BANK NEGARA MALAYSIA
CENTRAL BANK OF MALAYSIA

Bank Negara Malaysia Working Paper Series
WP3/2013

Global Monetary Easing: Spillovers and Lines of Defence

By Wang Sheair Chua, Norhana Endut, Nozlan Khadri, Wee Haw Sim

December 2013

Global Monetary Easing: Spillovers and Lines of Defence

Wang Sheair Chua
Norhana Endut
Nozlan Khadri
Wee Haw Sim[1]

Abstract

The primary aim of the quantitative easing (QE) measures by the US Federal Reserve (the Fed) is to stabilise the financial markets and economic activity in the United States, but it has also generated intense debates over its spillover effects on capital flows towards emerging market economies (EMEs). This paper finds evidence to corroborate the proposition that QE generates non-trivial spillover effects on asset prices, exchange rates and monetary conditions in EMEs. The paper also extended further the analysis by examining policy responses by EMEs in dealing with capital flow surges and and finds that in the case of Brazil and Korea, the implementation of capital flow management measures had helped to lessen the pace of inflows but at the cost of higher volatility in the respective financial markets.

JEL Classification Numbers: E44, E52, E58, F42, F62, G14

Keywords: Monetary Policy, Quantitative Easing, Federal Reserve, Capital Flows, Spillovers, Emerging Market Economies, Capital Flow Management Measures, Event Studies, Global VAR

Author's email addresses: sheair@bnm.gov.my, norhanae@bnm.gov.my, nozlan@bnm.gov.my, sim@bnm.gov.my

[1] The views expressed in this paper are those of the authors and do not necessarily represent the views or policy stance of Bank Negara Malaysia. Authors would like to thank Raja Syamsul Anwar, Tengku Azlan, Jarratt Ma, Roslaini Omar and Hazilah Harun for their research input and assistance. Comments are most welcome.

1.0 Introduction

Quantitative easing (QE) was one of the key elements that redefined central banks' conduct of monetary policy in the wake of the global financial crisis. As policy rates in crisis-hit advanced economies approached their floors (zero lower bound) and became ineffective as a policy signal, the advanced economies turned to QE, which took the form of asset purchases and expansion of central banks' balance sheets, to influence the long-term interest rates. QE by the Fed was particularly a subject of great interest among policy makers around the world, given the central role of the US economy and financial market. In general, the benefits of QE on the US economy have broadly been acknowldged, but concerns were often voiced over the unintended consequences, especially towards EMEs through its effect on global liquidity and capital flows. In particular, QE by the Fed was seen as an important push factor for the sizeable capital flows to EMEs, which were also found to be highly volatile amidst uncertain global environment. The announcement of the first quantitative easing (QE1) in November 2008 for instance, was followed by a period of large capital flows into EMEs, predominantly into equity, bond and property markets.

Several hypotheses have been developed to explain the channel through which QE could affect EMEs. The first is through the portfolio balance effect, in which large purchases of Treasury and agency securities by the Fed reduced the yields of these securities and consequently forced investors to purchase other assets, especially in EMEs, given the higher risk-adjusted returns. The second channel is through the various combination of signaling, liquidity and search for yield effects. Through this channel, QE announcement by the Fed helped to rebuild market confidence and lower risk premiums, supported by the Fed's commitment to stabilise financial markets and to keep the policy rate low for an extended period. At the same time, large scale asset purchases by the Fed injected a massive amount of liquidity into the US financial system. Once investors' risk appetite improved, the combination of abundant liquidity and expectations for a prolonged period of low interest rates in the US and other advanced economies generated incentives for yield-seeking investments into EMEs, attracted by the supposedly stronger macroeconomic fundamentals and positive growth prospects.

This paper seeks to provide more evidence of the spillover effects of QE by the Fed on EMEs by assessing both the short-term and medium-term impacts. The short-term impact is assessed through an event study approach, which measures the impact on EMEs financial markets following the announcement of the three QEs by the Fed, while the medium-term impact is assessed through the generalised impulse response functions from the Global VAR

model, which produces the impact of a US liquidity (as proxied by M2) shock on monetary conditions and real activities in the EMEs. The short-term results are broadly consistent with the existing literature. From the implementation of QE in 2008 until the most recent period, EMEs equity prices have increased by between 8% and 20%, while EMEs exchange rates have appreciated by between 0.4% and 12%. Government bond yields have declined by up to 20 basis points. The impact of QE1 on exchange rates, equity prices and bond yields was found to be larger compared to other phases of QEs. The medium-term result generally indicates that an increase in US M2 growth leads to higher inflation, credit growth, equity prices, exchange market pressure (EMP) and house prices in EMEs. In terms of magnitude, a liquidity shock in the US has a larger impact on financial markets (equity prices and EMP) compared to the real sector (GDP, inflation) and monetary conditions (credit). This evidence lends support to concerns that QE by the Fed could be one of the push factors for capital flows that has contributed to the build-up of financial imbalances in EMEs.

Given the impact of these measures and the consequent surges of capital flows into EMEs, a growing number of counter measures were put in place. The design of these counter measures, however, varies between countries, depending on the symptoms and sources of vulnerabilities that each country had to confront. Some countries focused on short-term capital flow measures while others resorted to more medium-term macro prudential measures. This paper reviews three key lines of defence that constitute the framework of capital flow management for EMEs, which has increasingly gained acceptance by the international community. Within the capital flow management framework, the first line of defence is to ensure that macroeconomic concerns are addressed by macroeconomic policy responses. Greater exchange rate flexibility coupled with adequate reserves would be more appropriate to deal with issues concerning exchange rate misalignment and extreme volatility. The second line of defence refers to the role of prudential measures to address financial stability concerns that may arise from potential leakages from the first line of defence. Examples of these leakages are domestic credit booms and asset price inflation fueled by capital inflows. In the event that the first two lines of defence fail to abate capital inflows and its associated risks, capital flow management measures (CFMs) could be deployed as the third line of defence to manage the residual risks. While it is not necessary for CFMs to be sequenced as the measure of last resort in managing capital flows, countries would usually exhaust other policy alternatives before turning to CFMs, given the well-known costs of implementing such measures. In terms of policy instruments, there are two broad types of CFMs, either through market-based controls, which aim to increase the cost of the targeted capital transactions to

discourage inflows; or administrative controls, which impose outright restrictions on cross-border capital transactions through prohibitions or explicit quantitative limits.

The paper draws some examples of counter measure policies by Korea and Brazil and assesses the impact of these policy measures on financial markets. In the case of Brazil, the paper finds evidence that following the policy announcements, both the currency and equity prices, on average, declined by 0.66% and 0.82% respectively, which suggests some influence that the CFMs may have had on the Brazilian financial markets. Similarly, in Korea, the Korean won and equity prices declined, on average, by 0.69% and 0.80% respectively following the announcements of the CFMs. There is a trade-off however, as financial markets in both countries experienced higher volatility indicating the uncertainty that may have emanated through such policies.

From the results, there are a number of useful observations that warrant greater attention for policy makers. First, the results show that the Fed's series of QEs have had a non-negligible impact on EMEs both in the short-term and medium-term. As such, EMEs that are highly open and strongly integrated with financial markets in the advanced economies are likely to face greater spillover effects, which raises the complexity for policymakers in ensuring macroeconomic and financial stability. Second, given the sheer volume of capital flows, the challenge for policymakers lies in their ability to strengthen the appropriate lines of defence against sudden surges and reversals in capital flows. Country experiences would serve as guidance in choosing the appropriate policy mix, taking into account the costs and benefits of the relevant-measures.

This paper is structured as follows: Section 2 provides stylised facts on the impact of QE on global liquidity and discusses the channels of transmission of US QE to the EMEs. Section 3 presents our assessment on the impact of QE by the Fed on EMEs and Section 4 assesses the lines of defence by EMEs to manage the surges of capital flows. Finally, Section 5 provides discussions on the policy implications of our findings and the conclusions.

2.0 Stylised facts of QE transmission channels to EMEs

The existing literature on the impact of QE initially centred around its domestic effects, of which many studies broadly found support that QE led to immediate and significant declines in yields for longer-term Treasury and corporate securities following key

QE speeches and announcements[2]. Nevertheless, a major development that has increasingly attracted scrutiny by policymakers is the potential spillover effects from QE on EMEs. Following each round of QE, EMEs have attracted a growing size and increased speed of capital inflows (Figure 1). Since QE1 was introduced by the US in November 2008, EMEs have experienced portfolio inflows of about USD234 billion, which went predominantly into equity and bond markets.

The conjecture from stylised observations suggests that the QE by the Fed was followed by periods of capital flow surges, sustained increases in equity and house prices, appreciation of exchange rates, strong credit expansion and declining yield spreads in EMEs. Figure 2 indicates that average equity prices have more than doubled between 2008 and April 2013, where as EMEs exchange rates appreciated by an average of 20% during the period. Also, average house prices of EMEs increased by about 40% while credit expanded from around 100% of GDP to over 120% of GDP. These indicators suggest potential excesses that have developed in EMEs since the first QE was implemented. Nevertheless, it should be noted that besides QE, there were also other push and pull factors that were driving inflows into EMEs. Structurally, the persistently high unemployment, impaired household balance sheets and the uncertainty over the fiscal situation in the advanced economies may have triggered a shift in investors' portfolio allocation towards EMEs, many of which enjoyed relatively stronger economic fundamentals. Of significance, the development of EMEs' domestic capital markets through progressive liberalization has increased market liquidity and provided further impetus for portfolio inflows[3]. Cyclically, the multispeed global growth led to the widening interest rate differentials between the advanced economies and EMEs and this set the stage for sustained large inflows towards EMEs. While the size of capital flows has grown exponentially, these flows have also become more volatile amidst ongoing uncertainty over the health of the global economy, resulting in sharp swings between investors' risk-off and risk-on appetite.

Currently, there are two dominant views on the impact of QE on EMEs. The first view has generally been echoed by proponents of QE, who argues that QE does not exert negative externalities on EMEs. In fact, QE helped to restore the stability in global macroeconomic and financial environment, which in turn,promoted stronger domestic growth,

[2] Nealy (2010) finds that the US QE lowered Treasury bond yields by 100 basis points, corporate bond yields by 80 basis points and lowered bond rates in the other advanced economies by 20-80 basis points and the value of US dollar by 4-11 percentage points. Also refer to Gagnon et al.(2011); Joyce et al.(2010); Neely (2012); and Bauer and Rudebusch(2011)

[3] Portfolio flows have in fact, grown to account for almost one-half of inflows, significantly bigger than direct investment and cross-border bank lending (IMF 2011).

and hence brought benefits for EMEs and the global economy through increased trade activity. The second view, voiced typically by EMEs policymakers, argues that QE adds liquidity into the global financial system and given the generous risk-adjusted interest differentials in favour of EMEs, would magnify the speed and size of capital inflows towards EMEs, fueling exchange rate and asset price misalignment, credit growth and overheating pressures in emerging economies. For instance, Fratzscher, Lo Duca and Straub (2012, henceforth FLS 2012) found evidence that capital flows into EMEs increased following QE1, but noted that the opposite happened during QE2. Chen, Filardo, He and Zhu (2011, CFHZ 2011) also found short-run evidence that QE by the Fed had an expansionary impact on a broad range of assets globally, including equity prices, government and corporate bond yields as well as CDS spreads. In the medium-term, however, the international spillovers differed across economies, especially for EMEs. A US monetary easing typically led to high capital inflow pressures, rapid domestic credit growth, and inflationary pressures but the exact impact depends on the different manner in which each economy reacted or adjusted to the US policy shock. This is determined to some extent by its economic and financial structure, policy framework, capital control and exchange rate regimes.

Despite growing evidence associating QE with capital flows into EMEs, researchers have yet to determine the underlying mechanism and channels for these spillovers. There are broadly two main channels through which QE may affect capital flow movements into EMEs;

2.1 Portfolio balance effect

Purchases of Treasury and agency securities by the Fed reduced the amount of these long-term bonds in the market and hence result in lower term premiums. When the Fed purchases a particular asset, it would reduce the amount of the long-term securities that the private sector holds, displacing some investors into holding other assets such as corporate bonds, thus making it cheaper for corporations to borrow. The effect may go beyond domestic border as the lower US long-term bond yields could trigger a search-for-yields, given the higher risk-adjusted return of EMEs. The channel essentially assumes imperfect substitutability between foreign and domestic assets and the change in risk-adjusted return would generate a portfolio rebalancing effect. FLS 2012 studies the portfolio balance effect by comparing between the impact of policy guidance or announcements and the actual operations by the Fed and found that the impact of Treasury and MBS purchases on portfolio allocations and asset prices dwarfed those of US Fed announcements. Thornton (2012), however, investigated the portfolio balance channel using three interest rate measures and

nine public debt supply measures that have been suggested in the literature, and found no evidence that the decline in longer-term rates and term premiums identified in the event-study literature are due to the portfolio balance channel.

2.2 Signaling, liquidity and search for yields effects

Through this channel, QE announcements convey signals to the market on the Fed's monetary policy stance based on its assessment on future economic conditions. In response, investors may revise their expectations of the future path of the short-term interest rates and this would influence the long-term interest rates as well. For instance, the FOMC statement in 2009 indicated their commitment to maintain "… exceptionally low levels of the federal funds rate for an extended period," which provided forward guidance that the interest rate is likely to remain low for a considerable amount of time. In such a case, interest rate differential will remain in favour of EMEs and coupled with the relatively weak economic growth prospects and ongoing structural issues such as high unemployment, impaired household balance sheets and uncertainty over the fiscal outlook in the advanced economies, investors shifted their interests towards EMEs in search for higher retunrs. QE also injected a massive amount of liquidity into the global financial system and this further amplified the magnitude of portfolio flows into EMEs.

Figure 1: The US Federal Reserve QE and cumulative portfolio inflows to EMEs

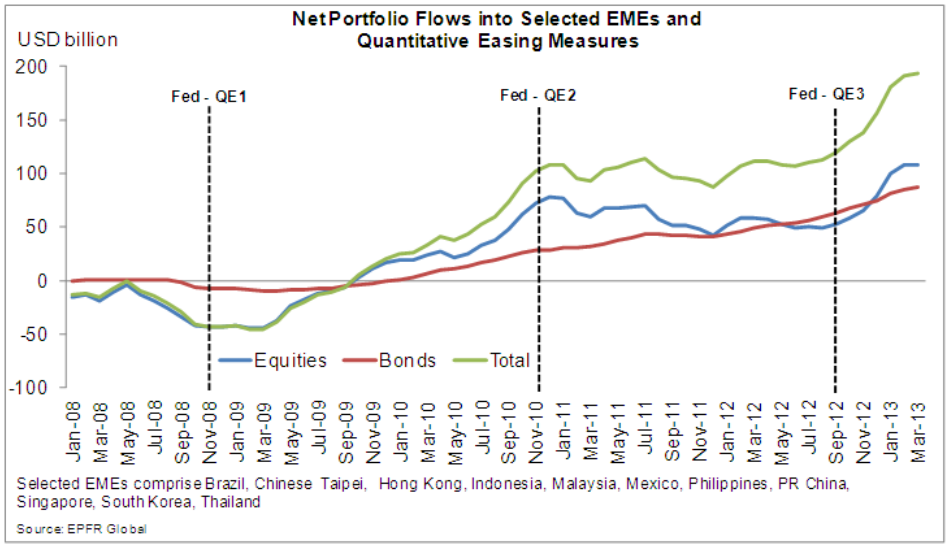
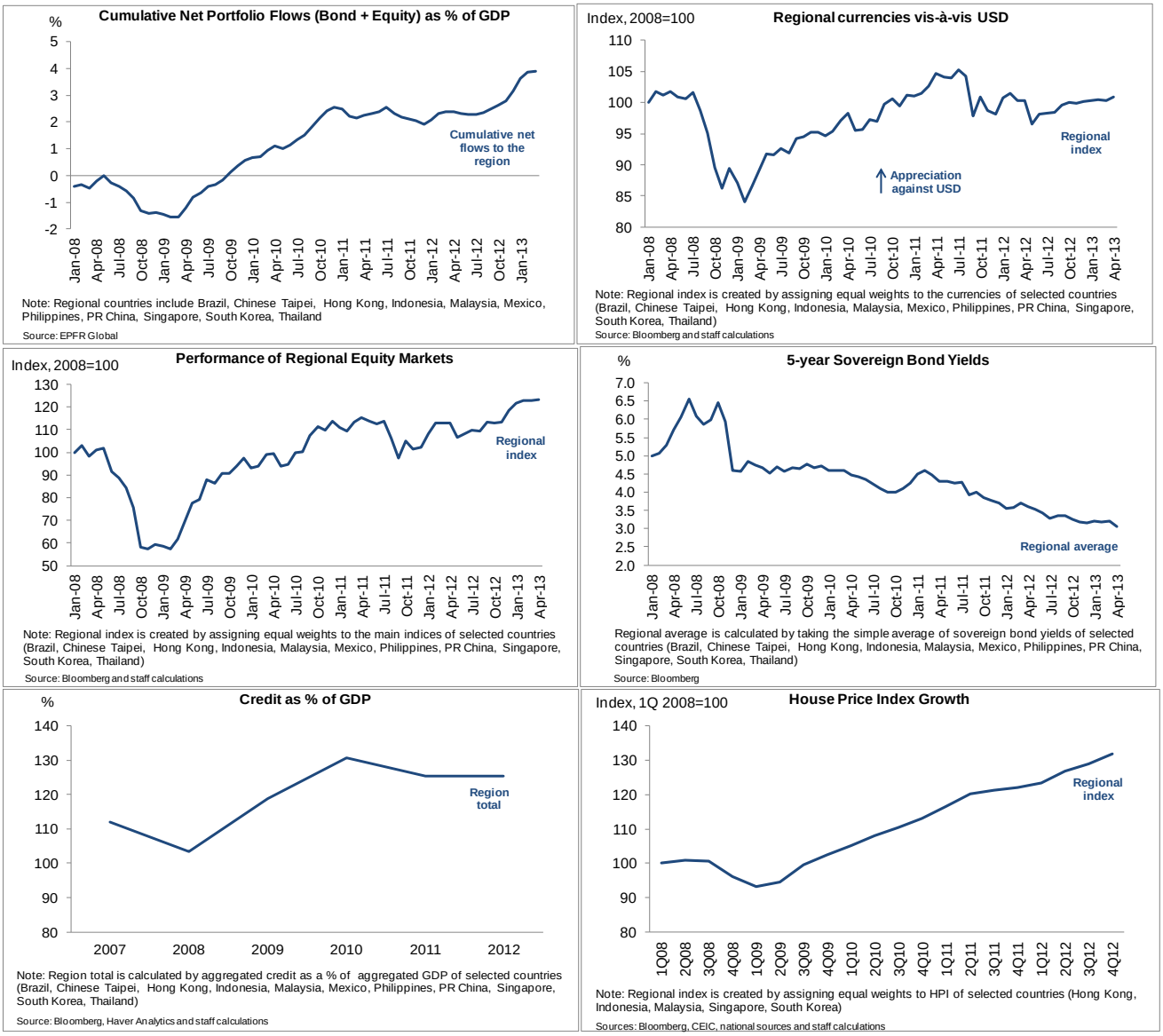


Figure 2: Performance of EMEs financial markets and monetary conditions since 2008



3.0 Assessment on the Impact of the QE on EMEs

3.1 Methodology

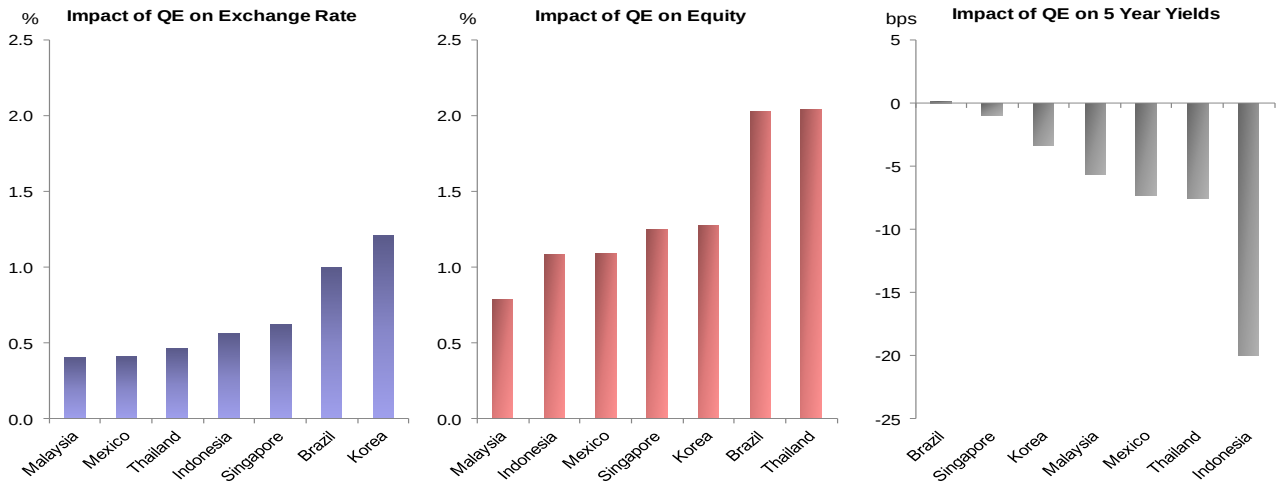
To assess the short-term and medium-term impact of QE on EMEs, two different methods were adopted. The first method assesses the short-term impact of QE announcements on EMEs using the event study approach. Under this approach, the assessment on short-term impact measures both the direction of financial assets and the degree of volatility in prices of these financial assets. The second method assesses the medium-term impact of QE on EME financial markets, monetary conditions and the real economic activity using the Global Vector Autoregressive (GVAR) model. This model allows for interconnections and interdependencies between both domestic and global factors,

which enable us to capture the potential cross-border spillovers of the on EMEs, after controlling for other domestic and international factors.

3.2 Short-run effects of the Fed's QE on EMEs financial markets

To assess the short-term impact of QE on asset price movements, we consider the event study approach using a two-day window periods around the announcement dates[4], a technique that is commonly used by others[5] in this type of study. While previous studies focused mostly on the cross border impact from QE1 and QE2, this study also incorporates the impact of QE3[6]. Table 1 (refer appendix I) shows a comparison on the announcement dates chosen by previous studies and this paper. Table 2 (refer appendix I) explains the considerations behind the selection of these announcement dates.

Figure 3: Impact of Fed's monetary easing on EMEs financial markets



Our results are broadly consistent with the existing literature. Figure 3 shows that the Fed's QE generally boosted equity prices, appreciated the exchange rates and lowered government bond yields of EMEs. Also consistent with previous studies is the divergence between the impacts during the three rounds of QEs. Following the implementation of several QEs since 2008, the EMEs equity prices have increased (on average) between 0.8% and

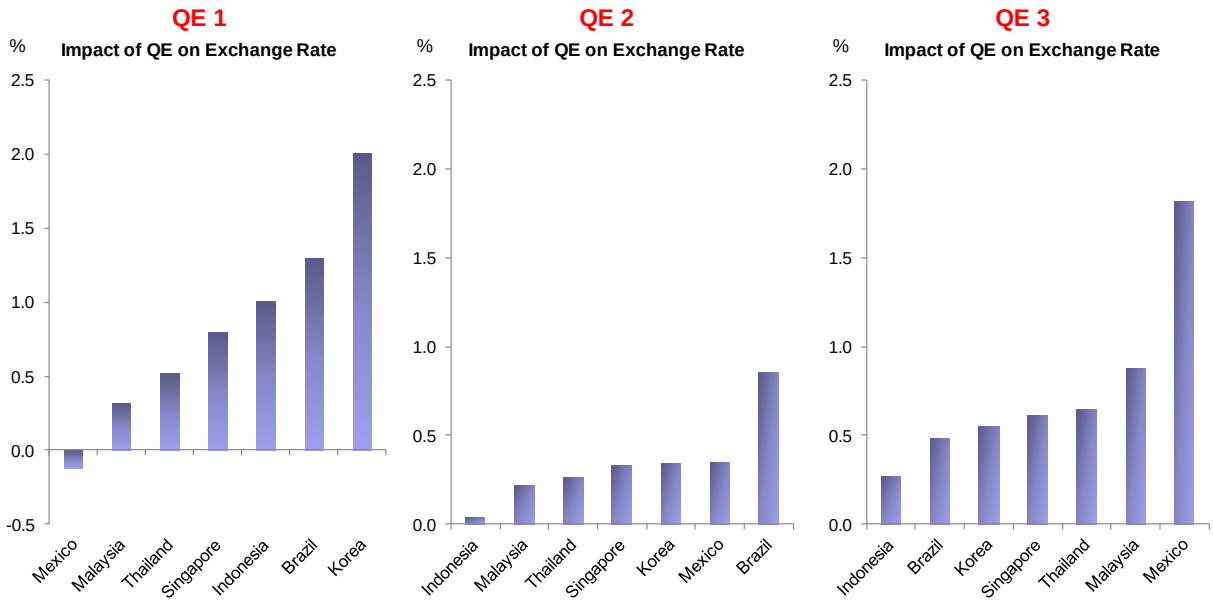
[4] A two-day window is justified in this instance because expectation of further easing would have caused the market to move even before the actual announcement given that FOMC meetings and speeches were pre-scheduled and the full announcement effects would be captured in the subsequent day when the emerging markets reopened. The two-day window is measured from the closing level (Asian time zone) of the day prior to the announcement to the closing level the day after the announcement.

[5] See for example Gagnon et al (2010,2011), CFHZ 2012(2011) and Neely (2010, 2012)

[6] Selected announcement dates include not only releases of FOMC statements but also speeches by the Fed Chairman that provided significant forward looking indication of further easing by the Fed

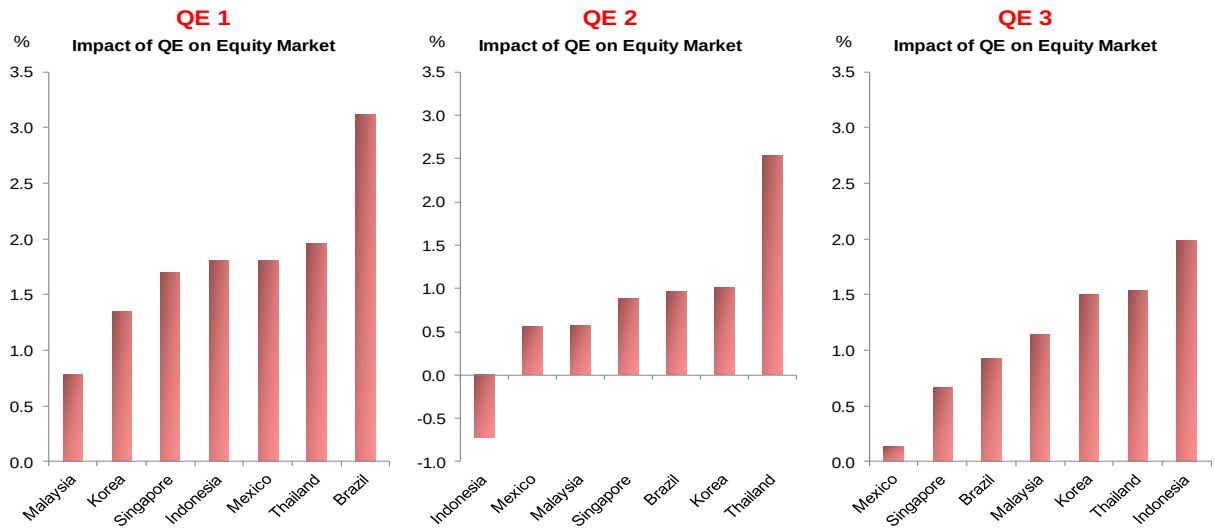
2.0%, while EMEs exchange rates have appreciated (on average) between 0.4% and 1.2%. The Government bond yields have declined (on average) by up to 20 basis points.

Figure 4: Impact of Fed's monetary easing on EM currencies



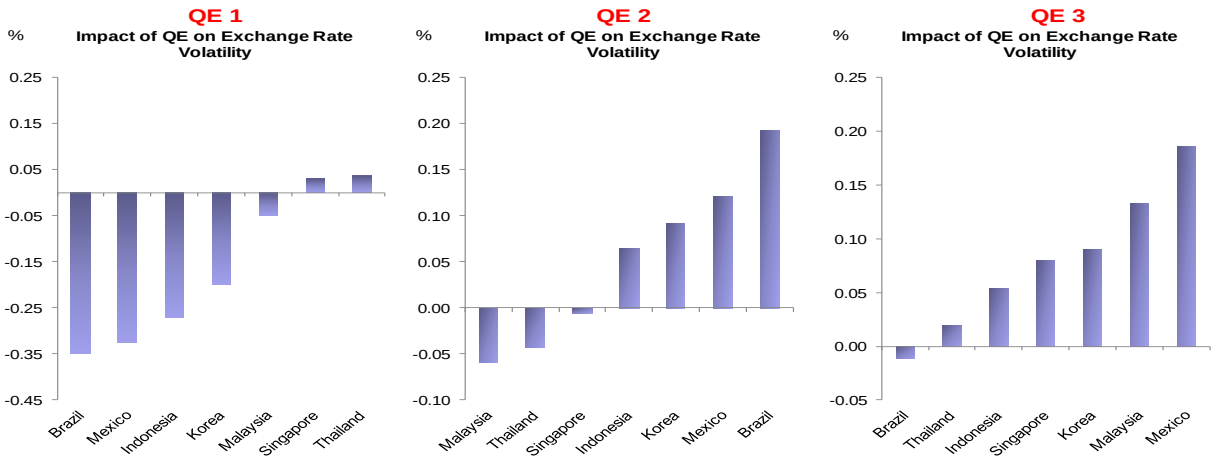
Dissecting the impact of each round of QEs on EME exchange rates, Figure 4 reveals that upward pressure on EME currencies was at its peak during QE1, which saw the Korean won and the Brazilian real being impacted the most. This is hardly surprising as both countries were the first to publicly raised their concerns over the strength of their currencies. While the impact of QE2 seems to be relatively weaker compared to the other two rounds of easing, it was possibly masked partly by EMEs forceful intervention during the period. In fact, the international reserves held by EMEs central banks increased at an unprecedented rate, whereby in 2010 alone, international reserves of selected EMEs increased in the range of USD9.8 billion and USD50.1 billion. In the EMEs equity markets, similar dynamics could be observed during the period (Figure 5), in which QE1 also had the largest impact on the equity markets, which increased (on average) between 0.8% and 3.1%.

Figure 5: Impact of Fed's monetary easing on EMEs equity markets



Turning to the assessment on volatility, we estimate the impact on the volatility level by employing the same event study approach but widen the period to seven-day gap prior and post-announcements to capture the variability of financial market indicators. Given the short-period of estimation, we have used the absolute value of the daily changes of the measured variables as a proxy for volatility[7].

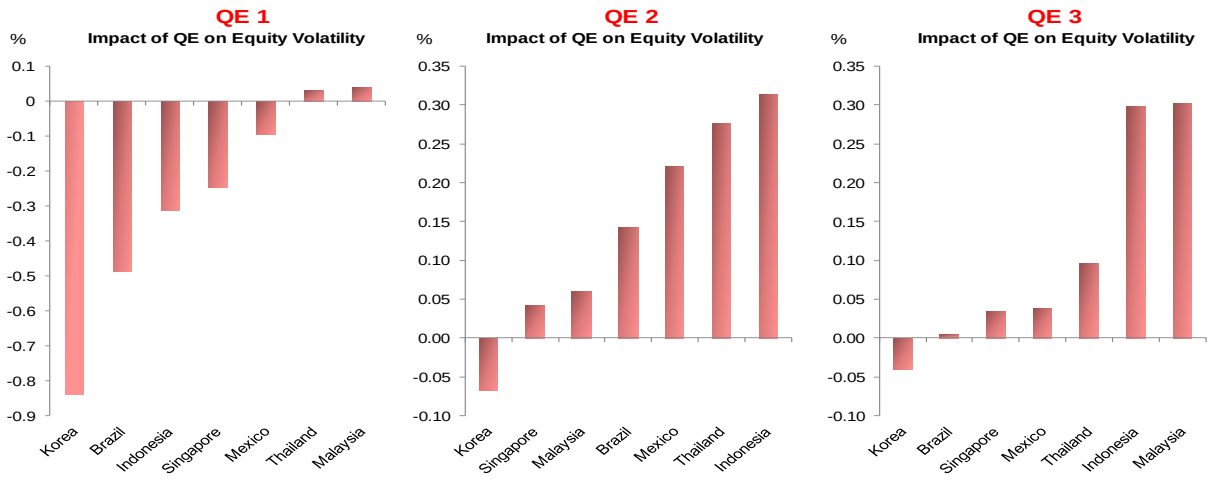
Figure 6: Impact of Fed's monetary easing on the volatility of EM currencies



[7] 30-day rolling historical volatility and a GARCH(1,1) volatility measure were also used for robustness checks. While the GARCH model yielded similar results, the 30-day historical volatility showed considerable divergence. This finding is expected given that the 30-day rolling calculations would mask the changes in the latest data points, understating the actual jump in volatility.

Figures 6 and 7 present the average daily variability around the announcement days. One notable difference between the three rounds of QEs is the lower volatility following announcements associated with QE1. QE1 was announced at a time when global uncertainty was at its peak and the announcement by the Fed helped to stablise the financial market and hence lessened the volatility. The subsequent easing announcements, however, did amplify the volatility of EMEs financial markets. This result is not surprising given that the economic backdrop during which QE2 and QE3 were announced were markedly different compared to QE1. It was increasingly evident in the post QE1 periods that the global economy was running on a multispeed trajectory, in which EMEs was driving global growth while the economic growth in advanced economies was rather anemic amid prolonged structural weaknesses. The ensuing policy rate normalization in EMEs further led to the widening of the interest differentials and attracted more portfolio inflows. The optimism towards EMEs, however, was held back by the ongoing global uncertainty over the state of the advanced economies, especially following the escalation of the sovereign debt crisis. Investors became very reactive to news, contributing to increased volatility. Unsurprisingly, the same impact was also seen in the equity markets.

Figure 7: Impact of Fed's monetary easing on the volatility of EMEs equity markets



3.3 Medium-term effects of the Fed QE on EMEs financial market and real activity

The medium-term assessment on the impact of QE employs the generalised impulse response functions from a GVAR model[8], which measures the impact of US liquidity shocks on EMEs. Specifically, we examine the impact of changes in US M2 growth on real GDP, inflation, equity prices, house prices, exchange market pressure[9] and credit in a sample of EMEs comprising of three regions, namely East Asia (China, HK, South Korea), South-East Asia (Singapore, Malaysia, Thailand, Philippines, Indonesia) and Latin America (Brazil, Chile, Mexico). As observed in Figure 8, the US M2 growth increases around the start of QE dates, implying that it can be a reasonable proxy for US liquidity and a signal for the the Fed's QE.

Figure 8: US M2

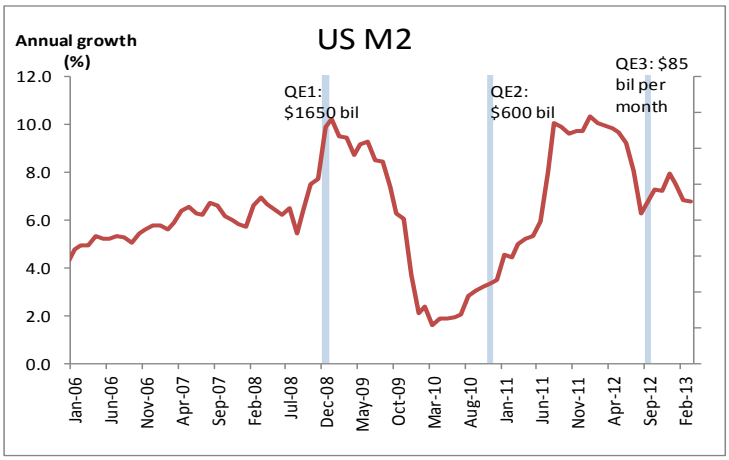


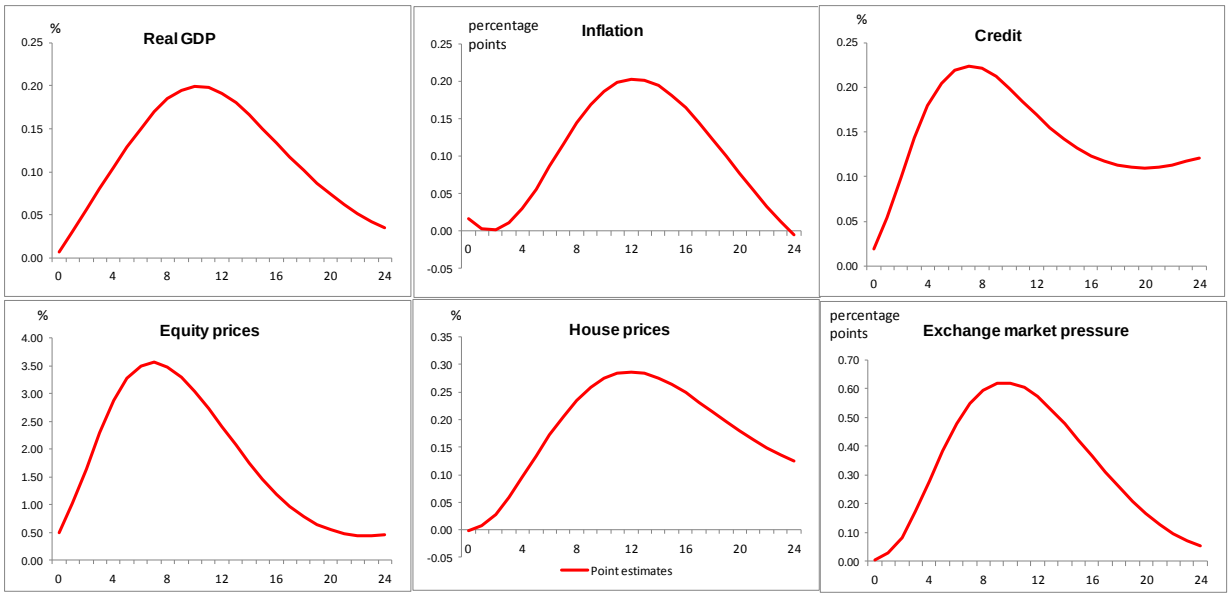
Figure 9 presents a summary of our findings from the impulse response functions obtained from a 1-standard error positive shock to the annual US M2 growth (which translates to approximately 2.1 percentage points) to the countries in our sample over 24 months. In general, we find that an increase in US M2 growth has a positive impact on real GDP, inflation, credit, equity prices, exchange market pressure (EMP) and house prices in EMEs. Looking at the path of the impulse responses, predictably we find that the impact of a liquidity shock in the US affects equity markets and credit growth in EMEs with a shorter lag (7 months) compared to the real sector (10-12 months[10]).

[8] See Appendix III for more details on the model, data and estimation procedure

[9] Exchange market pressure (EMP) is used instead of the exchange rate to take into account the fact that some countries intervene in the forex market to manage their currencies (see appendix for details on calculation). In this case, an increase in EMP implies appreciation pressure on the currency and vice-versa.

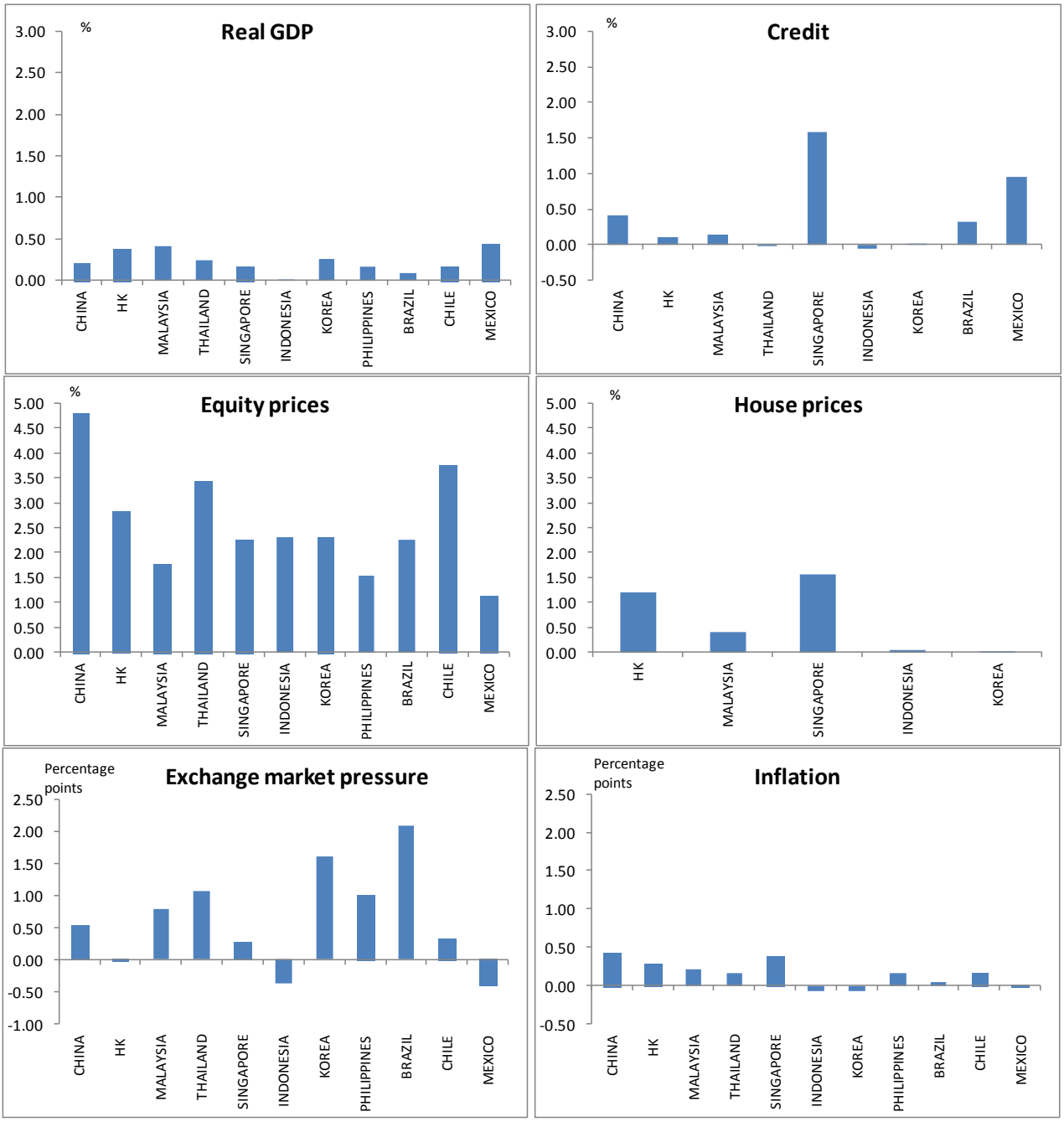
[10] Based on the peak of the aggregated impulse responses in Figure 10

Figure 9: Generalised impulse response functions for EMEs[11] from a 1-std dev shock to US M2 growth



[11] The impulse response functions (IRFs) represent a weighted average from the individual IRFs obtained from the countries in our sample. The weights are reflective of economy size, and are constructed from the USD-denominated PPP-adjusted real GDP of each country. Individual IRFs are in appendix.

Figure 10: Maximum of impulse response functions to a 1-std dev shock to US M2 growth



In terms of magnitude and significance, we find that a liquidity shock in the US has a larger impact on financial markets (equity prices and EMP) compared to the real sector (GDP, inflation) and monetary conditions (credit). This lends further support to the view that the Fed's QE could and have resulted in the buildup of financial imbalances in EMEs, and explains the escalating numbers of countermeasures by EMEs since the introduction of QE by the Fed. It is also worth pointing out that even when considering individual country models, the impact of a positive liquidity shock in the US has a positive impact on EMEs' real GDP. Intuitively, a shock to US liquidity can affect EMEs through several reinforcing

channels. First, a positive shock to US liquidity results in higher US growth, which in turn, stimulates demand for EMEs exports and GDP growth. Second, a shock to US liquidity causes EMEs currency appreciation vis-à-vis the USD through capital inflows. While this could lead to a loss of export competitiveness for EMEs, the effect could be offset by higher investment that could potentially generate higher growth dividend in the future. Third, the inflows could also generate wealth effects through the appreciation of domestic equity and property prices. Fourth, monetary easing in the US could influence selected EMEs to maintain accommodative domestic monetary policy and lastly, the easy global monetary condition could also lead to higher external financing among EMEs' financial institutions and corporations.

The general results above notwithstanding, it should be noted that when considering individual countries, the impact of a shock to US liquidity on EMEs can be quite diverse in terms of the significance, sign and magnitude of the spillovers. Of significance, the impact of a shock to US liquidity is more statistically significant (in terms of the number of domestic variables found to be statistically significant) in more "open" economies such as Singapore and Hong Kong. Property prices in these countries also seem to be more responsive to changes in US liquidity compared to other countries in our sample. This observed heterogeneity is in line with the findings from CFHZ 2011, reinforcing the argument that ultimately, the impact of QE on EMEs is dependent on the different ways a country adjusts or reacts to the liquidity shock, which is in turn influenced by an individual country's macroeconomic and financial structure, policy framework and exchange rate regime.

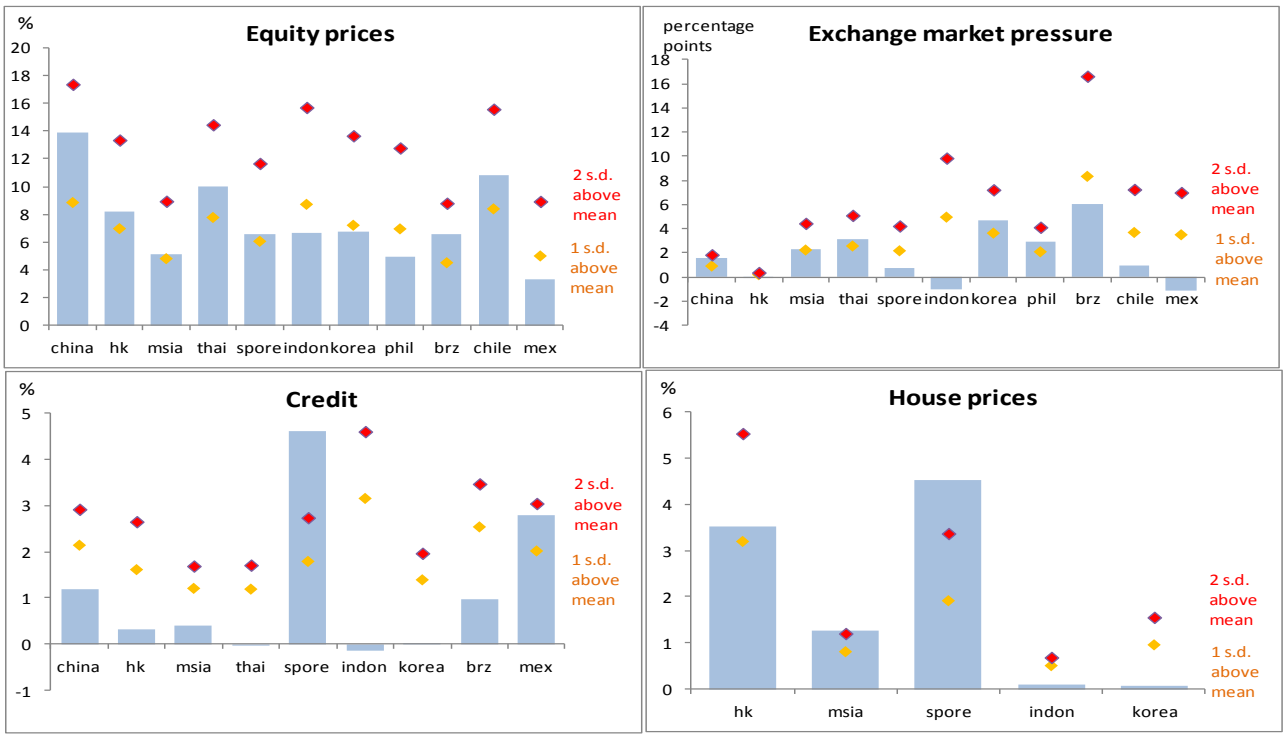
Inevitably, the next question would be, is the increase in asset prices from the expansion in liquidity large enough to warrant a concern? We attempt to provide some perspective to this via a simple extension of our results. Based on the impulse response functions, an increase of 2.1% to US M2 month-on-month growth (1 standard deviation) can result in a maximum increase of 1.1% to 4.8% (month-on-month growth) in equity prices in EMEs. During the course of QE1 and QE2, M2 in the US increased by 6.1% and 4.2% respectively. Assuming the impact of a shock to M2 is linear in nature, this would imply that EMEs could potentially have faced an increase in equity prices of 3.3% to 13.9% from QE1 and 2.3% to 9.7% from QE2. To give some context on whether this rise is strong enough of a concern to policy-makers, we compare the increase to its historical standard deviation. We also use this method for exchange market pressure, credit and house prices.

A few caveats on this thought experiment: Firstly, we do acknowledge this analysis could be seen as too simplistic to precisely determine if QE did lead to financial imbalances

in EMEs. Second, the asset purchases were conducted gradually over a time period, which means the resulting increase to US liquidity could be more gradual rather than a one-off large shock. Third, this analysis considers only the maximum growth over a month, and does not consider the cumulative effect over the duration of QE, which could potentially be larger. Fourth, this exercise estimates only the impact of an increase in liquidity in the US, which may have excluded the impact from other factors such as improved growth prospects and reduced tail-risks arising from QE, which may cause the overall impact of QE to be larger than indicated in our analysis.

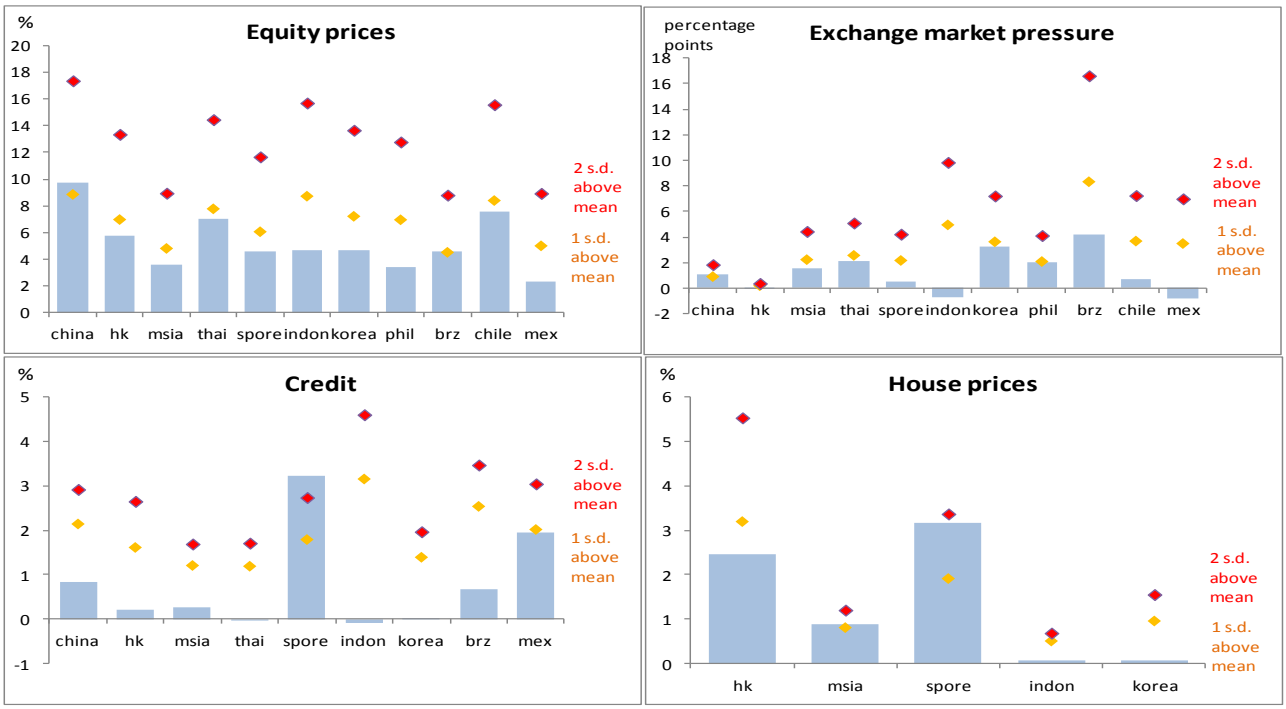
Figure 11 below shows the historical standard deviation[12] of each respective series, and the estimated potential increase in equity prices, exchange market pressure, credit and house prices arising from QE1 and QE2.

Figure 11: Impact of US QE1 on month-on-month growth in equity prices, EMP, credit and house prices, relative to its historical standard deviation



[12] As calculated from 2002-2012

Figure 12: Impact of US QE2 on month-on-month growth in equity prices, EMP, credit and house prices, relative to its historical standard deviation



From Figure 11 and 12, we can infer that generally, the expansion in liquidity from QE1 did cause a rise in EME equity prices above its historical standard deviation. The impact of QE2, however, was less obvious. The effects on exchange market pressure were somewhat mixed. We find that from QE1, China, Malaysia, Thailand, Korea and the Philippines did experience currency appreciation pressure above their standard deviations, but Hong Kong, Singapore, Indonesia, Brazil, Chile and Mexico did not. It is surprising to see that the impact on exchange market pressure in Brazil was not considered substantial (despite it being the highest in terms of magnitude), given that Brazil was among the most vocal of EMEs on the subject of spillovers from US QE, and, in fact coined the term "currency wars". This may be due to the fact that its historical standard deviation may have reflected the high currency volatility in the past[13].

In the case of credit, we find that the impact of QE on most EMEs is negligible, save for Singapore and to some extent, Mexico. In the case of Singapore, its domestic interest rates

[13] In 2002, the Brazilian real underwent a mini-currency crisis due to the prospect of the election of leftist candidate Luiz Inácio Lula da Silva, considered a radical populist by sectors of the financial markets. Many Brazilians feared another default on government debt or a resumption of heterodox economic policies, and rushed to exchange their reais into tangible assets or foreign currencies. In October 2002 the exchange rate reached its historic low of almost R$4 per US$1. The crisis subsided once Lula took office, after he and his finance minister Antonio Palocci, and reaffirmed their intention to continue the orthodox macroeconomic policies of his predecessor.

mirror those of the US's closely, hence near-zero borrowing and saving rates might have boosted the growth in credit. Furthermore, the spillovers from both QE1 and QE2 on house prices in Hong Kong, Singapore and Malaysia were found to be quite substantial(when compared to its standard deviation), especially in the case of Singapore. It is therefore not surprising that Singapore has been instituting a number of prudential measures on the property market since 2010.

4.0 Managing spillovers

4.1 Lines of defence

The extraordinary size and pace of portfolio inflows were broadly seen with mixed sentiments by EMEs policymakers. While portfolio inflows can help to develop and deepen financial markets in EMEs, it can also be a source of financial and macroeconomic instability if the inflows become excessive. In response to these concerns, EME central banks have used a wide array of policy instruments to manage capital inflows. These include currency appreciation, sterilized foreign exchange intervention, adjustments in fiscal and monetary policy, and strengthening the prudential framework. Of importance, there has been convergence of views in recent periods with greater recognition that traditional macroeconomic policies alone are not sufficient and there are complementary roles for capital flow measures to serve as another line of defence against the risks associated with sizeable and volatile capital flows. Figure 13 outlines the proposed framework for managing these flows.

Designing the appropriate measure to deal with capital flows should in principle be primarily based on the fundamental concerns arising from the flows. The first and arguably the most important line of defence is to ensure that policy responses could appropriately address macroeconomic concerns such as rapid appreciation of exchange rate, overheating of the economy or inflationary pressure. For a small and highly open economy, greater exchange rate flexibility is important to ensure adjustments in the currency towards equilibrium that is consistent with the country's economic fundamentals, which would lessen the risks from speculative capital inflows driven by one-way bet on appreciation expectations. Foreign exchange interventions may also be warranted to smooth extreme swings and ensure orderly adjustments in the foreign exchange market. In doing so, the adequacy of foreign reserves needs to be enhanced to ensure effective intervention. Alternatively, relaxation of restrictions on residents' outward investment may also help ease

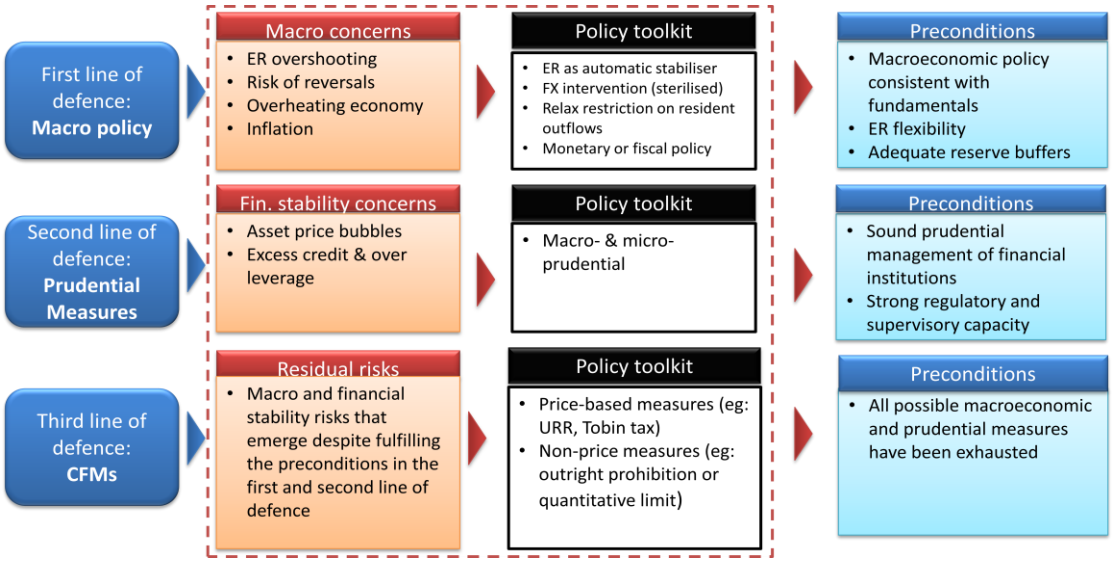
the pressure on exchange rate since this would allow resident outflows to balance out the impact from non-residents inflows.

Some central banks also considered monetary policy easing as a tool to contain the surge of capital inflows. Narrowing the interest rate differentials between EMEs and advanced economies could reduce the incentives for carry trade and search for yields, but it may not be appropriate when inflationary pressure is rising. Under such a situation, raising the reserves requirement may limit the pace of credit expansion arising from surge in capital inflows. Fiscal tightening could also be considered as an alternative tool. Reducing Government expenditure could lower the pressure on aggregate demand and contain wage and price inflation risks, which would deter inflows that are driven by interest rate differentials.

The second line of defence refers to the role of prudential measures to address financial stability concerns that may arise from potential leakages from the first line of defence such that the capital inflows fuel domestic credit booms and lead to price increases across asset classes. In this instance, both micro-prudential and macro-prudential measures (PMs) could be used on the targeted asset classes while building up the necessary buffer to withstand the effects of a liquidity or currency crisis (IMF, 2010a). In addition to conventional macro-prudential measures, other prudential measures with capital account implications such as measures that limit external borrowing by banks can also reduce the risk of balance sheet imbalances in the financial sector that may develop through excessive bank borrowing from external sources.

More targeted CFMs could also be deployed as the third line of defence to manage the risks associated with surges in capital flows. CFMs are generally designed to directly influence the magnitude and nature of capital flows and they can be categorized into two groups – measures that discriminate investors by residency and those that do not, but may discriminate by currency. The instruments that have been deployed thus far ranged from, amongst others, liberalizing for greater capital outflows, imposing withholding tax on capital inflows, to other administrative controls such as enforcing minimum holding period for holding certain type of assets. While it is not necessary for CFMs to be only considered as a last resort in managing capital flows, the most common scenario is for countries to exhaust all other alternatives before turning to CFMs given the well-known costs of implementing such measures (see Table 1 in Appendix II for the potential costs and benefits of some of these measures).

Figure 13: Proposed Framework of Capital Flow Management



Using a sample of 15 countries[14] that have implemented some form of PMs and CFMs and categorizing them according to the three lines of defence as discussed above, some useful observations can be extracted to gauge the types of measures that are preferred by these countries and the conditions under which the measures were implemented[15]. Table 2 (refer Appendix II) shows the PMs (second line of defence) implemented to mitigate the negative impact of capital flows and Table 3 (refer Appendix II) lists the CFMs (third line of defence) introduced by countries to directly influence capital flows. Below is the summary of key findings of this exercise.

First, in managing the risks associated with capital flows, policymakers seem to prefer to allow movements in capital flows but employ the second line of defence (PMs) to mitigate their negative impacts. This could be due to the fact that although there are risks associated with capital flows, they can help in developing a country's financial sector to become more competitive and sophisticated. Even if the risks do materialize, PMs are deemed sufficient to help contain the risks associated with these flows, namely the buildup of financial imbalances. The preference for PMs is apparent as 13 countries out of the sample of 15 have implemented these types of measures. The more frequently used tools are caps on Loan-to-

[14] Countries in the sample are Argentina, Brazil, Chile, China, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, South Africa, South Korea, Taiwan, Thailand, Turkey and Vietnam. These countries represent all EMEs that have implemented some of form of counter-measures post GFC

[15] It must be noted that countries' preferences are also reflections of the circumstances the countries were in

value (LTV) ratio, increase in reserve requirements, increasing or implementing countercyclical capital requirements, and caps on foreign or domestic currency lending.

Second, in cases where countries adopted the third line of defence, they generally opted for CFMs that do not discriminate investors by residency. One possible explanation for this is the higher costs associated with residency-discriminating measures given that these measures generally raise investor's perception of risk, which could potentially deter future investment. In our sample, 7 countries implemented non-discriminatory CFMs, while only 5 countries implemented residency-discriminatory CFMs. For the former, the more frequently used tools are reserve requirements on foreign currency or non-resident deposits and limits on exposure to FX derivatives. For the latter, we find that the policy tools fall under both price- or volume-based measures on capital flows.

Third, from the sample, it seems that countries that have less developed financial markets, but do attract capital because of its favorable macroeconomic conditions, are more likely to implement measures beyond the second line of defence (i.e. implement CFMs). This is not surprising as countries with less developed financial markets would generally see greater risk of financial imbalances arising from capital flows given their limited capacity to intermediate large capital flows. There are, however, cases where countries with relatively more sophisticated financial markets still implementing CFMs, perhaps due to excessive volume of flows flowing into the country. In our sample, countries that implement CFMs have an average financial development ranking of 43, which is lower than the whole sample's average ranking of 37. A higher ranking denotes a higher level of financial development[16].

In terms of policy instruments, there are two broad types of controls, either through market-based controls or administrative controls. Market-based (or price-based) controls aim to increase the cost of the targeted capital transactions as means to discourage further inflows. For example, measures such as unremunerated reserve requirement (URR) and taxes on capital inflows have been used by selected EMEs including Chile and Brazil. Both of the measures reduce the rate of return to investors on targeted financial transactions and can be applied on cross-border transactions. Furthermore, the tax rate and the URR can be differentiated to discourage certain types of capital inflows (i.e. portfolio vs FDI). Administrative controls (or non price-based) involve measures which restrict cross-border

[16] Level of financial development is defined by the WEF Financial Development Report as "factors, policies, and institutions that lead to effective financial intermediation and markets, as well as deep and broad access to capital and financial services". Measures of financial development are captured across the seven pillars of the index, including institutional environment, business environment, financial stability, banking financial services, non-banking financial services, financial markets, and financial access.

capital transactions through outright prohibitions or explicit quantitative limits. Examples of administrative measures include prohibition of sale of monetary instruments to non-residents as well as quantitative limits on trading and hedging activities of the financial institutions. These controls impose administrative obligations on the banking system and often involve significant documentation requirements. Enforcement of these controls normally resides with authorities with significant administrative authorities on foreign exchange (usually the central bank).

4.2 Assessment on impact of capital flow measures (CFM) – a case study on Brazil and South Korea

The various types of approaches by different central banks would suggest that there is no one size fits all approach. This section will focus on the experiences of Brazil and South Korea in implementing their respective CFMs and draw out the similarities and differences before measuring the impact of the policy announcements on the pace and direction of inflows.

4.2.1 Brazil's IOF

As shown in the previous section, Brazilian real was one of the most sought after currencies following the crisis driven by the significantly higher rate of return offered. Given this strong upward pressure on its currency, Brazil, on 19 October 2009, began introducing a series of CFMs aimed at reducing the attractiveness of the Brazilian real. The measure took the form of targeted tax on inflows, also known as the IOF. Table 3 lists the series of announcements by Brazil in managing the significant capital inflows.

Table 1: Brazil's CFM announcement dates and measures

Capital flows measures announcement dates	Pre-announcements (Hints)	Measures
19 Oct 2009 (market closed)	N/A	IOF tax of 2% on equities and bonds
4 Oct 2010	N/A	IOF tax increased to 4% on bonds and equity funds
18 Oct 2010 (market closed)	N/A	IOF tax increased to 6% on bonds and derivatives
6 Jan 2011	4 Jan 2011	Reserve requirement of 60% for USD positions
29 Mar 2011	N/A	Raised to 6% a tax on international bond sales and loans (abroad) of maturity up to 1 year (previously 5.38% and only 90 days)
6 Apr 2011	N/A	Tax on international bond sales and loans of maturity up to 2 years
27 Jul 2011	N/A	Tax of 1% (potentially up to 25%) on foreign exchange derivatives
1 Dec 2011	N/A	Removal of 2% IOF tax on equities and certain debentures
1 Mar 2012	29 Feb 2012	Tax on international bond sales and loans of maturity up to 3 years
12 Mar 2012	N/A	Tax on international bond sales and loans of maturity up to 5 years
14 Jun 2012	N/A	Tax on international bond sales and loans of maturity up to 2 years
5 Dec 2012	N/A	Tax on international bond sales and loans of maturity up to 1 year
31 Jan 2013	N/A	Removed 6% IOF tax on REITs to boost property market

Using the same event-study technique [17], the short-term impact of these announcements provides evidence that the announcements did have a significant impact on the Brazilian real and its financial markets (Figure 14). On average, the CFMs managed to exert downward pressure on the Brazilian real and the equity market (the Bovespa), which declined by 0.68% and 0.89% respectively following the policy announcements[18]. Of note, the performance of the Brazilian markets deviated considerably from the trend of other EMEs in the sample, which again point towards the role driven by the CFMs that attenuated the pressure on the Brazilian financial market. Figure 15 compares the impact of different types of measures on the financial market performance. It suggests some degree of differences that depends on the type of measures that are being implemented, although it should also be qualified that this assessment does not control for other factors during the announcement of these measures. Another important result to note here is that despite the apparent effectiveness of the measures in depreciating both the real and the Bovespa, the announcements had in fact amplified the volatility of these markets even more, a spill-over that is somewhat counter-intuitive given that most EMEs had intervened in the market with the intention of maintaining orderly adjustments in the financial markets.

[17] This time, however, a one-day window was used given that these announcements were made in the same time zone and hence there is no need to capture the effects on the day prior to the announcements. On a few of the announcements, pre-announcements or hints were already given prior to the actual announcement days and in these cases, the pre-announcement dates were chosen to estimate the impact of the respective measures.
[18] In this exercise, it is assumed that in the absence of major domestic developments, other external factors would generally have affected all the markets equally.

Figure 14: Impact of Brazil's CFMs on financial markets

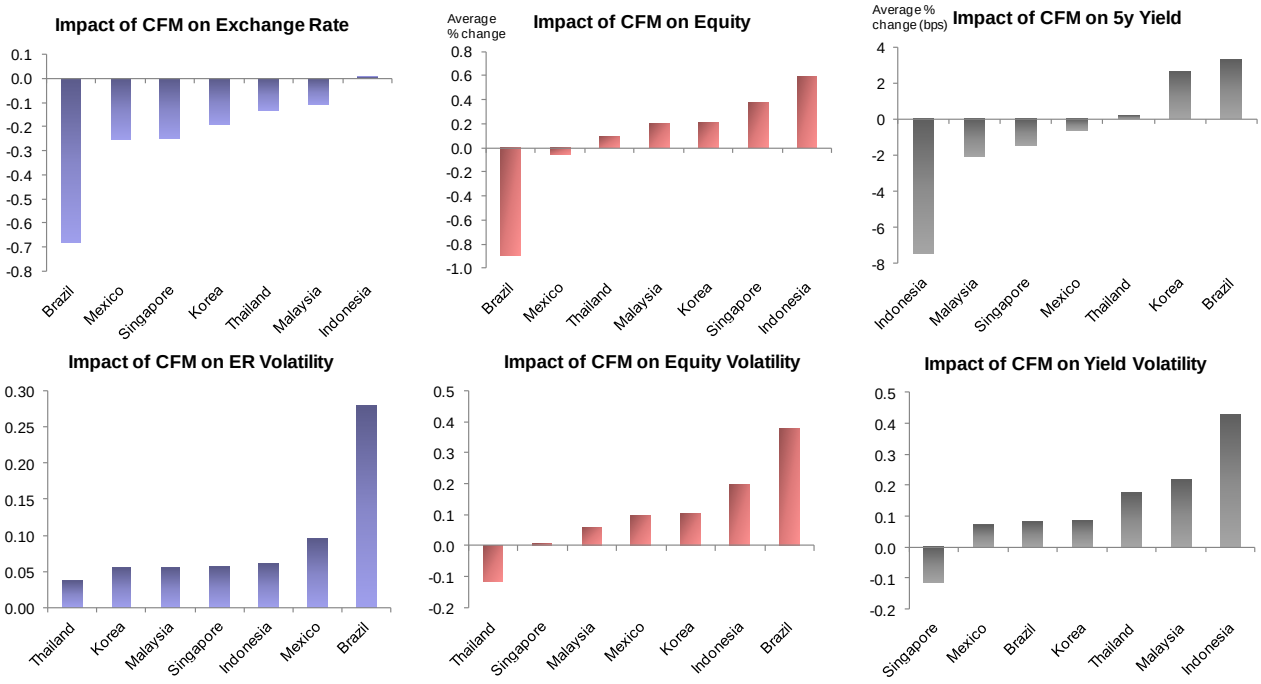
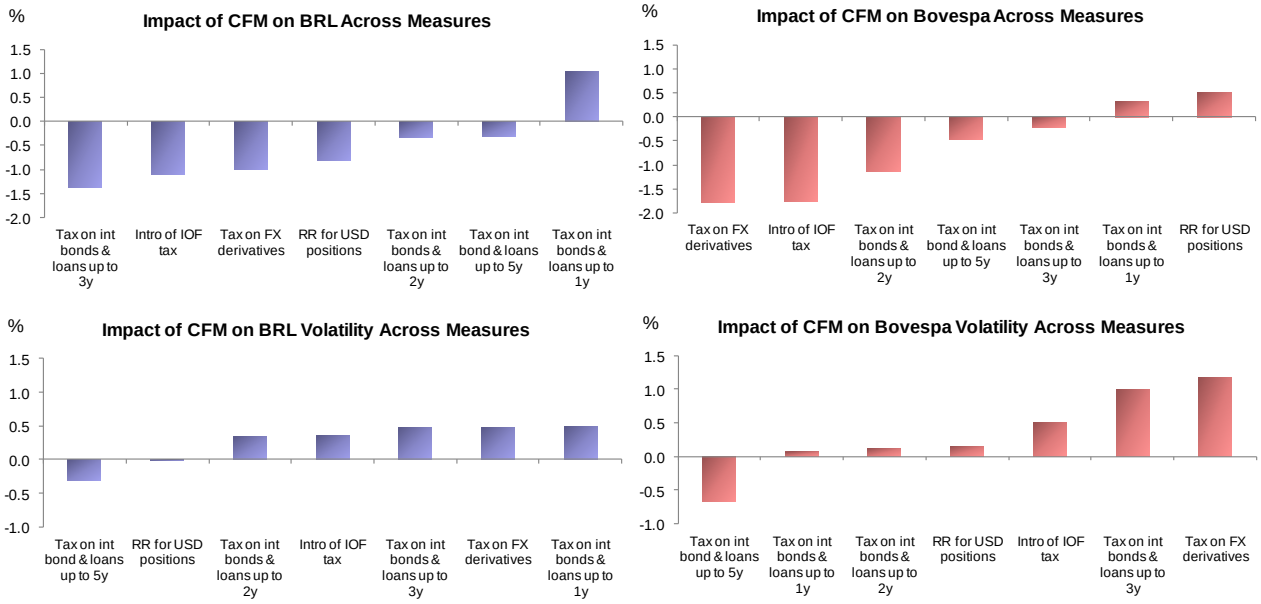


Figure 15: Impact of Brazil's CFMs on financial markets (across different measures)



4.2.2 South Korea

Similar to Brazil, the Korean authorities were also faced with a significant upward pressure on the won given the strong economic outlook and the higher rate of returns on Korean assets. At the same time, the authorities also faced concerns on the rising external exposure of the Korean corporate and banks, due to the availability of cheaper funding from abroad. Faced with these concerns, the authorities introduced a sequence of measures targeted at reducing the banks' external vulnerabilities while at the same time managing the impact on the rising won. Table 2 lists the series of CFMs announced by the South Korean authorities.

Table 2: South Korea's CFM announcement dates and measures

Capital flows measures announcement dates	Pre-announcements (first hints)	Measures
13 Jun 2010	**9 Jun 2010**	• Instituted a cap on banks' holdings of foreign-exchange derivative contracts (250% of equity capital for foreign bank branches and 50% for domestic banks) • Reduced the limit on currency forward transactions from 125% to 100% of the real transactions being hedged. • Tightened the existing regulations on the foreign currency liquidity ratio of domestic banks.
18 Nov 2010 (Legislation passed in Dec 2011)	**8 Nov 2010**	Reintroduced a 14% withholding tax on interest income and 20% capital-gains tax on Korean government bonds (KTBs) and monetary stabilization bonds (MSBs)
20 Dec 2010 (Legislation passed on 20 Apr 2011)	**15 Dec 2010**	Imposed a macro-prudential levy on banks' foreign exchange borrowings (non-deposit foreign-currency liabilities), strengthen punishment for inappropriate reporting of currency trades and may tighten rules on derivatives.
19 May 2011	N/A	Lowered the ceilings on FX derivatives from 50% to 40% for Korean domestic banks and from 250% to 200% for foreign bank branches
19 Jul 2011	**18 Jul 2011**	Banned financial firms from buying locally issued foreign-currency bonds (Kimchi bonds) for domestic use (i.e. issuer intends to swap the proceeds into Korean won)
7 Sep 2011	**6 Sep 2011**	Imposed 14% withholding tax on interest received by foreign investors in Kimchi bonds issued in South Korea

As can be seen in figure 16, the results of Korea's CFM are broadly in line with Brazil's experience. The measures were effective in pushing down the exchange rate and equity market in the short run but caused these markets to experience higher volatility post the announcements. On average, the CFMs managed to exert downward pressure on the Korean won and the equity market (the Kospi), which declined by 0.70% and 0.48% respectively following the policy announcements.

Figure 16: Impact of Korea's CFMs on financial markets

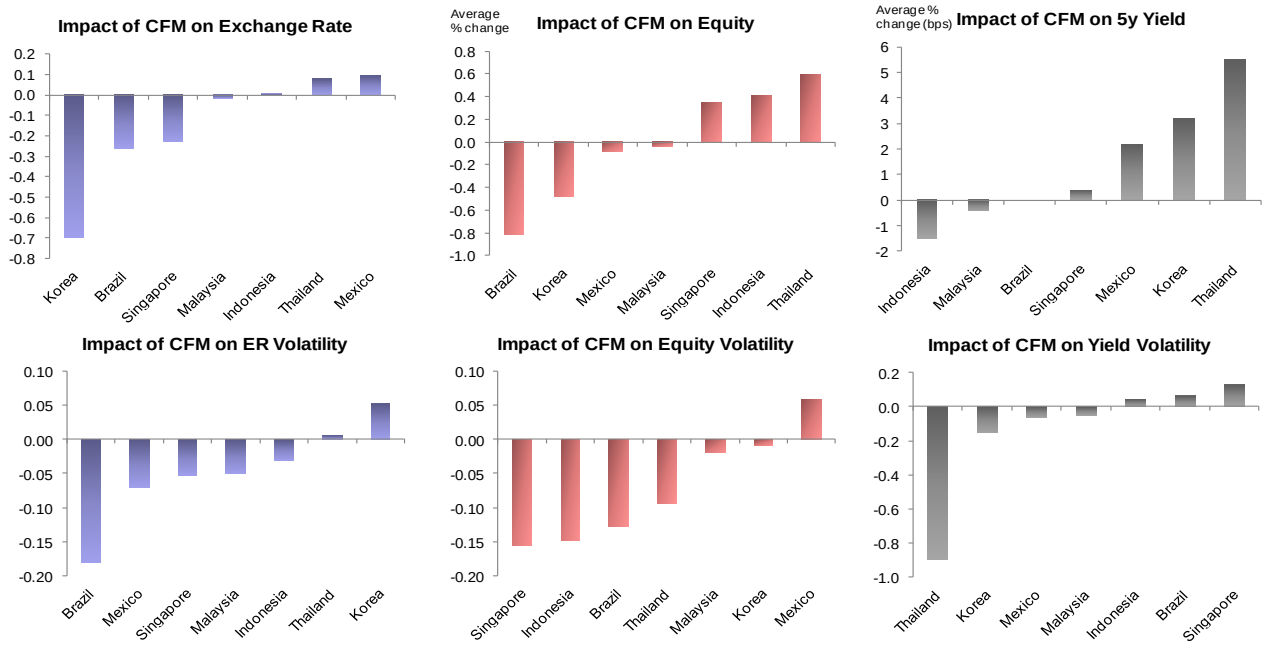
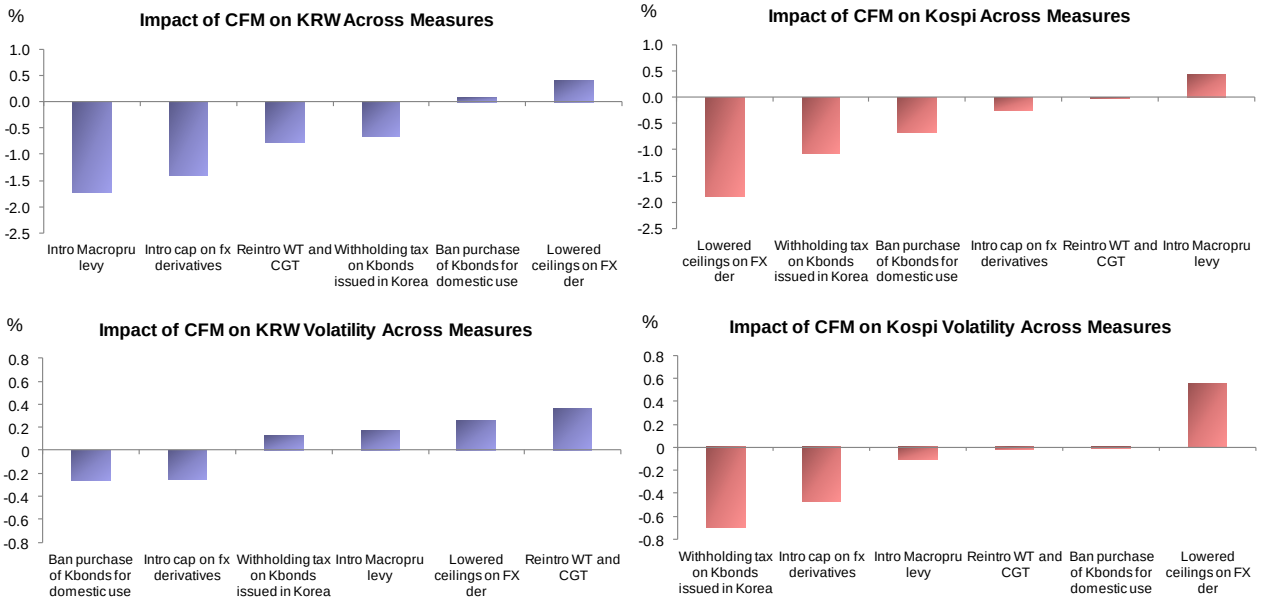


Figure 17: Impact of Korea's CFMs on financial markets (across difference measures)



5.0 Policy discussion and conclusion

The paper identifies two key observations that warrant greater attention for policy makers. First, the result shows that the Fed's QEs have had non-trivial impact on EMEs both in the short-term and medium-term. An important implication arising from this result is that, for EMEs that is highly open and strongly integrated to financial markets in the advanced economies, QE may have magnified the risks and magnitude of cross-border spillovers and thereby raised the complexity for policy makers to fulfill the mandate of macroeconomic and financial stability. An external shock could initiate sequence of reactions into domestic financial system and heighten the economy's exposure to boom-bust cycles. This is especially problematic if the EMEs' financial institutions and the private sector source their external financing using cheap short-term borrowing in foreign currency to fund domestic long-term investments, which exposes them to the risks of exchange rate and maturity mismatches[19]. Second, the prospect of an unwinding of the QE has increasingly gained policy makers attention, in which, as suggested by the result of this paper, could significantly affect EMEs that are financially open. The unwinding of liquidity injections is seen as a precursor to future interest rate increases, which would shift the risk-return tradeoff and this could trigger portfolio rebalancing towards advanced economies. The key question is therefore, whether the impact on EMEs will be as large as the inflows had. Asymmetric impact is plausible if a portion of inflows that EMEs are receiving now takes the form of structural inflows. In any case, EMEs will need to reinforce their line of defence against potential risks of sharp reversal that may ensue, while at the same time attracting more structural-type of inflows.

What can policy-makers in EMEs do to mitigate the risks of sharp and disorderly reversals from the eventual unwinding of QE? In addition to the standard practice of safeguarding financial stability by maintaining an appropriate monetary stance, monitoring growth of domestic credit, limiting exposures of firms and households to foreign currency debt and holding adequate amounts of foreign exchange reserves, policy-makers can seek to enhance the "pull" factors by enhancing their attractiveness to investors in order to mitigate the effect from the "push" factors when QE ends. The movement of portfolio flows to EMEs could potentially be structural instead of a cyclical phenomenon. FLS 2012FLS 2012 found that the effect of QE policies in foreign economies is related to risk and that countries with better institutions and more sound policies have been affected less by the Fed's policies.

[19] These were the key factors that contributed to the Asian Financial Crisis

Further financial market development is also important. In addition to improving the risk-adjusted returns of EME assets, deeper and more liquid markets ensure shocks are better absorbed and intermediated without disruptions. It is worth noting that despite having highly open financial markets, neither Hong Kong nor Singapore resorted to instituting capital account measures during the course of the QE.

Ensuring an orderly impact of the unwinding from a stimulus of such a scale would of course also be very much dependent on the manner which it is conducted. The IMF Spillover Report 2011 and a study by Fawley and Neely[20], which compares the spillovers from QE1 and QE2 offer some insights into this. The IMF report found that the near-term external impact from any given macroeconomic policy hinges on its effect on financial conditions. Even when comparing dollar-for-dollar, QE1 had a far more profound effect on the rest of the world than QE2[21] due to higher correlation in long-term yields when financial conditions are stressed and liquidity is tight. Fawley and Neely also claimed that QE1 announcements had a larger impact on financial markets than QE2 as QE2 was widely anticipated by the market compared to QE1. As such, it is important for the Fed to offer some form of forward guidance on the timing and magnitude of the exit to anchor market expectations and to ensure a gradual adjustment to the global financial markets.

The second part of the paper discusses the responses by EMEs to the consequent surges of capital flows from balance sheet expansion in the advanced economies. While the range of policy options in managing the challenges of capital flows vary across countries as circumstances dictate[22], the three lines of defence framework highlighted in this paper could serve as useful guiding principles. The fact remains that EMEs cannot – as much as they intend to – completely stop the flows from flowing into their countries, the policy challenge therefore lies in their ability to strengthen the appropriate defence mechanisms against the surge of capital inflows as well as the potential reversal. In choosing the right options, it is important to take into account the negative repercussions and costs of implementing PMs and CFMs, especially the ones that discriminate against foreign investors. The fact that only 5 out of a sample of 17 countries implemented discriminatory CFMs is an indication of the costs

[20] Federal Reserve Bank of St. Louis *Review*, January/February 2013, *95*(1), pp. 51-88

[21] Studies by Fawley and Neely (Federal Reserve Bank of St. Louis *Review*, January/February 2013, *95*(1), pp. 51-88) as well as Bayoumi and Bui (2011) came to the same conclusion, that QE1 had a larger impact on EMEs compared to QE2.

[22] The exact threshold that can be tolerated before these measures are instituted, or when authorities shift from looser to tighter form of controls, is a function of a host of considerations and would be country specific. Among others they include the intensity of the flows, ease and effectiveness of implementation of the measures, as well as socio-political considerations.

associated with such measures. The observation that most countries that had to resort to measures beyond the second line of defence are countries with lower level of financial market development (with the exception of South Korea) only heightens the risks of implementing CFMs.

In terms of the effectiveness of the CFMs implemented, the experience of Brazil and Korea would seem to suggest that the announcements of capital control measures had its desired effects in reducing exchange rate and asset price appreciation, at least in the very short-run. This, however, should be interpreted with some caution. Announcement effects do not necessarily translate to the actual impact of the counter-measures. In fact, most studies conducted on the effectiveness of capital controls in Brazil and Korea post-GFC suggest the exact opposite, that controls are largely ineffective in reducing the magnitude of inflows, but to some extent, they could alter the composition of inflows and lower exchange rate appreciation pressure. Also, the fact that both Brazil and Korea were announcing a series of measures, one after another, is a possible indication that the earlier measures may not have sufficiently lessened the tide of inflows, owing perhaps to too-high yield differentials or that investors had found ways of circumventing them altogether. Indeed, a survey of investment managers (Forbes et al, 2012) suggest that fund managers were more interested in the signal content of the capital account policy change rather than in the direct impact of the changes on their tax liability or profitability. Our results also suggest that there was actually a rise in volatility in the financial markets (exchange rate and equity markets) of both Brazil and South Korea – an unintended consequence which adds to the prevailing costs of implementing CFMs.

It is undeniable that despite the recent recognition of CFMs as part of the policy toolkit, the challenge remains on the assessment of its effectiveness. Given the potentially significant costs that may entail, why do countries still turn to it? We are of the opinion that there are some benefits to be had from it. First, it is able to alter the composition of inflows, thus enabling policy-makers to divert flows from asset classes that are more vulnerable to imbalances to other, less vulnerable segments. Second, it helps policy-makers preserve domestic monetary policy independence, as argued by Magud, Reinhart, and Rogoff (2011). Third, it acts as a form of signal to broadcast the intentions and concerns of the government, which may somewhat deter speculative investors from making one-way bets. Fourth, from our results, it does seem that announcements of CFMs do have an impact on financial markets, and can help to temporarily slow an alarming rate of exchange rate appreciation or the build-up of asset price bubbles.

Turning to the implementation of CFMs, one key difference between Brazil and South Korea is that the latter provided some form of "signaling" or "hints" before the official announcement of the measures (see table 1 and table 2). While the actual announcements of CFMs had the effect of reducing exchange rate and asset price appreciation in both countries, Brazil did experience higher volatility post-announcement compared to South Korea. This, to some extent, implies that transparent and gradual communication are key in order to mitigate the resulting side-effects in the form of market volatility.

Bibliography

Bauer, M.D., and G.D. Rudebusch. (2011) "The Signaling Channel for Federal Reserve Bond Purchases," Federal Reserve Bank of San Francisco Working Paper 2011-21.

Baumann, B and K. Gallagher (2012), "Navigating Capital Flows in Brazil and Chile," Initiative for Policy Dialogue Working Paper Series, Tufts University (June)

Bayoumi, T and, T. Bui (2011), "Unforeseen Events Wait Lurking: Estimating Policy Spillovers from U.S. to Foreign Asset Prices", IMF Working Paper 11/183

Chen, Q, A. Filardo, D. He and F. Zhu (2011), "International Spillovers of Central Bank Balance Sheet Policies", BIS Papers, Bank for International Settlements, number 66

Fawley, B and, C. Neely, "Four Stories of Quantitative Easing", Federal Reserve Bank of St. Louis Review, January/February 2013, 95(1), pp. 51-88

Forbes, Fratzscher, Kostka and Straub (2012), "Bubble Thy Neighbor: Direct and Spillover Effects of Capital Controls," NBER Working Paper no. 18052 (May)

Fratzscher, M, M. Lo Duca and R. Straub, "A Global Monetary Tsunami? On the Spillovers of US Quantitative Easing (October 2012)" CEPR Discussion Papers 9195

Gagnon, J., M., Raskin, J. Remache, and B. Sack, (2011) "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases," *International Journal of Central Banking*, *7*(1), 3-43.

International Monetary Fund, 2011, "Recent Experience in Managing Capital Flows – Cross Cutting Themes and Possible Policy Framework", IMF Policy Paper.

Joyce, M., A. Lasaosa, I. Stevens, and M. Tong. (2010) "Financial Market Impact of Quantitative Easing," Bank of England Working Paper 393.

Magud, N, C. Reinhart and K.Rogoff (2011), "Capital Controls: Myth and Reality - A Portfolio Balance Approach", NBER Working Paper No. 16805

Neely, C.J. (2012) "The Large-Scale Asset Purchases Had Large International Effects," Federal Reserve Bank of St. Louis Working Paper No. 2010-018C, revised April 2012.

Obstfeld, M, and A. Taylor (1998), "The Great Depression as a Watershed: International Capital Mobility over the Long Run" in ''The Defining Moment: The Great Depression and the American Economy in the Twentieth Century (1998), pp. 353-402, University of Chicago Press

Pesaran, M.H, T. Schuermann, S.M. Weiner (2001), "Modeling Regional Interdependencies using a Global Error-Correcting Macroeconometric Model", Journal of Business & Economic Statistics, Vol. 22, No. 2

Smith, L.V and A. Galesi (2011), GVAR Toolbox 1.1, www.cfap.jbs.cam.ac.uk/research/gvartoolbox/index.html

Appendix I

Table 1: Announcement dates associated with the Fed's monetary easing

	Dates of QE events	Fratzscher et al	Filardo et al	Gagnon et al	Neely	Wright	BNM
QE1	25 Nov 2008 (FOMC statement)	✔	✔	✔	✔	✔	✔
	1 Dec 2008 (Speech)	✔	✔	✔	✔	✔	
	16 Dec 2008 (FOMC statement)	✔	✔	✔	✔	✔	✔
	28 Jan 2009 (FOMC statement)	✔	✔	✔	✔	✔	
	18 Mar 2009 (FOMC statement)	✔	✔	✔	✔	✔	✔
	12 Aug 2009 (FOMC statement)	✔	✔	✔	✔	✔	
	23 Sep 2009 (FOMC statement)	✔	✔	✔	✔	✔	✔
	4 Nov 2009 (FOMC statement)	✔	✔	✔	✔	✔	✔
QE2	10 Aug 2010 (FOMC statement)	✔	✔			✔	
	27 Aug 2010 (Speech)	✔	✔			✔	✔
	21 Sep 2010 (FOMC statement)					✔	✔
	15 Oct 2010 (Speech)	✔	✔			✔	
	3 Nov 2010 (FOMC statement)	✔	✔			✔	✔
Twist	9 Aug 2011 (FOMC statement)					✔	
	26 Aug 2011 (Speech)					✔	
	21 Sep 2011 (FOMC statement)					✔	
QE3	20 Jun 2012 (FOMC statement)						
	31 Aug 2012 (Speech)						✔
	13 Sep 2012 (FOMC statement)						✔

Table 2: Reasons for omission of some announcement dates

	Dates of QE events	BNM	Reasons for omissions
QE1	25 Nov 2008	✔	
	1 Dec 2008		1) Only a clarification on the announcement on 25 Nov, 2) China, UK, and Russia manufacturing data fell to record low
	16 Dec 2008	✔	
	28 Jan 2009		News of potential easing crowded by 1) expectation of fiscal stimulus from the government, 2) Japan's retail sales had biggest drop in 4 years and 3) IMF forecasted growth to be lowest since World War II
	18 Mar 2009	✔	
	12 Aug 2009		Fed hinted at slowdown of purchases given that recession is slowing (not an easing announcement)
	23 Sep 2009	✔	
	4 Nov 2009	✔	
QE2	10 Aug 2010		News of potential easing offset by 1) Fed's assessment of slowing output and unemployment and 2) Singapore on the verge of entering technical recession
	27 Aug 2010	✔	
	21 Sep 2010	✔	
	15 Oct 2010		News of potential easing offset by significant risk aversion due to fear of capital controls by EMEs (Brazil raised IOF tax from 2% to 4%, Korea warned of currency volatility)
	3 Nov 2010	✔	
Twist	9 Aug 2011		News of potential easing offset by significant downside developments: - Escalation of European Sovereign Debt Crisis - Downgrade of US sovereign rating - Fed's warning of significant downside risks to the economy
	26 Aug 2011		
	21 Sep 2011		
QE3	20 Jun 2012		News of potential easing offset by significant risk aversion due to sharp jump in Spain's yield (above 7%) as Spain joined Greece, Ireland and Portugal to seek for bailout (on 21 June)
	31 Aug 2012	✔	
	13 Sep 2012	✔	

We did not measure the impact of all the announcements and omitted some dates selectively. The reason for omitting some of these announcement dates was mainly to ensure that the financial impact measured is a reflection of the pure announcement impact associated with monetary easing in the US, which allows for less ambiguity when discussing the impact of QE on EMEs. In this regard, announcement dates were omitted if they coincided with other significant announcements and events that could potentially crowd out or mask the clean impact of the monetary easing announcements. The final list of announcements did not occur concurrently with other macroeconomic news announcements and so it seems reasonable to assume that monetary easing by the Fed was the overwhelming driver of EMEs' financial markets during the chosen periods.

Appendix II

Table 3: Lines of defence – potential costs and benefits

Measures	Pros	Cons
1) Macroeconomic policy a. ER flexibility b. FX intervention c. Relaxing restriction on resident outflows d. Monetary or fiscal policy (lowering interest rates, reducing expenditure)	− Multilateral consistency − Ensures countries do not use controls as a substitute for needed policy adjustments − Not constrained by international obligations (e.g. FTAs, etc)	− Not targeted; policy could have negative repercussions (e.g. lowering interest rates creates inflation) − Requires adequate foreign reserves − FX intervention may be costly − Loss of policy independence
2) Prudential policy (micro-prudential and macro-prudential)	− More targeted at specific areas compared to macroeconomic policy − Better at dealing with financial-stability risks compared to macroeconomic policy − Able to reduce financial risks without affecting the volume of flows	− Ineffective against flows that bypass regulated markets and institutions − Effectiveness dependent on efficiency of financial sector supervision
3) Capital Flow Measures (CFM) a. Market or price-based (taxes, URR) b. Administrative controls (bans, quantitative limits on trading)	− Flexibility of design; can be broad or targeted − Allows for independent monetary and fiscal policy	− Potential distortions and negative spillovers to other countries − Effectiveness may be temporary as investors find ways to circumvent − Policies need to be specifically designed and tailored to different circumstances − May reduce "good" flows as well as the "bad"

Table 4: Second line of defence (PMs) against surges in capital flows

Preference	PMs	Specifics
1.	Cap on LTV ratio	• On housing loans **(CHN, INA, IND, MYS, TWN, THA, TUR)**
2.	Increase in Reserve Requirements	• Applied generally on most, if not all, types of domestic and foreign deposits **(ARG, BRA, INA, IND, MYS, PER, TUR)**
3.	Increasing or Implementing Countercyclical capital requirements	• Increase in capital requirements on new consumer credit operations (esp. personal credit, payroll-deducted loans and vehicles) **(BRA)** • Introduced a capital conservation buffer, a countercyclical buffer, and a systemic capital. Raised the minimum capital adequacy ratio to 11.5% from 8% for large banks (small banks: 10.5%) **(CHN)** • Introduction of capital surcharges for systemically important institutions, on top of Basel requirements **(SAF)**
4.	Caps on foreign or domestic currency lending	• 30% limit on short-term offshore borrowing of domestic banks **(INA)** • Ceiling on FX mortgage lending set at 50% of total mortgage lending **(POL)** • Limited credit to highly vulnerable sectors (mainly property credit, consumption credit, stock-related credit) **(VNM)**

Table 5 and 6: Third line of defence (CFMs) against surges in capital flows

Preference	Non-discriminatory CFMs	Specifics
1.	Reserve Requirement (RR) on FCY or NR deposits	• Unremunerated RR of 30% on short-term capital inflows for a year **(ARG)** • Unremunerated RR on domestic and FC deposits, FC liabilities with maturity less than 2 years **(PER)** • RRR on short-term FX deposits and other liabilities gradually increased **(TUR)**
	Limits on exposure to FX derivatives	• Ceiling on forward exchange position that can be held by resident and non-resident banks (ceiling set as a % of bank's equity capital) **(KOR)** • Holdings of onshore TWD derivatives (NDF & options) by domestic and foreign banks limited to 20% of total forex positions **(TWN)**
2.	Capital flows control through price or volume	• Limit on short-term offshore borrowing of the banks at 30% of capital **(INA)** •
	Levy on FCY Liabilities	• Macroprudential Stability Levy – Levy of up to 0.5% on financial institutions' non-deposit FCY liability balances **(KOR)**
	Restricted holding periods of investments	• Minimum holding period on Bank Indonesia bills **(INA)**
	Capital requirements for FX credit risk	• Higher capital requirement for banks to position foreign exchange forwards **(PHP)**

Preference	Discriminatory CFMs	Specifics
1.	Capital flows control through price or volume on non-residents only	• Tax on financial operations (IOF) for non-resident portfolio investment in equity and fixed income **(BRA)** • Fee on NR purchases of central bank paper, capital gains tax on NR investments in the stock market **(PER)** • Withholding tax on foreign purchases of treasury and money stabilization bonds **(KOR)** • Banned non-residents from placing funds in time deposits **(TWN)** • Withholding tax on capital gains and interest payments for government and state-owned company bonds earned by non-residents **(THA)**

Country abbreviations: Argentina (ARG), Brazil (BRA), Chile (CHL), China (CHN), India (IND), Indonesia (INA), Malaysia (MYS), Mexico (MEX), Peru (PER), Philippines (PHP), Poland (POL), South Africa (SAF), South Korea (KOR), Taiwan (TWN), Thailand (THL), Turkey (TUR), Vietnam (VNM)

Appendix III

Background on the GVAR model

We employ the use of a Global Vector Autoregressive model (GVAR) similar to the one in Dees, di Mauro, Pesaran and Smith (2007)[23], to estimate the medium-term impact of the US QE program on EMEs. A GVAR model combines individual country vector error-correcting models[24], in which domestic variables are related to country-specific foreign variables. The foreign variables are constructed from the domestic variables as to match the international linkages of the country under consideration, and serve as a proxy for common unobserved factors. This compact model of the world economy allows for interdependence across national and international factors in a transparent way that can be empirically evaluated, which provides a practical modeling framework for the quantitative analysis of the shocks emanating from QE in the US on EMEs.

[23] The GVAR model was first developed by Pesaran, Schuermann and Weiner (2004) and refined by the authors above. Special thanks to L.V Smith and A. Galesi for the use of their GVAR toolbox 1.1.

[24] In a normal unrestricted VAR(p) model encompassing k endogenous variables covering N countries, the number of unknown parameters to be estimated would be unfeasibly large. Hence, individual country models are estimated separately and then combined in a consistent and cohesive manner, enabling the GVAR model to be solved for the world as a whole

Estimation of the individual country models:

Consider a set of countries *i* = 0,1,2 . . . N. The equation for country *i* takes the form of a VARX (p,q) structure:

$$x_{it} = a_{i0} + a_{i1}t + \sum_{s=1}^{pi} \Phi_{is}\, x_{i,t-s} + \sum_{s=0}^{qi} \Lambda_{is}\, x^{*}_{i,t-s} + \varepsilon_{it}, \quad \varepsilon_{it} \sim i.i.d\,(0, \sum i\,) \tag{1}$$

where: x_{it} is a $k_i \times 1$ vector of domestic variables

$x*_{it}$ is a $l_i \times 1$ vector of foreign variables given by $x^{*}_{it} = \sum_{j=0}^{N} \omega_{ij} x_{jt}$ (2)

and ω_{ij} is a set of weights such that $\sum_{j=0}^{N} \omega_{ij} = 1$. The weight ω_{ij} for country *i* is constructed based on the share of flows obtained from country *j* to the total flows received by country *i*, and represents the linkages between country *i* and country *j*.

The country-specific foreign variables, x^{*}_{it} are treated as weakly exogenous (or "long-run forcing") in the model, i.e. the coefficients on the error correction terms are set to zero in the equations for foreign variables, which means that the dynamics of foreign variables are not influenced by deviations from the long-run equilibrium path, in contrast to the dynamics of domestic variables.

Each corresponding country model is estimated via reduced rank regression and OLS separately to obtain the individual country parameters

Solving the GVAR model:

Although estimation is done on a country-by-country basis, the GVAR model is solved for the world as a whole (in terms of a *k* x 1 global variable vector, $k = \sum_{i=0}^{N} k_i$), due to the contemporaneous dependence of the domestic variables x_{it} , on the foreign variables, x^{*}_{it}. The solution can then be used in deriving the impulse responses.

If $z_{it} = (x_{it} \quad x^{*}_{it})'$

Equation (1) can be rewritten as:

$$A_i z_{it} = a_{i0} + a_{i1}t + \sum_{s=1}^{pi} B_{is} z_{it-s} + \varepsilon_{it} \tag{3}$$

where $A_i = (I_{ki} \quad -\Lambda_{i0})$, $B_{is} = (\Phi_{is} \quad \Lambda_{is})$

From (2), we can obtain $z_{it} = W_i x_t$, where W_i is a $(k_i + l_i) \times k$ weighting matrix defined in terms of the country-specific weights ω_{ij}

Hence (3) becomes

$$A_i W_i x_t = a_{i0} + a_{i1}t + \sum_{s=1}^{pi} B_{is} W_i x_{t-s} + \varepsilon_{it}$$

and the individual country models are stacked together to provide the global model for x_t:

$$G_0 x_t = a_0 + a_1 t + \sum_{s=1}^{pi} G_s x_{t-s} + \varepsilon_t \quad (4)$$

where $a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \vdots \\ a_{N0} \end{pmatrix}$, $a_1 = \begin{pmatrix} a_{01} \\ a_{11} \\ \vdots \\ a_{N1} \end{pmatrix}$, $G_0 = \begin{pmatrix} A_{00}W_0 \\ A_{10}W_1 \\ \vdots \\ A_{N0}W_N \end{pmatrix}$, $G_s = \begin{pmatrix} A_{0s}W_0 \\ A_{1s}W_1 \\ \vdots \\ A_{Ns}W_N \end{pmatrix}$, $\varepsilon_t = \begin{pmatrix} \varepsilon_{0t} \\ \varepsilon_{1t} \\ \vdots \\ \varepsilon_{Nt} \end{pmatrix}$

Premultiplying (4) with G_0^{-1} we have

$$x_t = G_0^{-1} a_0 + G_0^{-1} a_1 t + \sum_{s=1}^{pi} G_0^{-1} G_s x_{t-s} + G_0^{-1} \varepsilon_t$$

which can be solved recursively to obtain future values of x_t and for deriving the impulse responses

GVAR model specification

In addition to the US, our sample consists of 11 emerging market countries, namely China, HK, Korea, Malaysia, Singapore, Indonesia, Philippines, Thailand, Brazil, Chile and Mexico Our estimation is based on monthly data from 2002-2012. Quarterly series are converted to monthly series using linear interpolation.

For each basic individual country models, the set of endogenous variables include: real GDP, inflation, bank credit, an exchange market pressure index, equity prices, house prices and a monetary policy indicator. The set of exogenous variables include foreign real GDP, foreign inflation, foreign equity prices and foreign monetary policy. Oil prices are treated as a global (and hence exogenous) variable for all the countries concerned save for the US. (see Table 1 for a listing of data and sources)

The VARX model is specified differently for individual countries to take into account the differences in country dynamics. For the US, we exclude foreign inflation, foreign equity prices and foreign monetary policy as given the size of the US economy; these variables are not expected to affect domestic US variables much. Instead of interest rates, US M2 growth is used as the indicator for monetary policy in the US as it is better able to capture the increase in liquidity from QE. Oil prices are also treated as endogenous in the US model. For Singapore, we exclude a variable for domestic monetary policy as the exchange rate (which comes in under the EMP) is already its policy tool. (see Table 2 for complete VARX model specification for individual countries)[25]

[25] Complete technical details on model specification such as VARX lag lengths, lag selection criteria, unit root tests, weak exogeneity tests, co-integrating relationships, persistence profiles, etc are available on request.

Table 7: Data, variables and sources

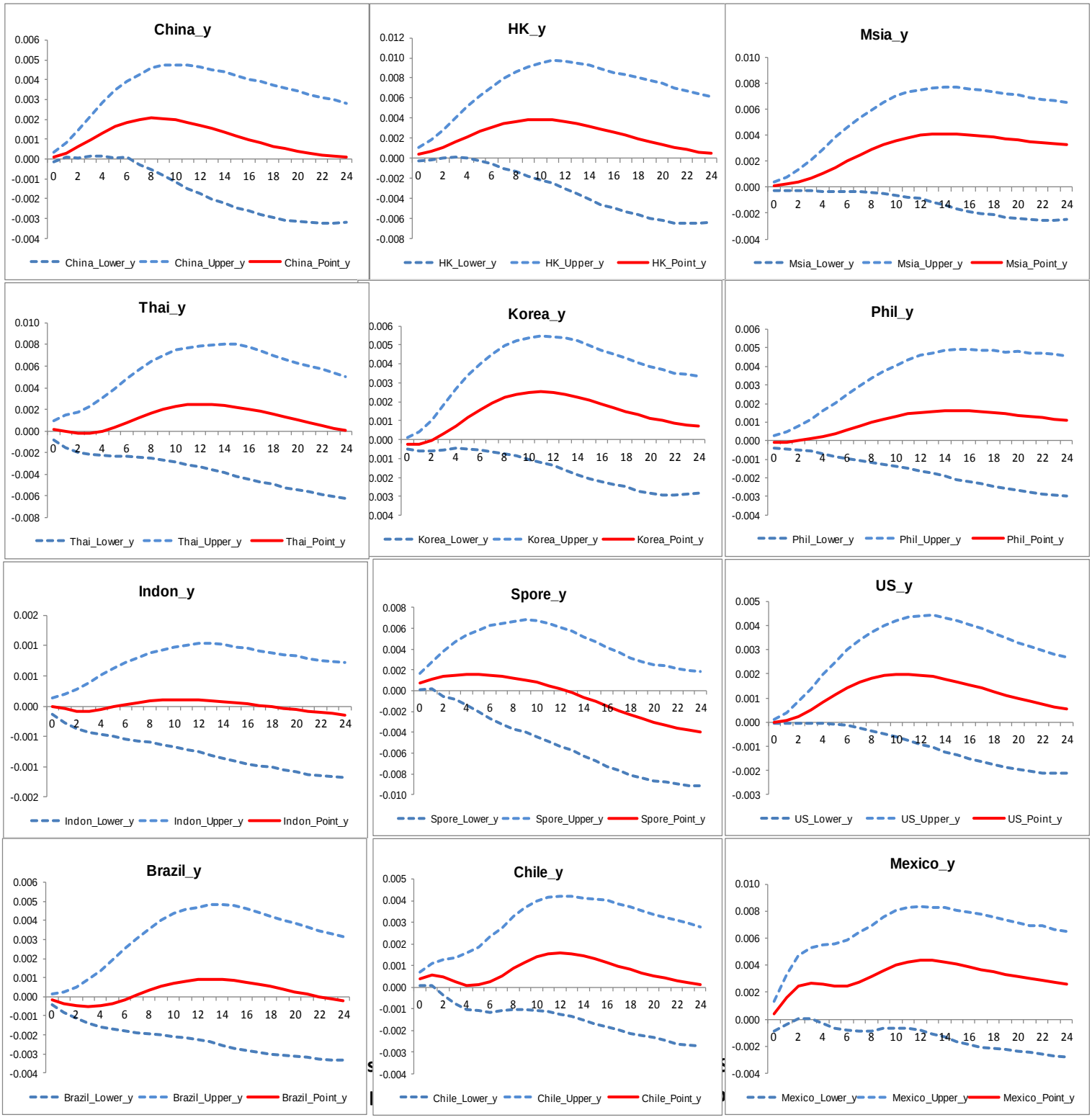
Variables for regression	Description	Source	Notes
Real GDP (y)	Natural logarithm of seasonally adjusted real GDP	Haver, Bloomberg	
Inflation (pi)	YoY change in CPI		
Exchange market pressure (EMP)	Weighted sum of change in reserves and exchange rate appreciation	Bloomberg	Calculated as per Eichengreen, Rose, Wyplosz (1994)
Equity prices (eq)	Natural logarithm of stock market index	Bloomberg	
House prices (hp)	Natural logarithm of national house prices	xx, BIS	
Credit (cr)	Natural logarithm of bank credit to private sector	Haver, BIS	
Monetary policy indicator (mp)	**US:** Annual growth in M2 **EM:** Continuously compounded monthly policy/3-month interbank rate	Bloomberg	
Oil prices (op)	Natural logarithm of the IMF oil price index	IMF	
Variables for constructing linkages	**Description**	**Source**	**Notes**
Cross-border flows	Share of total portfolio assets and liabilities held by a country	IMF CPIS	Used as weights in constructing the foreign variables and weight matrix for transmission of shocks
Regional weights	Share of PPP-adjusted real GDP	World Bank	Used in aggregating impact of shocks on a region

Table 8: Individual country VARX model specification
(non-inclusion of variable due to lack of data unless specified)

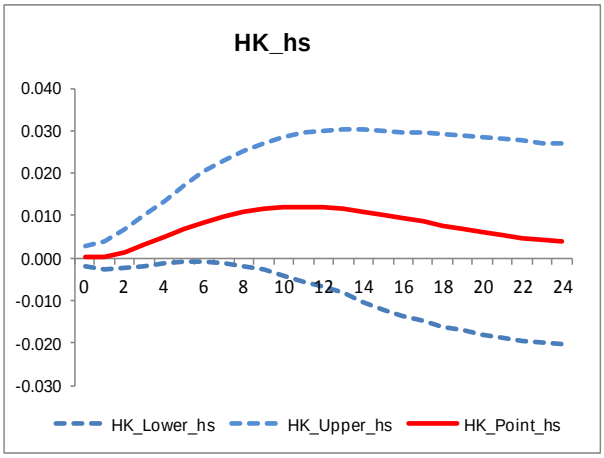
	Country	**Domestic variables**							**Foreign variables**					**Oil prices**
		y	pi	EMP	Eq	HP	Credit	MP	yf	pif	empf	eqf	mpf	
	US	✔	✔		✔	✔	✔	✔	✔		✔			Endogenous
East Asia	China	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	Exogenous
	HK	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	Exogenous
	Korea	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	Exogenous
ASEAN	Thailand	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	Exogenous
	Malaysia	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	Exogenous
	Singapore	✔	✔	✔	✔	✔	✔		✔	✔		✔	✔	Exogenous
	Philippines	✔	✔	✔	✔			✔	✔	✔		✔	✔	Exogenous
	Indonesia	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	Exogenous
LATAM	Brazil	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	Exogenous
	Chile	✔	✔	✔	✔			✔	✔	✔		✔	✔	Exogenous
	Mexico	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔	Exogenous

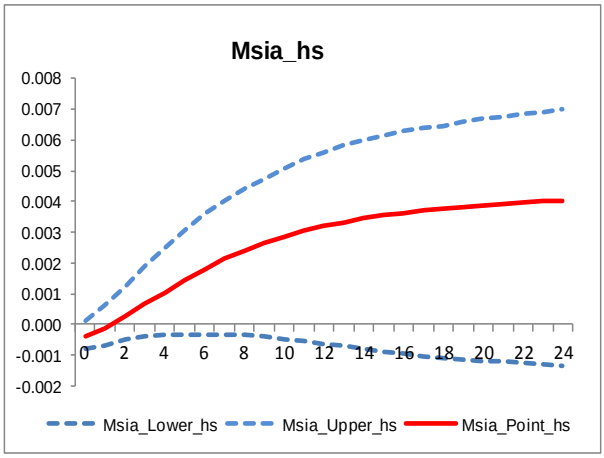
Charts: Individual country impulse response functions

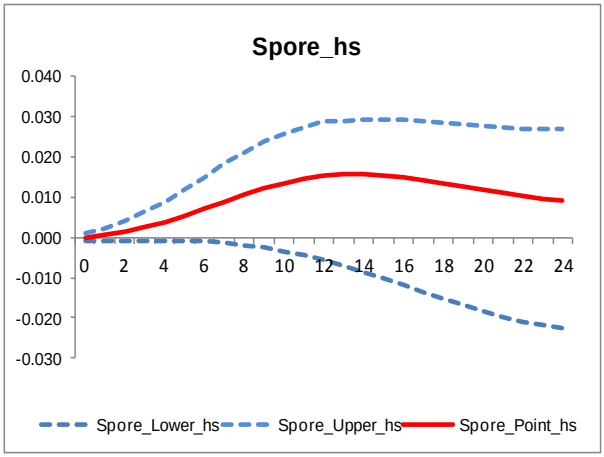
Generalised impulse response functions from a 1-std dev shock to US M2 growth on real GDP, with 90% bootstrapped error bands

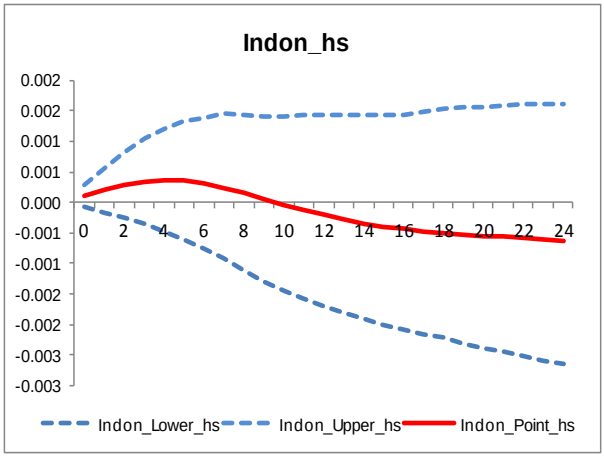


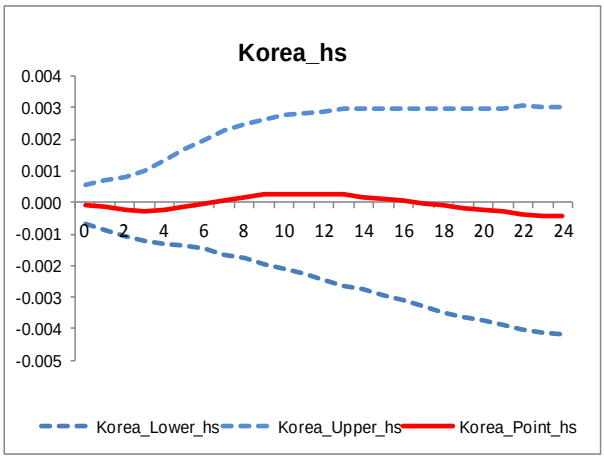
Generalised impulse response functions from a 1-std dev shock to US M2 growth on house prices, with 90% bootstrapped error bands

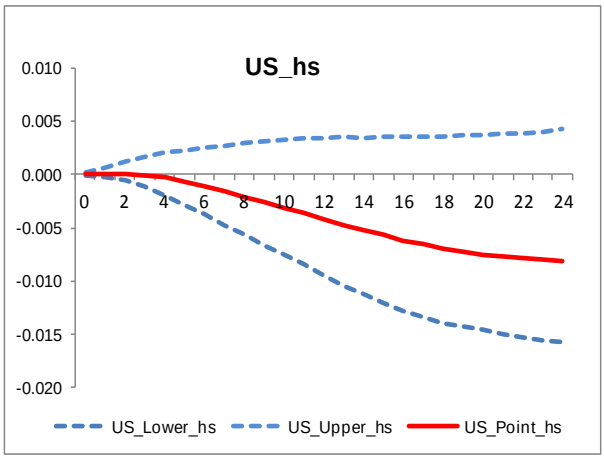




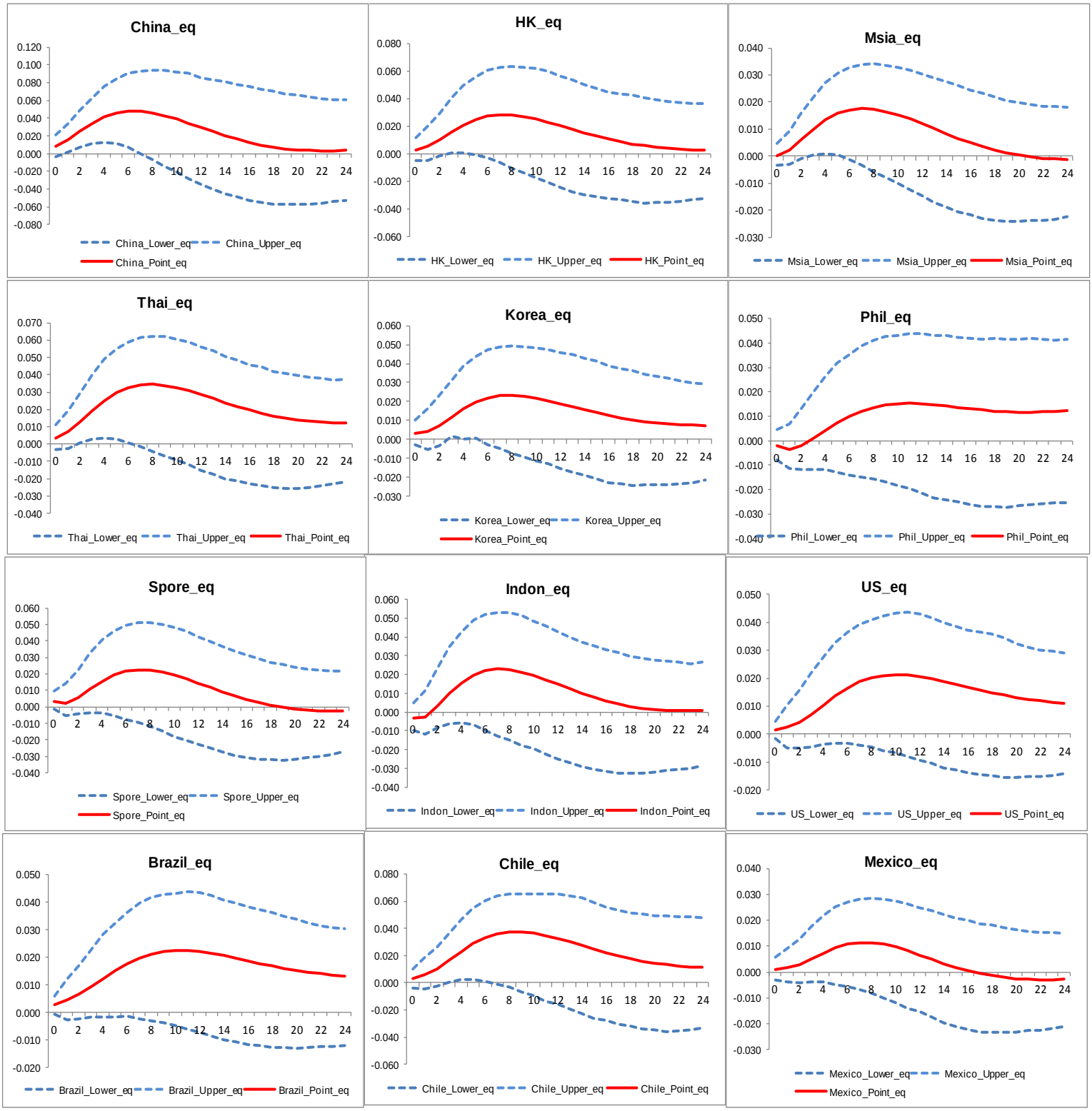




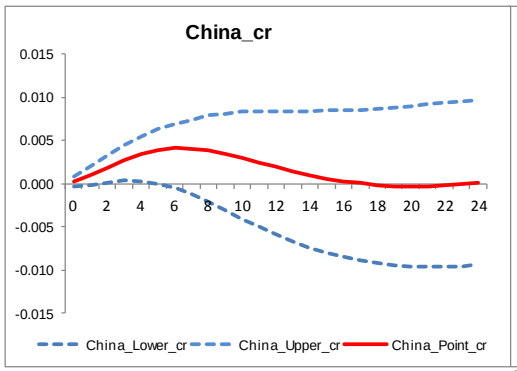


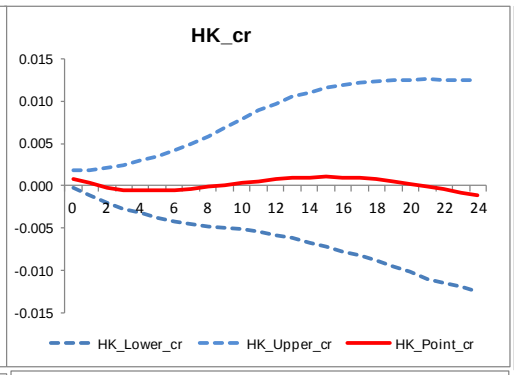


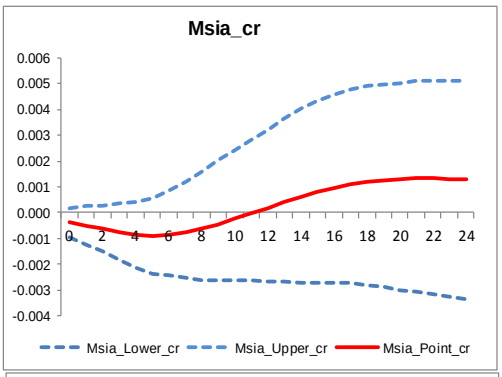
Generalised impulse response functions from a 1-std dev shock to US M2 growth on equity prices, with 90% bootstrapped error bands

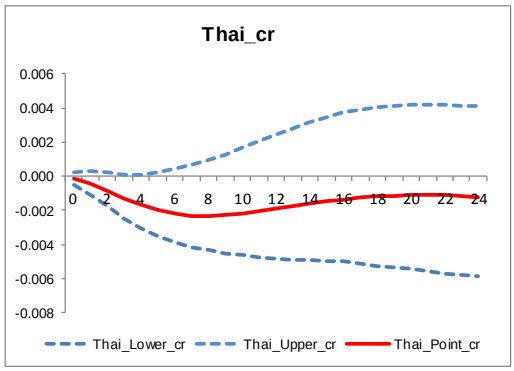


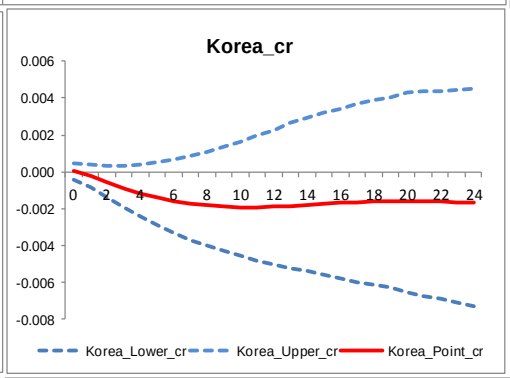
Generalised impulse response functions from a 1-std dev shock to US M2 growth on credit, with 90% bootstrapped error bands

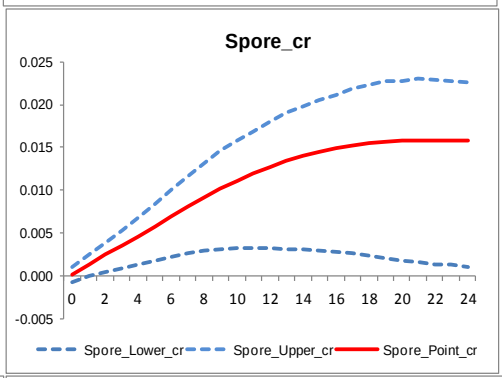


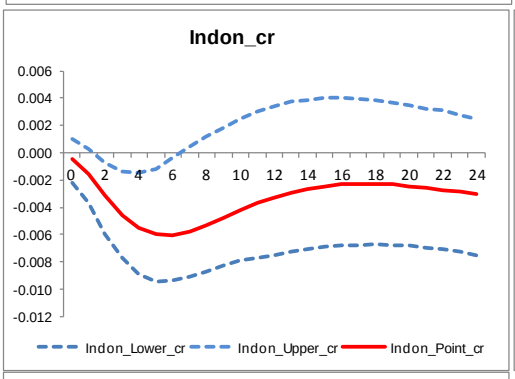


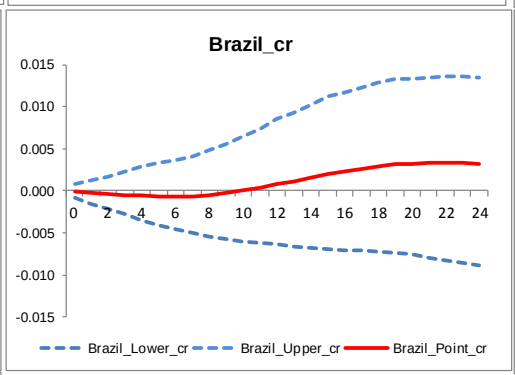


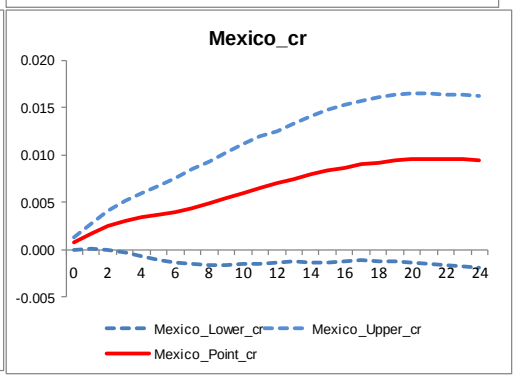


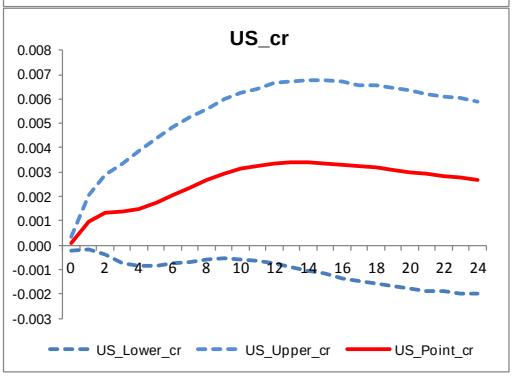




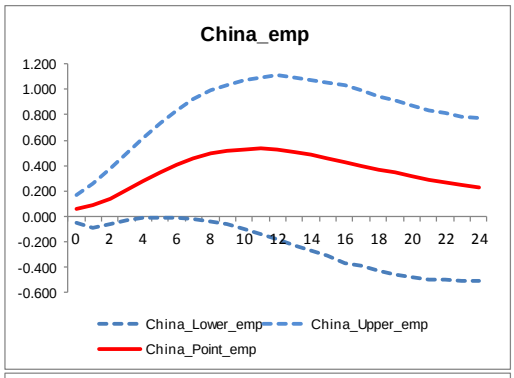


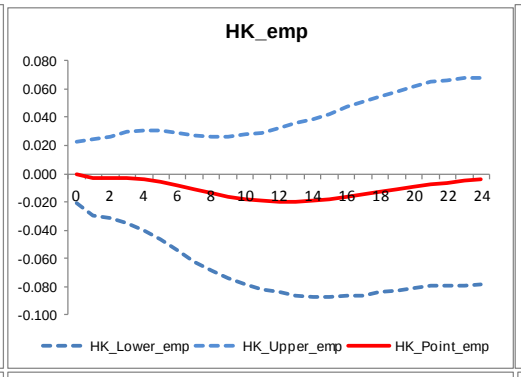


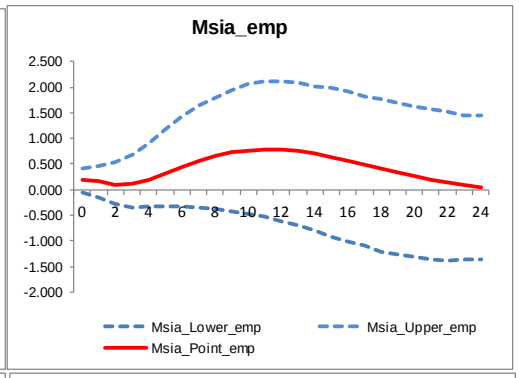


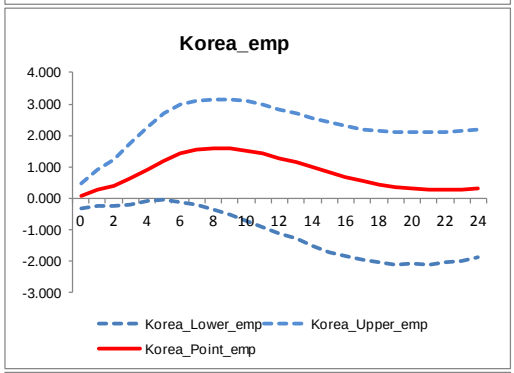


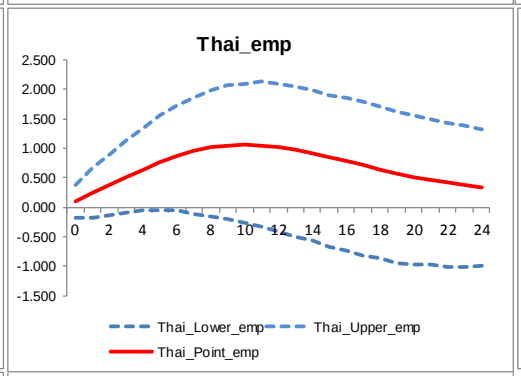
Generalised impulse response functions from a 1-std dev shock to US M2 growth on exchange market pressure, with 90% bootstrapped error bands

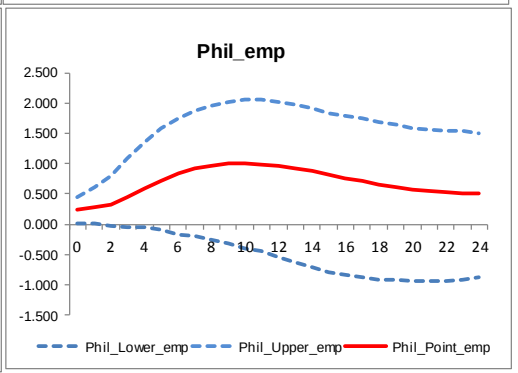


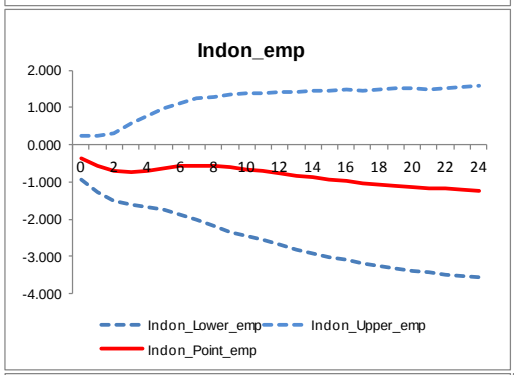


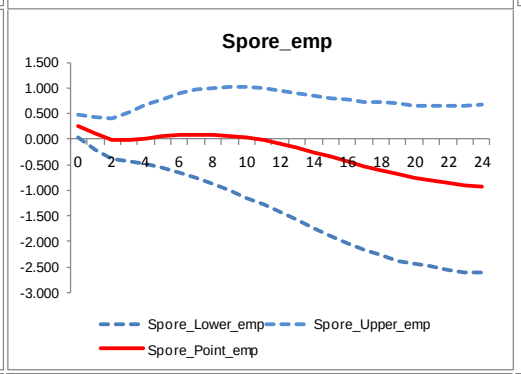


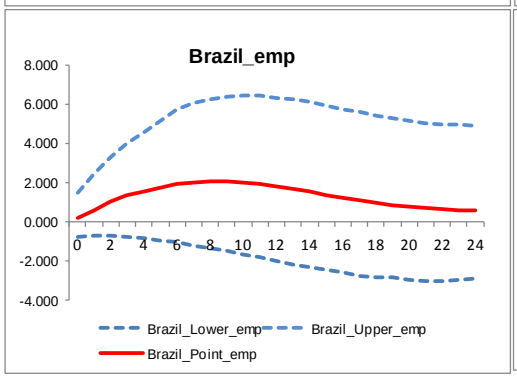


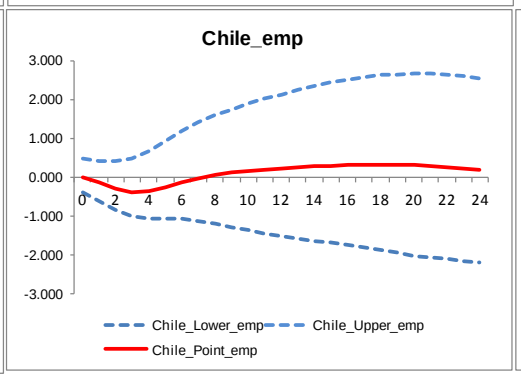


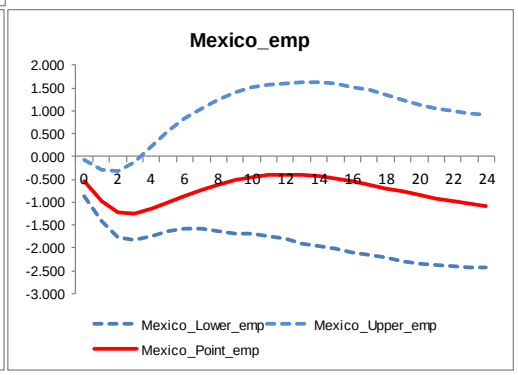












Generalised impulse response functions from a 1-std dev shock to US M2 growth on inflation, with 90% bootstrapped error bands