GLOBAL LIQUIDITY AND THE IMPACT ON SEACEN ECONOMIES



Peter Tillmann
Project Leader



The SEACEN Centre

The South East Asian Central Banks (SEACEN) Research and Training Centre
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FOREWORD

During the past 15 years, financial markets were characterized by strong fluctuations in global liquidity. Three properties of global liquidity pose challenges to policymakers in the SEACEN economies: First, from the perspective of a small open economy, fluctuations in global liquidity are typically exogenous. Domestic policies, either monetary, financial, structural, regulatory or macroprudential, have limited control over global liquidity. Second, global liquidity is typically extremely volatile leading to boom-bust cycles in capital inflows. Third, while generally growth-enhancing, inflows of global liquidity have important side effects such as asset price bubbles, an appreciation of the currency and an easing of financial conditions. The collaborative research project on "Global Liquidity and the Impact on SEACEN Economies" studies determinants of global liquidity, its effects on SEACEN economies, both from a cross-country and a country-specific perspective, and discusses policy responses to swings in global liquidity.

The project was led by Peter Tillmann, Professor of Monetary Economics at the Justus Liebig University Giessen, Germany, and Visiting Research Economist at the SEACEN Centre in FY2016. The project team consisted of representatives from the National Bank of Cambodia; Bank Indonesia; The Bank of Korea; The Bank of Mongolia; Bangko Sentral ng Pilipinas; Central Bank of Sri Lanka; Central Bank, Chinese Taipei and State Bank of Vietnam. SEACEN wishes to express it sincere gratitude to the participating central banks for their support.

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Dr. Hans Genberg
Executive Director
The SEACEN Centre
May 2017

EXECUTIVE SUMMARY

Strong fluctuations in global liquidity have emerged as a consequence of shifts in monetary policy in advanced economies, swings in global risk aversion and the extension of cross-border credit. From the perspective of SEACEN economies, the ups and downs in global liquidity pose a challenge to monetary, fiscal, regulatory and macroprudential policies:

- Sudden increases of global liquidity lead to a domestic boom in economic activity, a surge in asset prices and an appreciation of the exchange rate against the US dollar.

- Spillovers through global liquidity are not constant over time. They can turn out to be strong or weak depending on global financial conditions, the domestic macroeconomic environment and the policy responses taken. Likewise, the channels through which global liquidity affects emerging markets vary over time in their importance.

- The policy responses taken in SEACEN member economies are diverse. This reflects the fact that the effects of global liquidity, while broadly similar with regard to the core macroeconomic variables, gives rise to wide range of country-specific challenges. Policymakers are concerned about overheating property markets, an overly leveraged financial system, foreign currency borrowing, among many other facets of global liquidity, and should design policies directed towards these specific challenges.

- In this environment, searching for a "one-size-fits-all" policy response is misleading. While it is generally acknowledged that healthy macroeconomic fundamentals reduce the exposure to swings in global liquidity, the specific policies directed towards maintaining financial stability will likely to be diverse.

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Chapter 1

GLOBAL LIQUIDITY AND THE IMPACT ON SEACEN ECONOMIES: AN INTEGRATIVE REPORT

By
Peter Tillmann[1]

1. Introduction

During the past 15 years, financial markets were characterized by strong fluctuations in global liquidity. The concept of 'global liquidity' is naturally diffuse, but can be understood as "ease of finance" (Shin 2013a, Shin 2013b).[2] In principle, an abundance of funds available for investment is welcome, both for advanced and emerging economies.

However, three properties of global liquidity warrant a deeper analysis into the causes and consequences of global liquidity: first, from the perspective of a small open economy, fluctuations in global liquidity are typically exogenous.[3] With the determinants of global liquidity being located in advanced economies, emerging market economies take global liquidity as given and need to respond appropriately. Domestic policies, either monetary, financial, structural, regulatory of macroprudential, have limited control over global liquidity. To the extent that the inflow of liquidity into emerging Asian economies is driven by global factors, such as expansionary monetary policy and low risk aversion, they could add to the global financial cycle (Rey 2013) which severely affects the scope of domestic economic policy.

Second, global liquidity is typically extremely volatile. We have seen several phases of strong increases and collapses in liquidity over the recent years. As a consequence, emerging markets have been exposed to boom-bust cycles in capital inflows.

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1. Professor of Monetary Economics, Department of Economics, Justus Liebig University Gießen, and concurrently SEACEN Visiting Economist / Project Leader, FY 2016. I am grateful for SEACEN's generous hospitality and support. I also thank the referee for constructive comments.

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2. See also Caruana (2013) for a useful conceptual discussion.

3. Förster et al. (2014) study the driving forces behind capital inflows for a panel with many advanced and emerging economies. They show that, based on a dynamic hierarchical factor model, the contribution of global factors to capital inflows is small compared to local drivers. It remains open, however, whether this findings also applies to global liquidity, which is a broader concept than bilateral capital flows.

Third, while generally growth-enhancing, global liquidity has important side effects. Many market observers believe an increase in global liquidity leads to appreciation pressure on exchange rates and prices of other assets such as stocks, bonds and property, an easing of domestic financial conditions and a potential threat to financial stability in emerging market economies.

This paper forms the introductory chapter of the SEACEN research report on "Global Liquidity and the Impact on SEACEN Economies". The main purpose of the paper is to provide an integrative view on the concept of global liquidity, its measurement and its evolution over the past 15 years. We also survey the related literature and address a few important policy challenges. The following team project papers pick up these themes and apply them to the experiences of SEACEN member economies. The report focuses on emerging market economies in Asia, a region that is particularly susceptible to swings in global liquidity. At the same time, Asian economies offer a wide range of monetary policy frameworks ranging from inflation targeting to managed exchange rates, different degrees of financial market development and a large heterogeneity with regard to the degree of macroeconomic resilience. Thus, lessons drawn from Asia are also important for other regions of the world economy.

Exogenous swings in global liquidity raise a series of pressing policy questions: what characteristics make a country vulnerable to shifts in global liquidity? Has the importance of global liquidity and its sensitivity to its determinants, changed over time? What is the right policy mix to contain the consequences of liquidity shocks? Does macroprudential policy contribute to stabilize the financial system in the presence of global liquidity shocks? In the present volume, we discuss several of these issues based on the experiences of Asian emerging market economies over the most recent liquidity cycles.

To set the scene for the team project papers in this volume, we also discuss results from a Bayesian Panel VAR model for selected Asian emerging market economies. In this model, we study the response of key macroeconomic and financial variables for a sample consisting of Korea, Hong Kong, Singapore, Thailand, the Philippines, Malaysia and Indonesia over the period 2004Q1 to 2015Q2. A Panel VAR model is well suited to extract the responses to a shock to global liquidity for a hypothetical "average" Asian economy when the short sample size does not warrant estimating country-specific regression models. The drawback is that the model necessarily ignores the country heterogeneity mentioned before. However, after providing some benchmark results in this chapter, the subsequent contributions will shed light on the country-specific challenges arising from fluctuations in global liquidity. The results suggest that shocks to global liquidity, for which we use alternative proxies, have expansionary effects on output and prices and lead

to an appreciation of stock prices and real exchange rates. These effects are in line with a large body of existing empirical research. We also find that monetary policy typically responds to a sudden surge in liquidity by tightening monetary conditions. Our results suggest that spillovers of liquidity are not constant over time. In addition, the dependence of their intensity on the global economic context make the design of appropriate policies difficult. Therefore, structural reform policies and sound fundamentals that reduce the exposure and susceptibility to external liquidity shocks should be the primary policy task. Monetary, fiscal and macroprudential policies can cushion the immediate fallout from sudden inflows and sudden stops of global liquidity, respectively, but they cannot mitigate the underlying vulnerabilities.

This chapter is organized as follows: in Section 2 we survey the essentials on global liquidity, that is, its conceptual background, its measurement and its evolution over the recent past. Section 3 summarizes the recent literature on global liquidity and its effects while Section 4 presents results from the estimated Bayesian Panel VAR model as well as a battery of robustness tests. Section 5 discusses the use of macroprudential policies in Asia. Section 6 provides a preview on the subsequent chapters contained in this report. Finally, Section 7 draws some tentative policy conclusions.

2. Global Liquidity: Concept, Measurement and Experience

In this section, we provide an overview of several aspects related to the conceptual definition of global liquidity to its measurement and to the discussion of the evolution of global liquidity over the past 15 years.

2.1 What is Global Liquidity?

Shin (Shin 2013a, Shin 2013b) defines global liquidity as the "ease of finance". Global liquidity can be understood best by discussing the forces that contribute to its increase or decrease. Since many central banks in advanced economies employ non-standard monetary policy measures, many observers link global liquidity with the spillovers from policymaking in these countries. However, the focus on monetary policy captures only a part of the nature of global liquidity, although certainly a very important one in the post-2008 global financial system.

In fact, global liquidity is created by three players in the financial system:

1. Liquidity is provided by financial intermediaries when they extend credit to the private sector. Over the recent years, this increasingly takes the form of cross-border credit.

2. Central banks provide liquidity or shorten the supply of liquidity as a consequence of their policy steps. This is true for both conventional monetary policy and non-conventional monetary policy such as asset purchases. It is the scale of recent unconventional policy steps that put central banks center stage in the debate about global liquidity. Central banks in advanced economies, among them the Fed, the Bank of England, the European Central Bank and the Bank of Japan, have drastically increased the size of their balance sheet, thus providing an enormous amount of liquidity to the financial system. As a consequence of the role of central banks in the creation of liquidity, monetary policy indicators, such as short-term interest rates, are often used to proxy global liquidity. We come to the measurement issues below.

3. Changes in the risk appetite of investors drive global liquidity. A sudden drop in risk appetite of investors in advanced economies, often loosely referred to as an increase in risk aversion, leads to a drying-out of liquidity available to emerging economies as investors repatriate funds. The most pronounced spike in risk aversion was observed in the immediate aftermath of the Lehman Brothers collapse in September 2008.

It is important to treat these three determinants not as orthogonal driving forces of global liquidity. Rather, all three determinants are endogenous and jointly determined by structural shocks hitting advanced and emerging economies. The amount of liquidity provided to the global financial system depends on the interaction of central banks, financial intermediaries and private investors in the financial market. Banks' liquidity creation is likely to respond to monetary conditions and risk aversion. Liquidity creation exogenous only to the extent exogenous liquidity supply shocks are important. Likewise, monetary conditions are ultimately responsive to a shortage of liquidity and a spike in risk aversion like in the fall of 2008. In practice, this mutual interdependence means that (1) a set of indicators is needed to gauge the extent of global liquidity; and, (2) a formal econometric analysis is required to study the response of global liquidity to exogenous shocks.

2.2 How Can We Measure Global Liquidity?

Due to the complex nature of global liquidity, no single indicator captures all its facets. Instead, a wide array of indicators is typically used in order to gauge the different aspects of global liquidity.[4] In particular, the evolution of global liquidity can be characterized based on the dynamics of (1) outstanding credit in US dollar to the rest of the world and emerging Asia-Pacific, respectively; (2) interest rates, both long-term and short-term, in advanced economies; and, (3) a measure of global

4. See McGuire and Sushko (2015) for a summary of alternative indicators and a detailed discussion of stylized facts.

investors' risk aversion. While all three measures reflect a specific aspect of global liquidity and differ in their evolution over time, together they provide a consistent view.

These three indicators match the three driving forces of global credit discussed in the previous section: the first indicator is a quantity-based measure of global liquidity. The BIS has put together a very useful collection of quantify based indicators based on alternative currency denominations and geographical regions.[5] For the empirical analysis below, we will focus on the outstanding amounts of US dollar denominated credit to the non-resident non-bank sector taken from the BIS website.[6]

The second indicator, interest rates in advanced economies, is a price-based measure. Below, we use both US short-term policy rates and long-term bond yields to measure global liquidity conditions. A particular challenge is the zero lower bound on nominal interest rates which many central banks in advanced economies have circumvented using non-standard monetary policy measures such as asset purchases. Hence, since 2008 the short-term money market rate is no longer adequately reflecting liquidity conditions. Instead, we use the shadow interest rate for the US, the UK, the Euro Area and Japan as provided by Krippner (2016). The shadow rate is the policy rate we would observe in the absence of the zero lower bound on nominal interest rates and can be obtained from information incorporated in the term structure of interest rates.[7]

The third indicator is a risk-based measure of global liquidity. Often the VIX index of implied stock market volatility, i.e., the expected volatility over the short-term, as provided by the Chicago Board of Trade is used.[8] It should be kept in mind that the VIX index is an inaccurate measure of investors' risk aversion. Rather, the VIX reflects both risk aversion of market participants and the expected amount of risk.[9]

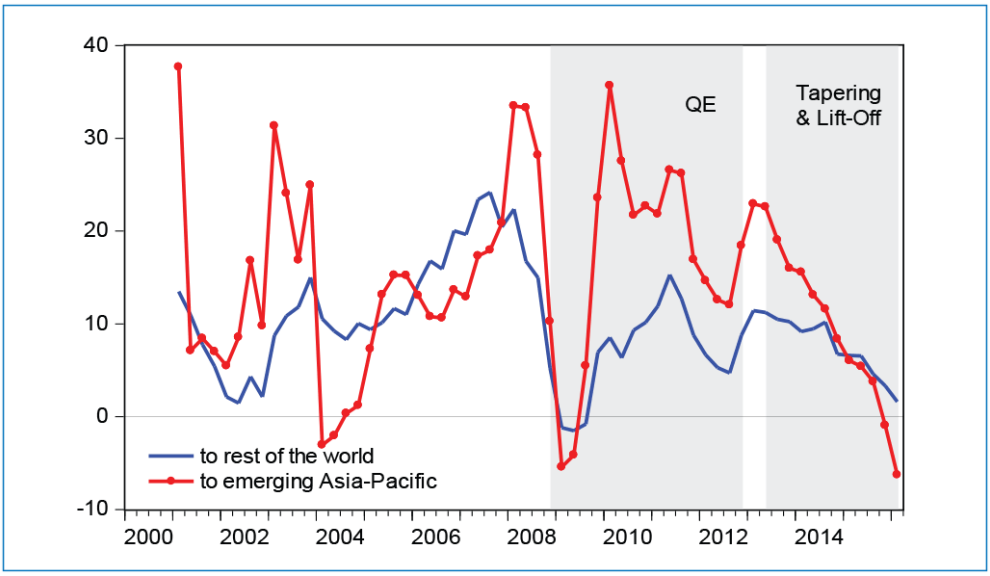
The subsequent section describes the recent evolution of all three types of global liquidity indicators.

5. The BIS data set can be found at https://www.bis.org/statistics/gli.htm.
6. McCauley et al. (2015) discuss a shortcoming of this measure: if firms obtain US$ credit from offshore affiliates, the measure we use is incomplete.
7. Available at http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy.
8. While the VIX measures volatility in the U.S. stock market, indices are also available for other economies such as the VSTOXX for the Euro Area.
9. Recent work by Bekaert et al. (2013) decomposes the VIX index in its two components.

2.3 The Evolution of Global Liquidity

In this section, we discuss the evolution of global liquidity based on three alternative indicators mentioned in the previous section. Following the classification of Shin (2013 a, b) and Azis and Shin (2015), we can distinguish three phases of global liquidity. The first phase describes the experience until the eve of the great financial crisis in 2008. The start of this first phase is often located at the end of the 2001 recession in the US, that is, in 2003.

Figure 1
Global Liquidity as Measured by Global US$ Credit



Notes: The blue line is the growth rate of global US$ credit (in percentage points) to the rest of the world. The red line is the growth rate of US$ credit to emerging Asia-Pacific. QE refers to the period of Quantitative Easing between 2008 and 2013 of the U.S. Fed. Tapering and Lift-Off refers to the exit from QE and the return of interest rate policy since May 2013.

Data Source: BIS Website on Global Liquidity Indicators.

Figure 1 presents quantity-based measures of liquidity conditions. The figure shows the evolution of the outstanding amounts of US dollar denominated credit to the non-resident non-bank sector.[10] We distinguish two recipient regions of US dollar credit: the rest of the world as an extremely broad definition and emerging Asia-

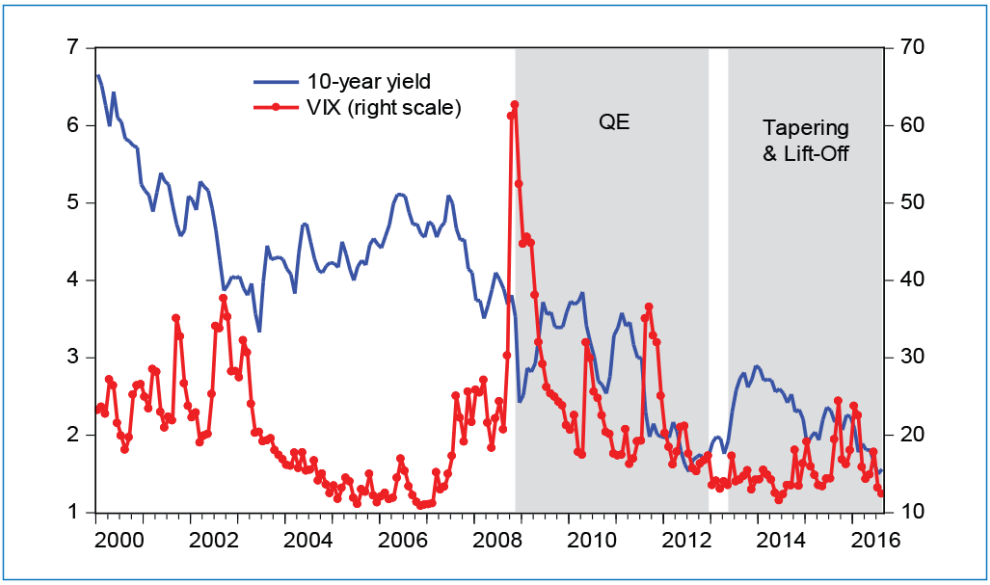
10. This data is taken from the BIS's global liquidity indicators website. He and McCauley (2013) survey the growth of foreign currency credit as a global transmission mechanism, which is in line with the measure of global liquidity used here.

Pacific as a more narrow and focused definition. In the empirical analysis below, we will also use US credit to all emerging market economies. Both credit series in Figure 1 are presented as quarterly year-on-year growth rates.

2.3.1 The First Phase of Global Liquidity

The first phase of global liquidity can be clearly seen: both credit growth rates increase steeply over time and reach their maximum in the summer of 2008. Right before the start of the financial crisis, global credit to emerging Asia-Pacific grew with a yearly rate of more than 30%. Figure 2 plots the evolution of the US long-term interest rate and the VIX index of implied volatility. While the former will be discussed below, the latter is a widely-used indicator of global investors' degree of risk aversion. The graph shows that the first phase of global liquidity was supported by exceptionally low levels of risk aversion.

Figure 2
Global Liquidity as Measured by US Bond Yields and Risk Aversion



Notes: The blue line is the U.S. 10-year constant maturity bond yield (left scale, in percentage points). The red line is the implied equity market volatility index (VIX), a measure of global risk aversion (right scale, in index numbers). QE refers to the period of Quantitative Easing between 2008 and 2013 of the U.S. Fed. Tapering and Lift-Off refers to the exit from QE and the return of interest rate policy since May 2013.

Data Source: FRED Database.

According to Shin (2013 a, b), the first phase of global liquidity had the global expansion of banks at its core. Through global banking groups, loose financial conditions were transmitted to the rest of the world. A characteristic of this process has been an increase in leverage of banks and other financial institutions (Shin 2013 a, b). The expansion of global banking also lays the ground for the rapid retrenchment of credit soon after the outbreak of the financial crisis.

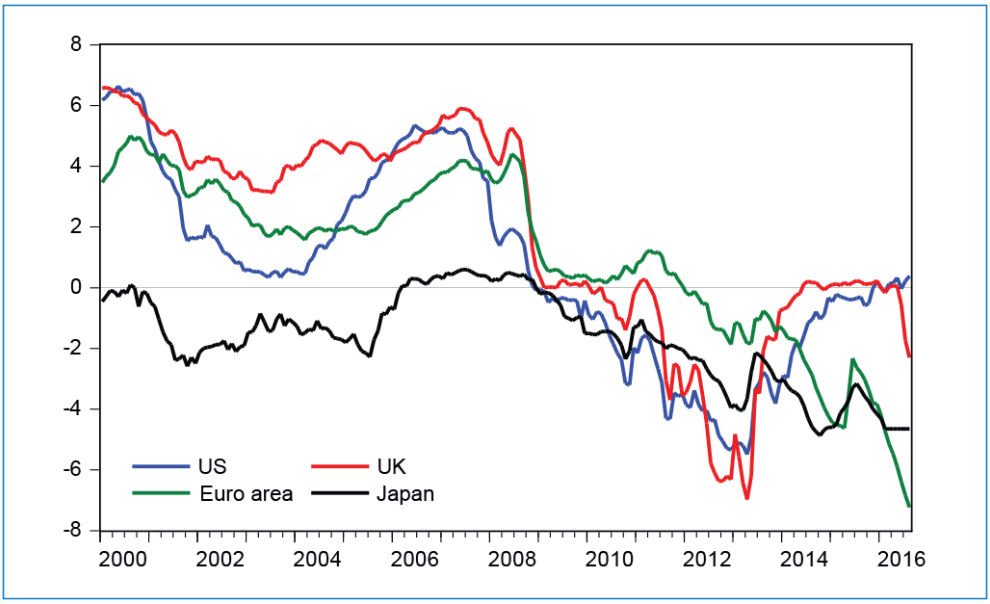
Within two quarters after the collapse of Lehman Brothers in September 2008, the growth rates of global credit fell below zero. Global liquidity came to a complete standstill as banks and investors were keen to repatriate their funds and global risk aversion exploded (see Figures 1 and 2). This sudden stop of capital inflows spread the crisis from advanced to emerging economies, which themselves did not suffer from systemic bank stress. Figure 1 shows that emerging Asia-Pacific was hit hard as the growth of credit fell from 30% to about -5%, a fall that was larger than the drop in credit to the rest of the world.

While the magnitude of the sudden stop was highest in Asia compared to other emerging regions, so was the speed and the size of the return of global liquidity. Within a year, credit growth has been even higher than the pre-crisis level. Throughout 2010, the growth of credit to Asia-Pacific was twice as large as the change in credit to the rest of the world.

2.3.2 The Second Phase of Global Liquidity

This reversal of liquidity is at the heart of the second phase of global liquidity. Following Shin (2013 a, b), the bond market now moves center stage. Global investors were "searching for yield" increasingly invested in emerging market economies, exploiting a huge return differential with respect to most advanced economies. To contain the fallout from the financial crisis and to stimulate aggregate demand, most central banks in advanced economies cut their policy rates aggressively. Upon reaching the zero lower bound on nominal interest rates, the US, the UK and, with some delay, also the Bank of Japan and the ECB adopted unconventional monetary policies in order to provide additional stimulus to their ailing economies. At the center of these unorthodox policies was Quantitative Easing (QE), the creation of central bank money in order to purchase government bonds and private sector-assets. In the years of Quantitative Easing, balance sheets of the central banks involved grew by a factor of two or three, thus generating an unprecedented abundance of liquidity.

Figure 3
Global Liquidity as Measured by (Shadow) Short-term Interest Rates



Notes: (Shadow) short-term interest rates set by central banks (in percentage points).

Data Source: Leo Krippner's RBNZ Website.

The scale of expansionary monetary policies can be represented by the shadow short-term interest rate. Figure 3 plots the shadow rates calculated by Krippner (2016) for the US, the UK, the Euro Area and Japan. Above the zero lower bound, the shadow rates correspond to the respective money market rates, i.e. the Federal Funds rate in the US case. Shadow rates in the US and the UK reached the minima in early 2013 at levels of -5 to -6%. Since the asset purchase programs of the Bank of Japan and the Euro Area were adopted in 2014 and 2015, respectively, the shadow rates for Japan and the Euro Area reach their minima towards the end of our sample period. Provided with cheap liquidity and with the perspective of interest rates staying close to zero for a long period of time, investors started to search for returns elsewhere - with emerging markets offering an attractive and, at that time, also safer alternative to advanced economies. This was supported by low risk aversion as measured by the VIX index reaching pre-crisis levels again.

During the second phase of global liquidity policymakers in emerging economies quickly started to worry about the side effects of such a strong inflow of liquidity raging from exchange rate appreciation, an unwelcome easing of credit conditions, the fear of property price bubbles to concerns about financial stability.

These concerns and some of the policy responses taken in emerging Asia will be described in some detail below.

2.3.3 The Third Phase of Global Liquidity

When in May 2013 Ben Bernanke, the Chairman of the US Federal Reserve, mentioned the possibility of unwinding asset purchases for the first time, markets reacted strongly. The resulting period of high volatility, an appreciation of the US dollar and a strong increase in US yields is known as the "taper tantrum". Long-term interest rates in the US (see Figure 2), rose by 100 basis points within weeks after Bernanke's remarks as higher future short-term policy rates were considered more likely.

The perspective of a return of monetary policy back to normal triggered a flight of liquidity from emerging markets.[11] The side effects of large capital inflows were now observed in reverse: emerging markets currencies lost value, bond yields rose and economies depending on cheap foreign capital stagnated. This episode is known as the third phase of global liquidity. Shadow short-term interest rate in the US and the UK gradually increased since 2013. The effects were magnified by the uncertainty surrounding the direction of Federal Reserve policy. While some expected an early tapering decision, possibly in June or July 2013, others expected a gradual reduction in asset purchases. This uncertainty, which was resolved in 2014 when the Fed communicated its stepwise reduction in asset purchases, was reappearing in the second half of 2015 when the Fed was expected to start the "lift-off", the eventual return to interest rate policy and the first interest increase for more than nine years. Throughout the third phase, the growth of US credit to emerging Asia fell steadily and reached zero in early 2016. This period is also characterized by an increasing awareness of Fed policy makers of the global spillovers of policy decisions (see Fisher 2015).

3. The Recent Literature on Global Liquidity and Emerging Market Economies

In this section, we highlight the connections of the present study with the existing literature. Since an extensive literature survey is beyond the scope of this project, we only discuss the most recent pieces of an otherwise large body of research.

11. Aizenman et al. (2016), Eichengreen and Gupta (2015) and Meinusch and Tillmann (2016) present empirical evidence on the effects of the "taper tantrum" on financial markets in advanced and emerging economies.

After the Asian financial crisis in 1997, a literature emerged that classifies capital flows to emerging markets as driven by push and pull factors (see Calvo et al. 1996). Push factors, such as expansionary monetary conditions or low growth expectations in advanced economies lead investors to channel funds into emerging markets yielding a higher return. Pull factors, in contrast, describe factors within emerging markets which attract capital inflows. Among them are high interest rates and a booming economy. In light of this literature, shocks to global liquidity reflect push factors rather than pull factors. The drivers of global liquidity are determined in advanced economies. The important consequence for policy making is that fluctuations in global liquidity are clearly exogenous from the perspective of emerging economies.

A second strand of the literature provides a systematic analysis of capital flow episodes. Based on a large panel data set, "surges" of capital inflows are separated from periods of retrenchment and other forms of extreme capital flows dynamics based on a consistent definition.[12] In a recent contribution to this line of research, Ghosh et al. (2016) provocatively ask: "when do capital inflows end in tears?". They show that global push factors such as monetary policy or risk aversion determine whether and how inflow surges come to an end. However, how painful the consequences of the sudden stop are is determined by whether the country has built up macroeconomic and financial vulnerabilities. The authors estimate a probit model to understand the determinants of soft versus hard sudden stops of capital and show that factors such as a large share of capital inflows in debt rather than foreign direct investment, low foreign exchange reserves, among others, make a painful stop more likely.

A third strand focuses on spillover effects to emerging economies originating from monetary and regulatory policies in advanced economies.[13] Important studies have been put forward by Bowman et al. (2014), Chen et al. (2012), Fratzscher et al. (2013), Lim et al. (2014) and Moore et al. (2013). The pre-crisis work by Kim (2001) and Mackowiak (2007), who use structural (Bayesian) VAR models, has been challenged by the new policy frameworks after 2008. One challenge is to aggregate the different unconventional policy measures used by the Fed and other central banks into one indicator of policy. Tillmann (2016) uses a Qual VAR that estimates a latent variable to capture the stance of monetary policy. The results suggest that spillovers are sizable and drive financial conditions in emerging markets. Another challenge is the identification of structural monetary policy shocks in a model with advanced and emerging economies. Tillmann

12. See also Forbes and Warnock (2012) and Ghosh et al. (2012), among others.

13. The spillovers to advanced economies are investigated by Bauer and Neely (2014) and Neely (2015). IMF (2013 a, b) provides useful surveys on the resulting policy issues.

(2013) identifies a capital inflow shock using suitable sign restrictions on a VAR model.[14]

Finally, there is a growing literature on global liquidity, which is conceptually slightly different from the work on capital inflows.[15] Cesa-Bianchi et al. (2015) study the evolution of house prices up to 2012 and investigate whether global liquidity plays a role for global house price appreciation. They estimate a VAR model which is identified using an external instrument as in Stock and Watson (2012), Gertler and Karadi (2015) and Mertens and Ravn (2013). The authors use changes in bank-to-bank credit as an instrument to identify global liquidity shocks. They find global liquidity to be a very important driver of house price dynamics.

Chen et al. (2012) combine quantity data on core and non-core liabilities with corresponding price data. Based on the interaction of prices and quantities, they are able to identify supply and demand shocks, respectively, of global liquidity, which have large real and financial effects. Eickmeier et al. (2014) employ a factor model for a large number of liquidity indicators for both advanced and emerging economies. The common factor that drives indicators across countries is proposed as a measure of global liquidity. By imposing restrictions of the signs of impulse response functions, they also identify a global credit supply and global credit demand shock, respectively.

4. Setting the Stage: A Bayesian Panel VAR Model for Asia

In this section, we present an empirical study that sets the stage for the team project papers in this report. In particular, we take a broad perspective and abstract from economy specific circumstances. We investigate how strong the effects on Asian emerging market economies of global liquidity shocks are. The purpose of this study is to characterize the macroeconomic and financial adjustment emerging markets go through once they are hit by a sudden increase in global liquidity. The team project papers following below will elaborate further on the specific challenges faced by individual economies.

The empirical study is based on an estimated Bayesian Panel Vector Autoregression (BVAR), which includes several Asian economies. Since the time span available for each economy, in particular the sample period after the financial

14. Belke et al. (2016) estimate a VAR model with high-frequency data for Asian economies and sheds light on the contribution of monetary policy in advanced economies on long-term interest rates.

15. See Sun (2015) for a survey of the changing financial systems in Asia due to large inflows of global liquidity and a discussion of the consequences for macroprudential and financial stability policies.

crisis, is relatively short, a panel model is preferable over a single-country model. While the panel structure is preferable from a methodological point of view, a drawback from an economic perspective is that we cannot take into account country-specific circumstances and policy responses. Rather, the model pools all economies together in order to maximize the degrees of freedom available for estimation. We believe this drawback is not too restrictive as the analyses presented in the remaining chapters of this report will be devoted to country-specific experiences. Nevertheless, we will also carve out the effects of country-specific characteristics by changing the composition of the panel. Leaving out economies or comparing groups of economies helps us isolate the heterogeneity of the dynamic responses across economies.

The benchmark panel VAR comprises data from seven economies: Korea, Hong Kong, Singapore, Thailand, the Philippines, Malaysia and Indonesia. Initially, we tried to include more economies. However, since we rely on a sufficient number of macroeconomic variables, which are not available for many other economies, we define this model as our benchmark specification. The data we include is measured at a quarterly frequency and covers the period 2004Q1 to 2015Q2. It turned out to be difficult to obtain data beyond 2015Q2 for all economies. The sample includes the pre-crisis period, the immediate aftermath of the crisis, the period in which the central banks around the global engaged in unconventional monetary policies and the recent return to conventional interest rate policy with the lift-off of the Federal funds rate in December 2015.

The following data series are included for each economy: real Gross Domestic Product (*GDP*), the consumer price index (*CPI*), the short-term (*Short*) and the long-term interest rate (*Long*), the exchange rate (*FX*) and the stock price (*Stock*) index. The first two variables capture the business cycle in each economy. The other four variables reflect monetary and financial conditions. All variables other than the two interest rate series are included in log levels (multiplied by 100). The two interest rate series are measured in percentage points.

While the variables introduced so far reflect domestic economic conditions, we also need to capture the dynamics of global liquidity. For this purpose, we use the log level of US$ dollar credit to non-financial institutions taken from the BIS website on global liquidity indicators mentioned before. This variable is included in each cross-sectional unit, i.e., for each country. We use three alternative geographical definitions of global credit (*glcredit*): the first measures the amount of credit given to the rest of the world. This is our benchmark global liquidity indicator, which we refer to as “global credit”. The second is US$ credit given to emerging market economies, which we refer to as “EME credit”. The third is US$ credit given to

emerging market countries in Asia and Pacific, which we refer to as "Asia-Pacific credit". To summarize, the vector of endogenous variables is:

$$Y_t = \{\log(glcredit_t)\ \log(GDP_t)\ \ \log(CPI_t)\ Short_t\ \ Long_t\ \ log(FX_t)\ \ log(Stock_t)\}'$$

A drawback of the model sketched thus far is that we include global credit, which from the perspective of each Asian economy is clearly exogenous, among our otherwise endogenous variables. However, the VAR coefficient estimates will most likely reflect this such that the feedback from national variables to global liquidity is minimal. Furthermore, the recursive identification scheme discussed below guarantees zero contemporaneous feedback from domestic variables to global credit.

One of the key advantages of using a VAR framework is its ability to show the response of the variables to shocks, that is, unexpected changes in macroeconomic conditions. To utilize this property of VAR models, identifying assumptions have to made. Here, we are interested in a shock to US dollar credit, which we interpret as a shock to global liquidity. We employ the most widely used identifying assumption which relies on restricting the contemporaneous responses of the variables. It is assumed that a shock to global conditions drive all other variables contemporaneously. The opposite, however, is not possible. As mentioned before, this is an innocuous assumption as all economies included in the panel model are small open economies whose feedback on global credit is negligible. This gives us a simple and very robust model -two properties which are highly valuable given the short sample period. We include two lags of the variables. In light of the short sample period, we prefer a parsimonious model over a model with a richer lag structure.

The model is Bayesian in the sense that it combines information from a prior on the distribution of the VAR coefficients (Normal-Wishart) and the variance-covariance matrix (inverted Wishart) with data from the sample. Making use of prior information is beneficial since the quarterly sample is relatively short.[16] The estimation has been carried out using the BEAR toolbox for MATLAB developed by Dieppe et al. (2016).[17]

4.1 Understanding Global Credit as a Measure of Global Liquidity

Before we present the results from the Bayesian Panel VAR model, we need to shed light on the properties of our primary measure of global liquidity. Global US$ credit, the measure we use, is itself driven by interest rates in advanced economies

16. We use 2000 estimations with a burn-in of 1000. This is sufficient for this relatively straightforward class of models.

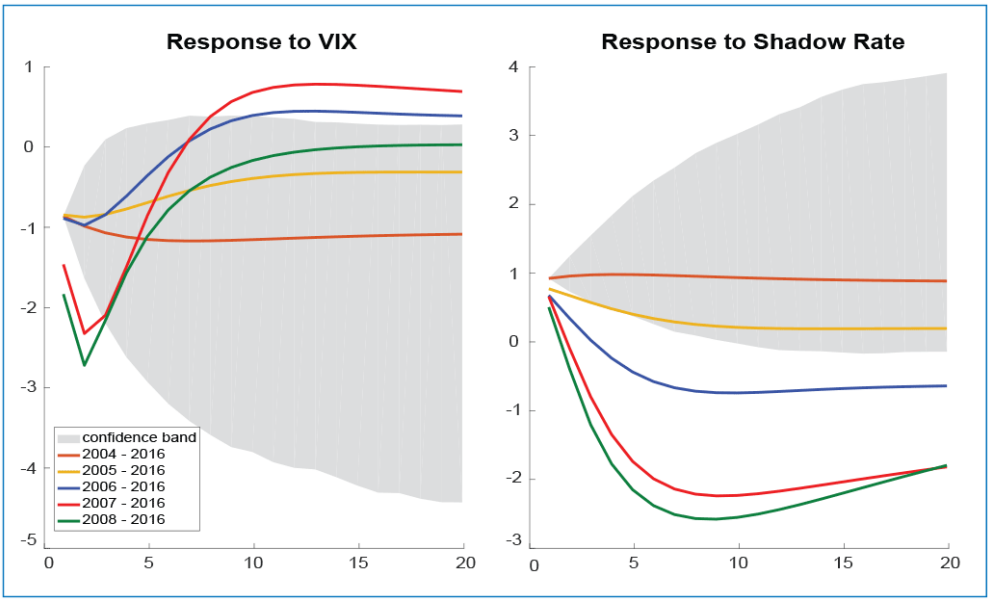
17. I thank David Finck for help with estimating the models.

and the risk appetite of investors. To show how sensitive global US$ credit is with respect to interest rates and risk aversion, we estimate a standard three-dimensional Vector Autoregression (VAR) first. The VAR model comprises three endogenous variables: first, the log of the VIX index of implied volatility. Second, the US shadow short-term interest rate provided by Krippner (2016). Third, the log of global US$ credit to Asia-Pacific emerging economies. Hence, the vector of endogenous variables is:

$$Y_t = \{log(VIX_t) \quad US\_Shadow_t \quad \log(glcredit_t)\}'$$

The identification of structural shocks is achieved through a Cholesky ordering: we assume that the shadow rate does not respond in a given quarter to risk aversion and global liquidity. At the same time, the VIX index and global liquidity are allowed to respond contemporaneously to monetary policy. We expect global liquidity to fall after a tightening monetary policy shock and a positive shock to risk aversion, respectively.

Figure 4
Response of Global Credit to VIX and US Monetary Policy



Notes: Response of US$ credit to Asia-Pacific emerging markets to a shock to the VIX index (left panel) and the (shadow) Federal Funds rate (right panel) for alternative estimation samples.

The results are presented in Figure 4. We depict the responses for the baseline sample (2004-2015) and for five alternative, more recent subsamples.[18] The results suggest that tighter monetary policy in the US and higher risk aversion, indeed, reduce global liquidity. The effectiveness of both shocks increases strongly for more recent sample periods suggesting that the events after the global financial crisis have implied structural breaks after which the sensitivity of global liquidity to its determinants intensified.

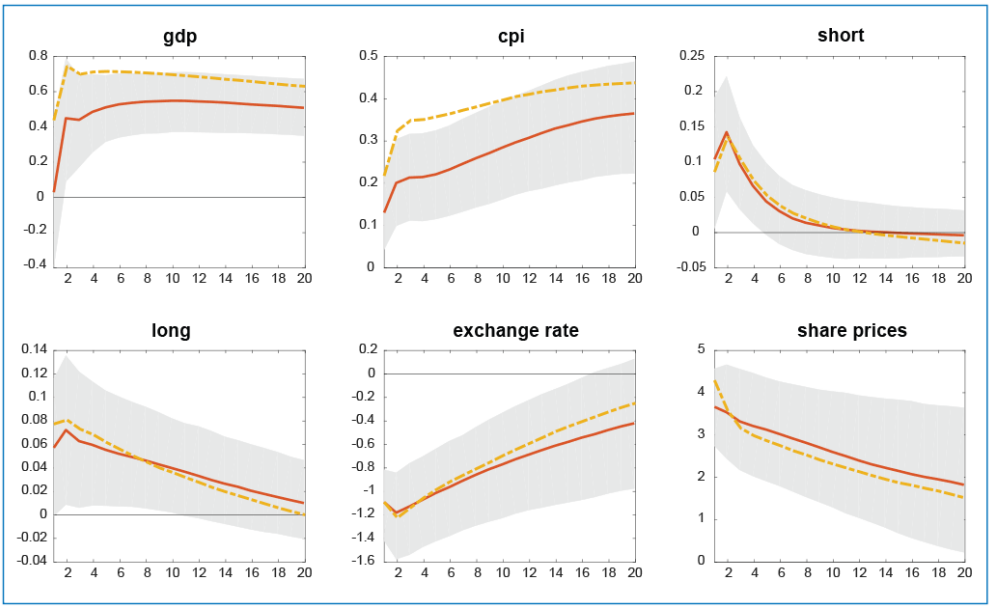
4.2 Benchmark Results

The results of the baseline model are shown in Figure 5. The figure shows the responses of the endogenous variables to a shock to global credit one standard deviation in size. In section 4.1, we have studied the underlying driving forces behind an increase in global credit. We depict the response to a shock to global US$ credit (in red) and to credit to emerging Asia-Pacific (in yellow). To save space, we do not report the response of global credit itself. A shock to global liquidity is expansionary for the domestic economy. Both real GDP and CPI increase by 0.3% to 0.4%. This response is long lasting as both variables return to their initial value more than 30 quarters after the shock. The persistence of the responses is a consequence of estimating the model in (log) levels. For both variables, the response is even stronger when a shock to credit to Asia-Pacific is considered. This is plausible since the global credit series covers liquidity flows to all parts of the world while the latter series covers the Asia-Pacific region only.

Short- and long-term interest rate increase following a liquidity shock. Since the short-rate rises more than the long-rate, the term structure flattens. A priori, the response of the interest rate is ambiguous. On the one hand, an inflow of global liquidity should ease monetary conditions and lead to a fall in long-term rates. On the other, domestic monetary policy will tighten in order to stabilize the economy after the shock. If the latter effect dominates the first, the long-term rate will increase.

18. Due to the short sample for the most recent estimation periods, we restrict the lag order to one.

Figure 5
Response of Asian Economies to a Shock to US$ Credit



Notes: The red line is the impulse response to a one standard deviation shock to global US$ credit flows. The shaded area is the 90% error band around this impulse response. The yellow (dotted) line is the response to a shock to US$ credit flows to emerging market economies. The horizontal axis indicates the quarters after the shock.

The remaining two variable reflect financial conditions. As expected, a shock to global liquidity, whether a shock to global or Asia-Pacific credit, leads to an appreciation of the real exchange rate, i.e., a fall in the exchange rate series, and a strong increase in stock prices. The real exchange rate appreciates by 1% and stock prices surge by 4%. To summarize, a shock to global liquidity leads to strong responses in Asian economies: the real economy expands and prices rise, interest rates go up and asset prices soar. All responses are highly statistically significant.

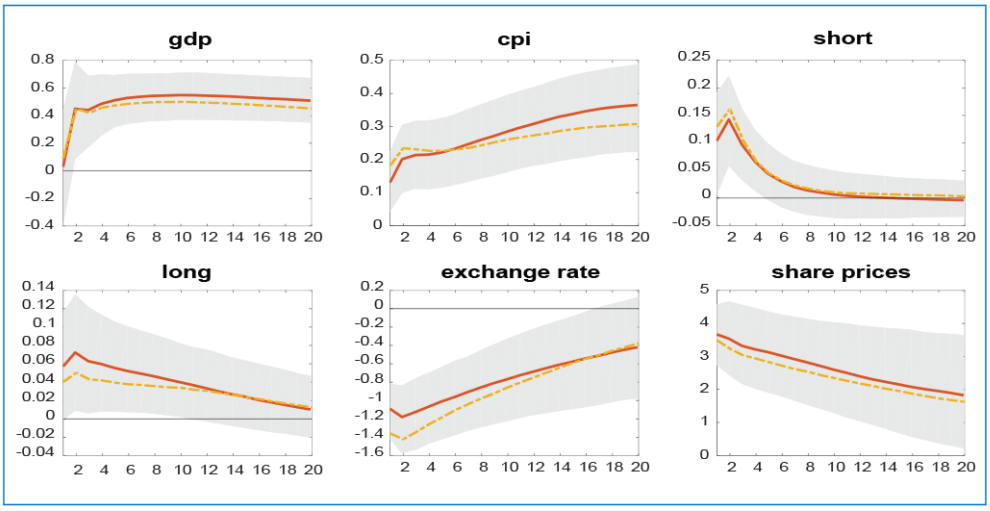
4.3 Results from Alternative Specifications

In this section, we present a battery of robustness checks in order to corroborate the reliability of our findings and to shed light on the role of country-specific characteristics. In Figure 6, we plot the benchmark responses (in red) against the responses of a sample of economies that excludes Hong Kong and Singapore. The reason for excluding these two economies is that both economies' monetary authorities actively manage their exchange rate. In the case of Hong Kong, a full currency board exists vis-a-vis the US$. In all other economies in our sample, the exchange rate is considered flexible. We expect that excluding economies with a

managed exchange rate leads to an even stronger real exchange rate response than for the full sample. A shock to global liquidity in the modified sample has broadly similar effects. Notably, the exchange rate response is substantively stronger.

In a second robustness check, we broaden the sample and estimate the model for two groups of economies. We want to see whether advanced economies in Asia respond differently compared to emerging economies in Asia. For that purpose, we split the data into two panels and estimate the model for each of the two panels. The first group consists of Korea, Chinese Taipei, Hong Kong and Singapore. We interpret these economies as reflecting more advanced Asian economies. The second group consists of Malaysia, Thailand, Indonesia and the Philippines. Since data on real GDP and prices were not available for all of these economies, we restrict this model to the financial variables only.

Figure 6
Response of Asian Economies to a Shock to US$ Credit – the Role of Hong Kong and Singapore



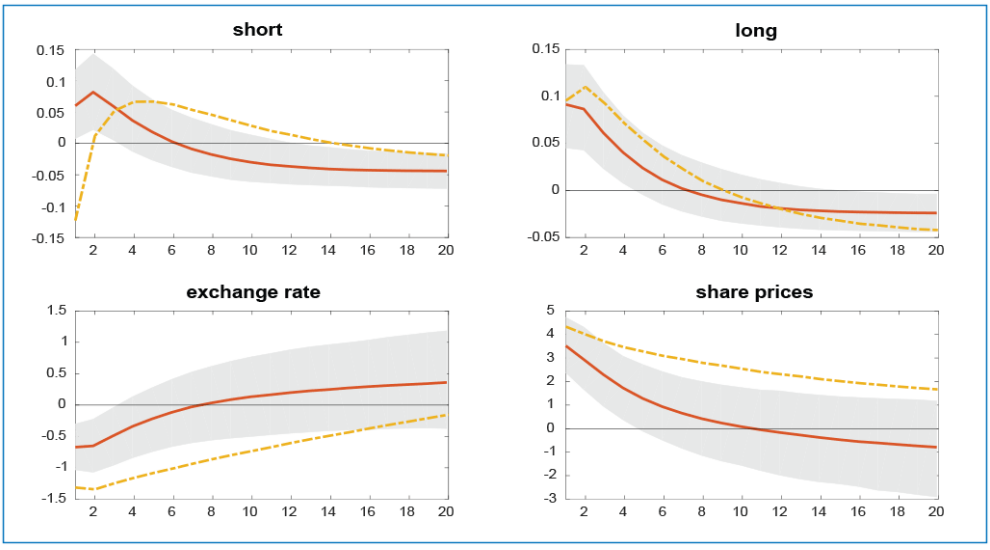
Notes: The red line is the benchmark impulse response to a one standard deviation shock to global US$ credit flows. The shaded area is the 90% error band around this impulse response. The yellow (dotted) line is the response of the sample that excludes Hong Kong and Singapore. The horizontal axis indicates the quarters after the shock.

Figure 7 reports the resulting impulse response functions for each group. For the long-term interest rate, the real exchange rate and stock prices, we see that the second group, developing Asia, responds much stronger to the shock than the first group, advanced Asia. For the real exchange rate and stock prices, the response for developing Asia lies outside the error band around the responses of emerging Asia. Thus, the adjustment in light of global liquidity shocks are much stronger in Malaysia,

Indonesia, Thailand and the Philippines compared to other Asian economies. It is worth noting that the response of the short-term interest rate is initially negative for developing Asia and positive for advanced Asia. This difference suggests that in developing Asia, monetary policy is more reluctant to tighten in light of inflows of global liquidity, possibly fearing the adverse feedback from higher short-term rates on capital inflows.

Before we discussed results for shocks to global US$ credit versus credit to emerging market economies. Now we narrow that further down to shocks to US$ credit to emerging Asia-Pacific economies. This geographical distinction follows the BIS's statistics on global liquidity and does not exactly correspond to the economies used in the panel presented before. Nevertheless, we expect the impulse responses to be stronger the more geographically focused the credit flow series is. Figure 8 presents the impulse response functions for two different shocks, one to emerging market economies in general and one to emerging Asia-Pacific economies. For the output and prices, our sample economies respond slightly more strongly to Asia-Pacific credit flows. The same is true for long-term interest rates and stocks prices. For the real exchange rate, there seems to be no difference in the impulse responses.

Figure 7
Response of Asian Economies to a Shock to US$ Credit – Advanced Versus Emerging Asia



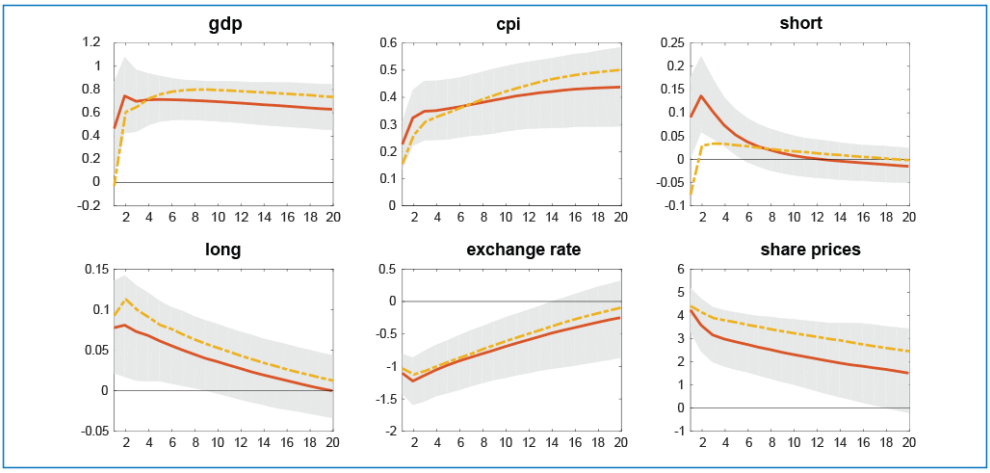
Notes: The red line is the impulse response of advanced Asian economies (Korea, Hong Kong, Singapore, Chinese Taipei) to a one standard deviation shock to global US$ credit flows. The shaded area is the 90% error band around this impulse response. The yellow (dotted) line is the response of emerging Asian economies (Malaysia, Thailand, Indonesia, Philippines). The horizontal axis indicates the quarters after the shock.

The most striking difference can be observed for the response of the short-term interest rate. A shock to Asia-Pacific credit flows leads to lower short-term rates as central bank ease monetary policy in order to reduce the return differential against the US economy. If instead, the aggregate credit flows series covering all emerging economies is used, we again find a positive response of the interest rate, that is, a policy tightening. However, this finding stems from the pre-2008 policy response as we will see below.

It is widely believed that spillovers of monetary policy as well as the repercussions of shifts in global risk aversion changed after the global financial crisis of 2008/09. To shed light on this hypothesis, we estimate the model with both US$ emerging market credit and Asia-Pacific credit over a shorter sample period that starts in 2008Q4, i.e., in the month after the collapse of Lehman Brothers which triggered the crisis. Figure 9 shows the impulse response functions for this shorter sample, again both for emerging market credit flows in general and the specific flows directed towards emerging Asia-Pacific economies. Two findings stand out: first, the stock price response is considerably stronger for the post-2008 sample. A shock to global liquidity flowing to Asia-Pacific now leads to an increase of the stock market of 7%. For the full sample, we find an increase of only 4%. Second, for the post-2008 sample, the response of the short-term interest rate is again positive, suggesting that monetary policy tightens in light of liquidity spillovers from advanced economies.

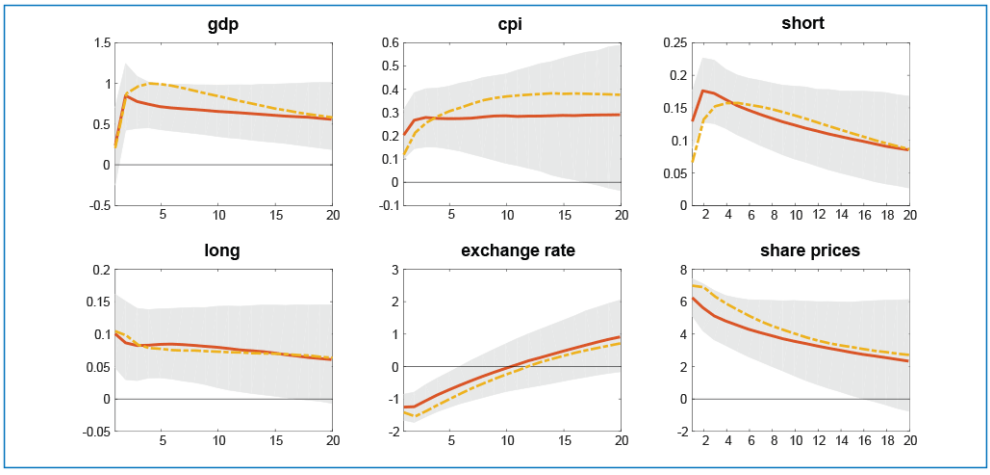
To summarize, we find that shocks to global liquidity, whether measured by global US$ credit, credit to emerging economies or credit to emerging Asia-Pacific, has the expected effects: output and prices increase, financial assets appreciate and monetary policy tightens. All spillover effects estimated here are highly statistically significant and support the view that liquidity spillovers are a quantitatively important challenge for domestic policy makers. As mentioned before, one of the drawbacks of the Panel VAR approach taken here is that we cannot use this model to discuss country-specific circumstances. While we have laid out the big picture, the following chapters collected in this report extensively report on a rich collection of country-specific experiences.

Figure 8
Response of Asian Economies to a Shock to US$ Credit -
Global Emerging Economies Versus Asia-Pacific Economies



Notes: The red line is the impulse response to a one standard deviation shock to US$ credit flows to emerging economies. The shaded area is the 90% error band around this impulse response. The yellow (dotted) line is the response to a shock to US$ credit flows to emerging Asia-Pacific economies. The horizontal axis indicates the quarters after the shock.

Figure 9
Response of Asian Economies to a Shock to US$ Credit -
Global Emerging Economies Versus Asia-Pacific Economies Post-2008

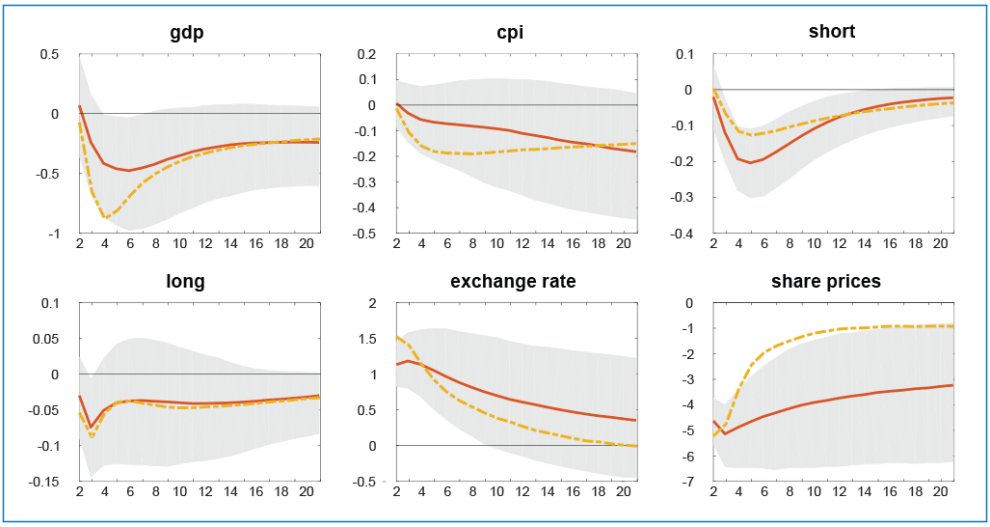


Notes: The red line is the impulse response to a one standard deviation shock to US$ credit flows to emerging economies. The estimation starts in October 2008. The shaded area is the 90% error band around this impulse response. The yellow (dotted) line is the response to a shock to US$ credit flows to emerging Asia-Pacific economies. The horizontal axis indicates the quarters after the shock.

4.4 Shocks to Global Risk Aversion

As mentioned before, surges in global liquidity can also be triggered by a fall in risk aversion of global investors. Likewise, a retrenchment of capital from emerging economies could be the result of a sudden jump in risk aversion as seen, for example, at the peak of the 2008/09 financial crisis. To study the quantitative effects of shifts in risk aversion on Asian economies, we use the panel VAR model and replace the global credit variable with the (log) VIX index, which is the benchmark measure of risk attitudes on global financial markets.

Figure 10
Response of Asian Economies to a VIX Shock - Pre-2008 Versus Post-2008



Notes: The red line is the impulse response to a one standard deviation shock to the VIX index for the full sample. The shaded area is the 90% error band around this impulse response. The yellow (dotted) line is the response to a shock to the VIX index for the post-2008 subsample. The horizontal axis indicates the quarters after the shock.

Figure 10 shows the impulse response functions for a surprise increase in the VIX of one standard deviation. The red line represents the impulse response obtained from a model estimated over 2004 to 2015 and the yellow line shows the response for a crisis sample that starts in 2008 and ends in 2015. As expected, a hike in risk aversion has contractionary effects on emerging economies with GDP and prices falling. This is consistent with the view that an increase in risk aversion leads to capital outflows from emerging economies. Interestingly, the effects on GDP and prices are much larger in the post-2008 subsample. This suggests that liquidity

inflows and outflows triggered by changes in risk aversion were particularly severe since 2008. While the effect on long-term interest rates is almost identical, short-term interest rates respond less in the second subsample. This reflects the reluctance of central banks in the region to tighten monetary policy in the event of a drop in risk aversion and the subsequent inflows of liquidity during the more recent phases of global liquidity.

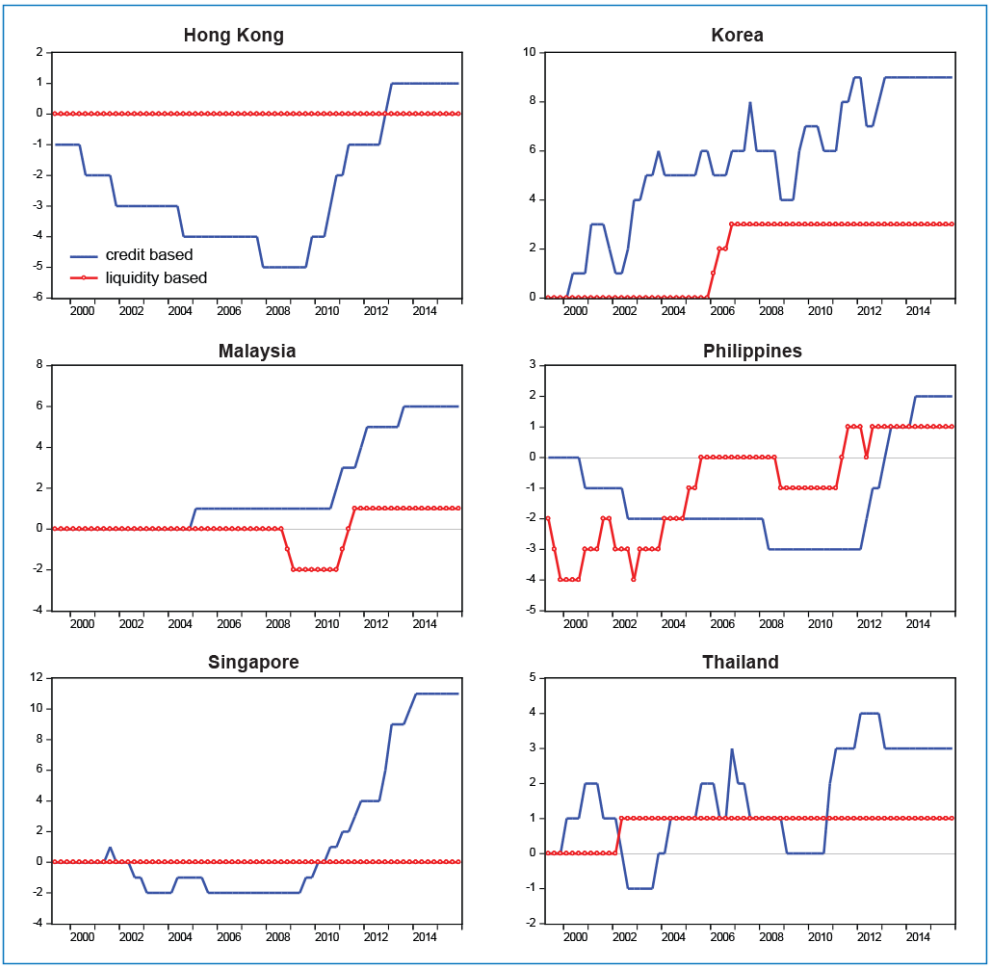
The appreciation of the real exchange rate is even more pronounced in the second subsample, which is again in line with our priors. The largest difference in responses across the sample periods can be observed for stock prices. While the impact effect is almost identical in both samples, stock prices return much faster to the sample mean in the post-2008 sample. This is a tendency that we can also observe for the real exchange rate response. This supports the notion of risk aversion shocks being equally strong in both samples but less short-lived after 2008 than before.

5. Policy Responses to Maintain Financial Stability

The results of the panel VAR model presented before show that, on average, Asian emerging economies reacted to global liquidity shocks by tightening monetary conditions. Raising the short-term interest rate, however, is a double-edged sword: on the one hand, tighter monetary conditions counteract the expansionary effect of global liquidity on the business cycle and the appreciation of asset prices. On the other, higher short-term interest rates widen the return differential against advanced economies even more, thus leading to even stronger capital inflows. Macroprudential policy tools offer a way out of this dilemma. In fact, Asian emerging economies pioneered the use of macroprudential policy in order to maintain financial stability since at least a decade while these tools are only recently been used in advanced economies.[19]

19. Tillmann (2015) shows the effectiveness of macroprudential policy shocks directed towards containing Asian property markets.

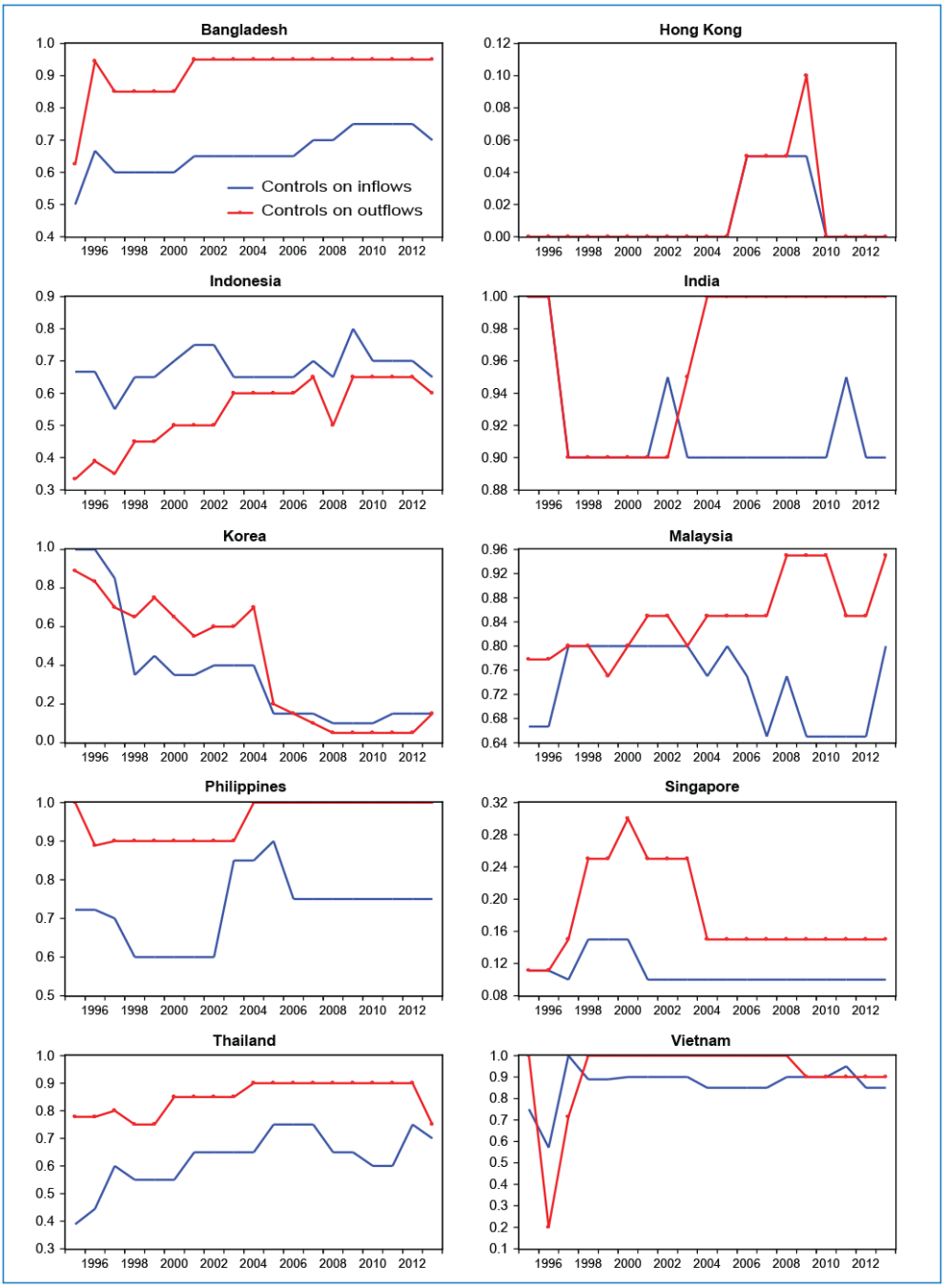
Figure 11
Macroprudential Policy Response



Notes: The data is taken from Lee et al. (2016). "Liquidity based" tools comprise limits on net open currency positions, limits on maturity mismatch in the balance sheet of financial institutions and reserve requirements imposed by the central bank. "Credit based" tools summarize caps on loan-to-value ratios, caps on debt-to-income ratios, caps on foreign currency lending and a ceiling on credit growth. To each of these individual policies we assign a +1 if the tool was used to tighten financial conditions in a given quarter. A -1 is assigned if the specific tool was used to ease financial conditions and a 0 is assigned if the tool remained unchanged. We then aggregate the individual tools and accumulate them over time.

A second factor makes the use of macroprudential instruments attractive: to the extent monetary policy maintains a fixed exchange rate or actively manages the exchange rate, using the short-term interest rate as an autonomous policy instrument is not feasible. For that reason, economies such as Hong Kong and Singapore, made ample use of macroprudential instruments.

Figure 12
Capital Control Measures



Notes: The data is taken from Fernández et al. (2015). A higher index means tighter controls. The red (blue) line reflects controls on capital outflows (inflows).

To provide an overview over the use of macroprudential tools, Figure 11 plots the macroprudential stance of each economy based on two alternative sets of tools. The data and the classification are taken from Lee et al. (2016).[20] The first set, summarized as "liquidity based" tools, comprises limits on net open currency positions, limits on maturity mismatch in the balance sheet of financial institutions and reserve requirements imposed by the central bank. The second set, referred to as "credit based" tools, summarizes caps on loan-to-value ratios, caps on debt-to-income ratios, caps on foreign currency lending and a ceiling on credit growth. To each of these individual policies, we assign a +1 if the tool was used to tighten financial conditions in a given quarter. A -1 is assigned if the specific tool was used to ease financial conditions and a 0 is assigned if the tool remained unchanged. We then aggregate the individual tools to "liquidity based" and "credit based" indicators and accumulate them over time. The resulting policy stance is depicted in Figure 11. The figure plots information for selected economies only. Due to data availability, we could not construct such an index for Sri Lanka, Cambodia, the Philippines, Vietnam and Mongolia and other economies.

The following observations stand out: first, many economies in Asia used their macroprudential arsenal to ease financial conditions in 2008/09, that is, at the peak of the global financial crisis. For example, the Philippines eased both credit- and liquidity based macroprudential measures, while Korea used credit-based measures only. Second, for all economies, we observe a fast, successive tightening of macroprudential measures as the immediate fallout of the crisis turned into the second phase of global liquidity. Again, credit-based measures are used more aggressively than liquidity-based macroprudential measures. Among these measures, tools targeting the overheating property markets such as limits on loan-to-value and debt-to-income ratios are used particularly often. Third, during the period between the 2013 taper tantrum and the 2015 lift-off, which saw a strong reduction in global liquidity, macroprudential constraints were not relaxed. This points to an interesting asymmetry in the use of macroprudential instruments after 2008: they are used to tighten during periods of inflows of liquidity but not to ease with the same vigor when global liquidity ebbs.

While macroprudential measures address specific weaknesses of the financial system such as overheating property markets or undercapitalized banks, capital controls restrict the flow of capital across borders. Figure 12 plots an index of capital controls constructed by Fernández et al. (2015) for selected Asian economies over the sample from 1995 to 2013. The index differentiates between controls on capital inflows and capital outflows and is bounded between zero and one. In general, the levels of both indicators vary strongly across economies. A common property is,

20. An alternative data set on macroprudential measures is provided by Cerutti et al. (2015). We choose the Lee et al. (2016) data because it covers a slightly longer time period.

however, that restrictions on outflows are usually tighter that restrictions on inflows. Some economies such as Korea and Singapore have effectively reduced capital controls while others such Malaysia and the Philippines still rely on relatively tight restrictions. Most importantly, the data suggests that policymakers do not use capital controls systematically as an instrument to offset financial spillovers since 2008. This is an important difference compared to macroprudential measures which have been tightened after 2008.

As a matter of fact, this analysis is comparative in nature and cannot carefully evaluate the motivation, design and effects of individual policy steps. However, details on selected, country-specific policy measures will be discussed in the remaining parts of this report.

6. What We Do in This Report

In this section, we provide an integrated overview over the studies contained in this volume. Each study focuses on one specific Asian economy and analyzes in detail the consequences of and the policy responses to shocks in global liquidity. The methods used to derive empirical evidence range from VAR-type models over high-frequency volatility models to panel regressions with bank data.

Raksmey Uch studies the consequences of global liquidity for small open economies against the backdrop of the experience of *Cambodia*. Two properties of the Cambodian economy make an analysis for Cambodia particularly interesting: first, Cambodia is a highly dollarized economy, thus reducing the importance of the exchange rate as an adjustment mechanism. Second, the financial system in Cambodia is less developed compared to other economies in the region. The latter facet means that global liquidity affects Cambodia not directly through global portfolio investors engaging in Cambodian financial markets, but rather through foreign direct investment channeled through other countries in the region. A key vulnerability is the increasing reliance of the banking system on foreign funding.

Hwang Moon Woo focuses his project paper in macroprudential policy in *Korea*. One element of Korea's macroprudential toolkit is a cap on banks foreign exchange derivatives positions. The ultimate aim of this policy is to foster financial stability by reducing foreign currency borrowing and, hence, the exposure to swings in global liquidity. The author studies the effectiveness of this measure in a panel model with bank data. The results suggest that the policy has indeed been effective. In addition, foreign banks seem to be more affected than domestic financial institutions.

In his team project paper on *Chinese Taipei*, *Jyun-Yi Wu* studies global liquidity spillovers through a measure of directional connectedness proposed by Diebold and Yilmaz (2015). Based on a sample that includes Indonesia, South Korea, Chinese

Taipei and Singapore, the United States, the United Kingdom, Japan and the Euro Area, the estimated model summarizes the connection among short-term interest rates in a single measure. The advantage is that the author can study bilateral spillovers among the sample economies, both in a static and a dynamic setting. He shows the different nature of spillovers among certain economy pairs and shed light on the spillover cycle suggesting the strength of spillovers varying strongly over time.

Ruby Anne Lemence provides an in-depth analysis of the effects of global liquidity on the *Philippines.* She proposes using local projections to quantify the responses of several macroeconomic variables to global liquidity shocks. The advantage of local projections is that estimates can be obtained without the need for a fully specific model. Thus, the resulting estimates are typically more robust than comparable VAR estimates. Based on three alternative definitions of global liquidity, US dollar credit, the US shadow short-term interest rate and the VIX index, she finds a tightening shock to US policy rates reduces capital inflows. Moreover, after 2008 shocks to global risk aversion became more important drivers for capital flows into the Philippines compared with a pre-2008 sample.

Sumila Wanaguru takes a perspective on the foreign exchange market of an emerging market economy and studies whether foreign exchange market interventions are effective in shielding the economy against global liquidity shocks. In her team project paper on *Sri Lanka*, she analyses volatility spillovers transmitted through foreign exchange markets. Based on data from Sri Lanka between 2002 and 2016, she models the volatility of the Sri Lankan rupee against the US dollar. In particular, she is interested in whether the intensity of spillovers changes in subperiods and whether interventions by the Central Bank of Sri Lanka effectively reduce volatility.

In the project paper on *Indonesia*, *Berry Harahap* models the spillovers of global liquidity shocks. To account for the complex interaction between economies, the author uses a global VAR (GVAR) model that takes account of trade and financial relationships among the 32 sample countries. The liquidity shocks do not originate in the US only, but are also allowed to stem from policy in the Euro Area and Japan as reflected in the shadow short-term interest rate of each of these three economies. Thus, the model reflects the global nature of liquidity. A liquidity shock is shown to lead to reactions of real GDP and the exchange rate in the group of ASEAN-5 economies.

Pham Xuan Lam and *Chu Khanh Lan* study the transmission to global liquidity to *Vietnam*. They discuss the challenges faced by Vietnam and estimate a reduced-form VAR model in which structural shocks to global liquidity are identified using a Cholesky ordering. A key result suggests that shocks to global liquidity have a positive impact on GDP and prices in Vietnam, thus positive shocks to global liquidity impact the economy similar to expansionary demand shocks.

Tsenguunjav Byambasuren presents a team project paper on *Mongolia* in which he surveys the channels through which global liquidity affects the Mongolian economy and finds that the commodity price channel is the most relevant. Global liquidity, the argument goes, drives up prices across a wide spectrum of commodities, thus affecting resource-rich economies indirectly. This argument is underlined by empirical evidence stemming from a structural VAR model in which shocks are identified in a non-recursive way. Based on data from 2001 to 2016, the author is able to show that global liquidity increases commodity prices, leads to capital inflows and has an expansionary effect on economic activity.

7. Conclusions

The past 10 years have seen a global financial crisis, exceptionally low interest rates in advanced economies, non-standard monetary policies pursued by many central banks and swings in investors risk attitudes. While the circumstances around these observations differ from economy to economy, a common consequence emerges: strong fluctuations in global liquidity available to the rest of the world. Global liquidity might be a diffuse concept, one that is difficult to measure and to categorize, but its consequences for small open economies are real. From the perspective of emerging economies, the ups and downs in global liquidity pose a challenge to monetary, fiscal, regulatory and macroprudential policies.

This chapter introduces a report on the consequences of global liquidity on Asian economies. The results of this chapter are threefold:

1) An estimated panel VAR model showed that positive shocks to global liquidity for a sample of seven Asian emerging market economies lead to a domestic boom in economic activity, a surge in asset prices and an appreciation of the exchange rate against the US dollar. All these effects are highly statistically significant. Since the results are derived from a Panel VAR that ignores country-specific characteristics, these are robust findings for the *average* emerging market economy. The results are in line with a wide literature on the spillovers of domestic liquidity.

2) The data and the empirical evidence suggests that spillovers through global liquidity are not constant over time. Rather, spillovers can turn out to be strong or weak depending on global financial conditions, the domestic macroeconomic environment and the policy responses taken. This observation is also supported by the subsequent economy-specific chapters in this report. The time-varying nature of liquidity spillovers and the dependence of their effects on the global economic context make the design of appropriate policies difficult.

3) The policy responses taken in the region are diverse. This reflects the fact that the effects of global liquidity, while broadly similar with regard to the core macroeconomic variables, gives rise to wide range of economy-specific challenges. Policymakers are concerned about overheating property markets, on overly leveraged financial system, foreign currency borrowing, among many other facets of global liquidity, and design policies directed towards these specific challenges. In this environment searching for a "one-size-fits-all" policy response is misleading. While it is generally acknowledged that healthy macroeconomic fundamentals reduce the exposure to swings in global liquidity, the specific policies directed towards maintaining financial stability will likely to be diverse.

In the following chapters, we draw lessons from the experiences of selected Asian economies with swings in global liquidity and the policy responses.

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Chapter 2

THE INDIRECT TRANSMISSION OF GLOBAL LIQUIDITY: THE CASE OF CAMBODIA

By
Raksmey Uch[1]

1. Introduction

Global liquidity has become the center point of discussions recently although there is no common view on its concept. Global financial factors have increased their impact on the domestic economic condition in individual countries through deeper regional as well as global integration. The buildup of global liquidity contributes to the risks and vulnerabilities of the financial system of a country which may be reflected by the currency and maturity mismatches across countries while the shortage of liquidity produces even more serious implications on international economic growth as experienced during the crisis period of 2008-2009.

Cambodia, a small open economy with GDP of around US$18 billion in 2015 and a growth rate of around 7% during the last decade, has benefited a lot from the influx of global liquidity, although the impact is not direct. The capital inflows resulting from the increase of global liquidity allows for investment and consumption growth, thus boosting economic expansion. The inflows are in the form of foreign direct investments, which in general, are secure and stable sources of funding. These are channeled into the key sectors of the economy such as financial activities, manufacturing and agricultural sectors as well as the construction and real estate activities. The short-term and most volatile liquidity flows are in the form of banks' external borrowings which have allowed the banking system to perform better in its role as financial intermediaries during the last decade. Besides these two, official development assistance (ODA), although the nature is long-term and less volatile, also benefits Cambodia's economy considerably, especially in enhancing its competitiveness since these funds are used for improving the physical infrastructure.

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Although global liquidity and capital flows benefit Cambodia, they come with potential risks to the financial system. Credit growth has increased rapidly during the last decade averaging 36% per year. Meanwhile, the deposits growth rate is not as fast as that of credit, which has resulted in a high credit to deposit ratio of more than 100%. This high ratio implies that Cambodia's financial sector, which is dominated by banks, has increased reliance on external sources of funding to maintain the credit growth rate. This rapid growth causes risks and vulnerabilities and places pressure on the financial system.

Moreover, the high dollarization as reflected by the ratio of broad money to the gross domestic product, is about 83% as of 2015 while more than 90% of deposits in the banking system is in US dollars. These have resulted in another vulnerability and limited the policy options as well as the policy implementation of the National Bank of Cambodia, the central bank, in tackling the potential risks that may emerge in the system.

In view of this, the purpose of the paper aims at finding out the relationship among the key global liquidity indicators and how they impact a small open and highly dollarized economy like Cambodia. Furthermore, we will attempt to suggest policies responses from the perspectives of both micro and macro prudential as well as monetary and fiscal policies. To have clear answer and understanding of this relationship, we first need to find more about the concept and the factors driving global liquidity as well as to attain a clearer picture on the indicators for global liquidity. Second, we will examine the impact of global liquidity on Cambodia's major trading and investment partners before attempting to investigate the spillover effects of global liquidity on Cambodia. Lastly, based on the results of the findings, we will suggest policy options to deal with the movement and the potential risk that may emerge with the evolution of global liquidity.

2. Literature Review

There are many studies and works conducted on the various aspects of global liquidity, from the concept and indicators to the transmission and the impact of the liquidity condition of a jurisdiction to the change in financial landscape in the region.

Cheng (2016) conducted an analysis of statistical properties of capital flows to identify the evolution of the size and volatility of Cambodia's capital flows and the risks and vulnerability associated with the domestic and external factors, specifically the anticipation of monetary policy normalization in the U.S. The paper found that the flow in the form of foreign direct investment contributes the most to the total capital inflows followed by bank and money market flow. He also observed that bank

and money market flow which forms a highly volatile composition of the total flows has been increasing in its share. Moreover, he pointed out that the spillover from the ample global liquidity had significantly increased the volatilities of all compositions of the flow after the 2009 crisis.

BIS (2013) showed that that the transmission of global liquidity to East Asia takes manifold channels, including both prices and quantities by employing the monthly penal data to estimate the impact of global liquidity on the transmission, capital flow and financial stability. Similarly, Sun (2015) found out that global liquidity was transmitted to ASEAN-5 countries through many channels including price, reflected by the fall of bond yields and quantities indicated by the increase in international debt security issuance and external borrowing and deposits. Furthermore, the financial landscape of the ASEAN-5 countries has changed, albeit at differentiated levels, with the expansion of the financial sector and the growth of nonbanks.

IMF (2014) discussed the development of the concept of global liquidity by presenting the evidence of commonality in the global financial condition that relates to specific drivers via a diversity of transmission channels, including cross-border banking and portfolio flows. A range of price and quantity factors, such as measure of risk, bank leverage, and interest rate in financial centers have been shown by empirical analysis as the drivers in parts of these flows. Furthermore, the transmission of global conditions is influenced by a country's specific policies, including the exchange rate regime and prudential framework. Nonetheless, there are many unidentified issues, such as the evolution of the structure of global funding, changing institutions, and continuous financial innovations affecting the mechanics of liquidity creation, the channels of liquidity transmission and potential risks going forward. The paper suggests the application of an indicators dashboard across various kinds of economies for tracking global liquidity.

Shin (2013) differentiated the evolution of global liquidity into two phases - the first phase started around 2003 and lasted until 2008 - revolving around global banking and the freer financial conditions across borders through the acceleration of banking sector capital. Meanwhile, the second phase of global liquidity started roughly in 2010 and the main theme was the bond market, particularly the opening of the debt securities market in the emerging economies to the international investors. There was increased access given to asset managers and "buy side" investors by the international banks. The transmission of financial conditions occurs through manifold channels such as "reaching for yield", the failing of risk premiums for debt securities and the increased issuance of guaranteed international debts securities to satisfy demand.

BIS (2011) discussed global liquidity and investigated global liquidity measurement, drivers, and policy implication from a financial stability perspective by utilizing the official and private liquidity concept. The paper defined official liquidity as "the funding that is unconditionally available to settle claims through monetary authorities", which can be accessed through a variety of tools, including foreign exchange reserves and swap lines between central banks, such that only the central banks can generate official liquidity. Meanwhile, private liquidity or liquidity created by the private sector refers to the cross-border operation of banks and financial institutions. The paper investigated the interaction among the three key categories of drivers - macroeconomic factors, other public sector policies and financial sector – for the creation of global liquidity. In response to the changing phase of global liquidity, both surges and shortage, a consistent framework that rests on three lines of defense was discussed. These lines of defense are: (i) the prevention of excessive liquidity surge through strengthening the regulatory framework, (ii) domestic policies including macroprudential measures and central bank liquidity provision, and (iii) the cooperative measures for the provision of liquidity in crisis situations.

Psalida and Sun (2011) employed various types of econometric tests using penal data to analyze whether G-4 liquidity expansion spills over to the rest of the world. They found that the changes in asset prices in the liquidity receiving economies have strong positive association with the expansion of G-4 liquidity, which suggests the vital role of the push factor players in the change of asset prices. The spillover of the liquidity expansion also has a strong relationship with official reserve accumulation and equity portfolio in recipients' economies. Moreover, the links between excess equity returns, excess credit growth and global liquidity have consequences of mounting risks on financial stability in the receiving economies.

3. Development of Global Liquidity

3.1 Concept

Recently, global liquidity has become the center point of studies by professionals and researchers. However, there is no common view on the concept of the global liquidity and the term has been used in a variety of ways. The Committee on the Global Financial System (CGFS) defines global liquidity as the "ease of financing", while the BIS uses the term global liquidity to mean "the ease of financing in global financial market or the ease with which perceptions of value can be turned into purchasing power". Shin (2013) mentions that the term global liquidity is often invoked by emerging market policy makers to denote the global factor that drive cross-border spillovers of financial conditions and credit growth, and is often used in connection with monetary policy spillovers from advanced economies.

3.2 Drivers

Although, there are many concepts for global liquidity, the center point revolves around the notion of ease of global financing or cross-border spillovers of financial conditions of advanced economies in connection with their monetary policy. Given these concepts, the common drivers of global liquidity include the following transmission channels: macroeconomic factors such as the GDP growth may lead to higher demand for credit or the source of funding which tend to correlate across countries through trade and direct investment links. Unconventional monetary policy and/or the expansionary policy implemented by many advanced economies create spillover effects in emerging countries. Normally, the change in policy rates in the key currencies hints at a change in the policy rate setting in the other jurisdictions. As argued by Taylor (2013), low policy rates in the key currencies lead to a change in policy rate setting in the rest of the world.

Financial factors, the level of financial connectedness among the countries in the region and the globe have significant effects on global liquidity and its movement, i.e., the greater the openness and integration, the greater cross-border financial flows will be for those countries. Financial innovation usually leads to the presence of new investment tools or securitization that enhances the transformation of illiquid assets into more liquid ones. The cross-border investment in those kinds of securities reflects that the innovation of those products contributes to global liquidity allocation.

3.3 Indicator

Having gone through various concepts and drivers of global liquidity, it can be observed that there is no single indicator that can provide a holistic picture of global liquidity. Good and reflective indicators that are able to depict the existing movement of global liquidity should at least include price and quantity measures. In alignment with this concept, we use global credit aggregate, the selected indicators published on the BIS web, to simplify the analysis of the global liquidity movement and its impact on some of Cambodia's trading and investment partners.

4. Global Liquidity and the Transmission to Selected Countries in East Asia and South East Asia

The development of the liquidity condition in a country has impact not only domestically but will have spillover effects on the global market as well. However, given the size of Cambodia's economy and the stage of development of its financial system, domestic liquidity is unlikely to have significant effects on the global market. In converse, a change in global liquidity may impact Cambodia's liquidity.

Having said that, due to the size of the economy and a relatively unconnected financial system, global liquidity may not have a direct impact on Cambodia. However, it may impact other countries in the region first, before the spillover affects Cambodia.

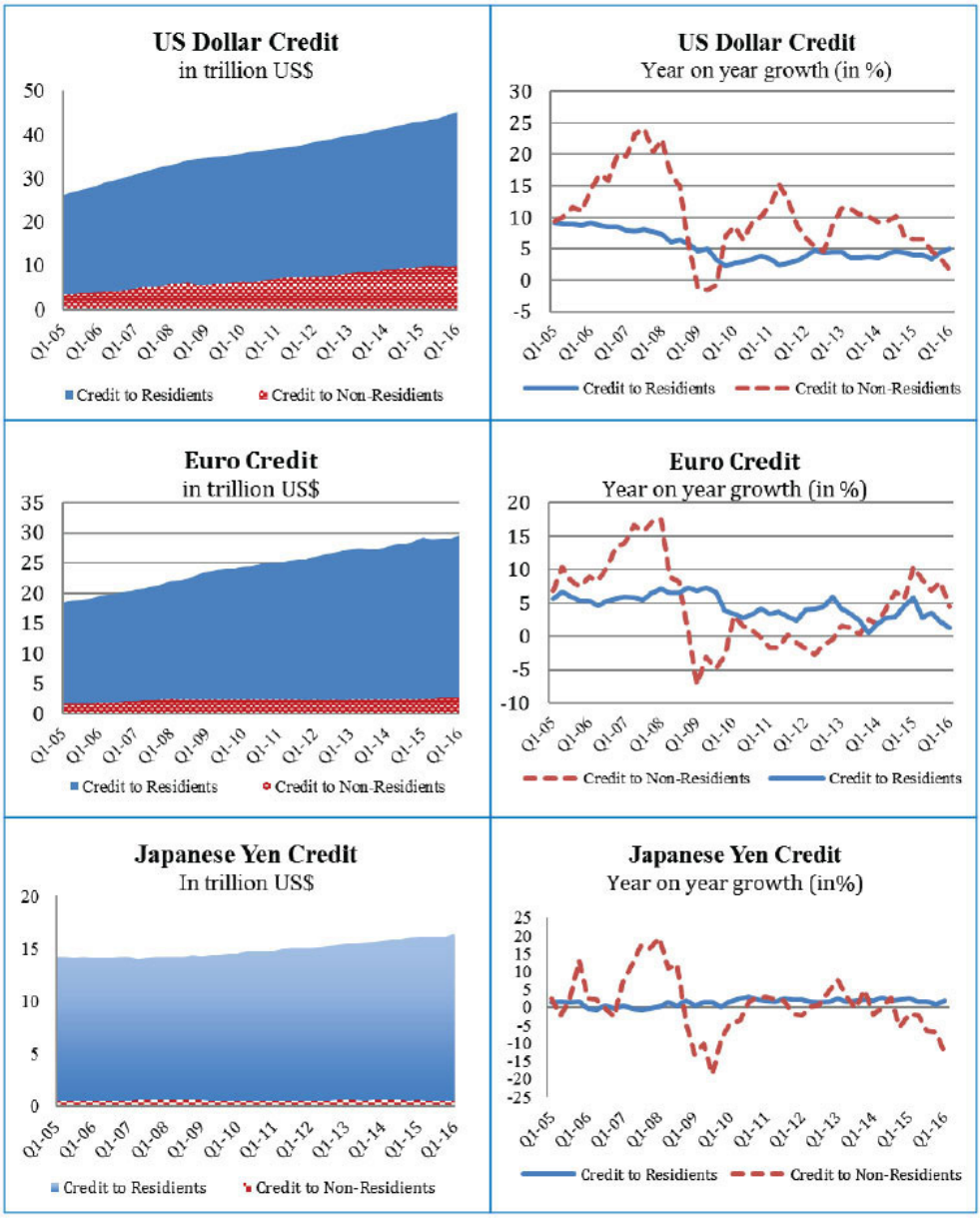
In this section, we look at the movement of global credit aggregate on the movement of non-residents along with the movement of some selected East Asia and Pacific countries viz China, South Korea, Singapore and Malaysia. These countries are selected for their strong connection in trade, FDI and other investments to Cambodia.

In general, global credit aggregates to non-residents in some advanced economies such as United States, Euro Area and Japan, have declined sharply during the global financial crisis, before going up again at the beginning of 2010. For the Euro Area, the volatility of the growth rate of credit to non-residents was not strong from 2010 to 2013 but it accelerated at the beginning of 2015 before going down again at the beginning of 2016. Meanwhile, the growth in the United States and Japan showed an increasing trend towards the first quarter of 2013, and subsequently started on a declining trend from then on.

If we look at the trend of the global credit aggregates of advanced economies and the movement of credit to the private non-financial sector of the selected Asian countries, they show a similar pattern before and after the global financial crisis. Credit to the private non-financial sector in percentage of GDP for the four selected countries declined during the global financial crisis before starting to increase in the first quarter of 2010 with little volatility. Although the pattern of the global credit aggregates of advanced economies is relatively volatile after the global financial crisis and only started to decline recently, credit to the private non-financial sector in percentage of GDP in the selected countries shows an increasing trend in general. Given that the GDP growth rate of the four countries are more or less stable or decreasing, the increasing trend of the ratio of credit to the private non-financial sector to GDP suggests that the credit used by the four selected countries were not for productive purposes in that it did not boost economic growth as much as it did before the crisis.[2]

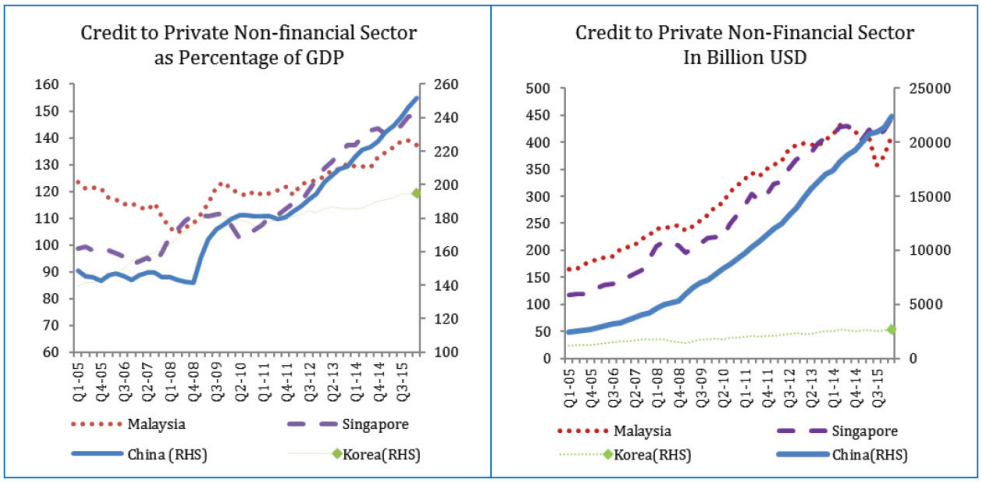
2. China moved from an export-driven economy to an investment based one to boost economic growth

Figure 1
Global Credit Aggregates of Major Advanced Economies



Source: BIS, Global Liquidity; Total Credit by Currency of Denomination.

Figure 2
Selected Asia Countries' Credit to Private Non-Financial Sector



Source: BIS, Long Series on Total Credit to the Non-financial Sector.

5. Development in Cambodia's Liquidity and Cambodia's Major Trading and Investment Partners

In this section, we try to investigate the relationship of the key liquidity indicators of Cambodia's major trading and investment partners and several economic variables in order to understand how liquidity movement in those countries impact the Cambodian economy.

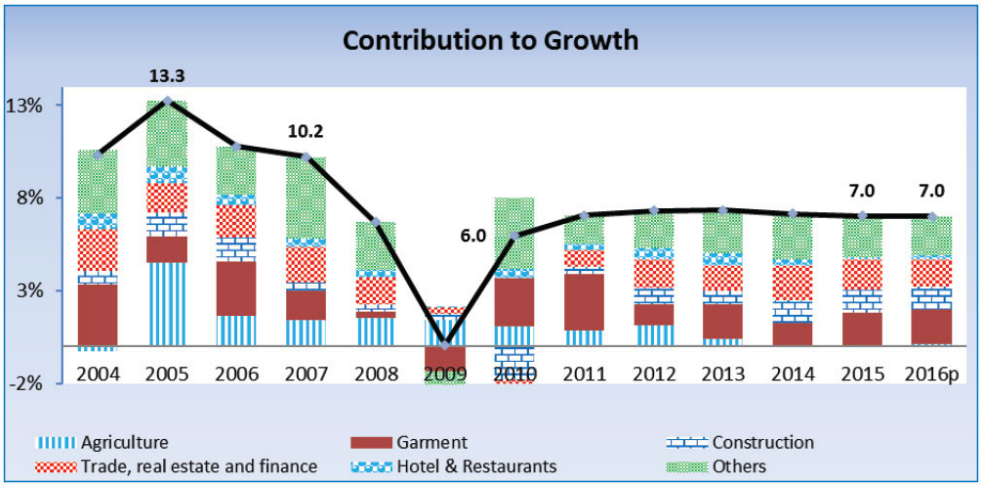
Regional integration creates increased connectedness of the financial system of the countries in the region, especially with the flow of funds moving from developing countries to the least developed ones. The influx of global liquidity has increased domestic credit and local investments of Cambodia's trading and investment partners markedly. This impact does not end with those countries as it further spreads to the smaller countries in the region such as Cambodia, Laos, Myanmar and Vietnam.

There are three main types of capital flows into Cambodia, i.e., banks' external borrowing, FDIs, and ODA. The liquidity in Cambodia is affected by the movement of these three flows, regardless of the long-term nature of FDI and ODA. The expectation is that the stronger the global liquidity transmission to the countries with trade and investment closely related to Cambodia, the higher the spillover effect on Cambodia's economy, resulting in higher FDIs, banks' external borrowing and official development assistance.

Capital flows into Cambodia yield significant benefits for economic agents, including the public sector. Capital flows into the country allows investors to diversify their risks and enhance their returns. They also provide opportunities for residents

of Cambodia to finance investments and increase consumption, contributing to economic growth. Capital flows play a crucial role in financing Cambodia's Balance of Payment. Due to higher imports than exports, Cambodia's current account is in deficit. Although there is a surplus in the relatively small proportion of net services for the last decade, it cannot offset the deficit of the current account. To finance this deficit, Cambodia needs to attract sizeable capital flows such as foreign direct investment, private sector borrowings of banks and non-banks[3] and official development assistance. Since Cambodia has just established the stock exchange, its portfolio investment is negligible.

Figure 3
Cambodia Economic Growth and Its Contributions



Source: National Institute Static, Ministry of Planning.

Global liquidity which is transmitted via the countries with which Cambodia has close financial and trade connection, especially China, through the three major channels, has benefited Cambodia's economy immensely in general and the banking system in particular. Cambodia has been able to maintain strong and robust GDP growth of around 7% after the global financial crisis, which would not have been possible without the flow of global liquidity and funds.

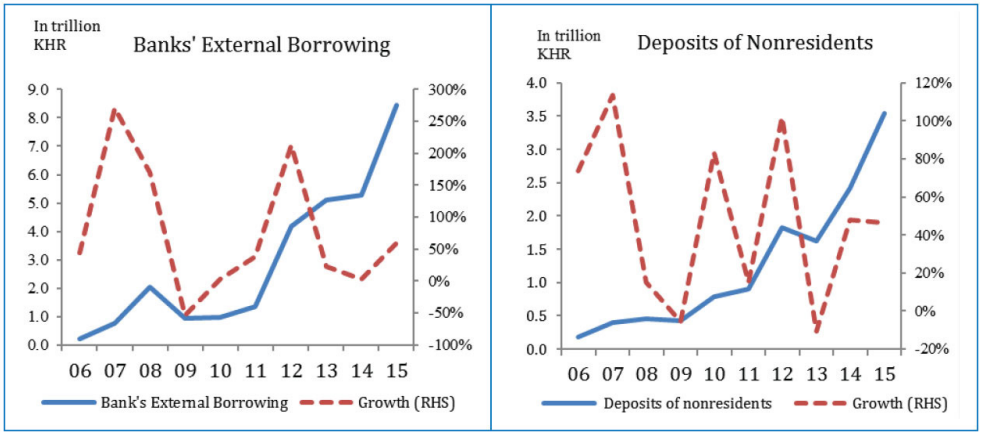
5.1 Bank's External Borrowing

Credit growth is relatively high during the last decade, averaging 36% per year. Meanwhile, the growth rate of deposits in the system was around 30% on average during the same period. The faster growth rate of credit to that of deposits has led the credit to deposit ratio to stand at 108% at the end of 2015 compared to 68% in 2006.

3. Due to the limitation of the data, we are not discussing the non-bank borrowing in this paper. There is some data available in the BIS, but is very limited.

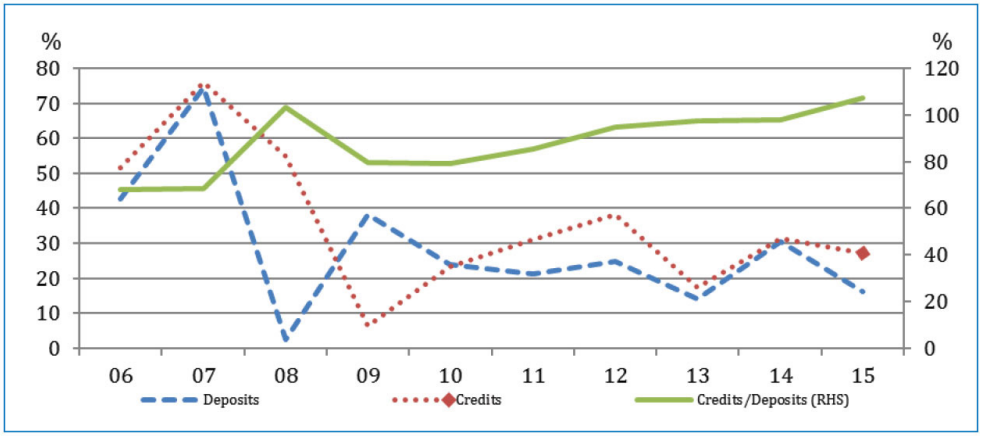
This suggests that there has been increasing reliance on external sources of funds to finance credit growth. We can classify the external sources of funds of the banks into two, i.e., non-resident deposits and external borrowing. These two flows are very volatile compared to FDIs and official development assistance. This reliance creates uncertainty and risks for the banking system, especially in the event of a liquidity shock in the global market. In cognizance of this, the National Bank of Cambodia has taken a preemptive measure by introducing a 12.5% required reserve on this type of funding. However, the effects of this measure are still not clearly discernable.

Figure 4
Banks' External Sources of Funds



Source: National Bank of Cambodia.

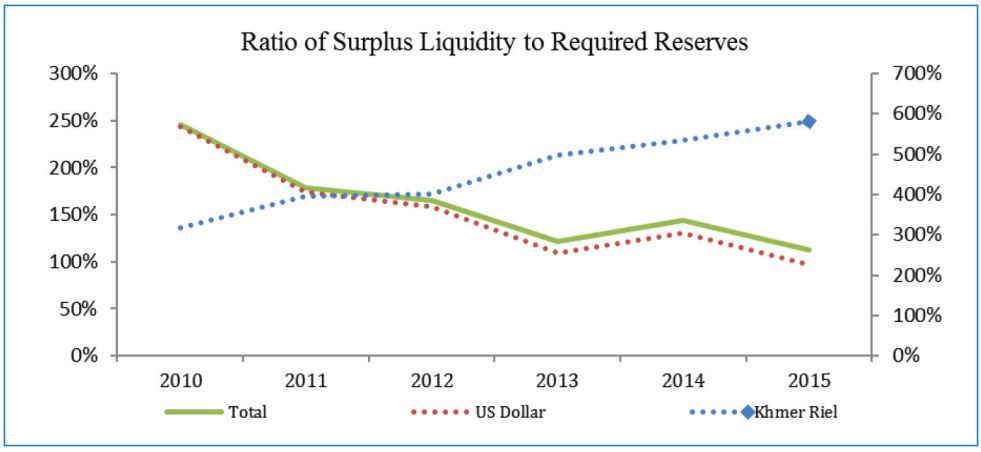
Figure 5
Deposits and Credit Growth and Credit to Deposits Ratio



Source: National Bank of Cambodia.

Although the credit to deposits ratio has increased markedly after the global financial crisis, Cambodia's banking system still has liquidity surplus. It can be observed that the ratio of liquidity surplus to required reserve is around 100% of which around 99% is in USD and almost 600% in local currency. This high surplus of liquidity in the system may, to some extent, work as a buffer to shocks of global liquidity.

Figure 6
Liquidity Surplus in the Banking System



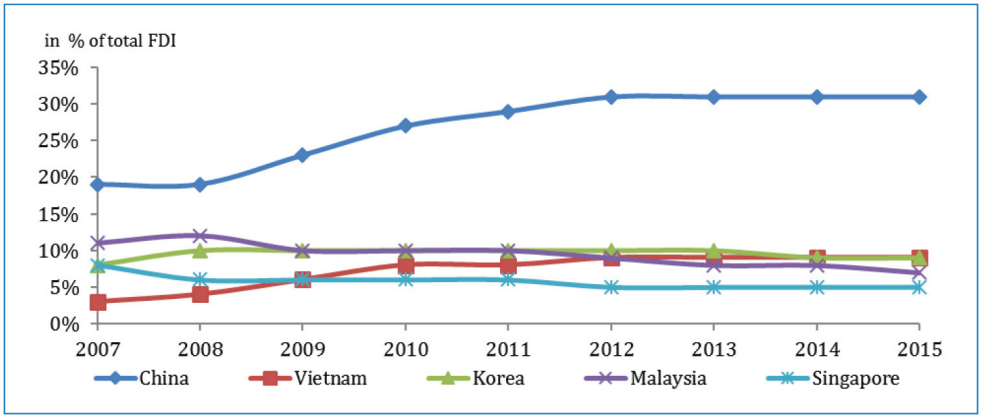
Source: National Bank of Cambodia.

5.2 Foreign Direct Investment

In view of Cambodia's small economy and underdeveloped financial system, most of the capital flows are long-term funds such as FDIs and official development assistance rather than short-term flows such as portfolio investments. To have a better comprehension of how global liquidity impacts Cambodia, we will also discuss long-term capital flows into Cambodia.

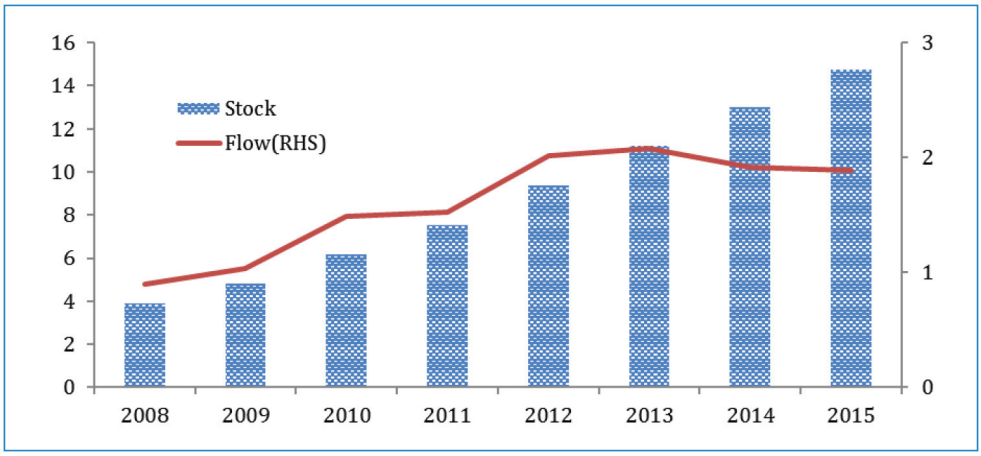
FDIs, the least volatile among the other capital flows, represent the largest proportion of flows into Cambodia every year, accounting for 13.5% of GDP on average during the last decade. Cambodia receives the most FDI flows from China, which was around 31% in 2015, followed by Vietnam and Korea. The flows from the four major FDI countries show a stable trend, except for the share of FDIs from China, which has increased significantly after the global financial crisis.

Figure 7
The Share of Five Majors FDI Countries



Source: National Bank of Cambodia.

Figure 8
FDIs in Billion USD



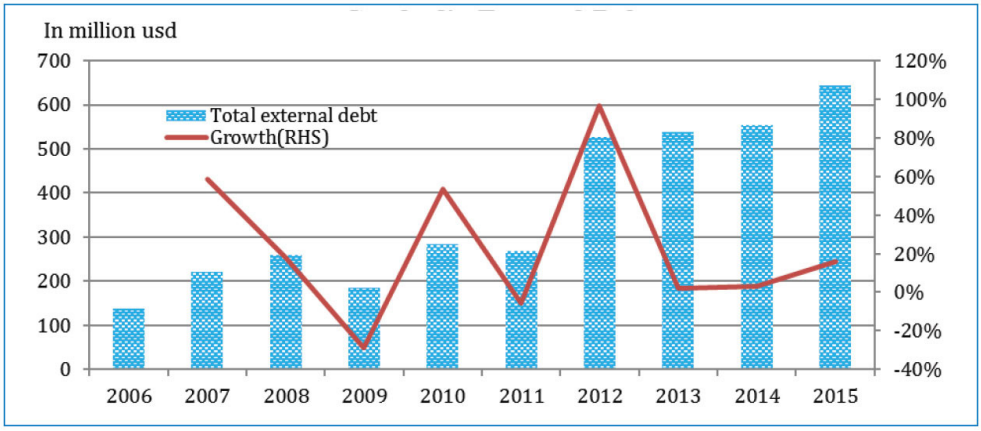
Source: National Bank of Cambodia.

5.3 Official Development Assistance

Although Cambodia has just graduated from a low income to lower middle-income country, it is still classified as less developed. The Government of Cambodia requires a lot of funding from its development partners to develop the country's infrastructures. Cambodia receives millions of dollars in aid and concessional loans annually to fund development projects as well as to support economic growth. Like FDI, concessional loans from China stand at the top of the list and continue to increase annually. Cambodia's external debt position has reflected an increasingly reliance on

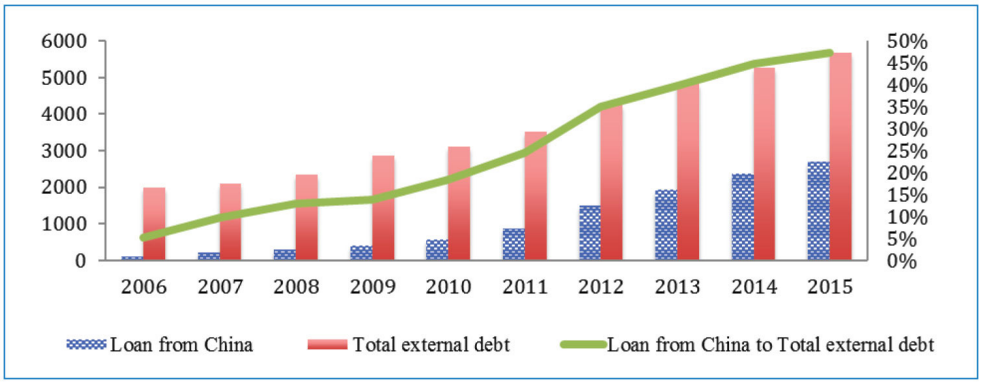
China during the last decade. The share of loans from China to total external debt increased markedly from around 5% in 2006 to nearly 50% in 2015. This shows the increasing spillover effect of China's liquidity into Cambodia as capital flows. According to the IMF Staff Report for the 2015 Article IV - Debt Sustainability Analysis, Cambodia's external debt was around 33% of GDP at the end of 2014. The report also projected that Cambodia's external debt to GDP will be around 30% of GDP in 2020. This means that Cambodia will continue to utilize a similar proportion of the recent debt to GDP ratio for the medium-term. Thus, capital flows in the form of official development assistance, especially from China, is likely to keep its pace, at least for the medium-term.

Figure 9
Cambodia's External Debts



Source: Ministry of Economy and Finance.

Figure 10
Share of Debt to China to Total External Debts
(in million US$)



Source: Ministry of Economy and Finance.

6. Findings and Conclusion

The unconventional policies adopted by some advanced economies have increased global liquidity in recent years. While global liquidity yields significant benefits for developing and emerging countries, it also presents potential risks to the recipient countries. Domestic policies need to accommodate for the movement of global liquidity to avert the adverse effects that can arise from the influx of capital flows or to cope with the shock of the capital outflows should there be a shock to the liquidity condition in the global market. Cambodia is no different; global liquidity has brought sizeable capital inflows into the country, although not directly due to the size of its economy and early stages of financial development. The impact can be observed from the spillover effects of global liquidity through Cambodia's major trading and investment partners via three major channels, i.e., banks' external borrowings, FDI and ODA. These inflows have supported the development and growth of both the private and public sectors in the country. Credit growth supports and facilitates the flow of funds into the economy. FDI creates jobs and provides opportunities for Cambodia to buildup capital and boost exports. ODA helps Cambodia in developing the necessary infrastructure to improve competitiveness. These three flows along with the commitment of the Government to diversify the economic base will help Cambodia in its quest for sustainable and inclusive economic development. However, given the size of Cambodia's economy and absorption capacity, the impact from changing global liquidity is not significant, although the effects could become stronger over time. This could create potential challenges as in the worst-case scenario, it may hinder the role of financial institutions as intermediaries to support growth, especially when there is a squeeze in external sources of funds. Therefore, policy makers have to be well-prepared and well-equipped with flexible policies that could ensure a soft landing for the credit cycle. In particular, building a sizeable liquidity buffer will be able to protect the banking system during incidents of high credit growth. Moreover, strengthening micro and macro prudential policies and their instruments should be considered along with a risk management framework. Moreover, supervisory capacity has to be further developed to avert risks in excessive credit growth. The high dollarization has limited the ability of the National Bank of Cambodia to respond to financial sector shocks should the risk materialize. Although this issue may not arise in the short-run, it needs to be tackled so as to create more space for policy options in the long-run. On the fiscal side, enhancing revenue collection by improving tax administration and the rationalizing public expenditure will ensure a sufficient fiscal buffer to maintain debt sustainability and to protect the country in the event of shortages in global liquidity.

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Chapter 3

SPILLOVER EFFECTS OF GLOBAL LIQUIDITY ON INDONESIA

By

Berry A. Harahap *and* Pakasa Bary[1]*

1. Introduction

The awareness about possible external shocks, especially from dominant economies, has intensified since the global financial crisis. Economic integration through trade and financial relations allows the transmission of shock from developed countries to other economies, including Indonesia, a small open economy. The International Monetary Fund (2014) has argued that the main source of spillover in the global economy is an unbalanced growth pattern. In recent years, the external shocks that have been discussed extensively is the monetary policy divergence from the advanced economies.

The US Federal Reserve Bank (Fed) raised its target for the policy rate to end nearly seven years of ultra-low interest rates in the United States (US) in December 2015. The Fed considered that the US economy has become sufficiently solid to face the risk of an increase in interest rates. This decision was taken in response to the continued strength of the macroeconomic conditions, including a decline in unemployment and the output gap. In addition, the Fed expected inflation in the medium-term to move in the range of 2%. Meanwhile, the European Central Bank (ECB) announced that it will maintain the policy rate at a low level and continue with the massive asset purchase program, at least until 2017. The Bank of Japan (BOJ) also continued loosen monetary policy by buying government bonds and imposed a negative interest rate. The tightening of monetary policy in the US and the easing in the Euro area and Japan reflect their uneven pace of economy recoveries and outlooks. In the US, growth is expected to rise to 2.2% in 2017 from 1.6% in 2016 and inflation is expected to rise close to its target of 2% by end of 2017. On the other hand, growth in the Euro area is expected to be 1.5% in 2017 and inflation is expected to be only 1.3%.

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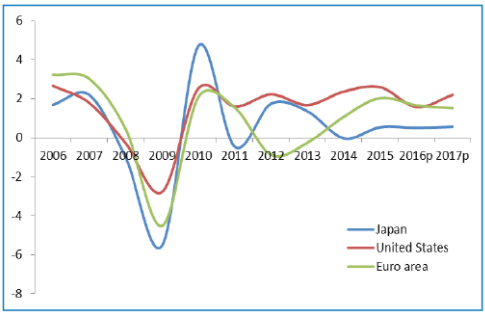
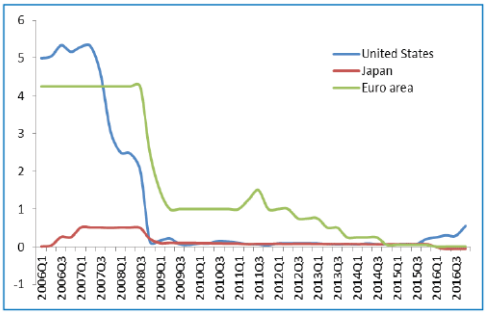
Figure 1
Advanced Economies GDP Growth



Source: WEO.

Figure 2
Advanced Economies Policy Rate



Source: New York Fed, BOJ, ECB.

This raises questions about the consequences of monetary tightening policy in US and easing in the Euro area and Japan on economic conditions for the ASEAN-5 economies in general and Indonesia, in particular.

2. Spillover Channels

Monetary policy in advanced countries can have spillover effects on other economies through several transmission mechanisms. The first is the portfolio rebalancing channel. Chua et al. (2013) showed that normalizing monetary policy in developed countries such as the United States, increases US long-term bond yields and pushes investors to rebalance their portfolios. Investors will also switch from assets in emerging markets to advanced economies that have a lower risk. Financial asset prices in emerging markets thus falls while long-term interest rates increases, as the financial conditions tightens in emerging markets.

The second channel is the risk-taking channel. Borio and Zhu (2012) and Adrian and Shin (2010) found a significant linkage between banks' risk-taking behavior and low interest rates. The risk-taking channel may operate via two mechanisms. First, the low returns on investments may incentivize banks to take on more risky assets. Second, low interest rates affect banks' valuations on incomes and cash flows, which in turn, can affect how banks measure the risk and may increase incentives for banks to take on more risk. In the international context, when global banks apply less stringent conditions on domestic banks' funding supply, the domestic banks in turn transmit the more lenient requirement onto their borrowers. Through this global and domestic banks interaction, global liquidity is transmitted. Forbes and Warnock (2012) and Bruno and Shin (2015) emphasize that the decline in the VIX is strongly associated with the surge of capital flows into emerging markets.

The third is the exchange rate channel. Mohanty (2014) explains that a tight monetary policy in advanced economies causes their currencies to appreciate but conversely, emerging markets' to depreciate. This may encourage speculation and increase the magnitude and volatility of capital flows. In countries with managed floating regimes, central bank intervention may lead to a decline of foreign exchange reserves, lowering domestic credit.

3. Empirical Framework

3.1 Global VAR

One of the most common methods used in the study of global economic spillover impact on the domestic economy is by using VAR (e.g., see Eichenbaum and Evans, 1995; Grilli and Roubini, 1996). One problem in the global macroeconomic VAR is over parameterization of empirical models. This problem arises when the number of variables is relatively large compared with the available time dimensions. In general, there are two ways to overcome the limitations of standard VAR in the literature, namely: (i) the shrinkage of data (e.g., factor model); and, (ii) the parameter space shrinkage (e.g., Bayesian shrinkage). An alternative way to overcome the VAR dimensionality problem is the GVAR modeling approach originally proposed by Pesaran, Schuermann and Weiner (2004).

This paper implements the GVAR, a modeling approach that combines time series, panel, and factor analysis. Technically, GVAR is a global model that chains the vector autoregression (VAR) model of each country, where domestic variables are associated with foreign variables specific to each country through trade, financial, or other patterns.

As stated in Smith and Galesi (2014) and Harahap et al. (2016), the GVAR has several advantages as it allows (i) national and international interrelationships to be transparent and tested empirically; (ii) long-term relationships that are coherent with the theory as well as short-term relationships that are coherent with the data; and, (iii) the creation of solutions that are coherent and based on economic theory, despite the serious issues related to the dimension of global economic modeling.

Cesa-Bianchi et al. (2016) wrote that the GVAR model has several advantages relative to some other modelling approaches: (i) it is a global model accounting for more than 90% of world GDP; (ii) all channels of transmission are captured; (iii) shocks can spillover through third countries (indirect effects); and, (iv) the GVAR is an empirical model so its captures the spillovers of shocks that have typically been seen in the past. Possible weaknesses of the model include: (i) the GVAR is linear; and, (ii) the GVAR can only distinguish between different sources of a shock by making a number of assumptions.

As was explained in Harahap et al. (2016), Chua et al. (2013) also stated that for each country, conventional VAR models are expanded with additional sets of foreign variables. A foreign variable is constructed as a weighted average of a trading partner. Suppose there are $N + 1$ countries in the global economy with an index $i = 0, 1, 2, \ldots, N$ where 0 is used as a reference country. The individual $VARX^*(p_i, q_i)$ for each country is

$$x_{it} = a_{i0} + a_{i1}t + \sum_{s=1}^{p_i} \Phi_i x_{i,t-s} + \sum_{s=0}^{q_i} \wedge_i x^*_{i,t-s} + \varepsilon_{it}, \ \varepsilon_{it} \sim i.i.d\,(0, \sum i) \qquad (1)$$

where x_{it} is a vector of domestic variable $k_i \times 1$, and x^*_{it} is a vector of foreign variable $l_i \times 1$ with

$$x^*_{it} = \sum_{j=0}^{N} \omega_{ij} x_{jt} \qquad (2)$$

where ω_{ij} is a constant weight with $\sum_{j=0}^{N} \omega_{ij} = 0$. ω_{ij} is constructed based on the portion of the flow from country j to the total flow received by country i, which represents the relationship between country i and country j. Country-specific foreign variables x^*_{it} are assumed as weakly exogenous, where the coefficient of error correction term is set as zero in the foreign variables equation. Hence, the dynamics of foreign variables are not affected by the long-run equilibrium path, in contrast to the domestic variable. Each country model is also estimated through reduced rank regression and ordinary least squares to obtain the parameters of individual countries.

This paper uses the weight matrix data employed by Harahap et al. (2016), where the weight is a combination of trade and financial relations between countries. The default matrix in Smith and Galesi (2014) is thus modified. Along with Chen et al. (2015), the weights are obtained through the following equation:

$$\omega^{agg}_{ij,t} = w^T_{i,t}\omega^T_{ij,t} + w^F_{i,t}\omega^F_{ij,t} \qquad (3)$$

where $\omega^T_{ij,t}$ and $\omega^F_{ij,t}$, respectively, are the weights of trade and financial relations between country i and j at time t. $w^T_{i,t}$ and $w^F_{i,t}$, respectively, are the degrees of relative importance between the flow of trade and financial flows in the economy. The two variables are formed from the current value of trade (exports and imports) and financial flows (inbound and outbound) relative to the total value of the two components. Weights between i and j are then fixed and obtained through

$$\omega_{ij} = \frac{1}{T}\sum_{t=1}^{T} \omega^{agg}_{ij,t} \qquad (4)$$

Trade and financial weight are represented by trade and financial relations, respectively, using data from 2011 to 2014. The trade relationship is based on the flow of exports and imports, while financial flows are represented by international bank lending from the Bank for International Settlements (BIS). However, in a small number of country-pairs, only the trade weight is used, as there is some availability issues in the financial flow dataset.

The GVAR model is estimated after country-level VAR models are obtained. Although the estimation is done separately for each country, the GVAR model is solved entirely ($k_i \times 1$ global vector variable, $k = \sum_{i=0}^{N} k_i$) because of its dependence on the same period between x_{it} domestic variable to foreign variable x_{it}^{*}.

Following Chua et al. (2013) as also stated in Harahap et al. (2016), if $z_{it} = (x_{it}, x_{it}^{*})'$, equation (1) can be written as follows

$$A_i z_{it} = a_{i0} + a_{i1} t + \sum_{s=1}^{p_i} B_{is}\, z_{i,t-s} + \varepsilon_{it} \qquad (5)$$

where $A_i = (I_{ki} - \wedge_{i0})$, $B_{is} = (\Phi is \wedge_{is})$.

From equation (2), $z_{it} = W_i x_t$ can be obtained, where W_i is the weight matrix, with dimension $(k_i + l_i) \times k$, and defined from country-specific weights ω_{ij}. Thus, equation (5) can be transformed into

$$A_i W_i x_t = a_{i0} + a_{i1} t + \sum_{s=1}^{p_i} B_{is}\, W_i x_{t-s} + \varepsilon_{it} \qquad (6)$$

The individual country models are then stacked into a global model x_t:

$$G_o x_t = a_0 + a_1 . t + \sum_{s=1}^{pi} G_s\, x_{t-s} + \varepsilon_t, \qquad (7)$$

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

Multiplying equation (7) with G_0^{-1} yields:

$$x_t = G_0^{-1} a_0 + G_0^{-1} a_1 . t + \sum_{s=1}^{p} G_0^{-1} G_s\, x_{t-s} + G_0^{-1} \varepsilon_t, \qquad (8)$$

Equation (8) can be solved recursively to obtain the future value and impulse response.

3.2 Data

In this paper, we use quarterly data for 31 countries from 1979 Q2 to 2015 Q4 taken from International Financial Statistics, BIS, Bloomberg, CEIC, and The Atlanta Federal Reserve Bank. Variables employed follows Dees et al. (2007) as the choice focuses on fundamental variables rather than short-term volatility. x_{it}^{*} includes real GDP, inflation, short-term interest rate, long-term interest rate, real exchange rate (RER), and index of equity prices. All variables were also included as x_x_{it}^{*}, except RER. Additionally, the model employs oil price, metal price, and raw material price as global variables. Further, from the year 2009, the paper uses the Wu-Xia Shadow Policy Rate (Wu and Xia, 2015) as the US short-term interest rate to represent the Fed's unconventional policy measure at zero lower bound. The paper also uses the Wu-Xia ECB Shadow Policy Rate and BOJ Shadow Policy Rate (Bloomberg Ticker: NZSSJAP Index). Most of the data are converted into natural log form, except for the variables in percentage form. The weight matrix ω_ij is based on the flow of exports and imports, while the financial flows are represented by cross-border bank lending data from BIS's International Banking Statistics.

There is some additional specification of the GVAR estimation that follows Dées et al. (2007). First, as the US market acts as a benchmark for global financial markets, the US VARX specification does not include several foreign variables, e.g., index of equity prices and interest rates. Second, concerning the difference in the degree of integration, the trend restriction is given on several variables, e.g., interest rates and inflation.

The existing literature on the spillover of unconventional monetary policy typically uses changes in interest rates as a proxy for monetary policy shocks. For example, Dees et al. (2007) compute monetary policy shock as a cut to the US short-term interest rate. Meanwhile Chen, et al. (2015) use the US term spread and the US corporate spread in order to assess the spillover of the USQE on the rest of the world. However, studies on the spillover of unconventional monetary policy have increasingly relied on other proxies for monetary policy shocks. If the interest rates are already at zero lower bound, using interest rates as an indicator of monetary policy is not an adequate approach. A decline in the interest rate at the zero lower bound will create no significant impact on the money supply. Therefore, one way to identify a monetary policy shock is through the expectation channel on stock prices. Cooley and Quadrini (1999) found that a contractionary monetary shock had a negative impact on the stock price. Rogers et al. (2014) found that unconventional monetary policy by the Fed, Bank of England, ECB and BOJ are

effective in easing financial conditions when policy rates are stuck at the zero lower bound. Furthermore, Ganneli and Tawk (2016) suggest that spillovers from BOJ's quantitative and qualitative easing (QQE) might have worked mainly through the impact of expectations and improved confidence, as represented by increases in equity prices.

Therefore, we model the impact of unconventional monetary policies from the Fed, ECB and BOJ through the conventional monetary policy channel and the expectations channel. We consider two types of scenarios - namely, a shock to interest rates and changes in equity prices as a proxy for unconventional monetary policies of the three advanced economies.

The results of the GVAR estimates are then used to obtain the impulse responses. This paper analyzes the Structural Generalized Impulse Response Function (SGIRF) instead of Orthogonalized Impulse Response Function (OIRF), as prior ordering is not required in SGIRF. Even if a suitable ordering of the variables in a given country model can be derived, it is not clear how to order countries in the GVAR. In addition, we use 10.000 bootstrap replications and analyze the median and confidence interval of each impulse response.

The bootstrap method also gives a confidence interval of each impulse response. One standard deviation shock is converted into a 1% shock by using the VECMX residual of the corresponding variable. Based on previous GVAR studies performed by Pesaran and Smith (2006), Dées et al. (2007), Chudik and Fratzscher (2011), and Chen et al. (2015), the confidence intervals of the GIRF tend to be wide and include both positive and negative regions. This is due to the limited degree of freedom as a result of a large number of variables. Thus, we use the 25th and 75th percentiles as the range of their error bands as did Chudik and Fratzscher (2012).

4. Results and Discussion

The analysis focuses on the impulse responses during the 8 quarters after the shock. The discussion on a shorter timeframe follows several previous studies (Sun et al. 2013; Chudik and Smith 2013; and IMF, 2014), considering the higher credibility of the results (Sun et al. 2013). Further, the analysis focuses only on the responses of real GDP and real exchange rate, as the central issue of the spillover effects is about economic growth and stability. Volatility of the real exchange rate may indicate volatility of the nominal exchange rate by assuming price rigidity in the short-term, thus indicating instability.

Several tests show that the GVAR model is stable and therefore can be used for impulse response analysis. The weak exogeneity test results indicates that external variables are weakly exogenous in nearly 95% of cases. Contemporaneous effects on domestic variables are generally consistent with the shocks on the equivalent external variables. The correlation residuals in each VECMX equation are relatively small, within the range of 0 - 0.3, which shows low correlation on the unexplained part between countries. Therefore, it shows that the estimated model does quite well in explaining the variations in the data and in explaining the interrelationships between countries (Sun et al. 2013).

4.1 Impact of Short-term Shadow Interest Rate Shock

Using the model, we simulated a shock in the form of a 1% changes in the US, Euro Area and Japan (shadow) short-term interest rate. The shock would induce a reduction/increase in global output and higher global inflation. However, we found that our calculations hardly generated statistically significant results for variables of Indonesia and the ASEAN-5 from the Euro Area and Japan short-term (shadow) interest rates shock. Therefore, only the impulse response from US shocks are presented in this subsection. The limited spillovers from the BOJ and ECB short-term interest rates shock could possibly be due to the fact that the money injected is not being circulated into the economy, given that the banks are not channeling the money into lending.

The results illustrated in Figure 3 shows the impact on the level of Indonesia GDP of a positive 1% shock to the level of US Fed Fund Rate. On impact, where it is significant at 75% confidence interval according to bootstrap replications, the model suggests the shock would reduce Indonesian GDP by -0.01% at the end of first year. That effect would then build over time to a peak of -0.02% in first two years and stays significant during four years after the shock. Although higher US interest rates lead to depreciation, thereby increasing real GDP via the trade channel, real GDP is expected to fall only slightly due to rising interest rates in Indonesia via the financial channel. These results are consistent with Harahap et al. (2013) and Soares (2013), where the transmission of a US interest rate hike was more potent through the financial rather than trade channel. Druck, Magud, and Mariscal (2015) stated that the rise in US interest rates will lead to an appreciation of the US exchange rate and lower commodity prices, reducing developing countries' real GDP.

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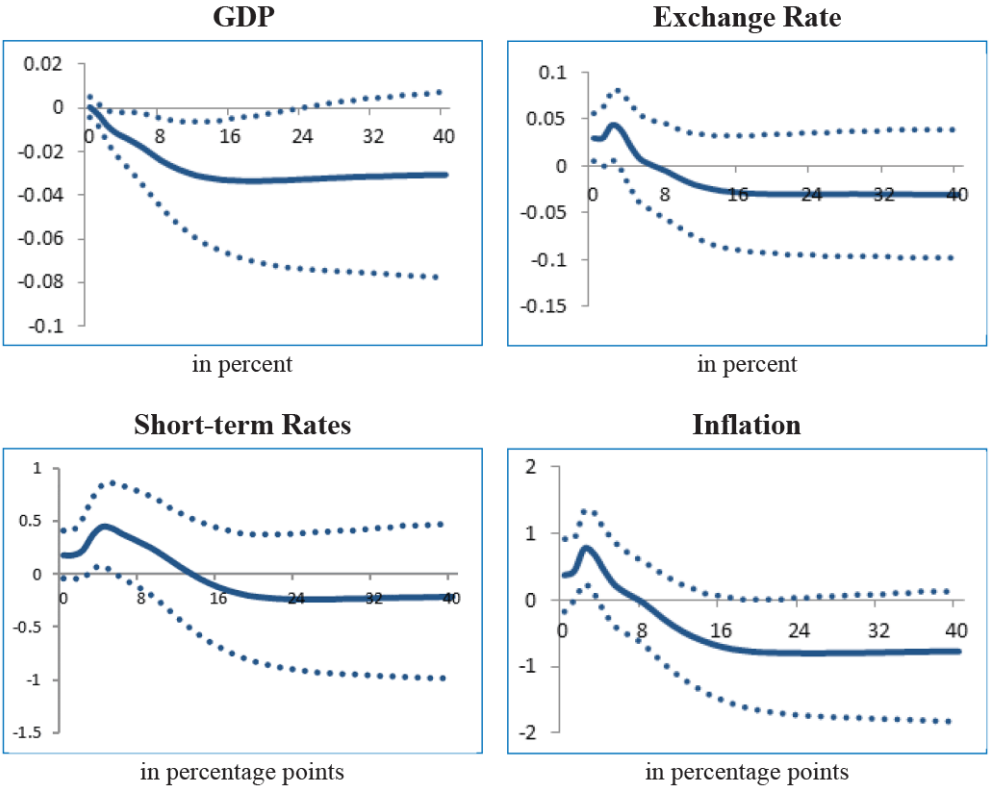
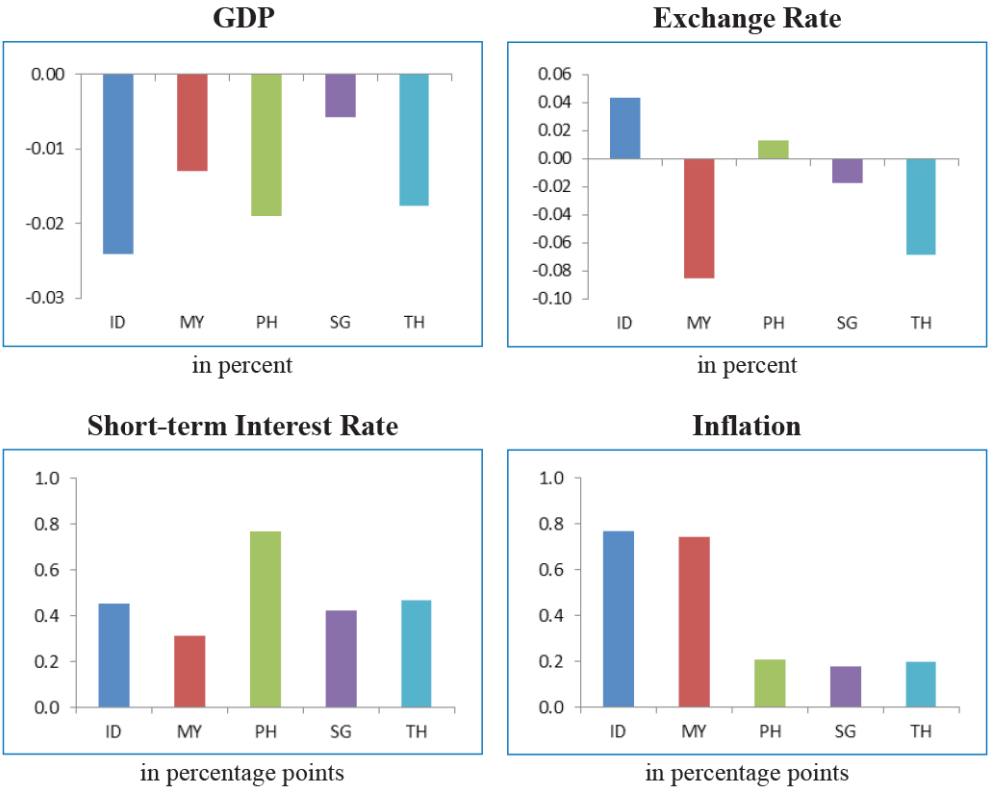
Figure 3
SGIRF of a Positive 1% US Short-term Interest Rate Shock



The largest output impact due to the US liquidity shock is on Indonesia followed by Philippines and Thailand, while Singapore's output is indicated to be the most resilient (Figure 4). This might be due to the closer trade and financial relationship of the US with Singapore compared with the rest of the ASEAN-5, as indicated in the weight matrix.

Figure 4
Maximum Impulse Response Function of US Short-term Interest Rate Shock



Note: ID=Indonesia, MY=Malaysia, PH=Philippines, SG=Singapore, TH=Thailand.

An increase in US FFR by 1% also makes the Real Exchange Rate (RER) of Indonesia to depreciate contemporaneously by about 0.03%. This effect would then build over time to a peak of 0.04% depreciation. There is some indication that Indonesian RER is the one which clearly overshoots contemporaneously in responding the shock, whereas in other ASEAN-5 countries, it generally undershoots. This might be due to the relatively shallow foreign exchange market in Indonesia, as indicated in BIS (2014). Moreover, Singapore and the Philippines have the lowest responses. This may be due to the managed exchange rate policy adopted by the Monetary Authority of Singapore and high volume of remittances in the Philippines.

The impact of US quantitative easing may differ significantly between countries and between variables. This implies that the transmission and adjustment may have different mechanisms among economies. For instance, the US FFR positive shock depreciates Indonesian RER by 0.04% and appreciates Malaysian RER by

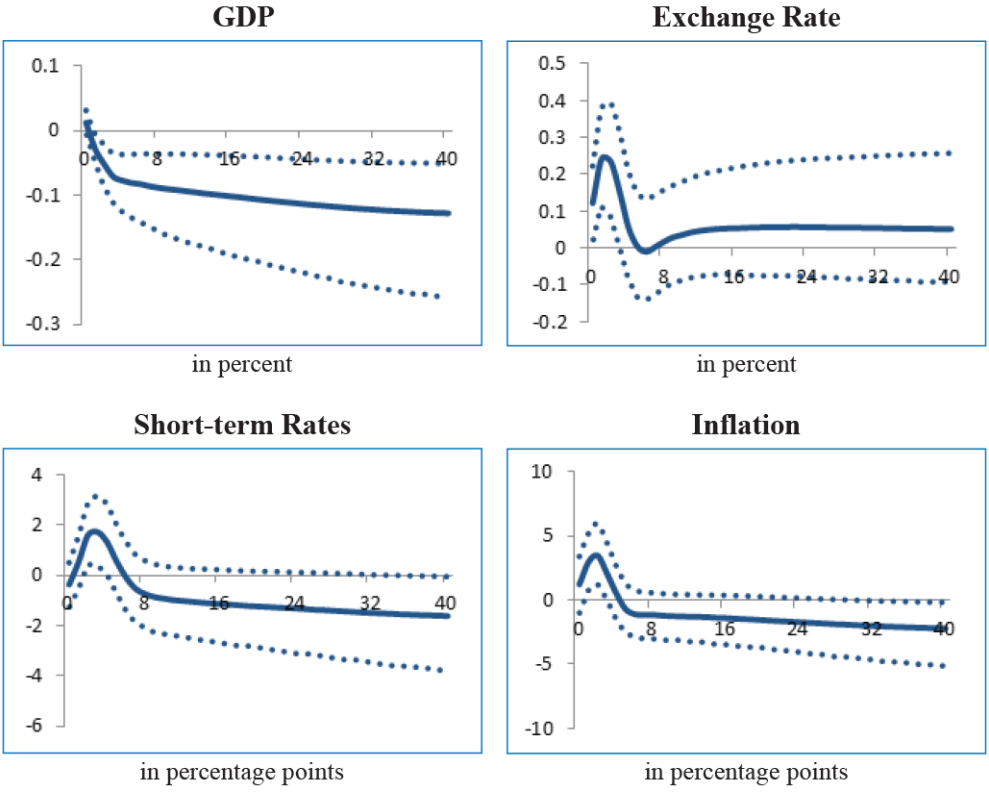
0.09%. However, the impact on short-term interest rate and inflation is positive for all ASEAN-5 economies.

4.2 Impact of Equity Price Shock

Figure 5 shows the responses of 1% negative shock to US real equity prices. The median estimates are reported in solid lines, while dotted lines show the 75% confidence bands. The GVAR estimates suggest that the spillovers to Indonesia would decrease output growth by 0.1 percentage points at its peak over the first 2 years. Moreover, the negative impact is significant on bootstrap confidence bands.

The effects on the exchange rate, short-term rates, and inflation are predicted to be only temporary, while significant on the majority of bootstrap replications. Indonesia's exchange rates depreciate contemporaneously and the peak is about 0.23% depreciation, which occurs about 2 quarters after the shock, and then diminishes soon after. The reduction of US real equity price also increases Indonesia's short-term interest rates and inflation during the first year after the shock.

Figure 5
SGIRF of a Negative 1% US Equity Price Shock



The impact of US equity price shock on Indonesia's GDP is similar to those on Philippines' and Thailand's, and on lesser extent for those of Malaysia and Singapore (Figure 6). However, Indonesia's exchange rate, interest rate and inflation are generally more sensitive to US equity price shocks, compared to the responses of those variables in other countries.

Figure 6
Maximum Impulse Response Function of a Negative 1% US Equity Price Shock

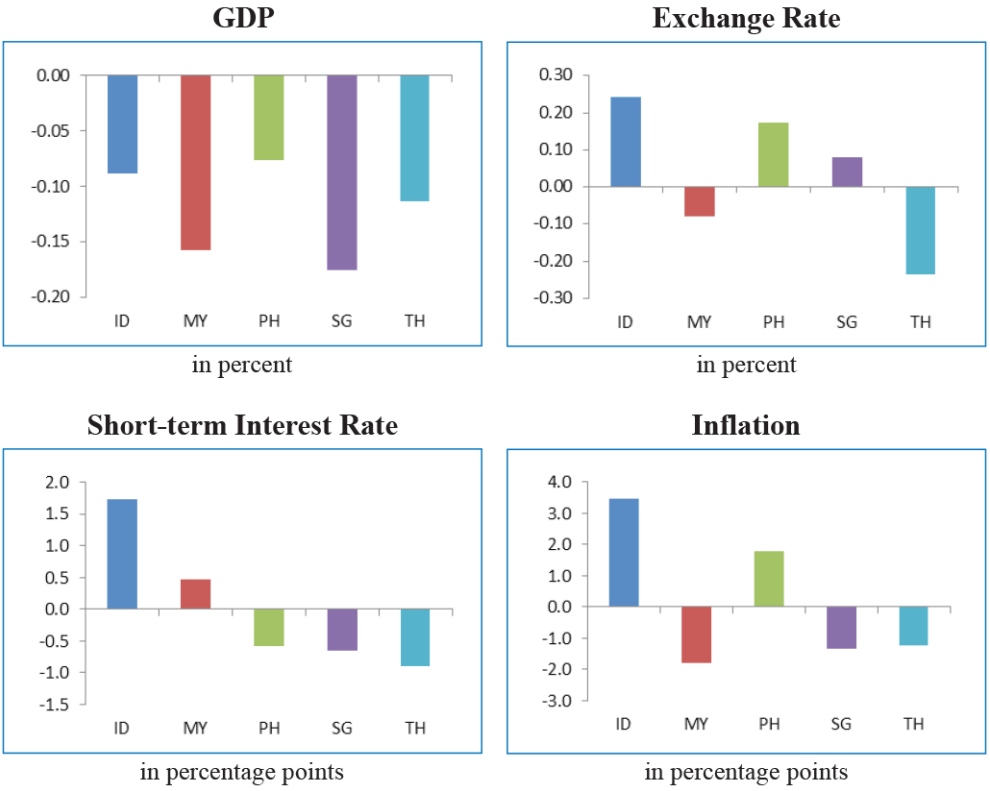
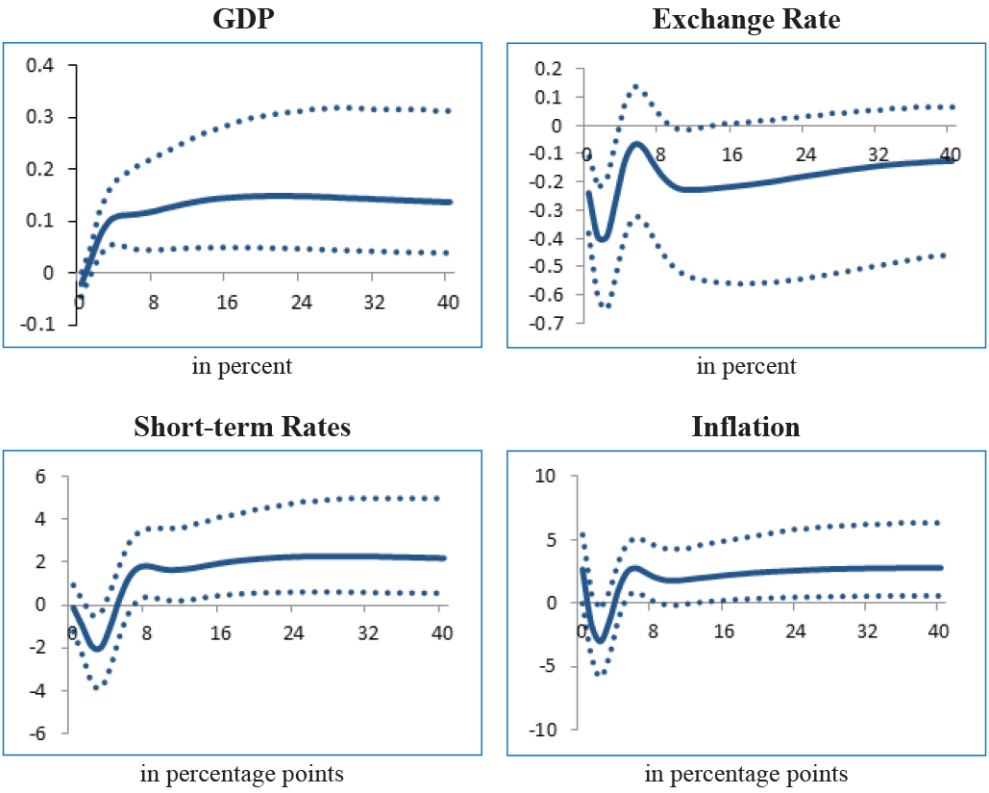


Figure 7 shows the responses of a 1% positive shock to Euro real equity prices. The median estimates are reported in solid lines, while dotted lines show the 75% confidence bands. The GVAR estimates suggest that the spillovers on Indonesia would increase output growth by about 0.12% at its peak over the first 2 years.

The impulse response of Indonesia's exchange rates, short-term rates and inflation are similar to some extent. The positive shock to Euro real equity prices finds the responses in exchange rate appreciation, short-term rates reduction, and inflation decrease in Indonesia during the first year after the shock.

Figure 7
SGIRF of a Positive 1% EU Equity Price Shock



The impact of EU equity price shock on GDP varies among countries in ASEAN (Figure 8). Indonesia's GDP decreases while Malaysia and the Philippines are not affected. In Singapore and Thailand, the GDP increases. The variation in the impact across countries in ASEAN occurs from the responses of short-term interest rate and inflation. However, the impact on exchange rate are similar, for which the Philippines, Indonesia and Singapore have the strongest responses.

Figure 8
Maximum Impulse Response Function of EU Equity Price Shock

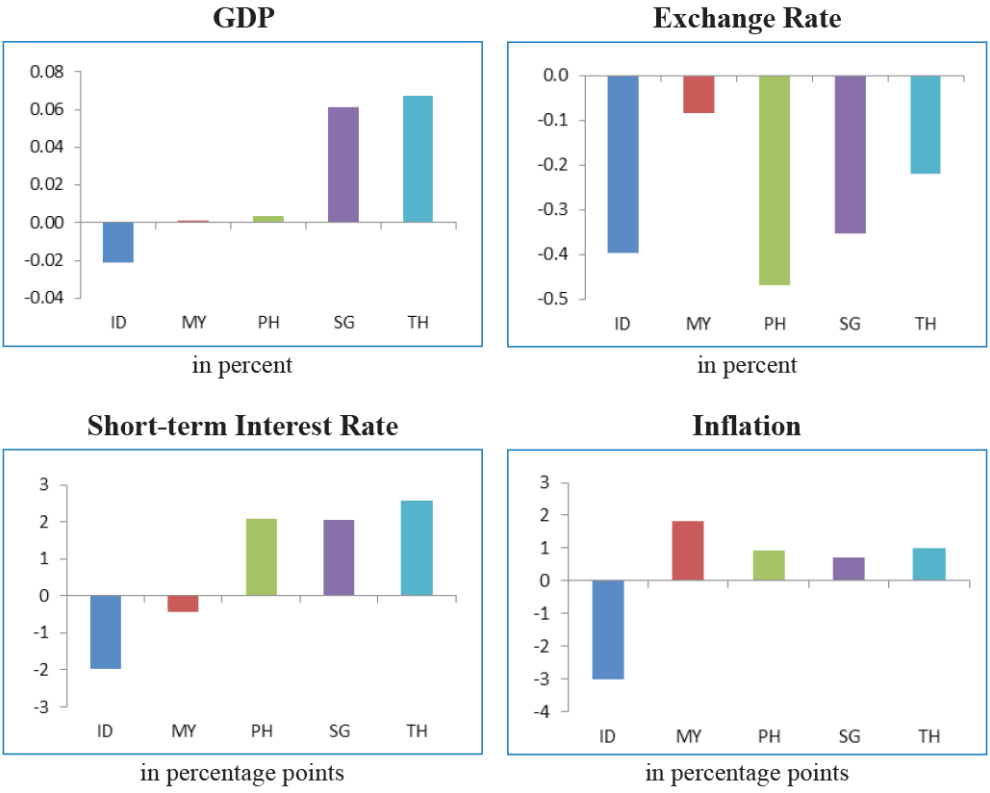
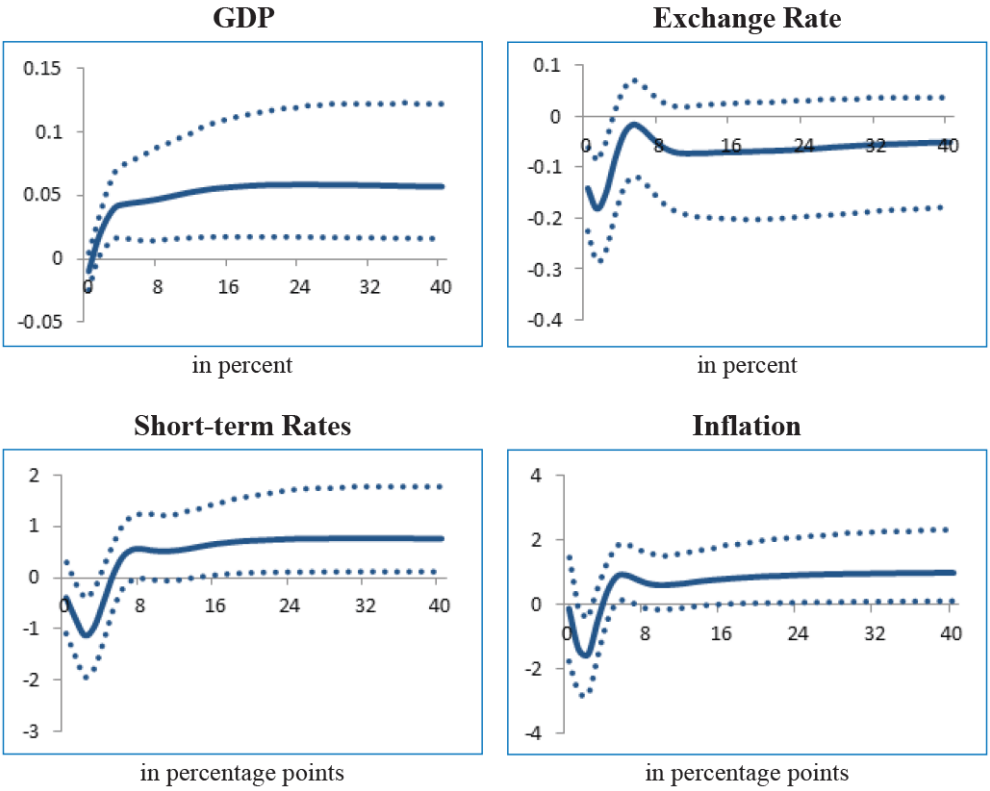


Figure 9
SGIRF of a Positive 1% Japan Equity Price Shock

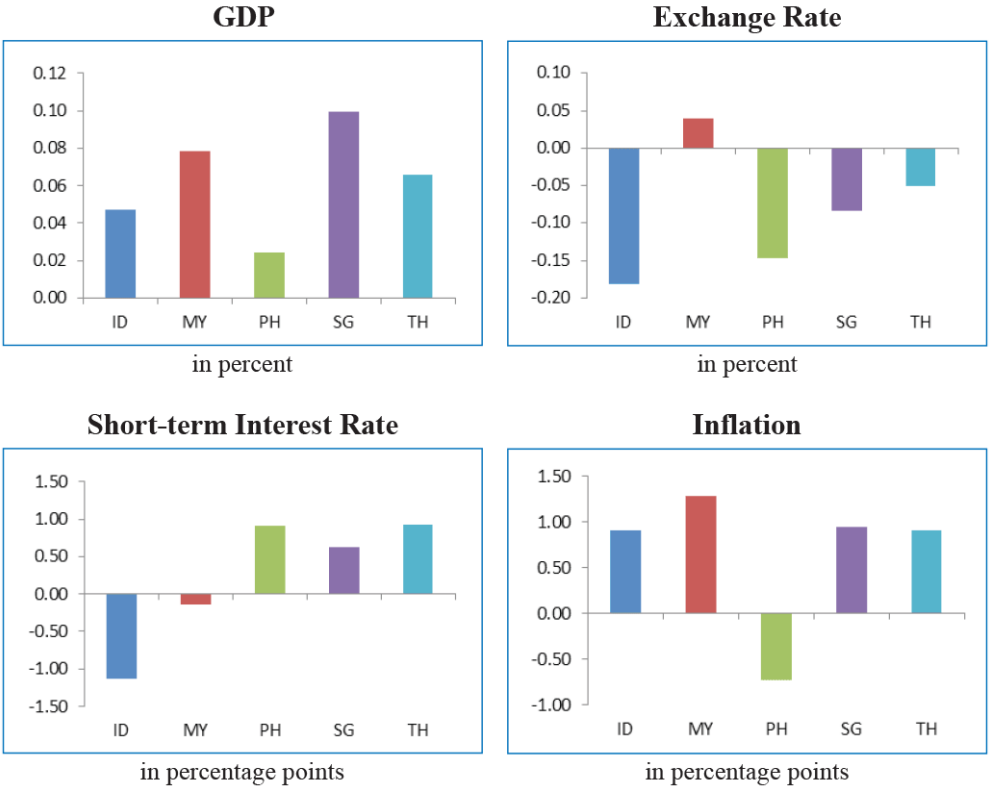


The shock from Japan has a smaller impact on Indonesia's real GDP. A positive 1% shock from the level of Japan's equity price would lead to a 0.05 percentage point increase in Indonesia's economic growth. Compared to the responses due to shocks on each of those three economies, Indonesia's GDP responses from the EU and Japan equity price is smaller than the response from the shock from US equity price.

In Indonesia, real exchange rate appreciation pressures rise in the first year after the shock of around 0.1% to 0.2%. The response due to EU's equity price shock is slightly larger than those from Japan's and US' equity shocks. However, it is crucial to note that a significant exchange rate contemporaneous effect from the Euro Area and Japan are from expectations only via equity prices. From this, we can see that important liquidity shocks for Indonesia's exchange rate originates from US, Euro and Japan, respectively.

In the ASEAN-5, Singapore and Malaysia appear to be among the economies which react most strongly to the quantitative easing of the Euro Area and Japan, while the Philippines among the least affected. This probably reflects differences in the transmission channels and in the adjustment mechanisms each economy chooses to rely on.

Figure 10
Maximum Impulse Response Function of Japan Equity Price Shock



5. Framework for Managing Monetary-Financial Stability

5.1 Evolution of Inflation Targeting Framework Implementation

The main objective of monetary policy in Indonesia is price stability, which is measured by a low and stable inflation with a stable exchange rate. To achieve this objective, Bank Indonesia introduced the Inflation Targeting Framework (ITF) in 2003 and has been fully implemented since mid-2005. The framework also includes the management of the current account deficit and foreign capital inflows. The main instruments used are interest rates, supported by exchange rate policy instruments, Capital Flows Management (CFM), statutory reserves and a number of other prudential arrangements. Despite having price stability as the ultimate target, monetary policy still has considerations for the macroeconomic conditions and the financial system as a whole, especially economic growth, balance of payments, and the effectiveness of monetary policy transmission.

Indonesia faces a number of challenges in the implementation of monetary policy relating to capital flows. Agung et al. (2016) explain that there are three challenges in the implementation of monetary policy in Indonesia during quantitative easing (QE) in advanced economies.

First, capital flows drive exchange rate volatility and hence the current account. From Q3 2009 to Q2 2011, these inflows triggered a significant rupiah appreciation and widened the current account deficit. An open capital account with an influx of capital flows affected the behavior of the exchange rate. Combined with the end of the commodity super cycle and a growing middle-income population in Indonesia, rupiah appreciation contributed to a current account (CA) surplus.

Second, capital flow volatility created vulnerability in the financial system. Large and persistent capital inflows might reverse suddenly due to shifts in market sentiment. Hence, they increase financial market volatility and act as a shock amplifier. These consequences were further magnified by a weak infrastructure and a lack of financial depth in Indonesia. Further, a significant portion of the capital inflows was invested in short-term financial instruments, such as government bonds (Surat Utang Negara/SUNs), central bank notes (SBIs) and stocks, which are particularly vulnerable to sudden reversals. As the Fed began the tapering-off in January 2014, domestic liquidity shrank.

Third, financial sector pro-cyclicality was amplified by foreign capital flows. The influx of capital propelled more liquidity into the banking system and further credit was given to the real sector. As a result, an asset price bubble emerged, especially in the property sector. As banks still dominates the financial system in Indonesia, the magnitude of the pro-cyclicality is reflected in the performance of

bank lending during each phase of the business cycle. In addition, behavior towards risk also contributed to pro-cyclicality in the financial sector.

These three challenges suggest that persistent foreign capital inflows had undermined the effectiveness of monetary management, especially orthodox policies in managing liquidity in the economy, such as interest rate increase. To prevent upward exchange rate pressures, high capital inflows required intensive intervention, which causes the amount of excess liquidity in the banking system to increase significantly. Hence, capital inflows reduce the autonomy of monetary policy and shift its orientation from a sole focus on inflation control towards mitigating exchange rate appreciation.

As mentioned in Agung (2016), the challenges after the global financial crisis have revealed some valuable lessons for monetary policy implementation in Indonesia. First, the existence of multiple challenges in conducting monetary policy implies that Bank Indonesia should have multiple instruments. In the event of persistent capital flows, while the exchange rate should remain flexible, it should also not be severely misaligned from its fundamental value. Simultaneously, measures are required to accumulate foreign exchange reserves as buffers given that short-term capital inflows entail a risk of sudden reversals. In terms of capital flow management, a variety of policy options are available to deal with the excessive pro-cyclicality. In terms of monetary management, the dilemmas have been partially resolved by applying a quantitative-based monetary policy in addition to the standard policy rate instrument. In addition, macroprudential policies aimed at maintaining financial system stability should also be implemented to minimize the risk of asset bubbles.

Second, while price stability should remain the primary objective of Bank Indonesia, the global financial crisis showed that keeping inflation on track only is not sufficient to preserve macroeconomic stability. A number of crises in recent decades have also shown that macroeconomic instability is primarily rooted in financial crises. Therefore, the key to managing macroeconomic stability is to manage not only the imbalance of goods (inflation) and externalities (balance of payments) but also imbalances in the financial sector, such as excessive credit growth, asset price bubbles and the cycle of risk-taking behavior in the financial sector. In this regard, Bank Indonesia would be effective in maintaining macroeconomic stability if also mandated to promote financial system stability. Hence, the ITF implementation requires an enhancement by including the substantial role of the financial sector.

Third, exchange rate policy should play an important role in the ITF of a small open economy. Under a standard ITF, Bank Indonesia would not attempt to manage the exchange rate. This benign view argues that the exchange rate system should be allowed to float freely, thus acting as a shock absorber for the economy. However,

in a small open economy with open capital mobility, exchange rate dynamics are largely influenced by investor risk perception, which triggers capital flows. In this environment, there is a case for managing the exchange rate in order to avoid excess volatility that could push the exchange rate beyond a consistent range to achieve the inflation target.

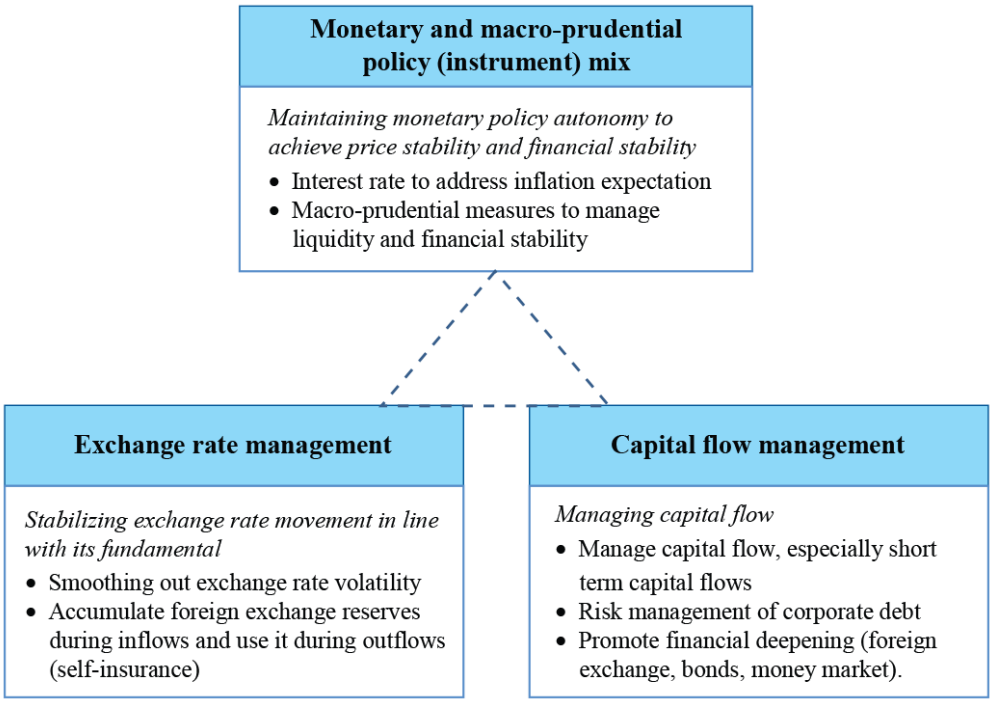
In addition, there are three structural challenges. First, Indonesia's economy is still dependent on the commodity sector, and therefore, often face food price volatility and imbalances in the balance of payments. Mitigation of internal and external imbalances requires a coordinated monetary policy with fiscal policy and structural reforms by the government to maintain macroeconomic and financial system stability. Second, the financial system in Indonesia is dominated by banks with undeveloped financial markets. Therefore, banking financial cycles tend to be accelerated by the economic cycle. And third, Indonesia's economy is relatively small with an open capital account, capital flows management, therefore, is crucial in order for foreign capital to be beneficial to the economy and not cause economic instability.

All three challenges of monetary policy, macroprudential policy, and CFM are interrelated and thus emphasizes the importance of a good policy mix. For instance, Indonesia experienced a mini-crisis in 2005 which was preceded by the rapid growth in domestic demand, bank lending and inflows of foreign capital from the economic boom fueled by high global commodity prices.

The formulation of an optimal policy mix in Indonesia depends on what kinds of shocks hit the economy. A fall in world GDP would elicit an accommodative monetary policy response and looser macroprudential measures. An increase in global interest rates would be followed by tighter monetary and macroprudential policy. Meanwhile, a broader current account deficit would require tighter monetary policy and looser macroprudential measures. On the other hand, capital outflows would require raising the policy rate and looser macroprudential measures. As Indonesia faces many challenges, when there are multiple shocks, the formulation of a policy mix is significantly more complex. Therefore, Bank Indonesia implements the monetary policy framework under a flexible ITF.

The purpose of a flexible ITF is to manage the monetary policy trilemma (as presented in Graph 3.1), to achieve three intermediate goals as follows: (1) maintaining monetary policy autonomy in achieving price stability by employing a monetary and macroprudential policy (instrument) mix; (2) stabilizing the movement of the exchange rate in line with its fundamental value by employing exchange rate management; and, (3) managing capital flow dynamics to support macroeconomic stability by implementing capital flow management.

Figure 11
Monetary Trilemma under Flexible ITF



Source: Agung et al. (2016).

From a theoretical perspective, the "impossible trinity" has place constraints for policy makers in small open economies in an era of a high degree capital mobility. The theory postulates that a policy maker can only choose two "corner solution" out of three. Nevertheless, studies by Mohan and Kapur (2009) and Aizenman, Chinn and Ito (2012) conclude that, in practice, EM tend to choose the middle ground solution by maintaining some degree of capital flows mobility and exchange rate flexibility while keeping monetary policy independent. To deal with the impossible trinity, Bank Indonesia implements a policy mix of monetary policy, macroprudential policy, CFM, and structural policy of strengthening the financial market to somehow make the "impossible trinity" possible. While Bank Indonesia uses monetary policy to anchor inflation expectation, macroprudential policy is used to support financial system stability and CFM to dampen capital flows and exchange rate volatilities.

To implement the framework, Bank Indonesia's policy mix has been formulated with the following four instruments (Warjiyo, 2014a, 2015b):

1. The policy interest rate was set to direct future inflation forecast within the target range of 4 ± 1% in 2016 and 2017.
2. The exchange rate policy aimed to maintain the stability of exchange rate movements in the market in line with its fundamentals and consistent with the inflation target. The exchange rate policy also ensures that volatility is not excessive which can lead to macroeconomic and financial system instability. Unlike developed countries, exchange rate stability is very important for EMEs since their financial markets are underdeveloped. Externalities can have major impacts on the stability of their banking and the financial system.
3. CFM is used to support the exchange rate policy, macroeconomic and financial system stability, particularly during periods of large capital inflows or large foreign capital reversal.
4. Macroprudential policies are directed to support the stability of the financial system and the effectiveness of monetary policy transmission. Details and objectives of macroprudential measures are represented on Table 1.

Table 1
Macroprudential Measures in Indonesia

No	Measure	Objectives
1	Minimum holding period on BI bills	To "put the brake" on short-term and speculative capital inflows and mitigate the risk of a sudden reversal.
2	Lengthen auctions and offer longer maturity of BI bills	To enhance the effectiveness of domestic liquidity management, including capital inflows, by locking investments into the longer term and helping develop domestic financial markets.
3	Non-tradable rupiah term deposits for banks	To lock domestic liquidity into the longer term and limit the supply of BI bills on the market.
4	Limits on short-term offshore borrowing by banks	• To limit short-term and volatile capital inflows. • To limit FX exposure of the banking system stemming from capital inflows.
5	Mandatory reporting of foreign exchange originating from export earnings	To increase dollar supply.
6	Primary rupiah reserve requirement (checking accounts held at BI)	To help absorb domestic liquidity.
7	Secondary rupiah reserve requirement (checking accounts held at BI, SBI and government bonds)	To absorb liquidity and to strengthen the banking system.
8	FX reserve requirements of the banks	• To strengthen FX liquidity management, and thereby banking system resilience, in the face of increasing FX exposure stemming from capital inflows • To help absorb domestic liquidity.
9	LDR-based reserve requirement	To absorb domestic liquidity and enhance liquidity management at banks without exerting negative impacts on lending that is needed to stimulate growth.
10	Loan-to-value (LTV) ratio for the property sector and down payments on automotive loans	To control accelerating credit growth in consumer sectors (especially the property and automobile sectors).
11	LTV for second and third properties	To slow the rate of increase of credit risk concentration in the property sector and to foster prudential principles.

Source: Agung et al (2016).

5.2 Stability Challenges and Policy Responses after Global Financial Crisis

Following the global financial crisis, emerging economies have been subjected to a number of external shocks and financial market volatility. The spillovers of the global crisis on emerging countries have become even more challenging with increasing volatility in the global financial market. In response to the pressures stemming from the heightened global growth and financial market volatility, Bank Indonesia have deployed different sets of policies that can be explained into three phases.

In the first phase, during the early stage of global recovery that was characterized by low interest rate and excess global liquidity, huge amounts of capital from advanced economies flowed into Indonesia's economy and commodity market, looking for higher investment returns. About US$ 70 billion entered Indonesia in the form of portfolio, FDI and foreign debts causing the rupiah to appreciate by around 15.4%. During this period, the Indonesia economy was generally in good shape, reflected by the above 6% GDP average growth and stable inflation of around 4%.

Table 2
Phases of Policy Mix after GFC

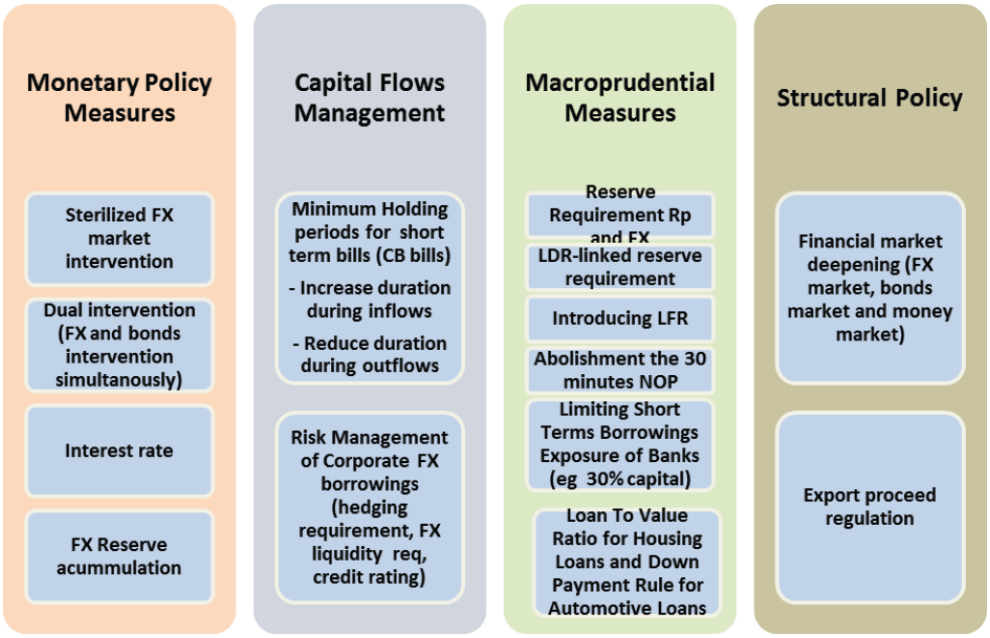
		2010-2012 *Early Global Recovery...*	2013-2014 *Uncertainties Era...*	2015 – Present *Sluggish Global Recovery..*

CONSIDERATIONS	GLOBAL	• Global GDP slowdown
		• Commodity prices peak in Q2-2011 & started to fall
		• Global excess liquidity
		• Ultra low interest rate
		• Quantitative easing in US and EZ
		• Moderate global market volatility
			• GDP slowdown esp. In EM
			• China rebalancing
			• Commodity prices continue to fall
			• High global volatility
			• Fed initiates monetary policy normalization (tapering)
				• Uneven and slow global growth
				• EM picking up; AE weaken
				• Consolidation in commodity prices
				• Moderate global uncertainty
				• Monetary Policy Divergence:
				  • FFR hiked, further increase IS expected at a slower pace
				  • Continued easing MonPol in EZ & JP

	DOMESTIC	• Current Account deterioration • Surge in capital inflow as portfolio inflows and debt • Rupiah appreciation • Stable inflation, inflation pressure from administered prices (fuel) • Solid GDP growth fueled by solid domestic demand and export • Strong credit growth	• CA deficit reach highest level • Large capital outflow in 2013 but inflow 2014 • Rupiah depreciation • High inflation pressure, from volatile and administered goods • Slow growth due to deterioration of external sector • Slower credit growth	• CAD improved; Capital inflows starting 4th q 2015 • Rupiah stabilized in 2015, appreciation trend in 2016 • Low inflation • Low exchange rate pass-through due to weak demand & fuel Reform • Sluggish growth due to export & limited fiscal space • Single digit credit growth
POLICY MIX		• **Easing Monetary Policy :** - Policy rate cut by 75 bps - Intervention to control volatility • **Macroprudential Policy:** - Enhancing bank risk management -Increased Rp. reserve requirement -Introduced LTV • **Tightening CFM's** - "Putting sand on the wheel" to mitigate impact of capital surges - Increased FX reserve requirement • **Coordination with government** - Regional inflation coordination team	• **Tightening Monetary Policy** - Stability over growth - Policy rate increased by 200 bps - Intervention to control volatility • **Macroprudential Policy:** - Tighter LTV requirement - LDR reserve requirement • **Easing of CFM's** - Smoothing capital flow volatility • **Coordination with government** - 2nd round inflation effect of AP hikes - Structural reform: subsidy policy	• **Easing Bias Monetary Policy :** - Easing Bias policy from Nov 2015 - Policy rate cut by 150 bps - New policy rate (Aug 2016) - Rp. reserve requirement cut by 1.5% - Intervention to control volatility • **Macroprudential Policy** - Relaxing LTV requirement • **Easing of CFM's** - Smoothing capital flow volatility • **Coordination with government** - Structural reform: infrastructure & investment climate

However, Indonesia's external balance started to deteriorate due to the strong demand for imports and weakening export performance. Indonesia's current account surplus declined over the period and became a deficit in late 2011. To cope with these challenges, Bank Indonesia implemented a combination of monetary policy loosening and capital flow management tightening. To keep inflation low, the policy rate was cut by 75 bps from 6.5% to 5.75%. The exchange rate policy was aimed at stemming excessive volatility of the rupiah due to the capital inflows. Macroprudential policy and capital flow measures were implemented to mitigate the risk of excessive capital surges. Macroprudential policy was designed to enhance banks' FX position risk mitigation and the use of structured products. On the CFM side, Bank Indonesia implemented the Minimum Holding Period for Bank Indonesia's Certificates (SBI) and reactivated limit on the bank's short-term debt.

Table 3
Bank Indonesia's Policy Mix and its Instruments



In the second phase from 2013 to 2014, the global economy entered an era of high uncertainties. The Fed in mid-2013, announced its plan for monetary normalization process, thus putting even higher risks for capital reversals and exchange rate pressures on emerging countries including Indonesia.

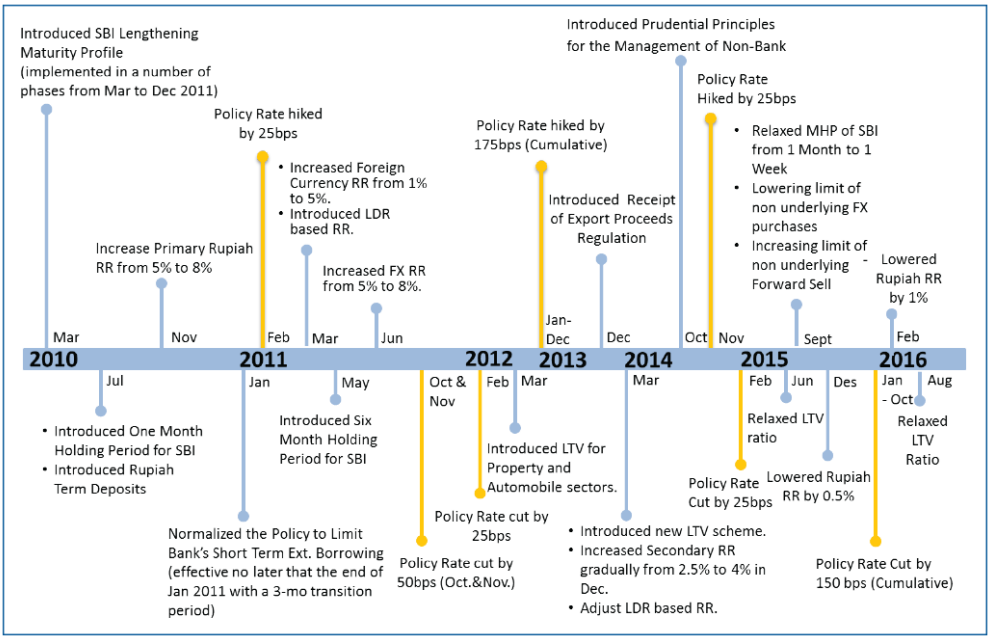
Indonesia's external balance continued to worsen - the current account deficit in 2011 reached an unprecedented level of -4.2% of GDP in 2013. The combination of capital outflows and large current account deficit resulted in large depreciation pressures on the rupiah exchange rate. In addition, the domestic economy also faced internal imbalances as inflation climbed. The government's subsidy reform of reducing the subsidies for fuels, cooking gas, and electricity increased inflation from 4.3% to 8.4% in 2014.

Facing external and internal imbalances, Bank Indonesia took a bold policy stance by choosing stability over growth to regain macroeconomic and financial system stability. To confront internal imbalances, Bank Indonesia tightened monetary and macroprudential policies to soften domestic demand and to anchor inflation expectation. The policy rate was increased by 200 bps from 5.75% to 7.75%. Bank Indonesia also tightened the Loan to Value (LTV) regulation for automotive and mortgage loans and implemented the LDR reserve requirement for banks. To manage the capital outflows, Bank Indonesia reduced the minimum holding period of central bank bills from 6 to 1 month to minimize the volatility. Bank Indonesia also worked closely with the government to lessen inflationary pressure as well as to improve Indonesia's external sector performance.

In the third phase of 2015 and 2016, Indonesia was facing sluggish global recovery. However, there was a silver lining in the horizon for the Indonesian economy as the internal balance improved. Global financial uncertainty has been receding since the mid-2015 as the FFR normalization had been implemented gradually. Inflation pressures started to decline as the rupiah and inflation expectation stabilized. While macroeconomic and financial stability has been restored, Indonesia's economic growth, however, has remained below expectation due to weakening global growth.

To mitigate the risk of vicious downward spiral in its economic growth, Bank Indonesia recalibrated the policy mix responses. Stable macroeconomic stability has provided some room for cautious monetary policy easing given the still-lingering volatility in the global financial market. In November 2015, Bank Indonesia reduced the reserve requirement by 50 bps and started the policy rate cut cycle in early 2016. To this date, Bank Indonesia has lowered interest rate by 150 bps and the rupiah reserve requirement by 150 bps from 8.0% to 6.5%. In addition, Bank Indonesia has also adopted a new policy rate with the use of the 7 days (reverse) repo rate from August 2016 to improve monetary policy transmission.

Figure 4
Timeline of Bank Indonesia's Policy



6. Conclusions

This paper conducted the GVAR analysis to look at the impact of global liquidity shocks. In particular, we estimated the Global VAR that includes 31 economies, and analyzed responses of Indonesia's macroeconomic variables to liquidity shocks originating from three advanced economies, namely US, Euro and Japan. The liquidity shocks are defined as short-term interest rate shock and real equity price shock via the expectations channel. These responses are compared with the responses of several other economies in the region. In addition, this paper also illustrated the monetary policy responses and other efforts in maintaining macroeconomic stability in Indonesia during period after global financial crisis.

The findings indicate a significant and permanent response of Indonesia's real GDP and temporary changes of the real exchange rate due to global liquidity shock. The temporary yet instantaneous response of RER indicates the volatility of the nominal exchange rate by assuming price rigidity, therefore indicating instability. In view of this, policymakers may counter the shock by supporting economic growth in the medium-term, as well as anticipating excessive exchange rate volatility in the short-term.

The responses of Indonesia's macroeconomic variables differ depending on the origins of the shocks. The transmission of monetary policy shocks originating from US is indicated by both the interest rate and expectation channel. Meanwhile, the monetary policy shocks from Japan and Euro are significant via the expectations channel only. Moreover, there are several notable variations of responses among economies in the region. This may be due to variations in trade or financial relationship, or due to different exchange rate regimes or policy frameworks.

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Appendix 1.a
Weak Exogeneity Tests of Foreign Variables (US Model)

Country	F Test	GDP	Inflation	Equity Price	Exchange Rate	Short-Run Interest Rate	Long-Run Interest Rate	Oil Price	Raw Material Price	Metal Price
AUSTRALIA	F(5,123)	1.67	2.42	0.46		0.26	0.92	0.19	1.41	0.26
BRAZIL	F(2,128)	2.19	3.37	2.59		0.38	1.53	1.02	0.02	0.14
CANADA	F(3,125)	**5.42**	2.50	1.34		1.37	0.60	1.42	0.66	1.98
CHINA	F(3,127)	0.13	0.98	0.13		1.58	1.92	2.66	0.51	0.26
CHILE	F(2,117)	0.17	0.00	0.52		0.14	1.06	0.45	0.29	2.25
EURO	F(2,126)	**3.31**	0.02	2.32		0.21	1.48	0.05	0.23	0.36
INDIA	F(2,127)	2.72	2.13	1.32		**3.97**	0.17	0.86	0.52	2.05
INDONESIA	F(3,127)	0.30	1.14	1.19		0.71	0.29	1.63	0.78	0.56
JAPAN	F(2,126)	**3.31**	1.79	0.16		0.12	0.24	**3.26**	0.38	**4.43**
KOREA	F(4,124)	0.37	0.91	1.71		0.72	0.68	0.69	1.33	0.18
MALAYSIA	F(2,127)	1.43	**3.17**	0.36		2.13	1.25	0.04	**2.95**	0.13
MEXICO	F(3,127)	0.28	**4.12**	0.52		0.77	1.11	1.64	0.82	**2.77**
NORWAY	F(3,125)	**2.88**	1.05	0.63		1.87	1.68	0.59	1.45	0.70
NEW ZEALAND	F(2,126)	0.08	0.27	1.89		0.38	0.20	0.96	0.19	0.58
PERU	F(2,128)	0.49	1.63	0.93		2.74	0.18	0.52	0.09	0.64
PHILIPPINES	F(2,127)	0.15	1.01	1.01		1.90	1.88	2.00	0.49	1.42
SOUTH AFRICA	F(2,126)	0.11	0.57	0.85		1.73	1.70	0.22	0.06	0.89
SAUDI ARABIA	F(1,130)	0.16	0.12	1.97		0.01	1.39	0.66	**4.82**	0.39
SINGAPORE	F(2,127)	0.38	0.76	**4.95**		1.09	1.81	2.08	1.67	2.01
SWEDEN	F(2,126)	0.59	0.43	0.02		0.19	0.81	0.39	0.70	2.86
SWITZERLAND	F(3,125)	1.80	2.14	2.32		0.46	0.16	0.35	0.41	0.47
THAILAND	F(3,126)	1.32	0.73	0.48		0.55	0.47	0.20	0.05	0.22
TURKEY	F(1,129)	0.18	1.03	0.34		0.49	2.46	1.97	0.03	0.01
UNITED KINGDOM	F(3,125)	1.78	1.23	0.55		0.12	1.66	**2.78**	0.77	1.84
USA	F(3,129)	0.18	2.48		0.50			1.19	2.61	2.68

GDP = gross domestic product.

Note: Bold indicates significance at 5%.

Source: Authors' calculations.

Appendix 2.b
Weak Exogeneity Tests of Foreign Variables (EU and Japan Model)

Country	F Test	GDP	Inflation	Equity Price	Exchange Rate	Short-Run Interest Rate	Long-Run Interest Rate	Oil Price	Raw Material Price	Metal Price
AUSTRALIA	F(4,124)	1.41	1.41	0.91		0.19	1.34	0.26	1.35	0.83
CANADA	F(3,125)	1.65	0.24	0.63		**2.70**	0.96	1.86	1.04	**4.06**
CHINA	F(2,128)	0.50	0.16	0.88		1.29	2.50	1.81	0.26	0.30
EURO	F(2,126)	0.31	0.16	0.08		1.82	0.88	0.22	0.18	0.85
INDONESIA	F(3,127)	0.21	**2.87**	0.70		0.88	0.49	0.83	0.25	0.65
JAPAN	F(1,127)	0.30	2.04	0.27		0.04	0.21	1.08	1.94	2.11
LATIN AMERICA	F(1,128)	0.30	1.79	1.32		0.72	0.04	1.39	0.34	0.28
MALAYSIA	F(3,126)	**2.94**	**5.57**	1.56		1.74	**3.85**	1.37	2.08	0.32
NEW ZEALAND	F(3,125)	2.64	0.33	1.28		0.27	0.52	0.63	0.24	0.52
PHILIPPINES	F(2,127)	0.67	0.80	2.26		0.28	1.02	2.04	0.56	1.47
REST OF WESTERN EUROPE	F(2,126)	1.38	0.15	0.01		0.12	0.94	0.76	0.50	0.41
REST OF THE WORLD	F(1,127)	**4.82**	3.35	0.01		0.32	0.57	1.19	0.00	3.28
SINGAPORE	F(3,126)	2.08	**3.43**	1.33		1.39	1.09	1.41	1.12	0.68
THAILAND	F(4,125)	0.47	0.98	0.27		1.12	0.38	0.95	0.44	0.37
UNITED KINGDOM	F(1,127)	0.32	0.04	0.05		0.05	**5.27**	3.84	0.42	0.26
USA	F(2,130)	0.79	0.81		1.24			0.02	2.29	0.24

GDP = gross domestic product.

Note: Bold indicates significance at 5%.

Source: Authors' calculations.

Appendix 2.a
Contemporaneous Effects of Foreign Variables (US Model)

Country	GDP	Inflation	Equity Price	Short-Run Interest Rate	Long-Run Interest Rate
AUSTRALIA	0.07	0.69	0.92	0.62	0.99
BRAZIL	0.49	5.84		4.99	
CANADA	0.52	0.49	0.87	0.67	0.99
CHINA	1.60	0.25		0.04	
CHILE	1.18	-0.25	0.60	0.51	
EURO	0.42	0.20	1.14	0.03	0.50
INDIA	-0.31	0.59	0.72	-0.08	
INDONESIA	0.46	0.92		0.25	
JAPAN	0.34	0.27	0.76	-0.08	0.53
KOREA	1.09	0.39	0.84	-0.13	0.31
MALAYSIA	1.38	0.91	1.18	-0.03	
MEXICO	0.49	-0.24		-0.10	
NORWAY	0.62	0.85	0.97	0.06	0.78
NEW ZEALAND	0.10	0.63	0.59	0.54	0.62
PERU	1.13	1.99		-1.47	
PHILIPPINES	1.05	-0.51	1.02	0.95	
SOUTH AFRICA	0.19	0.60	0.96	0.08	0.30
SAUDI ARABIA	-0.01	0.37			
SINGAPORE	1.59	0.41	1.15	0.38	
SWEDEN	1.57	0.84	1.19	0.30	0.93
SWITZERLAND	0.52	0.34	0.78	0.12	0.56
THAILAND	0.64	0.54	0.99	0.47	
TURKEY	1.70	0.86		1.73	
UNITED KINGDOM	0.41	0.54	0.81	0.05	0.75
USA	0.43	0.14			

GDP = gross domestic product.
Source: Authors' calculations.

Appendix 2.b
Contemporaneous Effects of Foreign Variables (EU and Japan Model)

Country	GDP	Inflation	Equity Price	Short-Run Interest Rate	Long-Run Interest Rate
AUSTRALIA	0.04	0.38	0.82	0.32	0.64
CANADA	0.04	-0.04	0.49	0.81	0.46
CHINA	0.86	0.37		0.06	
EURO	0.23	0.12	0.81	0.21	0.21
INDONESIA	0.24	0.63		-0.27	
JAPAN	0.13	0.06	0.64	0.02	0.64
LATIN AMERICA	0.59	-0.68	0.81	18.28	
MALAYSIA	0.99	0.67	1.19	-0.05	
NEW ZEALAND	0.03	0.33	0.54	-0.13	0.47
PHILIPPINES	0.97	-0.22	1.03	0.09	
REST OF WESTERN EUROPE	0.61	0.29	0.96	0.08	0.51
REST OF THE WORLD	0.20	-0.07	0.77	0.52	0.20
SINGAPORE	1.25	0.25	1.04	0.23	
THAILAND	0.12	0.26	0.86	1.03	
UNITED KINGDOM	0.16	0.34	0.74	0.22	0.80
USA	0.32	1.07			

GDP = gross domestic product.
Source: Authors' calculations.

Appendix 3.a
Correlation of VECMX Residual

Country	GDP	Inflation	Equity Price	Exchange Rate	Short-Run Interest Rate	Long-Run Interest Rate
AUSTRALIA	0.02	0.01	0.03	0.02	0.00	0.02
BRAZIL	0.02	-0.04		0.16	-0.04	
CANADA	0.01	0.04	0.07	0.17	0.07	-0.03
CHILE	0.00	0.01	0.06	0.10	-0.02	
CHINA	-0.05	-0.03		0.05	0.01	
EURO	-0.02	0.04	-0.13	0.23	0.05	-0.03
INDIA	0.00	0.02	-0.01	0.12	0.04	
INDONESIA	-0.02	0.02		0.06	0.03	
JAPAN	-0.04	0.01	-0.07	0.11	0.00	-0.03
KOREA	0.00	0.04	-0.01	0.11	0.05	-0.04
MALAYSIA	0.01	0.03	0.07	0.16	0.04	
MEXICO	0.02	0.00		0.03	0.01	
NEW ZEALAND	0.04	0.01	-0.02	0.16	0.01	0.03
NORWAY	0.00	0.01	0.08	0.26	0.00	0.01
PERU	0.01	-0.04		0.05	0.02	
PHILIPPINES	-0.01	0.01	0.03	0.11	0.00	
SAUDI ARABIA	0.00	0.02		-0.01		
SINGAPORE	-0.02	0.00	0.06	0.24	0.01	
SOUTH AFRICA	0.04	0.00	0.08	0.18	0.03	-0.01
SWEDEN	0.03	0.05	-0.02	0.21	0.01	0.04
SWITZERLAND	0.02	0.03	-0.01	0.25	0.00	0.04
THAILAND	0.03	0.02	0.06	0.16	0.03	
TURKEY	-0.01	-0.02		0.10	0.02	
UNITED KINGDOM	-0.02	0.01	0.00	0.01	0.04	-0.01
USA	-0.04	0.06	-0.01		0.03	-0.03

GDP = gross domestic product.
Source: Authors' calculations.

Appendix 3.b
Correlation of VECMX Residual

Country	GDP	Infla-tion	Equity Price	Exclusion Ratte	Short-Run Interest Rate	Long-Run Interest Rate
AUSTRALIA	0.05	0.04	0.05	-0.01	0.07	0.11
CANADA	0.03	0.10	0.08	0.19	0.06	0.17
CHINA	0.00	-0.03		0.04	0.04	
EURO	0.02	0.05	0.00	0.19	0.04	0.10
INDONESIA	0.01	0.01		0.08	0.06	
JAPAN	-0.01	0.03	-0.07	0.10	-0.01	-0.03
LATIN AMERICA	0.03	-0.04	-0.02	0.18	-0.07	
MALAYSIA	-0.01	0.07	-0.05	0.16	0.05	
NEW ZEALAND	0.04	0.05	-0.01	0.14	0.04	-0.01
PHILIPPINES	-0.03	-0.01	-0.06	0.13	0.01	
REST OF THE WORLD	-0.02	0.00	-0.10	0.22	-0.01	-0.13
REST OF WESTERN EUROPE	0.03	0.06	0.02	0.26	0.02	0.03
SINGAPORE	-0.07	-0.02	-0.05	0.24	0.00	
THAILAND	0.03	0.09	-0.01	0.15	0.05	
UNITED KINGDOM	0.01	0.04	0.04	0.03	0.05	0.07
USA	0.02	0.06	0.12		0.06	0.18

GDP = gross domestic product.
Source: Authors' calculations.

Chapter 4

FX RELATED MACROPRUDENTIAL POLICIES IN KOREA: A STUDY ON THE EFFECT OF THE FX DERIVATIVES POSITION RATIO POLICY ON THE BANKS' FOREIGN BORROWINGS

By
Moon Woo Hwang[1]

1. Introduction

Inflows of global capital help developing countries' economic growth by supplementing domestic capital. The easing of global monetary policy after the global financial crisis resulted in an increase of global liquidity, which led to capital inflows to the developing countries. By and large, these capital flows brought positive effects in terms of economic growth to the developing countries. However, sudden flows of global capital increase volatility of the domestic financial market and may negatively affect the economic growth of the developing countries. Due to this reason, developing countries have been concerned with sudden capital outflows and decrease in global liquidity.

Before 1990, Korea strictly controlled capital flows to minimize its effect on the domestic financial market. However, as foreign trade grew and market-opening pressure increased after 1990, Korea began to liberalize the capital market. In March 1990, the average market exchange rate system[2] was implemented so that the exchange rate was to be determined by demand and supply in the foreign exchange market. In January 1992, Korea allowed foreign investors to invest in the domestic stock market. In December 1997, a flexible exchange rate system was implemented and foreign investment in bonds was also allowed. By opening the domestic capital market, Korea was able to easily obtain global capital and grow rapidly.

On the other hand, Korea became vulnerable to external shocks. In 1997, right after opening the market to foreign investors, Korea faced sovereign default and needed IMF assistance for foreign exchange borrowings. During the global financial crisis in 2008, Korea experienced sudden outflows of capital and faced economic

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2. Under this system, the exchange rate of the Korean won against the US dollar was determined in the market within a specified range around the weighted average interbank rates of the previous day. A specified range was 0.4% of weighted average interbank rates of the previous day at first and had widened in several times to 2.25% in December 1995.

depression again. At the time, financial institutions in Korea increased short-term foreign borrowings with low interest rates from the global market and lent it to the domestic market in long-term at relatively high interest rates. Due to this structure, it was inevitable for Korea to be vulnerable to the global risks.

The recent two severe financial crises in Korea took place when capital inflows turned into sudden outflows. Capital was flowing in rapidly during the boom and flowing out during the depression. Such pro-cyclical capital flows caused the financial and foreign exchange market to be very volatile.

Korea's high capital flow volatility has been affected by the high degree of dependence on foreign trades and the openness of the capital market. The high dependence on foreign trade has meant that Korea has frequent capital flows for trade settlement. From 1997, since there is no limitation on the capital market, foreign bank branches have actively increased their short-term foreign borrowings and as a result, foreign investors have also actively invested in the Korean capital market.

Based on past experiences, Korea needed to curb capital flow volatility to avert a financial crisis. In 2010, just after the global financial crisis, Korea implemented a series of FX related macroprudential policies such as limitation on banks' FX derivatives positions, macroprudential stability levy and taxation on foreign investor's bond investment. In this paper, the effects of these macroprudential policies are discussed and the effects of the FX derivatives position ratio policy is analyzed empirically. The results of this paper will be able to provide directions in the future policy decision makings of the developing economies.

In the next section, related studies will be taken into a consideration. In Section 3, Korea's FX related macroprudential policies will be introduced. In Section 4, the changes after the implementation of the policies will be discussed. In Section 5, the effects of the FX derivatives position ratio policy will be analyzed using econometric models. Finally, Section 6 concludes and some implications will be drawn.

2. Related Studies

Precedent studies quantified FX related macroprudential policies and focused on analyzing their effects. Ostry et al. (2010) proclaimed that FX related macroprudential policies and capital control reduced the domestic banks' foreign liability based on the cases of 51 developing countries. Bruno et al. (2016) analyzed the macroprudential policies in 12 Asia-Pacific countries and concluded that countries which have the regulations showed a reduction in capital inflows throughout banks and bond markets.

While there have been many empirical studies on developing economies, there has been a lack of research on Korea. Choi (2014) analyzed the effect of macroprudential policies on banks' foreign borrowings and concluded that these policies decreased short-term foreign borrowings. Bruno and Shin (2014) focused on Korea's macroprudential policies on pro-cyclicality of capital flows and cross-border interconnections. They concluded that Korea is less sensitive to global factors after implementing the macroprudential policies compared to other countries. Huh and An (2014) analyzed the effects of Korea's FX related macroprudential policies on growth of foreign liability and changes in the structure of foreign liability. They concluded that limitation on FX derivatives positions have a significant effect on debt and short-term liability, but both the macroprudential stability levy and taxation on foreign investors' bond investments were found to be statistically insignificant.

3. Introduction of Korea's FX Related Prudential Policies

3.1 Limitation on Banks' FX Derivatives Position Ratio

In October 2010, Korea implemented the limitation on banks' FX derivatives position policy in order to decrease banks' foreign borrowings and its volatility. Banks in Korea, in particular, foreign bank branches, enjoy arbitrage profits through FX swap transactions. If there is no limitation on bank's FX derivatives position ratio, those banks have an incentive to borrow US dollar as much as they can because of the arbitrage profit. The first FX derivatives position ratio was 50% of their equity capital of the preceding month for domestic banks and 250% for the foreign bank branches.

When short-term foreign borrowings rapidly increased at the first half year of 2011, the Korean government decreased the FX derivatives position ratio limitation to 40% for domestic banks and 200% for foreign bank branches in July 2011. They once again decreased the ratio limitation to 30% for domestic bank and 150% for foreign banks in January 2013 to curb capital flows volatility which came from the Quantitative Easing(QE) of the developed economies.[3]

The FX derivatives position limitation policy is designed for the banks to be able to control their positions flexibly. The policy regulates the banks' FX derivatives positions to a certain ratio of their equity capital, and the banks can continue to trade the FX derivatives products by raising their capital. As only the net position is regulated, when the banks encounter the limitation, they can control the net position through reverse transactions of other derivative products.

3. The Korean government loosened the limitation ratio to 40% for domestic banks and 200% to foreign bank branches in July 2016.

3.2 Macroprudential Stability Levy

In order to curb excessive foreign borrowings and to increase the maturity of foreign liabilities, Korea has implemented a macroprudential stability levy policy in which allotments are imposed on the non-core foreign liabilities of financial institutions from April 2011. The rate of between 0.02% and 0.2% were imposed on the non-deposit foreign liabilities by their contract maturities.[4] The macroprudential stability levy is part of the foreign exchange stabilization fund and is to be used to support financial institutions in times of financial crisis.

In July 2015, Korea reformed the macroprudential stability levy to guarantee fairness among the financial institutions and to simplify imposing rate. Non-bank financial institutions were also included and a unitary rate of 0.1% was applied to the non-deposit foreign liabilities with less than one year of maturity.[5] A discounted rate (0.02% for contract maturity exceeding 2 years, 0.03% for exceeding 3 years, and 0.04% for exceeding 4 years) was applied to the long-term foreign liabilities.

3.3 Resumption of the Taxation on Foreigners' Bond Investment

In May 2009, Korea implemented a policy that exempted tax on capital gains and interest (14% and 20% each) on foreign investors' bond investments with concerns about the lack of domestic FX liquidity during the global financial crisis. However, due to the increase of global liquidity, recovery of the Korean economy, appreciation of the Korean won and the expansion of the difference in domestic and global interest rates, foreign investors' bond investments increased to the level it was before the global financial crisis.

As large inflows of foreign investors' bond investments increased the volatility of the financial market, the taxation on them was revived to curb speculative capital flows in January 2011. As an alternative, a flexible tax rate (0-14%) determined by the President was newly introduced.

4. Different macroprudential stability levy rates were imposed by maturities of non-deposit foreign liability. 0.2% was imposed for the contract maturity less than 1 year (included 1 year), 0.1% for between 1y and 3y, 0.05% for between 3y and 5y, and 0.02% for more than 5y.
5. The maturity here is not a contract maturity but a duration.

Table 1
Dates of FX-related Macroprudential Policies in Korea

Date	Policy
2010.7	Regulation on Foreign Currency Loan Use
2010.10	Regulate FX derivatives position ratio (50% to capital for domestic, 250% for foreign banks branches)
2011.1	Resumption of the Taxation on Foreigners' Bond Investment
2011.4	Macro-prudential Stability Levy
2011.7	Tightening FX derivatives position ratio (40% for domestic, 200% for foreign banks branches)
2013.1	Tightening FX derivatives position ratio (30% for domestic, 150% for foreign banks branches)
2016.7	Loosening FX derivatives position ratio (40% for domestic, 200% for foreign banks branches)

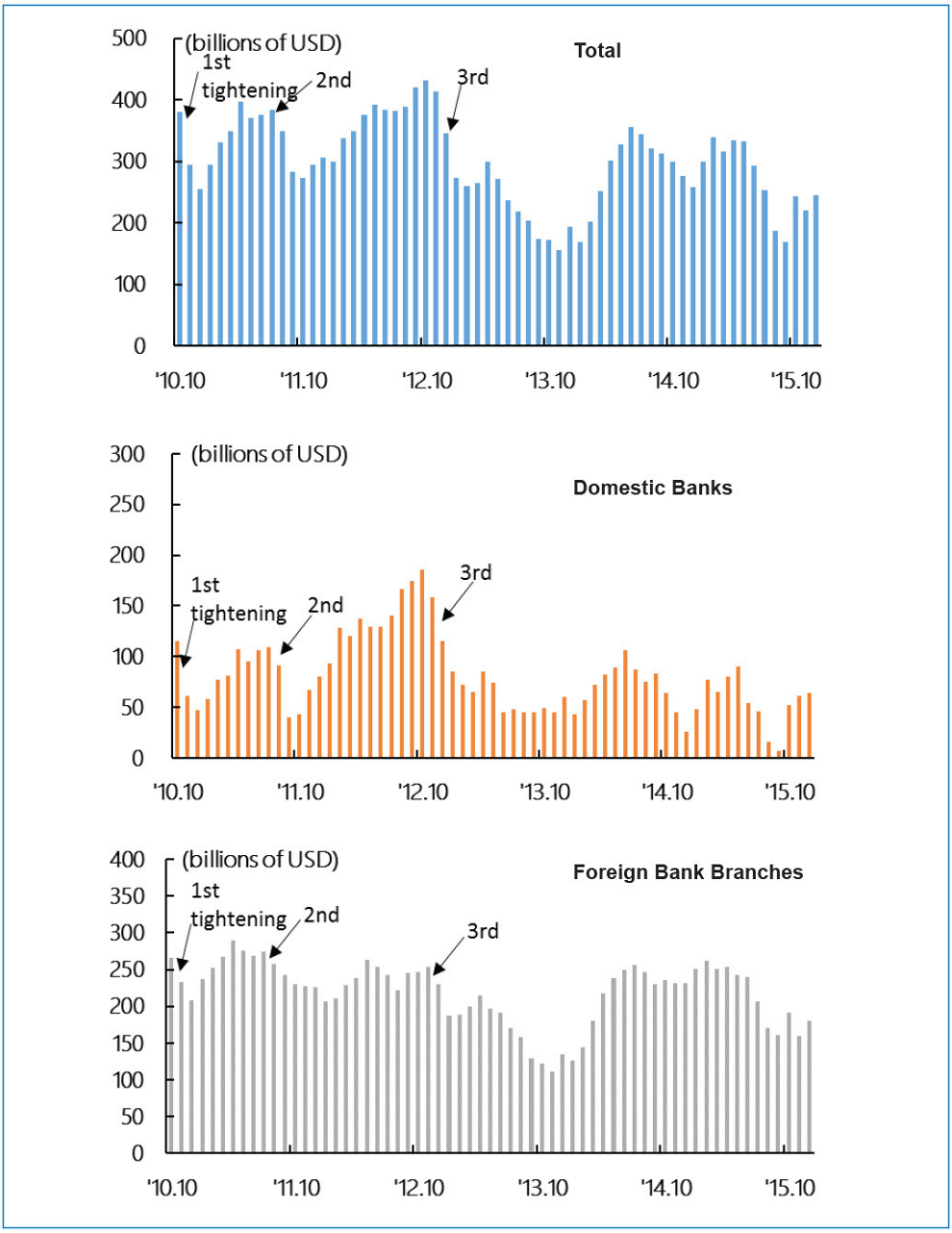
Source: Bank of Korea.

4. The Effects of the FX Related Macro Prudential Policies

4.1 FX Derivatives Position Ratio Limitation

The aggregate FX derivatives position of banks in Korea is depicted in Figure 1. As can be seen, the position was US$ 38.0 billion at the end of October 2010 when the FX derivatives position regulation was introduced. Just after introduction of the policy, it decreased sharply to US$ 25.0 billion. However, as short-term foreign borrowings rapidly increased during the first half year of 2011, it also increased rapidly. After the second tightening was implemented in July 2011, it decreased to US$ 27.2billion in October 2011. Due to the increase of global liquidity, however, the aggregate FX derivatives position was increased again in 2012. Reacting to this, the third tightening was introduced in January 2013. This led it to decrease to US$ 24.5 billion dollars at the end of 2015. For domestic banks, it was US$ 11.5 billion at the end of October 2010 and decreased to US$ 6.5 billion. For the foreign bank branches, it was US$ 26.5 billion at the end of October 2010 and decreased to US$18.0 billion at the end of 2015.

Figure 1
Aggregate FX Derivatives Position of Korean Banks

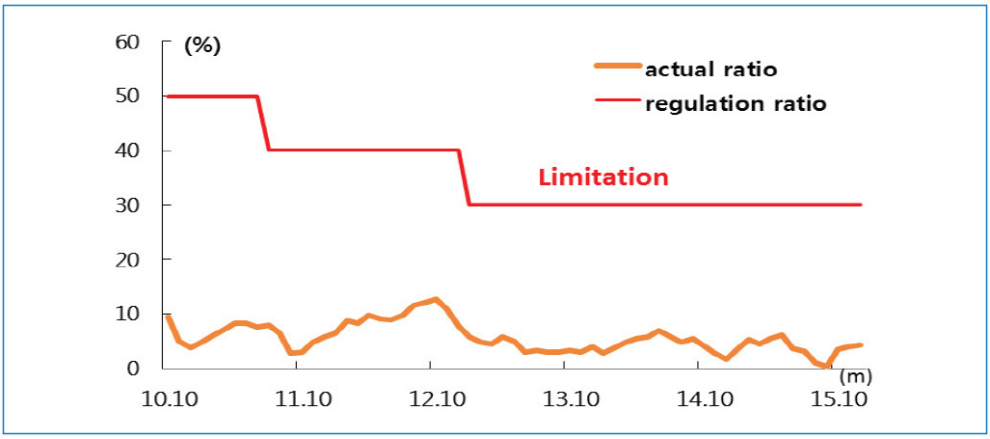


Source: Bank of Korea.

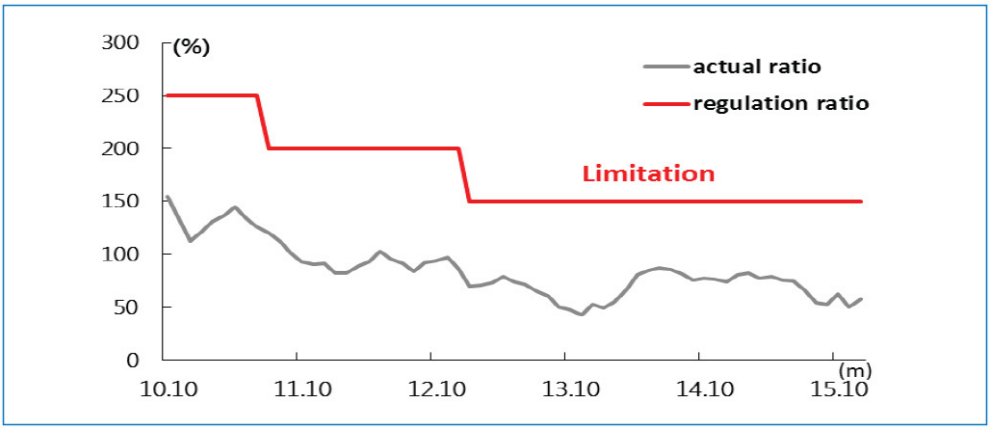
The average FX derivatives position ratio to equity capital is depicted in Figure 2. The limitation of the ratio was 50% of equity capital for domestic banks and 250% for the foreign banks at the beginning. The actual average FX derivatives position ratio of the domestic banks and the foreign bank branches were 9.5% and 154.3% respectively. After the FX derivatives position ratio was tightened to 30% for the domestic banks and 150% for the foreign bank branches in January 2013, the average FX derivatives position ratio of the domestic banks and the foreign bank branches dropped to 4.3% and 57.6% respectively at the end of 2015. After the implementation of the policy, the FX derivatives position ratio of the foreign bank branches dropped significantly.

Figure 2
Average FX Derivatives Position Ratio to Equity Capital

a. Domestic Banks



b. Foreign Bank Branches

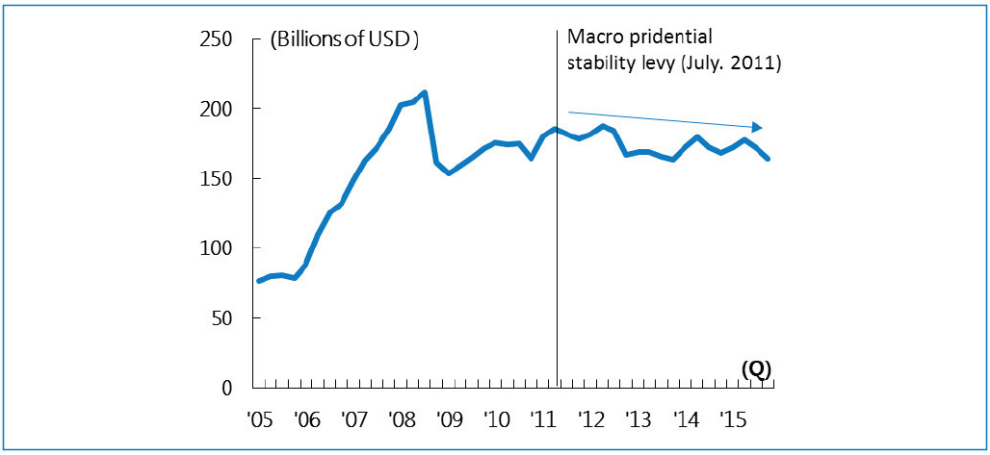


Source: Bank of Korea.

4.2 The Implementation of the Macroprudential Stability Levy

The aggregate non-deposit foreign liability of the financial institutions is depicted in Figure 3. It increased quickly but dropped significantly during the global financial crisis. It saw a slight increase of US$ 176.6 billion by the end of July 2011 when the macroprudential stability levy was implemented. After the policy was introduced, there was a decrease of US$ 15 billion until the end of 2015. The domestic banks saw an increase of US$ 115.8 billion after the regulation was implemented while the foreign bank branches saw a huge decrease of US$ 42.8 billion at the end of 2015.

Figure 3
Non-deposit Foreign Liability of Financial Institutions in Korea

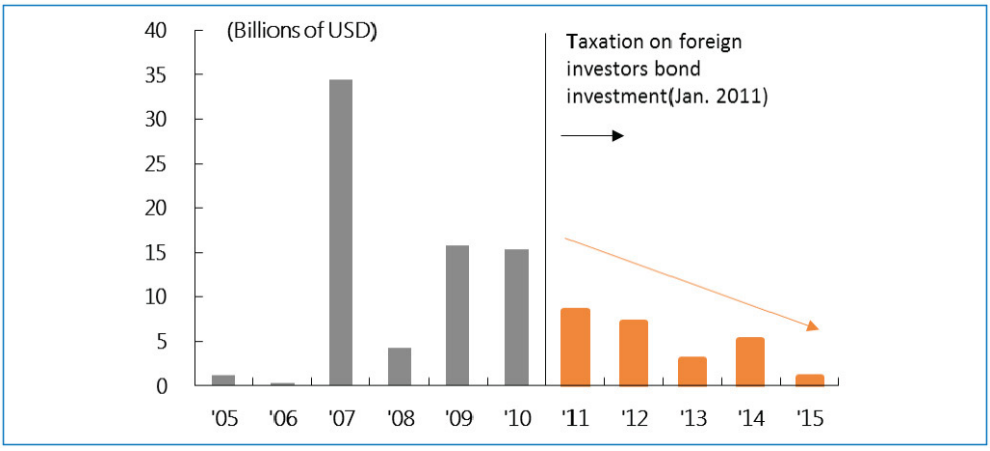


Source: Bank of Korea.

4.3 Taxation on Foreign Investors' Bond Investment

Foreign investors' bond investment flow is depicted in Figure 4. It saw a US$ 35 billion inflow in 2007 and decreased tremendously during the financial crisis. Before the taxation on foreign investors' bond investment, US$ 15.3 billion flowed into Korea in 2010. However, after the taxation, the inflow of investment by the foreigners has been decreasing and was US$ 1.0 billion in 2015, a decrease of US$ 14.3 billion compared to 2010.

Figure 4
Foreigners' Bond Investment Flows in Korea

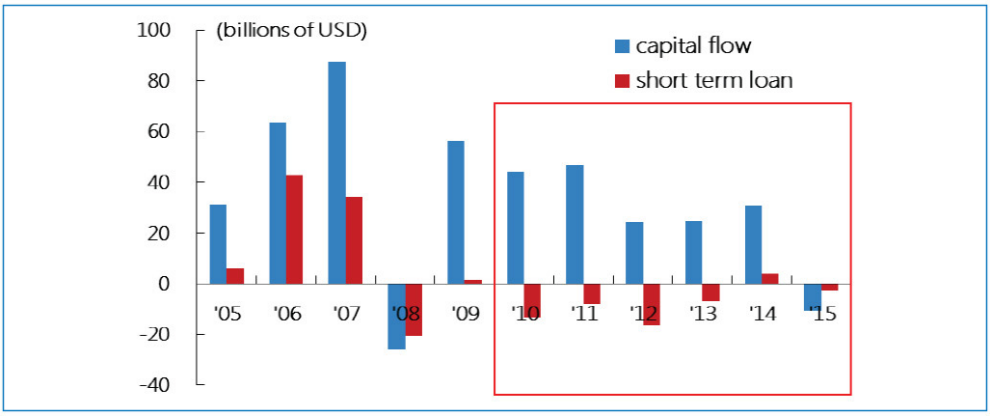


Source: Bank of Korea.

4.4 Capital Flows After the FX-related Macroprudential Policy

The overall capital flows of Korea are depicted in Figure 5. Short-term liability of the banks has decreased since 2010. It was minus US$ 7.3 billion on average from 2010 to 2015. The maturity structure of foreign liability was prolonged due to the decrease in short-term liability after the implementation of FX derivative position regulation and the macroprudential stability levy. Capital inflows also gradually decreased after the implement of the policies. There were US$ 56.3 billion inflows in 2009, but outflows recorded US$ 10.7 billion in 2015.

Figure 5
Capital Flows of Korea



Note: Capital flow = liability side of (FDI + portfolio investment + other investment)
Source: Bank of Korea.

5. The Effect of FX Derivatives Position Ratio Limitation Policy on the Foreign Borrowings of Individual Banks

5.1 Empirical Methodology

When global liquidity is sufficient, the foreign bank branches in Korea usually enjoy arbitrage profits through FX swap transactions. If there is no limitation on banks' FX derivatives position ratio or there is enough space in the position, these banks have an incentive to increase foreign borrowings as much as possible because of the arbitrage profit. However, if a limitation is placed on the position, their foreign borrowings will be curbed. To examine this effect of the FX derivatives position ratio policy on banks' foreign borrowings, a panel of individual bank's data is constructed. The panel includes the banks that had the foreign liability balance of over US$ 100 million at the end of 2015. There are 44 banks including 16 domestic banks (7 commercial banks, 4 local banks, 3 special banks, and 2 development institutions) and 28 foreign bank branches. Table 2 presents the statistical data.

Table 2
Statistics of the Data

	Domestic Banks				Foreign Bank Branches
	Commercial Banks	Local Banks	Special Banks	Development Institutions	
No. of Banks	7	4	3	2	28
Foreign Liability[1)]	24.4	1.2	10.4	79.2	5.1
Capital[1)]	11.7	2.4	9.2	15.9	1.1
FX Derivative Position Ratio in Average (%)	1.0	0.0	0.2	-0.6	0.6

Note: 1) US$ 100 million.

Source: Bank of Korea.

The variables used in the regression model are described in Table 3. The dependent variable is the volatility of foreign liability of every individual bank. It is calculated by the rate of monthly change in the foreign liability of the individual banks. This variable captures the volatility of individual bank's foreign borrowings.

In general, if individual bank's FX derivatives position ratio is approaching the policy limitation, they would stop foreign borrowings or settle the position through a reverse transaction. When the individual bank choose to stop foreign borrowings or repay, the volatility would decrease.

The explanatory variables are the FX derivative position ratio to the limitation, size of the bank and dummy variable of foreign bank branches. If the FX derivative position ratio to the limitation is near 100%, the bank is not able to increase foreign borrowings for investing in domestic assets and if they wish to do so, they have to reduce the ratio first.

The size of the bank variable captures the size effect. In general, the volatility of foreign borrowings would decrease as the bank size increases.[6] The foreign bank branch dummy captures their specialty in Korea.

Table 3
Variables in the Regression Model

	Name	Information
Dependent Variables	$Liab\_vol_{c,t}$	Volatility of Foreign Liability : $\frac{Foreign\ Currency\ Liability_{c,t}}{Foreign\ Currency\ Liability_{c,t-1}}(\%)$ where c : individual banks, t : month
Explanatory Variables	$FX\_position_{c,t}$	FX derivatives position ratio to the limitation : $\frac{FX\ derivatives\ position_{c,t}}{FX\ derivatives\ position\ limitation_{c,t}}(\%)$ where c : individual banks, t : month
	$Size_{c,t}$	1) log(capital) of individual bank 2) log(foreign asset) of individual bank
	$Foreign_c$	Foreign Bank Branches : 1 Domestic Banks : 0

Source: Bank of Korea.

6. Bank's foreign currency liability which is the dependent variable's denominator and numerator is related to the size of the bank positively. The dependent variable also can be related to the size of the bank.

The null hypothesis of the regression model is as below.

Null hypothesis

There is no relationship between the FX derivatives position ratio and the volatility of foreign liability of the individual banks.

The estimated model is described in an equation below.

$$Liab\_vol_{c,t} = \alpha_0 + \alpha_1 FX\_position_{c,t} + \alpha_2 Size_{c,t} + \alpha_3 Foreign_c + \alpha_4 Liab\_vol_{c,t-1} + \varepsilon_{c,t}$$

α_1 explains the effect of FX derivatives position ratio regulation on the volatility of foreign liability of the banks. If α_1 is negative and statistically significant, it means that the individual bank's volatility of the foreign liability becomes lower as the FX derivatives position ratio increases.

5.2 Results of Panel Analysis

Table 4 depicts the results of regression analysis. First of all, the volatility decreases as the FX derivatives position ratio increases. This shows that the banks tend to control their foreign borrowings when their derivatives position ratio becomes closer to the limit. Since the purpose of the FX derivatives position regulation is to control the foreign liability of the banks, the FX derivatives position policy seems to meet its goals.

Second, the volatility also decreases as the size of the bank increases. The size of foreign liability is roughly proportional to the size of equity capital and foreign assets. In general, the bigger the size of a bank, the smaller the volatility of foreign borrowings.

Third, the fixed effect coefficients of the foreign bank branches are mostly positive and these results mean that foreign bank branches have higher volatility on foreign liabilities compared to the domestic banks. The random effect model with foreign bank branch dummies also supports the same results.

Table 4
Results of the 1st Analysis

		$Liab\_vol_{c,t}$	$Liab\_vol_{c,t}$	$Liab\_vol_{c,t}$	$Liab\_vol_{c,t}$
α_0	Constant	0.110***	0.109***	0.144***	0.192***
α_1	$FX\_position_{c,t}$	-0.23***	-0.012*	-0.033***	-0.027***
α_2	$Log(capital)_{c,t}$	-0.015***		-0.014**	
α_2	$Log(asset)_{c,t}$		-0.017***		-0.036***
α_3	$Foreign_c$	0.040***	0.020***		
α_4	$Liab\_vol_{c,t-1}$	0.288***	0.299***	0.160***	0.158***
	$Adj.R^2$	0.184	0.184	0.253	0.255
	Total OBS	2,563	2,563	2,563	2,563
	No. of Banks	44	44	44	44
	Estimation Method	Random	Random	Fixed	Fixed

Note: ***, **, * mean 1%, 5%, 10% significant level respectively.

The foreign bank branches have invested in Korean assets actively by borrowing foreign liabilities and using FX swap markets. To consider this, another explanatory variable which is the foreign bank branch dummies multiplied by the FX derivatives position of the individual banks is added. This variable separates the effect of the foreign bank branches from the domestic banks.

Table 5 depicts the results which show a positive value for the domestic banks and negative value for the foreign bank branches. It can be seen that the FX derivatives position ratio policy do not curb the increase of foreign borrowings of the domestic banks, but curb those of foreign bank branches.

Table 5
Results of the 2nd Analysis

		$Liab\_vol_{c,t}$	$Liab\_vol_{c,t}$	$Liab\_vol_{c,t}$	$Liab\_vol_{c,t}$
α_0	Constant	0.110***	0.103***	0.144***	0.183***
α_1	$FX\_position_{c,t}$	0.026**	0.029**	0.011	0.007
α_2	$FX_{position_{c,t}} \times Foreign_c$	-0.073***	-0.060***	-0.058***	-0.044*
α_3	$Log(capital)_{c,t}$	-0.017***		-0.014**	
α_3	$Log(asset)_{c,t}$		-0.017***		-0.033***
α_4	$Foreign_c$	0.058***	0.035***		
α_5	$Liab\_vol_{c,t-1}$	0.278***	0.283***	0.158***	0.157***
	$Adj.R^2$	0.191	0.188	0.254	0.256
	Total OBS	2,563	2,563	2,563	2,563
	No. of Banks	44	44	44	44
	Estimation Method	Random	Random	Fixed	Fixed

Note: ***, **, * mean 1%, 5%, 10% significant level respectively.

From the results above, we know that the FX derivatives position ratio policy reduces the volatility of foreign bank branches' foreign borrowings. When global liquidity was overflowing, the foreign bank branches in Korea were operating very actively by increasing foreign borrowings and because of this, the Korean FX market became very volatile. However, after implementing the FX derivatives position ratio policy, those activities had been curbed and the volatility of the FX market had also

decreased. In short, the FX derivative position ratio policy achieved its goal and it is still effective.

There are, however, some limitations to this analysis. There can be other explanatory variables which are not included in this model. For example, the macroprudential stability levy policy could also have reduced the foreign borrowings of banks, but has not included in this model. These limitations need to be considered in the future researches.

6. Conclusions

The FX related macroprudential policy can be said to have reduced the volatility of the capital flows in Korea. After the implementation of the policies, 1) the FX derivatives position of the foreign bank branches decreased sharply; 2) the non- deposit foreign liabilities of the financial institutions have decreased; and, 3) the inflows of the foreign investors' domestic bond investment have slowed down.

In addition, the empirical analysis of the effect of FX derivatives position ratio regulation on the foreign borrowings of the individual banks showed that the implementation of the policy decreased the volatility of FX liability. In particular, the foreign bank branches were more affected by the regulation. Since the purpose of the regulation was to reduce the volatility of capital, the FX derivatives position regulation had achieved its goal to a certain extent.

As mentioned in the introduction, the developing countries have economic structures that are very sensitive to the global capital flows. Korea's FX related macroprudential policies have been working quite effective in countering the volatility of these flows. It is hoped, therefore, that this regulation can also be considered for other SEACEN economies that are concerned about excessive global liquidity. However, since the implemented regulation in Korea is still questionable in terms of whether it breaches the OECD Code for Liberalizing Capital Movements, the other economies must pay due heed to this factor.

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Chapter 5

GLOBAL LIQUIDITY: DOES IT MATTER FOR MONGOLIA?

By
Tsenguunjav Byambasuren[1]*

1. Introduction

With increasing financial globalization, conditions in global financial markets might impact individual economies. For emerging market economies (EMEs) facing capital shortages, sustainable capital inflows play an important role in economic growth and development. Following the 2008/09 global financial crisis (GFC), advanced countries have implemented large-scale unconventional monetary policy. For example, the U.S. Federal Reserve, the Bank of Japan and European Central Bank adopted strong monetary easing policies at the zero lower bound. As a result, the increased liquidity has spilled into EMEs.

However, capital flows from advanced economies into emerging and developing economies may contribute to the build-up of vulnerabilities and macroeconomic and financial imbalances, which could result in financial crisis in the individual EMEs (Borio, 2008). For instance, the Asian financial crisis, dotcom crisis, and the GFC have been associated with economic booms supported by capital inflows. The IMF (2010a) has also highlighted the spillover effects of monetary easing on other nations following a financial crisis in an advanced economy. The surge in global liquidity can lead to a boom in the economy through the appreciation pressure of the domestic currency, increase in asset prices, and easing of domestic monetary policy. On the other hand, a sudden halt in global liquidity due to investors' risk aversion or monetary policy tightening in advanced economies may damage recipient economies through the creation of a bust cycle.

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There are three phases to the recent episode of global liquidity. The first phase covers the period leading to the GFC, roughly from 2003 to 2008, when the global banking system expanded, generated by looser financial conditions across borders through the acceleration of banking sector capital flows. The second phase of global liquidity began around 2010 when central banks of major advanced economies started implementing quantitative easing (QE) monetary policy. During this phase, the bond market (e.g., market for emerging market debt securities) played key roles (Shin, 2012; Azis and Shin, 2013). The third phase of global liquidity started when the U.S. Federal Reserve announced the tapering of its QE in 2013, which led the capital flows to retrench from EMEs.

The macroeconomic impacts and transmission mechanism of global liquidity on regional economies differ from country to country, depending on the nature and unique characteristics of their economy. The regional macroeconomic spillover of global financial conditions generally pass through international capital flows into the local economy. However, owing to the underdevelopment of bond and equity markets, capital flows into Mongolia can be mainly traced to foreign direct investments (FDI) rather than bond and equity flows. Mongolia's FDI inflows are highly associated with the changes in commodity prices as most of the inflows are directed to the mining sector.[2] Therefore, the regional impact of the liquidity conditions in global financial markets and inflows is conveyed through commodity prices into Mongolia's economy.

This paper examines the nature of the macroeconomic impact of shifts in global liquidity conditions and its transmission mechanism on the Mongolian economy using a structural vector autoregression (VAR) approach for quarterly data from January 2001 to June 2016. In particular, we argue that global financial conditions highly affect the Mongolian economy, which is small and poorly integrated into the world financial market. The impact is mainly through the commodity price channel, confirming the 'overshooting theory of commodity prices" (Frankel, 1986).

The rest of the paper is organized as follows. Section 2 briefly discusses the measurement of global liquidity, while Section 3 reviews the literature on the transmission mechanism of global liquidity on individual economies focusing on the commodity price channel. Section 4 presents the identification of the structural VAR approach with non-recursive contemporaneous shocks and describes the data set used in the empirical analysis. Section 5 reports the key findings on the impulse responses of the economy to global liquidity shocks. Finally, Section 6 concludes the paper and discusses policy implications.

2. See Sukhee and Byambasuren (2016).

2. Understanding Global Liquidity

2.1 Concept

Recently, global liquidity has been widely discussed in debates about spillovers from monetary policy shocks of advanced economies into emerging market economies. Specifically, after the GFC, issues regarding global liquidity are considered as important factors in the development of vulnerabilities prior to the financial crisis (Borio, 2008; IMF, 2010b). Although the concept of global liquidity is increasingly used in both academic and policymaking circles, there is still no agreed definition. It usually referred to as the availability of funds for purchases of goods or assets from a global perspective. For instance, the Committee on the Global Financial System (CGFS) (2011) defines global liquidity in broad terms as global financing conditions, or "ease of financing" in the international financial system.

This overall "ease of financing" depends on the actions of both private investors and financial institutions as well as the public sector. From a global perspective, an essential distinction is between official liquidity – which is created by the public sector – and private sector liquidity (CGFS, 2011). Understanding the difference between liquidity created by private and public sector market participants is essential to insights for the source of global liquidity and its dynamics.

Official liquidity, on the other hand, is defined as the funding provided by the central bank as part of its monetary policy. Monetary authorities create official liquidity in their domestic currency through their regular monetary operations (e.g., supplying the means of payment in the form of base money) and emergency liquidity support (CGFS, 2011; Domanski et al., 2011). The terms and conditions for which they do so, in turn, affect funding and market liquidity in private markets (Domanski, Fender, & McGuire, 2011). While central banks play a critical role in the generation of global liquidity, global liquidity in turn reflects the ability and willingness of market participants to provide funding or to trade in securities markets.

In the light of capital mobility and international financial integration, the concept of global liquidity has come to cover also *private liquidity*. Private liquidity is created by private sector market participants such as international banks, institutional investors, and non-banking financial institutions. In many instances, these financial intermediaries give credit and thus provide liquidity. Movements in private liquidity are transmitted internationally through the behavior of the financial sector, and its willingness to provide cross-border and/or cross-currency funding. The availability and willingness are determined by private perceptions of risk, and risk appetite, as well as by broader financial and economic conditions. Financial institutions provide market liquidity to securities markets, for example, through market-making activity, or provide funding liquidity through, for instance, interbank lending.

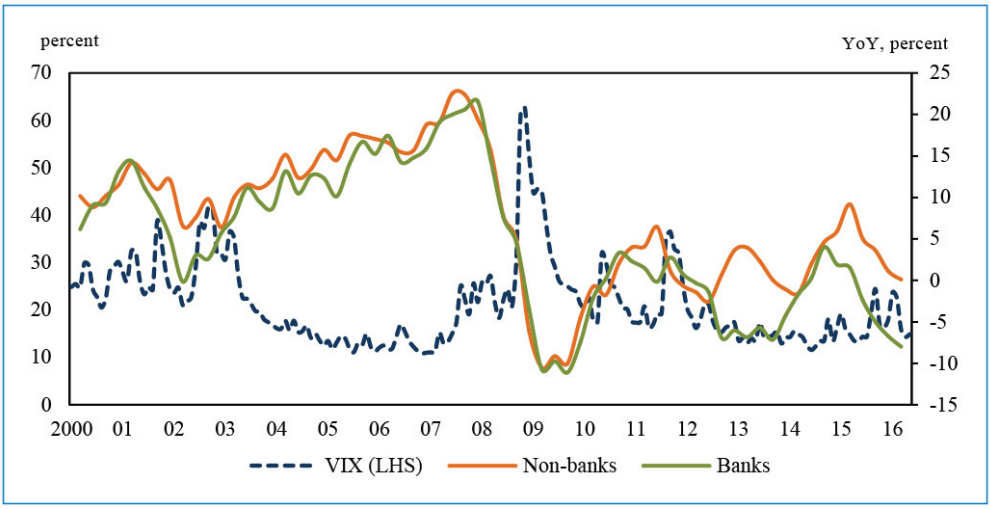
2.2 Indicators

The literature suggests that global liquidity conditions cannot be captured by a single indicator (e.g., Eickmeier et al., 2014; IMF, 2014), which means that there is no clear definition of how to measure global liquidity. However, several proxy indicators relating to different characteristics of liquidity have been developed over time by the Bank for International Settlements (BIS), considered to be effective in capturing vulnerabilities, such as price measures, quantity measures, and measures of investors' risk appetite.

2.2.1 Quantity-based Measures

The quantity-based measures are credit aggregates, which are the key indicators and the focus of global liquidity measures estimated by the BIS. The term "international bank claims" is used in the BIS Global Liquidity Indicators corresponding to its definition in the BIS locational banking statistics. International bank claims capture banks' cross-border claims in all currencies and their local claims in foreign currencies, wherein local claims refer to credit extended by banks' affiliates located in the same country as the borrower. The strong relationship between risk and liquidity is shown in Figure 1, which shows the indicators of cross-border credit extension across BIS reporting countries and the VIX index as a measure of risk appetite.

Figure 1
International Bank Claims
As at May 2016 (Quarterly)



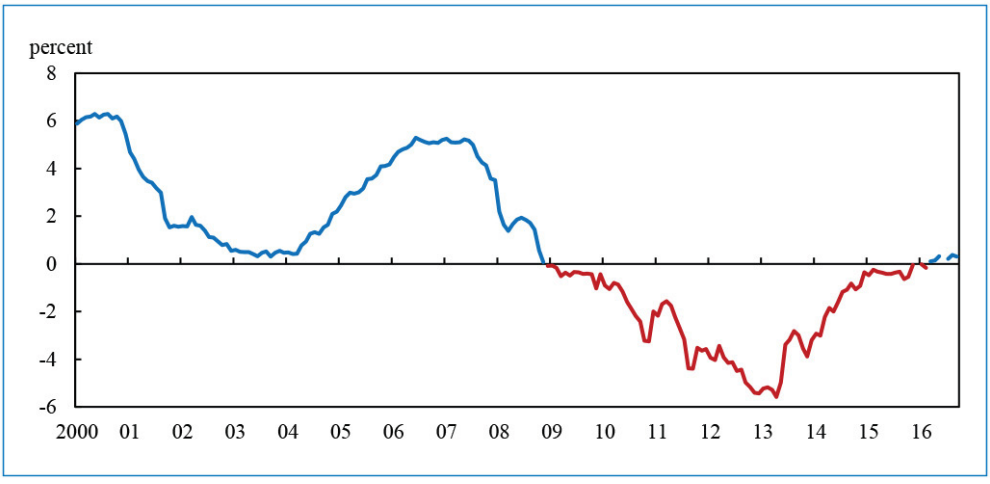
Source: BIS Quarterly Review, September 2016.

The growth of international bank credit exhibits boom-bust cycles that correspond closely to episodes of financial exuberance and distress. In addition, periods of strong growth in cross-border credit often coincide with episodes of elevated risk appetite and compressed risk premium, while periods of contracting cross-border credit seem to coincide with downward shifts in risk appetite. International claims (cross-border bank claims plus local claims in foreign currencies) on non-banks tended to increase since the GFC, while international claims on banks hardly rose until the second quarter of 2016. Thus, global credit has generally remained weak for the last few years (Figure 1).

2.2.2 Price-Based Measures

Besides these quantitative indicators, the literature also considers price-based indicators of global liquidity, which are basically interest rates. Specifically, global aggregates of the level of the short-term money market and long-term capital market interest rates (long-term U.S. government bond yields such as the 10-year constant maturity rate) are regarded as important indicators of global funding liquidity conditions.

Figure 2
Shadow Short Rate (SSR)
As at September 2016 (Monthly)



Source: Reserve Bank of New Zealand.

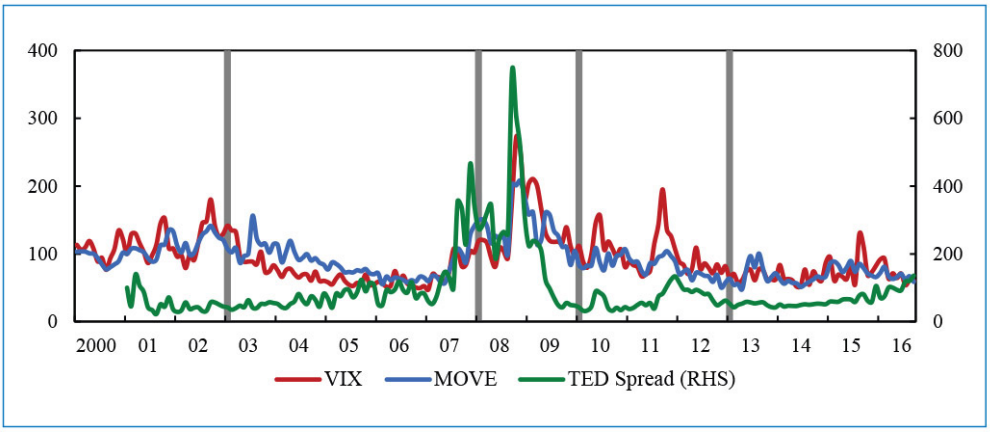
While the Federal Funds rate has remained almost unchanged for the last 9 years, a useful alternative is the "shadow Federal Funds rate". This shadow rate is the Federal Funds rate that would have been observed in the absence of the zero lower bound. The alternative measure of the shadow interest rate was calculated by Leo Krippner (Reserve Bank of New Zealand), and the shadow short rate (SSR) is the shortest maturity rate from the estimated shadow yield curve. The SSR has become a popular and intuitive indicator of the stance of conventional and unconventional monetary policy (see Krippner, 2011, 2012a, 2012b, 2013, 2015; Wu and Xia, 2013, 2014, 2016).

2.2.3 Risk-Based Measures

A third category of indicators reflects investors' shifts in risk-taking preferences. Even though risk-aversion or risk-appetite are hard to measure, the VIX index of implied stock market volatility in the USA is a widely-used or a prime proxy variable for investor risk appetite (see e.g. CGFS, 2011; Agrippino and Rey, 2012). Hence, the VIX is a key indirect indicator of the willingness to provide funding. The several empirical findings on global factors confirm the explanatory power of the VIX with flows decreasing in the face of greater volatility. Specifically, the VIX and the TED spread appear to be important drivers of portfolio flows. In particular, the aggregate offshore bond issuance by EME firms is negatively correlated with shifts in market risk aversion, as measured by the VIX (BIS, 2016).

It also should be noted that the implied stock market volatility expresses not only the level of uncertainty of future stock price changes, but also the perceived price. In light of this, Bekaert et al. (2013) decomposed the VIX index into components of risk aversion and uncertainty. Although these separated elements help policymakers to distinguish the interactions between global liquidity and market uncertainty/ risk aversion, in our case, we are only considering the usual aggregate VIX index. However, equity and bond flows into emerging market economies do not fully reflect the degree of risk. For example, the degree of investors' risk aversion was significant (high level of the VIX index) during 2009 and 2010, but it was observed that substantial amounts of private capital still flowed into emerging markets. Therefore, some scholars suggest that the link between risk appetite indicators and observed cross-border investment flows may have weakened recently. In particular, Azis and Shin (2013) showed that the impact of global market uncertainty, measured by the VIX index, seemed less significant in Asian countries, and the elasticity had an opposite sign in most cases.

Figure 3
Risk Appetite Indicators
A at September 2016 (Monthly, 31 January 2001 = 100)



* VIX = Chicago Board Options Exchange Market Volatility Index, a measure of the implied volatility of S&P 500 index options. Implied stock market volatility indices are forward looking measures of stock index volatility computed based on option prices and measure market expectations of stock market volatility in the next 30 days. For a more detailed discussion of the VIX and its interpretation, see Whaley (2009).

MOVE = Yield curve-weighted index of the normalized implied volatility on one-month Treasure options.

TED Spread = Calculated by BBA LIBOR US$ 3 Month minus the US Generic Government 3 Month Yield.

The vertical lines represent the periods of three phases of global liquidity.

Source: Bloomberg.

In addition, the movements of the abovementioned global liquidity indicators are not completely separate, which means that they are interrelated. For instance, Bekaert et al. (2013) showed that there is a close relationship between the Fed Funds rate and VIX index of implied volatility on U.S. equity options using a vector autoregression (VAR) assessment. They concluded that a loosening of monetary policy in the USA lowers the risk aversion in stocks for more than two years. Furthermore, CGFS (2011) states that there is a self-reinforcing interaction between risk appetite and liquidity, thus, implying that the relationship between risk appetite and liquidity is two-sided.

3. Transmission Channels

Global liquidity adds to the global financial cycle, which could lead to boom-bust phases in emerging market economies (EMEs). In the past, the interaction between global liquidity conditions and financial cycles in EMEs had received much attention. However, real economic spillovers in EMEs have tended to be neglected and till today, these implications are not fully understood. Excesses in global liquidity can contribute to the endogenous build-up of vulnerabilities, and liquidity shortages may have important implications for stability and growth.

The question of how liquidity conditions in global financial markets are transmitted to other economies, specifically, emerging market economies is an interesting one. The transmission channels of the activities of global investors and financial intermediaries can be substantiated by cross-border capital flows. There are three different channels through which global liquidity can be transmitted - via international equity portfolios, bond portfolios, and bank flows. Papers investigating the impact of global liquidity on capital flows include Sugimoto and Enya (2015). Additionally, He and McCauley (2013) investigated three price channels and two quantity channels of monetary policies of major economies in East Asia and found that lower bond yields from large-scale central bank bond purchases in advanced economies are transmitted to lower bond yields in local currency bond markets. However, Sukhee and Byambasuren (2016) suggested that capital flows in Mongolia are mainly driven by commodity prices (copper, coal, and gold) since mining sector investment flows dominate the aggregate capital flows.

A lot of research has been done to analyze the impact of global liquidity on world commodity prices. In the context of the Mongolian economy especially, the main channel of global liquidity is the interaction between global liquidity conditions and international commodity prices. The developments of commodity prices and global liquidity over the last decade illustrate that these variables move together and have the same cycle. For example, the boom in commodity prices up till 2008 was followed by a sharp drop during the GFC, with commodity prices substantially increasing subsequently since early 2009. In addition, from the beginning of the third phase of global liquidity, international commodity prices have declined to almost pre-crisis levels.

It is asserted that there is a strong interconnection between monetary policy developments and shifts in commodity prices (Frankel, 2006; Browne and Cronin, 2010). Due to the fact that commodity prices signal important information about

economic activity and inflation dynamics, they are closely observed by central banks or monetary authorities. But the role of commodity prices in monetary policy setting is still debatable (e.g., Angell, 1992; IMF, 2010b). Based on Dornbusch's (1976) "Theory of Exchange Rate Overshooting", Frankel (1986) introduced the "Overshooting Theory of Commodity Prices". Browne and Cronin (2010) argue that the adjustment process of commodity prices is relatively swift, while consumer prices tend to adjust in the longer run. When there is a change in monetary policy stance, the response of commodity prices tend to be larger than expected while consumer prices tend to be stickier. Thus, commodity prices are said to 'overshoot' their long-run equilibrium level.

Belke et al. (2010) separated the impact of global liquidity on commodity prices and other asset prices by examining a co-integrated VAR approach for major OECD countries for the period 1970-2008. Their results suggest that global liquidity increases spillovers to commodity prices and note that commodity price is an important forecaster of future inflation even at a global level (see for example Darius and Radde, 2010; Anzuini et al., 2010). In addition, Van Limbergen (2011) examined the effects of global liquidity and global monetary policy on housing, equity and commodity prices, adopting the structural VAR method using data from 1990 until 2007 for a country set of 85% of global gross domestic product.

Kang, Yu and Yu (2016) propose that the effect of global liquidity has been more pronounced for energy and metal prices since the GFC, by estimating a structural VAR model comprising of commodity supply, demand and prices. They also suggest that a price-based liquidity indicator has a greater explanatory power for commodity price dynamics than the commonly-used monetary aggregates in the post-crisis period. Furthermore, Chakraborty and Bordoloi (2012) show that excess global monetary liquidity plays a significant role in explaining the surge in commodity prices during the pre- and post-financial crisis of 2008, comparing the results from the Time Varying Structural VAR with the Stochastic Volatility (TVP-VAR) and State Space Model. In keeping with previous studies, Beckmann et al. (2014) found a significant and time-varying long-run relationship between global liquidity and commodity prices by estimating a Markov-switching vector error correction model. Additionally, Belke et al. (2013) support the hypothesis of a long-run relation between global liquidity and changes in food and commodity prices by applying a global cointegrated VAR model for the period 1980-2011. Ratti and Vespignani (2015) find that unanticipated increases in the liquidity of BRIC countries (Brazil, Russia, India, China and South Africa) is associated with significant and persistent increase in commodity prices using a structural factor-augmented error correction (SFAVEC) model.

Some studies examine the adverse impact of volatility in global liquidity and capital flow reversals on EMEs. For instance, Eichengreen and Gupta (2015) suggest that countries that experienced strong capital inflows and large currency appreciation pressures during 2010–12 underwent a sharp retrenchment of capital flows in 2013 when market volatility increased. In addition, Rey (2015) found that a global financial cycle in capital flows, asset prices, credit growth, and market volatility is mainly affected by US monetary policy stance through the leveraging of global banks and cross-border capital/credit flows. Capital flows and exchange rate volatility in small open economies induced by the change in global liquidity conditions can negatively affect macroeconomic and financial stability through domestic credit boom-bust and resource allocation (Caballero and Krishnamurthy, 2004; Caballero and Lorenzoni, 2014; and Korinek, 2010). Surging liquidity in the global perspective typically leads to appreciation pressure of the domestic currency, boom in asset prices such as bond prices, stock prices and housing prices, and an easing of domestic monetary policy.

Theoretically, liquidity expansion in advanced economies can spillover to output developments of EMEs either positively or negatively (Mundell-Fleming). A positive impact of global liquidity on both global output developments and individual country output in the short-run is generally agreed upon by scholars. Researchers also generally agree that the same kind of indicators are applicable on both the global and country level. Regarding international liquidity spillover on output, Sousa and Zaghini (2008) indicate that an increase in global liquidity will increase output in the Euro area in the short- and medium-term. Kim (2001) also verifies the spillover impact by affirming that a positive shock of US monetary policy raises both domestic and foreign output. Other studies look at the direction of international liquidity spillovers on foreign GDP growth (e.g., Rüffer and Stracca, 2006).

There is also substantial literature on the effects of global liquidity on inflation overseas. For instance, Ciccarelli and Mojon (2010) show that global liquidity accounts for 70% of the movement of inflation in 22 OECD countries. Sousa and Zaghini (2008) postulate that increases in global liquidity lead to the growth in Euro area inflation due to the corresponding hike in money supply. They conclude that global liquidity acts as a long-term factor for variations in inflation.

4. Methodology and Data

4.1 The Model

To empirically examine the transmission of global liquidity on the local economy, we estimated the structural vector autoregression (VAR) model. We applied the Kim and Roubini (2000) approach to identify the effects of monetary

policy shocks of advanced countries on exchange rates and other macroeconomic variables. In so doing, we generally followed the non-recursive system described by Sims and Zha (1995) and Kim and Roubini (2000). The structural vector autoregression models (SVAR) pioneered by Sims (1980) were introduced in the 1980s in response to the criticism of the use of non-restricted VAR models to analyze impulse propagation. Sims (1980) proposed a statistical orthogonalization method based on the Cholesky decomposition of error variance, and the recursive SVAR models were thus introduced. Despite the advantages of recursive SVAR models, they can be inconvenient and may lose out on economic simultaneity. The model used in this paper is described in the following equation:

$$G(L)y_t = e_t \tag{1}$$

where $G(L)$ is a matrix polynomial of the lag operator, y_t is a $n\times1$ variables vector of interest, and e_t is an $n\times1$ vector of structural disturbances with zero-mean and $var(e_t) = \Lambda$ (where Λ denotes a diagonal matrix). The estimation of the reduced-form equation of the structural model represented in (1) can be described as follows:

$$y_t = B(L)y_t + u_t \tag{2}$$

where $B(L)$ is a matrix polynomial of the lag operator and u_t is a vector of the VAR residuals with zero-mean and $var(u_t) = \sum$. Moreover, the relation between the structural disturbances (e_t) and the residual form VAR residuals (u_t) is defined by the following equation:

$$e_t = G_0 u_t \tag{3}$$

where G_0 is a matrix of parameters and at least $n\times(n-1)/2$ restrictions on G_0 will be needed to achieve identification since diagonal elements of G_0 are normalized to 1's. The recursive systems use the Cholesky decomposition to build the matrix of parameters (G_0). The disadvantage of this technique is the triangular matrix and losses in simultaneity. Therefore, the advantage of the structural VAR approach with non-recursive contemporaneous restrictions is that G_0 does not have to be triangular because it has sufficient restrictions.

4.2 Identification

In this model, the data vector is $\{GL, COM, FLOW, RER, CPI, RATE, GDP\}$, where GL is a measure of global liquidity, COM the commodity price, $FLOW$ the net capital flows, RER the real effective exchange rate, CPI the consumer price index, $RATE$ an interest rate, and GDP the real gross domestic product. While there

are several ways to impose restrictions, we will use the short-run restriction for non-recursive systems. For the restrictions on the contemporaneous structural parameters G_0, we generally emulate the idea of Sims and Zha (1995) and Kim and Roubini (2000). However, while they emphasize the effects of monetary policy shock on the economy, we highlight the macroeconomic impact of global liquidity on the individual emerging economies. Thus, the restrictions and the data sets are totally different from those of the aforementioned papers. The following equation outlines the identification based on Equation (3):

$$\begin{bmatrix} e_{GL} \\ e_{COM} \\ e_{FLOW} \\ e_{RER} \\ e_{CPI} \\ e_{RATE} \\ e_{GDP} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ g_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ g_{31} & g_{32} & 1 & 0 & 0 & g_{36} & 0 \\ g_{41} & g_{42} & g_{43} & 1 & 0 & g_{46} & 0 \\ g_{51} & 0 & 0 & g_{54} & 1 & g_{56} & g_{57} \\ g_{61} & g_{62} & g_{63} & 0 & 0 & 1 & 0 \\ g_{71} & g_{72} & g_{73} & g_{74} & g_{75} & g_{76} & 1 \end{bmatrix} \times \begin{bmatrix} u_{GL} \\ u_{COM} \\ u_{FLOW} \\ u_{RER} \\ u_{CPI} \\ u_{RATE} \\ u_{GDP} \end{bmatrix} \quad (4)$$

where $\{e_{GL}, e_{COM}, e_{FLOW}, e_{RER}, e_{CPI}, e_{RATE}, e_{GDP}\}$ are the structural disturbances, and $\{u_{GL}, u_{COM}, u_{FLOW}, u_{RER}, u_{CPI}, u_{RATE}, u_{GDP}\}$ are the residuals in the reduced form equations, which represent unexpected shocks of each variable.

As this paper analyses how liquidity conditions in the global financial market affect the economy of Mongolia, we chose both exogenous and endogenous variables in the structural VAR model based on the literature of transmission channels of global liquidity discussed in Section 3. The detailed descriptions of the selected macroeconomic indicators for the empirical analysis is provided in the following section.

4.3 The Data

The model is constructed using quarterly data from January 2001 to June 2016. As a proxy for liquidity conditions in global financial markets, three indicators (credit aggregates, US interest rate and VIX index) were included in our model sequentially, and we defined which one(s) is/are more applicable to illustrate an international spillover of global liquidity in Mongolia. The variables included in our model are real gross domestic product, consumer price index, domestic interest rate, real exchange rate, net capital flows, commodity prices, and global liquidity indicator. The definitions of the data are provided in Table 1. The seasonal effects of the variables were adjusted using the "TRAMO/SEATS" method.

Table 1
Data Definition

Variables	Definition	Source
Global Liquidity	Annual (year-on-year) growth rate of credit aggregate	BIS
	U.S. short-term shadow interest rate	Reserve Bank of New Zealand
	VIX index	Bloomberg
Commodity Prices	Log of commodity price index (weighted average of copper, gold and coal prices)	Bloomberg, IMF, Authors' calculation
Capital Flows	Log of equity flows (net)	BoM
	Log of bank flows (net)	BoM
	Log of non-bank flows (net)	BoM
	Log of total capital flows (net)	BoM
Exchange Rate	Log of real effective exchange rate (REER)	BoM
Inflation	Log of consumer price index	BoM
Interest Rate	Central bank bill rate	BoM
Output	Log of real GDP	NSO

Notes: BoM = Bank of Mongolia, NSO = National Statistics Office, IMF = International Monetary Fund, BIS = Bank for International Settlements

*, **, *** indicate probability to reject null hypothesis that there is a unit root, with respectively 10, 5 and 1% significance.

The presence of nonstationarity will not affect the statistical inference since the structural VAR model follows a Bayesian inference.[3] Sims, Stock and Watson (1990) concluded that:

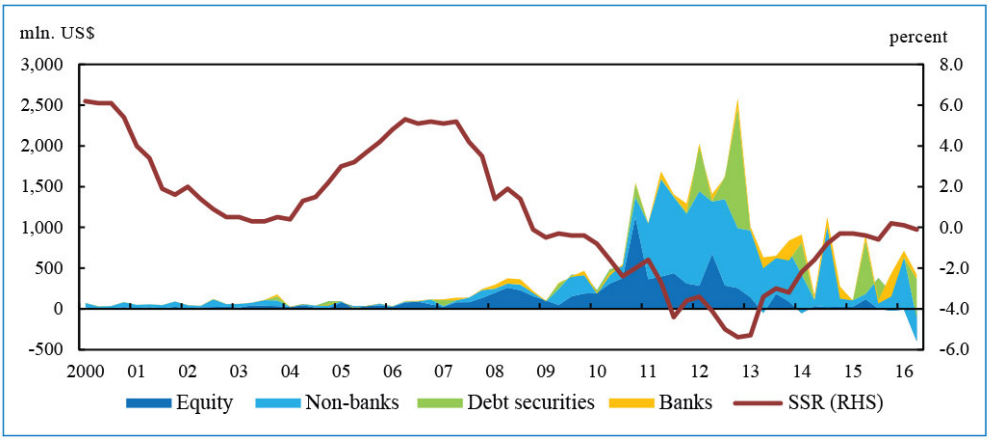
> "*...the common practice of attempting to transform models to stationary form by difference or cointegration operators whenever it appears likely that the data are integrated is in many cases unnecessary... Whether to use a transformed model when the distribution of a test of the hypothesis of interest depends on the presence of nonstationarity is a difficult question...*"

3. See Sims (1988), Sims and Uhlig (1991), Kim and Roubini (2000).

In backing this seminal work, we found that many of the applied research on monetary policy analysis using VAR approach, for example, Christiano, Eichenbaum and Evans (1999) did not necessarily transform the data from non-stationary to stationary.

The trends of capital inflows are shown in Figure 4. Capital flows into Mongolia started to surge from around 2010 to the end of 2013, mainly comprising of equity and non-bank financial flows. Since then, there has been a sudden drop in capital inflows due to sovereign bond and commercial bond issuances in the international capital market. The dynamics and trends of capital flows in Mongolia suggest that they are closely correlated with global liquidity conditions since 2008 (proxied by SSR in Figure 4).

Figure 4
Mongolia's Net Capital Flows and U.S. Shadow Rate
As at second quarter of 2016 (Quarterly)



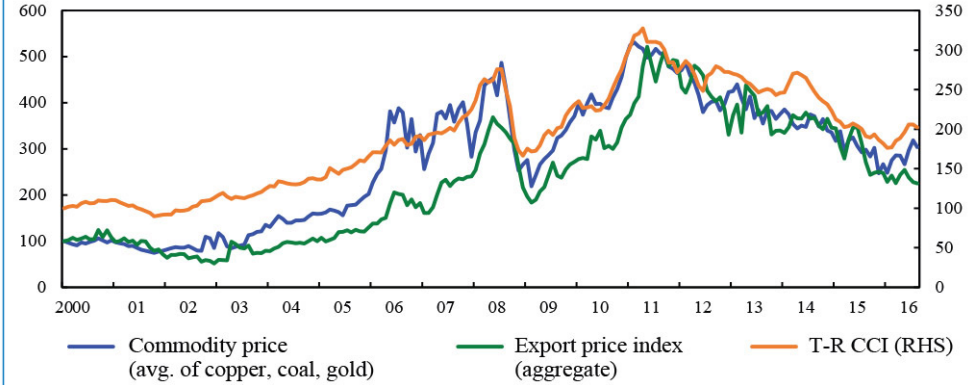
* SSR = Shadow Short Rate

Sources: Bank of Mongolia, Reserve Bank of New Zealand.

However, without the commodity price channel, capital flows into Mongolia would not have had reflected global liquidity. The dynamics of international commodity prices also suggest that it has the same cyclical component with the liquidity conditions in global financial markets. Thus, this paper hypothesize that the international spillover from global liquidity is transmitted through shifts in commodity prices induced by changes in global liquidity conditions. The commodity price channel for global liquidity is discussed at length in Section 3.

Figure 5 shows that the commodity price index (T-R CCI) and Mongolia's prices for its main exporting goods are strongly correlated and move closely together over time. Thus, it makes little difference in the choice of the commodity price indices that are used in our empirical analysis. It can be seen that the Mongolian economy is impacted from the capital inflows induced from shifts in international commodity prices and global liquidity conditions. It must be mentioned, however, that prior to the GFC, Mongolia seemed to be less connected to the international market. Prior to the crisis, the economy was experiencing year-on-year increase in the exchange rate and CPI inflation while money growth was relatively stable, with fluctuating domestic interest rate. After the GFC, there was a boom in global liquidity conditions and international commodity prices which led to surges of capital flows into Mongolia. This resulted in very high economic growth and substantial increases in money supply and total credit as well as the nominal exchange rate.

Figure 5
Commodity Prices
As at Aug 2016 (Monthly, January 2000 = 100**)**



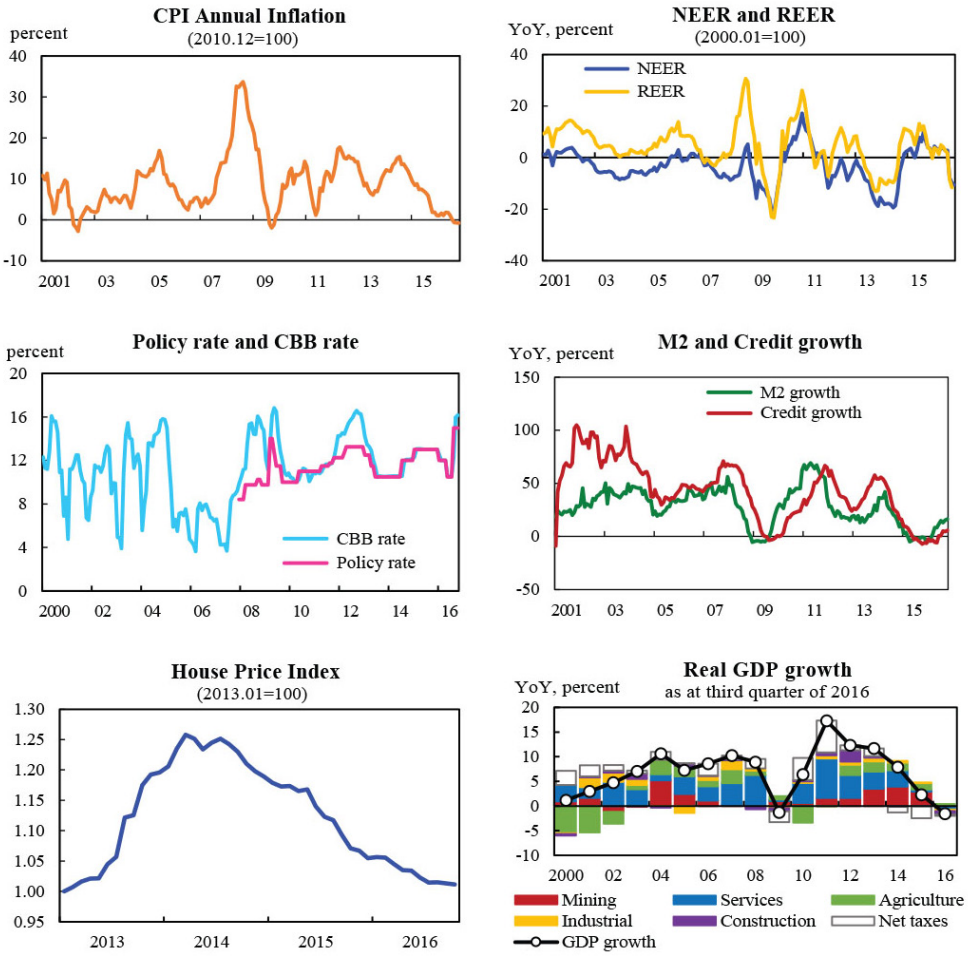
* Mongolia's aggregate index of export price includes 10 export goods including copper, gold, coal, zinc, crude oil, iron ore, molybdenum and cashmere.

T-R CCI = Thomson Reuters Equal Weight Commodity Index. The Continuous Commodity Futures Price Index is an equal-weighted geometric average of commodity price levels relative to the base year average price.

Source: Bloomberg, IMF.

However, since capital flows reversed in 2013 due to the contraction in global liquidity and downward shift in commodity prices, Mongolia's economy has slowed down, along with a significant depreciation in the exchange rate and deceleration in credit and money growth back to GFC levels.

Figure 6
Mongolian Macroeconomic Indicators
As at October 2016 (unless otherwise stated)



Source: Bank of Mongolia, National Statistics Office.

In general, Mongolian macroeconomic variables have tended to closely respond to global economic and financial conditions with corresponding cyclical patterns after the GFC.

5. Impact of Global Liquidity on the Mongolian Economy

In this section, we examine the impulse response functions of the estimated 7-variable structural VAR model from positive shocks of the liquidity indicators for each macroeconomic variable including commodity prices. The specification of the lag length of the VAR has strong implications for subsequent modeling choices.

Table 2
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-184.0217	NA	1.92e-06	6.702517	6.953418	6.800025
1	203.2477	665.8316	1.36e-11	-5.166586	-3.159378*	-4.386516*
2	256.2929	78.17184*	1.28e-11*	-5.308522	-1.545006	-3.845892
3	301.9680	56.09231	1.76e-11	-5.191861	0.327962	-3.046670
4	350.2530	47.43786	2.80e-11	-5.166772	2.109358	-2.339020
5	438.0999	64.72929	1.66e-11	-6.529821*	2.502616	-3.019508

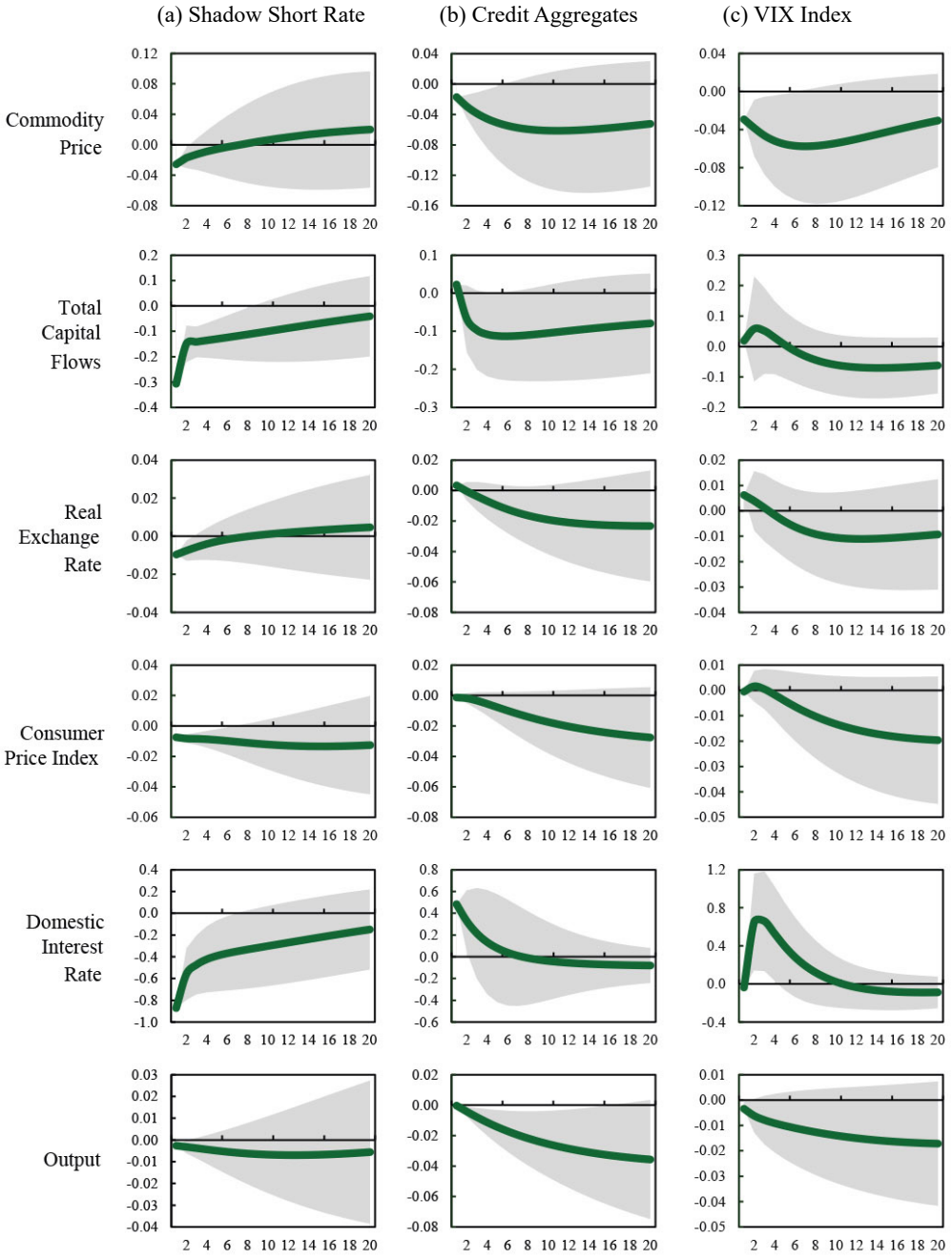
Notes: * indicates lag order selected by the criterion.
LR = sequential modified LR test statistic (each test at 5% level); FPE = Final prediction error; AIC = Akaike information criterion; SC = Schwarz information criterion; HQ = Hannan-Quinn information criterion

With regard to the formal testing, lag length criteria, based on the maximum likelihood function, the choice of lag length of one is supported for Mongolian quarterly data by the "Schwarz" and "Hannan-Quinn" information criteria (Table 2). Therefore, we estimate the reduced form VAR model with one lag. The shaded area plotted in each graph is of two-standard-error intervals.

We first looked at the price-based global liquidity indicator and analyzed its impact on the Mongolian economy. Figure 7(a) illustrates the impulse response functions of Mongolian macroeconomic variables to a positive shock in the short-term shadow interest rate (positive shock meaning an increase in SSR), and a contraction in global liquidity conditions. The results from the impulse-response show that there is a decline in the commodity price, decrease in capital inflows, depreciation in the real exchange rate, declines in inflation as well as interest rate while the gross domestic product decreases in real terms due to a reduction of global liquidity in the short-run. This impact of international spillover of global liquidity is in line with the theoretical assumptions and also confirms that commodity prices reflect the liquidity conditions in the global financial markets.

Secondly, the credit aggregates (international claims on banks and non-banks) are assessed as a proxy for global liquidity, and the impulse response functions for the Mongolian economy are illustrated in Figure 7(b). From the estimation results, it can be seen that there is a short-run negative relationship between global credit aggregates and commodity prices, which is inconsistent with the theoretical assumption. The statistically insignificant relationship (IRF) shows that an increase

Figure 7
Impulse Responses to Global Liquidity Shocks



Source: Author's Estimation.

in credit aggregates does not translate into total capital flows and thus, this proxy is not a relevant measure of global liquidity for Mongolia.

In terms of the VIX index as a global liquidity indicator, the estimation results show that it is not appropriate measure for Mongolia (Figure 7(c)) as the relationship between the VIX and Mongolia's macroeconomic indicators are statistically insignificant.

It is also interesting to explore whether these relationships or transmission mechanisms have varied since the GFC of 2008/09. Thus, we estimate the VAR model using the data prior to the GFC and compare the impulse response functions with the empirical estimation covering the whole period until 2016:06. As illustrated in Figure 8, there is no significant impact of global liquidity conditions on the Mongolian economy, exhibiting statistically insignificant relationships (IRFs) over the period before the GFC. Therefore, we posit that international spillover of global liquidity into Mongolia strengthened substantially after the end of GFC (since 2009).

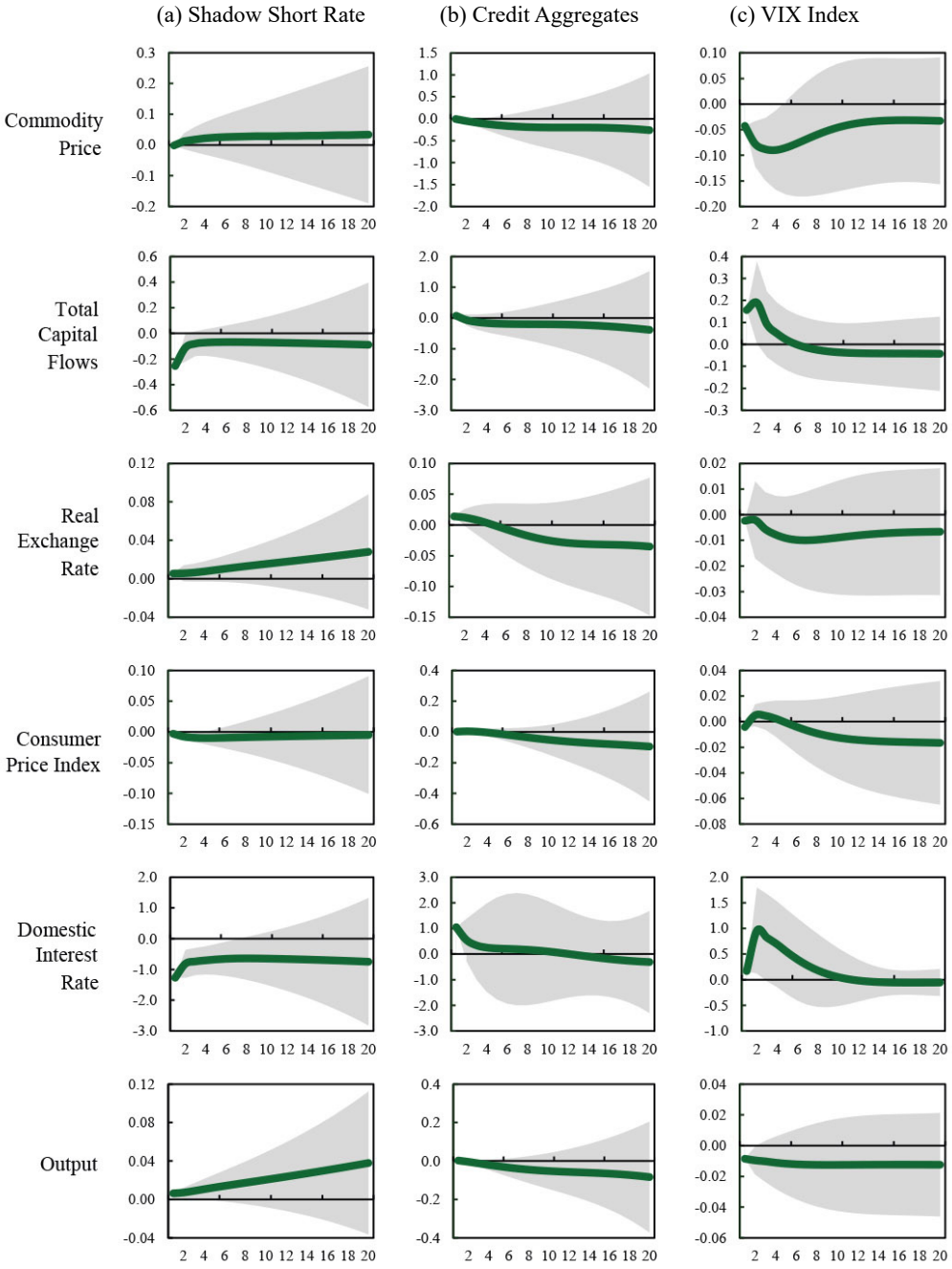
We also analyze the impact of global liquidity and commodity price shocks on different types of capital flows in Mongolia separately. From the IRFs portrayed in Figure 9, equity, bank and non-bank flows generally reflect global liquidity conditions (proxied by SSR). When commodity prices increase in the international market, equity and bank flows would surge into Mongolia. However, there is no relation between commodity prices and non-bank flows.

6. Conclusion and Policy Discussions

In an integrated world, global liquidity has a growing economic impact on domestic economic conditions and financial systems of individual countries. In view of this, the authorities of recipient countries may need to consider these feedback effects and internalize the spillovers in their policy-making processes. This paper, therefore, examined the international spillover of global liquidity on the Mongolian economy.

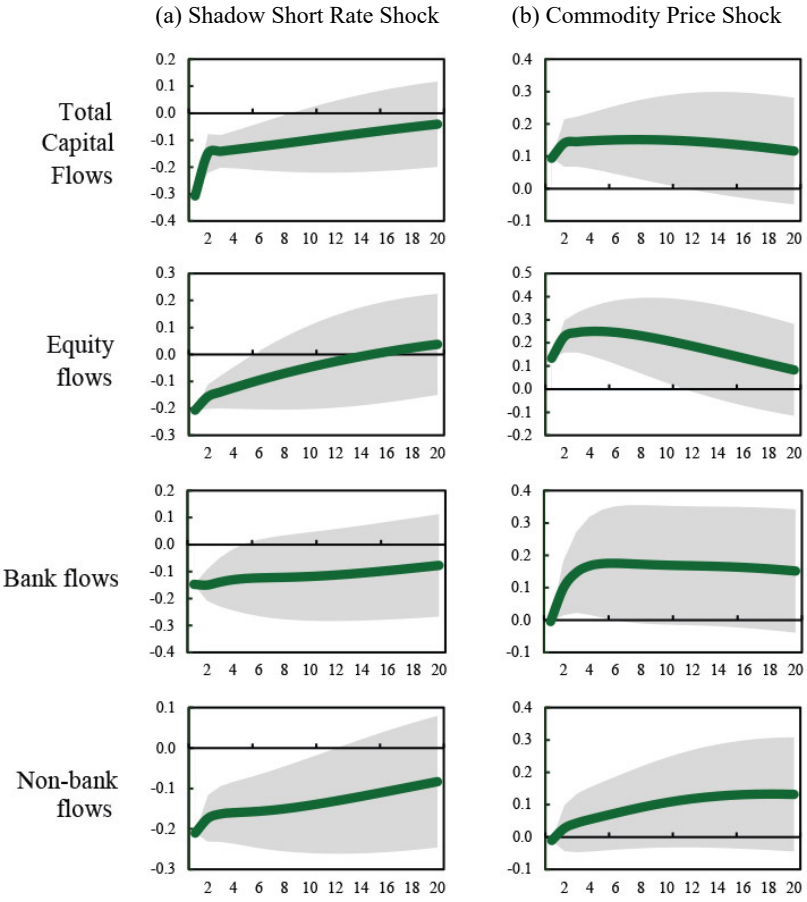
The structural vector autoregression (SVAR) approach with non-recursive contemporaneous restrictions was estimated using quarterly data over the sample period from January 2001 to June 2016. The key findings suggest that global financial conditions in Mongolia is reflected through the commodity price channel. The empirical results show that the easing of global liquidity conditions leads to an increase in the commodity price, surge in capital flows, as well as a strengthening of the real GDP growth. Local inflation and exchange rate fluctuations that are driven by strong economic activity can lead to changes in the domestic interest rate, and thus, domestic monetary policy generally responds to developments in global financial markets.

Figure 8
Impulse Responses to Global Liquidity Shocks (Prior to the GFC)



Source: Author's Estimation.

Figure 9
Impulse Responses to Specific Shocks (Types of Capital Flows)



Source: Author's Estimation.

The alternative indicators of global liquidity were also considered in the empirical analysis with the price-based measure (i.e., U.S. short-term interest rate) found to be more significant in the case of Mongolia. In addition, the structural VAR model was estimated with the same identification for different types of capital flows (equity, bank and non-bank flows). The estimation results show that both equity, bank and non-bank flows into Mongolia tend to reflect the shifts in global liquidity conditions (proxied by the shadow short rate–SSR), exhibiting boom-bust cycles. It is also shown that the commodity price channel only exists in the case of the total capital flows, equity and bank flows.

While the impact of global liquidity on the Mongolian economy was weak before the GFC, it is found that the international spillover effect of global liquidity conditions in the economy has emerged significantly since the GFC. Therefore, global liquidity conditions matter to Mongolia, with its positive impact on capital inflows and economic growth. Domestic monetary policy in Mongolia responds to global liquidity conditions counter-cyclically, i.e., interest rates are lowered in response to hikes in the U.S. shadow short-term interest rate.

Recently, global liquidity conditions have tended to reverse in view of tighter markets. The main reasons for this is the anticipated hike in the Federal rate and adverse situation in the European Union. This may result in capital flows retrenching from emerging market economies and into advanced countries. In this environment, relevant micro and macroprudential policy measures should be implemented to prevent the build-up of financial fragilities and the emergence of economic vulnerabilities. These, for Mongolia, may include liquidity and capital adequacy-related measures as recommended by the Basel III accord, as well as the adoption of internationally consistent capital management techniques. In addition, maintaining precautionary foreign exchange reserves and strengthening international cooperation would be important in the face of global liquidity shortages. Further improvements in the financial regulatory framework need to be made in order to allow the central bank to better supervise the domestic banking sector.

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Chapter 6

THE THREE PHASES OF GLOBAL LIQUIDITY AND THE PHILIPPINE CASE

By
Ruby Anne E. Lemence[1]

1. Introduction

The surge in foreign capital inflows to emerging market economies (EMEs) following the 2008 global financial crisis can be traced to the global liquidity created via quantitative easing policies in advanced economies (AEs). At the same time, the surge in capital flows is believed to have led to appreciation pressures on EME currencies and a build-up of financial imbalances in EMEs (Fratzscher, Duca and Straub, 2013).

The phrase "global liquidity" has been increasingly used in the context of discussions on spillovers of unconventional monetary policies in AEs to EMEs. According to Shin (2013), policymakers often invoke the term to denote global factors that drive cross-border spillovers in financial conditions and credit growth. While the use of the phrase is not always clear, the expression "global liquidity" commonly refers to the ease of financing in the global financial markets.[2]

The Philippines, like many other EMEs, have been on the receiving end of capital inflows brought about by global liquidity. The influx of portfolio capital flows in the years prior to the 2008 global financial crisis has contributed to the increase in foreign exchange inflows and was manifested in the acceleration of domestic liquidity growth and increased reserve accumulation along with strong peso appreciation during the period. The sustained inflow of foreign portfolio investments also supported the strong performance of the local equities market during the period. For the period 2010-2012, in particular, the resurgence of capital flows in the wake of the implementation of unconventional monetary policies in AEs has resulted in

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2. In a 2014 policy paper on "Global Liquidity - Issues for Surveillance," the International Monetary Fund argued that while concepts such as global liquidity have been used in discussing questions on the transmission of financial shocks in an interconnected global economy, the use of the said concept is not always clear partly because the term "liquidity" has many meanings.

sustained buildup in the level of foreign exchange reserves, strong peso appreciation pressures, and divergence of money market interest rates from the BSP's policy rates given the ample liquidity in the financial system.

This paper looks into evidence of the impact of global liquidity on Philippine financial markets. In particular, it examines how the three phases of global liquidity, as described by Azis and Shin (2013, 2015), have manifested themselves in the Philippines. The transmission of global liquidity to the Philippines is studied using regression analysis based on the variables used in panel regression analyses in Sun (2015) while the responses of selected macroeconomic variables to shocks in different global liquidity indicators will be explored using the local projection method proposed by Jorda (Nodari, 2015). Finally, the paper also looks into the policy options in responding to the impact of global liquidity.

2. Understanding Global liquidity

2.1 Global liquidity: Concept, Drivers, Transmission, and Outcomes

Eickmeier, Gambacorta, and Hofmann (2013) argued that despite its widespread usage, "global liquidity" remains without an agreed definition. In recent years, however, global liquidity has been increasingly used in literature in the context of discussions on spillover effects of unconventional monetary policies in advanced economies. For the purpose of this study, the term "global liquidity" will be used to refer to the ease of global financing in the global financial markets.

Overall ease of financing is determined through the interaction of factors such as macroeconomic policies and financial market participants. Global liquidity is driven by central banks' monetary policy, credit provision by financial intermediaries, as well as shifts in investors' risk appetite.

The 2014 IMF policy paper on "Global Liquidity - Issues for Surveillance" provided an operational framework for thinking about global financial conditions and global liquidity. The said framework distinguishes between drivers, transmission channels and financial conditions outcomes of global liquidity. Driven by prevailing conditions in major financial markets, ease of global financing is transmitted internationally by financial intermediaries that operate globally and by activities in international financial markets, and along with country-specific factors, leads to outcomes in local financial conditions. In the said framework, drivers of global liquidity are composed of policies, risk appetite, global bank leverage, terms of credit, and final investors. Driven by said factors, global liquidity is transmitted internationally through cross-border bank flows, non-core bank funding, international portfolio flows, and international debt issuance. The impact of global liquidity is then

manifested in terms of changes in credit growth, cost of credit, credit conditions, and asset prices.

In cognizance of the fact that there is no clear definition of global liquidity and that no single variable can capture global liquidity conditions, researchers use proxy variables for global liquidity which measures quantity, price and risk. Quantity-based indicators include credit aggregates and global aggregates of broad money while price-based indicators include interest rates. Meanwhile, risk-based indicators refer to indicators that measure shifts in risk-taking, as proxied, for example, by stock market volatility.

2.2 Phases of Global Liquidity

Azis and Shin (2013, 2015) identified three recent phases of global liquidity and discussed the implications of each in emerging Asia. The first phase of global liquidity was said to have started in 2003 and lasted until the 2008/2009 global financial crisis (GFC). This phase was marked by the expansion of the global banking system where financial conditions were transmitted across borders through capital flows intermediated by banks operating globally.

The second phase of global liquidity began roughly in 2010, around the time when central banks in major advanced economies had begun implementing quantitative easing and asset purchase policies to support their domestic economies. The said polices have impacted bond markets resulting in much more permissive conditions in fixed-income securities markets, characterized by higher duration, lower long-term yields, and volatility. Unlike in the first phase, where activity was largely led by the banking system, the key players in the second phase of global liquidity were asset managers and the key theme was the search for yields and explosion in bond issuances - both sovereign and corporate bonds.

Meanwhile, the US Federal Reserve Bank's (US Fed) announcement in May 2013 of a possible tapering of its bond-buying program signaled the end of the second phase and the start of the third phase of global liquidity, which saw volatility in financial markets and capital outflows in EMEs.

From a policy standpoint, an understanding of global liquidity and how it has been transmitted and impacted liquidity-receiving economies is important in determining policy options that would help mitigate the impact of capital flow reversals. Psalida & Sun (2011) argued that if the resumption of strong capital flows to emerging markets was due to push factors rather than pull factors, then liquidity-receiving economies are faced with policy challenges associated not only with managing capital flows but also because inflows could reverse abruptly if the G-4 cycle turns.

3. Impact of Global Liquidity in Emerging Market Economies: Observations Based on Recent Studies

Chen, et al. (2012) employed the global vector error correction models (VECM) approach in analyzing the impact of quantitative easing (QE) in major advanced economies by examining cross-border financial market impact of Central Bank (CB) balance sheet policies and studied the real effects of QE. The results of the study indicated significant spillovers from US monetary policy actions to a wide range of emerging financial markets. The authors also found evidence that the cross-border effects of the different stages of QE may have changed over time as the growth prospects of the advanced economies and emerging market economies diverged. Furthermore, they observed that the cumulative impact of US QE1 is greater than that of US QE2 and argued that Japan's QE earlier in the decade had a somewhat greater impact on the Asian region than did US QE2.

In the case of the Philippines, event studies involving sovereign and corporate bond yields, sovereign CDS spreads, equity prices, and exchange rates performed by Chen, et al. (2012) implied that the country was affected more by US QE2 than US QE1.[3]

Using flow-of-funds analysis, Azis and Shin (2013) observed that the Philippine financial sector exhibited a significant change in investment behavior between the pre-GFC and GFC periods, with preference for non-core funding sources (non-deposits) increasing. With growing non-core liabilities, investment by the financial sector is more diversified in favor of non-loans, particularly securities and equities.

4. Phases of Global Liquidity and the Philippines

Yap (2008) largely attributed capital flows to the Philippines to "push" factors, arguing that the ebb and flow of capital to the Philippines generally follow global patterns, particularly in the case of portfolio flows and that if "pull" factors were dominant, foreign direct investments (FDI) would have been much higher.

Meanwhile, the results of an econometric study by Peiris, et al. (2015) point to both "push" and "pull" factors as drivers of capital flows to the Philippines. Using the exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model of the gross financial account and non-FDI inflows to the Philippines for the period 2000-2014, results suggest that the most important factors driving gross inflows and non-FDI inflows are the VIX, global financial cycle, interest rate differentials, domestic fundamentals, and exchange rate expectations.

3. The authors looked into the cumulative 2-day changes around announcement days of US QE1 and QE2 for 17 emerging market economies.

The resurgence of capital flows to the Philippines observed in 2010-2012 was not entirely a new experience for the country as it has dealt with episodes of capital flows in the past. The influx of foreign capital into the country has contributed to the increase in foreign exchange inflows and resulted in the strengthening of the local currency. In certain periods, robust foreign portfolio inflows have likewise provided support to the local equities market.

Since the country has been a recipient of foreign capital inflows, an analysis of how global liquidity has affected the Philippines in the first and second phases is important in determining the policy options, particularly when capital flow reverses. The US Fed's announcement of a possible tapering of its bond-buying program in May 2013 sparked bouts of volatility in the Philippine financial market and foreign capital outflows and served as a reminder for policymakers that volatility is inevitable and that portfolio capital flows could easily reverse.

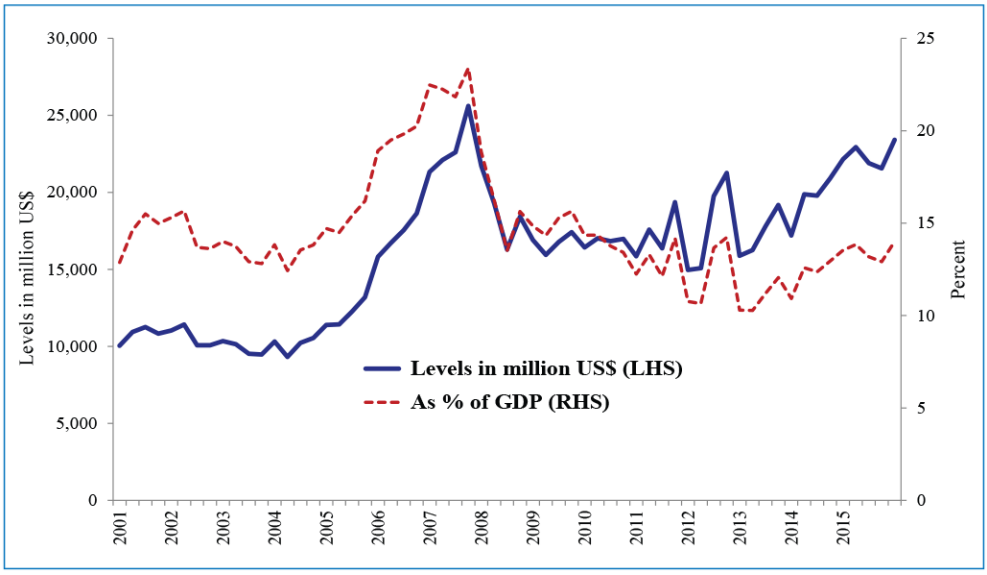
This section delves into the three phases of global liquidity as identified by Azis and Shin (2013, 2015) and examines how each phase is manifested in the Philippines.

4.1 First Phase of Global Liquidity: Run up to the 2008 Global Financial Crisis

Global banks played a major role in the transmission of loose monetary and financial conditions in advanced economies to emerging markets during the first phase of global liquidity which started roughly in 2003 up to the 2008 GFC (Shin (2013, 2015)). According to Shin (2015), foreign banks operating in the US, which have access to wholesale US dollar funding market through US money market funds, were active in channeling US dollar funding from the US to other parts of the world. This way, global banks become carriers of dollar liquidity across borders, allowing permissive liquidity conditions in the US to be transmitted globally and US monetary policy to affect global financial conditions.

Quarterly data on locational banking statistics compiled by the BIS showed sustained acceleration of external loans and deposits of BIS-reporting banks to Philippine residents in the run up to the 2008 GFC (Figure 1). From US$9.3 billion in Q2 2004, the outstanding amount of external loans and deposits to the Philippines reached a high of US$25.6 billion in Q4 2007 before it started to decline. At its peak in Q4 2007, the outstanding amount of external loans and deposit of banks was equivalent to about 23.4% of nominal gross domestic product (GDP) of the Philippines.

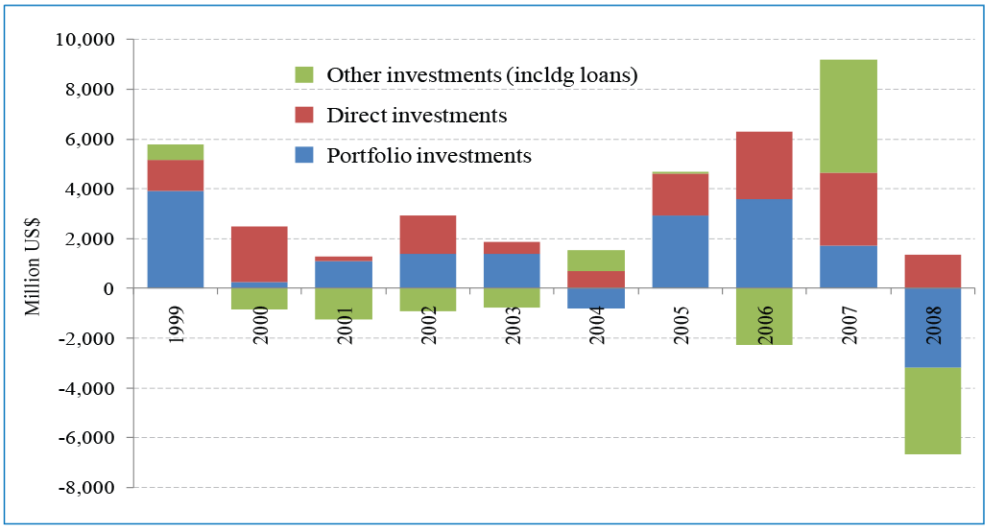
Figure 1
External Loans and Deposits to the Philippines, Q1 2001 - Q4 2015



Sources: Bank for International Settlements, Philippine Statistics Authority, Bangko Sentral ng Pilipinas, and Author's Calculations.

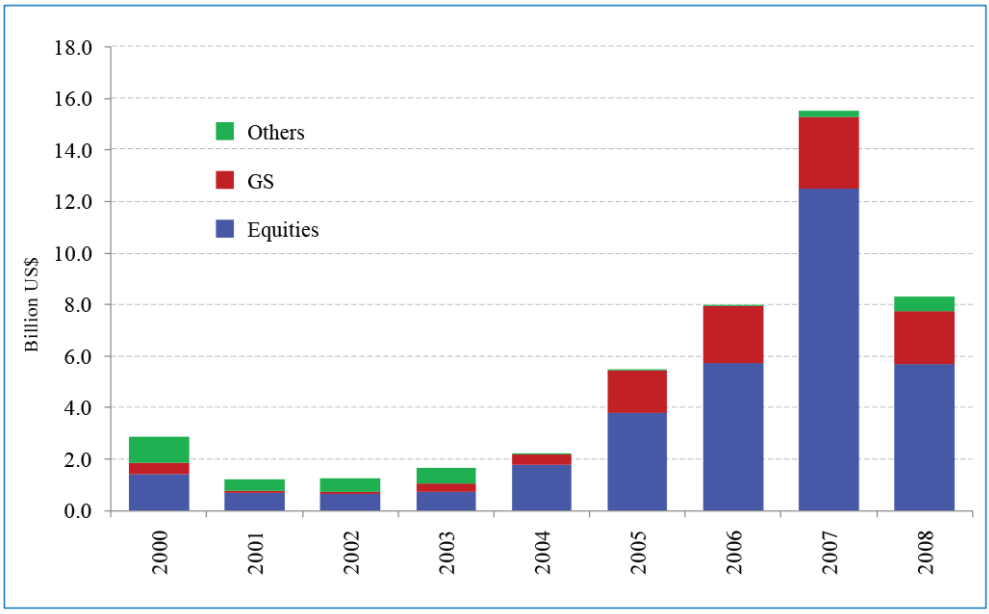
The period likewise saw a surge in capital inflows to the Philippines, driven in part by the rise in investor confidence attributed to several factors such as strengthening macroeconomic fundamentals (exhibited by low inflation, robust economic growth, and rising international reserves) and political stability as well as positive economic outlook following fiscal reforms implemented during the period. Based on balance of payments accounts data, the bulk of non-residents' investment to the Philippines are composed of portfolio inflows (Figure 2). Meanwhile, in terms of the type of financial instruments, most of these portfolio investments go to equities and Government Securities (GS) markets (Figure 3).

Figure 2
Non-residents Investments to the Philippines, 1999 - 2008



Source: Bangko Sentral ng Pilipinas.

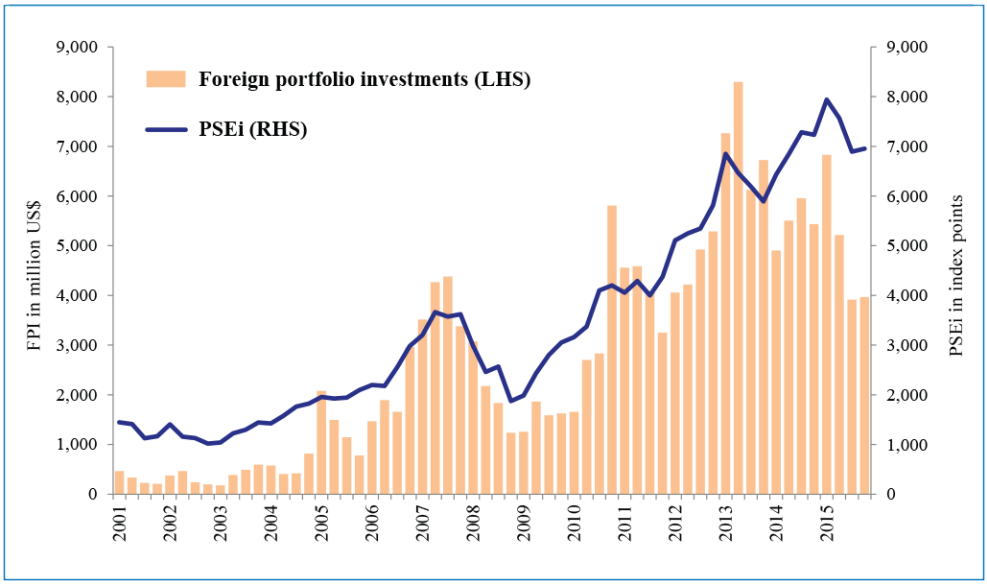
Figure 3
Foreign Portfolio Investments by Type of Instrument, 1999 - 2008



Source: Bangko Sentral ng Pilipinas.

The surge in capital inflows coincided with a sharp increase in the Philippine stock market price index (PSEi) (Figure 4) and elevated growth of domestic liquidity (Figure 5). The PSEi increased by more than three times from 1,039 index points in Q1 2003 to 3,660.9 index points in Q2 2007 before it eventually declined and bottomed out in Q4 2008. Meanwhile, from about 3.8% in Q4 2004, M3 grew by as high as 16.8% four quarters later. The slowdown in the growth of domestic liquidity towards the latter part of 2005 was due to BSP's implementation of policy measures aimed at slowing down the rise in liquidity and contain the potential risks to inflation.[4]

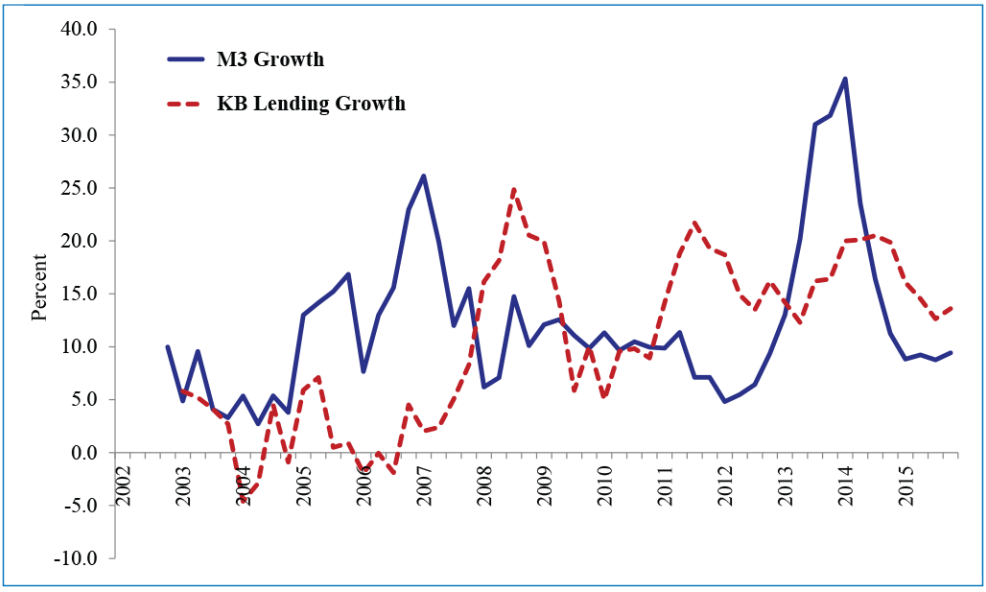
Figure 4
BSP-registered Foreign Portfolio Investments (FPI) and Philippine Stock Exchange Index (PSEi), Q1 2001 - Q4 2015



Sources: Bangko Sentral ng Pilipinas, Philippine Stock Exchange.

4. Said measures include increases in regular and liquidity reserve requirements by one percentage point to 10% and 11%, respectively, in July 2005 and 50-basis point cumulative hike in the BSP's policy rate in September – October 2005.

Figure 5
Domestic Liquidity and Loan Growth, Q4 2002 - Q4 2015



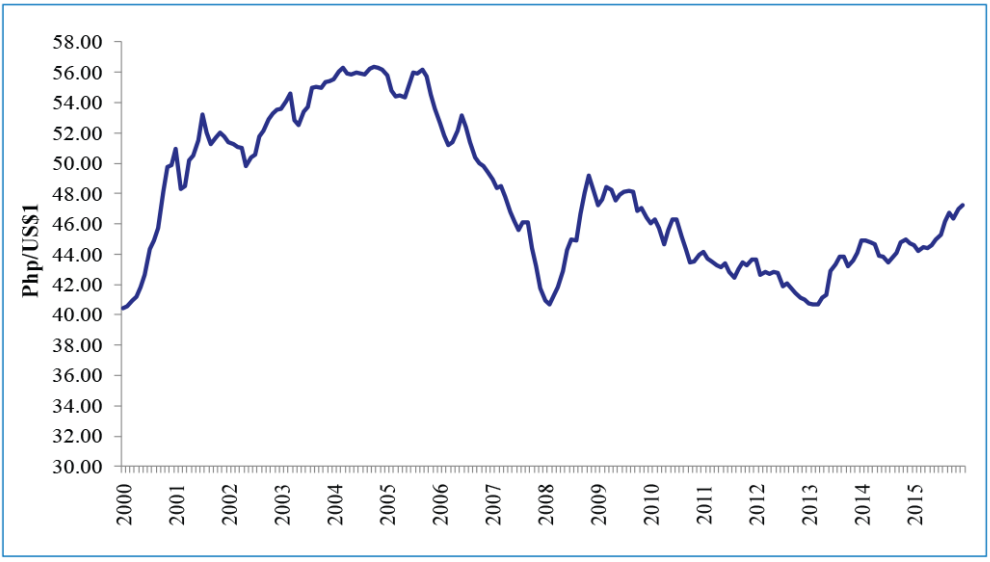
Source: Bangko Sentral ng Pilipinas.

Despite the ample level of liquidity in the financial system during the said period, domestic credit growth remained very sluggish, amid banks' generally cautious attitude towards lending to the corporate sector due to asset quality concerns. The improvement in the growth of credit activity from the latter part of 2006 onwards reflected the strengthening of private sector credit as banks resumed regular lending activity, which can be traced mainly to a decline in the levels of non-performing loans of commercial banks that were able to dispose of their non-performing loans under the Special Purpose Vehicle (SPV) law.[5]

The first phase of global liquidity was also manifested in the sustained foreign exchange inflows, resulting in the strong appreciation of the peso during the period (Figure 6). It should be noted, however, that the continued foreign exchange inflows during the said period was not due to the surge in capital inflows alone. Even before the said period, the Philippines already experienced strong foreign exchange inflows in its current account - from BPO receipts and remittances of overseas Filipinos, in particular. The current account has been in a structural surplus position since 2003 (Figure 7) due to resilient remittances and rising outsourcing receipts (Table 1). As shown in Table 1, despite slowdowns in capital inflows for the period 2006-2008, foreign exchange inflows remained strong supported by remittances from overseas Filipinos and exports receipts.

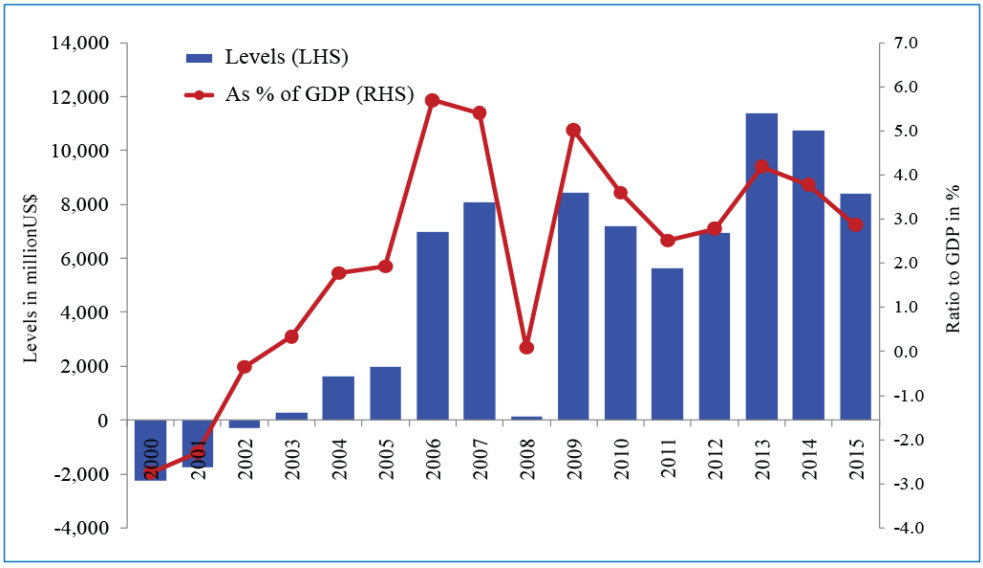
5. As discussed in the 2005 BSP Annual Report.

Figure 6
Peso-US Dollar Exchange Rate (average), Jan 2001 - Dec 2016



Source: Bangko Sentral ng Pilipinas.

Figure 7
Current Account Balance, 2000 - 2015



Sources: Bangko Sentral ng Pilipinas, Philippine Statistics Authority, Author's Calculations.

Table 1
Sources of Foreign Exchange Inflows to the Philippines (% of GDP)

Period	OF Remittances	Exports of Goods and Services	Foreign Portfolio Investments (Inflows)	Foreign Direct Investments (Inflows)	Other Foreign Investments (Inflows)
2000	7.5	50.3	0.3	2.8	-1.0
2001	7.9	45.1	1.4	0.3	-1.7
2002	8.5	46.5	1.7	1.9	-1.1
2003	9.0	46.2	1.6	0.6	-0.9
2004	9.4	46.9	-0.9	0.8	0.9
2005	10.4	32.8	2.9	1.6	0.1
2006	10.4	34.2	2.9	2.2	-1.8
2007	9.7	31.0	1.1	2.0	3.0
2008	9.5	27.5	-1.8	0.8	-2.0
Average (2000-08)	**9.1**	**40.0**	**1.0**	**1.4**	**-0.5**

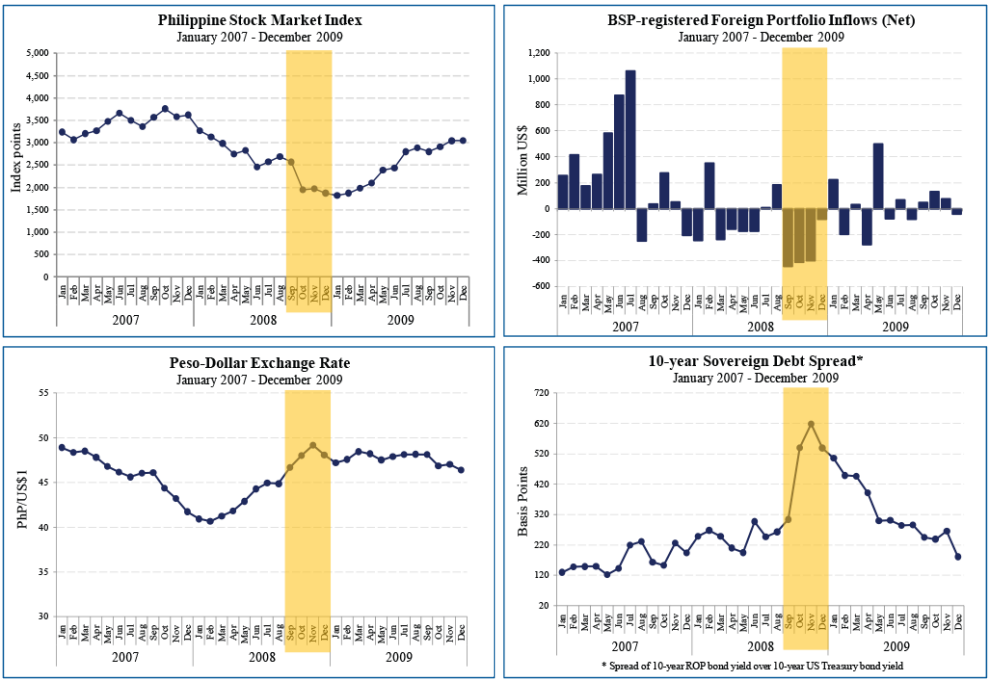
Sources: Bangko Sentral ng Pilipinas, Philippine Statistics Authority, Author's Calculations.

4.2 The Global Financial Crisis and Its Impact on the Philippine Financial System[6]

The financial crisis that originated in the US in the latter part of 2008 intensified into a global phenomenon and affected financial markets across jurisdictions. The negative developments in the global financial and macroeconomic environment spilled over to the Asian region, on account of the region's greater integration with the rest of the world, and contributed to sharp declines in Asian equity markets, widening of sovereign bond spreads, depreciation of regional exchange rates and the decline in offshore bank lending in the region.[7]

6. Guinigundo (2010) provided a more comprehensive discussion on the impact of the 2008 global financial crisis on the Philippine financial system.
7. "Recent Financial Turbulence - Course of Action," presented at the 44th SEACEN Governor's Conference on 30 January 2009, Bank Negara Malaysia as cited in Guinigundo (2010).

Figure 8
Impact of the 2008 Global Financial Crisis on Philippine Financial Markets



Sources: Philippine Stock Exchange, Inc., Bangko Sentral ng Pilipinas, Bloomberg.

The 2008 GFC had limited impact on Philippine financial markets given the marginal exposure of banks to derivatives/structured products owing to the conservative attitude of Philippine banks. The implementation of banking reforms aimed at strengthening the banking sector following the Asian financial crisis likewise contributed to the limited impact of the crisis on the Philippine financial markets (Guinigundo, 2010).

4.2.1 BSP's Response to the Global Financial Crisis

"In many ways, the BSP's interest rate easing and liquidity provision measures were confidence-building moves, signaling the BSP's commitment to ensuring ample money supply in order to fuel the economy's growth engine and maintaining low interest rates to reduce the cost of borrowing to firms and households and therefore support investment and growth."

Diwa C. Guinigundo, Deputy Governor, BSP
"The Impact of the Global Financial Crisis
on the Philippine Financial System - An Assessment"

Amid the potential tightening of liquidity conditions brought about by the global financial turmoil, the BSP carefully considered opportunities for monetary policy easing while remaining faithful to its core mandate of maintaining price stability. Owing to the limited impact of the crisis on the Philippine economy, the magnitude of monetary easing by the BSP was relatively small and involved conventional measures (Guinigundo, 2010).

The BSP reduced its policy rate by a cumulative 200 basis points from December 2008 to July 2009 to help stimulate economic growth and dampen the slowdown in economic activity by reducing the cost of borrowing, thereby reducing the financial burden of firms and households. Aside from policy rate reductions, the BSP also implemented liquidity-enhancing measures, such as the opening of a US dollar repo facility, increase in the rediscounting budget, and reduction in reserve requirements. To complement the said measures, the BSP also responded with time-bound regulatory forbearance measures and improved its transparency and communication practices.

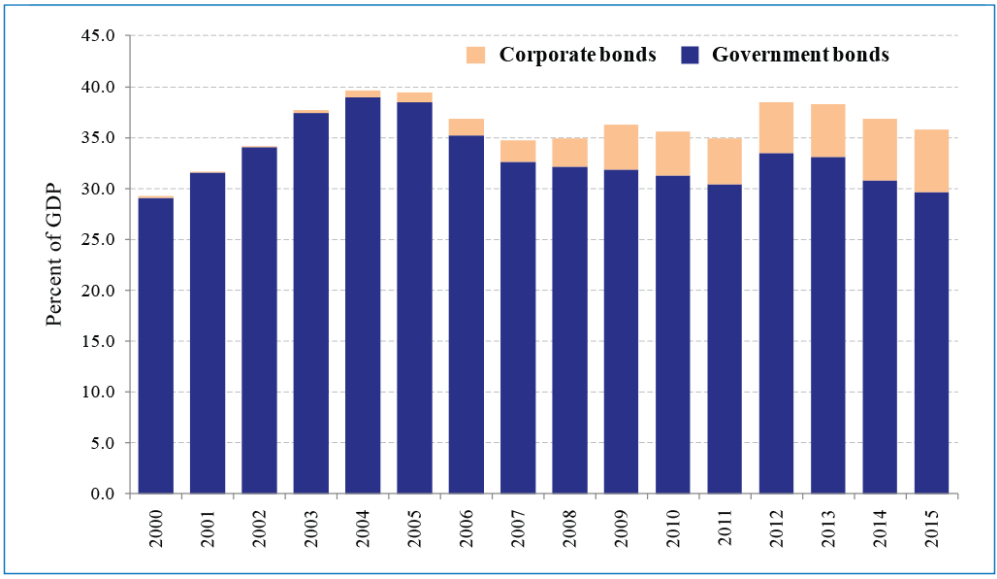
4.3 Second Phase of Global Liquidity: Impact of Unconventional Monetary Policies in Major Advanced Economies, 2010-2012

In the wake of the GFC in 2008, central banks in major advanced economies lowered their key policy rates with the aim of providing support to their respective domestic economies. The rapid reduction in central bank policy rates to near zero levels rendered further monetary easing through policy rate cuts difficult, prompting central banks to resort to unconventional measures, such as quantitative easing and asset purchase policies.

The resulting ultra-low interest rates in major advanced economies led investors to search for higher yields in other markets, leading to the rapid growth of bond markets in emerging markets, such as Asia (Azis and Shin (2015)). While banks played a major role in the first phase of global liquidity, the main protagonist in the second phase are real money asset managers. Borrowing the description provided by Azis and Shin (2015), the second phase of global liquidity was characterized by the expansion of credit through corporate bond markets open to international investors.

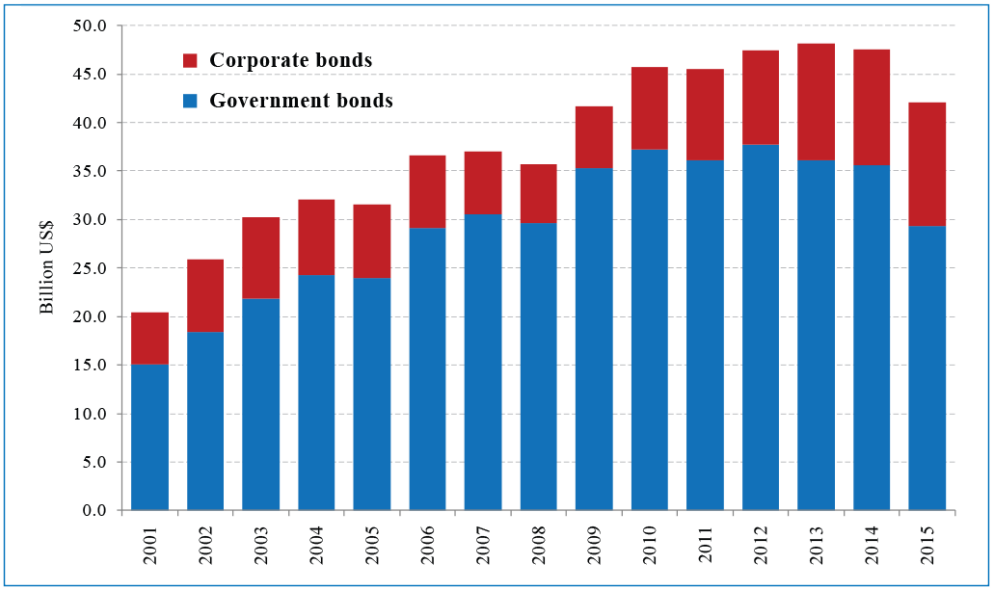
In the case of the Philippines, while the total size of the local currency-denominated bond market was relatively steady for the period 2007-2011, the size of the corporate bond market has increased from 2.7% of GDP in 2008 to about 5.0% of GDP in 2012 and 6.1% in 2015 (Figure 9). At the same time, the total volume of outstanding foreign currency-denominated bonds has increased from US$35.7 billion in 2008 to US$48.1 billion in 2013 on account of the significant increase in outstanding corporate bonds. From US$6.0 billion in 2008, outstanding foreign currency-denominated corporate bonds doubled to US$12.0 billion by the end of 2015 (Figure 10).

Figure 9
Size of Local Currency Bond Market (% of GDP)



Source: Asian Bonds Online.

Figure 10
Outstanding Foreign Currency Bonds

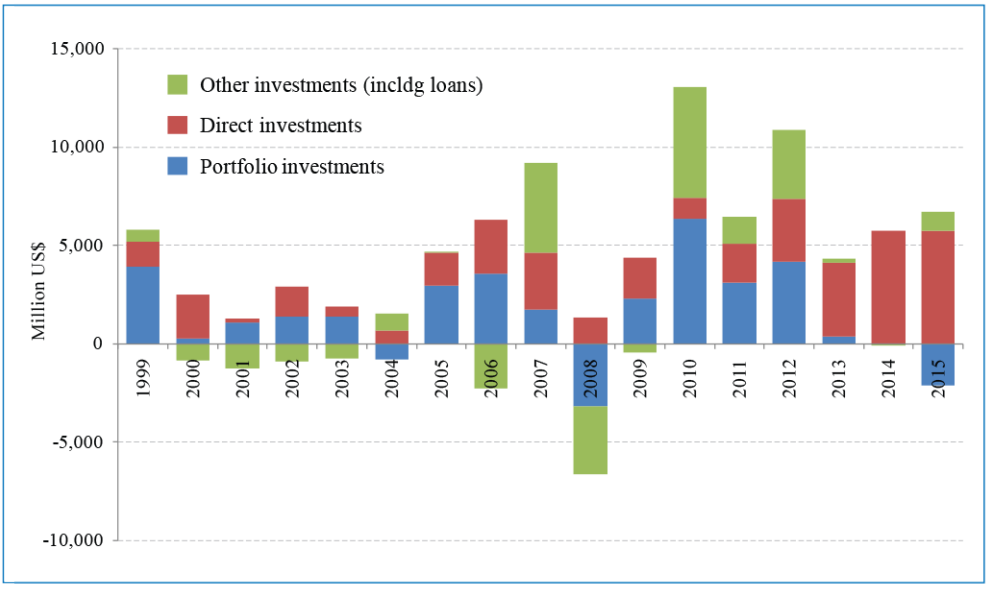


Source: Asian Bonds Online.

The period likewise saw the resurgence of capital inflows - both portfolio and direct - which contributed to the sustained foreign exchange inflows, in addition to overseas Filipinos (OF) remittances and export receipts. From a net outflow recorded in 2008, capital inflows turned positive in 2009 at US$3.9 billion and increased by more than three times in the following year to about US$13.9 billion (Figure 11). The strong foreign exchange inflows resulted in strengthening of the peso. From ₱49.19/US$1 in November 2008, the peso appreciated to a high of ₱40.71/US$1 in March 2013 (Figure 4).

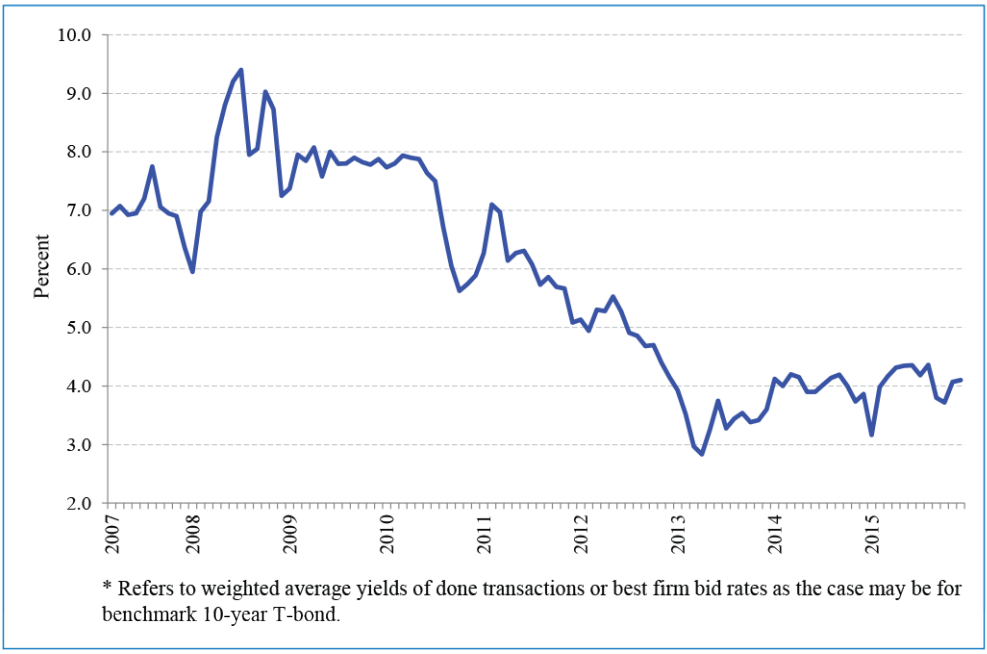
The resurgence of foreign capital inflows to the country likewise led to the sustained increase in the PSEi during the period as shown in Figure 2. Meanwhile, the strong demand for government securities (GS) amid ample supply of liquidity in the financial system led to the sharp decline in 10-year GS yield from 9.2% in June 2008 to 2.8% as of March 2013 (Figure 12).

Figure 11
Foreign Capital Inflows, 1999 - 2015



Source: Bangko Sentral ng Pilipinas.

Figure 12
10-year Treasury Bond Rate*
March 2007 - December 2015



Source: Philippine Dealing and Exchange Corp.

4.4 Third Phase of Global Liquidity: Risk of Capital Flow Reversals Amid Normalization of Monetary Policy in the US

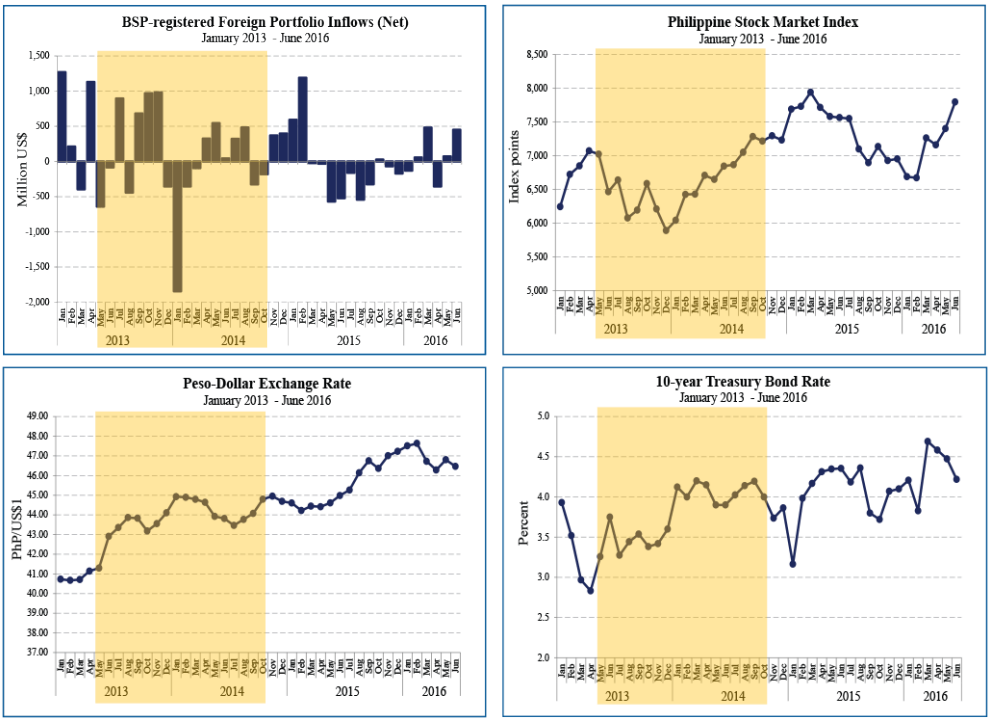
In May 2013, the US Fed officials hinted at a possible tapering of its bond-buying program in 2013 which sparked bouts of volatility in financial markets and resulted in foreign capital outflows from EMEs, including the Philippines. The impact of the US Fed taper announcement on the Philippine financial market is shown in Figure 13.

Following the US Fed's indication of potential tapering of its QE measures in May 2013, the Philippines posted a net capital outflow of US$641 million during the month, followed by a net outflow of US$23 million in the following month. The decline in portfolio flows during the period was traced to the net outflow from the country's equities market which amounted to US$326 million in May 2013 and US$541 million in June 2013. In July 2013, flows recovered as portfolio investments of non-residents posted a net inflow of US$895 million but reverted back to a net outflow of US$441 million in August 2013 sparked by the military tension between

the US and Syria and due to the uncertainty about the timing of US Fed Tapering decisions. Some degree of calm was observed in September to November 2013 after the Fed delayed tapering in the September 2013 meeting. However, a net outflow of US$354 million was observed again in December as investors started to rebalance their portfolios following the US Fed's announcement that it would start moderating its asset purchases by January 2014. As the US Fed started reducing its bond-buying program in January 2014, the Philippines recorded a significant amount of net outflow for the month amounting to US$1.8 billion.

The local equities market registered large losses as the statements made by the then US Fed Chairman, Ben Bernanke, on 22 May and 19 June indicating the possible scaling down of Fed's bond-buying program beginning 2013, resulted in a subsequent unwinding of foreign investors' position in the local bourse. From its 15 May 2013 peak of 7,392.2 index points, the PSEi declined sharply to 5,738.1 index points as of 28 August 2013.

Figure 13
Impact of the US Fed Tapering on Philippine Financial Markets



Sources: Philippine Stock Exchange, Inc., Bangko Sentral ng Pilipinas, Philippine Dealing and Exchange Corp.

In the case of the foreign exchange market, from the ₱41.18/US$1 posted on 22 May, the peso weakened against the US dollar by 8.7% to ₱44.75/US$1 on 28 August, its lowest level in 2013, as it reeled from the impact of the global speculation on the timing and scale of the winding down of the Fed's quantitative easing program.

Meanwhile, from the time the US Fed hinted at a possible tapering of its bond buying program in May 2013 up to the time the program officially ended in October 2014, the interest rate for the 10-year government securities rose by 74 basis points from 3.26% in May 2013 to about 4.00% as of end-October 2014. This increasing trend in GS yields reflected the return of investors to advanced economies' bond markets and their expectations of adjustments from an easy to a tight interest rate environment in the long run.

5. Econometric Study on the Impact of Global Liquidity on the Philippines

5.1 Transmission of Global Liquidity to the Philippines: A Regression Analysis Approach

Using a similar set of variables employed by Sun (2015) in a panel regression analysis of the transmission of global liquidity to EMEs, this section examines the transmission of global liquidity conditions to the Philippines using regression analysis. In particular, the objective of the exercise is to study the channels by which ease of global financing is transmitted to the Philippines. The approach involves estimating multiple regression models with measures of official liquidity, capital flows, and financial sector indicators as dependent variables and global liquidity indicators as one of the explanatory variables.

For the purposes of this exercise, the quarter-on-quarter changes in the volume of US dollar credit to EMEs, the shadow US Federal (Fed) funds rate,[8] and the implied volatility of the S&P 500 index options (known as VIX) were used as global liquidity indicators. Official liquidity was proxied by the growth of the ratio of foreign exchange reserves to GDP while growth rate of external loans and deposits sourced from the BIS data on locational banking statistics was used as a measure of capital flows. Financial sector indicators considered include equity return (computed as the change in the Philippine stock exchange index) and change in the Philippine financial stress index. Additional runs were performed with excess credit growth

8. "Shadow US Fed funds rate" refers to the US Fed funds rate that would have been observed if there were no zero lower bound. The shadow US Fed funds rate used in this study pertains to the shadow rate computed based on the research of Leo Krippner and are available at: http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy.

and excess equity returns[9] as dependent variables to examine the impact of global liquidity on financial stability risks. Moreover, real GDP growth, inflation rate, and changes in real effective exchange rate (with respect to all major trading partners of the Philippines) were used as explanatory variables, in addition to indicators of global liquidity. The data used in the exercise covers quarterly data for the period 2003-2015. To further study the transmission of global liquidity in the Philippines, the sample was divided into two periods - pre- and post-global financial crisis - to see if there is a difference between the two periods.

In brief, the results of the econometric exercise show that ease of global financing is transmitted to the Philippines through the impact of movements in US interest rates and volatilities in US stock market on the level of official liquidity and financial market indicators. At the same time, the results provide evidence of the impact of global liquidity on financial stability as shown by the statistically significant relationships of excess credit growth and excess equity return with US interest rates (before GFC) and with changes in VIX (after GFC).

Results of the estimations using the full sample covering the period 2003-2015 (Table 2) show that lower interest rates in the US are associated with increases in the level of foreign exchange reserves, higher equity returns as well as excess equity returns in the Philippines. The results also indicate evidence of lower financial stress associated with periods of when US dollar credit to EMEs is higher. At the same time, a higher VIX corresponds to an increase in the financial stress index and lower equity returns.

Meanwhile, the results of the estimations for the period before the 2008 global financial crisis (Table 2a) showed lower FX reserves and external loans and deposits associated with increase in VIX. At the same time, a rise in US Fed funds rate corresponds to higher equity returns and excess equity returns while excess growth appears to be lower.

For the period after the global financial crisis, however, an increase in VIX corresponds to lower equity returns and excess equity return as well as decline in excess credit growth and increased financial stress index (Table 2b).

9. Excess credit growth and excess equity returns were derived by first extracting the trend component of each series (using Hodrick-Prescott filter) and getting the difference between actual values and trend component.

Table 2
Impact of Global Liquidity Conditions on Capital Flows and Financial Stability, 2003 - 2015

Dependent / Explanatory Variables	Foreign Exchange Reserves			External Loans and Deposits			Equity Return		
Constant	-0.002 (-0.100)	0.001 (0.066)	0.000 (0.001)	0.006 (0.135)	-0.014 (-0.414)	-0.030 (-0.809)	1.122 (0.178)	4.669 (0.626)	-0.058 (-0.008)
Global Liquidity Indicators									
USD Credit to EMEs	0.181 (0.936)			-1.023 (-1.589)			118.055 (1.651)		
US Fed Funds Rate (Shadow Rate)		-0.015** (-2.444)			0.013 (0.711)			5.030** (2.219)	
VIX			-0.0006 (-0.641)			-0.001 (-1.551)			-0.565*** (-4.029)
Domestic Macroeconomic Factors									
GDP (1 lag)	-0.001 (-0.350)	-0.0002 (-0.065)	-0.0005 (-0.114)	0.003 (0.617)	0.001 (0.185)	0.003 (0.577)	-0.011 (-0.011)	-0.104 (-0.097)	0.571 (0.602)
Inflation (1 lag)	0.005** (2.626)	0.003 (1.687)	0.004** (2.214)	0.000 (0.002)	0.002 (0.454)	0.003 (0.627)	-0.145 (-0.225)	-0.167 (-0.237)	-0.004 (-0.005)
Real Exchange Rate (1 lag)	-0.077 (-0.666)	-0.017 (-0.149)	-0.062 (-0.608)	0.258 (0.889)	0.093 (0.277)	0.128 (0.382)	-15.830 (-0.469)	-16.239 (-0.440)	-3.613 (-0.107)
Dependent / Explanatory Variables	**Financial Stress Index**			**Excess Credit Growth**			**Excess Equity Return**		
Constant	-0.588 (-1.479)	-0.828* (-1.807)	-0.739 (-1.535)	-2.141 (-0.939)	-1.998 (-1.135)	-2.520 (-1.452)	0.499 (0.087)	3.478 (0.510)	-0.985 (-0.149)
Global Liquidity Indicators									
USD Credit to EMEs	-5.772* (-1.829)			0.524 (0.025)			90.431 (1.306)		
US Fed Funds Rate (Shadow Rate)		-0.130 (-1.189)			-0.556 (-0.767)			4.648** (2.141)	
VIX			0.016** (2.041)			-0.062 (-1.091)			-0.536*** (-4.223)
Domestic Macroeconomic Factors									
GDP (1 lag)	0.099* (1.767)	0.100* (1.722)	0.088 (1.564)	0.284 (1.171)	0.300 (1.236)	0.351 (1.764)	-0.226 (-0.252)	-0.327 (-0.339)	0.308 (0.383)
Inflation (1 lag)	0.043 (0.846)	0.062 (1.104)	0.060 (0.974)	0.151 (0.310)	0.107 (0.246)	0.163 (0.344)	-0.269 (-0.416)	-0.284 (-0.400)	-0.125 (-0.157)
Real Exchange Rate (1 lag)	-1.832 (-0.846)	-2.645 (-1.110)	-2.910 (-1.385)	-15.693 (-1.165)	-14.665 (-1.097)	-15.841 (-1.193)	-27.704 (-0.849)	-30.833 (-0.829)	-19.236 (-0.550)
Note: ***p<0.01, **p<0.05, *p<0.10									

Sources of Basic Data: Bangko Sentral ng Pilipinas, Bank for International Settlements, Bloomberg, http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy

Table 2a
Impact of Global Liquidity Conditions on Capital Flows and Financial Stability
Pre-Global Financial Crisis

Dependent / Explanatory Variables	Foreign Exchange Reserves			External Loans and Deposits			Equity Return		
Constant	-0.003 (-0.094)	-0.009 (-0.253)	-0.014 (-0.377)	-0.038 (-0.816)	-0.032 (-0.472)	-0.070 (-1.116)	-4.604 (-0.552)	0.951 (0.123)	-7.043 (-0.771)
Global Liquidity Indicators									
USD Credit to EMEs	0.032 (0.163)			-0.912 (-1.057)			58.640 (0.655)		
US Fed Funds Rate (Shadow Rate)		-0.011 (-1.077)			0.030 (1.359)			9.627*** (4.974)	
VIX			-0.002* (-1.820)			-0.005* (-1.735)			-0.577 (-1.679)
Domestic Macroeconomic Factors									
GDP (1 lag)	0.001 (0.109)	0.002 (0.266)	0.003 (0.289)	0.009 (0.933)	0.001 (0.093)	0.006 (0.694)	1.862 (1.384)	1.469 (1.362)	2.585** (2.155)
Inflation (1 lag)	0.003 (1.182)	0.003 (1.162)	0.004 (1.493)	0.003 (0.466)	0.007 (1.243)	0.009 (1.613)	-0.925 (-0.994)	-1.054 (-1.498)	-0.825 (-0.741)
Real Exchange Rate (1 lag)	0.106 (0.830)	0.157 (1.077)	0.099 (0.745)	0.360 (0.840)	0.138 (0.279)	0.247 (0.498)	-44.437 (-1.225)	-80.718** (-2.088)	-43.820 (-1.118)
Dependent / Explanatory Variables	**Financial Stress Index**			**Excess Credit Growth**			**Excess Equity Return**		
Constant				-1.195 (-0.311)	-0.845 (-0.207)	0.579 (0.147)	-1.245 (-0.137)	3.736 (0.411)	3.473 (-0.354)
Global Liquidity Indicators									
USD Credit to EMEs				-10.649 (-0.408)			56.335 (0.639)		
US Fed Funds Rate (Shadow Rate)					-2.262** (-2.197)			8.546*** (4.023)	
VIX						0.193 (1.182)			-0.533 (-1.602)
Domestic Macroeconomic Factors									
GDP (1 lag)				0.660 (1.090)	0.468 (0.753)	0.385 (0.723)	0.723 (0.500)	0.398 (0.323)	1.404 (1.170)
Inflation (1 lag)				-0.440 (-0.784)	-0.378 (-0.919)	-0.561 (-1.057)	-0.965 (-1.025)	-1.095 (-1.239)	-0.880 (-0.738)
Real Exchange Rate (1 lag)				-29.651 (-1.365)	-21.823 (-1.228)	-31.408 (-1.392)	-62.982* (-1.758)	-94.717** (-2.313)	-62.175 (-1.481)
Note: ***p<0.01, **p<0.05, *p<0.10									

Sources of Basic Data: Bangko Sentral ng Pilipinas, Bank for International Settlements, Bloomberg, http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy

Table 2b
Impact of Global Liquidity Conditions on Capital Flows and Financial Stability
Post-Global Financial Crisis

Dependent / Explanatory Variables	Foreign Exchange Reserves			External Loans and Deposits			Equity Return		
Constant	0.456*** (7.993)	0.464*** (8.613)	0.465*** (8.385)	0.063 (0.722)	0.039 (1.198)	0.033 (0.930)	-4.801 (-0.855)	-0.512 (-0.063)	-4.075 (-0.587)
Global Liquidity Indicators									
USD Credit to EMEs	0.534 (1.203)			-1.436 (-1.002)			188.402** (2.453)		
US Fed Funds Rate (Shadow Rate)		-0.003 (-0.169)			-0.009 (-0.367)			0.391 (0.140)	
VIX			0.0003 (0.219)			-0.001 (-0.460)			-0.529*** (-5.185)
Domestic Macroeconomic Factors									
GDP (1 lag)	0.011 (1.316)	0.011 (1.494)	0.010 (1.444)	-0.001 (-0.233)	-0.001 (-0.252)	-0.001 (-0.133)	-0.386 (-0.596)	-0.374 (-0.386)	0.067 (0.092)
Inflation (1 lag)	-0.010 (-1.300)	-0.009 (-1.014)	-0.009 (-0.997)	-0.008 (-0.666)	-0.010* (-1.759)	-0.009 (-1.794)	2.001*** (2.952)	1.957* (2.062)	2.143** (2.495)
Real Exchange Rate (1 lag)	-0.169 (-0.924)	-0.112 (-0.480)	-0.116 (-0.500)	0.168 (0.539)	0.027 (0.102)	0.032 (0.110)	8.158 (0.199)	25.889 (0.565)	31.483 (0.942)
Dependent / Explanatory Variables	**Financial Stress Index**			**Excess Credit Growth**			**Excess Equity Return**		
Constant	0.068 (0.385)	-0.026 (-0.147)	0.079 (0.641)	-7.650 (-6.354)	-6.659 (-5.463)	-7.318*** (-6.438)	-5.280 (-0.922)	-1.948 (-0.302)	-5.458 (-1.066)
Global Liquidity Indicators									
USD Credit to EMEs	-2.935 (-1.401)			1.660 (0.064)			128.390 (1.584)		
US Fed Funds Rate (Shadow Rate)		0.029 (0.245)			1.252*** (3.289)			1.017 (0.357)	
VIX			0.015** (2.111)			-0.105** (-2.303)			-0.525*** (-5.832)
Domestic Macroeconomic Factors									
GDP (1 lag)	0.041 (1.246)	0.040 (1.106)	0.029 (1.089)	0.478 (2.445)	0.430** (2.661)	0.551*** (4.697)	-0.338 (-0.511)	-0.357 (-0.411)	0.098 (0.156)
Inflation (1 lag)	-0.096** (-2.282)	-0.089*** (-2.942)	-0.096*** (-3.179)	1.347 (6.467)	1.208*** (4.042)	1.185*** (3.924)	1.507 (2.106)	1.427** (2.234)	1.579*** (2.999)
Real Exchange Rate (1 lag)	0.384 (0.153)	0.119 (0.047)	-0.026 (-0.014)	-6.106 (-0.392)	-7.483 (-0.552)	-5.867 (-0.546)	14.860 (0.364)	26.184 (0.597)	32.006 (1.033)

Note: ***p<0.01, **p<0.05, *p<0.10

Sources of Basic Data: Bangko Sentral ng Pilipinas, Bank for International Settlements, Bloomberg, http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy

5.2 Impulse-Response Analysis using Local Projections Method

In this section, the local projections method is implemented to determine how financial variables react to shocks to global liquidity indicators.

5.2.1 A Short Note on the Local Projections Method

Traditionally, impulse-response analyses are carried out using vector autoregression (VAR) approach, which assumes that variables included in the estimation are all endogenous. However, in the context of analyzing the impact of shocks to global liquidity to the Philippine economy, it is noted that while the Philippine economic variables are endogenous to shocks emanating from external sources, such as the advanced economies, developments in advanced economies are exogenous to shocks coming from a small open economy, such as the Philippines. In view of the said limitation, the Local Projections (LP) method[10] is used in lieu of a VAR model to estimate the impact of shocks to global liquidity variables on Philippine economic variables. Unlike VAR, the local projection method does not impose restrictions on the relationships between variables.

LPs are a flexible semi-parametric technique to estimate impulse-response functions which directly estimate a sequence of linear projections of the future values of the dependent variable on the current information set (Killian & Kim, 2011 in Caselli & Roitman, 2016).

As discussed in Nodari (2015), the LP methodology consists of a single-equation approach, which simply requires the estimation of separated regressions for each horizon, h, of interest. The linear specification is given by the following equation:

$$y_{t+h} = \alpha_h + \beta_h(L)x_{t-1} + \phi_h\epsilon_t + u_{t+h}$$

where y_t is the time series of interest, x_t is a vector of control variables, $\beta_h(L)$ is a polynomial in the lag operator, and ε_t is the structural shock whose effects one wants to estimate. The vector of controls, x_t, helps ensuring that the shock ε_t is exogenous. In addition to the control variables, equation (1) includes lags of y_t to control for serial correlation. The coefficient Φ_h gives the response of y at time $t+h$ to the shock ε at time t. Thus, the dynamics of y_t, conditional on the shock, are constructed as the sequence of the Φ_h's estimated in a series of h single regressions. The standard error estimates of Φ_h are then used to display error bands around the impulse responses.

10. Advocated by Jorda (2005) as indicated in Nodari (2015).

Lags of dependent variables may be included in the right-hand side of the equation to control for serial correlation and to ensure that shock is not capturing the dynamics from omitted variables (Nodari, 2015 and Caselli & Roitman, 2016).

5.2.2 Response to Shocks to Global Liquidity

Using basically the same set of variables included in the regression analyses in 5.2.1, the LP method was employed to determine how selected financial sector variables react to shocks in global liquidity. The set of dependent variables is composed of foreign exchange reserves, foreign portfolio inflows, external loans and deposits, domestic credit growth, equity return, and financial stress index. Each of the said variables was regressed on a set of variables representing domestic macroeconomic factors and an indicator for global liquidity. For the purposes of the exercise, three global liquidity indicators were considered namely, USD credit to EMEs, shadow fed funds rate for the US, and implied stock market volatility index (VIX). The results of the estimations for the period 2003-2008 are shown in Figures 14-16. Meanwhile, Figures 17-19 compare the results using two sample periods - before and after the 2008 global financial crisis.

The results show that for the period 2003-2015, a positive shock to the volume of USD credit to EMEs tend to reduce equity returns amid higher financial stress index after two quarters (Figure 14). Although not statistically significant, the results seem to suggest a positive impact of a shock to the volume of USD credit to EMEs on foreign exchange reserves and foreign portfolio inflows to the country. The impact on domestic credit growth is initially negative but becomes positive four quarters after the shock.

In terms of responses to monetary policy adjustments in the US (Figure 15), a sudden increase in the US Fed funds rate tends to lead to lower foreign portfolio inflows after six quarters and decline in domestic credit growth two quarters later, along with a higher financial stress index. Meanwhile, increased volatility in the global equities market lead to lower equity returns on the same quarter the shock occurred and higher financial stress index after one quarter (Figure 16).

Comparing the responses before and after the global financial crisis, the results suggest that responses to shocks in USD credit to EMEs were generally lower after the crisis for foreign exchange reserves, external loans and deposits, and domestic credit growth but higher for foreign portfolio inflows and equity returns. At the same time, the impact of shifts in investors' risk appetite (as proxied by VIX) is higher for foreign portfolio inflows, external loans and deposits, and equity returns after the crisis compared to the period before the crisis.

Figure 14
Response to a Shock in USD Credit to EMEs

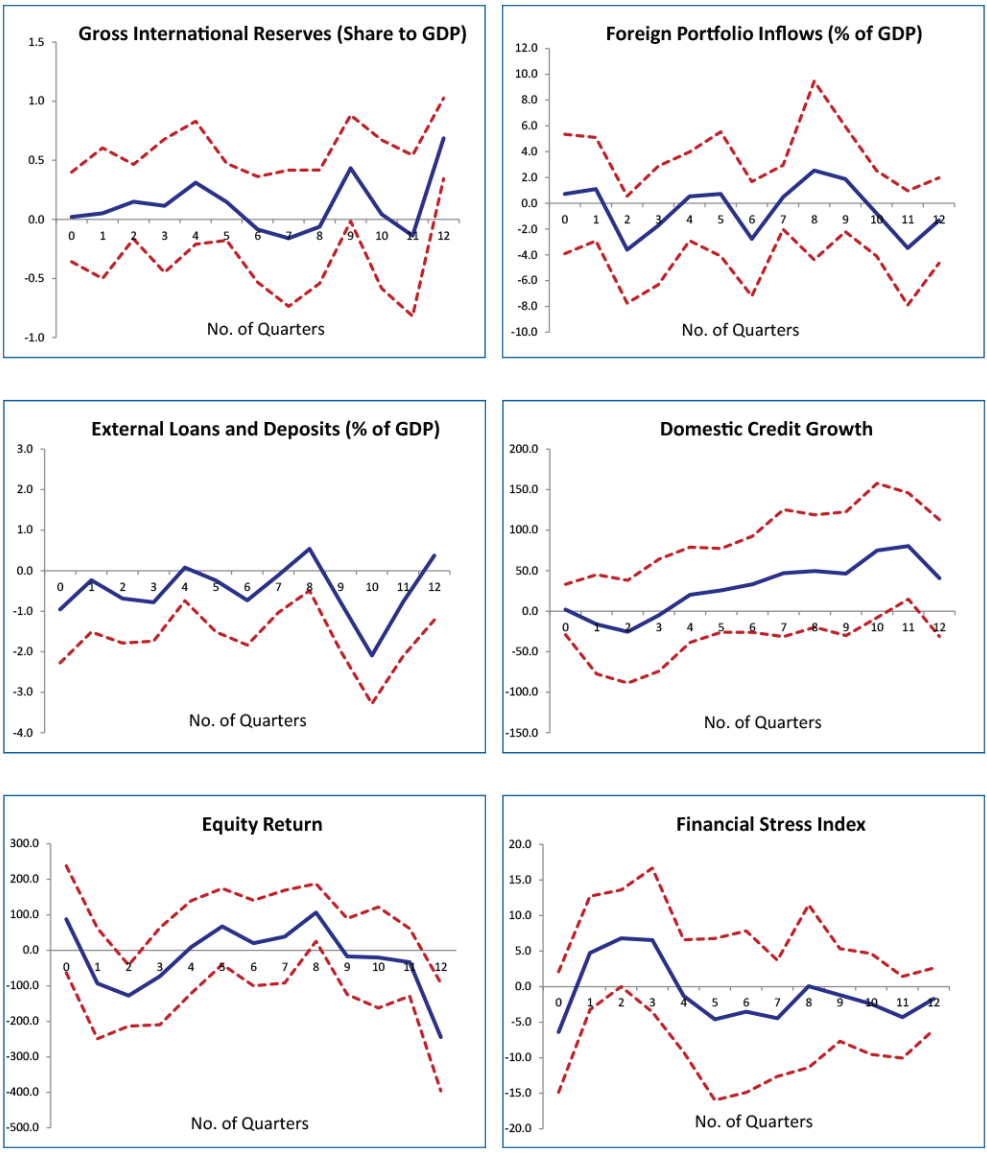
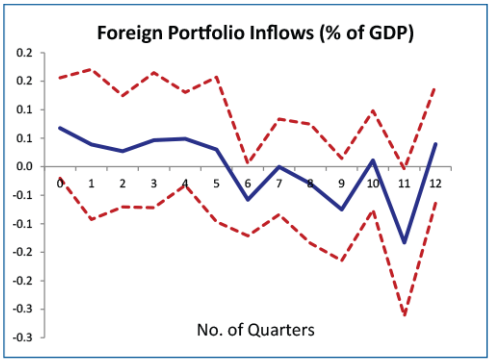
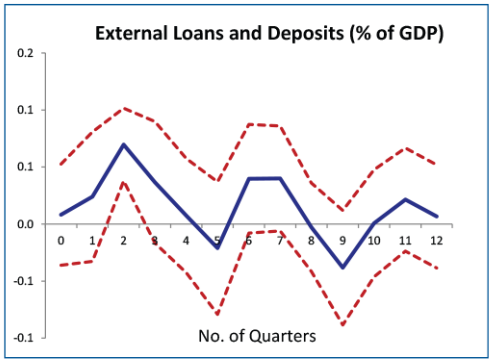
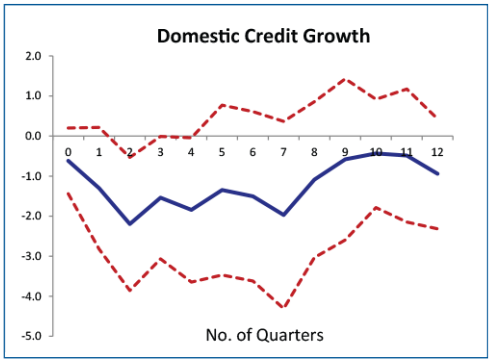
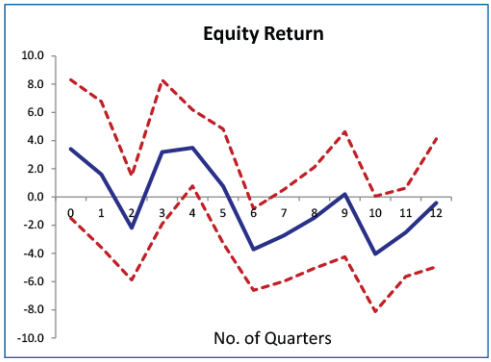


Figure 15
Response to a Shock in US Fed Funds Rate









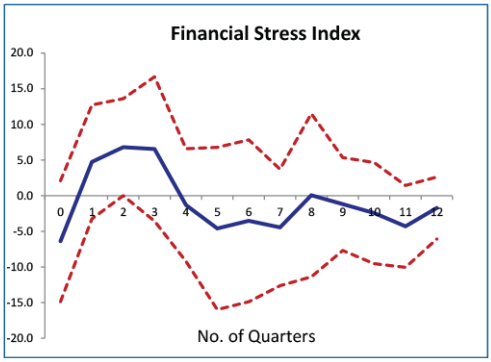
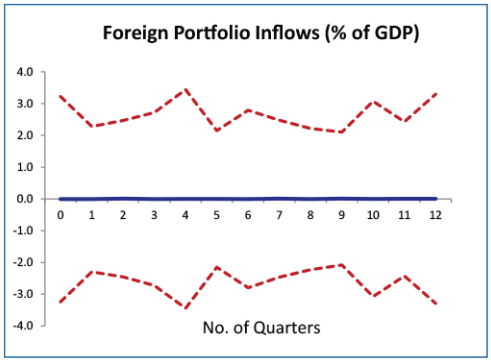
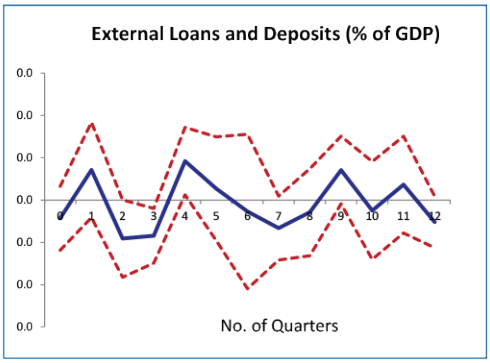
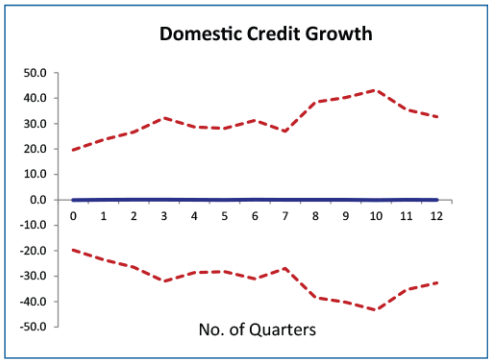
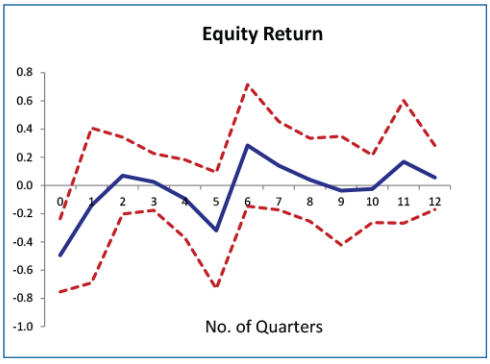


Figure 16
Response to a Shock in Implied Stock Volatility Index (VIX)









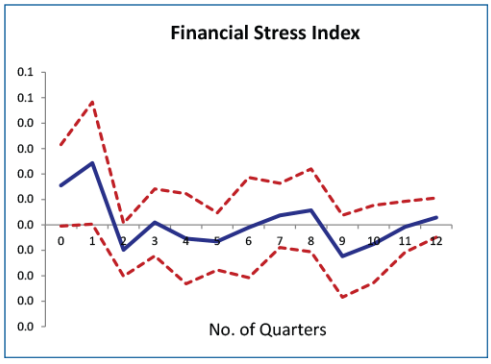


Figure 17
Response to a Shock in USD Credit to EMEs: Pre- and Post-GFC

Figure 18
Response to a Shock in US Fed Funds Rate: Pre- and Post-GFC

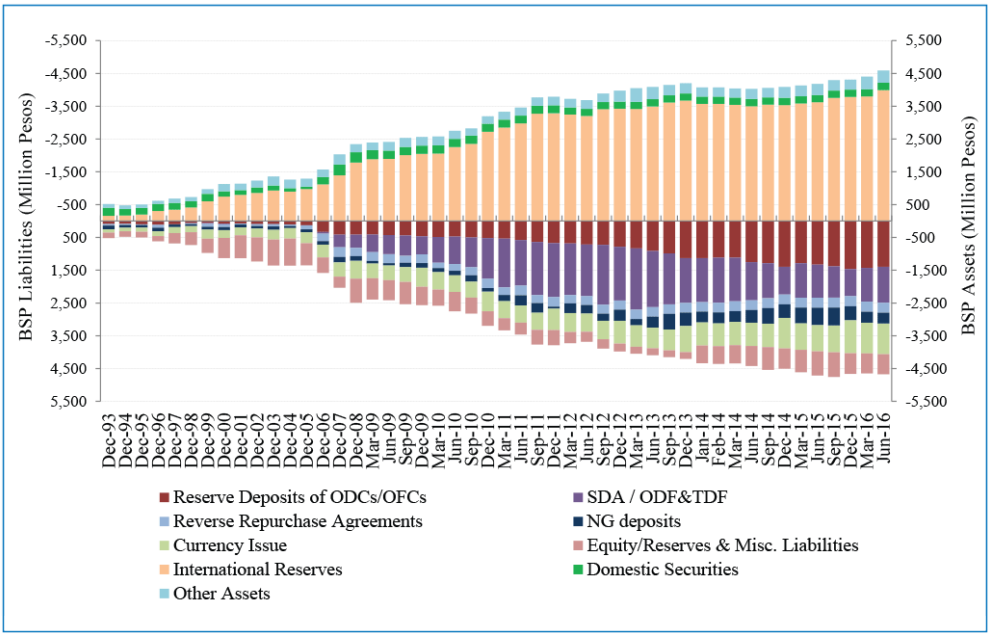
Figure 19
Response to a Shock in Implied Stock Volatility Index (VIX): Pre- and Post-GFC

6. Implications of Global Liquidity on Central Bank Operations and Monetary Policy Implementation

6.1 Impact on the BSP Balance Sheet

The composition of BSP assets has shifted significantly from domestic securities to international reserves with the gross international reserves (GIR) now accounting for more than 80% of total assets (Figure 20). On the liabilities side, deposits account for a substantial portion of BSP liabilities and the Special Deposit Account (SDA)[11] in particular comprised a substantial portion of BSP deposit liabilities.

Figure 20
BSP Assets and Liabilities
December 1993 - June 2016

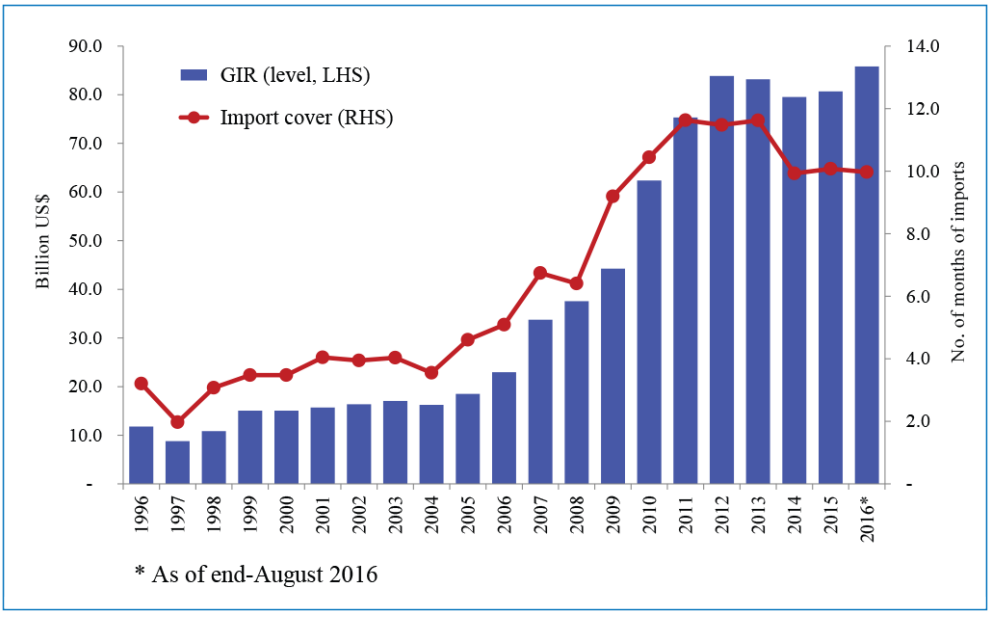


Source: Bangko Sentral ng Pilipinas.

11. With the BSP's adoption of interest rate corridor (IRC) system as the framework for conducting monetary operations in June 2016, the Special Deposit Account (SDA) facility was effectively replaced by the overnight and term deposit facilities (ODF & TDF).

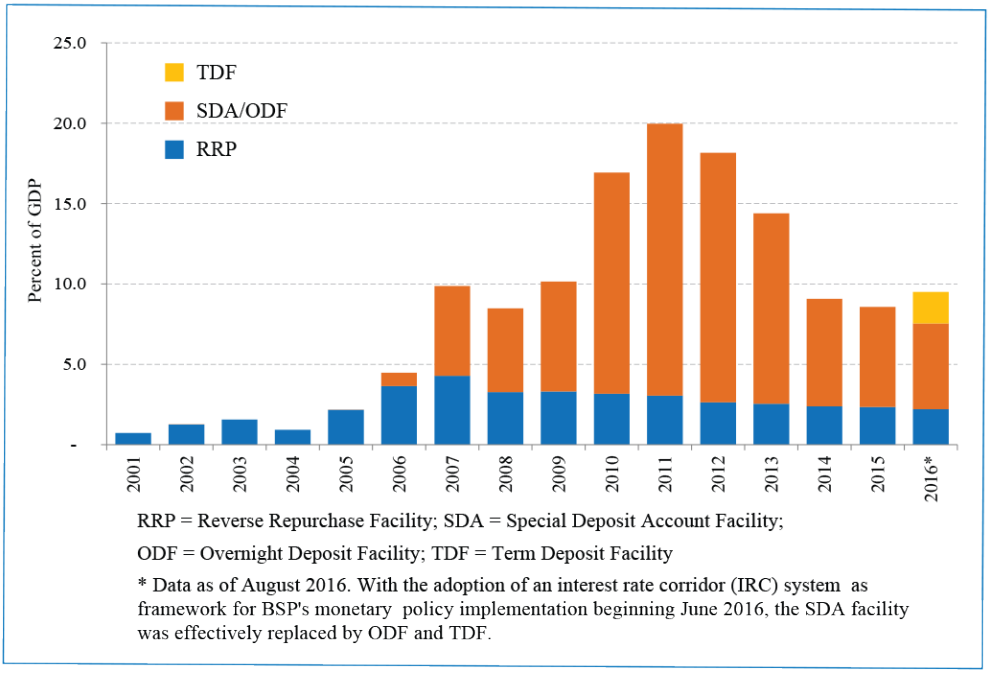
The surge in foreign exchange (FX) inflows into the Philippines has allowed the BSP to build up its international reserves, which help to insulate the economy against external shocks (Figure 21). While there are benefits to reserve accumulation, the BSP incurs financial losses from holding more foreign currency assets than foreign currency liabilities when the peso strengthens. In addition, costs are incurred by the BSP as it has to mop up the liquidity resulting from its FX operations (Figure 22). The surge in capital flows also exerted some pressure on the BSP's finances as the central bank incurred net losses in 2007, 2010, and 2011 due in part to losses from FX rate fluctuations.

Figure 21
Gross International Reserves, 1996 - 2016*



Source: Bangko Sentral ng Pilipinas.

Figure 22
Outstanding Placements in BSP Liquidity Facilities (% of GDP)
2001 - 2016*



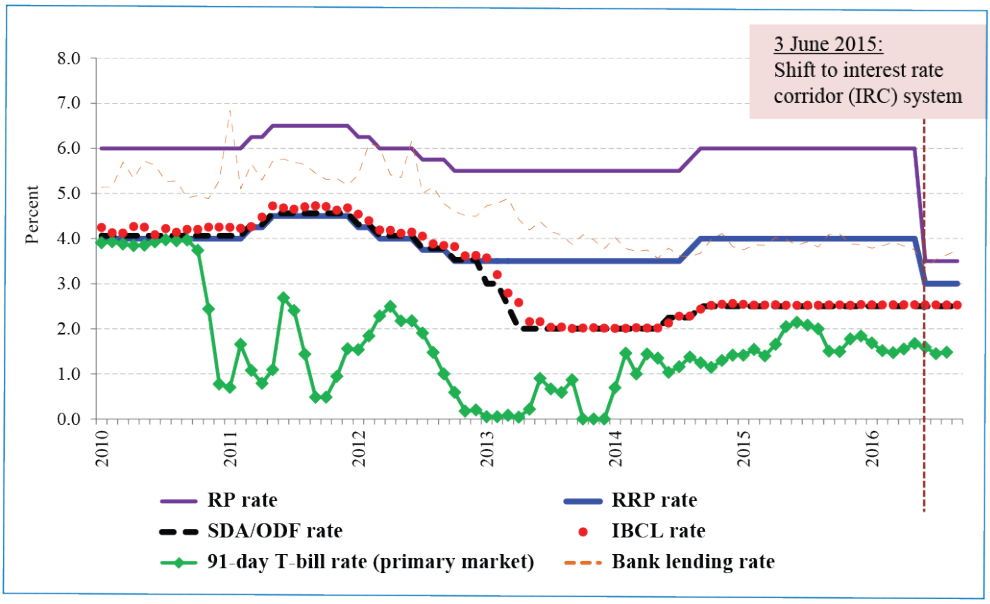
Sources of Basic Data: Bangko Sentral ng Pilipinas, Philippine Statistics Authority.

6.2 Impact on Monetary Policy Implementation

The resurgence in capital inflows during the second phase of global liquidity has posed considerable challenges for the BSP in pursuing its macroeconomic stabilization mandate. Capital flows appeared to have diminished the impact of monetary policy on market rates, as evidenced in part by the divergence between the BSP policy rate and T-bill rates in the primary market.

Market interest rates have diverged from the policy interest rates of the BSP since 2010. In 2011, T-bill rates continued to decline amid ample liquidity in the system even when BSP's policy rates were raised in the first half of 2011 in response to emerging inflationary risks. The continued decline in T-bill rates in 2011-2012 was caused by both increased foreign demand for Philippine GS and by the under-allocation of offered amounts at the primary GS auctions conducted by the Bureau of the Treasury (BTr) reflecting the National Government's comfortable cash position.

Figure 23
BSP and Market Interest Rates, January 2010 - September 2016



Sources: Bangko Sentral ng Pilipinas, Bureau of the Treasury.

A critical issue for the BSP at the moment is how to enhance the effectiveness of the monetary policy transmission mechanism - for example, through the implementation of an interest rate corridor (IRC) system as a framework for implementing monetary policy.

7. Policy Responses in the Face of Global Liquidity

7.1 Policy/Measures Implemented

Since the impact of easy global financing conditions are, most of the time, brought about by factors beyond the control of liquidity-receiving economies, policymakers are faced with the challenge of implementing measures that would help mitigate the adverse impact of foreign exchange inflows. For the central bank, the issue is not whether capital flows are good or bad; rather, the challenge is how to conduct monetary policy so as to ensure that policy actions remain effective in achieving the mandate of the central bank.

The surge in foreign capital inflows to EMEs has highlighted the importance of ensuring the soundness of the domestic financial system. While capital flows

could ultimately help generate opportunities for growth and employment, rapid capital flows could also feed credit booms, asset price bubbles, and other financial imbalances if these flows are not mostly absorbed by productive activities.

After the Philippine experience with the 1997 Asian financial crisis, the BSP pursued financial sector reforms aimed at increasing the resilience of domestic financial system to volatile capital flows and enable efficient allocation of capital flows. "[The] process of reform is geared towards greater commitment to risk management, strengthening of the regulatory framework and supervision techniques, promotion of transparency and good corporate governance, and putting in place the necessary infrastructure requirements."[12]

With a stronger domestic financial system brought about by the reforms implemented after the 1997 Asian financial crisis, the Philippines was able to weather the impact of the 2008 global financial crisis and did not experience as deep a crisis as in other jurisdictions.

7.2 Policy Options in the Event of Capital Flow Reversals

In determining the appropriate response to capital flows, a clear understanding of the true causes of surge in capital inflows, i.e., knowing the relative importance of "push" and "pull" factors is important. In the case of the Philippines, the surge in foreign capital flows is attributed to both push and pull factors. The flow of foreign capital to the Philippines had been driven not only by push factors such as the search for higher yields on the back of ultra-low interest rates in advanced economies but also by pull factors, particularly, the country's strong macroeconomic fundamentals and favorable macroeconomic prospects.

In addressing capital flow volatility, the BSP's policy mix includes a combination of the following measures: (1) increase in the reserve buffer; (2) exchange rate flexibility; (3) sterilization policy; (4) interest rate action; (5) liquidity-enhancing measures; (6) regulatory forbearance; and, (7) careful and clear communication.

Amendments relating to the explicit inclusion of financial stability in the BSP's mandate are being pursued to enhance its ability to strike a balance between its price and financial stability objectives. The BSP recognizes the need for having both monetary policy and macroprudential policy in its toolkit. Monetary policy is primarily aimed at maintaining price stability, while macroprudential policies are aimed mainly at targeting/pre-empting the build-up of risks to financial stability. Both work hand-in-hand for countercyclical macroeconomic management. Amid a

12. Quoted from Tetangco (2005) as cited in Yap (2008).

benign inflation outlook and low real interest rates, maintaining the current monetary policy stance could be the more prudent position. Keeping policy rates unchanged accords with financial stability concerns especially amid ample liquidity and robust credit expansion. Further monetary easing could amplify the risky behavior of banks chasing higher yields, and could drive asset prices.

The BSP has a toolkit of policy instruments which it can utilize as macroprudential tools. The BSP is ready to adjust the setting of these tools to use them in a countercyclical manner to prevent financial imbalances, systemic risks, and sudden reversal of capital flows. These policy instruments include: (1) concentration limits, which serves as a prudential safeguard against overconcentration of credits of universal and commercial banks to real estate lending; (2) limits on open foreign exchange positions or currency mismatches; (3) asset cover for banks' FCDUs; and, (4) higher risk weight for Non-Deliverable Forwards (Circular No. 740).

8. Summary and Concluding Remarks

Like many emerging market economies, the Philippines has been on the receiving end of foreign capital inflows resulting from global liquidity as a result of relatively easy financing conditions in advanced economies. A clear understanding of the drivers as well as the impact of foreign capital inflows on liquidity-receiving economies is important in determining appropriate policies to be implemented in responding to capital flows and in mitigating the impact of capital flow reversals.

In the case of the Philippines, the strengthening of the domestic financial system through the implementation of financial sector reforms following the 1997 Asian financial crisis has helped limit the impact of the 2008 global financial turmoil on the country. Nonetheless, the BSP has sufficient policy tools that it can use to prevent financial imbalances, systemic risks, and sudden reversals of capital flows.

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Chapter 7

SPILLOVER OF GLOBAL LIQUIDITY IMBALANCES TO CURR ENCY MARKETS: AN EMERGING ECONOMY PERSPECTIVE

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1. Introduction

Global liquidity is a popular term used by policy makers of emerging markets to refer to the "ease of funding" in global financial markets (Cerutti et al., 2014). The term "global liquidity" has attracted renewed interest in policy debates in recent years due to the integration of global financial markets as well as the increased frequency of external shocks from global economic and financial market volatility hitting emerging economies. The spread of the effects from the recent financial crisis and subsequent developments in financial markets of advanced countries, have compelled policy makers in emerging economies to investigate the spread of the volatility in global financial markets across borders. The developments in the aftermath of the financial crisis such as the quantitative monetary easing by advanced economies, gave rise to excess liquidity flowing into emerging economies while the subsequent normalization of monetary policy led to sudden outflows from the emerging financial markets. These occurrences made managing the macroeconomy and the stability of financial systems very challenging. Widespread impacts of the financial crisis such as the sluggish and uneven economic activity, the low levels of inflation followed by falling commodity prices and increased financial market volatility with divergent monetary policies, compelled policy makers in the emerging markets to design even more complex policy mixes to maintain economic and price stability as well as domestic and external balance.

The degree of variation of a trading price of financial instruments over time, as measured by the standard deviation of returns, is termed as financial volatility, and is often used as a basic measure of the total risk of financial assets (Brooks, 2002). Changes in volatility in a particular country's financial market might be affected by the financial market volatility of other countries. Such linkages which transmit

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financial volatilities across markets and borders are referred to as volatility spillovers (Kalemli-Ozcan et al., 2010 and Ke et al., 2010). Engle et al. (1990), who introduced the so-called "meteor shower" hypothesis, have suggested that volatility spills over to other markets, rather than remaining in one market. However, the magnitude of spillover effects among countries can be different depending on the macroeconomic, financial, socio-economic and regulatory conditions of these countries.

Understanding the origins and the transmission of volatility across markets and nations provides valuable insight for policy makers to articulate appropriate measures to mitigate the adverse effects that can be transmitted in periods of uncertainty. A better understanding of volatility transmission channels and their magnitudes is important for investors as their investment decisions may also be affected by the effects of financial volatility spillovers, thus supporting the necessity for international portfolio diversification. Information about cross-border volatility transmission is also important for institutional investors who formulate hedging strategies (Chinzara and Aziakpono, 2009). Knowledge about cross-country volatility transmission as well as spillover channels is invaluable for policy makers in formulating regulatory policies to ensure financial and general macroeconomic stability, particularly in emerging economies. For example, quantitative monetary easing by advanced economies in the aftermath of the global financial crisis led to huge capital inflows into emerging economies. However, the taper tantrum or the normalization of monetary policy by the Federal Reserve Bank led to huge capital outflows from these same economies. In this context, policy makers face the challenge of designing policy responses to mitigate the spillover effects of complex monetary and fiscal strategies. The practical importance of modelling the volatility of financial returns and analyzing the spillover effects has given rise to an ample volume of research, both on theoretical as well as on empirical fronts. However, much of the existing studies has focused on stock markets, the majority of which basically finds evidence for both the mean and volatility of spillovers (Lee, 2010).

Exchange rate is another key financial variable that is significantly affected by the changes in global financial markets. Exchange rate volatility, defined as the sharp fluctuations in the exchange rate, has attracted much attention from investors, financial institutions and policy makers, largely due to its impact on trade balance, inflation, investment and more generally, on economic growth (Danjuma et al., 2013; Wang and Barrett, 2007; Levy-Yeyati and Sturzenegger, 2002). Wanaguru (2012) identifies that the dynamic behavior of exchange rates stems from factors unique to the domestic currency market as well as factors which spillover from currency market interdependencies. In Sri Lanka, the source of currency market volatility is primarily external. Although there has been a plethora of studies on modeling volatility in foreign exchange markets, the issue of volatility spillovers onto domestic foreign currency markets is still not well understood (Melvin, 2003). Therefore, further investigations on the behavior of the domestic foreign exchange

market from spillover effects of global financial market volatility will constantly remain policy relevant.

The objective of this paper is to investigate how the volatility in the global financial markets over the past two decades has been transmitted to foreign exchange (forex) markets in emerging economies. This paper looks at the behavior of the domestic foreign exchange market in Sri Lanka for the period of 2002 to 2016 and analyzes whether the volatility emanating from spillover effects persists for considerable periods of time. As in other central banks, the primary role of monetary policy of the Central Bank of Sri Lanka (CBSL) is to maintain economic and price stability and financial system stability (CBSL, 2005). The exchange rate is also important in the monetary policy decision making process as it affects prices of exports and imports as well as investment decisions of international investors. CBSL, during the financial market crisis and the subsequent policy responses by the developed countries, faced the challenge of maintaining price stability in the domestic economy in light of pressures in the forex market and volatility in capital flows. Although Sri Lanka adopts a flexible exchange rate policy, which is considered to be an external shock absorber, foreign exchange intervention either through the supply or purchase of foreign exchange by the Central Bank, was nonetheless an important element in foreign exchange management. This is mainly attributed to the structure of Sri Lanka's foreign exchange market. Although the volume and the market participants have increased gradually over time, Sri Lanka's forex market is not sufficiently deep to absorb relatively large transactions. This set-up necessitates the presence of the Central Bank in the domestic forex market to prevent speculative trades which could cause the exchange rate to move against economic fundamentals (Jayamaha, 2007). In the aftermath of the financial crisis, the Central Bank frequently intervened in the forex market to curtail unwarranted volatility in the exchange rate.

Existing literature has employed a number of empirical approaches to model exchange rate volatility, but many of the recent studies are based on Engle (1982) and Bollerslev (1986) who specified volatility as an unobserved quantity. Following the modern strand of the literature, the exponential generalized autoregressive conditional heteroscedastic (EGARCH) model introduced by Nelson (1991) as an extension to the autoregressive conditional heteroscedastic (ARCH) and generalized ARCH (GARCH) model of Engle (1982) and Bollerslev (1986), is applied as the empirical methodology in our exercise. GARCH type models are particularly suitable for analyzing financial time series such as stock and exchange rate returns which have time-varying variances (Alberg et al., 2008; Bábel, 2008; Panorska et al., 1995). Unlike the linear structural models, these are very useful in explaining the stylized facts about financial returns such as fat tails and asymmetry in volatility (Liu and Hung, 2010; Alberg et al., 2008). In order to better understand the spillover effects during relatively tranquil and volatile periods in global financial markets, the time span is divided into two sub-periods. The first sub-period, which covers the period

from January 2002 to October 2008, represents a relatively low volatility period in the global foreign exchange markets compared to the second sub-period, which runs from November 2008 to May 2016, when financial markets were particularly volatile due to the global financial crisis.

The empirical investigation finds that there was a significant spillover effect from the global financial markets during the high volatility period, as captured through the impact of the change in the term structure or the changes in the difference between the long- and short-run interest rates in the United States (US). The change in the interest rate term structure during the relatively tranquil periods in the financial markets had no significant spillover effect on the forex market in Sri Lanka. Additionally, forex intervention is also found to contribute towards the reduction in foreign exchange market volatility during the crisis period. However, the signs of the estimated parameters give rise to some ambiguity about the findings. Neither foreign exchange intervention nor the change in the interest rate term structure is found to have an economically significant impact on the level of the exchange rate either in tranquil periods or in highly volatile periods. The spillover effects from highly volatile financial markets in developed economies suggest that policy makers in emerging economies should carefully design their own monetary and fiscal policy mix which can support price stability and domestic economic growth while curtailing any adverse effect stemming from the external front.

The rest of the paper is organized as follows. Section 2 specifies the inference procedure in the empirical investigation while Section 3 discusses the statistical properties of the data. The empirical results are presented in Section 4 and Section 5 provides a policy discussion. Section 6 concludes the paper.

2. Inference Procedure

Although forex markets are volatile, such volatility is not directly observable (Engle, 1982; Bollerslev, 1986). Additionally, financial time series are often characterized by volatility clustering, leptokurtosis and asymmetric leverage effects. Volatility clustering is a stylized phenomenon that leads volatility in financial markets to provoke more volatility (Cont, 2007; Engle and Patton, 2001). Leptokurtosis is attributed to the distribution of financial time series and often referred to as "fat tails", which suggest a higher probability of large losses or gains than the normal distribution would allow (McNeil and Frey, 2000; Adams and Thornton, 2013). Leverage effect is another stylized fact of financial time series which refers to the idea that price movements are negatively correlated with volatility. Capturing these stylized features of financial time series are particularly important as failure to do so would yield spurious results, which may lead to ineffective policy decisions. For example, failure to account for the heavy-tailed characteristic of a financial time series will lead to an underestimation of portfolio Value-at-Risk (Assaf, 2015). Similarly,

failure to model asymmetric effects indirectly assumes a symmetrical response of volatility to shocks in the market. However, in the literature, it is shown that positive and negative returns to the market of equal magnitude will not generate the same response in volatility (Palandri, 2015; Tanha and Dempsey2015; Rabemananjara and Zakoian, 1993). As such, conventional time series and econometric methodologies such as ordinary least squares and structural VAR are not good candidates for modeling volatility as they fail to capture the most stylized facts about financial returns. Therefore, financial analysts have been keen to develop models that are able to obtain precise estimates of the conditional variance process. Among these, the conditional heteroscedastic models proposed by Engle (1982) and subsequently developed by other scholars to capture various aspects of financial time series are often identified as the most suitable for modeling the conditional volatility of financial instruments. Therefore, conditional heteroscedastic models are frequently applied in recent efforts in modeling financial volatility. The EGARCH approach introduced by Nelson (1991) as an extension to the basic conditional heteroscedastic models, to capture non-linearity in financial time series, is used in this exercise to investigate the spillover effect and volatility in the forex market in Sri Lanka.

As per the initial ARCH model proposed by Engle (1982), time-varying volatility models are built on the basic ARCH(q) specification, where the model is defined by the mean and variance equations (Krichene, 2003). In this set-up, the exchange rate return follows an AR process (mean equation), where exchange rate returns, ERR_t, are explained by their past values,

$$ERR_t = a_0 + \sum_{i=1}^{T} a_i ERR_{t-i} + \epsilon_t \dots\dots\dots\dots (1)$$

where the unpredictable shock, ϵ_t, is defined as:

$$\epsilon_t = \sqrt{h_t} u_t \dots\dots\dots\dots\dots (2)$$

with, $u_t \sim i.i.d.N(0,1), E(u_t) = 0$ and $\epsilon_t | \Omega_{t-1} \sim N(0, h_t)$. The lag order is presented by T.

The conditional variance is captured through:

$$h_t = \omega + \sum_{i=1}^{q} \alpha_i {\epsilon^2}_{t-i} = \omega_0 + \alpha(L){\epsilon^2}_t \dots\dots\dots\dots (3)$$

where $\omega > 0$ and $\alpha_i > 0$, and L denotes the polynomial lag operator of order q.

The unpredictable shock, ϵ_t, is assumed to be normally distributed, and used to model the conditional volatility, h_t, based on the past information, Ω_{t-1}. The lag of the squared residuals from the mean equation, or the ARCH term, ${\epsilon^2}_{t-i}$, captures the volatility clustering phenomenon. Parameters in the conditional variance equation are expected to be positive to ensure the variance, h_t, is positive. Also, it is expected that $\sum_{i=1}^{q} \beta_j < 0$, thus ensuring the ARCH(q) process is stationary. The ARCH(q) specification was subsequently generalized by Bollerslev (1986) to present a more parsimonious way of modeling financial volatility (GARCH). The novelty of this GARCH model is that the dependence of the conditional variance is not only on the past squared errors, but also on its own past values. So the GARCH(p,q) model can be presented as:

$$h_t = \omega + \sum_{i=1}^{q} \alpha_i {\epsilon^2}_{t-i} + \sum_{j=1}^{p} \beta_j h_{t-j} \dots\dots\dots\dots\dots (4)$$

with α_i and β_i being the parameters which capture ARCH and GARCH effects. Importantly, $\alpha_i + \beta_j$ measures the long-run persistence volatility. Again, the GARCH(p,q) process is stationary if all the α_i and β_j are positive. At the same time, $\alpha_i + \beta_j$ is expected to be less than 1 for ϵ_t to be covariance stationary. However, neither the ARCH(q) nor the GARCH(p,q) model is in a position to capture asymmetry as the GARCH(p,q) methodology commonly assumes that volatility tends to decrease with high growth periods while increasing in periods of declining growth. Addressing this issues of asymmetry, Nelson (1991) developed the EGARCH(p,q) model, in which the conditional variance is given by:

$$\ln(h_t) = \omega + \sum_{j=1}^{p} \beta_j \ln(h_{t-j}) + \sum_{i=1}^{q} \alpha_i (\theta_i z_{t-i} + \gamma_i [|z_{t-i}|]) \dots\dots\dots\dots\dots (5)$$

where $z_{t-i} = \epsilon_{t-i}/\sqrt{h_{t-i}}$ is the lagged standardized shock that captures the asymmetric effects of positive and negative shocks, and θ_i is expected to be between -1 and +1. The effect of a shock is asymmetric if $\theta_i \neq 0$, such that negative shocks increase volatility more than positive shocks if $\theta < 0$. The impact of a positive shock on a financial return series is given by $(\alpha_i + \theta_i)$. If $(\alpha_1 + \theta_1) < \alpha_1$ when θ_1 is negative, the impact of a positive shock is said to be less than the impact of a negative shock. In addition to its ability in capturing asymmetry, the conditional variance is assured to be positive at each point in time in the EGARCH(p,q) methodology as the variance equation is expressed in logarithms while the actual variance is obtained by taking the exponential of this expression. Thus, it is not necessary to impose restrictions on the parameters α_i and β_j to ensure non-negativity of the conditional variances.

Following the basic set-up of the EGARCH(p,q) model, the empirically testable set of equations can be specified as:

$$ERR_t = \beta_0 + \beta_1 ERR_{t-1} + a_i X_{i,t} + \epsilon_t \dots\dots\dots\dots\dots (6)$$

$$\ln(h_t) = \omega + \alpha_1(\theta_1 z_{t-1} + \gamma_1[|z_{t-1}|]) + \delta_1 \ln(h_{t-1}) + b_k Y_{k,t} \dots\dots\dots\dots\dots (7)$$

with ϵ_t, u_t and z_{t-1} holding all the properties explained above. The term $X_{i,t}$ represents a vector of exogenous variables which causes the international transmission of change in global volatility and impact on exchange rate returns, as well as return volatility.

In the empirical estimation, the exogenous variables that affect exchange returns (Equation (6), the mean equation) are identified as the change in term structure and net purchases of foreign exchange through the intervention of the Central Bank. The change in term structure is the difference between long-term and short-term interest rates in the US, namely 10-year US Treasury bond rates and 3-month US Treasury bill rates. Intervention by the Central Bank in the forex market, on a net basis, is included in the exchange rate return equation Similarly, $Y_{k,t}$ represents the variables affecting the conditional variance of exchange rate returns (Equation (7), the variance equation). Both net purchase of foreign exchange by the Central Bank and the change in term structure are included as variables which affect the conditional volatility. The change in the term structure in the US is included in both equations as the paper focuses on spillovers for both the mean and the variance equations. Net purchases of foreign exchange by the CBSL is included in the mean equation as often central bank interventions are aimed at affecting the level of the exchange rate. Its inclusion in the variance equation is to investigate whether such intervention has been able to absorb at least a part of spillover effects that emanate from global financial market conditions.

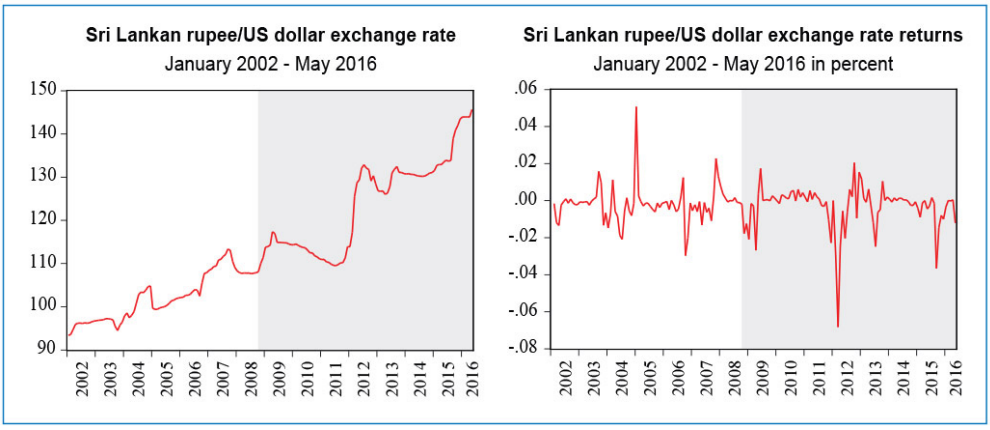
3. Statistical Properties of Data

The data used in the empirical investigation comprises the monthly bilateral exchange rate of the Sri Lankan rupee, expressed against the US dollar, for the period from January 2002 to May 2016, totaling 173 observations. This time span covers the post-float era in Sri Lanka, the period before the 2007 global financial crisis as well as the post crisis period. For estimation purposes, the sample period is divided into two sub-periods, i.e., January 2002 to October 2008 and November 2008 to May 2016. The first sub-period represents a relatively low volatility time frame in the global foreign exchange markets compared to the second sub-period when the volatility was much higher due to the global financial crisis. The second sub-period covers the period after the collapse of Lehman Brothers in the US, which triggered the global

spread of the financial crisis. The selection of these sub-periods is in line with the analysis on the chronology of the financial crisis by Wanaguru (2012). The exchange rate data is obtained from the CBSL. The movement of the exchange rate is defined in such a way that an increase in the exchange rate would indicate a depreciation of the Sri Lankan rupee against the US dollar. The movements of the monthly exchange rate over the period under investigation are shown in the left-hand panel of Figure 1. The exchange rate data is converted into continuously compounded exchange rate returns (ERR_t) as follows and presented in the right-hand panel of Figure 1:

$$ERR_t = ln(ERR_t) - ln(ERR_{t-1}).$$

Figure 1
Sri Lankan Rupee/US Dollar Exchange Rate Movements
(2002-2016)

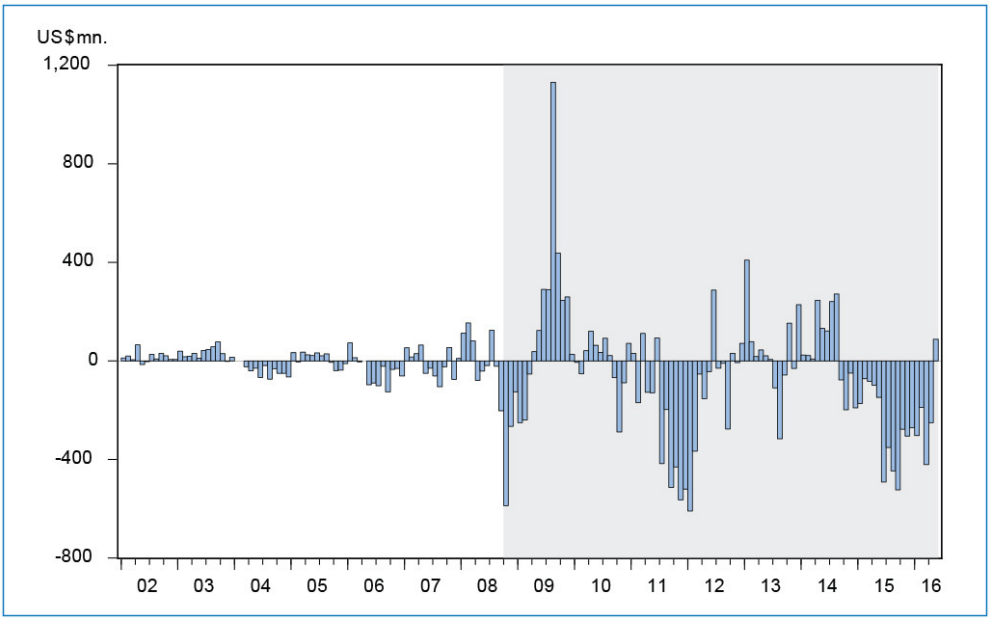


Notes: Left hand panel is the monthly nominal exchange rate of the Sri Lankan rupee against the US dollar. Right hand panel is the percentage of daily exchange rate returns of the Sri Lankan rupee against the US dollar. The shaded areas indicate the highly volatile period from October 2008 to May 2016.

Source: Central Bank of Sri Lanka.

The pattern of Central Bank intervention which is presented in Figure 2, suggests that the CBSL has often used "intervention in the foreign exchange market" as a policy tool in influencing the exchange rate. Although this intervention is in both directions, it is clear that the Central Bank has supplied a substantial amount of foreign exchange liquidity to the domestic forex market in the aftermath of the global financial crisis. It is also clear that the supply of foreign exchange liquidity has been substantial since the second half of 2014, coinciding with the market anticipation of a rate hike in the US and the subsequent rate hikes.

Figure 2
Monthly Net Intervention by the Central Bank of Sri Lanka
(2002-2016)



Notes: Positive values depict net purchases of foreign exchange from the market while negative values indicate net supply of foreign exchange. The shaded areas indicate the highly volatile period from October 2008 to May 2016.

Source: Central Bank of Sri Lanka.

In addition to exchange rate returns, several other important variables were also employed in estimating the EGARCH model for exchange rate returns to understand the spillover effect of global liquidity. Specifically, the US 10-year Treasury bond rates and the US 3-month Treasury bill rates are used to construct a series that captures the changes in the term structure in the US. The significant positive parameter value indicates the volatile spillover from the US to the Sri Lankan currency market. Additionally, data on the CBSL's interventions in the forex market is used to examine whether such interventions help to reduce the impact of spillover effects. The Summary Statistics of the Data used in the empirical analysis is present in Table 1.

Table 1
Descriptive Statistics of Data

	Log First Difference of Rs/USD Exchange Rate, Percentage	First Difference of the Term Structure, Percentage*	Net Foreign Exchange Purchases, USD mn
Full Sample: January, 2002 to May 2016			
Mean	-0.258	-0.997	-37.404
Median	-0.097	-1.265	-6.850
Maximum	5.067	86.580	1130.800
Minimum	-6.827	-74.320	-609.800
Std. Dev.	1.079	28.842	198.523
No of Obs.	172	172	172
1st Sub-period: January, 2002 to October 2008			
Mean	-0.18	-0.446	-4.078
Median	-0.134	-5.74	0
Maximum	5.067	86.58	153.4
Minimum	-2.973	-50.13	-202.7
Std. Dev.	0.973	31.604	56.807
No of Obs.	80	80	80
2nd Sub-period: November 2008 to May 2016			
Mean	-0.326	-1.476	-66.384
Median	-0.015	0.395	-51.15
Maximum	2.049	63.79	1130.8
Minimum	-6.827	-74.32	-609.8
Std. Dev.	1.164	26.375	263.499
No of Obs.	92	92	92

* Change in the term structure is calculated as the difference between the 10-year Treasury bond rate and the 3-month Treasury bill rate of the United States.

An augmented Dickey-Fuller test and a Philips-Peron test are used to test the non-stationarity of the time series used in this study. The null hypothesis tested is that the time series exhibits a unit root, against the alternative of stationarity. Table 2 presents the results. Accordingly, the exchange rate returns and the term structure are used in the first differenced form, while foreign exchange interventions are used in the level form.

Table 2
Unit Root Test

	Augmented Dickey-Fuller Test Satistic at Level with an Intercept Only (a)	Phillips-Perron Test Statistic at Level with an Intercept Only (b)
Log First Difference of RS/USD Exchange Rate	-8.850***	-8.985***
First Difference of the Term Structure	-12.760***	-12.760***
Net Foreign Exchange Purchases	-5.864***	-5.997***

Note: (a) denotes the Augmented Dickey-Fuller test with an intercept and a maximum number of 13 lags selected according to the Schwarz Information Criterion. (b) denotes the Phillip-Peron test with an intercept and Bartlett Kernel estimation method with Newly-West Bandwidth. As usual, *** indicates that the null hypothesis of a unit root is rejected at the 1% level.

4. Empirical Results

This section presents empirical results on how the change in interest rates or the term structure in the US spills over into the forex market in Sri Lanka. To this end, this study applies the EGARCH model explained by Equations (6) and (7) over the time span before the crisis as well as during the crisis period. More precisely, the estimated EGARCH model takes the following form:

$$ERR_t = \beta_0 + \beta_1 INTV_t + \beta_2 TERM_t + \epsilon_t \dots\dots\dots\dots\dots (8)$$

$$\ln(h_t) = \omega + \alpha_1(\theta_1 z_{t-1} + \gamma_1[|z_{t-1}|]) + \delta \ln(h_{t-1}) + b_1 INTV_t + b_2 TERM_t \dots\dots (9)$$

where $INTV$ represents net purchases of foreign exchange by the CBSL, literally US dollars in the case of Sri Lanka, while $TERM$ captures the change in the term structure in the US. The results of the empirical investigation for the period before the crisis and the crisis period are summarized in Table 3.

Table 3
Empirical Results of the Spillover Effects for the Period Before the Crisis and the Crisis Period

Parameter	Estimated Values for the Period Before the Crisis	Estimated Values for the Crisis Period
Conditional Mean Equation(10^{-2})		
β_0	-0.178 (0.005)	0.053 (0.268)
β_1	0.003 (0.011)	0.001 (0.212)
β_2	-0.009 (0.473)	0.093 (0.535)
Conditional Variance Equation (10^{-2})		
ω	-381.916 (0.189)	-217.176 (0.000)
α	45.095 9 (0.778)	63.457 (0.000)
θ	14.548 (0.501)	-10.705 (0.0418)
δ	63.834 (0.025)	84.454 (0.000)
b_1	-0.893 (0.001)	-0.215 (0.000)
b_2	-154.427 (0.149)	103.105 (0.047)
Diagnostic Test Statistics		
$Q(20)$	22.426 (0.318)	25.627 (0.179)
$Q^2(20)$	11.347 (0.937)	21.009 (0.397)
LM	0.028 (0.868)	0.220 (0.640)

Note: Models are estimated over period before the crisis from January 2002 to October 2008 and during the crisis period from November 2008 to May 2016. The dependent variable in the mean equation is the Sri Lankan rupee returns (ERR). Net purchase of foreign exchange is included in millions of US dollars. *p*-values are in parentheses.

4.1 Impact on Exchange Rate Returns

The parameter estimation suggests that the impact of net purchases of foreign exchange by the Central Bank on the level of the exchange rate is somewhat ambiguous. If the purchases of US dollars are to influence the exchange rate returns, the coefficient of $INTV_t$ should be positive and significant. Although the Central Bank's presence in the forex market as a net purchaser has a positive and significant impact during the period before the crisis, the effect is very small and cannot be considered economically substantial. More precisely, the purchase of US$100 million, on a net basis, from the forex market would tend to depreciate the

Sri Lankan rupee by 0.03%. This indicates that the purchase of US dollars from the forex market would help the Central Bank to build up reserves without significant pressure on the rupee in tranquil market conditions. However, if the markets are volatile, intervention through net purchases are neither statistically nor economically significant although the sign of the estimated parameter is in line with the prior expectation. This insignificant impact during highly volatile and turbulent market conditions, may be partly attributed to the market expectation of foreign exchange supply in the market to prevent a large depreciation of the rupee.

The estimated coefficients of the change in the term structure for both the periods before the crisis and after the crisis indicate that the change in interest rates has a very small negative impact on the exchange rate returns modeled in the mean equation (Equation 8). This result indicates that the increase in the interest rate gap between 10-year Treasury bonds and 3-month Treasury bills rates in the US tend to appreciate the external value of the Sri Lankan rupee against the US dollar, in line with prior expectations. The decline in short-term interest rates indicates that the US dollar is losing its safe haven status, as indicated by the movement of investments from the US to emerging economies with higher interest rates such as India, Indonesia, Malaysia and Sri Lanka. However, the impact is not statistically significant in both cases and it can thus be concluded that changes in the interest rates in the US do not significantly affect the level of the exchange rate between the Sri Lankan rupee and the US dollar.

4.2 Impact on Volatility of Exchange Rate Returns

The empirical investigation provides some intuitive results in terms of the impact of the change in the term structure on the volatility of the exchange rate between the Sri Lankan rupee and the US dollar during the two sub-periods. Interestingly, the results for the period before the crisis suggest that the change in the term structure of the interest rates in the US has no significant impact on the volatility of exchange rate returns of the Sri Lankan rupee against the US dollar, while the effect is, conversely, significant during the period after October 2008. Specifically, an increase in the interest rate gap between long-term and short-term interest rates by 1 percentage point increases the volatility of the exchange rate returns by 1.04%, at the 5% level, suggesting a significant spillover effect from the US financial market on the forex market in Sri Lanka during the crisis period. In terms of the exchange rate, the term "volatility" most frequently refers to the standard deviation of the change in the exchange rate and is often used to quantify the risk associated with the currency pair. In general, volatility refers to the degree of unpredictable change over time, but does not imply any direction. In terms of the forex market in Sri Lanka, it seems that the change in the term structure of interest rates in the US during relatively calm global financial market conditions, is comparatively low and insignificant. In contrast, the effect of the change in the term structure on volatility of the currency market in Sri

Lanka is large. However, if the direction of the volatility increase is considered, the sign indicates that the volatility in the exchange rate is large with an unexpected depreciation of the rupee against the US dollar, as the change in the term structure increases, which is in contrast to the prior expectation. Rationally, it is expected that a reduction in short-term interest rates in the US would reduce its attraction as a safe haven and boost the tendency of foreign investors to redirect investments to emerging markets. Any significant increase in foreign inflows should appreciate the domestic currency. The sign of the estimated coefficient is therefore unexpected. However, care should be taken in the parameter interpretation of exponential models as they are somewhat complicated.

Net purchases of foreign exchange by the Central Bank included in the variance equation, is found to be highly significant in both sub-periods at 1% significance level. The estimated parameter values for these two periods are -0.009 and -0.002, respectively, with negative signs, i.e., a net purchase of US$ 100 million by the Central Bank would lead to reducing of exchange rate volatility. Technically, this result suggests that an increase in intervention through the purchase of foreign currency - in the Sri Lanka's case, US dollars - tend to reduce the volatility through the lessening of the exchange rate depreciation. As is evident, the magnitude of the net impact of forex intervention is higher in the period before the crisis, indicating that the intervention by the Central Bank is not limited to curtailing spillover effects of the change in global financial market conditions. However, only the effectiveness of forex intervention in curtailing excessive volatility in rupee returns is assessed as the economic significance of the effect of intervention on the conditional volatility is difficult to measure numerically using the EGARCH model due to the non-differentiability of the absolute function $|z_{t-1}|$ at zero. In addition, the EGARCH results reveal that the conditional variance of exchange rate returns is affected by the direction of the shocks. The coefficient of the asymmetry and leverage effects, θ, is insignificant in the period before the crisis, but is negative and statistically significant at the 5% level in the case of the crisis period. As θ lies between 0 and 1 ($0<\theta<1$), it suggests that negative shocks increase volatility compared to positive shocks.

Finally, as a robustness check, the full sample period was estimated in the EGARCH framework, using all the variables as in previous cases, and empirical results are presented in Table 4.

Table 4
Empirical Results of the Robustness Analysis Using the Full Period

Parameter	Estimated Values
Conditional Mean Equation (10^{-2})	
β_0	-0.013 (0.807)
β_1	0.000 (0.165)
β_2	0.155 (0.179)
Conditional Variance Equation (10^{-2})	
ω	-178.860 (0.000)
α	43.121 (0.000)
θ	-13.466 (0.0785)
δ	85.103 (0.000)
b_1	-0.178 (0.000)
b_2	-21.967 (0.251)
Diagnostic Test Statistics	
$Q(20)$	25.627 (0.179)
$Q^2(20)$	22.474 (0.315)
LM	0.220 (0.640)

Note: Models are estimated over period before the crisis over January 2002 to October 2008 and the crisis period over November 2008 to May 2016. The dependent variable in the mean equation is the Sri Lankan rupee returns (ERR). Net purchase of foreign exchange is included in millions of US dollars. *p*-values are in parentheses.

The robustness analysis shows that Central Bank intervention has no impact on the level of the exchange rate, but has a significant impact on the volatility. Although intervention is found to be effective in the full sample period, the empirical analysis does not find any significant spillover impact on the forex market in Sri Lanka, as in the period before the crisis.

5. Policy Implications

The impact from the global financial crisis, the introduction of unconventional monetary policies and the recent exit or the preparation to exit from such policies, has sparked off debates among policy makers on the spillover effects on emerging market economies. Existing literature suggests that the introduction of unconventional monetary policies by advanced economies have resulted in substantial capital flows to emerging market economies (Ahmed and Zlate, 2014). However, the amounts

and the quality of such inflows are dependent on the fundamentals in emerging markets, i.e., relatively strong economies tend to receive capital flows for relatively longer periods while countries with weak fundamentals receive so called "hot money", which seeks high and quick returns at the fastest possible time. However, the announcement of the possibility of tapering of the quantitative easing program in the United States, disrupted the economic and financial stability of emerging market economies. Existing studies are silent on whether the spillover effects of policy decisions in advanced economies in the aftermath of the recent financial crisis are positive or negative as a whole. Instead, most of the studies are in consensus that increasing trends in financial and trade integration has triggered spillover effects through several channels such as portfolio balance, trade, exchange rate and signaling channels.

Policy decisions of advanced economies can result in the possible spillovers of volatility in the financial markets and subsequently to other sectors of emerging markets. Even emerging market economies with strong fundamentals, which are able to counter the effects of policy changes in advanced economies, will not be entirely free from adverse effects as they may have to face higher borrowing costs internationally and weaker global demand. In general, the most affected countries have been the ones with more open capital markets and greater financial linkages with the crisis affected advanced economies (IMF, 2013). Although most SEACEN economies have handled the impact from the financial crisis quite well, the spillover of volatility from the measures adopted by advanced economies to address crisis-related issues was large enough to prompt some turbulence. This resulted in the SEACEN economies adopting measures to counter or limit the adverse impact of unconventional monetary policies as well as their tapering. Generally, the measures implemented by the SEACEN economies included increases in policy rates, central bank intervention in the forex market, capital controls and provision of additional fiscal space. Additionally, some economies have adopted macroprudential policies to curb the volatility stemming from the policies taken by advanced economies (IMF, 2014).

Sri Lanka, like other SEACEN economies, also experienced the spillover effects in the aftermath of the global financial crisis. Like many other emerging market economies, Sri Lanka had weathered the initial effects of the crisis. The direct impact from the crisis was minimal as the Sri Lankan capital account is not fully liberalized and many local banks were not exposed to toxic assets (Jayamaha, 2007). The economic performance in Sri Lanka was improving steadily until the third quarter of 2008 when it reversed, mainly due to the second-round effects of the financial and economic crisis. The lack of counterpart funds in the international capital market led to a reduction in foreign inflows for the government, while short-term foreign inflows for the government and the private sector were withdrawn gradually with the announcement of the possible normalization of monetary policy

in the US. Reflecting the developments in capital flows, the Sri Lankan rupee faced continuous downward pressures, a significant amount of which came from the weakened inflows in the capital and financial accounts. This was driven mainly by lower than expected FDI inflows and sluggish implementation of externally financed public and private projects due to the exit of foreign investors from the government securities market (IMF, 2016). While global market volatility led investors to pursue a "wait and see" approach, the spillover effects of global financial market volatility were exacerbated by concerns about domestic policies due to two elections held in 2015. This necessitated the CBSL to intervene in the forex market to provide liquidity to curtail high volatility in the exchange rate.

Other than intervening in the forex market, the Central Bank and the government have also made several policy decisions to address the imbalances in the Sri Lankan forex market to limit the spillover effects of tapering by the Federal Reserve Bank. These included revising the policy interest rates upward to reduce monetary expansion, directing licensed banks to limit credit growth to affect the trade deficit and future inflation, restricting forward contracts to 90 days, reducing the Net Open Positions of banks to reduce speculation behavior, increase import duties of motor vehicles by the government and encouraging local counterparts to tap international markets. Despite the implementation of such policies, there were more occurrences of volatility in the domestic forex market when the Federal Reserve Bank increased the US policy rate again and when the Euro area began to normalizing monetary policies. As such, it was vital for Sri Lanka to build external and domestic policy buffers to ensure that it is ready to limit spillovers, not only from the US, but also from the Euro area. It was also important to maintain additional fiscal space to reduce the possible spillover effect on the external sector from the fiscal sector. Close monitoring of capital flows, especially from and to the Colombo Stock Exchange and from and to the government securities market would also give an early indication of the behavior of global capital flows, making it easy for the domestic policy makers to make quick policy decisions in case of high volatility in the markets.

In addition, more prudential regulations, close monitoring of financial institutions, sterilization programs of the Central Bank and appropriate monetary policies are essential for financial system stability. On the external front, foreign exchange policy is an effective tool for macroeconomic stability as has been the case for Sri Lanka. Therefore, economies with floating exchange rate regimes cannot simply rule out central bank intervention in the forex market, at least during times of financial turmoil. CBSL's significant intervention during times of large inflows as well as outflows has proven to be effective in mitigating some of the spillover effects. It has been observed that policy makers in small open economies with a developing foreign exchange market, are somewhat reluctant to allow the market to adjust automatically to capital flows due to the possible adverse impact on other sectors of

the economy. As such, only countries which are able to maintain high amounts of international reserves, especially during turbulent periods, would be able to adopt a managed floating exchange rate system successfully, to counter the adverse effects of financial market volatility.

For sustainable development, emerging economies should encourage more long-term capital flows such as foreign direct investments (FDI). In the case of Sri Lanka, attracting FDI will help not only in bridging the savings-investment gap, but also in broadening the sources of stable foreign exchange earnings, especially if they can be directed to trade related industries in a productive manner. In this context, Sri Lanka needs to attract 'good' FDI, i.e., investments that bring in technology, boost exports, and that links the country to new markets that have not been previously accessible. If the country can do so, it will reduce the burden of foreign borrowings for financing the budget deficit in the future. However, challenges such as policy coherence and policy inconsistencies have hindered the country's ability in attracting FDIs. As global competition for investments has heightened, implementing a clear and coherent FDI policy and an industrial policy are essential for attracting FDI and boosting exports. For example, Singapore in its effort to attract FDI, has identified the most important sectors within a broader industrial policy framework and vision by offering formulated incentives rather than ad hoc ones. This approach will help the country not only to increase total FDI, but also attract FDI that could positively influence the structural transformation of the economy. For Sri Lanka, the medium- to long-term requirements of undertaking urgent reforms to improve the overall business climate together with proactive approaches to fix the regulatory frameworks and streamline business procedures are necessary to make it an attractive FDI destination. Additionally, if the country can attract foreign exchange through more stable sources, such as FDI and export earnings, it would help avert speculation attacks. Another long-term strategy for the economies in the region would be the building up of external and domestic buffers. Adjustments to policies and maintaining buffers are needed to address the build-up of vulnerabilities since the crisis and from the responses to the crisis. Economies with limited policy buffers or weak fundamentals are vulnerable to fiscal slippages and external shocks. If a country builds up such buffers during tranquil periods, it would be in a better position to handle spillover effects during financial turmoil and to sustain a robust growth trajectory over the medium- to long-term.

6. Conclusion

Capital flows to and from emerging markets have become large and increasingly volatile in the years following the global financial crisis. Such volatility in capital flows has significant macroeconomic consequences, including undue volatilities in exchange rates especially in open economies which have free floating exchange rate regimes. Intervention by central banks is an important policy tool to stem volatilities

in the forex markets. Against this background, this paper examined how the volatility in the global financial markets has been transmitted to foreign exchange markets in emerging economies by analyzing the movements of the foreign exchange market in Sri Lanka over the period 2003-2016.

The empirical investigation was based on the exponential generalized autoregressive conditional heteroscedasticity (EGARCH) methodology, which is particularly suitable for analyzing financial time series with a time-varying variance such as the exchange rate and stock returns. The empirical investigation finds that there was a significant spillover effect from the global financial market with the changes in the term structure or the reduction in short-term interest rates in the US in response to the financial crisis. However, no significant spillover was observed during the relatively tranquil period. The findings also indicate the need for a monetary and fiscal policy mix on the domestic front and policies to curb excess volatility in the forex market to maintain price and financial system stability during turbulent times.

It is worth, however, to mention that one should be very careful in interpreting results of the empirical investigation. For example, it would not be prudent to conclude that central bank intervention is not effective in cases where the empirical analysis fails to find any statistically significant results. The insignificance may be partly due to the nature of the foreign exchange intervention by the central bank. Foreign exchange interventions are more effective if they are unexpected. As frequent intervention is a salient feature of exchange rate management policy in Sri Lanka, the market normally anticipates the presence of the Central Bank. If interventions are anticipated, statistical analyses may not indicate a significant effect, which is also a limitation of this study. As intervention is not the only instrument the Central Bank uses, the analysis can be extended in the future to include the management of domestic interest rate changes.

In recent times, with the normalization of monetary policy and economic recovery in advanced countries, short-term capital flows have become highly volatile and vulnerable to sudden reversals. Like many economies in the region, Sri Lanka was also a recipient to large amounts of capital flows in the government securities market, sometimes hitting the threshold of 12.5% allowed for foreign investors. Such investments are considered to be more sensitive to changes in global financial conditions such as hikes in policy rates by the Federal Reserve in comparison to long-term FDI. Sri Lanka experienced some premature liquidation of foreign investments in the government securities market in the later part of 2013 as the Federal Reserve Bank announced the possibility of hikes in policy rates, which created imbalances in the external sector of the economy. In view of this, economies in the region should encourage more long-term capital flows such as FDI. In case of Sri Lanka especially, attracting FDI will help bridge the savings-investment gap and broaden stable sources

of foreign exchange earnings. This will reduce the burden of foreign borrowings to finance the budget deficit as well as to avert speculative attacks.

CBSL has intervened in the forex market in times of volatile capital flows in order to reduce their impact on international trade and finance. As such, it is of paramount importance that Sri Lanka maintains a sufficiently large stock of international reserves, especially in times of financial market stress. This, in turn, emphasizes the need for the implementation of a clear and coherent FDI policy and an industrial policy to attract FDI and export earnings.

Looking forward, the "Road Map: Monetary and Financial Sector Policies for 2017 and Beyond" of the Central Bank of Sri Lanka, clearly spells out the monetary and exchange rate policy stances. The conduct of monetary policy will be strengthened through the move towards a flexible inflation targeting (FIT) framework. At the same time, a properly designed and widely accepted framework for exchange rate management will be introduced with the establishment of a market-based exchange rate system in the country. Under this enhanced monetary policy framework, the Central Bank would focus on stabilizing inflation in the mid-single digits over the medium-term, while supporting growth objectives and flexibility in exchange rate management. The FIT framework and market-based exchange rate is expected to help the country make in-roads over the medium-term in its development path.

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Chapter 8

GLOBAL LIQUIDITY CONNECTEDNESS: EVIDENCE FROM SEACEN MEMBERS

By
Jyun-Yi Wu[1]

1. Introduction

Global liquidity has become a popular concept for academic and policy discussions since the early 2000s. Global liquidity is a multifaceted concept that can be defined and measured in several ways (Committee on the Global Financial System, 2011; Domanski et al., 2011; European Central Bank (ECB), 2012; Gourinchas, 2012; International Monetary Fund (IMF), 2014; Landau, 2014). One is "official liquidity" which is funding provided by the public sector. The central bank supplies official liquidity in domestic currency in the form of reserve balances or reserve currencies, on terms and conditions that do not depend on the availability of funding in financial markets. Another is "private liquidity" which is created by market participants in the private sector, including international banks, institutional investors, non-bank financial institutions (including shadow banks) and so on. The other is "financial market liquidity" which is described as the ease with which large volumes of financial securities can be bought or sold without affecting the market price. In particular, the point of official and private liquidity is based on the financial stability perspective.

From the financial stability perspective, global liquidity spreads through international financial flows which are determined by decisions made in both the transmitter and recipient economies and by public and private sectors. In this perspective, the policy decision-making of central banks play an important role in influencing capital flows, in particular, massive capital flows from advanced economies into emerging markets during the past two decades. In view of this, monetary policies may be the main driver of global liquidity conditions.[2]

In order to capture the drivers of monetary policy, interest rates, policy rates as well as long-term interest rates are used as the proxy variables. As we know, an interest rate is a price-based indicator which could provide information about the liquidity supply condition in different markets (see for example Domanski et

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2. Committee on the Global Financial System (2011) states that global liquidity conditions are the results of interactions among macroeconomic factors, monetary policy, exchange rate regime, capital account policies, public sector policies, and financial factors.

al., 2011; ECB, 2012; McGuire and Sushko, 2015, among others).[3] The stance of monetary policy determines domestic short-term interest rates through expectations about the future path of policy rates. Longer-term interest rates are driven by more than simply monetary policy, and can be affected by factors such as global savings and investment patterns.

It is important to understand how the advanced countries influence liquidity in emerging markets. From a theoretical perspective, interest rates in advanced countries may affect interest rates of emerging markets because the policymakers of the latter tend to act against the occurrence of large interest rate differentials. A large interest rate differential may lead to exchange rate appreciation which could result in a loss of trade competitiveness and induce speculative short-term capital inflows. Elevated interest rate differentials across currency areas may be associated with over-optimistic risk perceptions and elevated risk tolerance, leading to a mispricing of assets and excessive easing of lending standards. Both of these occurrences could increase financial stability risks. However, very few empirical contributions have tried to scrutinize the transmission of global liquidity.

The aim of this paper is to analyze the transmission of major countries' interest rates (policy rate and long-term interest rate) on SEACEN economies due the rise of emerging markets in the globalization process, with focus on Chinese Taipei, with its rapid expansion of the financial market and extraordinary economic growth.

In our empirical approach, we adopt the connectedness methodology developed by Diebold and Yilmaz (2009, 2012, 2014, 2015) covering the United States, the Euro area, the United Kingdom, Japan and selected SEACEN economies (i.e., Indonesia, Malaysia, Singapore, South Korea and Chinese Taipei), using monthly data spanning 2000-2015.[4] The advantage of this method is that the proposed measures (i.e., "*TO others*", "*FROM others*", and "*NET*") are dynamic and directional. We are able to judge the extent of connectedness between economies at any particular date.

The main findings of this paper suggest that the total connectedness indexes show quite robust interdependence for global liquidity across our sample economies, with the SEACEN members being the "net receivers" of global liquidity shocks. In the static analysis, for policy rates, we find that the United Kingdom, the United States, and the Euro area appear to be dominant transmitters, while Chinese Taipei,

3. The quantity-based indicator is another kind of global liquidity indicator. It can capture how far such conditions translate into changes in exposures and risks (Domanski et al., 2011).

4. The connectedness concept quantifies to which extent two variables are related.

South Korea, Singapore, and Indonesia are net recipients. The dynamic analysis clearly shows that there has been a substantial increase in the total connectedness indexes since the global financial crisis and the European sovereign debt crisis. Chinese Taipei, South Korea, Singapore, and Indonesia are also net receivers over time.

For long-term interest rates, our static results indicate that the United States and the United Kingdom act as net transmitters of global liquidity shocks. In contrast, Malaysia, Chinese Taipei and South Korea are net recipients. The dynamic analysis indicates that the total connectedness reached a peak during the global financial crisis. Japan seems to be the dominant transmitter of shocks, while South Korea, Chinese Taipei, and Malaysia are net recipients during the sample period.

Our findings have obvious policy implications. For example, in order to monitor financial and macroeconomic stability, central banks need to understand the direction of global liquidity spillovers among major economies. When central banks are able to distinguish net transmitters from net recipients of global liquidity spillovers under different economic conditions, they are more able to formulate effective policies.

The rest of the paper is organized as follows: The next section provides some information on Chinese Taipei and some stylized facts about global liquidity. Section 3 outlines the directional connectedness measures proposed by Diebold and Yilmaz (2009, 2012, 2014, 2015). Section 4 provides a description of the dataset. In Section 5, a full sample static analysis and a rolling sample analysis are executed to check the dynamics of connectedness across time. Finally, Section 6 contains some concluding remarks.

2. Preliminary Evidence on the Effects of Global Liquidity on Chinese Taipei

In this section, we will briefly introduce the effects of global liquidity on Chinese Taipei. Figure 1 shows the change of the policy rate in Chinese Taipei. Policy rate changes can be divided into three periods for the last fifteen years from 2000 to 2015. The first period is roughly from 2000 to 2003. The policy rate which fell from 4.16% in 2000 to 1.02% in 2003, exhibited a downward trend as the central bank adopted accommodative monetary policies to foster an economic recovery during this period. The poor economic performance could be attributable to the bursting of the dot-com bubble, the 9/11 terrorist attacks and the SARS epidemic.

The second period is roughly from 2004 to 2008 when economic activity picked up. The policy rate trended upward during this period, rising from 0.97% in May 2004 to 1.9% at the end of 2008. The third is from 2009 to present. The fallout from the global financial crisis continued to shadow Chinese Taipei's economy during the first half of 2009. The policy rate went down sharply in the first quarter of 2009 and subsequently stayed low during monetary easing. During the continuing economic slowdown, the rate remained broadly stable at a low level.

Figure 1
Policy Rate in Chinese Taipei

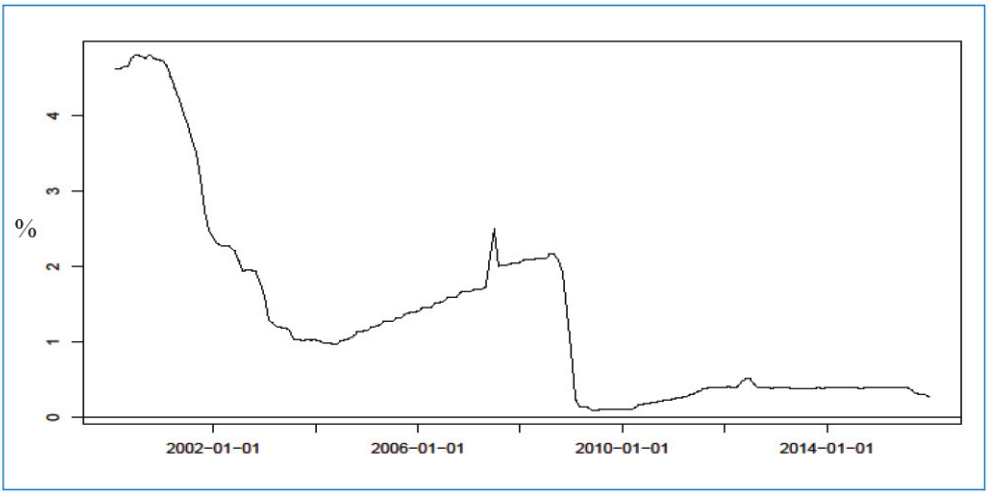
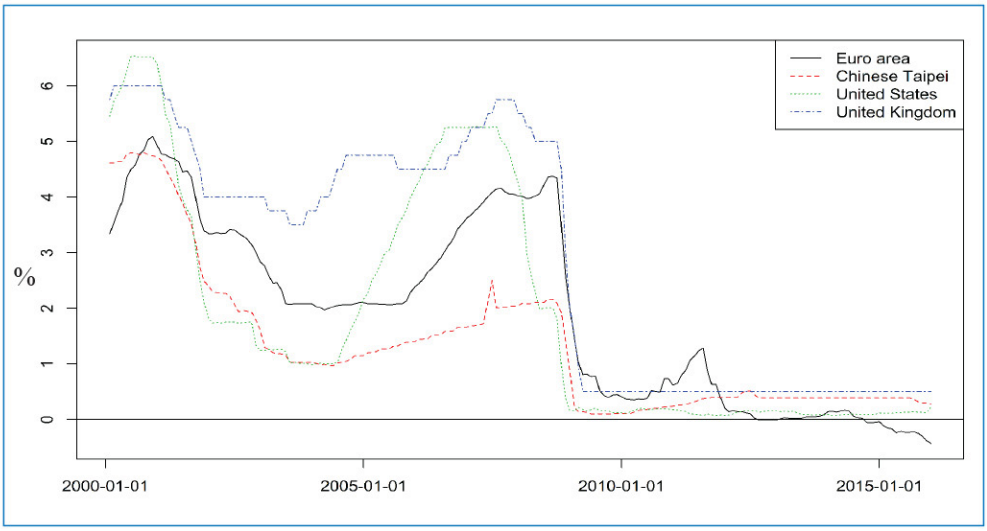


Figure 2 illustrates the policy rate in the Euro area, Chinese Taipei, United States, and United Kingdom. It can be confirmed that while the correlation between the rates of the Euro area/United Kingdom vis-à-vis the United States rates is very high, the amplitude of the interest rate cycle is much smaller in the Euro area/United Kingdom than in the United States. Comparing the policy rates in Chinese Taipei, the Euro area, United States, and United Kingdom, we also find a clear co-movement among them. The policy rates in United States and the Euro area may have a greater influence on Chinese Taipei due to it being a small and highly open economy. The preliminary evidence proposed above point to the existence of a possible interaction among Chinese Taipei, Euro area, United States, and United Kingdom. In this paper, we propose an empirical framework of analysis to evaluate this relationship.

Figure 2
Policy Rates in the Euro Area, Chinese Taipei, United States and United Kingdom



3. Econometric Methodology

The network connectedness measures that are proposed by Diebold and Yilmaz (2009, 2012, 2014, 2015) is employed. This method has been widely used to analyze financial markets (Diebold and Yilmaz, 2014, 2016), policy uncertainty (Klobner and Sekkel, 2014), inflation spillovers (Halka and Szafranek, 2016), oil price and equity markets (Maghyereh et al., 2016) and so on. The objective of this econometric exercise is to compute several interesting measures, "*TO others*", "*FROM others*", and "*NET*", for the transmissions of global liquidity in the selected economies of Indonesia, Singapore, South Korea, Chinese Taipei, Euro area, Japan, United Kingdom, and United States.[5]

We assume that the global liquidity indexes, GI, are modeled as a vector autoregressive (VAR) process that can be written as:

$$GI_t = \sum_{i=1}^{p} \Phi \, GI_{t-i} + \varepsilon_t \,,$$

where $GI_t = (GI_{1t}, GI_{2t}, \ldots, GI_{Nt})'$ denotes a (N×1) vector of economies. In our analysis, we use the policy rates and long-term interest rates as proxy variables of global liquidity. Φ is a N×N matrix of parameters to be estimated. The error term,

5. The limitation of this method is that it is designed for the multi-country univariate or single-country multivariate case (Greenwood-Nimmo et al., 2015).

ε, is a vector of independently and identically distributed errors with zero mean and Σ covariance matrix.

Diebold and Yilmaz (2014) suggest using the generalized variance decomposition (GVD) developed by Koop et al. (1996) and Pesaran and Shin (1998) in order to avoid the difficulties of identifying orthogonal shocks in VAR models. The GVD framework has an advantage over the orthogonalized variance decomposition because it is invariant to the ordering of the variables entering the VAR system.

Country *j*'s contribution to country *i*'s H-step-ahead GVD, d_{ij}^{gH}, is calculated as:

$$d_{ij}^{gH}(\mathrm{H}) = \frac{\sigma_{jj}^{-1}\sum_{h=0}^{H-1}(e_i' A_h \Sigma e_j)}{\sum_{h=0}^{H-1}(e_i' A_h \Sigma A_h' e_i)}, \quad \mathrm{H}=1, 2,\ldots,$$

where Σ is the covariance matrix for the error variance ε, σ_{jj} is the standard deviation of the error term for the j^{th} equation, A_h is H-th step moving average coefficient matrix and e_i is the selection vector with one as the i^{th} element and zero otherwise. In other words, a connectedness exists if country *j*'s liquidity measure contributes to the variance of country *i*.

Because shocks are not necessarily orthogonal in the GVD environment, sums of variance contributions are not necessarily equal to unity. We normalize them by dividing all entries of the GVD matrix with corresponding value of the row-sum:

$$\tilde{d}_{ij}^{gH}(\mathrm{H}) = \frac{d_{ij}^{gH}(\mathrm{H})}{\sum_{j=1}^{N} d_{ij}^{gH}(\mathrm{H})},$$

where $\sum_{j=1}^{N} \tilde{d}_{ij}^{gH}(\mathrm{H}) = 1$ and $\sum_{i,j=1}^{N} \tilde{d}_{ij}^{gH}(\mathrm{H}) = N$. $\tilde{d}_{ij}^{gH}(\mathrm{H})$ can be seen as a natural measure of the pairwise directional connectedness from country *j* to country *i* at horizon H. In general, we use the notation $C_{i\leftarrow j}(H)$ to represent this transmission. Note that in general, $C_{i\leftarrow j}(H) \neq C_{j\leftarrow i}(H)$. The net pairwise directional connectedness is:

$$C_{ij} = C_{i\leftarrow j}(H) - C_{j\leftarrow i}(H)$$

We are particularly interested in determining how all the countries collectively are contributing to a single country, so we aggregate partially. The total directional connectedness from all countries to country *i*, denoted by $C_{i\leftarrow.}(H)$("*FROM others*"), computed as:

$$C_{i\leftarrow.}(H) = \sum_{\substack{j=1 \\ j\neq i}}^{N} \tilde{d}_{ij}^{gH}(\mathrm{H})$$

We are also able to compute how a particular country *i* is contributing to the shocks in all other countries by aggregating partially. The total connectedness from country *i* to all countries, denoted by $C_{.\leftarrow i} = (H)$ ("*TO others*"), is computed as:

$$C_{.\leftarrow i}(H) = \sum_{\substack{j=1 \\ j\neq i}}^{N} \tilde{d}_{ji}^{gH}(\mathrm{H})$$

In general, net total directional connectedness ("*NET*") is

$$C_i(H) = C_{.\leftarrow i}(H) - C_{i\leftarrow.}(H)$$

This is an informative measure that might define the role of a country in the whole system of countries as a net transmitter or receiver of shocks.

The total aggregation of the variance decompositions across all countries measures the system-wide connectedness. The total directional connectedness in all countries is given by

$$\boldsymbol{C(H)} = \frac{\sum_{\substack{i,j=1 \\ i\neq j}}^{N} \tilde{d}_{ij}^{gH}(\mathrm{H})}{N}$$

We could apply the schematic connectedness as shown in Table 1 to understand the various connectedness measures and their relationships. For instance, $\tilde{d}_{12}^{gH}$ presents the pairwise directional connectedness from country 2 to country 1. $C_{.\leftarrow 1}$ is the total directional connectedness from country 1 to all countries. $C_{1\leftarrow.}$ is the total directional connectedness from all countries to country 1. The total directional connectedness in all countries is $\boldsymbol{C}$.

Table 1
Schematic Connectedness

	GI_1	GI_2	...	GI_N	*FROM others*
GI_1	$\tilde{d}_{11}^{gH}$	$\tilde{d}_{12}^{gH}$	...	$\tilde{d}_{1N}^{gH}$	$C_{1\leftarrow\cdot}$
GI_2	$\tilde{d}_{12}^{gH}$	$\tilde{d}_{22}^{gH}$	...	$\tilde{d}_{2N}^{gH}$	$C_{2\leftarrow\cdot}$
⋮	⋮	⋮		⋮	⋮
GI_N	$\tilde{d}_{N1}^{gH}$	$\tilde{d}_{N2}^{gH}$	...	$\tilde{d}_{NN}^{gH}$	$C_{N\leftarrow\cdot}$
TO others	$C_{\cdot\leftarrow 1}$	$C_{\cdot\leftarrow 2}$	...	$C_{\cdot\leftarrow N}$	$\boldsymbol{C}$

4. Data Description and Preliminary Statistics

As mentioned previously, to capture the spillover effect of global liquidity, we use policy rates and long-term interest rates.[6] After the global financial crisis, the Euro area (EA), Japan (JPN), United Kingdom (UK), and United States (USA) have reduced their policy rate to near or almost zero. It is very difficult to accurately assess monetary policy when interest rate is at the zero lower bound. In view of this, we used the "shadow short rate" (SSR) as a proxy variable for the economies for which the policy rate is in a zero lower bound environment (Bullard, 2012; Lombardi and Zhu, 2014; Krippner, 2015).[7] For other economies, however, policy rates were still used. The SSR data was collected from the

6. We use two different samples in this paper due to dataset restrictions. Data on interest rates, policy rates and long-term interest rates, is only available for some SEACEN economies in the IMF's IFS dataset.

7. Chen et al. (2014) introduced the estimated SSR to assess the domestic and global impact of the United States unconventional monetary policy. Claus et al. (2016) apply the SSR to investigate the United States and Japanese monetary policy spillover effect. Wu and Xia (2016) use the SSR as a quantitative measure of monetary policy in a factor-augmented vector autoregression.

Krippner data set.[8] The policy rates for Indonesia (IDN), South Korea (KOR) and Singapore (SGP) are collected from the IMF's IFS dataset (Concept: Interest Rate, Central Bank Policy Rate).[9] Chinese Taipei's policy rate is the interbank overnight call-loan rate collated from the dataset of the Central Bank, Chinese Taipei. Our sample period is from January 2000 to December 2015.

A variety of descriptive statistics for (shadow) policy rates is shown in Table 2. The means of policy rates are mostly positive (only JPN is negative). Figure 3 displays the time series plot of policy rates over the sample period. As can be seen from the graphs, the pattern of policy rates is quite similar in all the economies under analysis. While the policy rate in TPE is quite low, it is not constrained by the zero lower bound. [10]

Table 2
Descriptive Statistics of (Shadow) Policy Rates

Unit: %

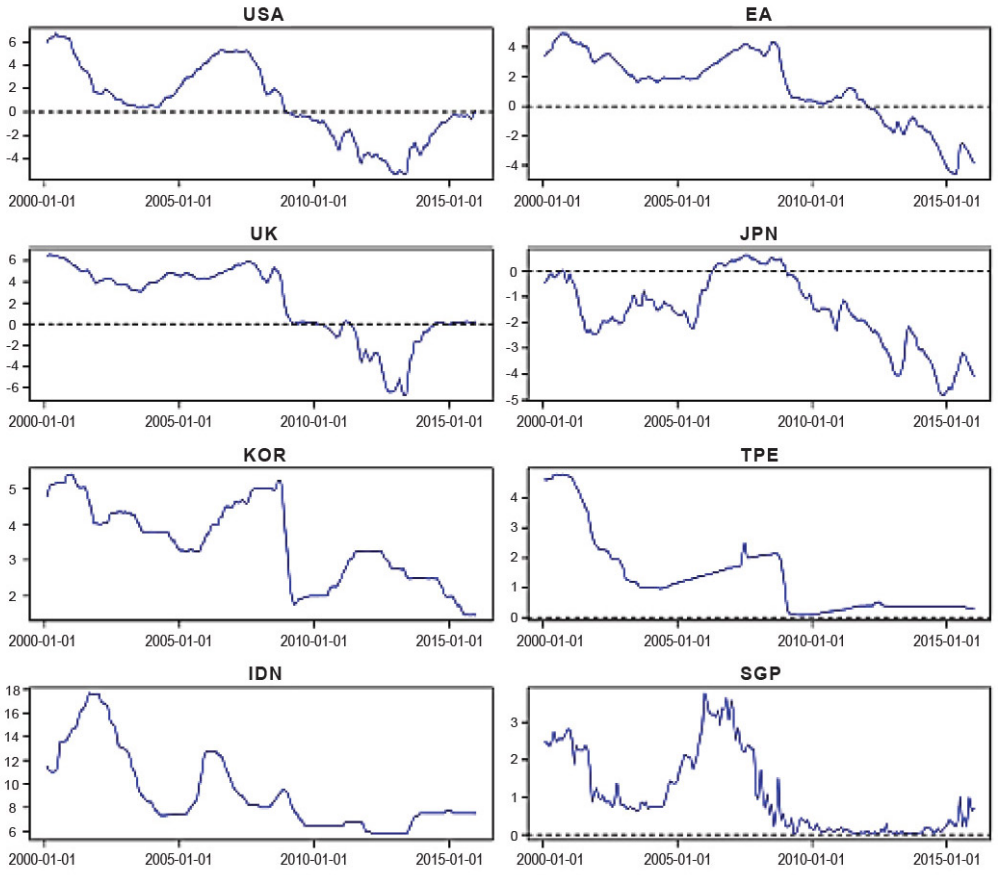
	USA (SSR)	*EA (SSR)*	*UK (SSR)*	*JPN (SSR)*	*KOR*	*TPE*	*IDN*	*SGP*
Mean	0.74	1.32	1.98	-1.56	3.48	1.35	9.20	1.07
Std. Dev	3.20	2.39	3.45	1.4	1.11	1.29	3.24	1.07
Min	-5.37	-4.59	-6.76	-4.82	1.48	0.1	5.75	0.02
Max	6.74	4.92	6.56	0.62	5.39	4.8	17.67	3.78

8. http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures

9. Data on policy rates is available for these SEACEN economies in the IMF's IFS dataset.

10. Perng Fai-nan, Governor of the Central Bank, Chinese Taipei, said that Chinese Taipei will not go to a zero interest rate environment. See https://englishnews.ftv.com.tw/read.aspx?sno=15DF2B22E969CB4A30C18EBBF9E9BDA5) He also said that Chinese Taipei does not need negative rates yet. (https://englishnews.ftv.com.tw/read.aspx?sno=346F2EB16325C2362420302ECC19CD74)

Figure 3
Time Series Plot of the (Shadow) Policy Rates



The other global liquidity indicator is the long-term interest rate. Long-term interest rates serve as proxies for liquidity since they reflect expected future monetary conditions. We put together a dataset for eight economies: USA, EA, JPN, UK, KOR, TPE, SGP and MYS, from January 2000 to December 2015, taken from the IMF's IFS dataset (Concept: Interest Rate, Government Securities, Government Bonds)[11] and the dataset of the Central Bank, Chinese Taipei (Concept: 10 Year Government Bond Rates in Secondary Market).

The descriptive statistics for long-term interest rates are provided in Table 3. KOR has the highest mean interest rate, followed by UK, EA, USA, MYS, SGP and TPE. The long-term interest rates are plotted in Figure 4, which shows a downward trend in all eight economies.

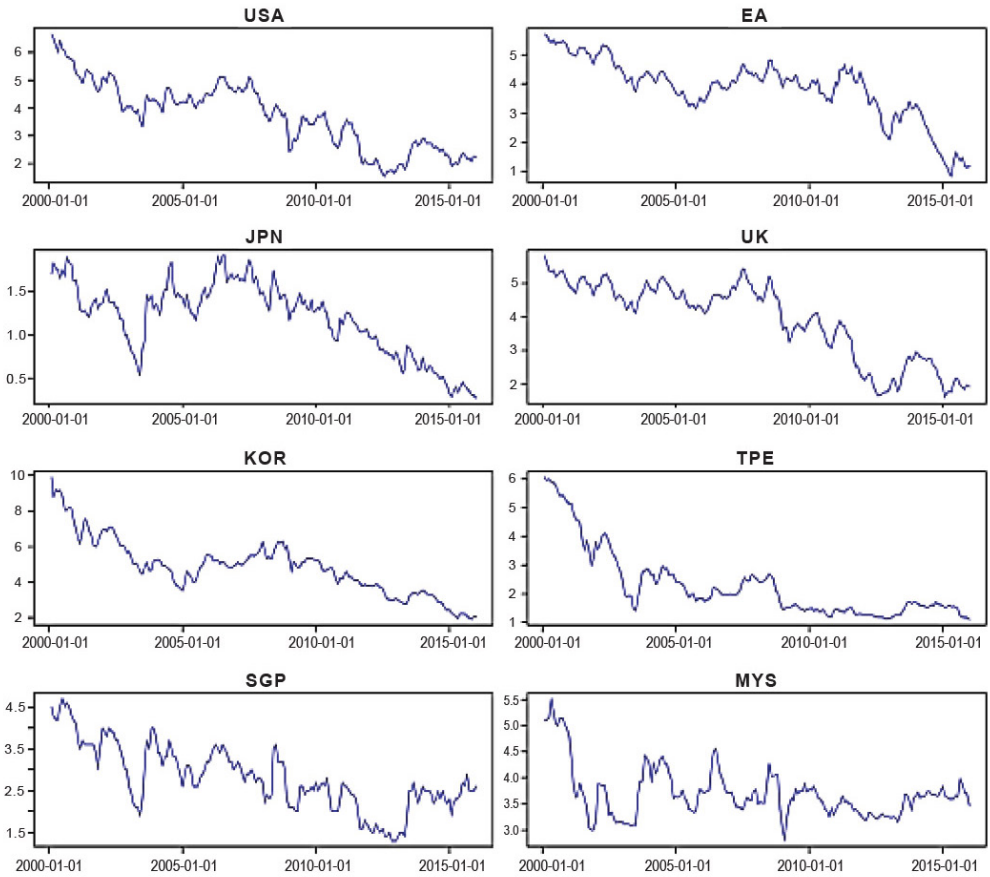
11. Data on long-term interest rates is available for these SEACEN economies in the IMF's IFS dataset.

Table 3
Descriptive Statistics of Long-term Interest Rates

Unit: %

	USA	*EA*	*JPN*	*UK*	*KOR*	*TPE*	*SGP*	*MYS*
Mean	3.71	3.84	1.19	3.89	4.84	2.28	2.79	3.70
Std. Dev	1.21	1.06	0.43	1.17	1.59	1.2	0.78	0.49
Min	1.53	0.85	0.27	1.59	1.91	1.11	1.30	2.79
Max	6.66	5.7	1.92	5.82	9.91	6.06	4.67	5.52

Figure 4
Time Series Plot of the Long-Term Interest Rates



5. Empirical Results

In the following, we analyze the transmission of global liquidity using policy rates and long-term interest rates. A static (full sample) and dynamic (rolling sample) analysis for connectedness is conducted for the sample economies.

5.1 Policy Rates

5.1.1 Static Analysis

The matrix in Table 4 presents the full sample cross-country connectedness of the policy rate. All results in the table are based on vector autoregressions of the order 3, selected by the general-to-specific sequential Likelihood Ratio test and generalized variance decompositions of 3-month step ahead forecast errors.[12]The diagonal elements of the matrix represent the own economy connectedness.[13] The off-diagonal elements of the matrix measure the pairwise directional connections and are particularly interesting in our research. The off-diagonal column sums or row sums are the directional connectedness "*TO others*" (measured by $C_{\cdot \leftarrow i}$) and "*FROM others*" (measured by $C_{i \leftarrow \cdot}$), and the difference between the "*TO others*" and "*FROM others*" is the "*NET*" directional connectedness. The total connectedness index is presented in the bottom-right corner.

The total connectedness index for the full sample period is 35.66%, indicating that less than 40% of the total variance of the forecast errors for the eight economies is explained by the connectedness of shocks across economies. In the connectedness "*TO others*" row, the UK is the country that contributed the most to other economies' forecast error variance (67.82%), followed by the USA (66.85%) and EA (61.24%). JPN, KOR and TPE contributed 23.12%, 26.37%, and 18.90%, respectively. In terms of the directional connectedness received "*FROM others*", IDN appears to be the economy that received the lowest percentage of shocks from other economies (6.19%), followed by SGP (27.61%) and JPN (29.40%). The USA received the highest percentage (52.96%) of shocks from other economies, followed by the UK (45.18%) and TPE (43.47%).[14]

12. Klobner and Sekkel (2014) also apply 3-month step ahead forecast error variance decomposition to investigate policy uncertainty shocks.
13. Diebold and Yilmaz (2015) denote that connectedness is based on assessing shares of forecast error variation in various locations due to shocks arising elsewhere.
14. The US Federal Reserve should consider the shock of foreign interest rate because it is the key variable of foreign activity in the FRB/US model. Fischer (2016) introduces the simulations that underlie the estimates of the effect of foreign interest rate disturbance for the federal funds rate, using simulations of the FRB/US model.

Table 4
Full Sample of Directional Policy Rate Connectedness

Unit : %

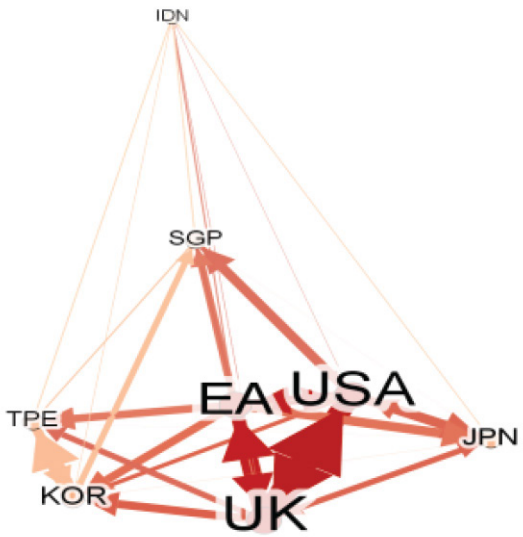
	USA	*EA*	*UK*	*JPN*	*KOR*	*TPE*	*IDN*	*SGP*	*FROM others*
USA	47.04	9.71	25.44	8.80	1.01	2.56	0.21	5.22	52.96
EA	11.44	56.98	16.83	5.98	1.76	3.20	0.02	3.79	43.02
UK	20.43	13.10	54.82	6.75	1.24	1.75	0.47	1.44	45.18
JPN	11.46	11.14	6.51	70.60	0.03	0.08	0.14	0.04	29.40
KOR	4.89	9.16	10.03	0.22	62.54	9.45	0.72	2.99	37.46
TPE	8.18	9.35	6.96	0.09	15.75	56.53	1.49	1.65	43.47
IDN	0.34	1.63	0.45	1.18	0.36	0.73	93.81	1.49	6.19
SGP	10.11	7.15	1.59	0.09	6.23	1.13	1.31	72.39	27.61
TO others	66.85	61.24	67.82	23.12	26.37	18.90	4.36	16.64	**35.66**
NET	13.89	18.22	22.64	-6.29	-11.09	-24.57	-1.83	-10.97	

The difference between the total directional connectedness "*TO others*" and the total directional connectedness "*FROM others*" gives the "*NET*" total directional connectedness to others ($C_i = C_{\cdot \leftarrow i} - C_{i \leftarrow \cdot}$). The "*NET*" connectedness varies from the lowest, -24.57%, for TPE, to the highest, 22.64%, for the UK. In between, the EA, USA, IDN, JPN, SGP and KOR have "*NET*" connectedness of 18.22%, 13.89%, -1.83%, -6.29 %, -10.97 %, and -11.09 %, respectively. To sum up, UK, USA, and EA appear to be dominant transmitters, while TPE, KOR, SGP and IDN are net recipients. These results indicate that advanced economies (UK, USA, and EA) may well channel capital to emerging markets.

Chart 4 presents the full-sample static connectedness plot. The nodes represent the eight economies examined in our paper. The size and color of each node indicate the size of the total connectedness of the policy rate "*TO others*" (from dark red (strongest) to peach, light salmon and beige (weakest)). The edge thickness indicates the average pairwise directional connectedness. The size of edge arrows indicates

pairwise directional connectedness "*TO others*".[15] This graph displays connections based on their distance and thickness. The UK, USA and EA have the highest total connectedness "*TO others*" as indicated by their dark red nodes. They are followed by KOR and JPN for which nodes are peach, and TPE and SGP with light salmon nodes. IDN has the lowest connectedness "*TO others*".

Chart 4
Pairwise Directional Connectedness over the Full Sample



We will next focus on the cross-country directional connectedness measures. We find that there are two main clusters. One is USA, UK, and EA, the other is TPE and KOR. The highest pairwise connectedness measure observed is from UK to USA (25.44%). In turn, the pairwise connectedness from USA to UK (20.43%) is ranked second. One factor behind the high pairwise directional connectedness between USA and UK is the high degree of business cycle synchronization. Furthermore, the connectedness from UK to EA, 16.83%, and from EA to UK, 13.10%, is due to the fact that there is a strong tie between their financial sectors.

Another important pair of economies is TPE and KOR. The connectedness from TPE to KOR is 9.45% while the connectedness from KOR to TPE is15.75%, both of which exceed the pairwise directional connectedness between TPE (KOR) and advanced economies. Based on our bilateral analysis, the high pairwise connectedness between the two economies could be due to the fact that they have several similarities, i.e., their industrial structure, common export markets and their being major Asian financial markets.

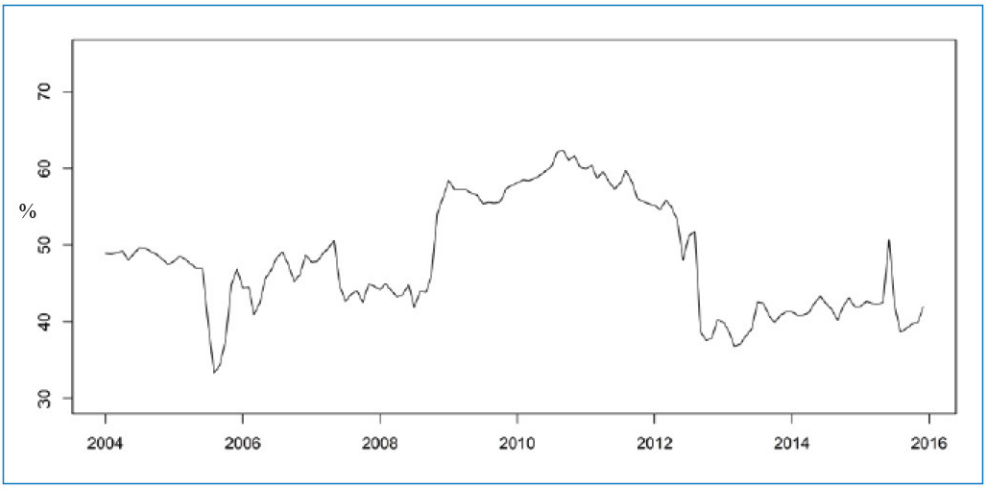
15. The node location is determined by the *ForceAtlas2* algorithm of Jacomy et al. (2014).

5.1.2 Dynamic Analysis

The static analysis only provides the characterization of connectedness over the full sample. It cannot help us understand how connectedness changes over time. Hence, we re-estimated the connectedness using a 48-month rolling sample, and we assessed the extent and the nature of variation in connectedness over time via the corresponding time series of connectedness indices. In Figure 5, the plot of the total connectedness over 48-month rolling-sample window is shown. From a bird's-eye perspective, the total connectedness plot in Figure 5 has some revealing patterns. The first cycle starts in mid-2004 and ends in 2006, while the total connectedness index fluctuates between 33% and 50%. This coincides with the tightening of monetary policy for USA, UK and EA. For example, during 2004 to 2006, the Federal Open Market Committee (FOMC) raised the federal funds rate target in 17 consecutive meetings, lifting the federal funds rate from 1.0% to 5.25%.

The second cycle coincides with the global financial crisis and the European sovereign debt crisis from 2008 to the end of 2012 when the index recorded the biggest jump in history. The index increased sharply from 41% in May 2008 to 56% in December 2008, and then to 62% in November 2010. The index subsequently fell during the taper tantrum. This cycle resulted from monetary authorities of USA, UK, EA, and JPN, responding quickly to the financial crisis shocks, but yet were still experiencing ongoing downward adjustments of policy rates that were constrained by the zero nominal bound. We could find monetary spillovers taking place from these countries to the SEACEN economies.

Figure 5
Total Policy Rate Connectedness (48-month Window)



We then estimated the abovementioned rows and columns of Table 4 dynamically in a manner precisely parallel to the total connectedness plot discussed earlier. The upper panel of Figure 6 presents the "*TO others*" connectedness. As discussed earlier, this is the directional connectedness from each economy to others and corresponds to the "*TO others*" row in Table 4. The middle panel of Figure 6 presents the "*FROM others*" connectedness, which is the directional connectedness from others to each economy and corresponds to the "*FROM others*" column in Table 4. Finally, the lower panel shows the "*NET*" connectedness of each economy as measured by the difference between its "*TO others*" and "*FROM others*" connectedness.

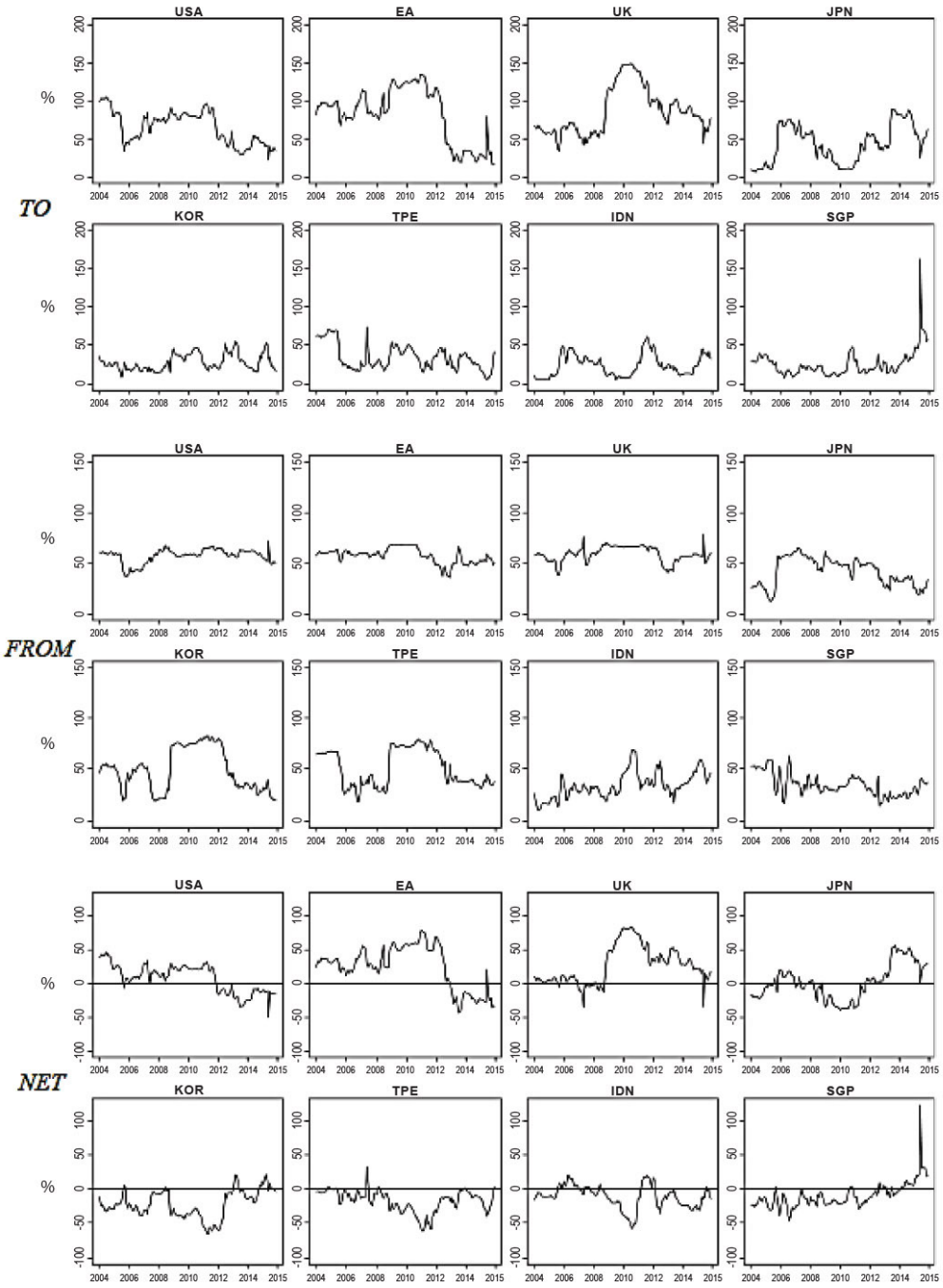
Looking at the upper panel of Figure 6, we find that the "*TO others*" connectedness measures of JPN, KOR, TPE, IDN, and SGP are much smoother compared to the other economies. This is because USA, EA, and UK generated the volatility connectedness to others during the global financial crisis until the end of 2011. For example, the "*TO others*" connectedness measure of UK jumped significantly (100 percentage points) following the crisis. Meanwhile, the "*TO others*" connectedness measure of EA jumped by 40 percentage points. This is expected due to the century low, near zero interest rates in USA, UK, and EA after the global financial crisis of 2008/2009 and the European sovereign debt crisis of 2010-2012. As these countries used monetary policy to provide liquidity and stimulate the economy, there were likely policy spillovers. In particular, we found that SGP jumped significantly (over 100 percentage points) in 2015. The reason for this may be due to the decision of the Monetary Authority of Singapore to further ease its monetary policy.[16]

We next focused on the "*FROM others*" connectedness measures in the middle panel of Figure 6. The "*FROM others*" connectedness measure of USA, EA and UK is around 50% during this length of time. Noticeably, the "*FROM others*" connectedness measures of KOR and TPE rocketed during the global financial crisis and the European sovereign debt crisis. While the "*FROM others*" connectedness stayed below 40%, they turned to a new high after the crisis by fluctuating around 80%. IDN's "*FROM others*" connectedness is less than 40% before 2008. The "*FROM others*" connectedness measure surged to above 70% in early 2010 and to approximately 50% in early 2012. This finding suggests that the monetary policies of USA, EA, and UK had sizable spillovers on SEACEN economies.

The "*NET*" connectedness measures (in the lower panel of Figure 6) of USA and EA are mostly positive from 2004 to the end of 2012. The "*NET*"

16. The MAS made a surprise cut to the slope of its Singapore dollar nominal effective exchange rate (S$NEER) in January 2015. In October 2015, the MAS kept the Singapore dollar nominal effective exchange rate policy band on a modest and gradual appreciation path.

Figure 6
Directional Policy Rate Connectedness



connectedness for them are 30% and 50%, respectively. From late 2008 to 2015, the "*NET*" connectedness of UK fluctuated between 40% and 80%, meaning that these economies are main contributors to other markets. We also found that JPN's "*NET*" connectedness reached a peak from 2012 until the end of 2014, and may be the result of "Abenomics" which included correction of the excessive yen appreciation, setting negative interest rates, radical quantitative easing, and so on. The "*NET*" connectedness measures of KOR, TPE, IDN, and SGP, on the other hand, have been mostly negative throughout the sample period, meaning that these economies are net receivers over time. This finding is consistent with those of Chen et al. (2012) and Rogers et al. (2014), both of whom provide evidence on the international spillovers of monetary policy by USA, EA and UK.

5.2 Long-term Interest Rate

5.2.1 Static Analysis

In Table 5, we analyze the connectedness of long-term interest rates in eight economies. The results are based on VAR (6) selected by the general-to-specific sequential Likelihood Ratio test, and the use of the 3-month step ahead forecast error variance decomposition. The total connectedness over the entire period is 60.54%, as shown in the lower right corner of Table 5. This result indicates that our sample economies are highly interconnected.[17] The UK has the highest "*NET*" connectedness value at 27.41%, followed by the USA at 26.62%, implying that the two economies are net transmitters of long-term interest rate shocks. In contrast, TPE, EA, MYS, and KOR have negative "*NET*" connectedness values at -32.22%, -28.28%, -23.49%, and -13.07%, respectively, suggesting that these economies are net recipients.

From the connectedness table, we find that the movement of long-term interest rates of USA, EA, and the UK is susceptible to other economies, while at the same time also contributing to spillovers in large proportions on other economies. To have a more intuitive understanding of the spillover effects, we used the data in Table 5 to plot the network graph presented in Figure 7, which shows the connections based on the distance and the thickness. We found that there is only one cluster, consisting of USA and UK, with the pairwise connectedness from USA to UK at 20.18%, and the pairwise connectedness from UK to USA at 23.90%. The higher the degree of financial linkages, the higher is the level of contagion from global liquidity shocks

17. This is relatively high compared to findings of papers, for instance, 27.1% for policy uncertainty (Klobner and Sekkel, 2014), 28.8% for business cycle (Diebold and Yilmaz, 2015), 33.3% for inflation spillover (Halka and Szafranek, 2016), 39.5% for stock market volatilities (Diebold and Yilmaz, 2009), and 42.7% for macroeconomic uncertainty (Yin and Han, 2014).

to long-term interest rates. We also observe that there is a large distance between EA and MYS, indicating that there is no significant direct connection between these two economies.

5.2.2 Dynamic Analysis

The total connectedness over time, obtained from a 48-month rolling windows approach is illustrated in Figure 8. As shown in the figure, there is a variation in the total connectedness measure, which turns out very responsive to extreme economic events, for example, reaching a peak during the global financial crisis period.

Table 5
Full Sample of Directional Long-Term Interest Rates Connectedness

Unit: %

	USA	*EA*	*JPN*	*UK*	*KOR*	*TPE*	*SGP*	*MYS*	*FROM others*
USA	27.88	8.04	9.76	23.90	5.52	4.21	13.71	6.98	72.12
EA	13.07	37.33	8.43	18.37	6.48	4.82	9.72	1.78	62.67
JPN	12.97	3.13	50.71	9.63	2.73	2.93	14.03	3.87	49.29
UK	20.18	7.98	11.22	34.7	3.42	6.06	12.09	4.36	65.3
KOR	10.91	4.71	3.79	10.27	51.68	1.14	13.22	4.27	48.32
TPE	12.63	4.64	12.94	9.63	2.39	39.28	11.38	7.11	60.72
SGP	14.79	3.82	16.31	13.15	7.29	4.62	32.98	7.03	67.02
MYS	14.18	2.07	7.90	7.76	7.41	4.72	14.86	41.11	58.89
TO others	98.74	34.39	70.34	92.71	35.25	28.50	89.00	35.41	60.54

Figure 7
Pairwise Directional Connectedness over the Full Sample

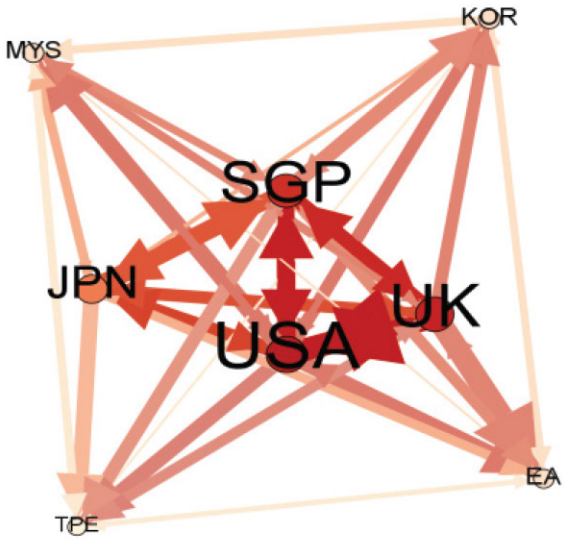
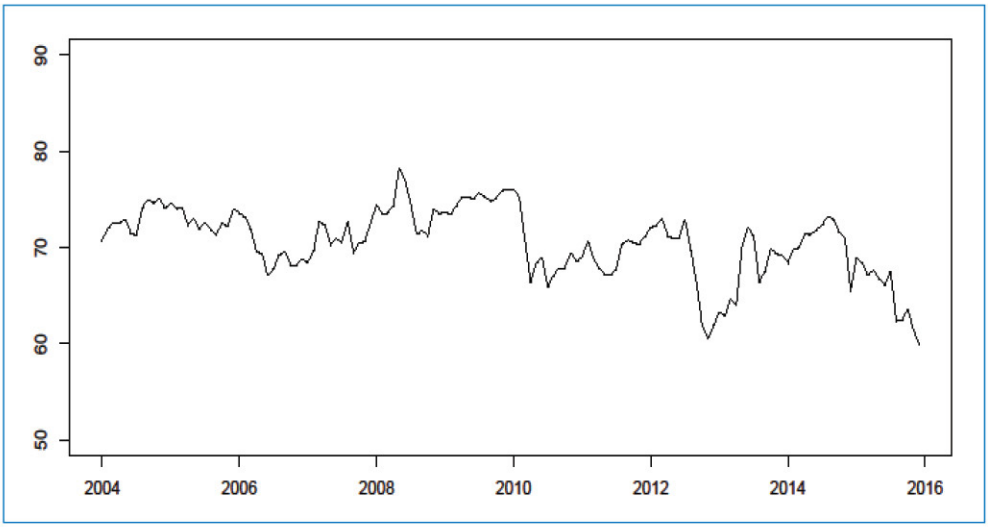


Figure 8
Total Long-Term Interest Rate Connectedness (48-month Window)



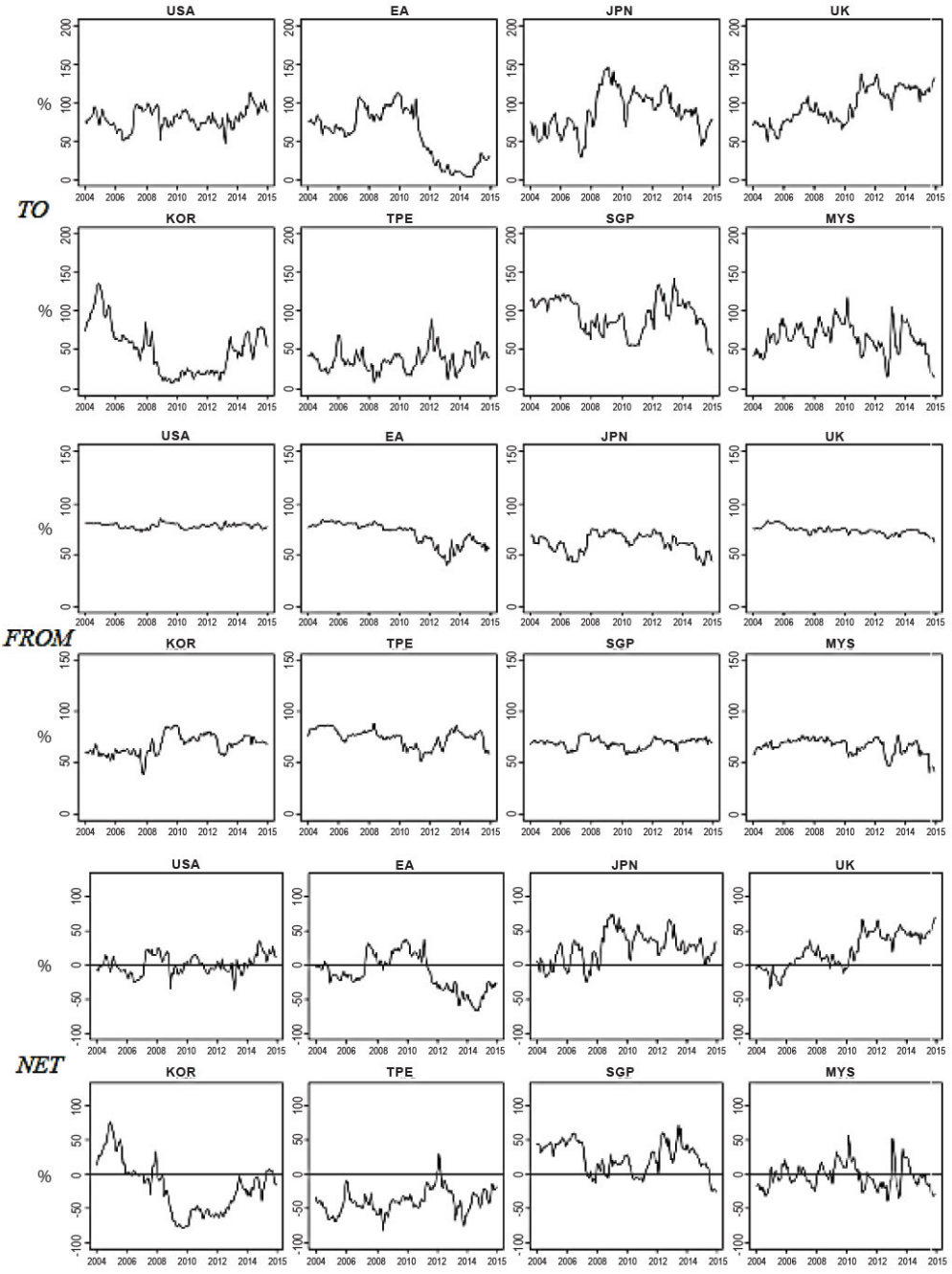
Time-varying depictions of directional connectedness of "*FROM others*", "*TO others*", and "*NET*" are presented in Figure 9. The upper panel of Figure 9 which shows the dynamic behavior of the directional connectedness is quite different across economies. The "*TO others*" connectedness measures of USA and UK have increased gradually since 2008. JPN's "*TO others*" connectedness is relatively volatile over the sample period, amounting to over 100% in late 2005, during the global financial crisis and the European sovereign debt crisis. Generally, the "*TO others*" connectedness measure of SEACEN economies (except SGP) is relatively low over the period examined.

In order to explore the roles of the economies, i.e., whether they are net transmitters or net receivers of global liquidity shocks, we concentrated only on the "*NET*" directional connectedness measures. It is evident in the lower panel of Figure 9 that JPN seems to be the dominant transmitter of global liquidity shock, with USA, EA, UK and SGP at the epicenter of the transmission process during the period of the global financial crisis and the European sovereign debt crisis.[18] Conversely, the plotting for KOR, TPE, MYS is mostly negative during the sample period, meaning that they are mainly recipients of net transmissions. In addition, we find that the "*NET*" connectedness of TPE moves only mildly.

On the whole, we find that no matter whether it is the policy rate or long-term interest rate, the results for the transmission of global liquidity for USA, UK, EA, JPN and SEACEN economies are consistent with our hypothesis. The bigger economy is a net transmitter of the global liquidity shocks to the smaller economies. The results are broadly in line with the findings of Choi et al. (2014) and Hofmann and Takat (2015) in that global liquidity generated from advanced economies inflicts an impact on emerging markets.

18. From a long-term interest rate perspective, SGP may be a transmitter because of its exchange rate-based monetary policy. The Singapore dollar is managed against a basket of currencies of major trading partners and competitors (i.e. USA, UK, and EA etc.). The choice of the exchange rate as the intermediate target of monetary policy implies that MAS relinquish control over domestic interest rates.

Figure 9
Directional Long-Term Interest Rate Connectedness



6. Conclusions

This paper aims to investigate the global liquidity transmission of advanced economies and selected SEACEN members, using monthly data over the time frame of 2000-2015. We applied the VAR-based connectedness approach by Diebold and Yilmaz (2009, 2012, 2014, 2015), which while well suited to this intention, has rarely been used for this purpose so far.

By monitoring the connectedness of global liquidity shocks, we set out to prove that the total connectedness indexes show quite robust interdependence of global liquidity across the sample economies, with SEACEN members being "net receivers" of global liquidity shocks in the period examined. For policy rates, we find that Chinese Taipei, South Korea, Singapore, and Indonesia are net recipients from UK and USA, with Chinese Taipei being the largest in the static analysis. The dynamic analysis clearly shows that there has been a substantial increase in the total connectedness index since the global financial crisis and the European sovereign debt crisis. Chinese Taipei, South Korea, Singapore, and Indonesia are also net receivers over time.

For long-term interest rates, our static results show that USA and UK have sizable spillovers onto the rest of the economies. Conversely, Malaysia, Chinese Taipei and South Korea are net receivers of global liquidity shocks. The dynamic analysis indicates that the total connectedness index displays no trend, but shows clear spurts, reaching the highest level during the global financial crisis. Japan seems to be the dominant exporter of shocks, whereas South Korea, Chinese Taipei and Malaysia are net importers over the examined period. Despite the significant findings, we acknowledge certain limitations in this paper in that only various bilateral linkages can be presented in the research. Our model does not have a proxy for global shocks and therefore, cannot capture all the dimensions of the effect of global liquidity.

From a policy perspective, the transmission of global liquidity to SEACEN economies needs to be understood and taken into account by central banks. Our research indicates that central banks should look carefully not only at the evolution of the domestic conditions but also at the external environment. Our findings are similar to those of He and McCauley (2013) which states that the transmission of global liquidity to Asian economies needs to be understood and taken into account by policy makers in advanced countries. Caruana (2014) also suggests that global conditions have a growing economic impact on domestic economic conditions in an interconnected world.

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Chapter 9

THE IMPACT OF GLOBAL LIQUIDITY ON THE ECONOMY OF VIETNAM

By
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1. Introduction

Global liquidity has been an ongoing concern for policy makers, and a debatable concept within the international monetary system among researchers. The concept of global liquidity is perceived as vague but it is a fundamental driver of capital flows, asset prices and inflation. The term "global liquidity" has been used in various ways, which will be further elaborated in detail in this paper. Briefly, it has been used to "show the stance of monetary policy in major currency areas." (Domanski, 2011). Policymakers and academics have come to the same consensus that global liquidity is more of a threat to financial stability rather that the positive effects it can have on an economy. Global liquidity as a whole and its drivers are of significant importance to global market conditions, both during the initial phase of the build-up of vulnerabilities, and after financial damage has been realized. This was explained by the Ad hoc Committee on Global Financial System as follows: (i) global integration creates an impact on each individual country's economic condition, causing changes in capital flows, credit dynamics, financial assets and property prices; (ii) the mismatches in currency maturities among major economies could also lead to the build-up of exposure to financial risks; (iii) shortages of global liquidity directly affects economic growth; and, (iv) policies that are designed to deal with a certain global liquidity level could also impact capital flow patterns and entire financial markets.

This paper focuses on the impact of global liquidity on the economy of Vietnam and its banking system. Firstly, it summarizes some literatures on the development and impact of global liquidity on the economy. Secondly, the paper reviews the State Bank of Vietnam's conduct of monetary policy which focuses on a growth target rather than a price stability target. The main findings are: firstly, although global liquidity generates increases in output, it ultimately leads to higher inflation and domestic currency appreciation. The failure to sterilize high foreign cash inflows encourages the banking system to give credit, leading to a very high risk

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balance sheet for both the banking system and households. Should there be an abrupt reversal, global liquidity can cause currency devaluation, deterioration in the balance sheet and macroeconomic instability.

2. Literature Review

A fair share of literature look at global liquidity as total money aggregates, connecting narrow money and broad money. Sousa and Zaghini (2004) conducted a research on global liquidity for the Euro sector and found that it is the main driver behind the different price fluctuations of the Euro area. Coming to a similar conclusion, Ruffer and Stracca (2006) recognized changes in the price level of the Euro area and Japan as resulting from the positive shock to global excess liquidity. Furthermore, global liquidity exerts, to a certain extent, certain impacts on asset and commodity prices.

Darius and Radde (2010) proxied global liquidity as money reserves along with foreign exchange reserves. They used a VAR-approach and found that global liquidity shocks had a sluggish but persistent impact on global house and commodity prices. However, there is a lesser impact on equity prices. Meanwhile, Thomas Muhleisen and Pant (2010) came up with a model which captured the strong effect of global liquidity on oil prices but did not find evidence for a speculative motive.

Belke and Gros (2010) managed to prove that key drivers of asset prices in a country is strongly dependent on global liquidity conditions. Global liquidity effects will first be captured through inflation in asset prices followed by inflation in consumer goods at a later stage. They also posit that it is difficult for central banks to keep a stable financial stance. Coordination is required to exit from an expansionary monetary policy stance and to mop up excessive liquidity.

Psalida and Sun (2011) found strong positive links between the G-4 liquidity expansion and asset prices (e.g., equities) in economies that were receiving the funds. A strong positive linkage was also found between global liquidity and inflows of equity portfolio and the accumulation of official reserves. It was shown in the paper that there are increased risks in the liquidity-receiving economies once there is an excess in equity returns, credit growth and global liquidity.

The majority of the literature on global liquidity assesses its global transmissions. Chudik and Fratzscher (2012) used an infinite-dimensional VAR model, initially introduced by Chudik and Pesaran (2011), to conclude that the transmission of liquidity shocks was highly heterogeneous across countries, asset classes and over time. The Global Financial Crisis (GFC) of 2007-2008 had a much larger effect on countries compared to the sovereign-debt crisis of 2010-2011. Countries also experienced different impacts with emerging market economies

exhibiting a twice-as-large sensitivity to shocks compared to advanced economies – both in terms of asset prices and capital flows. They also experienced a geographical flight-to-safety phenomenon during the GFC but to a lesser extent since 2009, as markets reacted differently to the liquidity shocks during the two crises.

He and McCauley (2013) looked at the monetary policy transmission of major economies on selected countries, namely, China, Hong Kong and Korea. They analyzed five different transmission channels that overlap one other to some extent, including three price channels and two quantity channels. With the integration of the global bond markets, it was found that there was a shift of large-scale central bank bond purchases from major markets to lower bond yields in the local currency markets. The authors also showed that there exist certain "blow-back" effects for major economies should monetary accommodation carry exposure to risks.

Some literature also looked at the adverse spillovers on emerging markets and the reversal effect of capital. Rey (2013) showed that there is a global financial cycle, caused mainly by monetary policy setting of the U.S. – this cycle includes capital flows, asset prices and credit growth. Eichengreen and Gupta (2014) observed that there were sharp reversals of capital flows from countries that experienced strong currency appreciation and rapid capital inflow pressures.

3. Global Liquidity Impacts on the Vietnamese Banking System and Economy

3.1 Global liquidity

The GFC of 2008/2009 resulted in severe recessions in advanced economies. As a result, major central banks applied Quantitative Easing (QE) policies as the primary tool to revitalize their affected financial channels as well as to revive domestic demand.

For example, these major central banks, namely, U.S. Federal Reserve (Fed), the Bank of Japan (BOJ), the Bank of England (BOE) and the European Central Bank (ECB) have all implemented QE, at varying degrees but for similar reasons. The Fed conducted a series of asset purchases and increased its holdings of securities from March 2009 to April 2013. The value of assets reached US$ 2.2 trillion.

The BOJ had always been a forerunner since the 2000s in implementing unconventional monetary policies. During the period from 2010 through 2014, its assets portfolio increased by a remarkable 35%. "Abenomics" has continued with its easing policies and expanded the balance sheet even further with what is called the Qualitative and Quantitative Monetary Easing (QQME) consolidating a monetary

base of about 60 to 70 trillion Yen. The BOE along with the ECB, applied vast QE programs roughly during the same period as the Fed. During the period from March 2009 till the end of 2012, total assets of BOE increased by 2.5 folds. The ECB conducted programs before 2015 with the aim of injecting liquidity into the market to ease the situation for banks that were facing massive deleveraging and to stabilize the banking sector. From January 2015 to September 2016, the ECB bought a total of 60 billion Euros in assets monthly.

All these QE programs had a huge impact on international markets, including those of the Association of Southeast Asian Nations (ASEAN) economies of which Vietnam is part of. The QE has resulted in an enormous amount of capital floating in the market. The overall liquidity generated during the period of 2009 to 2013 from the aforementioned 3 major central banks amounted to roughly US$ 3.95 trillion. As investors are always look at opportunities for higher yields, the ASEAN economies became targets with their annual average GDP growth of approximately 4.7%. This led to large capital inflows into these countries.

Being provided with more funds and capital inflows helped these economies to deepen and broaden their financial markets. Moreover, they also act as a counter effect should asset prices rise and destabilize the market. Such an effect would occur should a reversal in capital flows occur (Balakrishan et al., 2012).

3.2 Impacts on Vietnam and Policy Changes

In the context of Vietnam where the domestic economy is undergoing extensive global integration, this has led to an increase in the pace of trading and capital inflows, which in turn has complicated the process of designing and monitoring appropriate monetary policies. Flexible monetary policies have been conducted via the adaptation of several monetary policy tools as follows:

From early 2007 to June 2008, with the aim of reducing the excess liquidity caused by strong foreign capital inflows, The State Bank of Vietnam (SBV) constantly adjusted the interest rates. From end 2008 to early 2009, with the reduction in inflationary pressure, SBV decreased interest rates in order to foster economic development.

From 2009 to the first quarter of 2010, the central bank implemented the base interest rate mechanism for which financial institutions would set the lending and deposit rates within 150% of the base rate. In 2011, SBV increased rates to tighten monetary policy for dampening inflation.

In 2012, when inflation started to ease and stabilize, interests were once again reduced to a level which was appropriate for the targeted inflation.

Reserve requirement, namely, the required reserve ratio, was also used as a tool, and was adjusted flexibly in line with the objectives of monetary policies and economic development at each stage. In 2007, to neutralize the excess liquidity flowing in the banking system due to strong inflows of foreign currencies as well as to tighten policies to curb inflation, SBV decided to increase the required reserve for financial institutions from the middle of 2007 to early 2008, and adjusted the deposit reserve requirement rate.

The exchange rate was also adjusted significantly in the attempt to closely reflect demand and supply. For the period before 2011, the exchange rate had always been under pressure to increase. The exchange market was in turmoil, resulting in SBV adjusting the central rate to increase by 9.3% on February 2011, while also narrowing the trade band from 3% to 1%. Since then, the SBV has continued to intervene to maintain a stable exchange rate. In 2012 and 2013, the central bank targeted the exchange rate to increase by no more than 2-3% a year in order to control the expectations of the devaluation of the Vietnamese Dong, thereby fostering a stable economic environment for investors and businesses. In fact, the exchange rate was only adjusted by 1% on 28 March 2013. The pressure to stabilize the exchange rate for the Vietnamese Dong became more evident when the Chinese government decided to modify the exchange rate of the RMB and the U.S. Fed increased interest rates. SBV had to devaluate the Dong three times within the year of 2015 (January, May and August) by 1% each time. It also had to expand its band from ±1% to ± 3% on the 19 August 2015.

4. An Empirical Analysis of Global Liquidity Impact on the Vietnamese Economy

4.1 Methodology and Data

To examine the impact of global liquidity on Vietnam's economy and the response of monetary policy, this research employs the VAR (vector autoregressive model) model including both external and domestic variables. The reduced form of a VAR simply involves the regression of several variables on its own lags.

$$y_t = \alpha + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t \quad (1)$$

where: y_t is a 6×1 vector of external and domestic variables y_t=(liq_t, gdp_t, cpi_t, exc_t, ms_t, res_t). Liq is the US dollar, Euro and Japanese Yen credit to non-residents (non-bank sector), gdp is real gross domestic product, cpi the consumer price index, exc the nominal exchange rate, ms money supply, and res is bank reserves. A_i are 6×6 autoregressive coefficient matrices, ε_t is an 6×1 vector of serially and mutually exclusive innovations. All the variables are at log-levels.

The liq variable represents the availability of liquidity from the three largest advanced economies to non-resident recipients, including Vietnam. The gdp variable is the measure of economic activity while the cpi variable represents price level fluctuations. The exc variable measures the VND/USD exchange rate. Given the fact that the Central Bank of Vietnam usually manages the rate at a specified-target level, the exchange rate, GDP growth rate and the inflation rate are considered targets of monetary policy. Money supply is money plus quasi-money (including currency outside deposit money banks, demand deposits, time and saving deposits). The res variable is the reserve of deposit money banks (reserve money minus currency outside other depository corporations), which reflects the foreign exchange intervention of the central bank in response to foreign capital flows.

The global liquidity variable is ordered first as a largely exogenous variable. Given that the real sector reacts sluggishly to financial variables, the real gross domestic product and price level are ranked before exchange rate and monetary variables. Since the exchange rate is kept quite stable, the exchange rate variable is ordered before money supply and bank reserves.

The sample period is from 2004m01 to 2015m09. The data on global liquidity is extracted from the Bank for International Settlements (BIS) global liquidity indicator data, and only the US dollar, Euro, and Japanese yen credit to non-residents (non-bank sector) is used. For domestic variables, the consumer price index, broad money supply, bank reserves are taken from International Financial Statistics (IFS) of the International Monetary Fund. The gross domestic product data is collected from the Vietnam's General Statistics Office. The global liquidity and gross domestic variables are interpolated from quarterly to monthly data. All variables are seasonally adjusted and expressed in logarithm. A lag order of three month is chosen.

4.2 Empirical Results

Figure 1 shows the impact of a global liquidity shock on the economy of Vietnam. Higher liquidity availability increases both real GDP and the price level. The response of real GDP to a global liquidity shock is statistically significant at the 10% level for 9 months. After that, the appreciation of the Vietnam Dong in response to higher capital inflows constraints the dynamics of export industries and encourages the public to spend more on imported goods, limiting the positive impact of foreign cash inflows. Similarly, a global liquidity shock causes a significant increase in the consumer price index because of higher money supply (the central bank buys US dollar to increase foreign reserves), credit (higher bank reserves encourages increased bank lending) and import (due to higher income and stronger domestic currency).

Figure 1a
Response of real GDP to a One Standard Deviation Shock to Global Liquidity[3]

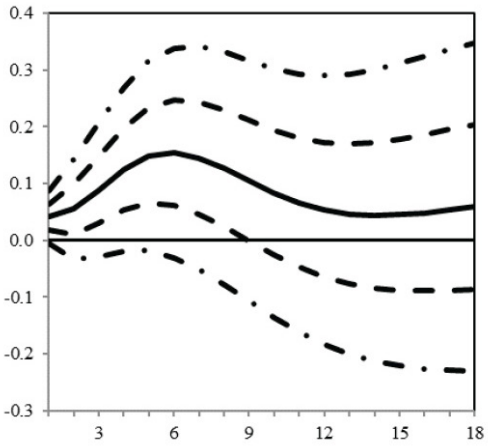


Figure 1b
Response of CPI to a One Standard Deviation Shock to Global Liquidity

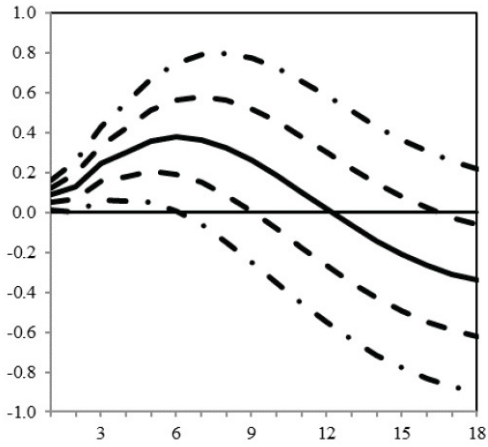


Figure 2 shows the response of the exchange rate to a one standard deviation shock to global liquidity. The domestic currency appreciates gradually as more foreign currency is poured into the country and reaches the highest impact after 15 months. In response to higher foreign inflows, bank reserves increase significantly (Figure 3). The impact is magnified by the foreign exchange intervention of the

Figure 2
Response of the Exchange Rate to a One Standard Deviation Shock to Global Liquidity

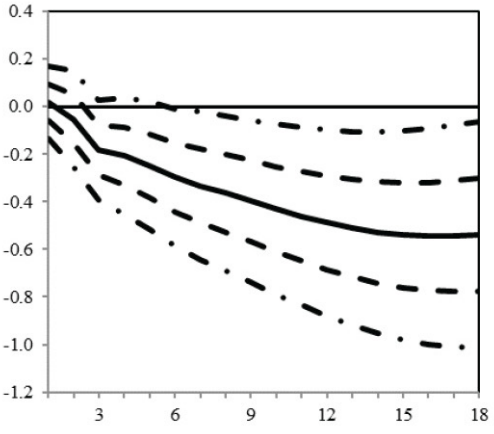
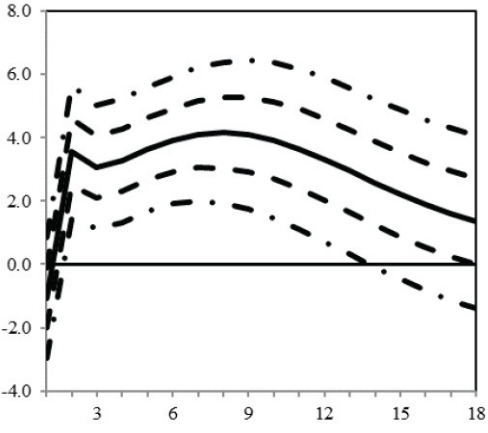


Figure 3
Response of Bank Reserves to a One Standard Deviation Shock to Global Liquidity

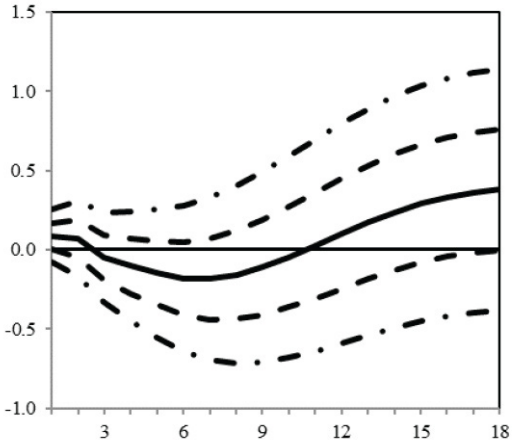


3. Round and dash dot lines represent one and two standard error bands.

central bank. The US dollar inflow increases foreign reserves and without (or not equivalent) offsetting intervention, the reserves of commercial banks would increase dramatically. This results in increased commercial bank lending in high risk areas of consumer, real estate and securities debts.

In response to higher output and price level, the central bank tends to tighten monetary policy by decreasing money supply (Figure 4). The response is not significant at 5% and 10% respectively, reflecting the fact that in some periods, the central bank focuses on the growth target rather than the price stability target. This is supported by the response of money supply to output and price level shock. While money supply is contracted by monetary policy tightening in response to inflation rate shock, the money supply is increased to continue supporting economic growth.

Figure 4
Response of Money Supply to a One Standard Deviation Shock to Global Liquidity



When the output was higher than potential output in the period of 2006 – 2007 and 2009 – 2010, Vietnam's economy suffered very high inflation in the subsequent years, the year 2008 and 2011 respectively (Figures 5a and 5b). This is clear evidence of a monetary policy that favor the economic growth target rather than price stability target.

Figure 5a
Response of Money Supply to a One Standard Deviation Shock to Output

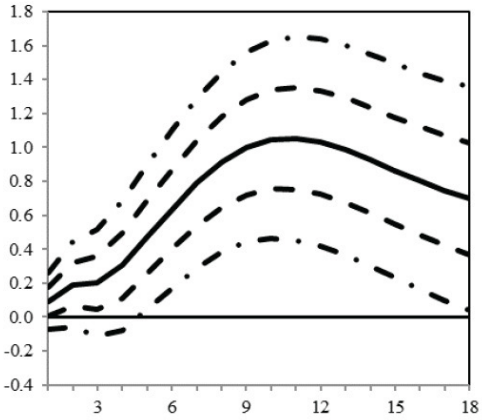
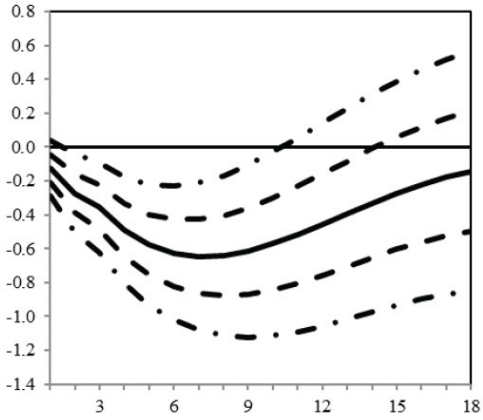


Figure 5b
Response of Money Supply to a One Standard Deviation Shock to Consumer Price Index



Two robustness checks for the above analysis were also conducted. The first check comprised choosing different variables representing global liquidity. Instead of using total U.S. dollar, Euro, and Japanese yen credit to non-resident to represent the global liquidity indicator, two other variables were selected. The first is the U.S. dollar, Euro, and Japanese yen credit to both residents and non-residents. The second variable is the VIX – CBOE Volatility Index. In the second check, a different sample period was selected, i.e.., when the credit from the three areas to other countries collapsed, from 2008m04 to 2015m09. None of robustness checks generate significantly different results from the aforementioned analysis.

5. Conclusion and Recommendations

The qualitative and quantitative analysis of this paper indicates that global liquidity has a significant impact on the economy of Vietnam and its banking system. On the one hand, while global liquidity causes output to increase; it also leads to higher inflation and domestic currency appreciation. Should the central bank fail to sterilize the high foreign cash inflows, bank reserves would increase dramatically and encourage the banking system to increase lending. This practice leads to a highly risky balance sheet for households, enterprises and the banking system. When the foreign cash flow reverses abruptly, it causes the domestic currency to devalue and the quality of balance sheet to deteriorate. For these reasons, SBV have had to implement several measures to stabilize the banking system and the economy such as the tight control of money supply, interest rate, bank credit, exchange rate and increased bank capital.

From the analysis, it should be emphasized that, firstly, price stability must be the top priority objective of monetary policy. Although the Law on State Bank of Vietnam enacted in 2010 states this objective clearly, during some periods, multi-objective monetary policy was implemented. Under the request of the government to achieve the predetermined macro-economic targets, the Central Bank had to pursue many conflicting objectives such as economic growth, inflation control, currency stabilization and some social-economic goals. In view of this, the Central Bank needs to specify the price stability target to accomplish the pre-specified economic growth rate. If price stability is the priority objective and in the event of excessive global liquidity pouring into the domestic economy, the monetary authority has to tighten monetary policy to withstand potentially negative impacts.

Secondly, it is very important to enhance the resilience of the banking system through capital related measures. Higher capital ratios help the banks to enhance the loss absorbency capacity. Recently, the Central Bank urged ten of the biggest commercial banks in Vietnam to apply international bank management standards in accordance with Basel II. These banks will complete the pilot by 2018 and Basel II will subsequently be applied for the remaining banks. Given the fact that Vietnamese commercial banks tend to increase lending in an environment of excess liquidity due to high economic growth expectation and loose monetary policy, the countercyclical buffer would be very effective in regulating the credit growth rate. However, it is quite difficult for Vietnamese commercial banks at present, to increase their capital adequacy ratio given weaknesses such as low profitability and ongoing restructuring efforts.

Thirdly, the Central Bank should focus on liquidity management of commercial banks. The periods of unstable macroeconomic condition (2008 and 2011) witnessed high cash outflows as the net foreign assets of commercial banks changed from positive to negative within only one quarter. A stricter liquidity coverage ratio should be applied as it requires commercial banks to have sufficiently high quality and liquid assets to pay for both projected and unexpected cash outflows over a period. The Central Bank can set a higher rate for foreign liabilities when calculating the coverage ratio so that foreign loans and deposits would become less attractive for the banks. Another liquidity related measure is the net stable funding ratio that is designed to prevent excessive maturity transformation by requiring a minimum amount of stable funding source, taking into account the liquidity profile of the assets and off-balance sheet commitments.

Finally, a more flexible exchange rate regime is advocated for Vietnam. Raising the domestic interest rate is not sufficiently effective when the ultra-easy monetary policy of advanced countries is reversed. Allowing the domestic currency to depreciate can help Vietnam to preserve a low level of foreign exchange reserves. Moreover, employing higher interest rate to avert capital outflows can worsen

domestic conditions. Since the end of 2016, the Central Bank has switched from a nearly fixed exchange rate regime to a more flexible one, for which the daily reference rate is based on a weighted average of the Vietnamese Dong against eight major foreign currencies.

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