MONETARY POLICY SPILL-OVERS FROM ADVANCED MARKET ECONOMIES TO EMERGING MARKET ECONOMIES

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ABSTRACT

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Abstract

This paper assesses the monetary policy spill-overs from the Advanced Market Economies (AMEs) to the Emerging Market Economies (EMEs) by using linear regression models to estimate the association between the monthly changes in excess money supply in ten representative EMEs and the four largest AMEs which are the US, EMU, UK and Japan. The models estimated the different impacts of each AMEs on the EMEs and considered the role of unconventional monetary policy on the spill-overs. Moreover, the economic-condition differences among the EMEs were also studied to analyze their heterogenous responses to shocks from the AMEs. We found that, there were significant spill-overs from the AMEs to EMEs, with the largest impact caused by the US, and the amplified effects from both QE and tapering events. Finally, countries with relatively lower financial development, financial openness and degree of exchange rate flexibility experienced larger monetary policy spill-over influences from the AMEs.

Key words: monetary policy, spill-over, capital flows, quantitative easing, tapering, advanced market economies, emerging market economies, financial development, financial openness, exchange rate regime.

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TIIVISTELMÄ

Tekijä	
Työn nimi	
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Päivämäärä	Sivumäärä
Tiivistelmä Myös suomenkielinen tiivistelmä on tarpeen suomenkielisille opiskelijoille mm. maturiteetin suorittamiseksi ja jotta peruskäsitteet hallitaan myös suomen kielellä.	
Asiasanat	
Säilytyspaikka	

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1 INTRODUCTION

The world economy has, nowadays, become more and more integrated with close linkages of all open economies in the common world financial market due to the process of globalization and the increase in capital liberalization in each country. The benefit of this integration to the world development is undeniable but associated with it is the demand for profound research and sound policies to manage possible instabilities that the spill-over effects from one country's monetary policy can cause to others. Therefore, this research focuses on the effect of monetary policy spill-overs from the advanced market economies (AMEs) such as the United States (US or Fed-Federal Reserve System), the European Monetary Union (EU or ECB-European Central Bank), United Kingdom (UK or BoE-Bank of England) and Japan (BoJ-Bank of Japan) on the emerging market economies (EMEs).

In contrast with the AMEs, EMEs have been fluctuated greatly in economic fundamentals and vulnerable to external changes as, for instance, their Gross Domestic Product (GDP) volatilities were found to be about 50 percent higher than those of AMEs for the period from 1960 to 2008 according to Kose & Prasad (2011). The importance of external shocks in explaining the fluctuation in EMEs were also concluded by the studies from Canova (2005) who focused on the Latin American region, Maćkowiak (2007) who studied EMEs from Asia and Latin America, and from Fink & Schüler (2015) who added the South Africa to the observation and studied them in an updated time period.

Among the four AMEs, the one with the most attention has been the US's Fed with its quantitative easing and tapering programs' impacts on EMEs through different transmission channels including the capital flows. There has been a massive amount of literature focusing on the impacts of solely the US monetary policy (Fratzscher, Lo Duca & Straub, 2012; Aizenman, Binici & Hutchison, 2014; Eichengreen & Gupta, 2015;) as well as financial shocks (Fink & Schüler, 2015;) which implies its dominant role in the global financial market

comparing to other AMEs. The significant linkage between the US financial market and the EMEs can also be seen during the previous global financial crisis through the rapid contagion of the shock which originated from the US market. Figure 1 (Fink & Schüler, 2015) shows the time series of quarterly GDP growth for a group of 20 EMEs and the US from 2006 to the end of 2009 which illustrates the quick spread of the financial crisis during 2007-2008 to EMEs. The study also found that, on average, up to 13% of the below fluctuation in EMEs' real GDP and 10% of the cyclical in their real economic activity was explained by the financial shock from the US.

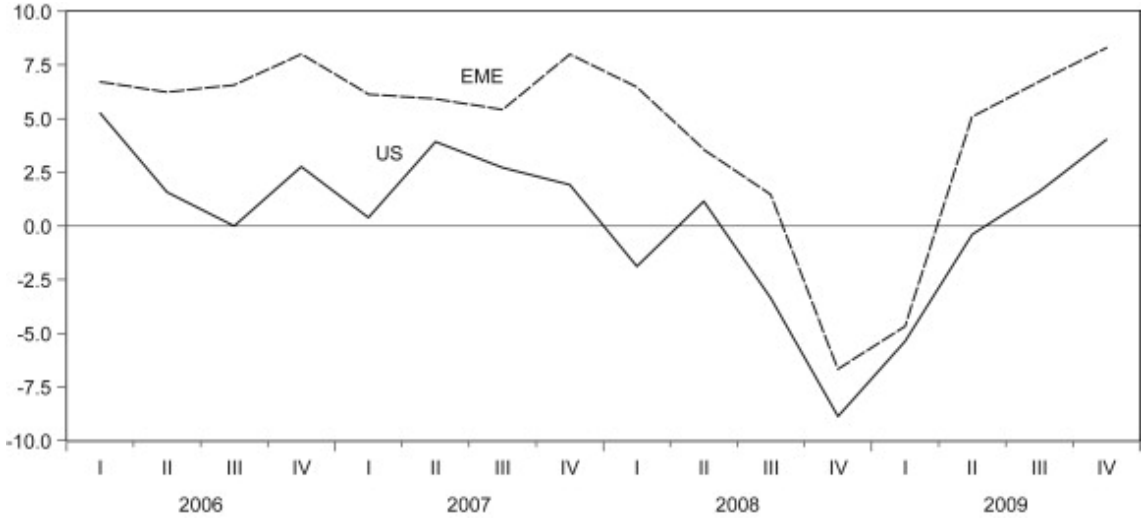


FIGURE 1. Growth in GDP in EMEs and the United States, 2006–2009
(Source: Fink & Schüler, 2015)

However, there has been limited empirical evidence where the impacts of monetary policy from the other AMEs mentioned earlier was considered (except for the Fawley & Neely, 2013; Fratzscher, Duca & Straub, 2016).Therefore, this research extended the studies to make comparison between the impacts of four different AMEs (US, Japan, UK and EMU) for the period from 2006 which was right before the global financial crisis until latest updated to the end of 2017. The effects of monetary policy spill-overs on EMEs are identified by the monthly changes in excess money supply in those countries and, on the other side of the

regression equation, the monthly changes in excess money supply of the AMEs. The purpose of using the monthly changes in excess money supply variable is that the excess money supply reflects the liquid assets circulating in the economy at a particular time that is adjusted for inflation and excluded the money used in transactions, so the changes in this variable illustrates the external spill-over impacts of monetary policy on the country's economic activity at the time it is implemented.

Moreover, the study also considers the differences in the financial market and economic condition of different EMEs countries such as the exchange rate regime, openness of the market and the soundness or development of the financial system which affect strongly the accommodation of the capital inflows and the policy response of monetary authority. For instance, Fink & Schüler (2015) found that, Mexico and Thailand responded most strongly to the US financial stress, while the Philippines was least affected during the period from 1999 to 2012. Moreover, while most EMEs from Asia and Africa experienced significant capital outflows during the US financial stress, the result found from Latin America countries was insignificant. Study from Aizenman *et al.* (2014) also divided the EMEs in two groups of "robust" and "fragile" fundamentals and found different in responses from each group to monetary policy news from the Fed and more financially developed economies are more exposed to the external news announcement.

Therefore, in this paper, EMEs are selected from different regions to study the influences of AMEs to each part of the world and, moreover, to find the most and least affected countries to see the reasons why one emerging country can be less vulnerable to external changes than others. There are ten EMEs in this study which are Brazil, Mexico and Argentina from Latin America; Turkey, Indonesia, Malaysia, Philippines, South Korea and China from Asia; and South Africa from Africa.

Having a similar purpose with previous researches from Canova (2005), Maćkowiak (2007), Aizenman *et al.* (2014), Miyajima, Mohanty & Yetman (2014),

Fink & Schüler (2015), Tillmann (2016) and Bhattarai, Chatterjee & Park (2017), this paper aims to, firstly, identify and compare the significant impacts of four major AMEs' monetary policy on ten representative EMEs from different parts of the world; secondly, estimate the level of influences between two opposite unconventional monetary policies (QE and tapering) from the AMEs on EMEs to find out if the effects are symmetric; and thirdly, apply the VAR analysis to study how different EMEs responded to the spill-over from AMEs.

The estimated result of this study confirmed the significant impact of monetary policy spill-over from the advanced economies to the developing ones. Among all major economies the US, indeed, had relatively the largest spill-over to EMEs. The EMU and UK had similar impact regarding the sign and the value of their coefficients. Lastly, Japan did not result in significant monetary policy spill-over impact on the EMEs in the regression model and the VAR model with individual EMEs. Furthermore, the unconventional monetary policy events from AMEs also significantly amplified the spill-over to EMEs, positive one for QE and negative one for tapering events. However, when estimated in terms of individual AMEs unconventional monetary policies, the effects became all negative for both QE and tapering. In terms of the size of the effects, tapering events were consistently larger throughout all models. On the affected side, there were heterogenous responses from individual EMEs. Taking the country-specific characteristics into account, the paper found that countries with relatively lower financial development, financial openness and degree of exchange rate flexibility experienced larger monetary policy spill-over influences from the AMEs which was in line with study of Hausman & Wongswan (2011) and Bowman, Londono & Sapriza (2015).

The paper is structured as follows. Firstly, the importance and the overview of the research purpose is presented the introduction part. Secondly, the literature reviews part discusses the important role of capital flows to the recipient EMEs countries as an important channel of the monetary policy spill-overs from

AMEs, then, the previous findings about the impacts of the spill-overs in different countries and how it was modelled and estimated. Thirdly, in the data and methodology sections, based on the suggested research methods from previous papers, this paper proposes a linear regression analysis method that can be applied to study the spill-overs of monetary policy from AMEs on EMEs through the changes in excess money supply. Finally, from the results presented in the fourth section, the last one gives conclusion and some suggestions for further study on how the EMEs can manage all the possible vulnerabilities of these spill-over effects.

2 LITERATURE REVIEWS

2.1 Capital flows

Back to the time before the 1990s, from 1985 to 1989, when there was a debt crisis in Latin America and when the markets in most developing countries in Asia were strictly restricted, the capital inflow to those countries was only about 133 billion dollars for five years in total. However, the number surged five times higher to 670 billion dollars for the next five years from 1990 to 1994 and stayed substantially high even after the decline due to the Mexican currency crisis in the end of 1994 (Calvo, Leiderman & Reinhart, 1996). This has started to affect developing countries in many ways by improving overall domestic economic performance. Moreover, it also reflected the fact that the world was moving toward a more integrated capital market and globalisation trend.

During the period from 1997 to 1998 of the Asian financial crisis, the capital flows to this area experienced a sharp fall and fluctuation. However, after the crisis, there was increasing and steady inflows of capital again which led to the complex liquidity conditions in Asian countries. The flows peaked in the mid-2007 and started to fall as the recession in the US led to a liquidity crisis in AMEs.

During and after the 2007-2008 global financial crisis, there were also loose monetary policies and growing risks in advanced economies which acted as a push factor for capital flows into emerging Asia to rise back. As a result, the size of the capital flows to Asia surged and their volatility increases as well. In addition, agents' preferences increased for investing in financial assets as there was more opportunities for financial investment resulted from financial liberalisation and innovation. This also increased the demand for financial assets and the capital inflows to Asia, which boosted the financial sector development and stimulated growth but also increased the financial instability.

The surge in capital flows peaked abnormally in 2007 and 2008 due to the crisis, but then, dropped dramatically for a short period of time before coming up strongly in 2010 and stayed at that high level for whole period from 2010 to 2013 according to the following figure (Figure 2) from study of Qureshi & Sugawara (2018) for emerging and frontier markets' financial inflows.

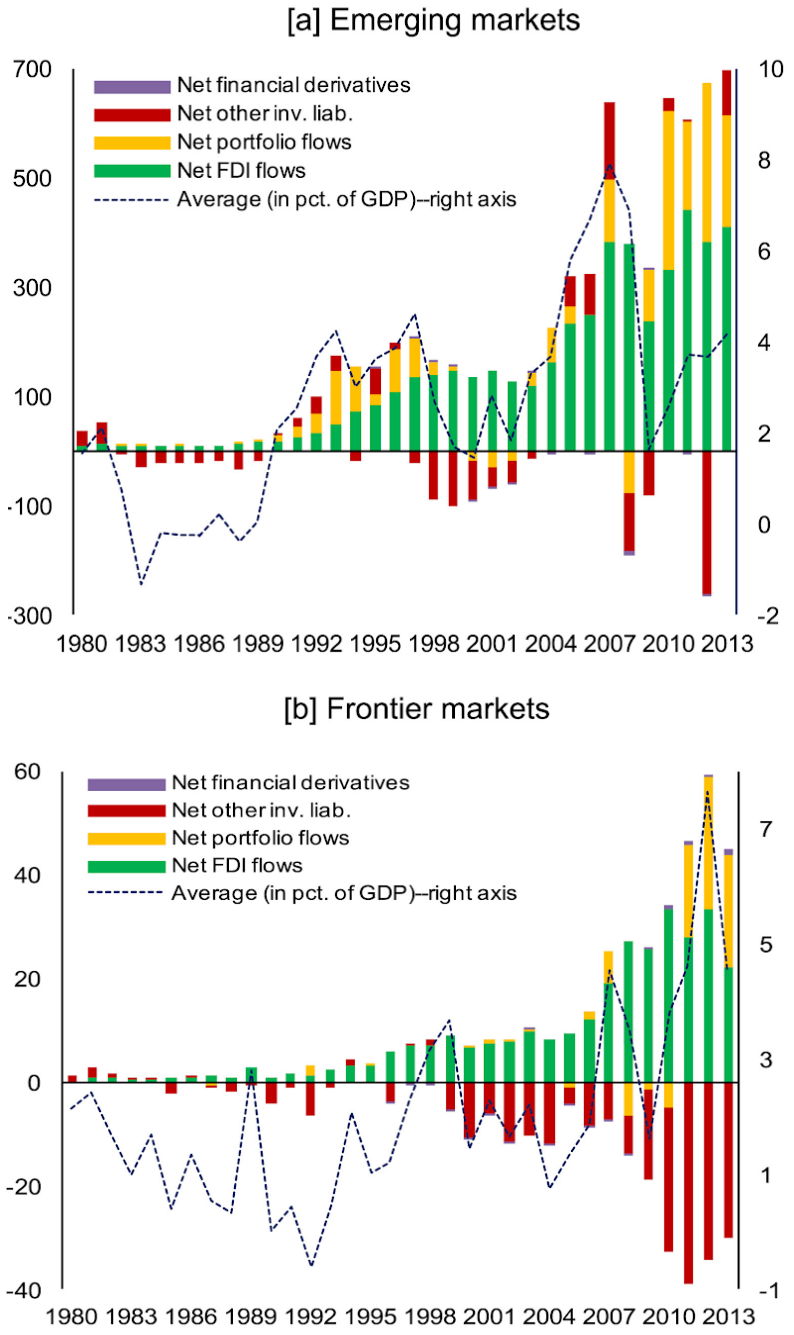


FIGURE 2. Net private financial flows to EMs and FMs in US dollars, 1980–2013 (Source: Qureshi & Sugawara, 2018)

2.1.1 Causes of capital flows

The capital inflows are caused by both external and internal factors of the recipient countries, which have equally important roles in explaining the amount and composition of inflows. While foreign factors accounted for about half of the flows to Latin American countries and about one-third for Asian countries (Chuhan, 1993), a country´s sound fundamentals also have strong links with the level of foreign direct investment flows into its domestic market (Edwards, 1990).

One important factor is the interest rate level as low interest rate levels in developed markets makes investors want to switch to invest in a higher-yields developing markets and, at the same time, the low interest rate improves the debtor countries' creditworthiness and increases their secondary market prices of their bank debts Calvo *et al.* (1996). From the early 1990s, the short-term interest rates in the United States decreased steadily and the secondary market prices for loans increased by the similar rate. However, due to the monetary policy tightening in the US in the beginning of 1994, the interest rate started to rise back and, as a result, the prices for bank claims fell which made investments in developing markets less attractive.

Another reason for the increasing inflows of capital to the developing markets is the recessions in developed markets such as the US, European countries and Japan which also made investment in developing countries more attractive during the early 1990s until the recession was over in the mid-1990s. Furthermore, according to Gooptu (1993) and Edwards (1990), there has been an international diversification trend of investment in major financial centers in US and European countries and the domestic policies in developing countries has also made significant progress in improving the relations with external creditors. More specifically, many countries in Asia and Latin America have increased their capital market liberalization by adopting sound monetary and fiscal policies with market-oriented reforms starting already from the late 1980s (Obstfeld, 1986). Lastly, contagion is also a factor that causes the increase in capital inflows in a

developing country as once investors find their investments in one country have good yields, they may be more willing to invest in the neighbor countries, which generates externalities for those countries (Calvo *et al.*, 1996).

In addition to these reason for surge in capital inflows, according to study from Qureshi & Sugawara (2018), emerging countries that have higher likelihood to experience surges in capital flows are ones with higher need of trade exchange and external finance, thus, they have more open trade and capital accounts, and better institutional quality. However, Qureshi & Sugawara (2018) found that EMEs with better financial market development or better current account balance are more likely to experience large reversals due to speculation or increase in foreign investments of domestic investors. Moreover, it is also suggested that the US interest rate and the global risk aversion had significant impacts on the surge and reversal of capital flows.

2.1.2 Effects of capital flows to EMEs

The inflows of funds from advanced economies to emerging ones have great influences on the development of both parties. On one hand, it benefits the developing countries by stimulating economic growth and increasing overall welfare as well as helping investors from developed countries diversifying their portfolios internationally. On the other hand, the surge of capital inflows in the context of high capital mobility can also cause negative effects on the macroeconomic performances such as rapid monetary expansion, increase in inflation, exchange rate appreciation and high current account deficits in the recipient countries. Furthermore, the increase of capital inflows in developing countries also causes economic vulnerability which required adequate policy implementation.

Firstly, in recipient countries, the capital inflows are largely channelled to the foreign exchange reserves. From 1990 to 1994, the proportion of inflows passed to the reserves in Asia was about 59 percent and in Latin America was about 35 percent which in total accumulated for about 209 billion dollars (Calvo *et al.*, 1996). Another channel to which the inflows were passed was the current

account widening as the national investment rose in most developing countries and the rate of saving fell. However, the correlation between investment and saving within developing countries has been declining as the capital market has become more integrated (Montiel, 1994). Furthermore, as the national saving falls, the private consumption increases, at the same time, as well as imports.

Secondly, in most developing countries, increase in capital inflows leads to increase in output and the rapid growth in money supply (Berument & Dincer, 2004) which also results from the growing of economic activities in those countries as the investment is poured in. Moreover, realizing that the market is active makes the opportunity cost of holding fall and reduces the inflation rates. The surge in liquidity in Asian financial systems also increased the investment in financial instruments of agents and institutions due to financial liberalization (Azis, 2014). However, in many countries, in dealing with the large inflows of capital in the short term the central bank can have a 'sterilized intervention' to control the accelerating effect of the money supply grow to some extents by allowing the domestic currency to appreciate as the demand for domestic assets increases, by which reduce the foreign exchange reserves accumulation and monetary base expansion; or alternatively, the central bank can issue more domestic bonds for internationally purchases which increases bank's holding of foreign currency and reduces the domestic liquidity at the same time.

Thirdly, the stock and real estate prices in EMEs also rose sharply as the capital flows increased. In Latin American countries, Argentina have an annual dollar return of 400 percent in 1991, and in Chile and Mexico, it was also high at about 100 percent (Calvo *et al.*, 1996). Fourthly, there are also effects on the recipient country's real exchange rates but in research of Calvo *et al.* (1996) it was a mixed result as while the real exchange rates appreciated in most Latin American countries as the capital flow increased, in Asia, for most countries, the real exchange rates were remained stable except for the Philippines. Also, in research of Turkey's economy, Berument & Dincer (2004) found that positive innovations in capital flows appreciate the country's domestic currency. As an explanation, the

differences in each country's aggregate demand or public-sector consumption may cause the differences in changes in real exchange rates. Later study by Fink & Schüler (2015) also found mix results of the effects between Latin American countries and others.

Furthermore, according to Azis (2014), the capital inflows to Asian countries also affect the financial instability in the countries, associated with increasing income gaps and decreasing employment elasticity. This affects also the banking sector operation as capital inflows from advanced economies are considered as a non-core sources of funding that leads to changes in banks' assets allocation. Due to the increase in funds, bank loans also rise which leads to the risks of pro-cyclicality and creates asset bubbles.

2.2 AMEs monetary policy spill-overs on EMEs

Previous researches about the monetary spill-overs from AMEs on EMEs has been based on the effects of two mains unconventional monetary policy program from the Fed which are the Quantitative easing and the tapering program which creates large and sudden flood and stop of capital inflows in EMEs.

2.2.1 Quantitative easing program

A quantitative easing (QE) program is known as an unconventional monetary policy tool used by the Central Bank with the purpose of increasing money supply and lowering interest rates in the economy by purchasing in a large scale of government bonds or other securities from financial institutions. This intervention is made when the economy is struggling to promote the economic activities and ease the financial conditions for companies to recover after the financial crisis. QE increases lending capacity and liquidity in the market without the need of printing more banknotes. However, this program also has drawbacks as it might

causes inflation if the money supply increase too quickly and, also, it is impossible for the Central Bank to fully control the money that banks lend out to the market, thus, unable to make sure the economy gets the sufficient stimulation.

Although this is an unconventional monetary policy, several QE programs have been implemented by the US Federal Reserve (Fed) in response to the global financial crisis 2007-2008 as well as the European Central Bank (ECB), Bank of England (BoE) and the Bank of Japan (BoJ) to expand their monetary bases. The programs in all AMEs shared the same purpose of stimulating economic activities and releasing the financial distress. However, for different major AMEs, the QE programs had different ways of implementation, such as providing more loans to banks in the more bank-centric economies in Europe and Japan or purchasing bonds in the more bond-market dominant economies in the US and UK (Fawley & Neely, 2013). Another point worth mentioning is that, during the QE, while all AMEs' monetary base was increased remarkably, their broader monetary aggregates increased at a much lower rates (Figure 3 – Fawley & Neely, 2013) because banks voluntarily chose to hold the excess amount of money and liquid assets in their excess reserves during the economic uncertainty periods.

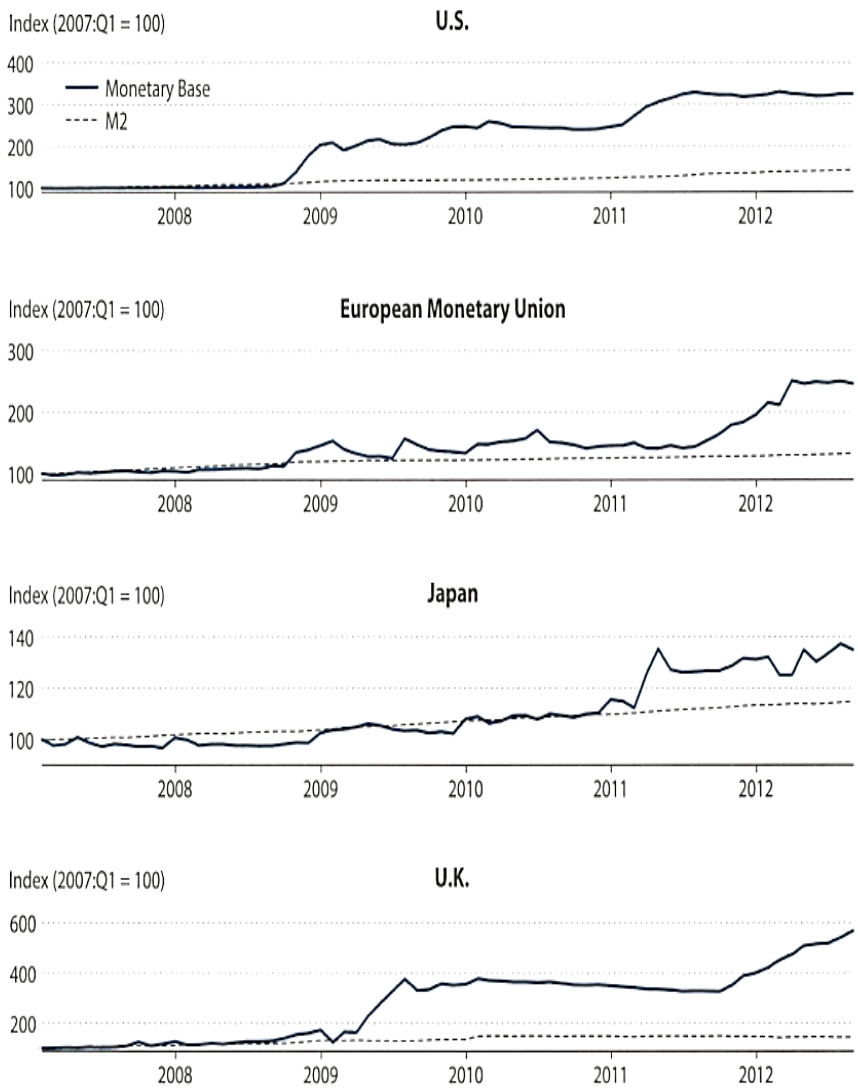
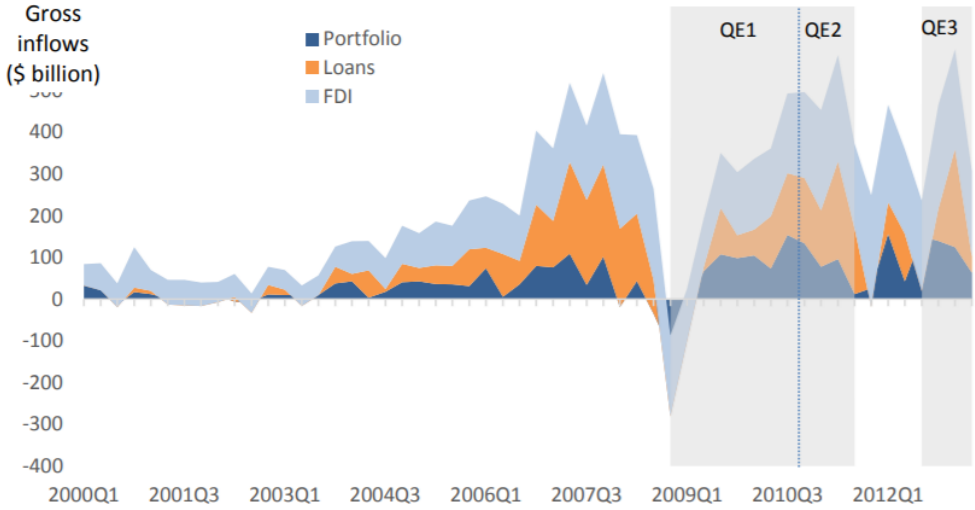


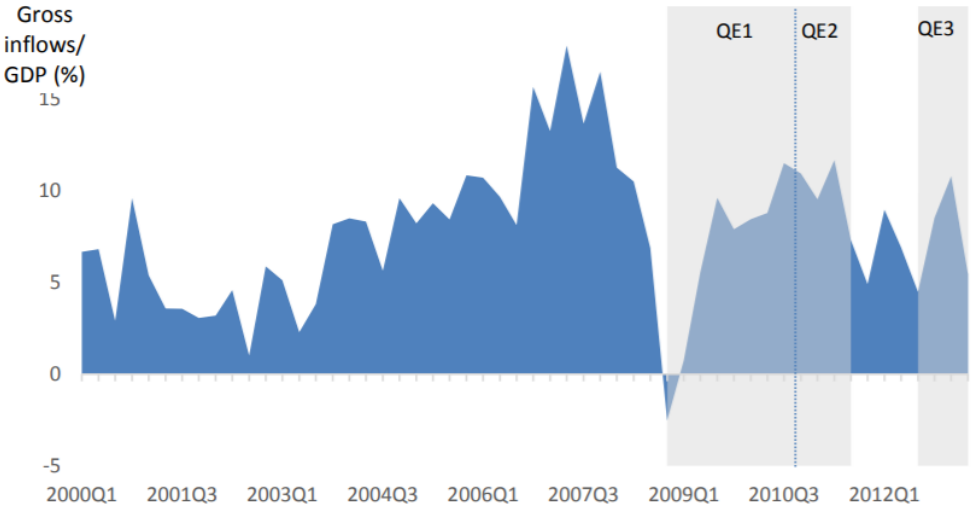
FIGURE 3. Monetary base and M2 expansion in four AMEs, 2007 - 2013 (Source: Fawley & Neely, 2013)

The asset purchases in large scale of AMEs affected not only themselves, but also increased the global liquidity which created the spill-overs into EMEs through capital flow acceleration as studied in Fratzscher *et al.* (2012) for the US case and later in Fratzscher *et al.* (2016) for the EMU case. This was referred by the Brazil's president - Dilma Rousseff (2012) as a "monetary tsunami" as the large amount of finance flowed into EMEs. This created concerns among the EMEs of the spill-overs through the increase in cross-border volatile financial in-

flows and forced them to build up foreign exchange reserves to prevent the currency from appreciating (Beckner, 2013). According to Lim, Mohapatra & Stocker (2014) in figure 4, the EMEs had the right to concern as from the middle of 2009 till the beginning of 2013, the cumulative gross financial inflow to EMEs increased from 192 billion US dollars to 598 billion, much faster comparing to the earlier period from 2002 to 2006 (which excludes the pre-crisis "bubble" period from 2006 to 2008).



(a) Gross inflows to developing countries, cumulative value



(b) Gross inflows to developing countries, as share of GDP

FIGURE 4. Gross financial inflows to EMEs in cumulative US dollar (a) and as share of EMEs GDP (b) (Source: Lim, Mohapatra & Stocker, 2014)

Tillmann (2016) found that, regarding different steps of the QE programs by the Fed, the impacts of QE1, which was run during the period of 2008-2009, on EMEs were found to be limited, while the impacts of later QE2 and QE3, which were run during the period of 2010-2012, were found to have significant effects on the changes in EMEs' variables. In more detail, Aizenman *et al.* (2014) found that after the QE announcement, the exchange rate in EMEs significantly appreciated and the stock market prices also increased largely. Moreover, the effects of QE announcement were found to be broader than the tapering announcement which is discussed in the following part.

2.2.2 Tapering program

In the context of QE, as it can possibly lead to high inflation, tapering is considered as the reduction of the previous QE program, but it is implemented gradually depending on the previous adjustment of short-term interest rates in order to balance the long-term market expectations. In the case of Fed, after the QE program to help the economy recover from the global financial crisis 2007-2008, Fed's Chairman Ben Bernanke mentioned possible scaling back of the large-scale asset purchase program in May 2013 (Bernanke, 2013), and later announce to lower the amount of assets purchase gradually each month, for example, from 75 billion dollars to 65 billion dollars from January to February 2014 and so on. By a moderately slow tapering program, Central Bank can expose their future approach and adjustment plan to investors to help them set their market expectations accordingly and reduce uncertainty. Announcing any plan beforehand also allows the market to start making adjustments toward the targeted direction of the monetary policy.

However, this also leads to concerns in EMEs as tapering, even just an announcement, creates a "sudden stop" of capital inflows which causes disruption in the financial markets in EMEs, or even reverses the flows back to AMEs. Figure 5 illustrates the effect of tapering events on the net capital inflow to Asia, Latin

America, Central and Eastern Europe and South Africa (Bevilaqua & Nechio, 2016). According to the figure, both the congressional testimony in May 2013 (Bernanke, 2013) and the FOMC statement release in March 2015 had considerably close relationship with the large reduction in EMEs from all regions, though the size of effect were different between them.

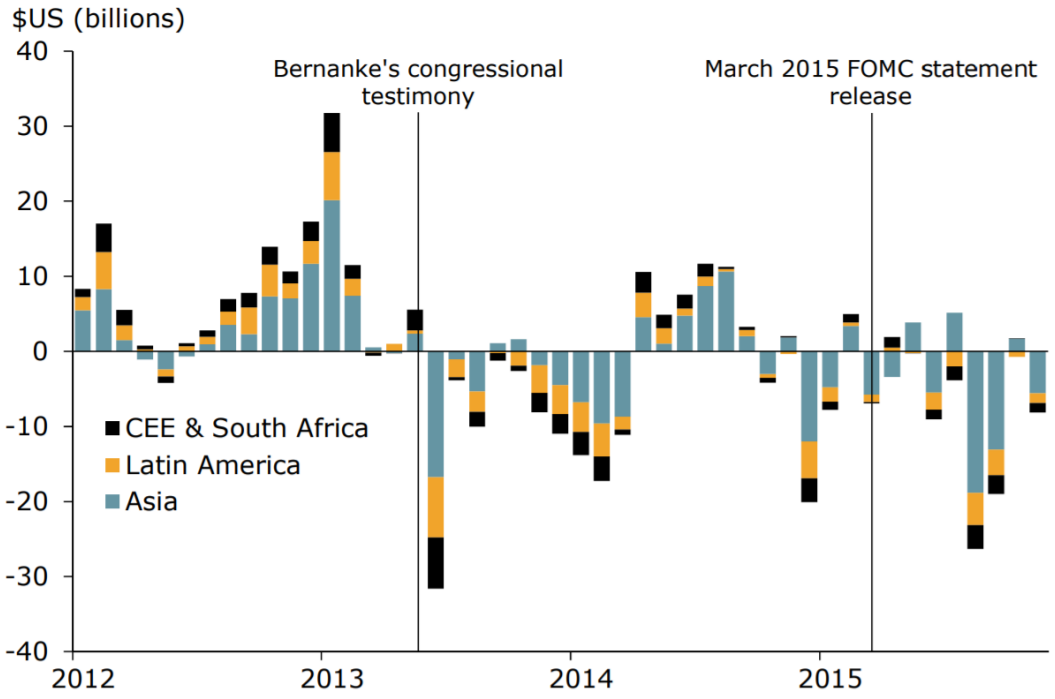


FIGURE 5. Monthly net capital inflows to EMEs' portfolio funds (Source: Bevilaqua & Nechio, 2016)

Research from Aizenman *et al.* (2014) and Eichengreen & Gupta (2015) on the announcement of tapering news and EMEs reactions found significant responses of EMEs to this type of unconventional monetary policy announcement from the Fed in terms of exchange rate depreciation and stock market indices decline which was caused by the reduce in expectation of capital inflows and carry-trade activity to EMEs. In addition to the changes in exchange rate and stock market indices, Eichengreen & Gupta (2015) also added the changes in foreign reserves from the EMEs. They found an overall negative impact of the tapering on EMEs, but the impact was heterogeneous as all seven EMEs studied

experienced exchange rate depreciate and reserve falling, except for China, which was known for its monetary policy aim of stabilizing its currency against the US dollar.

2.2.3 Impacts of monetary policy spill-overs on EMEs

The impacts of monetary spill-overs from AMEs to EMEs have received great attention with significantly large amount of research on closely related topics. Despite the differences in study period and method employed, previous researchers have been moderately agreed on the conclusion that there has been, in fact, the spill-over effects from the AMEs' monetary policy on different EMEs countries and regions. Previous researchers have found that the low interest rates in major currencies from developing countries creates easier financial conditions in Asian countries including China, Hong Kong SAR and Korea (He & McCauley, 2013).

The crucial role of the US systemic financial stress shocks to the economic dynamics and fluctuations in EMEs is also found on study of Fink & Schüler (2015) for eight EMEs from Latin America, Asia, and Africa from 1999 to 2012 (specifically, the countries are: Brazil, Chile, Mexico, Korea, Malaysia, the Philippines, Thailand, and South Africa). It is discussed that the financial stress from the US led to the significant capital outflows in EMEs in the long-run. This sudden stop of foreign capital flows put the pressure that depreciated the real exchange rate. In response, to prevent further capital outflows, monetary authorities in EMEs increased the interest rate and tightened the credit conditions, which restricted the availability of source of finance and slowed down the real economic activity.

Later, Tillmann (2016) estimated the response of EMEs to QE shocks in the US and found significant effects of QE on the emerging market countries' financial conditions through capital flows as well as equity prices and exchange rates. As a result, a QE shock, in fact, leads to a significant rise in capital outflows, especially in portfolio outflows with 0.03 percentage points at peak, 30 bp lower

bond spreads, 5 percent higher stock price index and 2 percent lower US exchange value. The following figure (Figure 6) shows the level of portfolio inflows to EMEs and the fraction of the flows that can be explained by the Fed's QE shocks. The QE shocks have much larger explanatory power to this variable than to the total capital outflows. In particular, the QE shocks explained almost completely the decrease in capital inflows to EMEs in 2012.

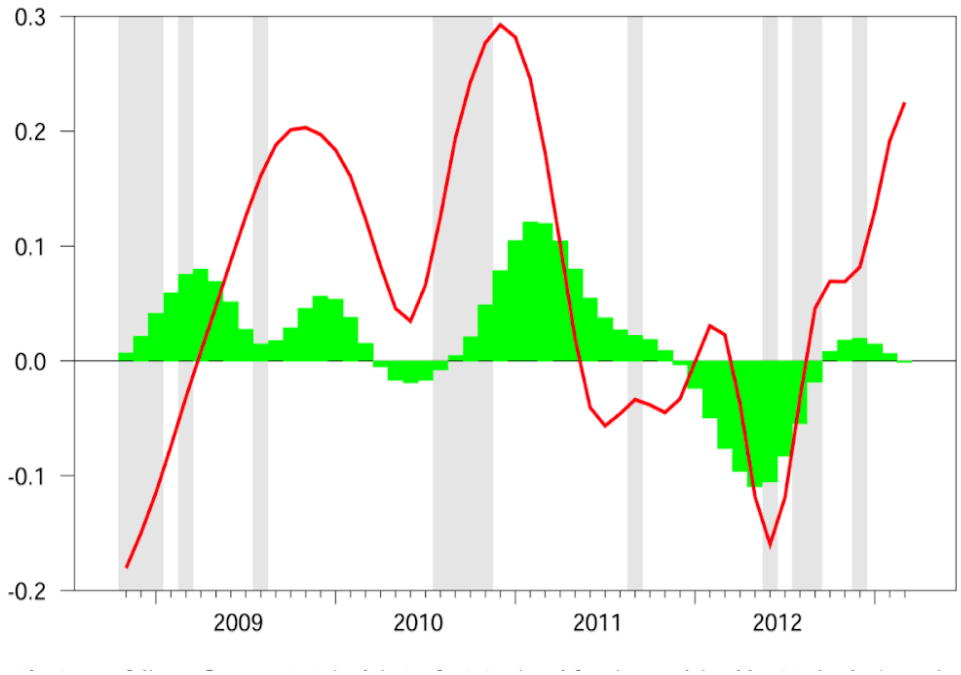


FIGURE 6. Portfolio outflows to EME (red, in % of US GDP) and fraction explained by QE shocks (green), 2008 - 2013
(Source: Tillmann, 2016)

The study by Canova (2005) about the transmission of US monetary shocks to the Latin America region with eight countries of EMEs (which are: Mexico, Panama, Brazil, Chile, Ecuador, Argentina, Uruguay and Peru) has similar findings as Maćkowiak (2007) (for Korea, Malaysia, Philippines, Thailand, Hong Kong, Singapore, Chile and Mexico) and the more recent one of Bhattarai *et al.* (2017) about the US monetary policy spill-overs on 15 major ones (these countries includes: Chile, Colombia, Brazil, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Russia, South Africa, South Korea, Taiwan, Thailand and Turkey) during

the flexible exchange rate regime (from 2004 to 2015). All found significant financial and macroeconomic effects abroad of the US monetary policy shocks. A contractionary monetary policy from the US leads to certain responses in the EMEs including the increase in long-term spread and short-term policy rate, exchange rate depreciation as well as decrease in domestic stock prices and capital inflows. This also leads to the contraction in EMEs output and increases their external balance.

All these domestic fluctuation in EMEs caused by monetary shocks from the US raised the requirement for policymakers in EMEs to be more careful in monitoring the international financial market, in particular to any major monetary policy announcement from Fed, to be able to react properly to those external imbalances (Canova, 2005). More specifically, Fink & Schüler (2015) suggested that monetary authority in EMEs should consider options which can dampen the international transmission, especially in capital control to avoid being affected strongly by any sudden stop of foreign capital inflows. Moreover, stabilizing the value of domestic currency and easing the foreign currency access for private sector through the foreign exchange reserve is also important for high foreign denominated debt EMEs to avoid credit problems if their currencies suddenly depreciate.

2.2.4 Modelling the AMEs monetary policy spill-overs on EMEs

In many models, the exchange rate regime had impacts on the monetary consequences of the capital flows. Consumption and investment booms will lead to the increase in money demand. For a small open economy with floating exchange rate, the capital inflows will lead to nominal exchange rate appreciation, while with fixed exchange rate regime, it will lead to increase in foreign exchange reserves in central bank and in money supply (Calvo *et al.*, 1996). However, in terms of macroeconomic performance in the example of Turkish - a small, emerging

and open economy, later found in research of Berument & Dincer (2004), the exchange rate regime does not have influence on the effects of capital flows on the country's macroeconomic performance.

Canova (2005) treated the US shocks as exogenous with respect to Latin America economies and identified them using sign restrictions with the US supply, real demand and monetary disturbances and found that the US monetary disturbances had significantly large impacts on the macroeconomics variables in those countries studied which were amplified through the interest rate channel. The study found the transmission of the impact through the trade channel which is contradicted with the later findings from Fink & Schüler (2015) which emphasized the importance of financial interconnectedness of EMEs with the US in relative to trade relations as the international transmission. The later study (Fink & Schüler, 2015) used the structural VAR model for eight EMEs with their monthly data from 1999 to 2012 and the US shocks were identified as unexpected changes in the financial conditions index of the Fed.

Tillmann (2016) paper proposed a Qual VAR model to estimate the effects of unconventional monetary policy such as QE on EMEs that includes the macroeconomic by integrating binary information of QE announcements with a standard VAR model of variables from the US and EMEs. The binary information is indicated as 1 if there is a QE announcement in that month and 0 if otherwise. In order to find the effects of QE on EMEs, the model uses four variables which are the total capital flow out of the US to EMEs, the change bond spreads in EMEs, the change in EMEs equity price index and the change in value of US in EMEs' currencies. The model can anticipate the unobservable movements for the Fed's QE and generates the impulse responses for EMEs variables to the QE shocks. Moreover, the model already accounted for the endogeneity and forecast ability of the QE announcements.

In the paper of Bhattarai *et al.* (2017), the US monetary policy shocks from the US data are estimated using the standard VAR method and identification

strategy. For the 15 major EMEs, they used the monthly panel VAR which is similar to Miyajima *et al.* (2014), which includes the US shocks as a regressor to estimate their average effects across all the studied EMEs. The variables used in this research consist of macroeconomic, financial and a set of open-economy variables such as asset prices, exchange rates, capital flows, trade flows, as well as long-term country spreads to study the international effects and transmission channels of US monetary policy.

In this paper, in order to find the spill-over from the AMEs to EMEs, the estimations seek to find the significant relationship between the changes in excess money supply between them. The impact from the AMEs side was estimated in linear regression models and further measured with the spill-overs from different AMEs as well as with the intervention of unconventional monetary policy events. Then, in the later part, the heterogenous responses from the EMEs were estimated by a VAR model consisted of ten countries from the EMEs.

2.3 Country-specific characteristics within EMEs

In this paper, the ten EMEs selected to study include: Malaysia, Philippines, Korea and China are identified as "robust" fundamental and Brazil, Argentina, Mexico, Turkey, South Africa and Indonesia are identified as "fragile" fundamentals according to Aizenman *et al.* (2014) based on the surplus of their current account, high foreign exchange reserve/GDP ratio (above 20%) and low external debt/GDP ratio (below 34%).

TABLE 1 Emerging market economies' current account balance, international reserves and external debt (Source: Aizenman *et al.*, 2014)

Country	CAB/GDP (%)	Reserves/GDP (%)	External Debt/GDP (%)
Robust group			
Korea	4.61	26.86	37.74
Malaysia	3.49	43.11	32.87

TABLE 1 Emerging market economies' current account balance, international reserves and external debt (Source: Aizenman *et al.*, 2014)

Country	CAB/GDP (%)	Reserves/GDP (%)	External Debt/GDP (%)
Robust group			
Philippines	2.51	27.04	30.34
China	2.50	39.32	8.99
Fragile group			
Turkey	-7.38	12.85	43.30
South Africa	-6.07	11.82	34.40
Argentina	-0.75	7.13	24.25
Brazil	-3.38	16.75	19.74
Mexico	-1.34	12.37	29.90
Indonesia	-3.41	12.55	25.86

Beside the economic fundamentals, the development of the financial system also plays an important role in absorbing shocks and reducing vulnerability of the country. Svirydzenka (2016) from the International Monetary Fund (IMF) introduced the new index, which focuses on the country's financial development (FD) based on their depth, access and efficiency of the financial institutions (FI) and financial markets (FM). The following table presents the FI, FM indices and the summarized FD index in the developing order.

TABLE 2 Emerging market economies' financial development index (Source: Svirydzenka, 2016)

Country	FD	FI	FM
Argentina	0.3376576	0.4218162	0.2485781
Indonesia	0.3639323	0.4307461	0.2918147
Philippines	0.3777103	0.388372	0.3615441
Mexico	0.4091886	0.449557	0.3628569
Turkey	0.5029746	0.481705	0.5169141

TABLE 2 Emerging market economies' financial development index (Source: Svirydzenka, 2016)

Country	FD	FI	FM
Brazil	0.5709821	0.6186364	0.5150067
South Africa	0.6178052	0.7373663	0.4892406
China	0.6513166	0.6178361	0.6753053
Malaysia	0.6600142	0.7074282	0.6029816
Korea	0.855473	0.8361167	0.8623621

Another criteria worth considering when measuring a country's financial openness is the Chinn-Ito index which measures a country's restrictions on cross-border financial transactions according to the IMF's report (Chinn, Menzie D. and Hiro Ito, 2006). The index has been built since 1970 and updated till 2016 for 182 countries. The 2016 financial openness of the ten EMEs included in this study were shown in Table 3, from the most to least open degree in capital account.

TABLE 3 Emerging market economies' dergree of capital account openness (Source: The Chinn-Ito Index, 2016)

Ranking	Country	KAOPEN	KA_OPEN
1	Korea	2.3599	1.0000
2	Mexico	1.0735	0.6987
3	Turkey	0.0066	0.4489
3	Philippines	0.0066	0.4489
5	Indonesia	-0.1355	0.4156
5	Malaysia	-0.1355	0.4156
7	South Africa	-1.2023	0.1658
7	Argentina	-1.2023	0.1658
7	Brazil	-1.2023	0.1658
7	China	-1.2023	0.1658

1. KAOPEN is the Chinn-Ito index.
2. KA_OPEN is the Chinn-Ito index normalized to range between 0 and 1.

Furthermore, the exchange rate restriction of a country is also an important factor in managing the amount of capital inflow to its economy. Ilzetzki, Reinhart & Rogoff (2017) provides the exchange rate classification for 194 countries over the period from 1946 to 2016. The classification was coded where increasing values indicate increasing flexibility in the exchange rate regime. For the use of this paper, the study period of the ten EMEs exchange rate classification are collected from 2006 to 2016 in Table 4. For most countries, the exchange rate regime stayed the same or had minor changes for the whole period, except for: Argentina changed from being crawling pegged regime during the whole period into freely falling in 2016, China loosened the announced crawling pegged regime for the last three years of the period, and Indonesia in 2006 started from being managed floating into crawling band within 2 percent from 2007 onward and within 5 percent in 2016.

TABLE 4 Fine De Facto Exchange Rate Arrangement Classification (Source: Ilzetzki, Reinhart & Rogoff, 2017)

Country	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Argentina	8	8	8	8	8	8	8	8	8	8	14
Brazil	12	12	12	12	12	12	12	12	12	12	12
China, PR	5	5	5	5	5	5	5	5	7	7	7
Indonesia	12	8	8	8	8	8	8	8	8	8	10
Korea	11	11	11	11	11	11	11	11	11	12	12
Malaysia	11	11	11	11	11	11	11	11	11	11	12
Mexico	12	12	12	12	12	12	12	12	12	12	12
Philippines	10	10	10	10	10	10	10	10	10	10	10
South Africa	12	12	12	12	12	12	12	12	12	12	12
Turkey	12	12	12	12	12	12	12	12	12	12	12

Previous studies also found substantial degree of heterogeneity in responses from different EMEs to the monetary policy spillovers from AMEs. For instance,

based on individual responses, Chuhan (1993) found that country-specific factors had much important role in influencing the capital flows to Asian countries. Later, Fink & Schüler (2015) found mixed results between Asian and Latin America countries, among their EMEs observation, Mexico and Thailand responded most strongly to US financial stress, while Philippines was least affected. However, while most EMEs from Asia and Africa experienced significant capital outflows during the US financial stress, the result found from Latin America countries was insignificant.

In studying the effects of tapering events from the US on the EMEs, Rai & Suchanek (2014) found that the EMEs experienced more exchange rate depreciation, fall in stock market index and capital flows were ones with weaker fundamentals and, importantly, tighter capital account and financial openness. Fratzscher *et al.* (2012) also addressed how policymakers in EMEs actively shielded themselves through interventions such as increasing capital controls or adjusting the exchange rate toward a more pegged regime, which led to the heterogenous responses to spill-overs. The study found that, in response to externalities, countries with better financial institutions and more active monetary policy were less affected. However, another research based on economic conditions from Aizenman *et al.* (2014) and Eichengreen & Gupta (2015) found that more financially developed economies are more exposed to the external news announcement.

A number of existing literature has found the substantial role of country-specific characteristics in its degree of exposure to monetary spill-over, including: Calvo, Izquierdo & Mejía (2008) and Georgiadis (2016) study on the role of financial integration and financial market development on mitigating the country's economics vulnerability; Edwards (2004), Edwards (2007) and Cavallo & Frankel (2008) studies on the trade openness role in reducing the exposure to sudden capital flow disruption; Broda (2001) and Edwards (2004) studies on the role of flexible exchange rate regime in insulating the economy from disturbances and accommodating shocks better.

3 DATA AND METHODOLOGY

3.1 Data description

This part of the study describes the set of data collected and the methodology employed to test the study hypotheses. The monetary policy spill-overs is originated from four major Central Banks from AMEs which are the Federal Reserve System of the US (Fed), European Central Bank (ECB), Bank of England (BoE) and Bank of Japan (BoJ). On the affected side, the ten EMEs studied in this research include: Brazil, Mexico and Argentina from Latin America; Turkey, Indonesia, Malaysia, Philippines, South Korea and China from Asia; and South Africa from Africa.

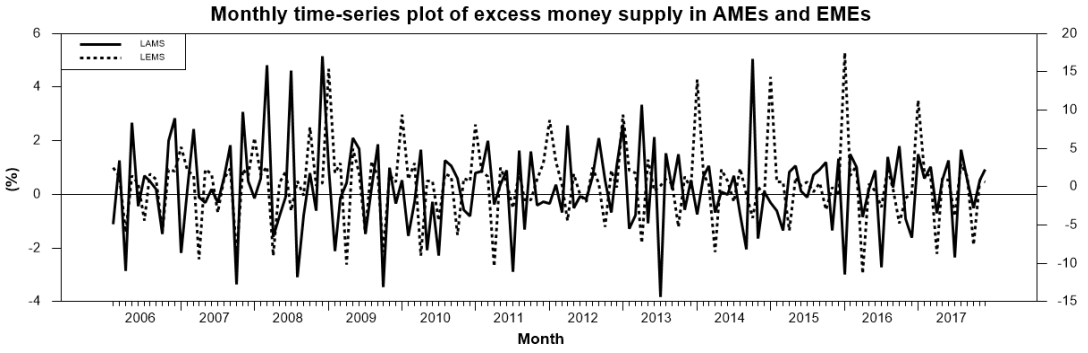
The paper studied monthly data of money supply (M2) and quarterly data of Gross Domestic Product (GDP) from the beginning of 2006 to the end of 2017, which were gathered from Thomson Reuter Datastream (2018). The set of country includes four countries from the AMEs group which are the US, UK, Japan (JP) and the EMU (EM) and ten countries from the EMEs group which are Brazil (BR), Mexico (MX), Argentina (AG), Turkey (TK), Indonesia (ID), Malaysia (MY), Philippines (PH), Korea (KO), China (CN) and South Africa (SA). All countries national currency values were converted to US dollar values using the monthly exchange rate data retrieved from the Federal Reserve Bank of St. Louis Economic Data (2018).

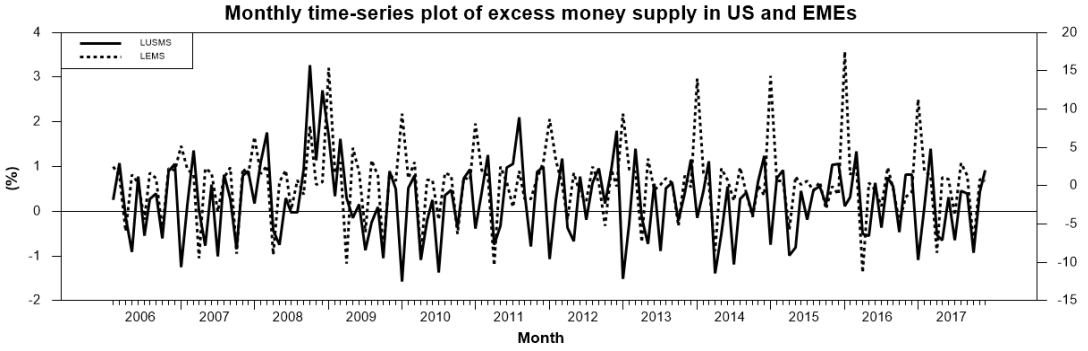
The variables are: M2 which is already in monthly frequency and the quarterly GDP which is converted by WinRats to be used as monthly frequency in analysis. More specifically, the quarterly GDP data is first executed by the author into monthly data by divided the total GDP of the whole quarter of three months into one month ($One\ month\ GDP = \frac{One\ quarter\ GDP}{3}$); and in WinRats, it is converted into monthly data by repeating the value of each second month of the quarter to the other two months. The excess money supply variable (MS) for each country is constructed as:

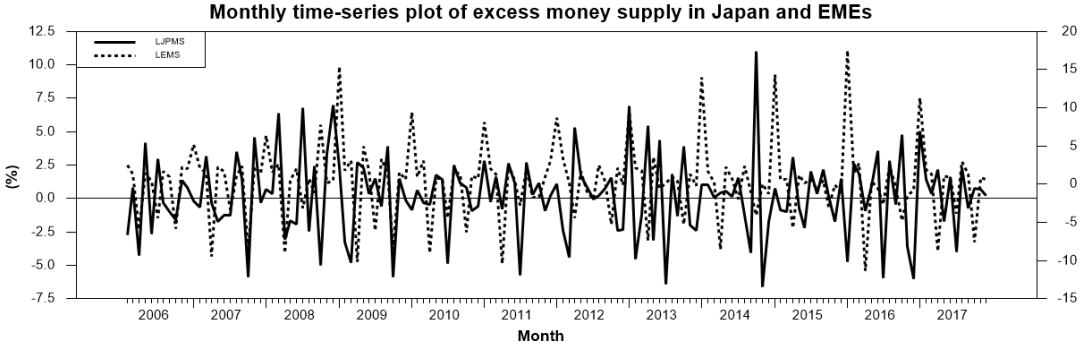
MS = lnM2 - lnGDP

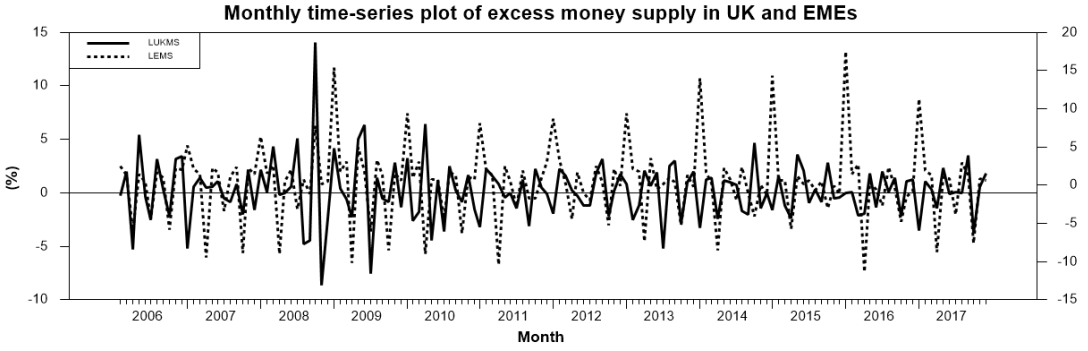
Where M2 represents the total money supply in the economy and GDP represents the money used in transactions. The total excess money supply variable (MS) for group of countries such as the AMEs and EMEs groups are generated from the logarithmic (log) of sum of all M2 minus the log of sum of all GDP of the countries belong in each group. Therefore, the monthly percentage changes in the excess amount of money in the economy, which is estimated in log value also, represents the impacts of monetary policy spill-overs from AMEs to EMEs. The representative variable names for them are LAMS and LEMS, respectively. For individual country's effect, the variable name for each country was formed as 'L' as it is in log form, country name 'US', for example, for the US, and 'MS' means the excess monthly supply. Thus, the individual variables for the four AMEs countries are LUSMS, LJPMS, LUKMS and LEMMS for the US, Japan, UK and EMU.

The following figure (Figure 7) illustrates the overall monthly percentage changes of excess money supply in AMEs (referred as LAMS) and EMEs (referred as LEMS), from January 2006 to December 2017. The first graph shows the overall relationship between all AMEs and EMEs and the others four show the relationships between each AME to the whole group of EMEs. Overall, the movements followed each other closely, especially during the first half and the very end of the studied period, which indicates a possible linear relationship between the two groups of market.


Monthly time-series plot of excess money supply in AMEs and EMEs
LAMS
LEMS
(%)
Month
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Monthly time-series plot of excess money supply in US and EMEs
LUSMS
LEMS
(%)
Month
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Monthly time-series plot of excess money supply in Japan and EMEs
LJPMS
LEMS
(%)
Month
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Monthly time-series plot of excess money supply in UK and EMEs
LUKMS
LEMS
(%)
Month
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

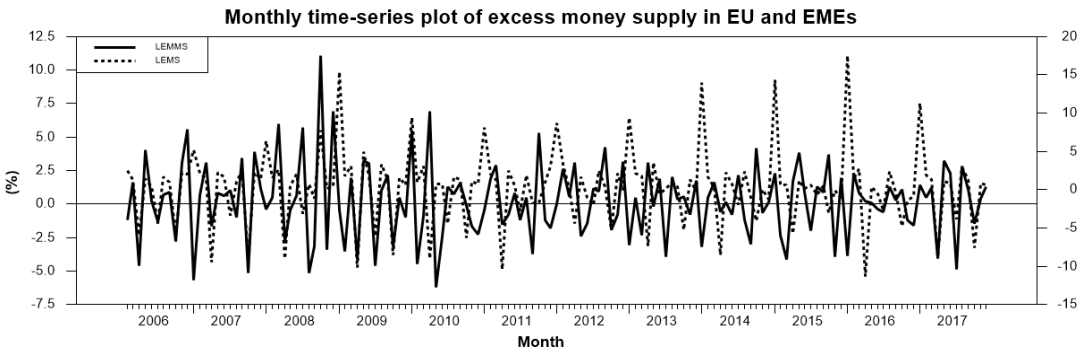


FIGURE 7. Monthly percentage changes of excess money supply in AMEs and EMEs, 2006–2017.

Since the data used in estimation for the GDP is originally quarterly data, the graph drawn for the quarterly changes of excess money supply in AMEs and EMEs seems to present the relationship between the two series more clearly as in Figure 8. Overall, the EMEs series followed the ones from AMEs closely at the beginning of the research period. After that, they still moved in similar patterns but the spread between them was not as close as before, especially during the period from 2011 to the end of 2014. Furthermore, according to the monthly figure (Figure 7), the total changes in excess money supply in individual AMEs toward the end of the period appeared to be more stable with narrower range of movements than the total changes in EMEs.

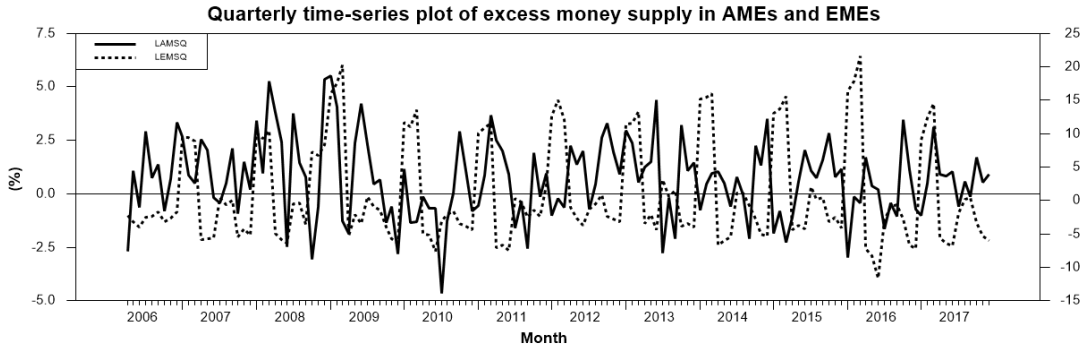


FIGURE 8. Quarterly percentage changes of excess money supply in AMEs and EMEs, 2006–2017.

The following table (Table 5) summarizes the general statistics of all the variables for the monthly percentage changes of excess money supply in total groups of AMEs and EMEs; and in four individual countries in AMEs and in ten individual countries in EMEs group. Countries in EMEs are dependent variables and countries in AMEs are independent variables. The numbers of observations are 143 months for the period of 12 years from the beginning of 2006 to the end of 2017. The average monthly percentage changes in money supply in EMEs were higher than one in AMEs which were 0.31 percent and 0.23 percent; in which, countries such as Brazil, Mexico, Turkey, Philippines and South Korea were the ones with largest changes in EMEs. Considering the fluctuation in changes shown in the standard error of the variables, the deviation of changes in AMEs (1.62) were much lower than in EMEs (4.74). Moreover, individually, countries in AMEs also had lower fluctuation than countries in EMEs. Especially in the US, the standard deviation of changes in excess money supply were only as much as 0.85, the lowest and most stable in all countries studied; and for other countries in AMEs, Japan, UK and EMU also had the standard deviation from 2.77 to 2.99. On the other hand, in EMEs, the range were much wider, as low as Mexico (3.17), Malaysia (3.31) and South Korea (3.86), but there were also countries as high as Argentina (6.63), Turkey (6.56), Philippines (6.64) and the highest deviation from China (6.79) – the most fluctuated one.

TABLE 5 Summary statistics for the monthly percentage changes of excess money supply in AMEs and EMEs, 2006-2017.

Variable	Name	Observation	Mean	Standard error
Dependent variables				
Emerging market economies	LEMS	143	0.3147	4.7402
Brazil	LBRMS	143	0.2751	4.8909
Mexico	LMXMS	143	0.1929	3.1706
Argentina	LAGMS	143	-0.0862	6.6318

TABLE 5 Summary statistics for the monthly percentage changes of excess money supply in AMEs and EMEs, 2006-2017.

Variable	Name	Observation	Mean	Standard error
Dependent variables				
South Africa	LSAMS	143	0.0376	4.4265
Turkey	LTKMS	143	0.1904	6.5656
Indonesia	LIDMS	143	0.0224	4.3425
Malaysia	LMYMS	143	0.0698	3.3181
Philippines	LPHMS	143	0.2513	6.6487
South Korea	LKOMS	143	0.1744	3.8670
China	LCNMS	143	0.0919	6.7945
Independent variables				
Advanced market economies	LAMS	143	0.2324	1.6205
US	LUSMS	143	0.2484	0.8514
Japan	LJPMS	143	0.1866	2.9926
UK	LUKMS	143	0.1796	2.7791
EMU	LEMMS	143	0.2221	2.8321

Firstly, unit root tests need to be conducted to examine the stationarity of the time series of each country's changes in excess money supply. Regarding different unit root tests for the stationary of all the time series, four tests applied were Augmented Dickey-Fuller (ADF), the Dickey-Fuller (DF), the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test and the Phillips-Perron (PP) test. The ADF test can handle more complex models than the original DF, which is based on linear regression and can be used with autocorrelation. The PP test is a modification from DF and corrected for autocorrelation and heteroscedasticity. The KPSS test shows if a time series is stationary around a mean, a linear trend or is non-stationary because of a unit root.

In terms of the two variables LAMS and LEMS, both get the strongly stationary results in all tests, so they are good to be used in linear regression analysis. Same tests applied for the individual monthly percentage changes in excess money supply in each country, four from the AMEs and ten from the EMEs group. For AMEs, all the tests resulted in stationary variables, so the variables are stationary and do not have unit roots. Finally, for EMEs' variables, the results from most of the tests, except for only the ADF test for LPHMS, concluded that there is no unit root in the variables, and they are good to be used in the linear regression analysis. The results are presented in the following table (Table 6).

TABLE 6 Unit root tests for monthly percentage changes of excess money supply in all countries, for the period from 2006–2017.

Variable	ADF	DF	KPSS	PP
LAMS	-10.6938*** (n=2)	-17.8831***	0.0860***	-18.3967***
LEMS	-3.3676*** (n=15)	-13.1600***	0.0352***	-13.2580***
LUSMS	-5.2024*** (n=3)	-11.9383***	0.0833***	-12.0233***
LJPMS	-10.1710*** (n=3)	-18.5243***	0.0460***	-19.2130***
LUKMS	-11.7962*** (n=2)	-18.7082***	0.0869***	-19.9966***
LEMMS	-15.0991*** (n=1)	-18.6123***	0.0968***	-19.5557***
LBRMS	-15.2087*** (n=1)	-17.4016***	0.1026***	-18.1448***
LMXMS	-13.2661*** (n=1)	-17.6708***	0.0230***	-18.2431***
LAGMS	-3.6938*** (n=16)	-13.6036***	0.0535***	-13.7245***
LSAMS	-15.7714*** (n=0)	-15.7714***	0.0373***	-15.9953***

TABLE 6 Unit root tests for monthly percentage changes of excess money supply in all countries, for the period from 2006–2017.

Variable	ADF	DF	KPSS	PP
LTKMS	-2.7284* (n=14)	-12.7186***	0.0254***	-12.8095***
LIDMS	-12.6818*** (n=1)	-18.7855***	0.0364***	-19.3981***
LMYMS	-13.5641*** (n=0)	-13.5641***	0.0943***	-13.6704***
LPHMS	-2.5154 (n=12)	-12.6908***	0.0323***	-12.7832***
LKOMS	-15.2486*** (n=0)	-15.2486***	0.0278***	-15.4235***
LCNMS	-3.0981** (n=15)	-12.7084***	0.0326***	-12.8004***

1. The amount 'n' indicates the optimal lag length that is suggested by the ADF test.
2. *, ** and *** implies that the time series is significantly stationary at 10% 5% and 1% level respectively.
3. The KPSS test and Phillips-Perrons test were tested at lags = 4 and lags = 1.
4. The variable names consist of 'L' as they are in log value, 'MS' referred to the excess money supply, and the two letters in the middle is the countries' names in short.

3.2 Methodology

In order to measure the effects of monetary policy spill-overs, the dependent variables used in this research are the changes in excess money supply of ten countries from the EMEs group. The excess money supply is adjusted in the way that the money used for transaction purpose, which is measured by the GDP, are taken into consideration. The independent variables are the changes in excess money supply from four major countries in AMEs.

Linear regression analysis is employed to estimate the association between the variables of changes in excess money supply in ten EMEs and the changes in excess money supply in the four largest AMEs which are the US, EMU, UK and

Japan. The model is presented as follow (1) (2) and (3), in which, LEMS and LAMS is the log of monthly changes in excess money supply in total of all EMEs and AMEs.

$$LEMS_t = \alpha_t + \beta_1 LAMS_t + \varepsilon_t \quad (1)$$

$$LEMS_t = \alpha_t + \beta_1 LAMS_t + \beta_2 LAMS_{t-1} + \beta_3 LAMS_{t-2} + \beta_4 LAMS_{t-3} + \beta_5 LAMS_{t-4} + \beta_6 LAMS_{t-5} + \beta_7 LAMS_{t-6} + \beta_8 LAMS_{t-7} + \beta_9 LAMS_{t-8} + \beta_{10} LAMS_{t-9} + \varepsilon_t \quad (2)$$

$$LEMS_t = \alpha_t + \beta_1 LUSMS_t + \beta_2 LJPMS_t + \beta_3 LUKMS_t + \beta_4 LEMMS_t + \varepsilon_t \quad (3)$$

Firstly, the linear regression is run to find the total effects of monetary policy spill-overs from all four AMEs on all ten EMEs (1) to find the overall impacts. In the case of the delayed impact, lagged variables are also considered in the model (2). Then, in the next model (3), the impacts from each AMEs are measured separately from which we can compare the levels of significant impact from each AMEs and from each half of the period, before and during the global financial crisis (2006 to 2011) and the period after that (2012-2017), to EMEs.

Secondly, the EMEs are divided into groups depending on the development of their financial systems to see the role of financial institutions, especially of the banking sector, in accommodating the capital inflows and respond to the monetary shocks from AMEs. By looking at the most and least vulnerable EMEs, we can find the country's specific factors which keep the economy stabilize from external monetary spill-overs.

Thirdly, in order to test the impact of monetary spill-over under the effect of the unconventional monetary policy including QE (from all four AMEs) and tapering (from the US), we use the dummy variables of 1 during the QE or tapering era and 0 outside the affected period in model (4) where the AMEs impact is measured as a total variable and in model (5) where the impacts from each AMEs are measured separately. QE is the dummy variable for QE events and TP is the

dummy variable for tapering events. The dummy variables are estimated in form of interaction regressor with the AMEs' variables.

$$LEMS_t = \alpha_t + \beta_1 LAMS_t + \beta_2 LAMS_t \times QE_t + \beta_3 LAMS_t \times TP_t + \varepsilon_t \quad (4)$$

$$LEMS_t = \alpha_t + \beta_1 LUSMS_t + \beta_2 LUSMS_t \times USQE_t + \beta_3 LUSMS_t \times TP_t + \beta_4 LJPMS_t + \beta_5 LJPMS_t \times JPQE_t + \beta_6 LUKMS_t + \beta_7 LUKMS_t \times UKQE_t + \beta_8 LEMMS_t + \beta_9 LEMMS_t \times EMQE_t + \varepsilon_t \quad (5)$$

Figure 9 visualizes the QE time periods in each country in the AMEs including the US, Japan, UK and EMU and the QE period in the whole AMEs; the Tapering time period in the US; and the overall unconventional monetary policy shocks in the whole AMEs which combines both QE and Tapering events. The data on QE and Tapering announcement dates and period are retrieved from study of Fawley & Neely (2013) and from official websites of the US Federal Reserve (Fed), the European Central Bank (ECB), Bank of England (BoE) and the Bank of Japan (BoJ).

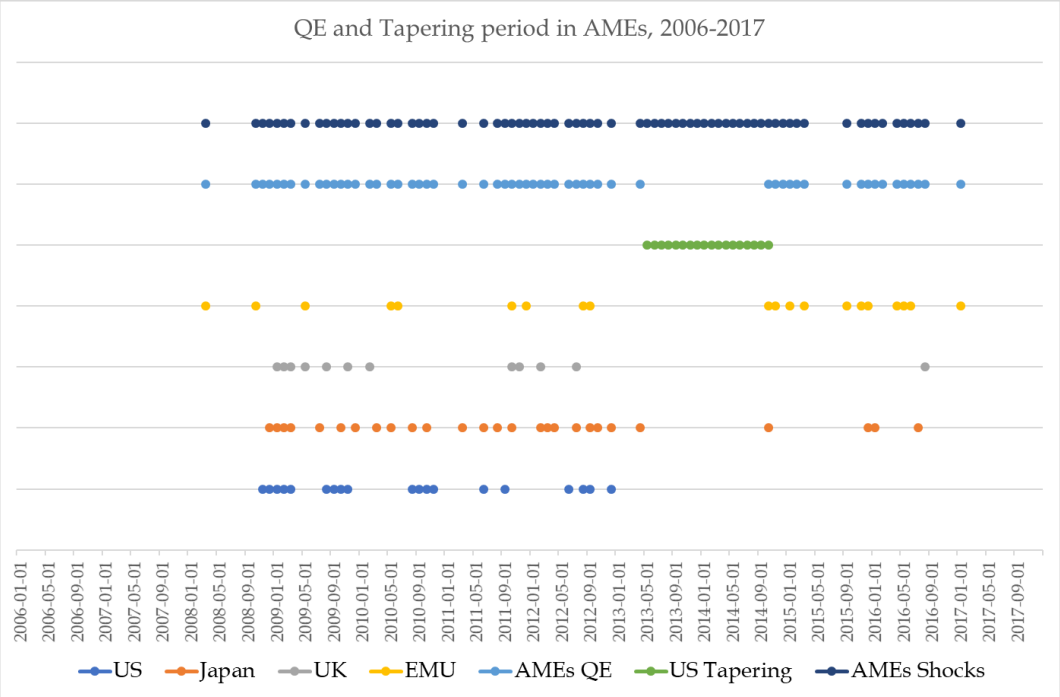


FIGURE 9. QE and Tapering periods in each country in AMEs and the whole group together, 2006–2017.

The four AMEs had moderately similar periods of unconventional monetary policy announcement and implementation, where the QE era was mostly concentrated in the later part of the Global financial crisis from the beginning of 2009 to the end of 2012 as the QE3 program from Fed ended. After that, there was a tapering period in the US from May 2013 till October 2014. Although the tapering happened in the US only, there was not any QE during that period from the other three AMEs either. However, right after the tapering period in US ended, there were, again, some more QE events in the UK and Japan and, especially, in the EMU until the beginning of 2017.

The later part of the study undertakes the VAR analysis and generates the impulse responses for each individual country in the EMEs to each of the four countries in AMEs. Furthermore, the EMEs country-specific characteristics, which were mentioned in the third part of the literature review (2.3.1), including the financial development, financial openness and the exchange rate regime are also considered along with the residual sum of squares of each EMEs in the model with all the AMEs (model 6 is an example for the Brazil's case).

$$LBRMS_t = \alpha_t + \beta_1 LUSMS_t + \beta_2 LJPMS_t + \beta_3 LUKMS_t + \beta_4 LEMMS_t + \varepsilon_t \quad (6)$$

The purpose of this method is to explain the heterogeneity between the ten emerging countries and find the relationship between each country economic conditions and the degree of explanatory power of the AMEs changes in excess money supply to that from that country.

4 RESULTS AND ANALYSIS

4.1 Estimation of spill-over impact from AMEs

4.1.1 Total AMEs impact

In order to estimate the overall total effects of monetary policy spill-over from all AMEs to all EMEs, we estimated the linear regression model with LEMS (changes in excess money supply from EMEs) as the dependent variable and LAMS (changes in excess money supply from AMEs) as the independent one. The result is shown in Table 7.

In this first model (1), there was an insignificant relationship between the total monthly percentage changes in excess money supply in AMEs and total one in EMEs and the explanation power-R^2 of the model was also as low as only 0.95 percent. This indicated that there was no immediate impact of the monetary policy spill-over from AMEs to EMEs.

$$LEMS_t = 0.2482 + 0.2864 \times LAMS_t + \varepsilon_t \quad (1)$$

Then, the second model (2) included the LAMS variable with its lags from t-1 to t-9 which tested the possible delayed spill-over from the AMEs to EMEs. The result found that only the variable $LAMS_{t-3}$ had significant and positive impact on the dependent variable $LEMS_t$ at 10 percent significant levels and R^2 also improved to 10.00 percent. The Lagrange Multiplier (LM) test for each variable in model (2) failed to reject the null hypotheses (the targeted independent variable has no effect on the dependent variable – $LEMS_t$ as other factors have been controlled) at all cases, except for the case of $LAMS_{t-3}$ variable at the 15% level (LM test result table in Appendix).

Furthermore, model (2′) was tested to find the impact of only $LAMS_{t-3}$ variable on $LEMS_t$, and as a result, the model found that all coefficients, significant levels and the adjusted R^2 were improved.

$$LEMS_t = 0.1627 + 0.7554 \times LAMS_{t-3} + \varepsilon_t \quad (2')$$

According to the result of model (2′), within the studied period from 2006 to 2017 there was a significant and positive spill-over effect from the AMEs to EMEs. The coefficient of the independent variable $LAMS_{t-3}$ was 0.7554, meaning that 1 percent increase in the excess money supply in AMEs can result in 0.7554 percent increase in EMEs, but the spill-over came only after a three-period lag.

TABLE 7 Monetary policy spill-overs from total AMEs to total EMEs , monthly data from January 2006–December 2017 (dependent variable – LEMS).

	Models		
Independent variables	(1)	(2)	(2′)
Constant	0.2482	0.3428	0.1627
	(0.6206)	(0.6113)	(0.4135)
LAMS	0.2864	0.2125	
	(1.1683)	(0.7264)	
LAMS (1)		-0.0956	
		(-0.2878)	
LAMS (2)		-0.0540	
		(-0.1543)	
LAMS (3)		0.6754	0.7554
		(1.9134)*	(3.1589)***
LAMS (4)		-0.1636	
		(-0.4681)	
LAMS (5)		0.0194	
		(0.0556)	
LAMS (6)		-0.3753	
		(-1.0603)	
LAMS (7)		-0.2340	
		(-0.6729)	
LAMS (8)		-0.0095	
		(-0.0287)	
LAMS (9)		0.2629	
		(0.9091)	

TABLE 7 Monetary policy spill-overs from total AMEs to total EMEs , monthly data from January 2006–December 2017 (dependent variable – LEMS).

	Models		
Independent variables	(1)	(2)	(2′)
N	143	134	140
R2	0.0095	0.1000	0.0674
Adj. R2	0.0025	0.0268	0.0606
F-test	F(1,141)= 1.3650	F(10,123)= 1.3671	F(2,138)= 9.9786
Significance Level of F	0.2446	0.2032	0.0019
DW	2.1952	2.1321	2.1452

1. N indicates the number of observations.
2. *, ** and *** implies the level of significance at 10% 5% and 1% level, respectively.
3. The t-value is in the parentheses under the coefficient.
4. DW is the Durbin-Watson Statistic.

4.1.2 Individual AMEs impact

The next regression studied the impact of individual countries in AMEs to the whole group of EMEs and found some significant results (Table 8). Since in the first part there was a delayed monetary policy spill-over from the AMEs to EMEs found in the last model (2′), this part will also estimate the model with lagged variables.

$$LEMS_t = -0.0691 + 1.1762 \times LUSMS_{t-3} + 0.0562 \times LJPMS_{t-3} + 0.2336 \times LUKMS_{t-3} + 0.2496 \times LEMMS_{t-3} + \varepsilon_t \quad (3)$$

When all four variables from the AMEs were included in one model (3), there were significant influence found on EMEs from only the changes of the US at the significant level of 5 percent, and the model's R^2 was 14.71 percent. When taking each country variable separately in regression with the total EMEs, the significant impacts were seen more clearly at 1 percent, while the explanation power R^2 understandably dropped almost in half for the US, UK and the EMU.

Japan's changes in excess money supply did not result in any significant impact to the changes in EMEs in all regression during the studied period.

In terms of the signs of the coefficients, all of them were positive, which were similar to the sign of the total effect of AMEs in model (2'). Moreover, the US variable also had the largest influence on the changes in EMEs due to the high value of its coefficient, 1.1762 in model (3) and 1.5523 when tested separately. The coefficients of UK and the EMU's variables were 0.5022 and 0.5011, both were highly significant at 1 percent when tested separately. However, they did not generate significant results when being in the same model (3). This might result from the closely related economic and geographic conditions between the UK and the EMU. Thus, when choosing the best fitted model (3') to explain the changes in excess money supply of EMEs, the US and EMU's variables had the best significant coefficients as well as the highest explanation power of R^2 equals 13.77 percent.

$$LEMS_t = -0.0685 + 1.2423 \times LUSMS_{t-3} + 0.4193 \times LEMMS_{t-3} + \varepsilon_t \quad (3')$$

TABLE 8 Monetary policy spill-overs from individual AMEs to total EMEs , monthly data from January 2006–December 2017 (dependent variable – LEMS).

	Models					
Independ-ent variable	(3)	US	Japan	UK	EMU	(3')
Constant	-0.0691	-0.0520	0.3118	0.2398	0.2244	-0.0685
	(-0.1757)	(-0.1287)	(0.7745)	(0.6203)	(0.5814)	(-0.1749)
LUSMS(3)	1.1762	1.5523				1.2423
	(2.5598)**	(3.4020)***				(2.7370)***
LJPMS(3)	0.0562		0.1412			
	(0.4175)		(1.0592)			
LUKMS(3)	0.2336			0.5022		
	(1.2126)			(3.6136)***		
LEMMS(3)	0.2496				0.5011	0.4193
	(1.2742)				(3.7076)***	(3.0968)***
N	140	140	140	140	140	140

TABLE 8 Monetary policy spill-overs from individual AMEs to total EMEs , monthly data from January 2006–December 2017 (dependent variable – LEMS).

	Models					
Independent variable	(3)	US	Japan	UK	EMU	(3′)
R2	0.1471	0.0773	0.0080	0.0864	0.0905	0.1377
Adj. R2	0.1219	0.0706	0.0008	0.0864	0.0840	0.1251
F-test	F(4,135)= 5.8250	F(1,138)= 11.5739	F(1,138)= 1.1220	F(1,138)= 13.0585	F(1,138)= 13.7468	F(2,137)= 10.9424
Significance Level of F	0.0002	0.0008	0.2913	0.0004	0.0003	0.0000
DW	2.1366	2.1833	2.1967	2.1647	2.1290	2.1222

1. N indicates the number of observations.
2. *, ** and *** implies the level of significance at 10% 5% and 1% level, respectively.
3. The t-value is in the parentheses under the coefficient.
4. DW is the Durbin-Watson Statistic.

Based on the best model estimated, there was also significant and positive spill-over from two AMEs including the US and EMU to EMEs, in which the largest impact was from the US which was about three time larger than the one from the EMU. The spill-over from the UK to EMEs was also significant and positive if tested separately from the one from the EMU. Lastly, tests for Japan did not result in any significant spill-over to EMEs during the studied period.

4.1.3 QE and Tapering events impact

In the fourth model (4), the impact of monetary spill-over with special events of the unconventional monetary policy, QE (from all four AMEs) and tapering (from the US), was tested using the dummy variables' values of 1 and 0 for during and outside the QE or tapering era. QE is the dummy variable for QE events and TP is the dummy variable for tapering events. The variables in this part were also lagged variable to be consistent with the other two (part 4.1.1 and 4.1.2).

$$LEMS_t = 0.1815 + 0.5550 \times LAMS_{t-3} - 0.0962 \times LAMS_{t-3} \times QE_{t-3} + 1.5812 \times LAMS_{t-3} \times TP_{t-3} + \varepsilon_t \quad (4)$$

Running regressions for this model, the result turned out to be insignificant for the AMEs variable and lower in value for its coefficient comparing to the previous model (2'). Moreover, the interaction regressor of the AMEs changes in excess money supply and QE dummy variable was also insignificant and the coefficient was also very low and negative (only -0.0962). The case of the tapering was, in contrast, resulted in a significant, positive and high coefficient (1.5812). Overall, this was not the best model to be used to identify the impact of QE and tapering events on the monetary policy spill-over from AMEs to EMEs.

Moving on, we estimated a larger model which included more lags from three to six period further for both QE and TP dummies. According to the result found (Table 9, 'Lagged' column), even though only the lag 3 and 6 of the tapering dummy resulted in significant impact on EMEs, the variable of AMEs and the lag 5 of the QE dummy also had considerably high t-value (value in the parentheses under the coefficient). Finally, model (4') was the best fitted one found, with the variables consisted of the lag 3 changes in excess money supply of AMEs ($LAMS_{t-3}$), lag 5 QE dummy (QE_{t-5}) and lag 6 tapering dummy (TP_{t-6}).

$$LEMS_t = 0.1158 + 0.7308 \times LAMS_{t-3} + 0.5813 \times LAMS_{t-5} \times QE_{t-5} - 1.1475 \times LAMS_{t-6} \times TP_{t-6} + \varepsilon_t \quad (4')$$

This model pointed out the significant impact of the unconventional monetary policy from AMEs in amplifying the spill-over effect to EMEs during the studied period. The QE events had a positive impact on the spill-over to EMEs with 5 months delayed, while the tapering events had 6 months delayed but caused a larger negative impact with an almost double value of coefficient (-1.1475 for $LAMS_{t-6} \times TP_{t-6}$ comparing to 0.5813 for $LAMS_{t-5} \times QE_{t-5}$).

TABLE 9 Monetary policy spill-overs from total AMEs to total EMEs with dummy variables , monthly data from January 2006–December 2017 (dependent variable – LEMS).

	Models		
Independent variables	(4)	Lagged	(4′)
Constant	0.1815	0.1461	0.1158
	(0.4674)	(0.3507)	(0.2904)
LAMS(3)	0.5550	0.5070	0.7308
	(1.6039)	(1.3947)	(3.0377)***
QED(3)	-0.0962	0.0106	
	(-0.2058)	(0.0220)	
QED(4)		0.0522	
		(0.1415)	
QED(5)		0.5799	0.5813
		(1.5677)	(1.6933)*
QED(6)		-0.0534	
		(-0.1476)	
TPD(3)	1.5812	1.4610	
	(2.4531)**	(1.9624)*	
TPD(4)		0.0611	
		(0.0745)	
TPD(5)		-0.4830	
		(-0.5854)	
TPD(6)		-1.2501	-1.1475
		(-1.7369)*	(-1.8972)*
N	140	137	137
R2	0.1076	0.1539	0.1166
Adj. R2	0.0879	0.0939	0.0966
F-test	F(3,136)= 5.4668	F(9,127)= 2.5671	F(3,133)= 5.8527
Significance Level of F	0.0014	0.0095	0.0008
DW	2.1699	2.1629	2.1290

1. N indicates the number of observations.

TABLE 9 Monetary policy spill-overs from total AMEs to total EMEs with dummy variables , monthly data from January 2006–December 2017 (dependent variable – LEMS).

		Models	
Independent variables	(4)	Lagged	(4′)

2. *, ** and *** implies the level of significance at 10% 5% and 1% level, respectively.
3. The t-value is in the parentheses under the coefficient.
4. DW is the Durbin-Watson Statistic.
5. QED(t) is the integrated variable $LAMS \times QE$ with lag t.
6. TPD(t) is the integrated variable $LAMS \times TP$ with lag t.

The QE and tapering dummies for each economy in the AMEs were also tested separately to compare the impacts of the unconventional monetary policy from different developed countries. The dummy variables represent different AMEs' QE periods in the US, Japan, UK and EMU and, particularly, the tapering period in the US. In the first column of the following table (Table 8) is the regression of all the countries' changes in excess money supply, QEs and tapering variables as in model (5).

$$LEMS_t = 0.0292 + 1.7632 \times LUSMS_{t-3} - 2.6761 \times LUSMS_{t-3} \times USQE_{t-3} - 1.0580 \times LUSMS_{t-3} \times TP_{t-3} - 0.0142 \times LJPMS_{t-3} + 0.3469 \times LJPMS_{t-3} \times JPQE_{t-3} + 0.1448 \times LUKMS_{t-3} - 0.1267 \times LUKMS_{t-3} \times UKQE_{t-3} + 0.2494 \times LEMMS_{t-3} + 0.2339 \times LEMMS_{t-3} \times EMQE_{t-3} + \varepsilon_t \quad (5)$$

Among all dummy variables in this model, only the US changes in excess money supply and its interaction regressor with QE dummy had significant effects on the changes in excess money supply in EME. Then, the effects were tested separately for each country of the AMEs and found more significant results; especially for the US, where it was found that, in addition of the US's QE dummy (QE_{t-3}), the lag 6 tapering dummy (TP_{t-6}) also had significant impact on the spill-over to EMEs, and the US individual model had the highest R^2 among all other countries (0.1465). The EMU variables also generated significant results, but with the lag 6 QE dummy (QE_{t-6}); while there were not any significant results found for the Japan and UK dummy variables on the spill-over. Therefore, the best

model found for this part (5′) consisted of variables from the US and EMU only with all significant coefficients as follow and with remarkably high R^2 value of 21.87 percent.

$$LEMS_t = 0.1191 + 1.9279 \times LUSMS_{t-3} - 2.4104 \times LUSMS_{t-3} \times USQE_{t-3} - 2.9283 \times LUSMS_{t-6} \times TP_{t-6} + 0.3989 \times LEMMS_{t-3} - 0.4291 \times LEMMS_{t-6} \times EMQE_{t-6} + \varepsilon_t \quad (5')$$

Regarding the impact of unconventional monetary policy from individual countries in the AMEs, the model (5′) suggested that all the unconventional monetary events had negative impacts on the spill-over from the AMEs to EMEs regardless of QE or tapering events. However, the tapering events from the US had larger impact than the QE events from all other countries in decreasing the spill-over effect. Overall, among all AMEs individual countries' unconventional monetary policy, the US impact was significantly clear and larger than any other countries, with the highest coefficient of the tapering dummy interaction regressor equal up to -2.9283, while the coefficient of the QE dummy from the EMU was only as much as -0.4291.

TABLE 10 Monetary policy spill-overs from individual AMEs to total EMEs with dummy variables, monthly data from January 2006–December 2017 (dependent variable – LEMS).

	Models					
Independent variable	(5)	US	Japan	UK	EMU	(5′)
Constant	0.0292	0.0980	0.2959	0.2812	0.3231	0.1191
	(0.0742)	(0.2439)	(0.7371)	(0.7202)	(0.8255)	(0.3069)
LUSMS(3)	1.7632	2.2742				1.9279
	(3.2772)***	(4.5058)***				(3.8802)***
USQE(3)	-2.6761	-2.6736				-2.4104
	(-2.3859)**	(-2.5276)**				(-2.2857)**
USTP(3)	-1.0580					
	(-0.6952)					
USTP(6)		-3.4712				-2.9283
		(-2.3482)**				(-2.0394)**

TABLE 10 Monetary policy spill-overs from individual AMEs to total EMEs with dummy variables, monthly data from January 2006–December 2017 (dependent variable – LEMS).

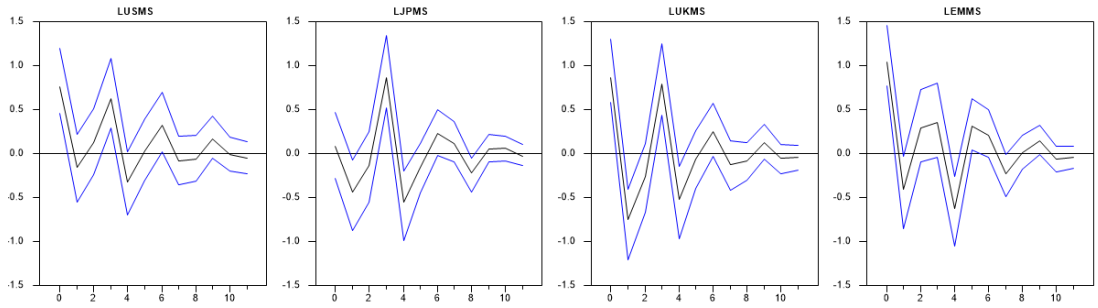
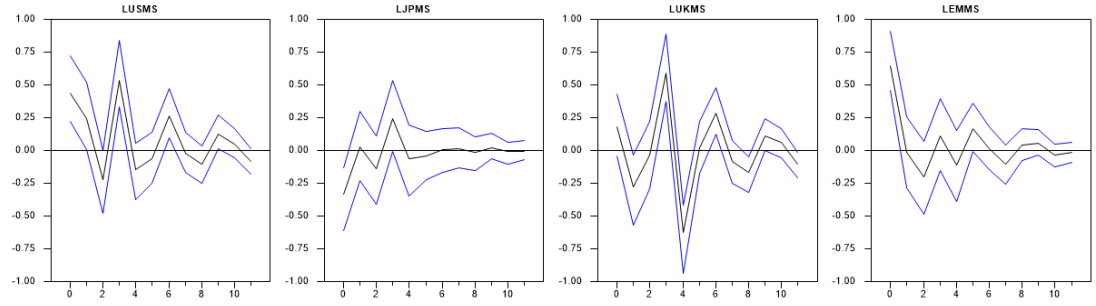
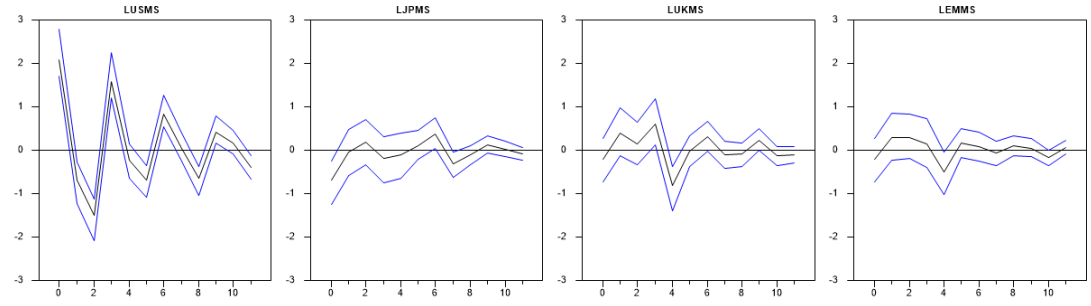
	Models					
Independent variable	(5)	US	Japan	UK	EMU	(5′)
LJPMS(3)	-0.0142		0.0124			
	(-0.0904)		(0.0766)			
JPQE(3)	0.3469		0.3937			
	(1.3065)		(1.3924)			
LUKMS(3)	0.1448			0.5309		
	(0.7084)			(3.6958)***		
UKQE(3)	-0.1267			-0.4570		
	(-0.2230)			(-0.8048)		
LEMMS(3)	0.2494				0.4935	0.3989
	(1.1784)				(3.6209)***	(2.9736)***
EMQE(3)	0.2339					
	(0.7869)					
EMQE(6)					-0.5423	-0.4291
					(-2.1445)**	(-1.7274)*
N	140	137	140	140	137	137
R2	0.2018	0.1465	0.0219	0.0907	0.1168	0.2187
Adj. R2	0.1466	0.1273	0.0076	0.0774	0.1036	0.1888
F-test	F(9,130)= 3.6539	F(3,133)= 7.6131	F(2,137)= 1.5343	F(2,137)= 6.8365	F(2,134)= 8.8664	F(5,131)= 7.3340
Significance Level of F	0.0004	0.0000	0.2192	0.0014	0.0002	0.0000
DW	2.1047	2.0933	2.2086	2.1490	2.0711	1.9914

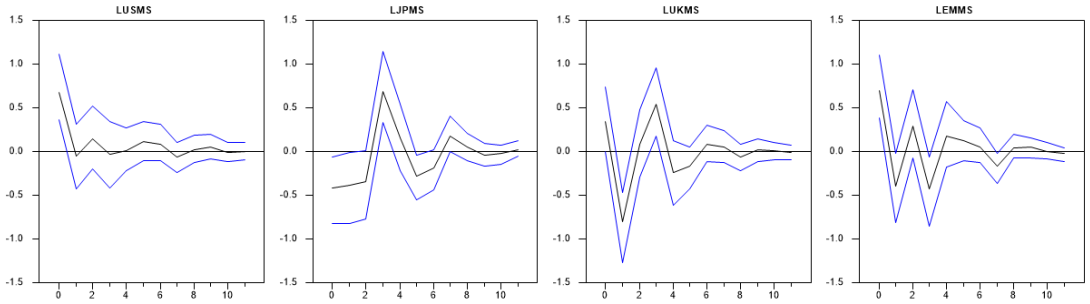
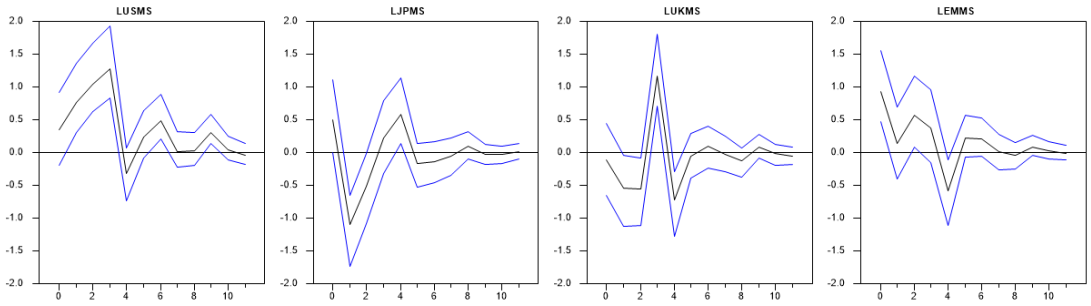
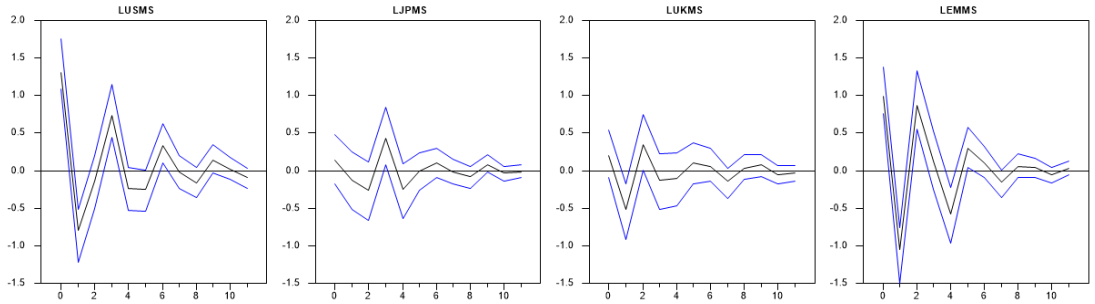
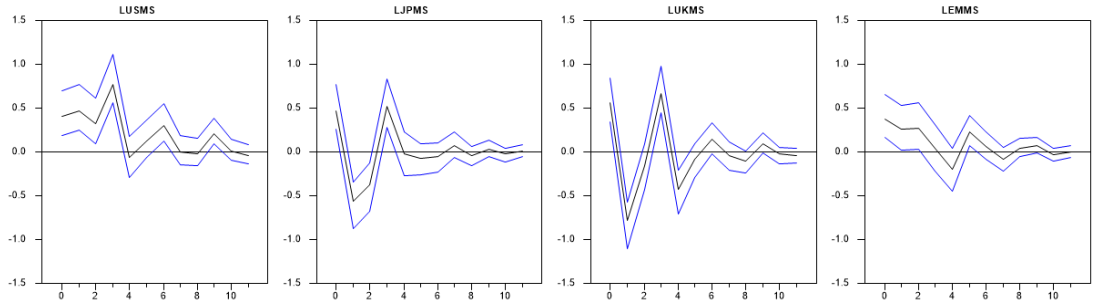
1. N indicates the number of observations.
2. *, ** and *** implies the level of significance at 10% 5% and 1% level, respectively.
3. The t-value is in the parentheses under the coefficient.
4. DW is the Durbin-Watson Statistic.
5. USQE(t) is the integrated variable $LUSMS \times USQE$ with lag t, similarly to other countries intergrated variables.
6. USTP(t) is the integrated variable $LUSMS \times TP$ with lag t.

4.2 Spill-over impact to different EMEs

4.2.1 Individual EMEs VAR analysis

This part of the study estimates the spill-over to EMEs as individual countries using the VAR model with impulse response analyses. This analysis demonstrates the differences in the dynamic structure of the spill-over from AMEs to each EMEs. The impulse responses to shock in the AMEs of each country in EMEs with 68 percent confidence interval level error bands are illustrated in the following figure 10.

EMEs	US shock	Japan shock	UK shock	EMU shock
Brazil				
Mexico				
Argentina				

EMEs	US shock	Japan shock	UK shock	EMU shock
South Africa				
Turkey				
Indone-sia				
Malay-sia				

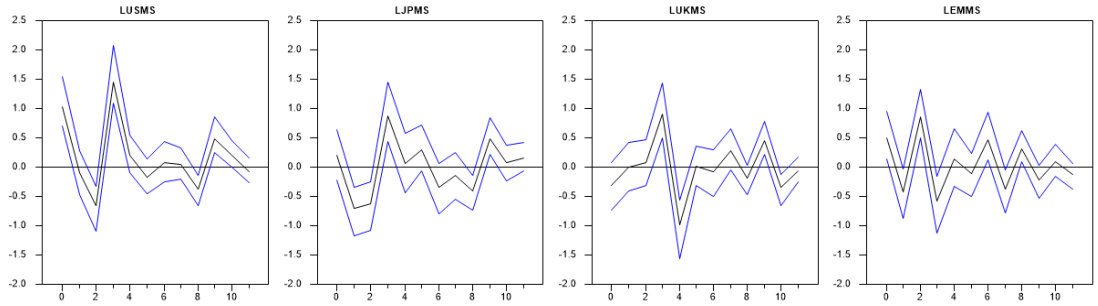
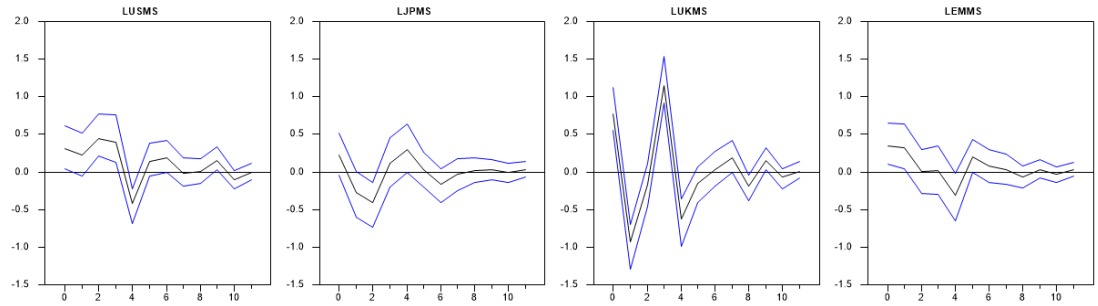
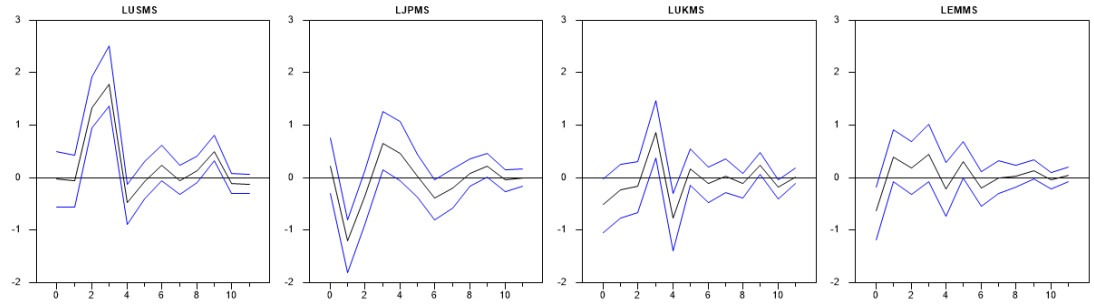
EMEs	US shock	Japan shock	UK shock	EMU shock
Philip-pines				
Korea				
China				

FIGURE 10. Each EMEs' responses to shock from each AMEs, 2006-2017.

In most cases according to the impulse responses result, Japan's monetary policy spill-over had relatively smaller impact to individual emerging countries comparing to other three AMEs. Although from previous part, the US always has the largest impact comparing to all other AMEs, in this part, the responses from the EMEs to the monetary policy shocks from the US does not shown to be clearly more significant than that from the EMU and UK.

Regarding the affected side, the countries that had the strongest responses to monetary shocks from most countries of the AMEs were Brazil, Turkey and Philippines. However, there were also countries, who responded particularly

strongly to only a specific AMEs, such as Argentina and China to shocks from the US, Indonesia to shocks from the US and EMU, and Korea to shocks from the UK. Overall, the responses of individual EMEs changes of excess money supply to shocks from the AMEs were heterogenous even within the geographical region of the countries. Therefore, the next part examines further how the EMEs experienced the spill-over from AMEs based on country-specific characteristics, or more specifically, the differences in economic conditions.

4.2.2 EMEs economic conditions and exposure to spill-over

Due to the heterogenous responses of EMEs changes in excess money supply to the AMEs monetary shocks, this part of the study investigates whether an emerging country's specific economic conditions relate to their responses to external monetary policy shocks from the AMEs.

The economic conditions considered in this part includes the development of the financial system, the financial openness and the exchange rate classification. The exposure of EMEs monetary condition to external shock was measured by the residual sum of squares (RSS) of each emerging country's changes in excess money supply as dependent variable in the model with the four AMEs. The three figures (Figure 11 (a), (b) and (c)) illustrate negative trends of the relationship between economic conditions of all countries in the EMEs group and their monetary exposures to spill-over from AMEs.

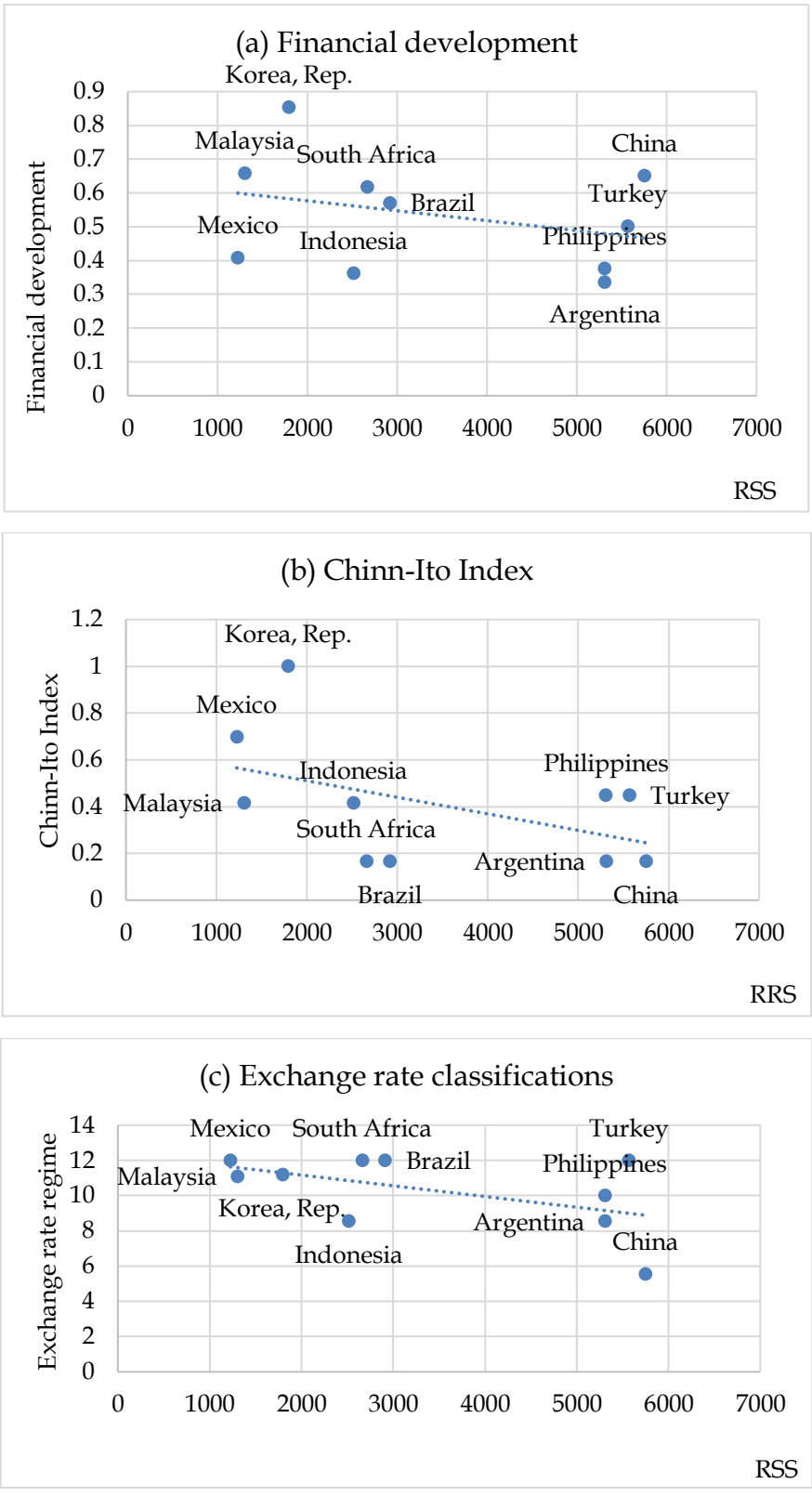


FIGURE 11. Relationships between each EMEs (a) financial development, (b) financial openness and (c) exchange rate regimes with external monetary influences by AMEs.

The first figure (a) shows that emerging countries with more developed financial institutions and financial markets such as Korea and Malaysia experienced smaller spill-over effects from the advanced countries. Philippines and Argentina, on the other hand, with the lowest financial development index were also two of the most exposed countries to the external monetary policy spill-over from the AMEs. However, in the case of China, although the financial development was considerably high, China's changes in excess money supply were still affected largely by the external AMEs, especially from the US as can be seen from the impulse responses figure from the previous part. Thus, we also need to consider other characteristics of the EMEs economic conditions such as the financial openness to explain their degree of exposure to spill-over.

Indeed, the most obvious negative trend found for the RSS was with the Chinn-Ito index of financial openness, where the less financially open countries were more affected by external monetary policy shocks. Again, Korea, which was among the least exposed countries, was also the one with the highest degree of openness based on the Chinn-Ito index scale. In contrast, Argentina and China were both the least financially open economies and the most monetary influenced by the AMEs. Moreover, both China and Argentina during the study period had the lowest degree of exchange rate flexibility which was also an important factor affecting their exposures to external monetary shocks.

The degree of exchange rate flexibility relationship with the RSS also have the result implied that EMEs with less flexible exchange rate regime were more expose to the monetary policy spill-over from AMEs. In the case of Argentina and China with the relatively pegged exchange rate regime, the two countries' changes in excess money supply were affected most strongly by the spill-over from the US monetary shocks according to the impulse responses from the VAR analysis. Exceptionally, Turkey and Philippines, even though had floating exchange rate regime, still had relatively high monetary exposure to all the four

AMEs according to both the RSS and the VAR impulse responses analysis. However, considering other characteristics of these two countries, they had relatively low levels of both financial development and financial openness.

4.3 Discussion

According to the results found, this part discusses the paper's own findings in comparision with previous papers. In overall, this paper has drawn similar conclusions on the impact of monetary policy spill-over from the AMEs to EMEs with a more updated data set until the end of 2017. Moreover, it contributed to previous literature by adding more dimensions to the level of the spill-over including the individual impacts of, in addition to the US, each AMEs; extraordinary events of unconventional monetary policy and EMEs different economic conditions.

The findings of this paper support the argument from Georgiadis (2016) that the spill-over from monetary policy are substantial and can be even larger to some of the EMEs than the domestic effects in AMEs. Overall, this paper found the impacts of monetary policy spill-over from AMEs to EMEs were significantly positive. Besides the impacts found on capital flows, output, stock market asset prices and exchange rates in Berument & Dincer (2004), Fratzscher *et al.* (2012), Lim *et al.* (2014), Aizenman *et al.* (2014), Tillmann (2016) and Bhattarai *et al.* (2017), and price level, real output and real economic activity in Maćkowiak (2007) and Fink & Schüler (2015); this paper addressed the spill-over impact on the excess money supply which resulted in a positive relationship, similar to Berument & Dincer (2004) and Lim *et al.* (2014) who also assessed the spill-overs on changes in MS.

Among all AMEs, the effect of monetary policy spill-over from the US was, in fact, found to be the most significantly dominant throughout all models. This has been studied and analyzed profoundly in enormous number of previous re-

searches including Canova (2005), Maćkowiak (2007), Miyajima *et al.* (2014), Bowman *et al.* (2015), Fink & Schüler (2015), Tillmann (2016) and Bhattarai *et al.* (2017). Thus, this model contributed to the literature by assembling models including the other three major countries which were the EMU, UK and Japan. In this way, we have a sharper look at the monetary policy impact from the US to the EMEs, in comparision with other AMEs. As implied from the estimation result, monetary policy from the EMU also had significant spill-over to the EMEs, however, the effect was much lower than the siginificant effect from the US, as also found in Fratzsche *et al.* (2016).

In terms of the unconventional monetary policy events from the AMEs – QE and tapering in the US, they were found to have amplified effect on the spill-over to EMEs which is similar to Bowman *et al.* (2015) who found that EMEs asset prices also experienced large fluctuation around the announcement dates of unconventional monetary policy from the Fed. Fratzsche *et al.* (2012) also discussed that the US QE events had exacerbated the pro-cyclicality of the capital flows to EMEs and their later study on the ECB QE (Fratzsche *et al.*, 2016) also found positive spill-overs to equity price and lower credit risk to other economies. In contrast to the effect of QE events, later literature by Aizenman *et al.* (2014), Eichengreen & Gupta (2015) found negative impacts of the tapering announcements to the EMEs. Both QE and tapering events studies from previous papers were consistent with finding from this paper on the positive impacts of QE events and the negative impacts of tapering events from the AMEs to EMEs. Moreover, this paper also answered the question from study of Lim *et al.* (2014) and Tillmann (2016) that, in fact, the effects of QE and tapering events were asymmetric and tapering events had much stronger impact on the spill-over than QE events.

The negative signs of the interactions of QE from both the US and the EMU and the changes in excess money supply in these two countries is also another point worth mentioning. This finding is similar to what was found in Lim *et al.* (2014) about the negative affect of the QE×M2 variable to financial inflow to EMEs. The study discussed that the monetary policy after the financial crisis

might actually had contractionary effect as the M2 increased rapidly lowered the liquidity premia and raised the demand for liquid assets which substituted for the EMEs assets. This also in line with the idea of Fawley & Neely (2013) that the QE in AMEs after the uncertainty periods increased the monetary base at much higher rate than the broader monetary aggregates because banks chose to hold the excess money and liquid assets in excess reserves.

Considering the responses from EMEs, some implications concerning the EMEs country-specific characteristics emerged from the results of this study. Firstly, regarding the financial development, the finding suggested that more developed financial markets and institutions experienced smaller spill-over from the AMEs. This was a contrast idea with studies from Eichengreen & Gupta (2015) and Aizenman *et al.* (2014), which found that countries with larger and more liquid financial markets allowed investors to rebalance their portfolio easier, thus, exposed more by the spill-over pressure. However, it was supported by other studies from Fratzscher *et al.* (2012) and Georgiadis (2016). Another point worth noticing was the argument from Calvo et al. (2008), suggesting that the increase in a country financial integration reduced the probability of exposing to a sudden shock, but this should be accompanied by the financial development of institutions, who responsible for implementing credible instruments.

Therefore, secondly, this paper focused on the financial openness characteristic estimated based on the Chinn-Ito index (2006) and found that the more financially open emerging countries were less exposed to external spill-over. This findings was the same in Rai & Suchanek (2014) who also used the Chinn-Ito index, but contrast to Eichengreen & Gupta (2015) who used another measure. Together with the first characteristic of financial system development, we can see that countries such as: China, which had high level of financial development but was also the lowest financially open country and Philippines, which was more open but had the nearly lowest level of financial development were the two most exposed to spill-overs.

Thirdly, as Edwards (2007) and Fratzscher *et al.* (2012) found that having a restricted capital mobility and keeping the exchange rate regime pegged did not significantly help the EMEs to insulate themselves from spill-over, this study also estimated a negative relationship between the EMEs' degree of exchange rate flexibility with the monetary exposure to shocks from the AMEs. The most obvious example was the case of Mexico and Malaysia in this study, which were least affected by spill-overs, while both countries had a medium level of both financial development and openness, but they had, exceptionally, the highest level of flexible exchange rate regimes. Finally, among the countries, which had the least influences from the AMEs monetary policy spill-over, Korea was the one with both well developed financial system and financially open and, moreover, high degree of exchange rate flexibility.

5 CONCLUSIONS

This research concludes the impact of monetary policy spill-overs to the EMEs from the four AMEs including the US, Japan, UK and EMU for the period from 2006 to the end of 2017. More specifically, to represent the effect of the spill-over, the impact of the AMEs monetary policy were identified by the monthly changes in excess money supply and the same variable was also estimated on the EMEs side of the regression equation. The estimation resulted in significant impacts of monetary policy spill-overs from the four advanced countries to the ten developing ones.

In line with most previous literatures, the US had the significantly strongest monetary influence on the emerging group of countries. Moreover, this paper also found the second and third strongest monetary influences were from the EMU and UK and, lastly, there was not any significant spill-over impact found from Japan on the EMEs both in the linear regression and the VAR analysis. The paper also considered the impact of the unconventional monetary policy events from AMEs. Particularly, QE and tapering events had significant amplified effects on the spill-over to the EMEs and the effects were asymmetric in terms of the size, since the effects found for tapering events were consistently much larger than QE in all models.

Furthermore, this study also considers the economic differences between the emerging countries and the observation of EMEs were selected from different part of the world. They were Brazil, Mexico and Argentina from Latin America; Turkey, Indonesia, Malaysia, Philippines, South Korea and China from Asia; and South Africa from Africa. The VAR impulse responses for individual EMEs resulted in heterogenous responses, and the country-specific characteristics analysis found that countries with relatively lower financial development, financial openness and degree of exchange rate flexibility experienced larger monetary policy spill-over influences from the AMEs.

As a result, the findings from this study emerged significant policy implication. It is suggested that, EMEs, in order to insulate themselves better from the substantial monetary policy spill-over from the AMEs, need to have a certain degree of exchange rate flexibility as well as high level of integration, but, most importantly, how high these two factors need to be depends on that country's specific development of their financial system of institutions and markets.

Finally, there are still plenty of room for further research in analyzing the EMEs country-specific characteristics' role on the degree of monetary exposures of each country to external shocks from the AMEs. For example, estimating the differences in economic conditions in a panel data regression model to generate more significantly valuable results and evaluate further the important of each factor. Additionally, more emerging countries with up-to-date data can also be included in the study for a more detailed picture of the spill-over from the AMEs. From there, one would find more evidences to making suggestion on possible monetary policy adjustment that EMEs can make to insulate themselves from spill-overs from the AMEs.

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APPENDIX

APPENDIX 1. Lagrange Multiplier (LM) test results for model 2 (dependent variable – LEMS).

Independent variables	Chi-square ($\chi 2$)	*p*-value (Significant level)
LAMS	0.572461	0.75108952
LAMS (1)	0.090182	0.95591026
LAMS (2)	0.025947	0.98711054
LAMS (3)	3.873275	0.14418797
LAMS (4)	0.238296	0.88767626
LAMS (5)	0.003375	0.99831369
LAMS (6)	1.213893	0.54501239
LAMS (7)	0.491513	0.78211282
LAMS (8)	0.000901	0.99954940
LAMS (9)	1.022867	0.59963550

APPENDIX 2. Residual Sum of Squares and country-specific characteristic indices.

Country	RSS	Financial development	Chinn-Ito openness	Exchange rate classifications
Argentina	5309.7035	0.3376576	0.1658	8.55
Brazil	2914.0878	0.5709821	0.1658	12
China	5747.2055	0.6513166	0.1658	5.55
Indonesia	2514.7331	0.3639323	0.4156	8.55
Korea	1794.6104	0.855473	1.0000	11.18
Malaysia	1304.0419	0.6600142	0.4156	11.09
Mexico	1224.8093	0.4091886	0.6987	12
Philippines	5306.0067	0.3777103	0.4489	10
South Africa	2663.3595	0.6178052	0.1658	12

APPENDIX 2. Residual Sum of Squares and country-specific characteristic indices.

Country	RSS	Financial development	Chinn-Ito openness	Exchange rate classifications
Turkey	5565.276	0.5029746	0.4489	12