-2.25	-2.56	-2.61	-3.36
ps (with trend)	WS	-3.17	-4.09	-0.16	-2.41	-2.00	-2.66	-4.66	-3.91	-2.67	-2.67	-3.17	-3.17
ps (no trend)	ADF	-2.87	-1.08	2.90	-1.60	-3.22	-3.75	-1.15	-2.38	-3.04	-3.11	-1.25	-2.87
ps (no trend)	WS	-1.16	-0.87	0.18	0.48	-0.45	-1.28	0.71	-1.28	-1.24	-0.81	-0.47	-1.16

Dps	ADF	-2.45	-2.74	-2.45	-3.20	-1.72	-2.56	-5.42	-3.37	-3.22	-3.13	-1.91	-2.45
Dps	WS	-1.93	-2.84	-1.80	-3.48	-2.06	-2.22	-5.89	-1.99	-2.30	-2.92	-2.41	-1.93
DDps	ADF	-3.96	-7.26	-6.12	-6.06	-7.05	-4.36	-6.59	-4.37	-4.27	-3.83	-7.58	-3.96
DDps	WS	-2.21	-7.80	-6.55	-6.47	-7.47	-2.73	-5.76	-2.73	-2.74	-2.84	-8.03	-2.21
mps (with trend)	ADF	-3.45	-0.78	-2.18	-2.30	-2.46	-2.38	-3.14	-2.24	-2.95	-2.86	-2.69	-2.69
mps (with trend)	WS	-3.24	-1.47	-2.73	-2.17	-2.21	-1.13	-2.48	-2.57	-2.21	-3.05	-1.89	-2.47
mps (no trend)	ADF	-2.89	-0.87	-2.70	-0.90	-2.47	-1.92	-2.55	-1.18	-3.12	-2.85	-2.67	-2.74
mps (no trend)	WS	-2.55	-1.07	-3.10	-1.25	-2.18	0.25	-1.34	-1.38	-1.89	-2.27	-1.86	-2.28
Dmps	ADF	-2.89	-5.69	-3.40	-4.10	-3.96	-4.89	-3.82	-3.96	-3.24	-3.95	-4.08	-5.06
Dmps	WS	-2.55	-0.73	-3.66	-4.34	-3.31	-0.73	-0.86	-3.81	-0.96	-1.83	-1.16	-5.37
DDmps	ADF	-2.89	-3.73	-4.64	-5.21	-7.73	-4.94	-6.72	-5.94	-4.09	-4.69	-5.77	-8.14
DDmps	WS	-2.55	-1.64	-4.68	-5.53	-8.06	-1.99	-2.56	-6.33	-3.41	-4.35	-3.83	-8.47

Appendix Table 4. 8 Cointegration Results: term spread

Detailed Cointegration Results for the Trace Statistic at the 5% Significance Level											
Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
# endogenous variables	5	4	4	4	4	4	4	4	4	4	4
# foreign (star) variables	1	5	5	5	5	5	5	5	5	5	5
r=0	103.65	163.58	175.40	170.85	152.26	200.18	198.10	118.92	159.75	154.36	139.10
r=1	65.16	92.02	94.64	105.26	97.94	120.84	128.94	82.27	80.48	79.21	79.16
r=2	38.47	48.65	48.31	64.46	47.14	63.99	63.24	48.12	46.66	35.65	40.47
r=3	20.32	21.65	19.82	30.98	19.34	30.17	22.19	18.60	18.10	12.13	18.18
r=4	5.77										
Critical Values for Trace Statistic at the 5% Significance Level (MacKinnon, Haug, Michelis, 1999)											

Country	USA	ARGENTINA	BRAZIL	CHINA	INDIA	INDONESIA	MEXICO	RUSSIA	SARBIA	SOUTH AFRICA	TURKEY
# endogenous variables	5	4	4	4	4	4	4	4	4	4	4
# foreign (star) variables	1	5	5	5	5	5	5	5	5	5	5
r=0	100.29	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03
r=1	73.31	78.52	78.52	78.52	78.52	78.52	78.52	78.52	78.52	78.52	78.52
r=2	50.25	50.72	50.72	50.72	50.72	50.72	50.72	50.72	50.72	50.72	50.72
r=3	31.05	26.24	26.24	26.24	26.24	26.24	26.24	26.24	26.24	26.24	26.24
r=4	15.46										

Appendix Table 4. 9 VARX* Order of Individual Models (p: lag order of domestic variables, q: lag order of foreign variables) and numbers of cointegrating relations: Term spreads

	p	q	# Cointegrating relations
USA	1	1	1
ARGENTINA	2	1	2
BRAZIL	2	1	2
CHINA	2	1	4
INDIA	2	1	2
INDONESIA	2	1	4
MEXICO	2	1	3
RUSSIA	2	1	2
SAUDI ARABIA	2	1	2
SOUTH AFRICA	2	1	2
TURKEY	2	1	2

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