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Spillover effects of unconventional monetary policy in Asia and the Pacific

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ADB Working Paper Series

**SPILLOVER EFFECTS
OF UNCONVENTIONAL
MONETARY POLICY IN
ASIA AND THE PACIFIC**

Maria Teresa Punzi and
Pornpinun Chantapacdepong

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Abstract

We assess the evolution of spillover effects of unconventional monetary policies (UMPs) on Asia and the Pacific region, and evaluate the impact on and implications for the macroeconomy. We develop a Panel Vector Auto Regression model for Asia and the Pacific region for a period covering data from first quarter 2000 until first quarter 2015. We split the overall sample into two subsets: the Pre-Crisis (2000q1–2006q4) and Post-Crisis (2009q1–2015q1) samples. We identify UMP shocks with a shadow interest rate estimated by Krippner (2013).

We find that Asia and the Pacific region has responded to the advanced economies' actions with accommodative monetary policy. Such lower interest rates were coupled with currency appreciation, asset price inflation, and strong movements in capital flows. Foreign investors have shifted their preferences for bonds in Asia and the Pacific. If prior to the Global Financial Crisis (GFC), the "global saving glut" hypothesis (i.e., Asian savings flight to the US) was one of the major effects resulting in booming US house prices, it is clear that a reversal effect has dominated the economy after the GFC: funds flight to Asia and the Pacific region putting pressure on asset prices, leading to financial vulnerability.

JEL Classification: E44, E52, F41

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1. INTRODUCTION

Greater global trade and financial integration has created challenges for governments and monetary authorities worldwide. Policies (monetary policy, fiscal policy, quasi-fiscal policy) in one part of the world easily generate spillover effects in the rest of the world. The channels of transmission of shocks have increased and become more complicated. An economic slowdown in one country can have implications for another, not only through the trade channel, but also through the sentiment channel. The latter can have an impact on real economic activities as well as financial market activities. At the outset of the Global Financial Crisis (GFC), financial markets and monetary authorities were concerned about the external vulnerability of the advanced economies' financial assets, deleveraging, and a short-term US dollar squeeze following the subprime mortgage crisis in 2008. The European sovereign debt crisis in 2010 created further financial uncertainty and concerns about a major slowdown in global real economic activity. Over half a decade after the eruption of the crisis, the slow economic recovery and the monetary policies of the world's five largest systemic economies (the US, the European Union [EU], Japan, the UK, and the People's Republic of China [PRC]) create another challenge for policy makers. These five systemic economies have strong trade and financial linkages with Asia. The sources of several challenges the economies in Asia and the Pacific region are faced with are as follows.

A series of monetary policy easing in the advanced economies resulted in episodes of significant capital inflows and exchange rate appreciation, which complicated macroeconomic management and created pressures in asset markets. The intense pressure on currencies could result in an erosion of competitiveness that affects the real economy. The cheap external funding could also result in possible exposure to foreign-currency denominated debt on domestic balance sheets. In addition, some of these flows could fuel credit and asset price booms, amplifying financial fragilities. The above challenges and concerns triggered a variety of policy responses from Asia, both in the form of conventional measures (such as allowing exchange rate appreciation, reserve accumulation, changes to policy interest rates, and reserve requirements) and unconventional policy measures (such as macroprudential measures, capital flow management measures, and liberalization of capital outflows).

The vulnerability to sudden changes in market mood and the reliance on demand from the five systemic economies was another source of challenges for the economies in Asia and the Pacific. The "taper tantrum," i.e., the expectation that the Federal Reserve (Fed) would wind down its asset purchases in the summer of 2013, triggered financial market turmoil in the "fragile five" economies—Brazil, India, Indonesia, South Africa, and Turkey. These countries experienced large capital outflows and their credit default swap (CDS) spreads rose markedly. Several factors characterized the vulnerabilities of these countries, such as significant current account deficit problems, political uncertainty, and large shares of foreign holdings in the local bond and stock markets. Worries surrounding the fragile five created short-term financial stress for other economies in Asia and the Pacific region as well. In addition, global investment funds have become more selective, making their investments conditional on the economic fundamentals of each Asian economy. The expectation of an interest rate hike after the Federal Open Market Committee meeting and after the regular announcements of macroeconomic indicators, such as the unemployment rate, household spending, inflation expectation, job gains, etc., also resulted in exchange rate volatility. The low growth in advanced economies also translated into lower external demand, which had been a major growth engine of most Asian economies.

The neighborhood effect of the slowdown in growth of the PRC also had a significant negative impact on Asian exports and economic sentiment, which slowed economic activity. The slowdown in the PRC's growth not only had a big impact on trade, but also on commodity prices. This further suppressed export receipts of many Asian countries, which mainly export agricultural products, commodities, and crude oil.

Recently, as the global economy has shifted from crisis to recovery mode, **a changing global growth pattern** has created a new type of global spillovers. Asia and other emerging market economies (EMEs) are slowing in a synchronized manner. In contrast, the US economy has seen a gradual recovery with the Fed raising interest rates in December 2015 for the first time in nearly a decade. The Fed has not raised rates again since December and is not expected to do so in the short run. The monetary policy normalization in the US has profound implications for global financial conditions and capital flows. It could tighten conditions in the global financial market, as interest rates and yields rise with the improvement in the economic outlook. The current volatility in foreign exchange markets and capital flows stems from uncertainty regarding the timing and pace of further monetary policy tightening by the Fed. Meanwhile, recovery in the EU and Japan has remained slow, but has been strengthening. The Bank of Japan (BOJ) and the European Central Bank (ECB) signaled their willingness to extend monetary policy stimulus and, as a result, markets showed greater concerns about the unintended consequences of negative policy rates. The uneven recovery and monetary policy divergence in advanced economies creates significant uncertainty for developing Asia. The continued easing in the EU and Japan could cause large swings in exchange rates of major currencies, which could affect emerging economies with balance sheet vulnerability and high foreign exchange exposure. The impact this has on economies depends on the strength of their policy frameworks, such as current account balances, reserves, depth and development of their financial markets, etc. The implications for trade remain unclear. The economic recovery of advanced economies could translate into higher external demand, which would increase economic activity in Asia. It is hoped in future this could help to offset the negative impact from tighter financial conditions.

There has also been **growing concern about financial stability after the policy normalization of the advanced economies**. Corporate sectors in most emerging economies issued more external debt after the GFC. These debts are mostly denominated in US dollars, which could make the countries concerned more vulnerable to rollover risk, interest rate risk, and exchange rate risk. These countries can be vulnerable to US dollar appreciation as they have large amounts of US dollar-denominated debt and their income streams are mostly in local currency. The issue of debt could also be affected by a maturity mismatch—the corporate sector could be struggling to roll over foreign currency short-term debt funding, while relying on long-term funding revenue.

This paper assesses the evolution of spillover effects of the aforementioned channels, and attempts to predict the future impact on and implications for the macroeconomy. The countries of Asia and the Pacific region have responded to the advanced economies' actions with accommodative monetary policy. Such lower interest rates were coupled with currency appreciation, asset price inflation, and strong movements in capital flows. Foreign investors have shifted their preferences away from bonds in Asia and the Pacific. If prior to the GFC the "global saving glut" hypothesis (i.e., a flight of Asian savings to the US) had been a key factor behind the booming US house prices, it is clear that a reversal effect has dominated after the GFC: funds flight to Asia and the Pacific region has put pressure on asset prices, leading to financial vulnerability.

The paper is organized as follows: Section 2 provides a comprehensive literature review of previous studies related to international spillover effects of unconventional monetary policies (UMPs) in advanced economies. Section 3 describes the data and defines the transmission channels. Section 4 discusses the Panel Vector Auto Regression (VAR) technique used in the estimation. Section 5 presents the baseline results and Section 6 presents more extended results. Section 7 provides relevant policy implications and Section 8 concludes the paper.

2. RELATED LITERATURE

There is a vast literature documenting domestic and international spillover effects of UMPs.

Meaning and Zhu (2011; 2012) found that quantitative easing has lowered the 10-year Treasury yield by approximately 180 basis points. Chung et al. (2012) found that the Fed avoided a strong increase in the unemployment rate by increasing its balance sheet. Del Negro et al. (2011) and Chen, Curdia, and Ferrero (2012) obtained similar results to those of Chung et al. (2012) in the context of a dynamic stochastic general equilibrium model where the policy rate hits its zero lower bound. Baumeister and Benati (2013) identified UMP shocks by assuming that the Fed's policy actions led to a fall in long-term yields.

Gambacorta, Hofmann, and Peersman (2014) found that an increase in central banks' balance sheets led to an increase in output and prices in eight advanced economies during crisis periods. Fratzscher, Lo Duca, and Straub (2014) studied the impact of non-standard policy adopted by the ECB on asset prices and exchange rates in the eurozone and for the G20. They found that UMP actions adopted by the ECB affected financial markets across the eurozone.

Bowman, Londono, and Sapriza (2015) investigated US UMPs on emerging countries with a quasi-event study approach and found a particular impact on sovereign bond yields. Ahmed and Zlate (2013) studied the determinants of net private capital flows to EMEs and found that global risk appetite and growth and interest rate differentials are the main explanatory variables.

Dahlhaus and Vasishtha (2014) estimated the impact of a policy normalization shock in the US on portfolio flows in 23 emerging countries using a vector autoregressive model. They identified that UMP shock resulted in an increase in the US long-term bond yield, but they found only a small impact on capital flows. Lim, Mohapatra, and Stocker (2014) also estimated a VAR model of a relative status quo of no change in quantitative easing, and found a small impact on capital flows in emerging countries.

Miyajima, Mohanty, and Yetman (2014) estimated a Panel VAR and found US UMP spillovers to Asia through a low long-term bond yield and a low-term premium. Anaya, Hachula, and Offermanns (2015) estimated a global VAR and found that the Fed's increase in balance sheet assets led to an increase in US portfolio outflows and EME portfolio inflows. As a result, EMEs lowered their policy rate.

Finally, Chen et al. (2015a) estimated a global vector error-correcting macroeconometric model using Lombardi and Zhu's 2014 shadow rate and found that US UMPs have persistent effects on output growth, inflation, equity prices, and exchange rates. Using a similar model, Chen et al. (2015b) compared US and European UMPs and found that both regions experienced an effective impact, but US measures tended to affect the eurozone, whereas the opposite did not hold.

3. STYLIZED FACTS AND TRANSMISSION CHANNELS

Asian economies were affected by the GFC and the UMPs of advanced economies in several ways. The volatile capital flows created pressure on asset prices and foreign exchange rates, and complicated monetary policy and macroeconomic management. They also created more uncertainty in financial market conditions and real economic activities. The transmissions, listed below, are not mutually exclusive since some channels can occur simultaneously. We summarize below the most important channels and suggest possible indicators for those channels.

3.1 Portfolio Rebalancing Channel

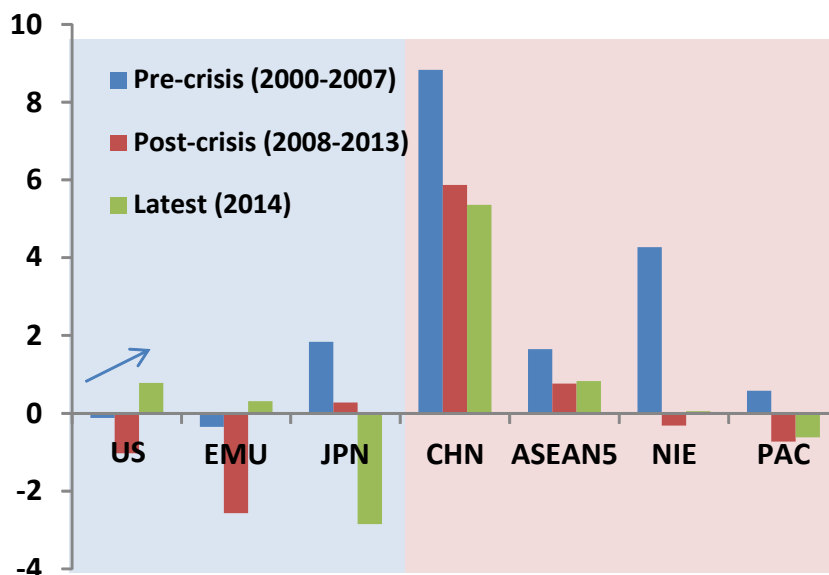
UMPs in advanced economies after the GFC created volatility in international capital flows, which were driven not only by cyclical factors but also by structural factors. A cyclical widening of differentials between advanced economies and economies in Asia and the Pacific region, both in terms of nominal yields and real growth rates, led to capital inflows; for example, advanced economies, faced with weak growth prospects and high unemployment, have maintained low interest rates and accommodative liquidity conditions, whereas many EMEs have had to raise interest rates to curb rising inflationary pressures. Interestingly, structural factors themselves play an increasingly important role as the inflows have been due to a fundamentals-based rebalancing of institutional portfolios toward EME assets. Investor perceptions of the risks associated with EME assets have abated, and EMEs were resistant to the GFC, thanks to better external and fiscal fundamentals than many advanced economies. This has been reflected in a positive trend in EME sovereign ratings, reinforcing the attractiveness of these markets for foreign investors. Figure 1 shows that during the pre-crisis period of 2000–2007, and the post-crisis period of 2008–2013, real economic growth in Asia, especially in the PRC and the Association of Southeast Asian Nations (ASEAN)⁵—Indonesia, Malaysia, the Philippines, Singapore, and Thailand—was quite high, whereas advanced economies like the US and those of the EU saw negative economic growth. This is in line with the increasing 10-year sovereign bond spreads of ASEAN over the US depicted in Figure 2, which reflects higher relative returns on holding Asian financial assets. Short-term policy interest rates in Asia (see Figure 3) also remained high until March 2015. Even though central banks reduced policy interest rates right after the GFC to ease the monetary conditions that had arisen due to global deleveraging and in the expectation of a slowdown in global economic activities in the medium term, policy rates were raised to curb overheating economic activities. Figure 4 shows that during 2000–2007, the external fundamentals of the Asian economies were very strong, as their current accounts had improved drastically. The global liquidity and portfolio rebalancing played a major role in the capital inflows into Asia and the Pacific region. Capital inflows increased at a high rate and were mainly made up of portfolio flows (see Figures 5 and 6). Capital moved into the Asian economies regardless of the different economic fundamentals and cyclical positions within Asia. Banking flows remained slow in this period.

The sustained global economic slowdown during 2008–2013 resulted in weakened external positions of the EMEs and the current accounts of Asian economies deteriorated. The monetary policies of many Asian economies became more accommodative and policy rates were reduced to help stimulate economic activity.

But with signs of a US economic recovery and the taper tantrum in May 2013, international investors became more sensitive to economic conditions in Asia; hence, portfolio flows slowed and became more selective. Indonesia and India suffered large

capital outflows due to their large current account deficits and fiscal deficits. The relative return on investment in EME assets also became narrower after the US recovery; the 10-year sovereign bond spreads over the US (see Figure 2) declined.

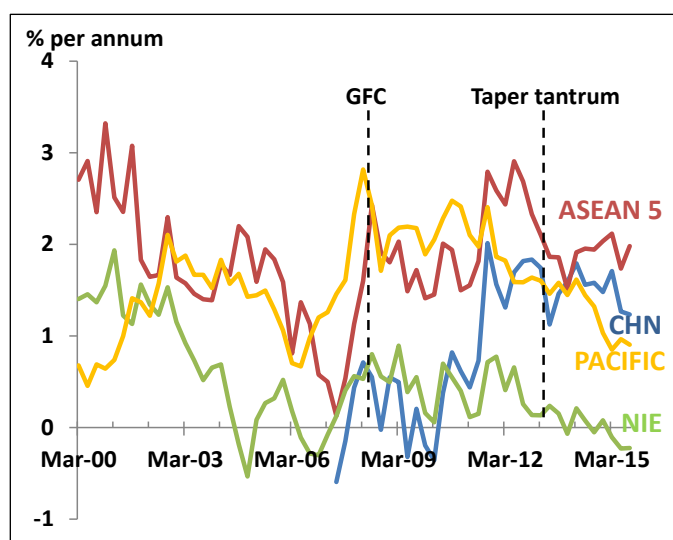
Figure 1: Real GDP Growth Rate
(annual %)



GDP = gross domestic product; US = United States; EMU = European Monetary Union; JPN = Japan; CHN = PRC; ASEAN5 = Indonesia, Malaysia, the Philippines, Singapore, and Thailand; NIE = newly industrialized economies of Asia (Hong Kong, China; and the Republic of Korea); PAC = Pacific countries (Australia and New Zealand).

Source: Author's calculation from the World Bank's World Development Indicators.

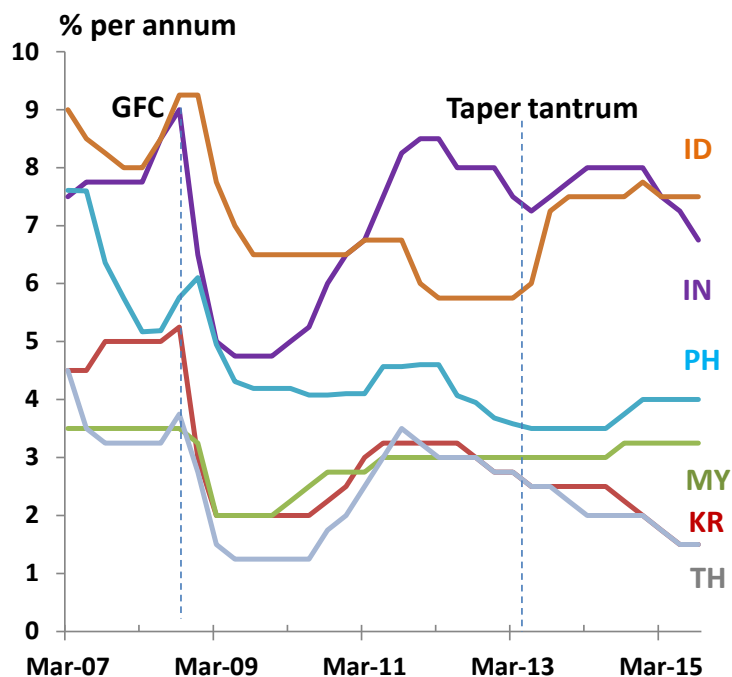
Figure 2: Ten-year Sovereign Bond Spreads over the US
(%)



US = United States; GFC = Global Financial Crisis; ASEAN5 = Indonesia, Malaysia, the Philippines, Singapore, and Thailand; CHN = PRC; PACIFIC = Pacific countries (Australia and New Zealand); NIE = newly industrialized economies of Asia (Hong Kong, China; and the Republic of Korea).

Source: Author's calculation from the World Bank's World Development Indicators.

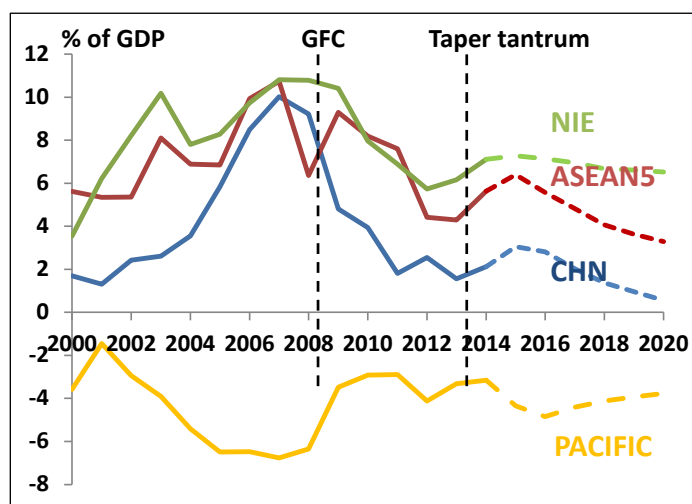
Figure 3: Policy Interest Rates
(%)



GFC = Global Financial Crisis; ID = Indonesia; IN = India; PH = Philippines; MY = Malaysia; KR = Republic of Korea; TH = Thailand.

Source: CEIC data and national central banks.

Figure 4: Current Account Balance
(% of GDP)

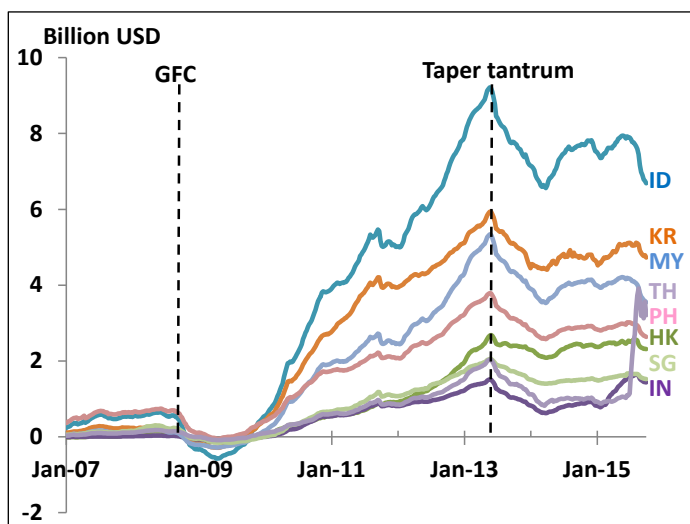


GDP = gross domestic product; GFC = Global Financial Crisis; NIE = newly industrialized economies of Asia (Hong Kong, China; and the Republic of Korea); ASEAN5 = Indonesia, Malaysia, the Philippines, Singapore, and Thailand; CHN = PRC; PACIFIC = Pacific countries (Australia and New Zealand).

Note: Figures after 2014 are the International Monetary Fund (IMF) forecast.

Source: World Economic Outlook, IMF.

Figure 5: Net Bond Flows

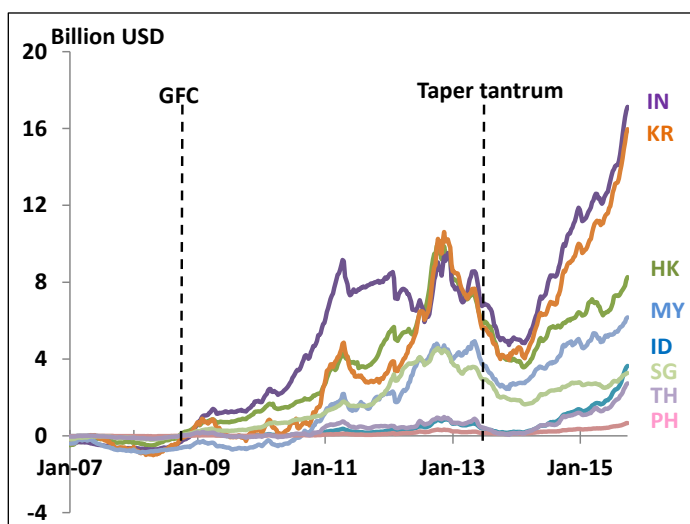


USD = US dollars; GFC = Global Financial Crisis; ID = Indonesia; KR = Republic of Korea; MY = Malaysia; TH = Thailand; PH = Philippines; HK = Hong Kong, China; SG = Singapore; IN = India.

Note: Figure is the cumulative net flows from September 2005.

Source: EPFR Global Database.

Figure 6: Net Equity Flows



USD = US dollars; GFC = Global Financial Crisis; IN = India; KR = Republic of Korea; HK = Hong Kong, China; MY = Malaysia; ID = Indonesia; SG = Singapore; TH = Thailand; PH = Philippines.

Note: Figure is cumulative net flows since September 2005.

Source: EPFR Global Database.

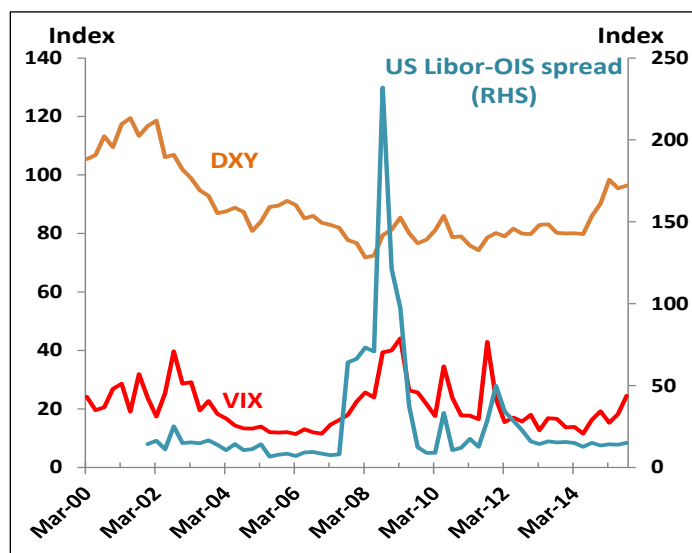
Candidates for identifying the portfolio balance are the yield curve (the difference between the long-term interest rate and short-term policy rates), risk premium, gross domestic product (GDP) growth, inflation, expectations of future short-term rates, exchange rates, and external fundamentals. All those variables capture the effect generated by quantitative policies in lowering long-term yields, and hence temporal rebalancing toward higher-risk assets in Asia and the Pacific region.

3.2 Liquidity and Confidence Channels

For the confidence channel, quantitative easing and forward guidance signal the intention of the Fed to maintain zero lower bound policy interest rates and keep the long-term interest rate low. The US long-term yield thus declined. This generated interest rate differentials relative to EMEs and global investors consequently searched for higher yields in Asian assets. This helped to improve liquidity conditions in Asia. The variables that can explain the confidence channels are the short-term interest rate, the VIX Index,¹ and the Citigroup Economic Surprise Index.

For the liquidity channel, quantitative easing increases reserves on the balance sheets of private banks, which decreases the liquidity premium. As a consequence, there will be a decline in borrowing costs and an increase in overall bank lending, including lending to developing countries. This may make domestic non-financial corporations in Asia a type of financial intermediary. They can issue debt in international markets to earn a spread by depositing the proceeds in the banking system. This would result in an increase of private external debt in emerging Asia. Indicators for this channel are the short-term interest rate, which measures the reduction in liquidity premium; the money supply (M2) of advanced economies, which quantifies available liquidity; and the US London Interbank Offered Rate (LIBOR)–Overnight Indexed Swap (OIS) spread, which is a price measure of the global liquidity condition.

Figure 7: US Dollar Value, US Dollar Liquidity Condition, and Global Risk Sentiment



US = United States; Libor = London Interbank Offered Rate; OIS = Overnight Indexed Swap; RHS = right-hand side; DXY = Dollar Index.

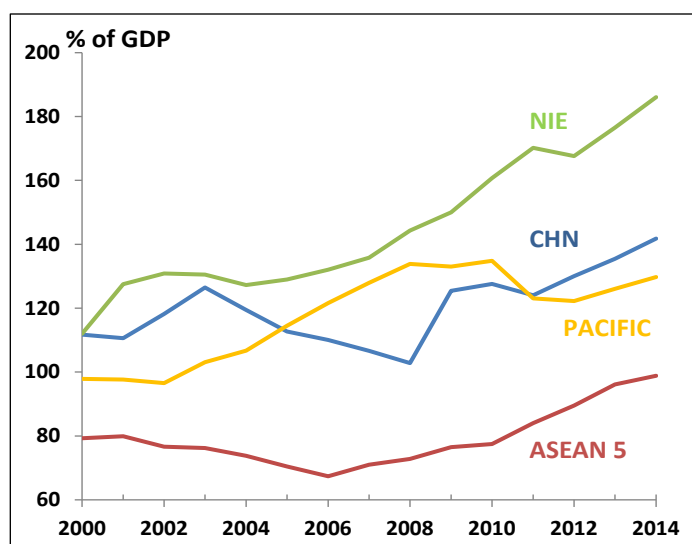
Source: Bloomberg.

¹ VIX is a trademarked ticker symbol for the Chicago Board Options Exchange Volatility Index, a popular measure of the implied volatility of Standard & Poor’s 500 index options. Recent studies have shown that a surge in capital flows is associated with a lower VIX (see Forbes and Warnock [2012]) and Bruno and Shin (2014). In particular, Rey (2015) showed that low values of the VIX during boom periods are associated with higher capital inflows and outflows, more credit creation, more leverage, and higher asset price inflation.

3.3 Financial Accelerator Channel

This channel means that the wealth gains from temporary reductions in the domestic currency value of foreign currency debt can boost demand for credit and the credit worthiness of borrowers, which encourages banks to expand credit. An accommodative monetary policy in the US resulted in higher US dollar liquidity and a weakening of the US dollar against local currency. Households and corporate sectors that accumulate debt denominated in foreign currency can gain from currency appreciation. This leads to increasing demand for credit. The variable that explains this channel is the dollar index and private credit growth. Figure 8 shows that domestic credit growth accelerated after the GFC, especially in the ASEAN5 and the newly industrialized economies of Asia (Hong Kong, China; and the Republic of Korea).

Figure 8: Domestic Credit to the Private Sector (% of GDP)



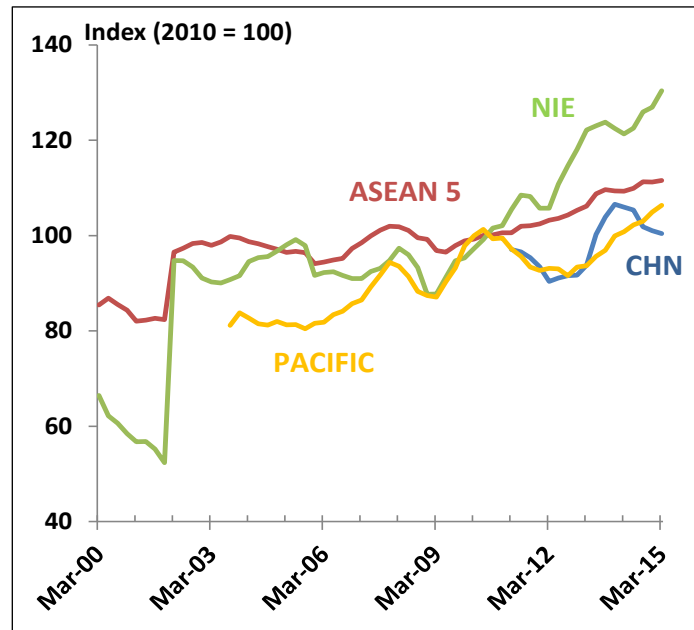
GDP = gross domestic product; NIE = newly industrialized economies of Asia (Hong Kong, China; and the Republic of Korea); CHN = PRC; PACIFIC = Pacific countries (Australia and New Zealand); ASEAN5 = Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

Source: The World Bank’s World Development Indicators.

3.4 Asset Price Channel

The easing of monetary policy in advanced economies acted as a push factor for capital flows into Asian financial markets. When investors have a “risk on” sentiment (i.e., investors are willing to purchase risky assets, as indicated by a low VIX index), they tend to invest more in the Asian bond and equity market, which poses a challenge to financial stability. Capital inflows are associated with booming house prices in the case of Hong Kong, China; and Singapore, which do not have monetary policy autonomy. Variables that explain the asset price channel are equity prices, house prices, and the Morgan Stanley Capital International–Emerging Markets Index.

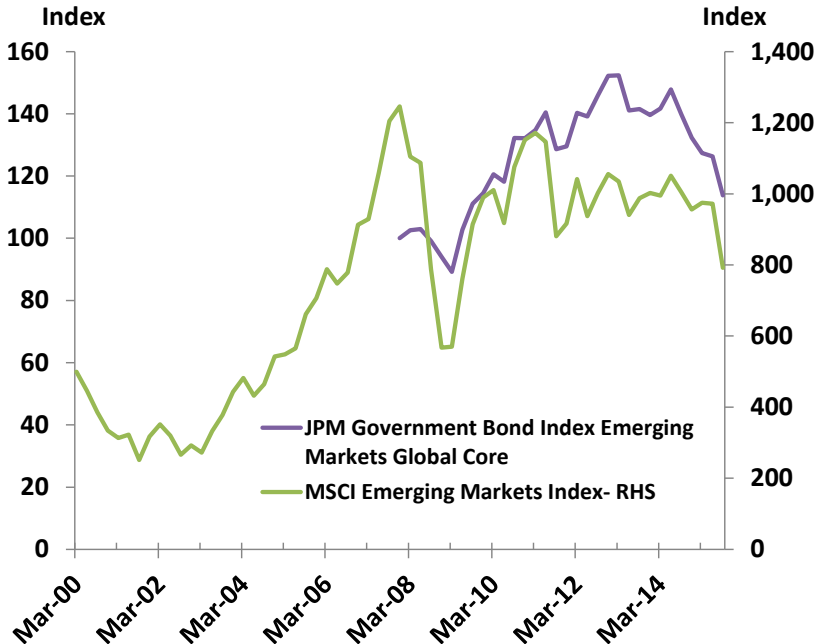
Figure 9: Residential Real Property Prices



NIE = newly industrialized economies of Asia (Hong Kong, China; and the Republic of Korea); ASEAN5 = Indonesia, Malaysia, the Philippines, Singapore, and Thailand; CHN = PRC; PACIFIC = Pacific countries (Australia and New Zealand).

Source: Bank for International Settlements.

Figure 10: Bond and Equity Prices



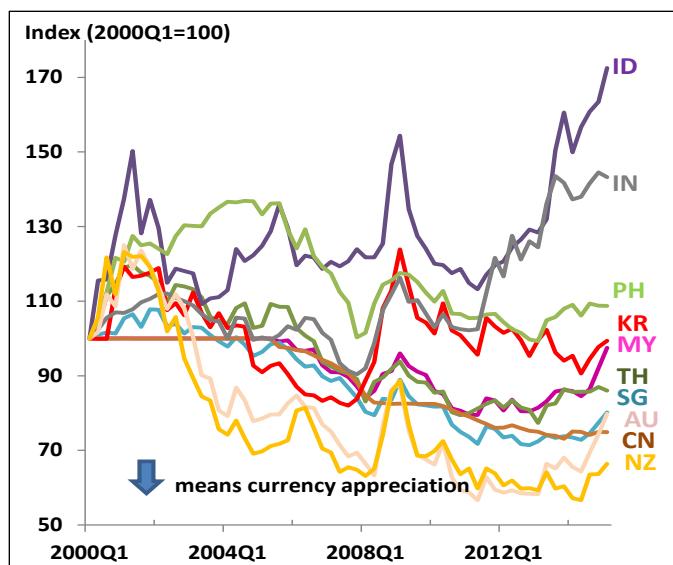
Note: Left vertical axis: JPM = JP Morgan Government Bond Index (Emerging Markets Global Core); Right vertical axis: MSCI = Morgan Stanley Capital International Emerging Markets Index.

Source: Bloomberg.

3.5 Exchange Rate Channel

The rebalancing of portfolio flows will result in a depreciation of the US dollar and, therefore, an appreciation of domestic currency in Asia and the Pacific region. The real exchange rate appreciation can reduce export price competitiveness. This reduces export receipts and weakens growth prospects. Indicators for this channel are the bilateral exchange rate, the real effective exchange rate, imports, exports, and trade openness.

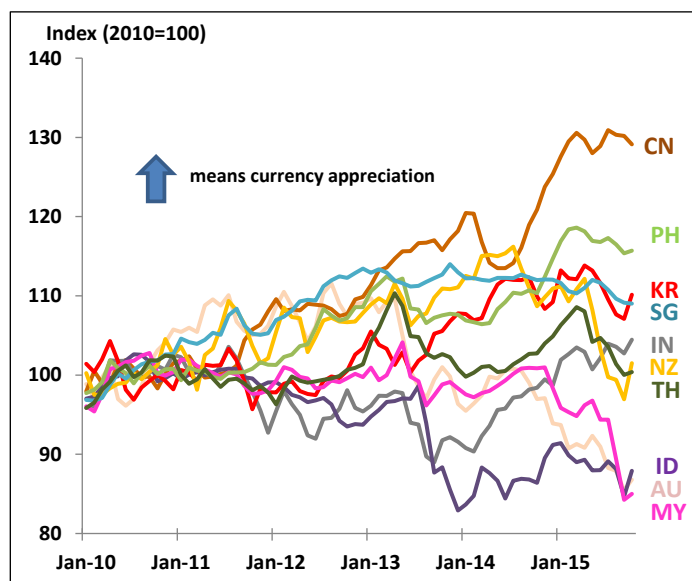
Figure 11: Exchange Rate (local currency versus US dollar)



ID = Indonesia; IN = India; PH = Philippines; KR = Republic of Korea; MY = Malaysia; TH = Thailand; SG = Singapore; AU = Australia; CN = PRC; NZ = New Zealand.

Source: Author's calculation from Bloomberg.

Figure 12: Real Effective Exchange Rate Index



CN = PRC; PH = Philippines; KR = Republic of Korea; SG = Singapore; IN = Indonesia; NZ = New Zealand; TH = Thailand; ID = Indonesia; AU = Australia; MY = Malaysia.

Source: Bank for International Settlements.

4. MODEL AND IDENTIFICATION

We develop a Panel VAR model for Asia and the Pacific region, which includes Australia; the PRC; Hong Kong, China; India; Indonesia; Japan; the Republic of Korea; Malaysia; New Zealand; the Philippines; Singapore; and Thailand. We cover the period from first quarter 2000 until first quarter 2015.

We estimate the following system:

$$Y_{it} = A Y_{it-1} + B X_{it-1} + u_i + e_{it}$$

Where

Y_{it} is a (1xk) vector of dependent variables, X_{it-1} is a (1x1) vector of exogenous covariates, and u_i and e_{it} are (1xk) vectors of dependent variable-specific panel fixed-effects and idiosyncratic errors, respectively. For all $t > s$, $E[e_{it}] = 0$, $E[e_{it}' e_{it}] = \Sigma$, and $E[e_{it}' e_{is}] = \Sigma 0$.

General Method of Moments (GMM) is used to estimate the Panel VAR, which regresses each endogenous variable on its own lag(s) as well as the lags of all other variables in the system. Following Love and Zicchino (2006), we apply forward mean differencing or orthogonal deviations (the Helmert procedure) to remove the fixed effects; all variables in the model are transformed in deviations from forward means. See Arellano and Bover (1995).

To evaluate the international monetary policy spillovers, we estimate in detail the following model:

$$\begin{pmatrix} Y_{US,t} \\ Y_{AP,t} \end{pmatrix} = \begin{pmatrix} A_{11} & 0 \\ A_{21} & A_{22} \end{pmatrix} \begin{pmatrix} Y_{US,t-1} \\ Y_{AP,t-1} \end{pmatrix} + \begin{pmatrix} B_{11} \\ B_{21} \end{pmatrix} \begin{pmatrix} X_{US,t} \\ X_{AP,t} \end{pmatrix} + \begin{pmatrix} e_{US,t} \\ e_{AP,t} \end{pmatrix} + u_i$$

To identify the shocks, we rely on Cholesky's decomposition of the covariance matrix, which assumes a recursive exogeneity structure.² Therefore, the first variable in the VAR is only affected contemporaneously by the shock to itself; the second variable in the VAR is affected contemporaneously by the shocks to the first variable and the shock to itself, and so on. The US is ordered first because we assume that the variables for Asia and the Pacific respond to an exogenous shock by decisions of the Fed. The number of lags in the model is set equal to one.

5. BASELINE IMPULSE RESPONSES

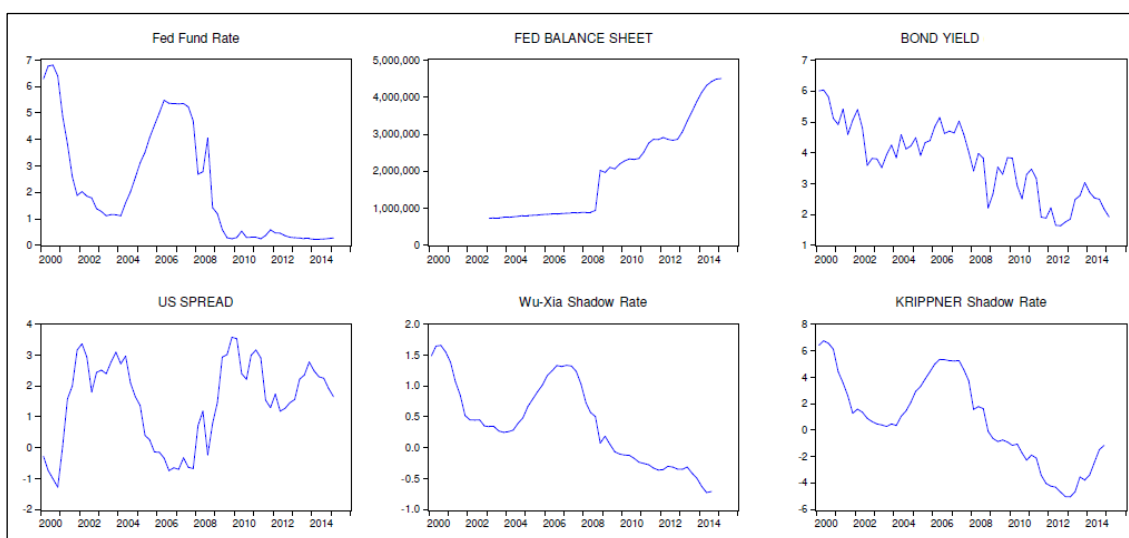
First, we evaluate what proxy to use to identify UMP shocks and study through which channels foreign policies affect the economy in Asia and the Pacific region. To evaluate the spillover effect of foreign policies, we compare two sample periods: the Pre-Crisis (2000q1–2006q4) and the Post-Crisis (2009q1–2015q1) samples. This allows us to determine whether the international mechanism transmission of foreign shocks changed due to the GFC and how channels presented in Section 3 work as a result of the main advanced economies adopting unconventional measures to deliver monetary policy. As shown below, portfolio rebalancing is the main channel through which US UMP spillover to Asia and the Pacific region occurs. Foreign investors shifted their

² The orthogonalized shocks should not be interpreted as structural shocks, but rather as orthogonalized reduced-form shocks. Identification of structural shocks is possible under a different shock identification scheme, such as a combination of long-run and short-run restrictions or sign restrictions.

preference to investment opportunities in Asia and the Pacific, contributing to exchange rate appreciation and asset price inflation. Central banks in the region responded by decreasing the policy rate, opening an important discussion on how independent central banks are today.

Concerning UMP shocks, several measures have been proposed in the literature. Krippner (2013), Lombardi and Zhu (2014), and Wu and Xia (2015) provided an estimated shadow interest rate to accommodate UMPs.³ Gambacorta, Hofmann, and Peersman (2014) and Anaya, Hachula, and Offermanns (2015) identified UMP shock with an exogenous innovation to the Fed balance sheet.⁴ Miyajima, Mohanty, and Yetman (2014) relied on decreasing US 10-year long-term bond yield and compressing US term premium to replicate UMPs. Similarly, Chen, Curdia, and Ferrero (2012) and Baumeister and Benati (2013) assumed that the central bank is effectively trying to reduce long-term yields while operating at the zero lower bound.

Figure 13: Evidence of US Unconventional Monetary Policy



Source: Authors' calculation.

Since December 2008, the Fed's funds rate has been at its zero lower bound; in November 2008, the Fed had started implementing several quantitative easing actions by increasing its balance sheet. As a consequence, the US 10-year bond yield and the US spread compressed. The corresponding shadow rate of those monetary policy actions estimated by Krippner (2013) and Wu and Xia (2015) highlight a clear accommodative monetary policy. However, the two shadow rates differ considerably. Krippner (2013)'s shadow rate is much more negative and volatile than the one calculated by Wu and Xia (2015), because they rely on different models.

³ Wu and Xia (2015) estimated the shadow rate with a latent factor extracted from a large panel of monetary and financial quantities. Krippner (2013) applied an option-based approach to estimate the shadow rate. Krippner (2013) assumed that the price of bonds constrained by the zero lower bound (ZLB) should be equal to the price of unconstrained shadow rate bonds minus the price of a call option conditional on possible negative values that would be for unconstrained shadow rates. Lombardi and Zhu (2014) estimated a shadow rate with a dynamic factor model on the yield curve, monetary aggregates, reserves, and the size and composition of the Fed's asset holdings to identify different actions taken by central banks since the ZLB.

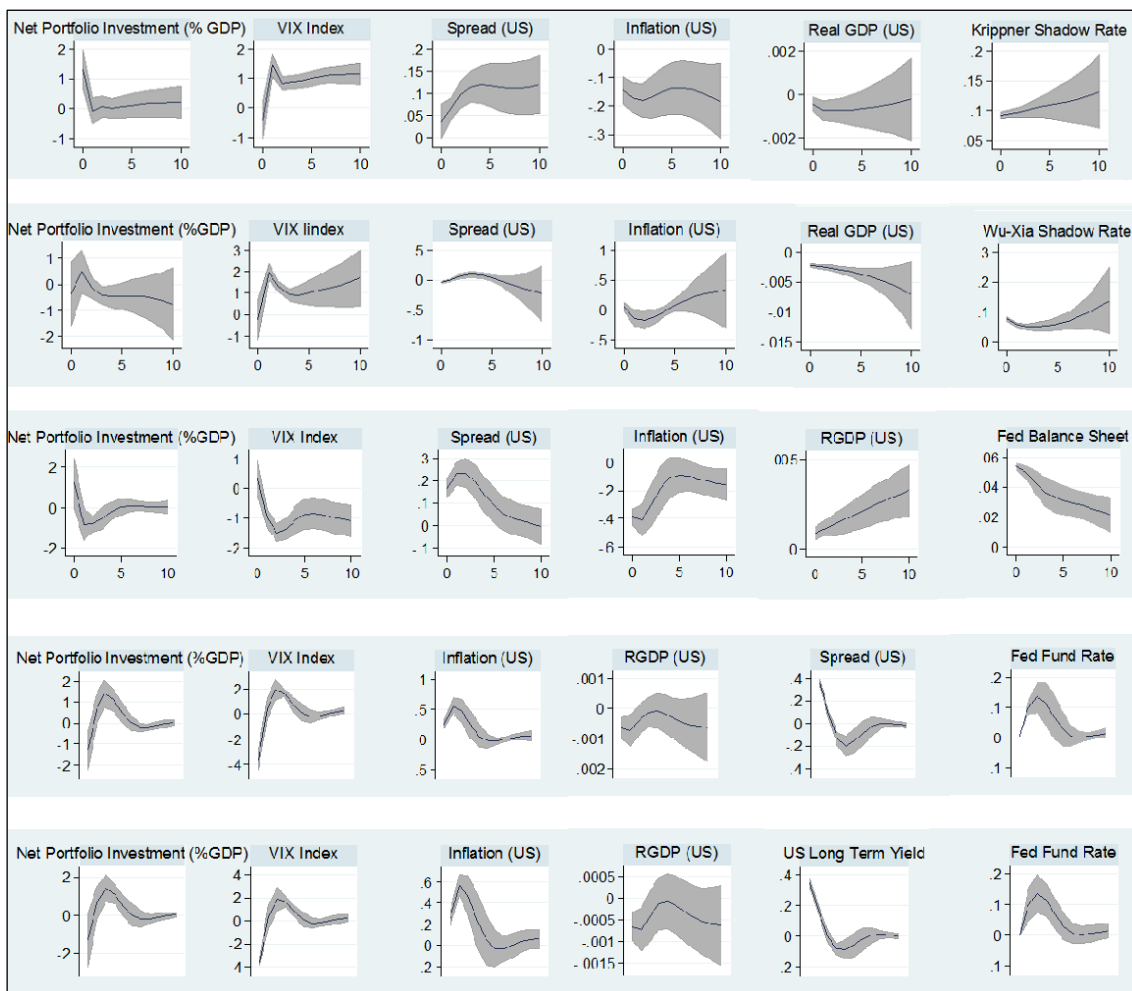
⁴ Lim, Mohapatra, and Stocker (2014) identified UMP shocks by defining a status quo of no change in quantitative easing as a scenario in which the flow of asset purchases continues at the same pace as that before the start of tapering by the Fed.

To understand what proxy to use to identify UMP shocks, we first estimate a Panel VAR including US variables and a measure for capital flows. We include the following variables:

$$Y_{it} = \{UMP, \text{Real GDP (US)}, \text{Inflation (US)}, \text{Spread (US)}, \text{VIX}, \text{Capital Flows (AP)}\}$$

For capital flows, we consider the portfolio investment in Asia and the Pacific (AP) region, as a percentage of GDP. This measure is calculated as the difference between assets and liabilities, i.e., the net difference between total equity and debt securities.

Figure 14: Report of Impulse Responses to Unconventional Monetary Policy Shocks Using Different Measures



GDP = gross domestic product; US = United States; VIX = VIX Index; RGDP = real GDP.

Source: Authors' calculation.

The first row shows responses to a shock to Krippner's estimated shadow rate.⁵ Real GDP and inflation for the US all decrease on impact, and the response is significant for at least one year. This is consistent with Canova and de Nicoló (2002), who found that output and prices rise following an expansionary monetary policy shock. The US spread increases, meaning that the long-term rate also increases as a response to contractionary monetary policy.

The VIX index, which indicates the degree of market volatility and uncertainty, increases after one quarter and is persistent over time. The persistence reflects the forward-looking action of the Fed to keep its policy rate unchanged, and this reflects the low uncertainty perceived by economic agents. Net portfolio investment, as a percentage of GDP, increases on impact, meaning those holdings of foreign assets increase or that foreign holdings of domestic assets decrease. Indeed, Asia and the Pacific region decreased the quantity of US assets holdings, whereas foreign investors increased their holdings of Asian assets. The second row of Figure 5 reports the response to the Wu–Xia shadow rate. This index leads to responses similar to the Krippner shadow rate shock, except regarding inflation and net portfolio investment, which are not significant. The third row reports the impulse response to an increase in the Fed's balance sheet, but this shock leads to an increase in the spread term. The fourth and fifth rows report impulse responses to a US spread and US long-term yield, respectively. Both shocks lead to a short decrease in the VIX index on impact, which increases again after two quarters, and similar behavior can be seen regarding portfolio investment. Taking into account those results, we decide to conduct our following Panel VAR estimations based on Krippner's estimated shadow rate, since the responses are more in line with the data.

Further below we include more variables for Asia and the Pacific region to evaluate international spillover effects, as follows:

$$Y_{it} = \{\text{UMP, Real GDP (US), Inflation (US), VIX, Capital Flows (AP), RGDP (AP), ST-Rate (AP)}\}$$

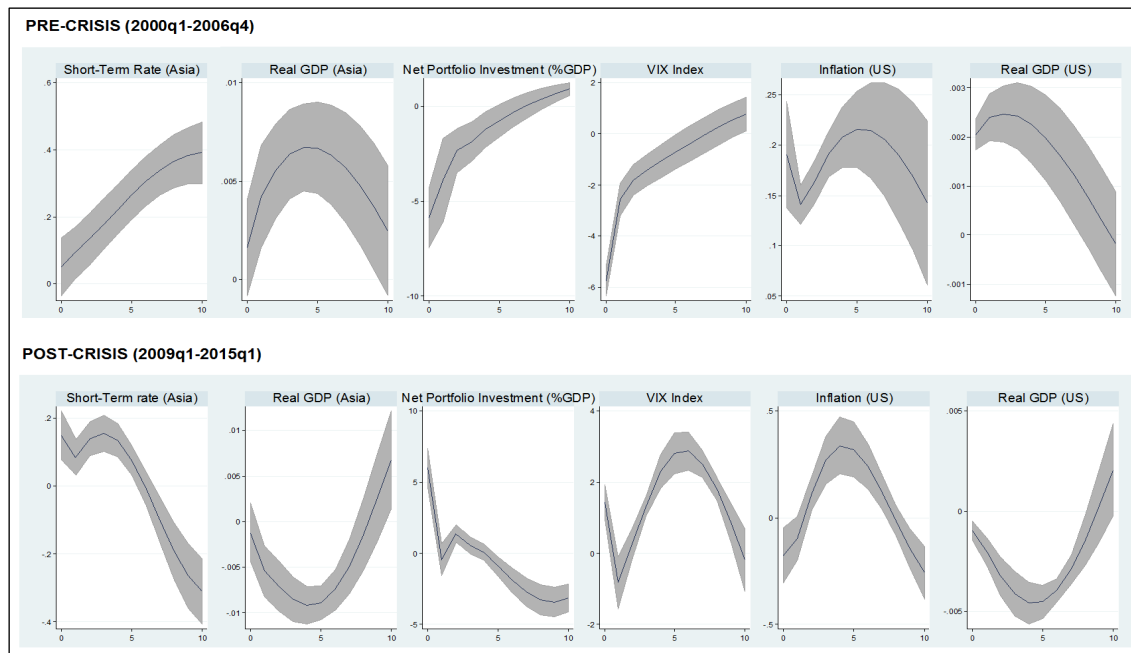
Figure 15 reports responses to Krippner's index for the Pre-Crisis (2000q1–2006q4) and Post-Crisis (2009q1–2015q1) samples. The latter sample clearly shows the US monetary policy spillovers to Asia and the Pacific region through the portfolio balance channel (i.e., increases in net portfolio investment) and interest rate channel (i.e., increases in the short-term interest rate). Quantitative easing actions generate clear international business cycle synchronization with co-movements in real GDP and short-term interest rates. The perception of low market uncertainty leads to foreign investors holding more liabilities in Asia and the Pacific region. These findings shed light on the recent discussion started by Helen Rey⁶ on “dilemma not trilemma,” since central banks appear to lose their monetary policy independence even under floating exchange rates. The top panel of Figure 15 shows opposite responses to monetary policy shocks. A positive shock to the Fed's fund rates prior to the GFC led to a decreasing VIX index, and positive US GDP and US inflation. GDP and short-term rates for Asia–Pacific economies report the same sign as for the US, and net capital inflow is negative. Asian and Pacific economies had a preference for US assets. This finding corroborates the “global saving glut” hypothesis proposed by Bernanke (2005, 2007). The Fed created a lot of uncertainty in the US financial markets, especially the

⁵ We report responses to a 1% increase in the shadow rate. However, the UMPs reflect a decreasing shadow rate. Therefore, the reader should keep in mind that the idea of the paper is to evaluate the impact of a decrease in the shadow rate, as shown in the data.

⁶ The quotation is from Rey (2013), p. 287.

stock market, as can be seen from the higher VIX index. This is consistent with the findings in Leduc and Liu (2012) that show empirically that an increase in uncertainty leads to a significant decline in inflation and a large increase in unemployment.

Figure 15: US Unconventional Monetary Policy (UMP) Shock (Model 1)



Note: Panel VAR includes: UMP, Real GDP (US), Inflation (US), VIX, Capital Flows, Real GDP (Asia), ST Rate (Asia).
Source: Authors' calculation.

Table 1: Variance Decomposition

Net PI	UMP	RGDP (US)	Inflation (US)	VIX	RGDP	ST Rate
1	.11	.03	.07	.08	.00	.00
4	.07	.09	.05	.08	.02	.16
8	.08	.16	.05	.07	.10	.13
12	.11	.15	.06	.05	.26	.09
24	.14	.19	.07	.02	.42	.04
RGDP	UMP	RGDP (US)	Inflation (US)	VIX	Net PI	ST Rate
1	.00	.09	.01	.02	.00	.00
4	.06	.13	.03	.01	.00	.00
8	.10	.10	.05	.00	.00	.00
12	.09	.20	.05	.00	.00	.00
24	.13	.26	.07	.00	.00	.00
Short Rate	UMP	RGDP (US)	Inflation (US)	VIX	Net PI	RGDP
1	.06	.03	.05	.04	.08	.01
4	.11	.04	.04	.04	.07	.04
8	.10	.25	.04	.03	.05	.06
12	.14	.25	.07	.01	.02	.31
24	.15	.26	.08	.01	.01	.44

PI = portfolio investment; UMP = unconventional monetary policy; RGDP = real gross domestic product; US = United States; VIX = volatility index; ST = short-term interest rate.

Source: Authors' calculation.

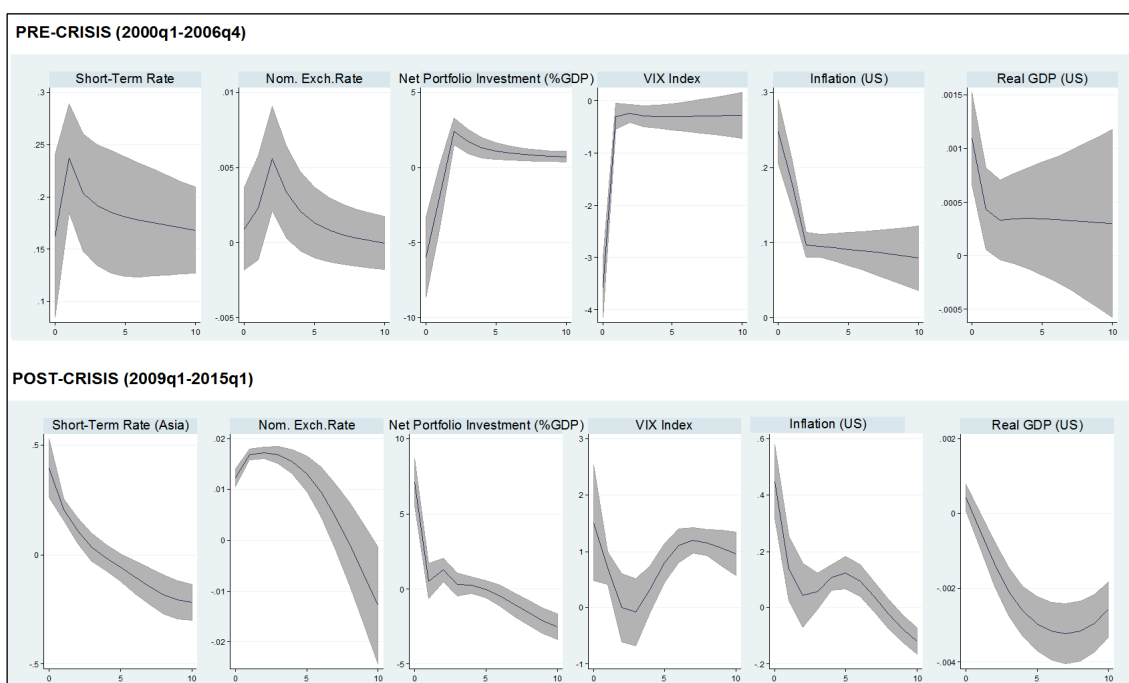
Table 1 reports the forecast error variance decomposition and shows the proportion of the unanticipated changes of a variable that can be attributed to innovations in the variable itself and to other variables in the system. The US UMP shocks explain about 11% of the variation of net portfolio investment and about 6% of the variation of the short-term rate on impact. The US shocks also explain about 14%, 13%, and 15% of the 24-steps ahead forecast error variance of net portfolio investment, real GDP, and short-term rate, respectively, in Asia and the Pacific region.

6. EXTENDED IMPULSE RESPONSES

We extend the previous analysis by including more variables of interest, such as nominal exchange rate and asset prices, and further below we distinguish between net portfolio investment’s important components: equity and bonds.

Figure 16 shows a strong depreciation of the nominal exchange rate (i.e., domestic currency against one US dollar) due to an increase in the shadow rate in the post-crisis sample; it is not significant in the pre-crisis sample, except for a marginal depreciation in the second quarter. Also, here the short-term interest rate increases due to an increase in the shadow interest rate, again highlighting the “dilemma” idea of central banks losing their monetary policy independence.

Figure 16: US Unconventional Monetary Policy Shock (Model 2)



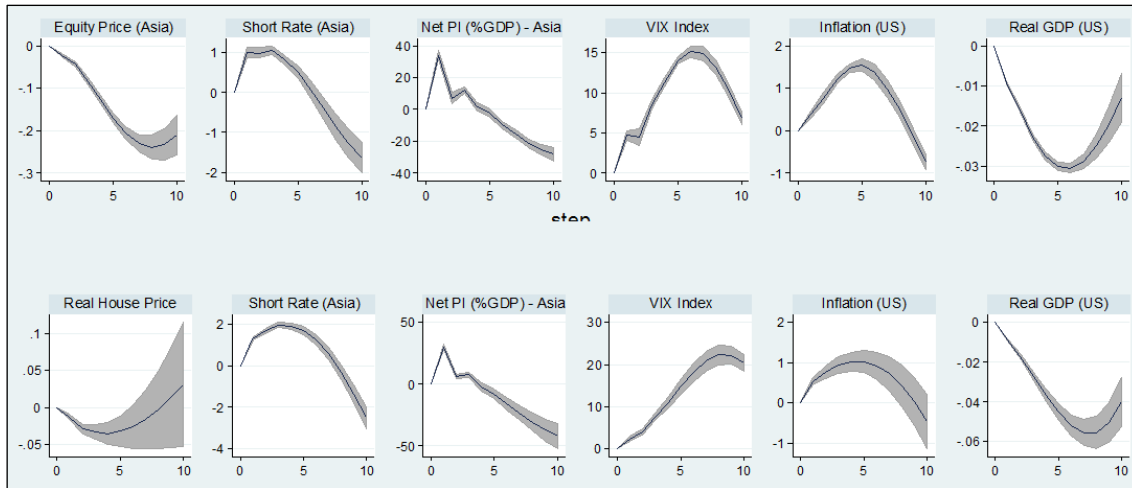
Note: Panel VAR – $Y_{it} = (\text{UMP, Real GDP [US], Inflation [US], VIX, Capital Flows, Nom. Exchange Rate [Asia], ST Rate [Asia]})$.

Source: Authors’ calculation.

The appreciation is consistent with the uncovered interest parity condition. Moreover, the response of the exchange rate reflects the sudden surge of capital flows to Asia and the Pacific region. As a result, monetary authorities in Asian and Pacific countries lower the policy rate to avoid a further appreciation of the exchange rate and to try to control excess volatility of capital flows.

Figure 17 explores the impact on asset prices: contractionary UMPs lead to a decrease in both equity and house prices. A lower interest rate contributes to a search for yields, making shares more attractive than bonds, thus boosting demand for and prices of equities. For housing there is a similar mechanism at work—low interest rates make housing finance very cheap and attractive for households who reduce their money balances to increase house holdings.

Figure 17: US Unconventional Monetary Policy Shock (Model 3)



Note: Panel VAR – Y_{it} = (UMP, RGDP [US], Inflation [US], VIX, NPI [AP], ST Rate [AP], Asset Prices [AP]).

PI = portfolio investment; US = United States.

Source: Authors' calculation.

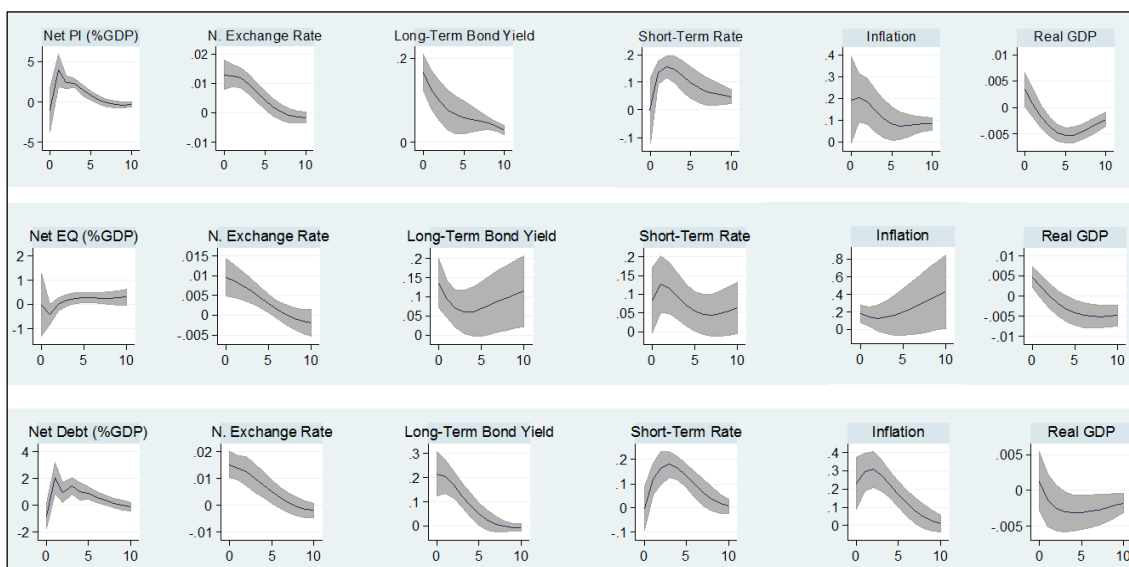
These findings confirm the transmission mechanism of monetary policy on asset prices, as in Jarocinski and Smets (2008), Goodhart and Hofmann (2008), Bernanke and Gertler (1995), Erceg and Levin (2006), McCarthy and Peach (2002), Vargas-Silva (2008), Musso, Neri, and Stracca (2011,) and Huber and Punzi (2015). The top panel shows that the impact on equity prices is much more pronounced relative to the housing market. Also, Rigobon and Sack (2014) found that a contractionary monetary policy has a negative impact on stock prices and a positive impact on market interest rates, in particular rates with short-term maturities.

Our results also corroborate the “global saving glut” hypothesis proposed by Bernanke (2005, 2007), assuming that capital inflows from EMEs to advanced economies led to booming asset prices and lower interest rates in the recipient countries. In our regression, quantitative easing in the US leads to lower interest rates and increasing capital inflows in Asia and the Pacific region. Such a surge in capital flows is associated with booming equity and house prices. See also Aizenman and Jinjarak (2009), Punzi (2013), Mendicino and Punzi (2014), and Punzi and Kauko (2015).

Further, we study the impact of UMPs on the components of portfolio investment flows in the countries in Asia and the Pacific. Since it is not possible to include too many variables in the VAR, we consider only variables for Asia and the Pacific region and, compared with the previous estimation, we take out US variables and include a long-term interest rate (10-year yield) with the rest of the variables for Asia and the Pacific.

Figure 9 shows that the change in net portfolio investment is mainly due to an increase in net bond flows, while net equity flows have an impact only after five quarters.

Figure 18: US Unconventional Monetary Policy Shock (Model 4)



PI = portfolio investment; GDP = gross domestic product; EQ = equity price.

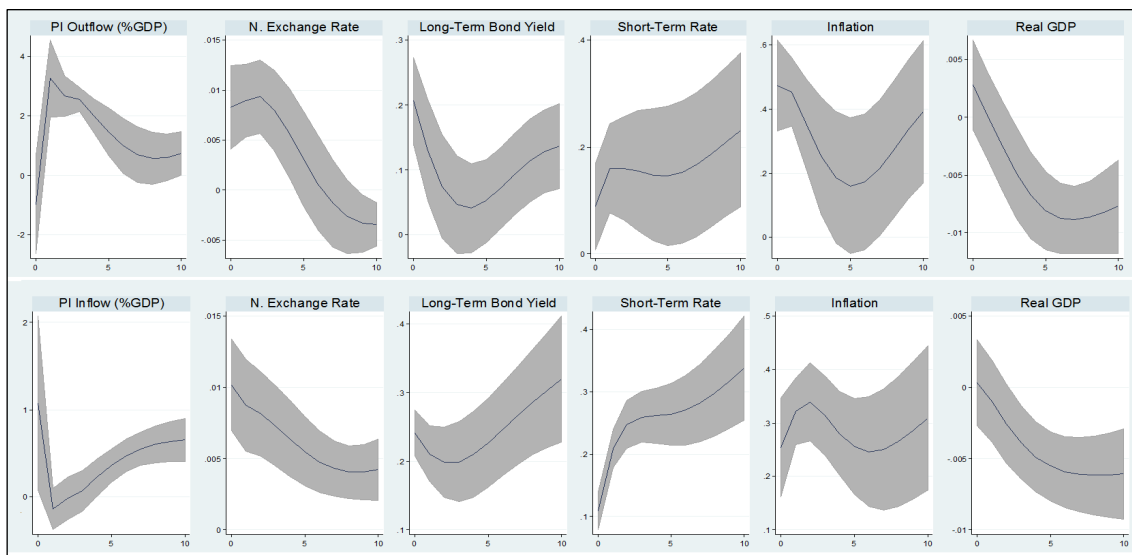
Source: Authors' calculation.

To account for the importance of gross flows relative to net flows, we distinguish between net and gross flows when considering portfolio investment flows. Forbes and Warnock (2012) found different results affecting capital flows if gross capital flows, rather than net capital flows, are considered. The focus on gross flows is important because different factors can affect inflows versus outflows; moreover, shocks can affect them in different ways. If global risk and contagion, through bilateral exposure of the banking systems, are important factors determining stop and retrenchment episodes, they are no longer significant when explaining net capital flows. With a particular focus on the banking sector, Shin (2012) suggested that the easy credit conditions in the US were due to gross cross-border positions rather than net capital flows.

Figure 19 shows that an increase in net portfolio flows is mainly determined by persistent changes in assets, whereas liabilities increase only on impact.

This can lead to a misunderstanding of the results. We consider in detail the components of portfolio investment flows: equity and bond flows. Equity assets and liabilities both increase with similar quantities, leading to insignificant net equity flows (see Figure 11), whereas for bond flows, assets and liabilities increase in the opposite direction (see Figure 12). Clearly, this result shows that since the start of quantitative easing and forward guidance, Asia and the Pacific region has held fewer US bonds whereas foreign countries have held more assets in Asia and the Pacific.

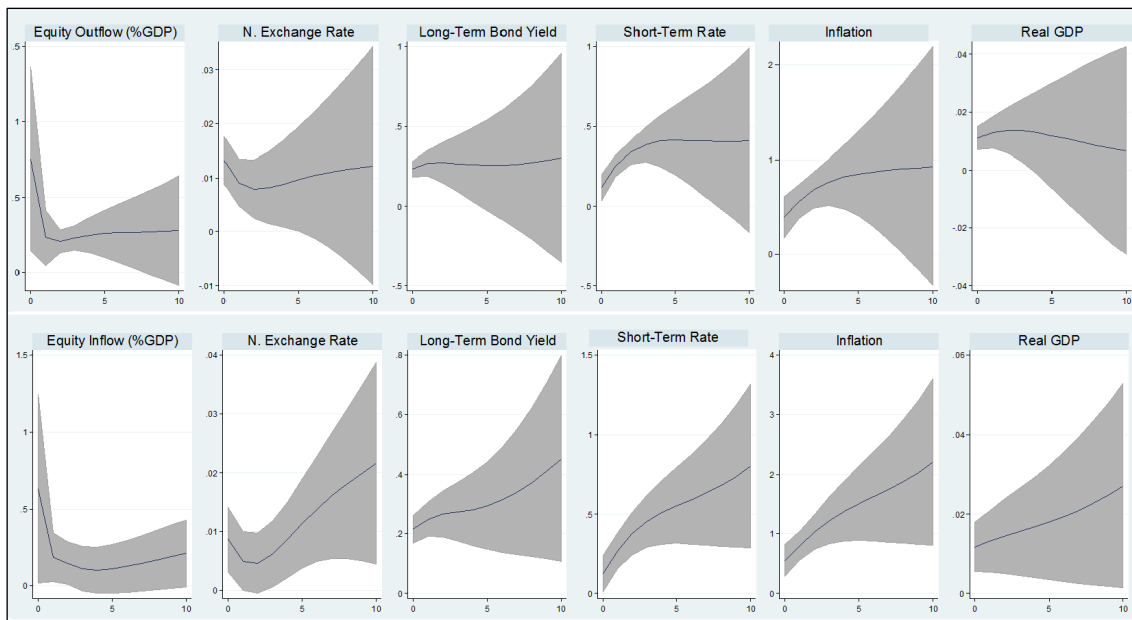
Figure 19: Panel Vector Auto Regression – Impact on Net and Gross Portfolio Investment Flows during the Post-crisis Period



GDP = gross domestic product; PI = portfolio investment.

Source: Authors' calculation.

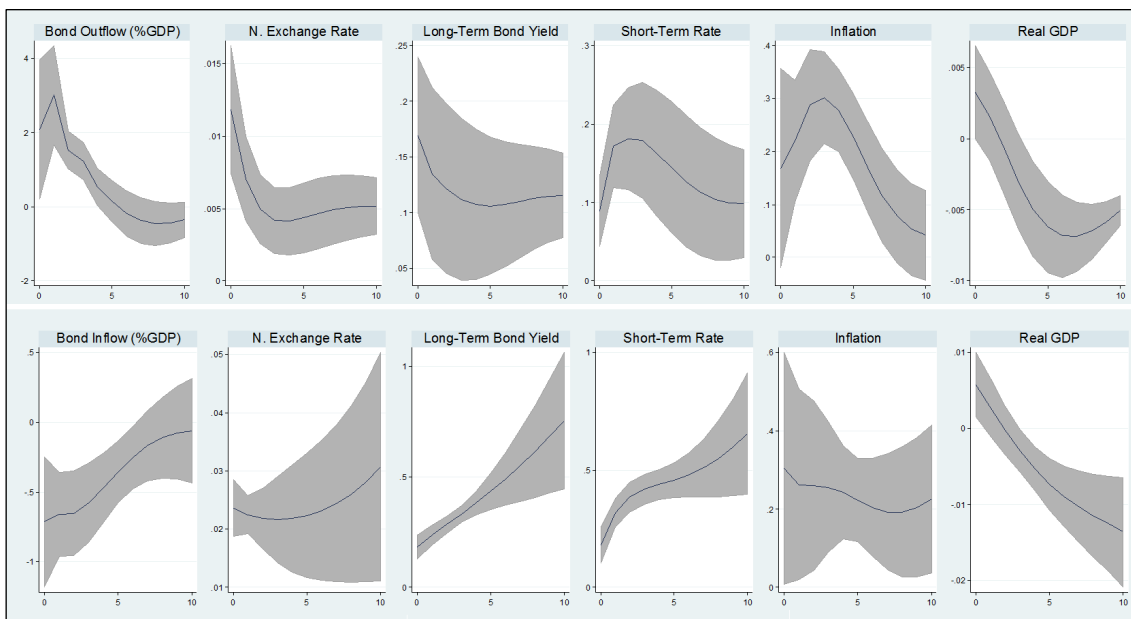
Figure 20: Panel Vector Auto Regression – Impact on Net and Gross Equity Portfolio Investment Flows



GDP = gross domestic product; N. Exchange rate = bilateral exchange rate against US dollar rate.

Source: Authors' calculation.

Figure 21: Panel Vector Auto Regression – Impact on Net and Gross Debt Portfolio Investment Flows

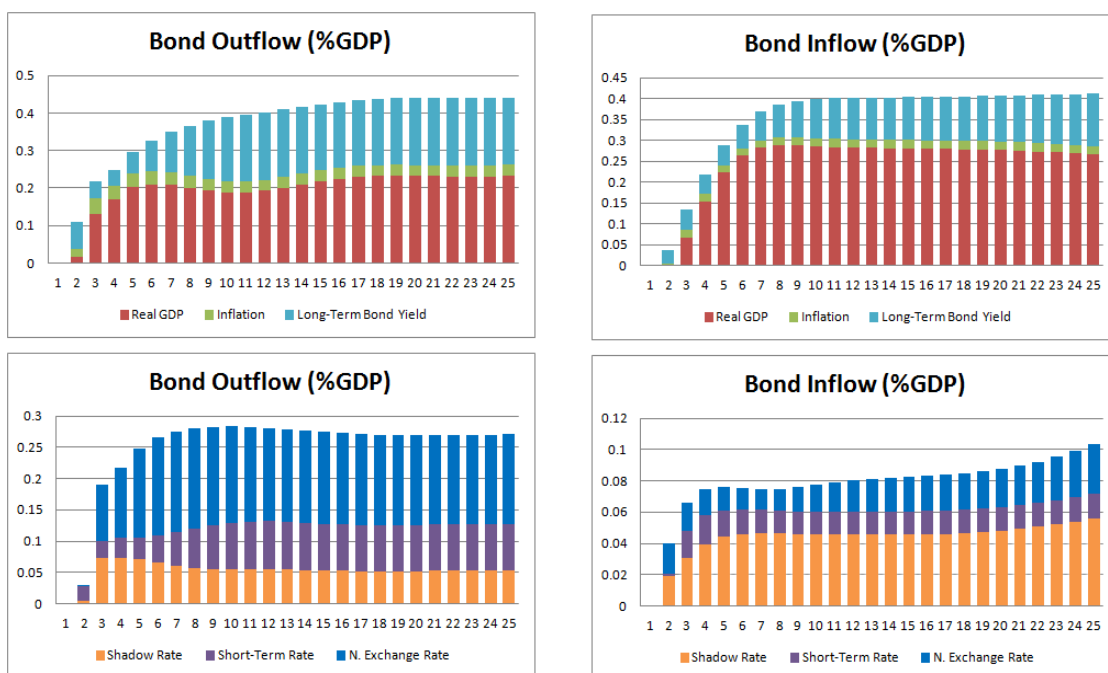


GDP = gross domestic product; N. Exchange rate = bilateral exchange rate against US dollar rate.

Source: Authors' calculation.

Figures 22–24 show the variance decomposition for variables of interest. We can see that real GDP in Asia and the Pacific region is the major variable contributing to the increase in bond inflows and outflows, with a more pronounced impact on gross inflows. The US shadow rate contributes more to explaining bond inflows than bond outflows. The nominal exchange rate has a major impact on the latter (see Figure 22).

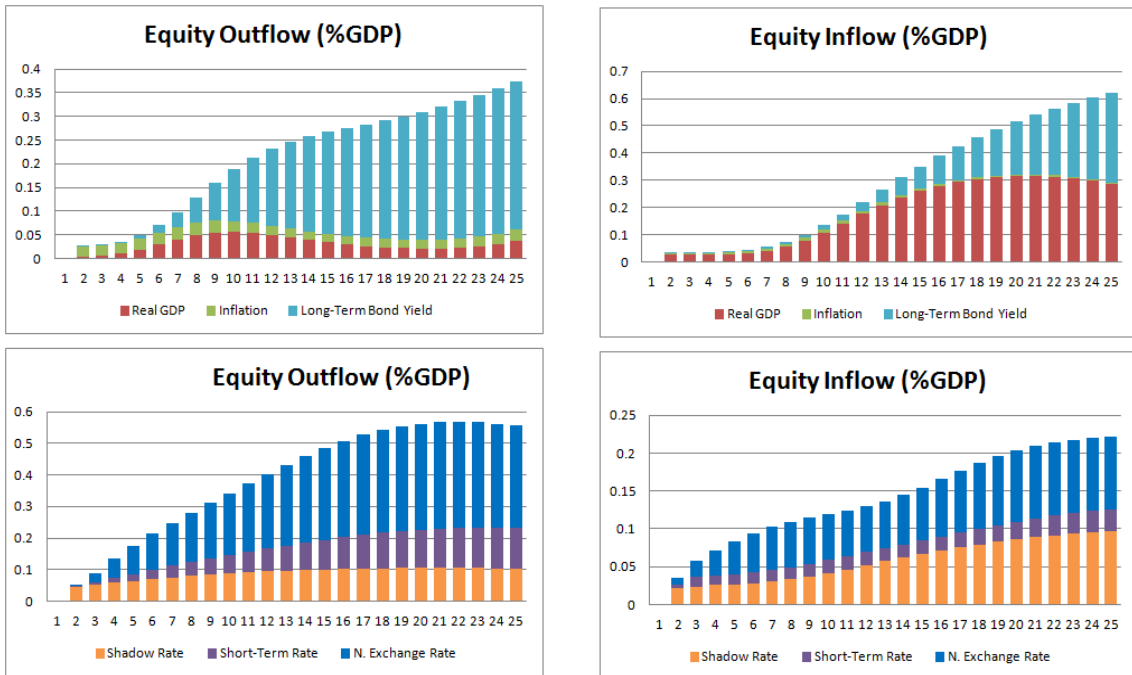
Figure 22: Variance Decomposition: Bond Inflows versus Outflows



GDP = gross domestic product.

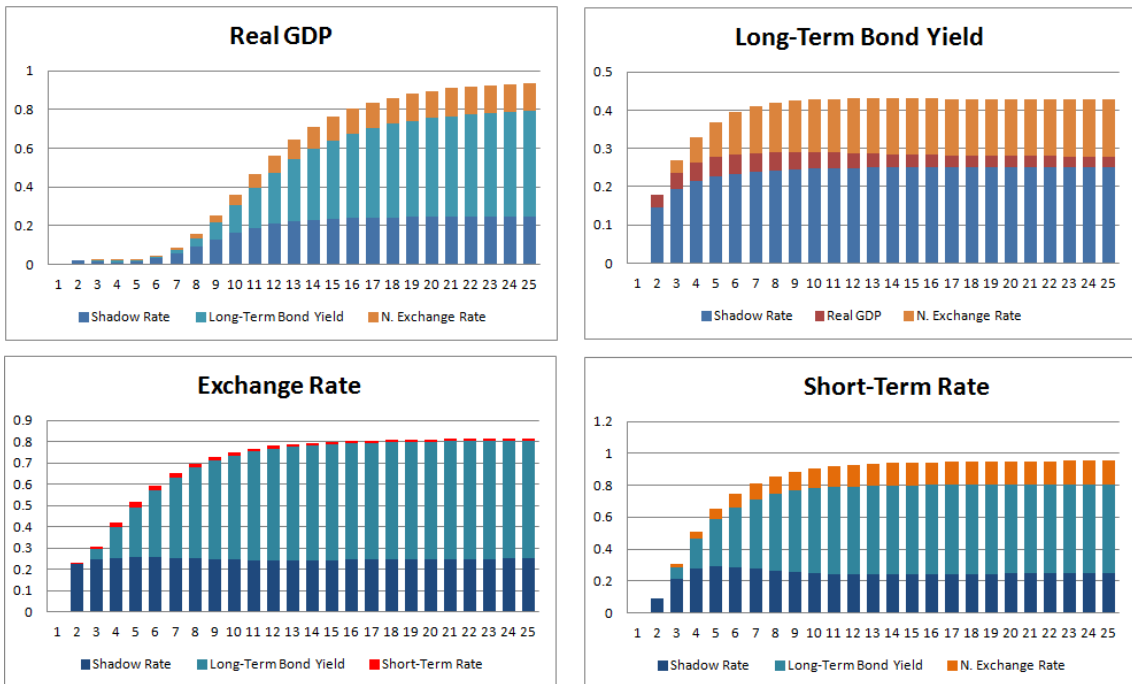
N. Exchange rate = bilateral exchange rate against US dollar rate.
 Source: Authors' calculation.

Figure 23: Variance Decomposition: Equity Inflows versus Outflows



GDP = gross domestic product.
 N. Exchange rate = bilateral exchange rate against US dollar rate.
 Source: Authors' calculation.

Figure 24: Variance Decomposition (Panel Vector Auto Regression includes Bond Inflows)



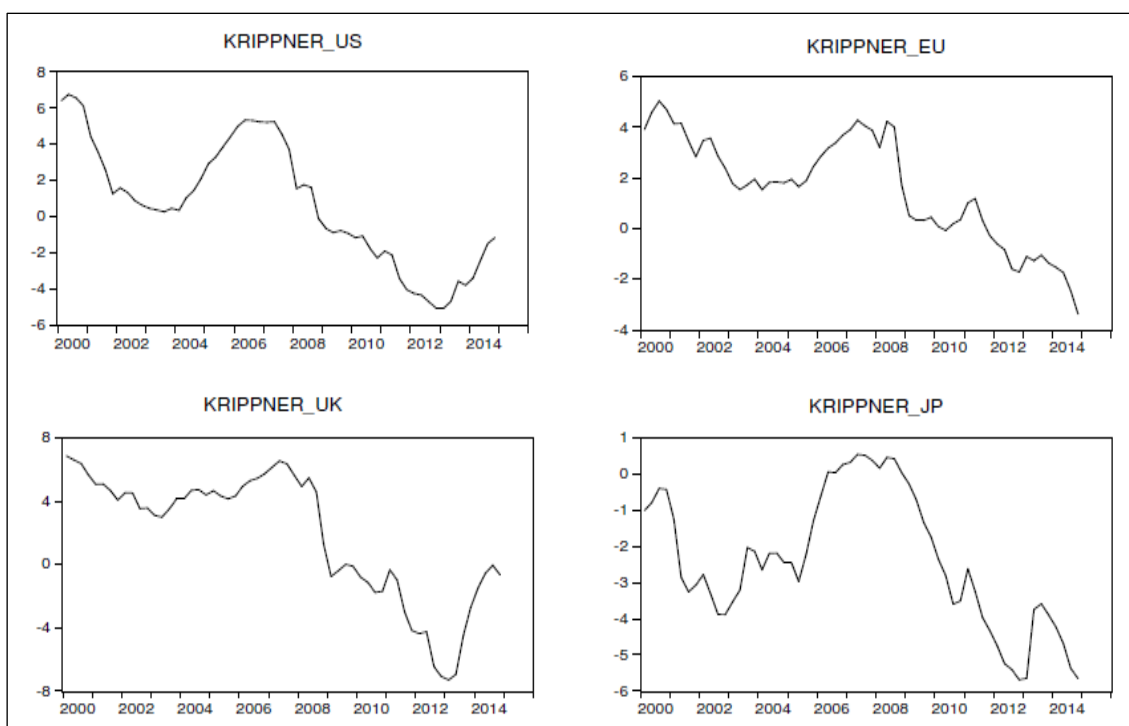
GDP = gross domestic product; N. Exchange rate = bilateral exchange rate against US dollar rate.
 Source: Authors' calculation.

The US shadow rate and nominal exchange rate have a similar impact on equity flows. Real GDP has a much more limited impact on equity inflows and outflows, relative to bond flows, whereas long-term bond yields have a strong impact on equity outflows (see Figure 23).

We also examine the forecast error variance decomposition for other variables, when our Panel VAR system includes bond inflows (see Figure 24). US UMPs and the long-term yield in Asia and the Pacific can explain most of the variability of real GDP, exchange rates, and short-term rates. Moreover, the US shadow rate is the main variable explaining the volatility of long-term yields.

Finally, we estimate the impact of quantitative easing from other central banks, such as the Bank of England, the ECB, and the Bank of Japan. We use the Krippner estimated shadow rate for those other countries as well (see Figure 25).

Figure 25: Krippner Shadow Rates



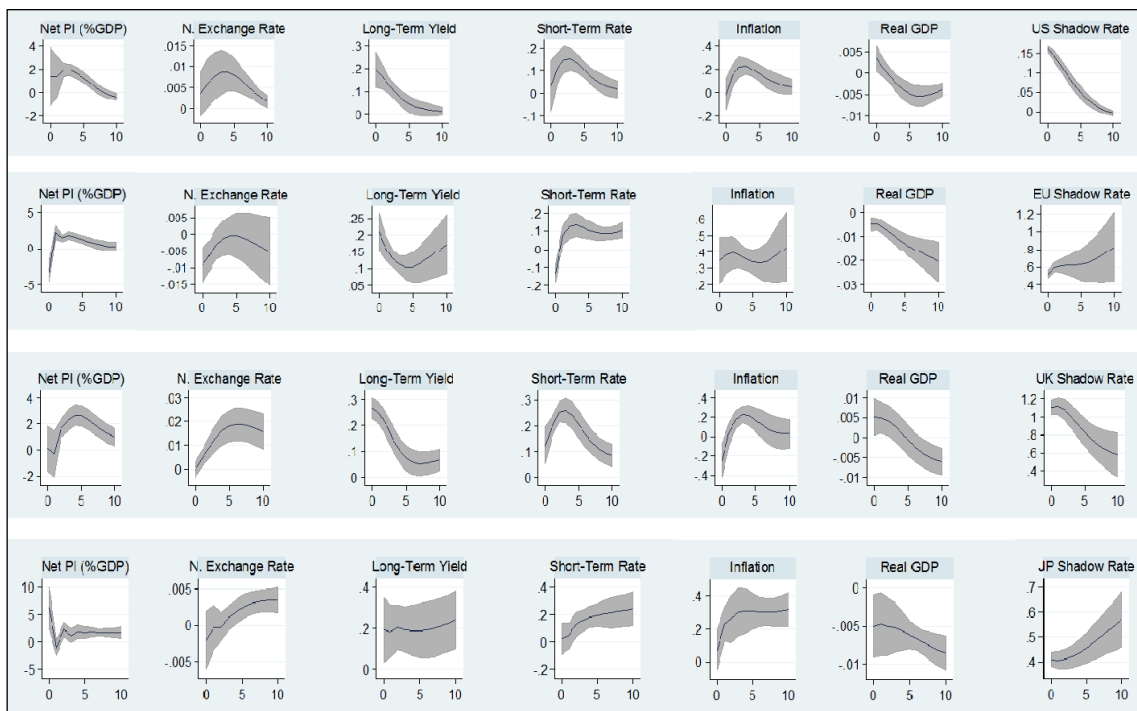
US = United States; EU = European Union; UK = United Kingdom; JP = Japan.

Source: Authors' calculation.

All countries' UMPs have an impact on Asia and the Pacific region, but the EU and Japan do not replicate exchange rate pressure, as shown in the data.⁷ Instead, contractionary UMPs in the United Kingdom lead to a puzzling increase of real GDP in Asian and Pacific economies (see Figure 26). Since the impulse responses to other central banks' UMPs show different signs from the data behavior, we conclude that the main spillover effects come from the US.

⁷ The Asia and Pacific region excludes Japan.

Figure 26: Panel Vector Auto Regression – Impact of Unconventional Monetary Policies from several Central Banks hitting the Zero Low Bound



GDP = gross domestic product; PI = Portfolio Investment; US = United States.

Source: Authors' calculation.

7. POLICY RECOMMENDATION

International non-standard monetary measures have generated high volatility in capital flows and consequential currency appreciation in most countries in Asia and the Pacific region. Such negative UMP impact could ultimately spill back to advanced economies, especially in the case of Fed tapering.

How should policy makers in Asia and the Pacific region respond to international spillover effects? Our results show that central banks have already lowered their policy rates to stabilize GDP and inflation after a strong exchange rate appreciation. Our results are in line with recent findings by Rey (2015), who concluded that monetary conditions in advanced economies are transmitted to EMES through gross capital flows, regardless of the exchange rate regime. Therefore, a combination of free mobile capital markets and floating exchange rates cannot insulate economies from the global financial cycle. As a result, independent monetary policies can be achieved only through careful control of the capital account, irrespective of the exchange rate regime.

Large gross capital inflows and outflows can easily trigger episodes of financial instability and have to be carefully monitored.

Time-varying controls on portfolio debt can be implemented during boom phases of the cycle. Relative to other types of restrictions, such as macroprudential policy, capital control measures are much simpler to implement and easily adopted in countries where the regulatory and supervisory system is not that well developed. Moreover, it should be pointed out that macroprudential policies work in different directions. In particular, capital controls on bonds can reduce debt inflows/outflows, leaving the

exchange rate unchanged, but this will lead to a search for alternative investments, thus increasing inflows of other types of assets, such as equity. On the other hand, if capital control targets equity, bond inflows will increase with strong currency appreciation.

Although several capital control measures have been actively implemented in Asia since the GFC, they were incapable of preventing a surge of capital inflows and financial instability. Indeed, Chantapacdepong and Shim (2015) found an increasing bond flow correlation when a country loosens controls on bond inflows, whereas no correlation is found for tightening policy actions. Most EMEs have implemented controls on capital inflows, but very few have attempted to control outflows. Malaysia introduced control measures on capital outflows and those measures have been quite effective in limiting the volume of flows.

Since the introduction of UMPs in advanced economies, countries in Asia and the Pacific have responded with an easing of monetary policies to avoid excess exchange rate volatility. Is this an efficient policy measure? One possible policy recommendation would be to allow central banks to let the policy rate respond to inflation targeting or exchange rates. Indeed, Singapore, by choosing the exchange rate as the intermediate target, has limited the volatility of asset prices and capital flows. Another possible instrument that central banks could use to mitigate the influence of foreign monetary policy would be to sterilize foreign exchange rate intervention. Therefore, when foreign investors switch their holdings of foreign assets to domestic bonds, central banks will do the opposite by holding more foreign assets relative to the decreasing demand for domestic assets. This will not require any change in the exchange rate or policy rate, but will result in an increase in capital inflows. Still, the surge in capital flows will cause upward pressure on credit and asset prices, contributing to financial fragility of the economic system.

No instrument is efficient at avoiding surges of capital inflows and currency appreciation without excessively lowering the policy rate. Policy makers should consider a policy mix. If central banks are mostly interested in avoiding currency appreciation and excess credit growth, measures of capital control or sterilization of foreign exchange intervention are recommended. If central banks are more interested in exchange rate stability, without affecting equity prices, then capital controls on bonds are the optimal instruments, followed by foreign exchange intervention, and lastly easing of monetary policy. However, it should be noted that several Asian countries have been adopting capital control measures since the GFC. As a result, bond capital inflows slowed and equity prices dropped. Countries should carefully monitor exactly what kinds of flows are coming in and going out, and pursue time-varying capital control to avoid any negative consequences for financial development.

8. CONCLUSION

Quantitative easing, as well as other non-monetary policy measures adopted by various central banks, has important international spillover effects. In particular, US UMPs led to rapid capital inflows, strong currency appreciation, and asset price and credit booms in Asia and the Pacific region. Central banks responded to foreign monetary policy shocks by lowering their short-term interest rates. Such a situation confronted central banks with a policy dilemma, rather than the well-known policy trilemma. Central banks should define their goals and pursue a mixture of policies by choosing a combination of foreign exchange interventions with capital controls on equity and/or bonds.

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