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# Effects of US Interest Rate Hikes and Global Risk on Daily Capital Flows in Emerging Market Countries

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### Effects of US Interest Rate Hikes and Global Risk on Daily Capital Flows in Emerging Market Countries\*

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#### Abstract

The interest rate hikes in the United States and higher global risk aversion have increased capital outflows from emerging market countries in recent years. This paper attempts to investigate the effects of global risk and interest rate hikes in the United States on capital flows in emerging market countries on a daily basis during a period from 11 November 2015 to 2 October 2018. Vector Autoregressive (VAR) models are employed to obtain the following main empirical results. Firstly, we found that both a higher interest rate in the United States (both market rates and market expectations on future interest hikes) and a higher global risk aversion possibly decrease portfolio flows (both equity flows and debt flows) in most of the sampled emerging market countries, although not all of them are statistically significant. Secondly, exchange rate depreciation of emerging market country currencies against the US dollar and plunges in equity prices of emerging market countries significantly lead to portfolio outflows from most of the sampled countries, demonstrating the large driving power of emerging market portfolio flows. Fourthly, we found that the portfolio outflows (both equity flows and debt flows) tend to significantly lead to further outflows. Fourthly, we found that the portfolio outflows from emerging market countries significantly deteriorate their domestic equity prices and depreciate their home currencies against the US dollar. Finally, we found wide contagion effects of portfolio flows among emerging market countries. It shows that portfolio outflows from emerging market countries will be reinforced and become more serious under the circumstances of global portfolio outflows from emerging market countries, and will be transmitted more severely among the emerging market countries with highly regional economic and financial nexuses.

Keywords: capital flows, emerging market countries, US interest rate hike, global risk, contagion

JEL classification: E43, F32, F42, G11

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#### 1. Introduction

Since the Federal Reserve Board (FRB) announced to raise the policy interest rates in December 2015, scholars and policymakers have worried that a tightened monetary policy in the United States might drive large-scaled global portfolio investments to flow out of emerging market countries. It further might trigger financial instability and domestic economic deceleration in emerging market countries in a situation of their high external financial liabilities and vulnerability to intensive capital flight. The recent interest rate hike began in December 2015 when the FRB raised the target Federal Fund (FF) rates from 0.25% to 0.5%, firstly after the global financial crisis in 2008. As the tightened monetary policy has been accelerated, the target FF rates have been raised to 2.5% until December 2018, leading to a sharp increase in interest rates in the United States. On the contrary, in recent years most emerging market countries experienced decelerated economic developments, making their policymakers be difficult to select a tightened monetary policy. It is widely known that a sharply narrowed interest rate differential between the emerging market countries and the United States leads to a decrease in capital inflows or even net capital outflows. Furthermore, increasing global risk aversion seems to weaken capital inflows into emerging market countries. Since the Quantitative Easing (QE) monetary policy was implemented, the stock bull market in the United States has experienced a historic long-run. However, the global equity sell-off and the global stock market crash show the bullbear market switching. It shrinks global investors' high-risk portfolio investments in emerging market countries. Hence the recent trend of global risk aversion is regarded as a severe threat to portfolio flows to emerging market countries.

Previous studies have investigated the key driver role of interest rates in the United States and global risk aversion on portfolio flows in emerging market countries. In earlier literature, the drivers of capital flows are classified using the traditional "push vs. pull" framework, which separates country-specific "pull" factors and external "push" factors. The "push vs. pull" framework has been proved useful to explain the behavior of capital flows during the financial crisis (Calvo and Reinhart, 1996; Montiel and Reinhart, 1999; Stiglitz, 2000). Basing on the "push vs. pull" framework, large number of studies have provided empirical evidence that among the "push" (external) factors, interest rates in the United States and global risk aversion (or risk appetite) have been proved the key drivers for capital flows in emerging market countries, which are stronger than the "pull" (internal) factors (Alderighi, Cleary, and Varanasi, 2018; Bowman, Londono, and Sapriza, 2015; Koepke, 2018; Pundit, 2017). Moreover, effects of "push" and "pull" factors on capital flows have been proved to differ by country in their different economic situations (Fratzscher, 2012; Sarno, Tsiakas, and Ulloa, 2016).

Building on a large literature in determinants of portfolio flows in emerging market countries, this paper attempts to investigate the effects of interest rate in the United States and global risk aversion on daily portfolio flows (equity flows and debt flows) in emerging market countries during the recent interest rate hike in the United States from 11 November 2015 to 2 October 2018 by employing VAR models. Additionally, we also analyze other possible determinants of portfolio flows in emerging market countries, including equity prices in the United States, equity prices, interest rates, and exchange rates emerging market countries mentioned in previous studies. Also, we focus

on whether portfolio outflows shocks from emerging market countries make temporary or persistent effects on themselves. Furthermore, this paper uses VAR models to give some evidence on the effect of portfolio outflows on financial markets which include domestic interest rates and, exchange rates, and equity prices. We analyze how financial markets in emerging market countries effectively react to the interest rate hike in the United States and global risk aversions. Lastly, we investigate the simultaneous contagions of portfolio flow among emerging market countries, which are considered to further worsen the balance of payments (BoP) of emerging market countries in financial crisis.

The main contributions of this study are as follows. Firstly, this paper provides empirical evidence of portfolio flows determination in emerging market countries on a daily basis. Due to data constraints, many studies employ lower frequency data (e.g. monthly capital flows data or quarterly BoP data). Secondly, a country-specific analysis is taken in this paper. Because of some inherent differences among emerging market countries, e.g. economic size, financial market openness, or external financial liability, behaviors of portfolio flows are largely different among emerging market countries. Thirdly, we find which emerging market countries play an important role in contagion effects of portfolio flows among them.

# 2. The recent movements in interest rates, global risk aversion, and daily portfolio flows in emerging market countries

Regarding the recent interest rate hike in the United States, both the market interest rates and the market expectations on future interest rate hike have continuously increased since the FRB increased the target FF rates from 0.25% to 0.5%, firstly after the global financial crisis on 16 December 2015. The FRB has been accelerating tightened monetary policy. The FRB has raised the target FF rates four times in the single year of 2018. Until the end of 2018, the target FF rates have been raised to 2.5%, reaching a high level since the global financial crisis in 2008. Panels in Figure 1 shows that the tightened monetary policy in the United States has led to sharp surges both in market interest rates hike (settlement prices of Chicago Board Options Exchange (CBOE) Federal Fund futures). Meanwhile, interest rates in emerging market countries have different movements. Many of them decreased, narrowing the interest rate differentials against the United States (see Figure 2) and depreciating emerging market country currencies against the US dollar (see Figure 3).





Source: Datastream.





Source: Datastream.



Figure 3. Exchange Rates of Emerging Market Country Currencies against the USD

Source: Datastream.

Furthermore, besides the recent interest rate hike in the United States, the higher global risk aversion is considered to be another possible determinant of capital outflows from emerging market countries. Figure 4 shows the CBOE S&P 500 Volatility Index and US BBB-rated Corporate Bond Spread over US Treasury Securities, which are considered as representative proxies for evaluating global risk appetite. Since the interest rate hike began in December 2015, the global risk aversion mainly has decreased from 2015 to 2017 though we find some sharp but not long-living surges in some specific periods, e.g. at the Brexit shock in June 2016, at the Trump shock in November 2016, and at the North Korea shock in August 2017. However, accompanying the global equity sell-off in early 2018, the global risk aversion sharply and continuously raised to a high level, which means the bull-bear market switching. The sharply surged global risk aversion makes global investors shrink high-risk portfolio investments in emerging market countries and further large portfolio capital outflows.





Source: FRED data; Datastream.

This paper focuses on the portfolio flows behaviors in emerging market countries on a daily basis. We use Institute of International Finance (IIF) Daily Portfolio Flows database<sup>1</sup> to analyze determinants of portfolio flows in emerging market countries on a daily basis. In this point, our analysis is different from many previous studies which used lower-frequency data (monthly, quarterly or even annual flows data). The IIF data reports the daily portfolio flows. Portfolio flows arise through the transfer of ownership of securities from one country to another. The securities involved into these transactions can be either "stocks" ("equity flows") or "bonds" ("debt flows"), tracking the net purchases (or sales) by non-residents. Note that the concept of "portfolio flows" is often referred to as "gross inflows" including transactions of both residents and non-residents. Hence, from the perspective of an emerging market country, the IIF data seeks to measure the net change of all external liabilities in the portfolio flows changes in an emerging market country.

In the IIF Portfolio Flows database, each classification of portfolio flows has different samples of emerging market

<sup>&</sup>lt;sup>1</sup> Institute of International Finance (IIF) Daily Portfolio Flows data. See more details on https://www.iif.com/

countries. Specifically, data on equity flows of emerging market countries covers ten sample countries: Indonesia, India, Korea, Thailand, South Africa, Brazil, the Philippines, Vietnam, Taiwan, and China; on one hand, data on debt flows in emerging market countries covers six sample countries: Indonesia, India, Thailand, South Africa, Hungary, and Mexico; only the total portfolio (equity and debt) flows data in Malaysia is provided in the IIF database. We calculate the total portfolio flows of other four sample countries (Indonesia, India, Thailand, and South Africa) by summing up their equity flows and debt flows.

Panels in Figure 5 show the daily data on portfolio flows in aggregate data of sample emerging market countries and the accumulated flows for each classification. Both of the equity flows and the debt flows in emerging market countries have experienced a large increase during the recent interest hike in the United States from December 2015. The accumulated inflows have largely increased and reached \$ 120 billions in equity and \$ 80 billions in debt. They are huge volumes to be able to affect their domestic equity and debt markets. Furthermore, considerable plunges or fluctuations in both equity flows and debt flows are found during some periods of global risk aversion, e.g. the mid 2015 (the China shock), June 2016 (the Brexit shock), and November 2016 (the Trump shock), which imply the negative effect of global risk aversion on portfolio flows in emerging market countries. Particularly in January 2018, all of the equity flows, debt flows and the total flows of equity and debt simultaneously plunged accompanying with the accelerating interest rate hike in the United States and the higher global risk aversion after global equity sell-off. Additionally, the aggregated total portfolio flows of equity and debt flows show a similar trend, reaching to net portfolio flows of about \$ 200 billions accumulated from October 2014.



Figure 5. Daily Portfolio Flows in Emerging Market Countries

Note: This panel shows the daily equity flows measuring the daily net purchase (or sales) of stocks and the aggregated sum of the daily equity flows in ten sample countries, including Indonesia, India, Korea, Thailand, South Africa, Brazil, Philippines, Vietnam, Taiwan, and China.



Note: This panel shows the daily debt flows measuring the daily net purchase (or sales) of bonds and the aggregated sum of the daily debt flows in six sample countries, including Indonesia, India, Thailand, South Africa, Hungary, and Mexico.



Note: This panel shows the daily total of equity and debt flows measuring the daily net purchase (or sales) of stocks and bonds and the aggregated sum of the daily total of equity and debt flows in five sample countries, including Indonesia, India, Thailand, South Africa, and Malaysia.

Source: IIF Daily Portfolio Flows data; authors' calculation.

However, daily portfolio flows by country reported large country-specific differences. Regarding daily equity flows (see Figure 6), some equity flows in sample countries have rapidly increased immediately after the start of the interest rate hike in the United States, and stopped surging or even plunged in 2018, e.g. India, Korea, Brazil, and Taiwan. Equity outflows from Indonesia, Thailand, South Africa, and the Philippines have also been found in the recent interest rate hike in the United States. China is the only emerging market country who enjoyed long-lasting equity inflows, possibly because of its capital market size and enhanced capital flows restrictions. Furthermore, the volume of accumulated equity flows in China (about \$ 90 billion until December 2018) is far larger than that of the other emerging markets (less than \$ 25 billion) It shows that the increase in accumulated equity flows in emerging market countries attribute to the increasing equity inflows in China. Furthermore, trends of equity flows and debt flows in some sample countries seem to be very different (see Figure 7). For example, debt inflows in Indonesia and Thailand kept increasing in recent years, while equity flows considerably plunged simultaneously. Debt flows in South Africa has a similar trend with its equity flows, experiencing a huge decrease in 2018 though it is cumulatively net inflows until October 2018. Debt flows in Hungary have fluctuated and cumulatively decreased in recent years. Debt flows in Mexico also have fluctuated since 2016. Though total equity and debt flows in Indonesia, India, Thailand, South Africa, and Malaysia perform very differently, all of them seem to be extremely affected by the sharp surge of global risk aversion in early 2018 (see Figure 8). In summary, though the accumulated portfolio flows in emerging market countries increased during the recent interest rate hike in the United States, portfolio flows by country show large country-specific difference among our sample countries.



Figure 6. Daily Equity Flows in Emerging Market Countries by Country



Source: IIF Daily Portfolio Flows data; authors' calculation.

Note: Panels shows the daily net purchase (or sales) of stocks in ten sample countries, including Indonesia, India, Korea, Thailand, South Africa, Brazil, Philippines, Vietnam, Taiwan, and China (unit: \$million).



#### Figure 7. Daily Debt Flows in Emerging Market Countries by Country

Source: IIF Daily Portfolio Flows data; authors' calculation.

Note: Panels shows the daily net purchase (or sales) of bonds in six sample countries, including Indonesia, India, Thailand, South Africa, Hungary, and Mexico (unit: \$million).



Figure 8. Daily Total Portfolio Flows in Emerging Market Countries by Country

Source: IIF Daily Portfolio Flows data; authors' calculation.

Note: Panels shows the daily net purchase (or sales) of stocks and bonds in five sample countries, including Indonesia, India, Thailand, South Africa, and Malaysia (unit: \$million).

#### 3. Previous Literature

Previous studies on the portfolio flows determination have been taken under the "push vs. pull" framework since it was investigated by Calvo and Reinhart (1996) and Fernandez-Arias (1996). Under the "push vs. pull" framework, determinants of capital flows are divided into two factors: the country-specific "pull" factors and the external "push" factors. Capital flows are classified into four main components: foreign direct investments (FDI), equity portfolio investments, debt portfolio investments, and other investments including bank lending. Here we focus on non-residents' equity portfolio investments and debt portfolio investments. Broner, Didier, Erce, and Schmukler (2011) and Koepke (2015) focused on them to investigate capital flows in emerging market countries. The main reason why focus on non-resident capital flows is that emerging market economies are typically most affected by the behavior of foreign investors. Also, movements of non-residents' capital flows are rather more volatile than residents' capital flows. They are an important driver of exchange rates, domestic interest rates, and other financial markets in emerging

market countries.

Referring to the determinants of non-residents' portfolio flows, most studies address three push factors (global risk aversion, interest rates in developed countries, and output growth in developed countries) and two pull factors (domestic output growth and asset return indicators). Among the push factors, global risk aversion and interest rates in developed countries have been proved the key drivers for capital flows of emerging market countries, which are stronger than the "pull" (internal) factors (Alderighi et al., 2018; Bowman et al., 2015; Koepke, 2018; Pundit, 2017). For example, Calvo and Reinhart (1996) analyzed the Latin American emerging market countries under the severe pressure in the 1990s to find capital flows movements in all of the emerging market countries were significantly affected by swings in interest rates in the United States. Also, Broner et al. (2011) used data on portfolio flows of Asian and Latin American emerging market countries from 2002 to 2013 to provides evidence that the interest rate differentials and the global risk aversion were the key determinant role. It suggests that portfolio flows in emerging market countries become more sensitive to the interest rate differentials between the United States and emerging market countries for 2008.

Regarding the recent interest rate hike in the United States, Ogawa and Wang (2016) investigated the effects of US quantitative easing monetary policy exit strategy on capital flows in East Asian countries. They suggested capital outflows from East Asian emerging market countries under the interest rate hike in the United States. IMF (2018) warned that the FRB may respond to faster inflation than expected by further tightening monetary policy. In such a situation, global financial conditions could tighten sharply, triggering to risks of sharp cuts in inflows to emerging market countries. Alderighi et al. (2018) investigated the increasing role of pull factors attributed to emerging market countries' remove of barriers attracting foreign capital inflows in the long-run. They suggested that the effect of such external factors as the interest rates in the United States and the global risk aversion should be more influential for emerging market countries.

Furthermore, previous studies show the existence of contagion effects of capital flows among emerging market countries. Calvo and Reinhart (1996) described the comovement across capital flows among emerging market countries as "herding behavior" to provide evidence that contagion may be more regional than global. They attributed the reason for regional contagion as the highly integrated regional capital markets, regional trade patterns and arrangements. It is suggested that the capital flows in larger countries usually infect that in small countries according to financial market size. Ito (2000) showed the existence of the contagion process in the Asian Currency Crisis in 1997. Ito and Hashimoto (2005) further provided empirical evidence of a high-frequency contagion process in Asian stock markets and exchange rates. Highly connected trade linkage has been proved to enhance the regional contagion process. Gabriele, Baratav, and Parikh (2000) had a similar viewpoint that the East Asian crisis is due largely to herd behavior and regional contagion.

#### 4. Empirical analysis on determinants of portfolio flows in emerging market countries and

#### contagions of portfolio flows

#### 4.1. Empirical methodology

To analyze the determination of portfolio flows in emerging market countries, we build up vector autoregressive (VAR) frameworks on a daily basis. The estimation structure is as follows. Let  $Y_t$  be a  $k \times 1$  vector of endogenous variables, The *p* th order VAR is written as:

$$Y_t = c + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + u_t$$
  

$$E(u_t) = 0$$
  

$$E(u_t u_t') = D$$
  

$$E(u_t u_{t+s}') = 0, \forall s \neq 0$$

where the observation  $Y_{t-i}$  is the *i* th lag of *Y*, *c* is a  $k \times 1$  vector of constants,  $A_i$  is a time-invariant  $k \times k$  matrix, and  $u_i$  is a  $k \times 1$  vector of error terms satisfying: every error term has mean zero; the contemporaneous covariance matrix of error terms is a  $k \times k$  positive-semidefinite matrix *D*, and for any non-zero *s* no serial correlation exists in individual error terms. Lag *p* is chosen by the Akaike Information Criterion.

4.2. Empirical models for equity flows determination in emerging market countries

For equity flows determination, a 7-variable VAR is employed (k=7), including: the interest rate in the United States ( $i_{US}$ ), the interest rate in an emerging market country ( $i_{EM}$ ), the equity price in the United States ( $EP_{US}$ ), the equity price in an emerging market country ( $EP_{EM}$ ), the global risk (risk), the exchange rate of an emerging market currency against the US dollar (s), and the equity portfolio flows in an emerging market country ( $flow_equity$ ). Among these variables, both the interest rate in the United States and the global risk aversion are shown more exogenous than financial variables in an emerging market country. Moreover, the daily data except for the equity portfolio flows in an emerging market day. Note that the time difference between the United States and emerging market countries on the same calendar day exists. For example, the closing values of the variables in US markets on calendar day t lags than that of the variables in Asian emerging markets. Hence we conduct two sub-types of VAR. For emerging markets of earlier equity trading time than the United States in a calendar day (Indonesia, India, Korea, Thailand, South Africa, the Philippines, Vietnam, Taiwan, and China), the vector of endogenous variables is

Model 1-1: equity flows determination in emerging market countries (for Indonesia, India, Korea, Thailand, South Africa, the Philippines, Vietnam, Taiwan, and China)

$$Y_{t} = \begin{bmatrix} i_{US,t-1} & EP_{US,t-1} & risk_{t-1} & i_{EM,t} & s_{t} & flow\_equity_{t} & EP_{EM,t} \end{bmatrix}^{T}$$
(1)

where we use variables on calendar day *t*-*1* to represent the US financial markets ahead of the emerging markets. In the other sub-type of VAR, for emerging markets of the same or later equity trading time than the United States in a calendar day (only Brazil), the vector of endogenous variables is written as:

Model 1-2: equity flows determination in emerging market countries (for Brazil)

$$Y_{t} = \begin{bmatrix} i_{US,t} & EP_{US,t} & risk_{t} & i_{EM,t} & s_{t} & flow\_equity_{t} & EP_{EM,t} \end{bmatrix}'.$$
 (2)

Shocks Impulse Responses	$i_{US}$	$EP_{US}$	risk	i <sub>em</sub>	S	flow_equity	EP <sub>EM</sub>
$i_{US}$	+	0	0	0	0	0	0
$EP_{US}$	-	+	-	0	0	0	0
risk	+	-	+	0	0	0	0
$i_{EM}$	0	0	+	+	+	-	0
S	+	- or +	+	-	+	-	-
flow_equity	-	+ or -	-	+	-	+	+
$EP_{_{EM}}$	-	+ or -	-	-	-	+	+

Table 1. Expected Signs of Impulse Responses in Equity Flows Determination Models

Note: signs in this table show the expected impulse responses of VAR models "+", "-", or "0" represent positive, negative, or no impulse responses to shocks.

Table 1 shows the expected signs of accumulated impulse responses. Here we assume the case of a small open economy which fulfills three conditions: (1) the small country which could not affect the global financial market (2) the small country adopts a floating exchange regime (3) there are no capital controls. The US interest rate hike does not lead to an increase in the domestic interest rate when the small country chooses to maintain its monetary policy autonomy. The domestic currency of the small country will depreciate against the US dollar, leading to a negative shock on its capital flows. Hence, the narrower interest differential between the small country and the United States will lead to portfolio outflows from the small country and depreciation of its home currencies against the US dollar. Regarding the effect of global risk on the small country, we suppose that global risk aversion will make global investors decrease their investments in the small country, leading to the higher interest rates, depreciation of its home currency, and lower equity prices in the small country. In addition, higher domestic interest rate, appreciation of an emerging market currency against the US dollar, and higher domestic equity price will drive net portfolio flows into emerging market countries. For equity price in the United States, there are two possible scenarios: when equity price in the United States increases, equity portfolio flows are driven out of emerging market countries into the United States for higher portfolio returns; on the other hand, increasing equity price in the United States implies booms in global economy, leading to expansion of global portfolio investments. Hence, the equity price in the United States has a positive effect on equity flows in an emerging market country.

#### 4.3. Empirical models for debt flows determination in emerging market countries

Different from the empirical models for equity flows in emerging market countries, the VAR models for debt flows have five variable without the equity price in the United States and the equity price in emerging market countries. They include the interest rate in the United States ( $i_{US}$ ), the interest rate in an emerging market country ( $i_{EM}$ ), the global risk (*risk*), the exchange rate of the emerging market country currency against the US dollar (*s*), and the debt

portfolio flows in an emerging market country (*flow\_debt*). As mentioned below, a difference of the trading time between the United States and emerging market countries should be mentioned. Hence two types of VAR for debt flows determination are built up as follows: for emerging markets of earlier equity trading time than the United States in a calendar day (Indonesia, India, Thailand, South Africa, and Hungary)

Model 2-1: debt flows determination in emerging market countries (for Indonesia, India, Thailand, South Africa, and Hungary)

$$Y_{t} = \begin{bmatrix} i_{US,t-1} & risk_{t-1} & i_{EM,t} & s_{t} & flow\_debt_{t} \end{bmatrix}$$
(3)

where we use variables on calendar day *t*-*1* to represent the US financial markets ahead of the emerging markets. In the other sub-type of VAR, for emerging markets of the same or later debt trading time than the United States in a calendar day (only Mexico), the vector of endogenous variables is written as:

Model 2-2: debt flows determination in an emerging market country (for Mexico)

$$Y_{t} = \left| i_{US,t} \quad risk_{t} \quad i_{EM,t} \quad s_{t} \quad flow\_debt_{t} \right|.$$

$$\tag{4}$$

Following the assumptions mentioned in sector 3.1, we suggest the expected signs of impulse responses in models for emerging market debt flows determination, as shown in Table 2.

Shocks Impulse Responses	$\dot{i}_{US}$	risk	i <sub>EM</sub>	S	flow_debt
$i_{US}$	+	0	0	0	0
risk	+	+	0	0	0
i <sub>EM</sub>	0	+	+	+	0
S	+	+	-	+	-
flow_debt	-	-	+	-	+

Table 2. Expected Signs of Impulse Responses in Debt Flows Determination Models

Note: signs in this table show the expected impulse responses of VAR models "+", "-", or "0" represent positive, negative, or no impulse responses to shocks.

4.4. Empirical models for total portfolio flows determination in emerging market countries

Similar to empirical models for debt flows determination, the VAR models for total portfolio flows (equity and debt) determination have five variables, including: the interest rate in the United States ( $i_{US}$ ), the interest rate in an emerging market country ( $i_{EM}$ ), the global risk (*risk*), the exchange rate of an emerging market currency against the US dollar (s), and the total portfolio flows of equity and debt in an emerging market country (*flow\_total*). Different from models of portfolio flows determination for equity and debt, all of the sample emerging market countries in IIF have earlier trading time than that of the United States in a calendar day. Hence only one type of VAR model is built up as follows:

Model 3: total portfolio flows determination in emerging market countries (for Indonesia, India, Thailand, South Africa, and Malaysia)

$$Y_{t} = \begin{bmatrix} i_{US,t-1} & risk_{t-1} & i_{EM,t} & s_{t} & flow\_total_{t} \end{bmatrix}.$$
(5)

Following the assumptions mentioned in sector 3.1 and 3.2, we suggest the expected signs of impulse responses in models for total portfolio flows (equity and debt) determination in emerging market countries, as shown in Table 3.

Shocks Impulse Responses	$i_{_{US}}$	risk	i <sub>EM</sub>	S	flow_debt
$i_{US}$	+	0	0	0	0
risk	+	+	0	0	0
i <sub>EM</sub>	0	+	+	+	0
S	+	+	-	+	-
flow_debt	-	-	+	-	+

Table 3. Expected Signs of Impulse Responses in Total Portfolio Flows Determination Models

Note: signs in this table show the expected impulse responses of VAR models "+", "-", or "0" represent positive, negative, or no impulse responses to shocks.

4.5. Contagions of portfolio flows among emerging market countries

Here we analyze the contagion effects of portfolio flows among emerging market countries on a daily basis. We conduct a *k*-variable VAR analysis for this analysis by asset (equity flows, debt flows, and total flows of equity and debt). The ordering of the endogenous variables is set by the trading time difference of the emerging market countries.

Model 4-1: contagions of equity flows among emerging market countries (for Indonesia, India, Korea, Thailand, South Africa, Brazil, the Philippines, Vietnam, Taiwan, and China)

$$Y_{t} = \left| flow\_equity_{1,t} \quad \cdots \quad flow\_equity_{j,t} \right|$$
(6)

Model 4-2: contagions of debt flows among emerging market countries (Indonesia, India, Thailand, South Africa, Hungary, and Mexico)

$$Y_{t} = \begin{bmatrix} flow\_debt_{1,t} & \cdots & flow\_debt_{j,t} \end{bmatrix}$$
(7)

Model 4-3: contagions of total portfolio flows among emerging market countries (Indonesia, India, Thailand, South Africa, and Malaysia)

$$Y_{t} = \left| flow\_total_{1,t} \quad \cdots \quad flow\_total_{i,t} \right|$$
(8)

where *j* represents the number of sample emerging market countries. Different pairs of sample emerging market countries are examined for robustness check, e.g. all sample emerging market countries, Asian emerging markets, and BRICS (except for Russia). Contagion effect should show that the sign of the impulse response of portfolio flows in one emerging market country to portfolio flow shocks in another portfolio flows in an emerging market country

are expected to be positive, shown in Table 4.

Shocks Impulse Responses	flow <sub>1</sub>		flow <sub>i</sub>		$flow_n$
$flow_1$	+	•••	+		+
:	:	·	:	•••	:
flow <sub>i</sub>	+	•••	+	•••	+
:	:	•••	:	·	:
$flow_n$	+		+	•••	+

Table 4. Expected Signs of Contagions of Portfolio Flows

Note: n shows the number of the sample emerging market portfolio flows. "+" in this table show an expected positive accumulated impulse response of row variables to the shocks in column variables. Flows are in the same classification, which could be either equity flows, debt flows, or total flows of equity and debt flows.

In addition, we conduct empirical analysis according to another type of VAR models to control the effects of common shocks which include shocks of interest rates in the United States and global risk aversion on capital flows of emerging market countries for robustness check. The ordering of the endogenous variables is set by the trading time difference of the emerging market countries. The models are set as follows.

Model 5-1: contagions of equity flows among emerging market countries (Indonesia, India, Korea, Thailand, South Africa, Brazil, the Philippines, Vietnam, Taiwan, and China)

$$Y_{t} = \begin{bmatrix} i_{US,t}, risk_{t}, flow\_equity_{1,t} & \cdots & flow\_equity_{j,t} \end{bmatrix}$$
(9)

Model 5-2: contagions of debt flows among emerging market countries (Indonesia, India, Thailand, South Africa, Hungary, and Mexico)

$$Y_{t} = \begin{bmatrix} i_{US,t}, risk_{t}, flow\_debt_{1,t} & \cdots & flow\_debt_{j,t} \end{bmatrix}$$
(10)

Model 5-3: contagions of total portfolio flows among emerging market countries (Indonesia, India, Thailand, South Africa, and Malaysia)

$$Y_{t} = \begin{bmatrix} i_{US,t}, risk_{t}, flow\_total_{1,t} & \cdots & flow\_total_{j,t} \end{bmatrix}$$
(11)

where  $i_{US,t}$  represents the interest rates in the United States, and  $risk_t$  represents the global risk aversion. A higher interest rate in the United States and a higher global risk aversion is expected to lead to decreases in capital flows in an emerging market country (either equity flows, debt flows, or the total of equity and debt flows). Contagion effect should show that the sign of the impulse response of portfolio flows in one emerging market country to portfolio flow shocks in another portfolio flows in an emerging market country are expected to be positive

#### 4.6. Analytical period and data

To examine the effects of the recent interest hike in the United States and higher global risk aversion on portfolio

flows in emerging market countries, this paper selects a sample period from 10 November 2015 to 2 October 2018 as an analytical period. The recent interest hike has begun since 16 December 2015 in the United States. However, market rates have responded in advance from November 2015 when the FRB officially announced to increase the target FF rate. Accordingly, we choose 10 November 2015 as the start of the analytical period.

The daily portfolio flows data are obtained from the IIF Daily Portfolio Flows database, which tracks the nonresidents' portfolio flows in emerging market countries. The IIF data measures net purchases (or sales) by nonresidents, basing on the reports from national banks, government agencies, and securities exchanges. Three types of portfolio flows are arranged by country. Daily equity flows data covers ten emerging market countries which include Indonesia, India, Korea, Thailand, South Africa, Brazil, the Philippines, Vietnam, Taiwan, and China. Daily debt flows data covers six emerging market countries which include Indonesia, India, Thailand, South Africa, Hungary, and Mexico. Total portfolio (equity and debt) flows data covers five emerging market countries which include Indonesia, India, Thailand, South Africa, and Malaysia. All of the portfolio flows are denominated in the US dollar.

Regarding the IIF Daily Portfolio Flows database, there are two points that need attention. Firstly, we follow the classification of emerging market countries by the IIF database according to the characteristics of financial markets. Most sample countries in the IIF database are the same with the IMF, while Korea and Taiwan are classified as advanced economies according to their economic development by the *World Economic Outlook* of IMF. Arslanalp and Tsuda (2015) argued that these two counties are traditionally seen as emerging markets according to the trading restrictions on foreign investors. In addition, Korea and Taiwan are classified as emerging markets because they fail the accessibility criteria in MSCI Market Classification<sup>2</sup>, e.g. restrictions on trading hours and trading account for foreign investors. Hence, this paper follows the classification of emerging market countries in the IIF database which covers Korea and Taiwan as emerging market economies. Furthermore, note that the high-frequency IIF equity flows series is often nearly identical to official portfolio flows data in the BoP while the high-frequency debt series is not as so accurate. The reason is different sectoral coverage of country-specific debt statistics. For example, all of the debt flows include government bonds. On the other hand, it is debt flows in India, South Africa, and Thailand that include corporate bonds.

Push and pull variables including market interest rates in the United States and the emerging market countries, equity prices in the United States and emerging market countries, global risk aversion, and exchange rates of the emerging market country currencies are obtained from Thomson Reuters Datastream and Federal Reserve Economic Data (FRED). Regarding interest rates in the United States, we use LIBOR (USD, 3 months, closing rate) and the settlement prices of CBOE Federal Fund (FF) futures 3 months to represent the market rate and the market expectations on future interest rates in the United States, respectively. Note that higher settlement prices of FF futures mean expectation of lower FF rates in the future. Hence, all expected signs of impulse responses involving FF futures in VAR models have opponent expected signs with those involving LIBOR. Due to lack of data, either 3-month interbank rates (Indonesia, Korea, Thailand, South Africa, Vietnam, Taiwan, China, Hungary, and Malaysia) or 3-

<sup>&</sup>lt;sup>2</sup> See MSCI Market Classification from https://www.msci.com/market-classification

month government benchmark leading rates (India, Brazil, Philippines, and Mexico) are employed to represent domestic interest rates in the emerging market countries. Furthermore, similar with most studies which include Illing and Aaron (2005) and Koepke (2015), we employ CBOE S&P500 Volatility Index (VIX) and U.S. BBB-rated corporate bond spread over U.S. Treasury securities as a proxy of global risk aversion. Exchange rates of emerging market country currencies against the US dollar are also used. Daily closing stock indexes of the United States (S&P500 index) and the emerging market countries are used as equity prices.

Since data of portfolio flows in IIF database are not available in some trading days which include national holidays. The days with missing data are excluded from the dataset. Furthermore, for stationarity in the VAR framework, solutions on data are taken as follows. We take first differences of the interest rates in the United States and the emerging market countries. Also, we take logarithm differences of global risk aversion, the exchange rates of emerging market country currencies, and the equity prices in the United States and the emerging market country are the emerging market countries. Raw data of portfolio flows in the emerging market countries are employed. All data are stationary after some solutions.

#### 5. Empirical results

#### 5.1. Determinants of equity flows in emerging market countries

Table 5 summarizes the empirical results of equity flows determination in the emerging market countries (see more details of the impulse responses in Appendix). Regarding the equity portfolio determination, we find that equity portfolio flows in most of the emerging market countries except for South Africa and Vietnam have expected positive impulse responses to shocks of FF futures. It shows that market expectations of higher interest rates in the United State in the future decrease equity portfolio flows in most of the emerging market countries. Equity flows in Thailand, Taiwan, and China have significantly positive impulse responses to FF futures while equity flows in Indonesia, India, Korea, Brazil, and the Philippines have positive but insignificant responses. Equity flows in South Africa and Vietnam have an unexpectedly negative response to FF futures though they are statistically insignificant. In other words, all significant impulse responses of equity flows in emerging market countries to FF futures have the expected positive signs. It shows that the higher expectation of future interest rate hike in the United States decreases equity inflows into the emerging market countries.

Moreover, the significant impulse responses of equity flows in the emerging market countries (Brazil and China) to global risk aversion have the expected negative signs. Equity flows in other emerging market countries (Indonesia and Thailand) also negatively respond to higher global risk aversion though they are statistically insignificant. On the contrary, equity flows in Korea, South Africa, and Vietnam have unexpected positive signs though they are not significant. Hence, the analytical results show that higher global risk aversion possibly decreases equity inflows into emerging market countries.

Regarding other determinants on equity flows in the emerging market countries, we find that equity flows in all of

the emerging market countries except for Vietnam significantly increase when equity price in the United States increases. Also, we find that equity flows all of the emerging market countries except for Vietnam decrease when emerging market country currencies depreciate against the US dollar. When the interest rates in the emerging market countries increase, equity inflows into South Africa significantly increase; on one hand, equity inflows into China significantly decrease. It shows the differentiated effects of monetary policies in the emerging market countries on their equity flows. Furthermore, equity flows in all of the emerging market countries except for Vietnam significantly increase when their equity prices increased. Lastly, equity flows all of the emerging market countries except for Vietnam significantly and positively respond to changes in their own equity flows. It implies that the equity outflows continue once they experience equity outflows.

Shocks (expected signs) Impulse responses	FF futures (+)	EP_US (+or -)	VIX (-)	i_EM (+)	S (-)	flow_equity (+)	EP_EM (+)	LIBOR (-)	BBB_spread (-)
Indonesia	+	+*	-	+	-*	+*	+*	-	-
India	+	+*	-Δ	+	-*	+*	+*	+	-
Korea	+	+*	+	+	-*	+*	+*	-	-
Thailand	+*	+*	-	-	-*	+*	+*	-	-
South Africa	-	+*	+	+*	-*	+*	+*	+*	-
Brazil	+	+*	_*	-	-*	+*	+*	-	_*
Philippines	+	+*	-	-	_*	+*	+*	-	-
Vietnam	-	+	+	+	+	+	_*	-	-
Taiwan	+*	+*	-	-	-*	+*	-	-	-
China	+*	+*	_*	_*	_*	+*	_*	_*	-

Table 5. Results of equity flows determination in emerging market countries

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock. Signs in the column labeled "LIBOR" show empirical results according to alternative models using LIBOR rates to proxy market interest rates in the United States, while signs in the column labeled "BBB\_spread" show empirical results according to alternative models using BBB spread to proxy global risk aversion.

Here we also employ alternative models using LIBOR to proxy market interest rates of the US dollar (LIBOR) and alternative models using U.S. BBB-rated corporate bond spread over U.S. Treasury securities (BBB\_spread) for more information. The results show that equity inflows into most of the emerging market countries decrease when market interest rates in the United States increase. However, equity flows in India and South Africa unexpectedly have positive impulse responses to shocks in LIBOR rates. Moreover, the response of equity flows in South Africa is even significant. Furthermore, the results of alternative models using BBB\_spread show high explanatory power that equity flows in all of the emerging market countries seem to decrease when BBB\_spread increases though only equity flows in Brazil has a statistically significant sign.

In summary, an increase in interest rates in the United States (both market expectations on interest hike in the United States and market interest rates) should lead to equity outflows from the emerging market countries though it is inconsistent in some emerging market countries, e.g. India, South Africa, and Vietnam. Moreover, as expected, higher global risk also should lead to equity outflows from the emerging market countries although it is statistically

significant in only a few emerging market countries, e.g. Brazil and China. Regarding other determinants of equity flows, exchange rates of emerging market country currencies and equity prices in the emerging market countries show high significance for most of the emerging market countries. It is interesting that equity prices in the United States have significant positive effects on equity flows in emerging market countries. As mentioned above, we can explain that an increase in equity price in the United States implies global economic booms and leads to expansion of global portfolio investments. Lastly, equity outflows from emerging market countries lead to persistent equity outflows rather than a temporary one. It weakens BoP situations of emerging market countries further.

#### 5.2. Determinants of debt flows in emerging market countries

Table 6 summarizes empirical results of debt flows determination in the emerging market countries (see more details of impulse responses in Appendix). We find that debt flows in Indian Thailand, and South Africa have expected positive impulse responses to shocks of FF futures. It shows that market expectations of higher interest rates in the United States in the future decrease the debt inflows into the emerging market countries. On the other hand, debt flows in Indonesia, Hungary, and Mexico increase responding to a higher expectation of interest rate hike in the United States. However, debt flows in most of the emerging market countries except for Hungary have expected negative responses to increases in market interest rates in the United States rather than the market countries correspond more with the market interest rates in the United States rather than the market expectation of future interest rates in the United States.

Moreover, we also find different responses of debt flows in the emerging market countries to global risk aversion when we use either VIX or BBB\_spread as a proxy of global risk aversion. Debt inflows into Indonesia, Thailand, South Africa, and Hungary decrease when VIX as a proxy of global risk aversion increases. Among them, only the response of debt flows in Indonesia is significant. However, when we use BBB\_spread as a proxy of global risk aversion, it is only Thailand that has a significant sign responding to global risk aversion though its sign is opposite with our expectation.

The other determinants of debt flows in the emerging market countries show highly similar results of impulse responses. Exchange rates of emerging market country currencies show a large role in debt flows in the emerging market countries. Debt flows into all of the emerging market countries significantly decrease when the emerging market currencies depreciate against the US dollar. Furthermore, the effects of domestic interest rates in the emerging market countries on debt flows vary. Debt flows in Mexico is the only significant one though its sign is opposite to our expectation. Lastly, debt outflows from emerging market countries lead to persistent debt outflows rather than temporary ones.

In summary, effects of an increase in interest rates in the United States (either market expectations on interest rate hike or market interest rates) and global risk aversion on debt flows in the emerging market countries seem to be not consistent. On the contrary, the exchange rates of emerging market country currencies against the US dollar are more significant in debt flows determination for the emerging market countries. Debt flows in the emerging market

countries significantly respond to their own shocks.

Shocks							
(expected signs)	FF futures	VIX	i_EM	S	flow_debt	LIBOR	BBB_spread
Impulse	(+)	(-)	(+)	(-)	(+)	(-)	(-)
responses							
Indonesia	-*	-*	+	*	+*	-	-
India	+	+	+	*	+*	-	+
Thailand	+*	-	+	*	+*	-	+*
South Africa	+	-	+	*	+*	-Δ	-
Hungary	-*	-	-	1	+*	+	-Δ
Mexico	-	+	_*	-	+*	-	+

Table 6. Results of debt flows determination in emerging market countries

Note: signs in this table show the accumulated impulse responses of capital flows by emerging market countries in line to one stand deviation shocks of variables in column after 20 periods. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance at 2 standard errors. "( $\Delta$ )" represents an instantaneous shock rather than a permanent shock. Signs in the column labeled "LIBOR" show empirical results according to alternative models using LIBOR rates to proxy market interest rates in the United States, while signs in the column labeled "BBB\_spread" show empirical results according to alternative models using the proxy global risk aversion.

#### 5.3. Determinants of total portfolio flows in emerging market countries

Table 7 summarizes the results of total portfolio flows determination in the emerging market countries (see more details about impulse responses in Appendix). Comparing with the results in equity flows and debt flows determination, results in the total portfolio flows determination are more in line with our expectation. All of the impulse responses in models using FF futures and VIX have the expected signs though not all of them are significant. Noting that total portfolio flows in South Africa significantly increase when the market interest rates in the United States increase. Moreover, the results of total portfolio flows in the emerging market countries are consistent with those of equity flows. The reason is that its equity flows usually larger than its debt flows for one emerging market country in our samples.

Shocks (expected signs) Impulse responses	FF futures (+)	VIX (-)	i_EM (+)	S (-)	flow_total (+)	LIBOR (-)	BBB_spread (-)
Indonesia	+	*	+	*	+*	-	-
India	+	-Δ	+	-*	+*	-	-
Thailand	+*	-	+	-*	+*	-	+
South Africa	+	_*	+	_*	+*	+*	_*
Malaysia	+*	_*	$+\Delta$	-*	+*	-Δ	_*

Table 7. Results of total portfolio flows determination in the emerging market countries

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+"/"-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock. Signs in the column labeled "LIBOR" show empirical results according to alternative models using LIBOR rates to proxy market interest rates in the United States, while signs in the column labeled "BBB\_spread" show empirical results according to alternative models using BBB\_spread to proxy global risk aversion.

#### 5.4. Effects of portfolio flows on financial markets in emerging market countries

Tables 8 to 10 summarize the impulse responses of domestic interest rates, exchange rates, and equity prices to

portfolio flows in the emerging market countries. It is shown that all of the equity inflows, debt inflows, and total portfolio inflows possibly lead to a significant appreciation of their home currencies. Furthermore, equity prices in the emerging market countries increase when there are net equity inflows. On the contrary, the effects of portfolio inflows on domestic interest rates in the emerging market countries are different. Portfolio inflows decrease interest rates in most of the emerging market countries.

Impulse responses (expected signs) Capital flows Shocks	i_EM (-)	S (-)	EP_EM (+)
Indonesia	+	-*	+
India	-	I	+
Korea	-	-*	+*
Thailand	-	-*	+*
South Africa	+	-	+*
Brazil	+*	-	+*
Philippines	-	-	+*
Vietnam	+	-	$+\Delta$
Taiwan	-	-*	+*
China	+	-*	+*

Table 8. Effects of equity flows on financial markets in emerging market countries

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

Tabla 0 Effacts (	of dobt flows	on financia	l markats in	omorging	markat countries
Table 9. Effects	JI UCDI HOWS	Uli illiancia	i mai kets m	emerging	mai ket counti ies

	-	-
Impulse response (expected signs) Capital flows Shocks	i_EM (-)	S (+)
Indonesia	+	-Δ
India	-	-
Thailand	-*	-
South Africa	-	-
Hungary	-	-
Mexico	+	-

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

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Impulse response (expected signs) Capital flows Shocks	i_EM (-)	S (+)
Indonesia	+	-
India	-	-*
Thailand	-*	-
South Africa	+	-
Malaysia	-	-*

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E.

#### 5.5. Contagions of portfolio flows among emerging market countries

The empirical results show the wide contagion effects of equity flows among emerging market countries (see Tables 11 to 17). Among them, we find that emerging market countries with a relatively advanced financial market (Korea and Taiwan) could affect the portfolio flows in other emerging market countries. For example, equity flows in Korea significantly affect equity flows in most of the other emerging market countries except Vietnam and South Africa. Furthermore, we find significant contagions of equity flows among ASEAN emerging market countries. The results were obtained by the previous studies (Ito, 2000; Ito and Hashimoto, 2005). The possible reason for the contagion effects among ASEAN countries should be the tight regional economic connection. Additionally, equity flows in Vietnam and South Africa are significantly affected by other emerging market countries. They do not seem to obtain a significant contagion effect on most of the other emerging market equity flows. Also, we conduct empirical analysis on sub-samples of emerging market countries in Asia and BRICS countries (except for Russia) to investigate the robustness of the results.

The empirical results show that the wide contagion effects of debt flows among emerging market countries are similar to those in the case of equity flows. Furthermore, there are significant contagion effects in debt flows among Asian countries because they have tight regional economic connections. On the contrary, debt flows in Mexico does not affect the debt flows in ASEAN countries while debt flows in Asian countries do not affect those in Mexico possibly due to lack of regional economic connections. Empirical analysis on sub-samples of Asian emerging market portfolio flows show robustness of the results.

Lastly, we find wide contagions of total portfolio flows. Total portfolio flows significantly affect each other among most Asian countries which include India, Indonesia, Thailand, and Malaysia. On the contrary, total portfolio flows in South Africa could not significantly affect those in any Asian country. Empirical analysis of contagion effects in total portfolio flows sub-samples of Asian countries shows robustness.

Additionally, since the empirical results of daily capital flows determinations showed the effective determinant role of external factors (the US interest rate and global risk aversion) for emerging market countries, we add two variables, the interest rates in the United States (FF futures rate) and the global risk aversion (VIX), into the models in order to take into account of common external factors that affect all of the emerging market countries. Regarding the empirical results, we found that many impulse responses among daily capital flows of emerging market countries keep positive and significant (see Tables 18 to 20). These results show the robustness of widely-existing contagion effects among daily capital flows of emerging market countries when we controlled the influence of external factors (the US interest rate and the global risk aversion). Moreover, it is illustrated that these contagion effects are more regional than global. Finally, the global risk aversion is proved to be the key determinant for most of the daily capital flows in emerging market countries.

In summary, contagions of portfolio flows among emerging market countries widely exist in equity flows, debt flows, and total portfolio flows. Among these, contagions among Asian countries are most significant because of tight

regional economic connections. However, there is an exception for portfolio flows in Vietnam which seems not to have two-side contagions effects with the other Asian countries. Furthermore, the emerging market countries with the relatively advanced financial market, e.g. Korea and Taiwan, could significantly affect equity flows in the other emerging market countries (see more details of the magnitudes of impulse responses in Appendix).

Shocks Impulse responses	Korea	China	Taiwan	Philippines	Thailand	Indonesia	Vietnam	India	South Africa	Brazil
Korea	+*	+	+	+*	+	+	+	-	-	+
China	+*	+*	-	+	+	+	+	+	-*	+
Taiwan	+*	+*	+*	+*	+	+	-	-	_*	+*
Philippines	+*	+	+	+*	+	+*	-	_*	-	+
Thailand	+*	+	+*	+	+*	+*	-	-	-	+*
Indonesia	+*	+	+*	+	+*	+*	+	-	-	+
Vietnam	-	+	-	-	-	-	+*	+	_*	-*
India	+*	+	+*	+*	+*	+	+	+*	-	+
South Africa	+△	+	+	+	-	-	+	+	+*	+
Brazil	+*	+*	+*	+	+*	+		_*		+*

Table 11. Contagions of equity flows among all sample emerging market countries

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

Shocks Impulse responses	Korea	China	Taiwan	Philippines	Thailand	Indonesia	Vietnam	India
Korea	+*	+	+	+*	+	+	+	-
China	$+\Delta$	$+^*$	-	+	+	+	+	+
Taiwan	+*	$+^*$	+*	+*	$+\Delta$	+	-	-
Philippines	+*	+	+	+*	+	+*	-	*
Thailand	+*	+	$+^*$	+	+*	+*	-	-
Indonesia	+*	+	+*	+	+	+*	+	-
Vietnam	-	+	-	-	-Δ	-	+*	+
India	+*	+	$+^*$	+*	+*	+	+	+*

Table 12. Contagions of equity flows among Asian emerging market countries

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

Table 13. Contagions of equity flows among BRICS (without Russia)

Shocks Impulse responses	China	India	South Africa	Brazil
China	+*	+	-	+
India	+	+*	+	+
South Africa	+	+	+*	+
Brazil	+*	-	-	+*

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E.

Shocks Impulse responses	Thailand	Indonesia	India	Hungary	South Africa	Mexico
Thailand	+*	+*	+	+	+	-
Indonesia	+*	+*	+*	+	+	-
India	+*	+	+*	+	+	+
Hungary	+	-	+*	+*	+	-
South Africa	+	+	+	+*	+*	-
Mexico	+	_	_	+	+	+*

Table 14. Contagions of debt flows among all sample emerging market countries

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E.

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lahle	15	( 'οπέρσιοπς (	nt deht	tiows	among	Asian	emerging	market	countries
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Shocks Impulse responses	Thailand	Indonesia	India
Thailand	+*	+	+
Indonesia	+*	+*	+*
India	+*	+	+*

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E.

#### Table 16. Contagions of total portfolio flows among all sample emerging market countries

Shocks Impulse responses	Thailand	Indonesia	Malaysia	India	South Africa
Thailand	+*	+*	+*	+	+
Indonesia	+*	+*	+*	$+^*$	+
Malaysia	+*	+*	+*	+	+
India	+*	+*	+*	+*	+
South Africa	$+ \triangle$	+	+*	+	+*

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

Table	17.	Contagions	of total	nortfolio	flows	among	Asian	emerging	market	countries
Labic	1/.	Contagions	UI LULAI	portiono	110 11 3	among	ristan	chief ging	mai net	counti ics

Shocks Impulse responses	Thailand	Indonesia	Malaysia	India
Thailand	+*	+*	+*	+
Indonesia	+*	+*	+*	+*
Malaysia	+*	+*	+*	+
India	+*	+*	+*	+*

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E.

							8		,			
Shocks Impulse responses	FF futures	VIX	Brazil	Korea	China	Taiwan	Philippines	Thailand	Indonesia	Vietnam	India	South Africa
FF futures	+*	+	+	-*	-	+	-	+	+	-	+	-
VIX	+	+*	+	_*	-△	_*	-	-	-	+	+	+*
Brazil	+	-*	+*	+*	$+ \triangle$	+*	+	+*	+	_*	-*	-
Korea	$+ \triangle$	-*	-	+*	+	+	+*	+	+	+	-	-
China	+	-*	-	+	+*	-	+	+	+	+	+	_*
Taiwan	$+ \triangle$	-*	+	+*	+*	+*	+*	$+ \triangle$	+	-	-	_*
Philippines	+	_*	+	+*	+	+	+*	+	+*	-	_*	-
Thailand	+	-*	+*	+*	-	+*	+	+*	+*	-	-	-
Indonesia	+	-*	-	+*	-	+*	+	$+ \triangle$	+*	+	-	-
Vietnam	+	+	_*	-	+	-	-	_*	-	+*	+	_*
India	+	-	-	+*	+	+*	+*	+*	+	+	+*	_
South Africa	-	_*	+	+*	-	+	+	-	-	+	+	+*

 Table 18. Contagions of equity flows among all sample emerging market countries (with consideration of the interest rates in the United States and global risk aversion)

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

Table 19. Contagions of debt flows among all sample emerging market countries (with consideration of the

Shocks Impulse responses	FF futures	VIX	Mexico	Thailand	Indonesia	India	Hungary	South Africa
FF futures	+*	+	+	+	+	_	_*	-
VIX	+	+*	-	_	+	+	_*	-
Mexico	-	+	+*	+	-	-	+*	-
Thailand	+*	-*	-	+*	+*	+	+	+
Indonesia	+	-*	-	+*	+*	+*	+	+
India	+	-	+	+*	+	+*	-	+
Hungary	-	-	-	+	_	+*	+*	+
South Africa	+	-	-	+	+	+	+	+*

interest rates in the United States and global risk aversion)

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

 Table 20. Contagions of total portfolio flows among all sample emerging market countries (with consideration of the interest rates in the United States and global risk aversion)

Shocks Impulse responses	FF futures	VIX	Thailand	Indonesia	Malaysia	India	South Africa
FF futures	+*	+	+	-	-	-	-
VIX	-	+*	-	+	- $\bigtriangleup$	+	-
Thailand	+*	_*	+*	+*	+*	+	+
Indonesia	+	-*	+*	+*	+*	+*	+
Malaysia	+*	-*	+*	+*	+*	+	+
India	+	-	+*	+*	+*	+*	+
South Africa	+	- 🛆	$+ \triangle$	+	+*	+	+*

Note: signs in this table show the empirical results of accumulated impulse responses in 20 days of VAR models. Country names in this table shows the daily capital flows of emerging market countries. "+"/"-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

#### 6. Conclusions

The interest rate hike in the United States and the increase of global risk aversion in recent years have increased capital outflows of emerging market countries. Building on a large literature in determinants of capital flows in the emerging market countries, this paper used VAR model to investigate the effects of the interest rate hike in the United States and global risk aversion on portfolio flows of emerging market countries in daily basis during a sample period from 11 November 2015 to 2 October 2018.

The main empirical results are as follows. Firstly, we found that both a higher interest rate in the United States (either market rates or market expectations on future interest hike) and a higher global risk aversion possibly decrease portfolio inflows (both equity flows and debt flows) into most emerging market countries though not all are statistically significant. Secondly, among the other determinants of portfolio flows in emerging market countries, exchange rate depreciation of emerging market currencies and plunges in emerging market equity prices significantly lead to portfolio outflows of most emerging market countries, showing large driving power of emerging market countries tend to significantly lead to further outflows (both in equity flows and debt flows) from emerging market countries tend to significantly lead to further outflows, showing the persistence of portfolio flows after they face in a portfolio outflow shock. Fourthly, we also found that the portfolio outflows from emerging market countries significantly deteriorate their domestic equity prices and depreciate their home currencies against the US dollar. Finally, we found the wide existence of contagions of portfolio flows among emerging market countries. It implies that under a global emerging market portfolio outflows circumstance, the portfolio outflows from emerging market countries are reinforced and become more serious, especially among the emerging market countries with the highly regional economic nexus.

One of the main policy implications is that the monetary authorities in emerging market countries should be cautious about market participants' expectation of interest rates in the United States and global risk aversion of market participants when they face possible capital outflows. For the reason, they should monitor not only such an actual policy interest rate as FF rate but also such the FF futures which show market participants' expectation of changing the FF rate in the near future. Moreover, the monetary authorities of emerging market countries should watch movements in both global risk and global risk aversion of market participants to monitor that both of them could affect capital outflows.

Furthermore, the finding that accumulated response of its own capital outflow to a capital flow shock is not temporary but persistent implies that capital outflows would continue for some time once it faced in capital outflow. In addition, the outflowing capital would not return to emerging market countries in the short run. It is important for the monetary authorities to take an initial action to stop capital outflow. Moreover, given the contagion effects of a larger emerging market country's capital outflow on other emerging market countries, it is not only the relevant country but also a region or the world who should cope with it. For the purpose, the monetary authorities should secure international coordination and promote international cooperation. Our analysis on daily capital flows is limited to a part of emerging market counties due to data constraint that daily data of capital flows are available for them. It is necessary to construct a database of daily data on capital flows for all of the emerging market countries. For the purpose, all of the monetary authorities should monitor capital flows on the daily base to collect data on them. The monetary authority of each country has a limitation in monitoring and collecting cross-border capital transactions. Therefore, it is necessary to make international cooperation on a regional or global base for the construction of a database on international capital flows.

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### Appendix 1: Accumulated Impulse Responses in Models for Determinants of Portfolio Flows in Emerging Market Countries

I. Equity flows determination in emerging market countries



#### (1) Indonesia

#### (2) India



#### (3) Korea



#### (4) Thailand


#### (5) South Africa



(6) Brazil



#### (7) Philippines



(8) Vietnam



#### (9) Taiwan



#### (10) China



## II. Debt flows determination in emerging market countries



(1) Indonesia

(2) India



(3) Thailand



(4) South Africa



(5) Hungary



(6) Mexico



## III. Total portfolio flows determination in emerging market countries

#### Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ?2 S.E. Accumulated Response of FF\_FUTURE(-1) to FF\_FUTURE(-1) Accumulated Response of FF\_FUTURE(-1) to VIX(-1) Accumulated Response of FF\_FUTURE(-1) to INT\_EM Accumulated Response of FF\_FUTURE(-1) to S Accumulated Response of FF\_FUTURE(-1) to FLOW\_TOTAL 016 014 .010 010 010 .00 .005 006 Accumulated Response of VIX(-1) to FF\_FUTURE(-1) Accumulated Response of VIX(-1) to VIX(-1) Accumulated Response of VIX(-1) to IN T\_EM Accumulated Response of VIX(-1) to S Accumulated Response of VIX(-1) to FLOW\_TOTAL .0 .03 . .03 .0 .02 .02 0. -.01 Accumulated Response of INT\_EM to FF\_FUTURE(-1) Accumulated Response of INT\_EM to FLOW\_TOTAL Accumulated Response of INT\_EM to VIX(-1) Accumulated Response of INT\_EM to INT\_EM Accumulated Response of INT\_EM to S 777 10 15 - 10 15 Accumulated Response of Sto FF\_FUTURE(-1) Accumulated Response of Sto FLOW\_TOTAL Accumulated Response of Sto VIX(-1) Accumulated Response of Sto INT EM Accumulated Response of Stp S .003 m 00 .003 .002 002 002 002 .001 .001 .001 .001 Accumulated Response of FLOW\_TOTAL to FF\_FUTURE(-1) Accumulated Response of FLOW\_TOTAL to INT\_EM Accumulated Response of FLOW\_TOTAL to FLOW\_TOTAL Accumulated Response of FLOW\_TOTAL to VIX(-1) Accumulated Response of FLOW\_TOTAL to S 300 200 200 200 -200 200 -100

#### (1) Indonesia

(2) India



(3) Thailand



(4) South Africa



#### (5) Malaysia



# Appendix 2: Accumulated Impulse Responses in Alternative Models for Determinants of Portfolio Flows in Emerging Market countries (using LIBOR USD rates)

I. Equity flows determination in emerging market countries



#### (1) Indonesia

#### (2) India



#### (3) Korea



#### (4) Thailand



#### (5) South Africa



#### (6) Brazil



# (7) Philippines



#### (8) Vietnam



#### (9) Taiwan



#### (10) China



## II. Debt flows determination in emerging market countries



(1) Indonesia

(2) India



(3) South Africa



(4) Hungary



(5) Mexico

Accumulated Response of LIBOR to VIX Accumulated Response of LIBOR to INT\_EM Accumulated Response of LIBOR to S Accumulated Response of LIBOR to FLOW\_DEBT Accumulated Response of LIBOR to LIBOR .012 .012 .012 .012 .012 .008 .008 .008 .008 .008 .004 .004 .004 .004 .004 .000 0.00 000 000 0.00 5 10 15 20 10 15 20 10 15 20 10 20 10 15 20 Accumulated Response of VIX to LIBOR Accumulated Response of VIX to VIX Accumulated Response of VIX to INT\_EM Accumulated Response of VIX to S Accumulated Response of VIX to FLOW\_DEBT .04 .04 .04 .04 .04 .03 .03 .03 .03 .03-.02 .02 -.02 .02 .02 -.01 .01 .01 .01 .01 .00 .00 .00 .00 10 15 5 10 15 20 20 10 15 10 15 10 15 20 20 20 Accumulated Response of INT\_EM to LIBOR Accumulated Response of INT\_EM to VIX Accumulated Response of INT\_EM to S Accumulated Response of INT\_EM to FLOW\_DEBT Accumulated Response of INT\_EM to INT\_EM .04 .04 .04 .04 .04 .02 0.2 .02 .02 0.2 .00 .00 5 10 15 2 15 15 15 5 10 20 20 5 10 20 10 15 20 10 20 Accumulated Response of Sto FLOW\_DEBT Accumulated Response of S to LIBOR Accumulated Response of Sto VIX Accumulated Response of Sto INT\_EM Accumulated Response of Sto S .008 .008 .008 .008 .008 .006 -.006 -.006 .006 .006 .004 .004 .004 .004 .004 .002 -.002 .002 .002 .002 .000 .000 .000 .000 .000 15 10 15 20 20 20 Accumulated Response of FLOW\_DEBT to LIBOR Accumulated Response of FLOW\_DEBT to VIX Accumulated Response of FLOW\_DEBT to INT\_EM Accumulated Response of FLOW\_DEBT to S Accumulated Response of FLOW\_DEBT to FLOW\_DEBT 400 -400 -400 400 400 200 200 200 200 200 10 10 15 10 15 20 10 15

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ?2 S.E.

#### III. Total portfolio flows determination in emerging market countries



68



(2) India

# (3) Thailand



# (4) South Africa



(5) Malaysia


# Appendix 3: Accumulated Impulse Responses in Alternative Models for Determinants of Portfolio Flows in Emerging Market countries (using US BBB-rated Corporate Bond Spread over US Treasury Securities)

I. Equity flows determination in emerging market countries



### (1) Indonesia

#### (2) India



#### Accumulated Response to Cholesky One S.D. (d.f.adjusted) Innovations ?2 S.E. (c1) to BBB\_SPREAD(-1) Accumulated Response of FF\_FUTURE(-1) to INT\_EM Accumulated Accumulated Response of FF\_FUTURE(-1) to FF\_FUTURE(-1) Accumulated Response of FF\_FUTURE(-1) to EP\_US(-1) Accumulated Response of FF\_FUTURE(-1) to BBB\_SPREAD(-1) Accumulated Response of FF\_FUTURE(-1) to S Accumulated Response of FF\_FUTURE(-1) to FLOW\_EQUITY Accumulated Response of FF\_FUTURE(-1) to EP\_EM .01 .015 .015 .015 .015 .015 .015 .010 .010 .01 .010 .010 .010 .010 .005 .005 0.05 .005 0.0 0.05 .005 .00 .000 .000 .00 5 10 15 5 10 15 10 15 20 5 10 15 5 10 15 5 10 15 10 15 Accumulated Response of EP\_US(-1) to FF\_FUTURE(-1) Accumulated Response of EP\_US(-1) to EP\_US(-1) Accumulated Response of EP\_US(-1) to BBB\_SPREAD(-1) Accumulated Response of EP\_US(-1) to INT\_EM Accumulated Response of EP\_US(-1) to S ated Response of EP\_US(-1) to FLOW\_EQUITY Accumulated Response of EP\_US(-1) to EP\_EM .004 .00 .004 .004 .004 .00 0.04 .000 .00 .000 .00 0.00 0.0 - 10 - 15 - 10 10 10 - 5 - 10 15 10 Accumulated Response of BBB\_SPREAD(-1) to FF\_FUTURE(-1) Accumulated Response of BBB\_SPREAD(-1) to EP\_US(-1) Accumulated Res onse of BBB\_SPREAD(-1) to BBB\_SPREAD(-1) Accumulated Response of BBB\_SPREAD(-1) to INT\_EM Accumulated Response of BBB\_SPREAD(-1) to S Accumulated Response of BBB\_SPREAD(-1) to FLOW\_EQUITY Accumulated Response of BBB\_SPREAD(-1) to EP\_EM .02 .02 -.02 .02 .0 .00 5 10 15 20 5 10 15 5 10 15 20 5 10 15 5 10 15 5 10 15 5 10 15 20 Accumulated Response of INT\_EM to FF\_FUTURE(-1) Accumu ated Response of INT\_EM to EP\_US(-1) Accumulated Response of INT\_EM to BBB\_SPREAD(-1) ted Response of INT\_EM to INT\_EM ulated Response of INT\_EM to S Response of INT\_EM to FLOW\_EQUITY ed Response of INT\_EM to EP\_EM Accum .015 .015 .015 .015 .015 .015 -.015 .010 .010 .010 .010 .010 \* .010 .010 .005 .005 .005 .00 .005 .005 .005 .000 .00 .000 .000 .00 10 10 15 10 10 15 10 10 10 Accumulated Response of S to FF\_FUTURE(-1) Accumulated Response of S to EP\_US(-1) Accumulated Response of Sto BBB\_SPREAD(-1) Accumulated Response of S to INT\_EM Accumulated Response of S to S Accumulated Response of Sto FLOW\_EQUITY Accumulated Response of S to EP\_EM .004 .00 .004 .004 .00 .004 .004 .002 .002 .002 .002 .00 .002 .00: .000 .00 .000 0.0 -.002 --.002 . 0.0.2 -.002 -.002 -.002 10 15 10 15 10 5 10 15 5 10 15 10 15 10 46 Accumulated Response of FLOW\_EQUITY to FF\_FUTURE(-1) Accumulated Response of FLOW\_EQUITY to EP\_US(-1) Accumulated Response of FLOW\_EQUITY to BBB\_SPREAD(-1) Accumulated Response of FLOW\_EQUITY to INT\_EM Accumulated Response of FLOW\_EQUITY to S Accumulated Response of FLOW\_EQUITY to FLOW\_EQUITY cumulated Response of FLOW\_EQUITY to EP\_EM 300 300 301 30 300 300 30 200 -200 200 200 200 200 200 100 100 100 100 -100 -100 -100 --100 10 10 10 10 Accumulated Response of EP\_EM to FF\_FUTURE(-1) Accumulated Response of EP\_EM to BBB\_SPREAD(-1) Accumulated Response of EP\_EM to INT\_EM mulated Response of EP\_EM to S Accumulated Response of EP\_EM to FLOW\_EQUITY Accumulated Response of EP\_EM to EP\_US(-1) ed Response of EP\_EM to EP\_EM .004 .004 .004 .004 .004 .004 .004 .002 .002 .002 .002 .002 .002 .002 .000 .000 .000 .000 .00 .000 .000 -.002 -.002 -.002 . . . . -.002 . ... 10 10 15 15 10 15 10 15 10 15

(3) Korea

### (4) Thailand



## (5) South Africa



(6) Brazil



#### Accumulated Response to Cholesky One SD. (df.adjusted) hnovations ?2SE Accumulated Response of FF\_FUTURE(-1) to EP\_US(-1) Accumulated Response of FF\_FUTURE(-1) to SBB, SPREAD(-1) Accumulated Response of FF\_FUTURE(-1) to S Accumulated Response of FF\_FUTURE(-1) to FF\_FUTURE(-1) Accumulated Response of FF\_FUTURE(-1) to FLOW\_EQUITY Accumulated Response of FF\_FUTURE(-1) to EP\_EM .01 .015 .015 .015 .015 .015 .015 .010 .010 .010 .010 .010 .01 .010 .005 .00 0.04 .005 0.0 .005 .005 .000 .000 .000 .00 .001 5 10 15 5 10 15 10 15 10 15 5 10 15 10 15 5 10 15 Accumulated Response of EP\_US(-1) to FF\_FUTURE(-1) Accumulated Response of EP\_US(-1) to EP\_US(-1) Accumulated Response of EP\_US(-1) to BBB\_SPREAD(-1) Accumulated Response of EP\_US(-1) to INT\_EM Accumulated Response of EP\_US(-1) to S ted Response of EP\_US(-1) to FLOW\_EQUITY Accumulated Response of EP\_US(-1) to EP\_EM .006 .00 .006 .006 .00 .006 .006 .004 .004 .004 .004 .00 .004 .002 .002 .002 .002 .002 .002 -.002 .00 .000 .00 .000 .000 10 15 10 10 10 - 5 10 10 -5 Accumulated Response of BBB\_SPREAD(-1) to FF\_FUTURE(-1) Accumulated Response of BBB\_SPREAD(-1) to EP\_US(-1) Accumulated Response of BBB\_SPREAD(-1) to BBB\_SPREAD(-1) Accumulated Response of BBB\_SPREAD(-1) to INT\_EM Accumulated Response of BBB\_SPREAD(-1) to S Accumulated Response of BBB\_SPREAD(-1) to FLOW\_EQUITY Accumulated Response of BBB\_SPREAD(-1) to EP\_EM 0 0.2 .01 .00 .00 -.0 -.0 -.01 5 10 15 20 5 10 15 5 10 15 20 5 10 15 5 10 15 2 5 10 15 5 10 15 20 Accumulated Response of INT\_EM to FF\_FUTURE(-1) Accumulated Response of INT\_EM to EP\_US(-1) Accumulated Response of INT\_EM to BBB\_SPREAD(-1) ted Response of INT\_EM to INT\_EM ulated Response of INT\_EM to S Response of INT\_EM to FLOW\_EQUITY ted Response of INT\_EM to EP\_EM Accum 10 15 10 10 15 10 15 10 15 10 15 10 Accumulated Response of S to FF\_FUTURE(-1) Accumulated Response of S to EP\_US(-1) Accumulated Response of S to BBB\_SPREAD(-1) Accumulated Response of S to INT\_EM Accumulated Response of S to S Accumulated Response of Sto FLOW\_EQUITY Accumulated Response of S to EP\_EM .003 .00 .003 .003 .00 .003 .00: .002 .002 .002 .002 .00 .002 .003 .001 .001 .001 .001 .00 .00 .000 .000 .000 0.0 .00 10 10 15 10 15 5 10 15 5 10 15 10 15 5 10 15 Accumulated Response of FLOW\_EQUITY to FF\_FUTURE(-1) Accumulated Response of FLOW\_EQUITY to EP\_US(-1) umulated Response of FLOW\_EQUITY to BBB\_SPREAD(-1) Accumulated Response of FLOW\_EQUITY to INT\_EM Accumulated Response of FLOW\_EQUITY to S Accumulated Response of FLOW\_EQUITY to FLOW\_EQUITY cumulated Response of FLOW\_EQUITY to EP\_EM 4.0 10 10 10 10 15 10 10 Accumulated Response of EP\_EM to FF\_FUTURE(-1) Accumulated Response of EP\_EM to BBB\_SPREAD(-1) Accumulated Response of EP\_EM to INT\_EM umulated Response of EP\_EM to S Accumulated Response of EP\_EM to FLOW\_EQUITY Accumulated Response of EP\_EM to EP\_US(-1) d Response of EP\_EM to EP\_EM .010 .010 .010 -.010 .01 .010 .005 .005 .005 .005 .00 .005 .005 .000 .00 000 .00 10 10 15 15 10 10 15 10 10 15

(7) Philippines

#### (8) Vietnam



#### Accumulated Response to Cholesky One SD. (df.adjusted) hnovations ?2 SE. Accumulated Response of FF\_FUTURE(-1) to FF\_FUTURE(-1) Accumulated Response of FF\_FUTURE(-1) to EP\_US(-1) Accumulated Response of FF\_FUTURE(-1) to BBB\_SPREAD(-1) Accumulated Response of FF\_FUTURE(-1) to FLOW\_EQUITY Accumulated Response of FF\_FUTURE(-1) to EP\_EM 5 10 15 10 15 20 5 10 15 5 10 15 5 10 15 5 10 15 5 10 15 Accumulated Response of EP\_US(-1) to FF\_FUTURE(-1) Accumulated Response of EP\_US(-1) to EP\_US(-1) Accumulated Response of EP\_US(-1) to BBB\_SPREAD(-1) Accumulated Response of EP\_US(-1) to INT\_EM Accumulated Response of EP\_US(-1) to S Accu mulated Response of EP\_US(-1) to FLOW\_EQUITY Accumulated Response of EP\_US(-1) to EP\_EM .004 .004 .004 .004 .00 .004 .004 .000 .000 .000 .001 000 0.0 - 10 - 15 - 10 10 10 10 15 10 10 Accumulated Response of BBB\_SPREAD(-1) to FF\_FUTURE(-1) Accumulated Response of BBB\_SPREAD(-1) to EP\_US(-1) Accumulated Res onse of BBB\_SPREAD(-1) to BBB\_SPREAD(-1) Accumulated Response of BBB\_SPREAD(-1) to INT\_EM Accumulated Response of BBB\_SPREAD(-1) to S Accumulated Response of BBB\_SPREAD(-1) to FLOW\_EQUITY Accumulated Response of BBB\_SPREAD(-1) to EP\_EM .02 .02 = .02 .02 .01 .0 .00 5 10 15 20 5 10 15 5 10 15 20 5 10 15 20 5 10 15 2 5 10 15 5 10 15 20 Accumulated Response of INT\_EM to FF\_FUTURE(-1) Accumu ated Response of INT\_EM to EP\_US(-1) Accumulated Response of INT\_EM to BBB\_SPREAD(-1) ed Response of INT\_EM to INT\_EM ulated Response of INT\_EM to S Response of INT\_EM to FLOW\_EQUITY ed Response of INT\_EM to EP\_EM Accu .00 .003 .003 .003 \* .003 .003 .003 .002 .002 .002 .002 .00 .002 .002 .001 .00 .00 .001 .00 .00 .00 .000 .000 000. .000 .00 .00 10 10 10 15 10 10 10 15 15 Accumulated Response of S to FF\_FUTURE(-1) Accumulated Response of S to EP\_US(-1) Accumulated Response of Sto BBB\_SPREAD(-1) Accumulated Response of S to INT\_EM Accumulated Response of S to S Accumulated Response of S to FLOW\_EQUITY Accumulated Response of S to EP\_EM .003 .003 .003 -.003 -.003 .003 .003 .002 .002 .002 .002 .00 .002 .002 .001 .001 .001 .00 .000 .000 .000 .00 .001 .000 .000 -.001 .001 -.001 -.001 -.001 --.001 -.001 \* 10 15 10 15 10 15 5 10 15 5 10 15 10 15 5 10 15 Accumulated Response of FLOW\_EQUITY to FF\_FUTURE(-1) Accumulated Response of FLOW\_EQUITY to EP\_US(-1) umulated Response of FLOW\_EQUITY to BBB\_SPREAD(-1) Accumulated Response of FLOW\_EQUITY to INT\_EM Accumulated Response of FLOW\_EQUITY to S Accumulated Response of FLOW\_EQUITY to FLOW\_EQUITY Accumulated Response of FLOW\_EQUITY to EP\_EM 400 400 400 400 400 400 400 200 200 200 200 200 200 20 -200 -200 -200 \* -200 \* -200 -200 -200 10 10 10 15 10 15 10 Accumulated Response of EP\_EM to FF\_FUTURE(-1) Accumulated Response of EP\_EM to BBB\_SPREAD(-1) Accumulated Response of EP\_EM to INT\_EM mulated Response of EP\_EM to S Accumulated Response of EP\_EM to FLOW\_EQUITY Accum d Response of EP\_EM to EP\_US(-1) ted Response of EP\_EM to EP\_EM 0.0 0.04 004 004 004 0.04 0.04 .002 .002 .002 .002 .002 .002 .002 .000 .000 .000 .000 000 .000 .000 -.002 -.002 -.002 -.002 -.002 -.002 -.002 -.004 -.004 -.004 -.004 -.004 -.004 -.004 15 10 10 10 15 15 10 15 10 15 10

#### (9) Taiwan

#### (10) China



# II. Debt flows determination in emerging market countries



(1) Indonesia

(2) India



(3) Thailand



(4) South Africa



(5) Hungary



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(6) Mexico



# III. Total portfolio flows determination in emerging market countries



(1) Indonesia





(3) Thailand



(4) South Africa



# (5) Malaysia



# Appendix 4: Accumulated Impulse Responses in Models for Contagions of Equity Flows among Emerging Market Countries



(1) All sample emerging market countries

# (2) Asian emerging market countries



# (3) BRICS countries (except for Russia)

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ?2 S.E.



# Appendix 5: Accumulated Impulse Responses in Models for Contagions of Debt Flows among Emerging Market Countries



### (1) All sample emerging market countries

# (2) Asian emerging market countries

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ?2 S.E.

Accumulated Response of THAILAND to THAILAND

Accumulated Response of THAILAND to INDONESIA

Accumulated Response of THAILAND to INDIA



Appendix 6: Accumulated Impulse Responses in Models for Contagions of Total Portfolio Flows among Emerging Market Countries



### (2) Asian emerging market countries

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ?2 S.E.



# Appendix 7: Accumulated Impulse Responses in Alternative Models for Contagions of Portfolio Flows among Emerging Market Countries

Icomulated Reporce of IFF/UUR(-1) to IFF/UUR(-1)	Assemulated Reponse of IPT/USR(-1) to VX(-1)	Accumulated Reporce of IPT_PUBJE(-1) to BRZ1(-1)	Acumulated Reporte of IFF_RUBE(-1) to KORA	Acumulated Reports of IFF_UURE(-1) to ONA	Ammitted Reports of IF_UUE(-1) to TAWAN	Accurated Repose of #J/CUR(-1 to PHURINE	Accumulated Reporter of IFF_ICURE(-1) to THELAD	Ammitted Repres of IFF/UUR(-1) to IND/NBA	Accumulated Reponse of IFT_FULLIR(-1) to VIENAM	Acumulated Reports of IFF_PUUR(-1) to INDA	Accumulated Reponse of IFF_RUME(-1) to SOUH(ARE
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# (1) Contagions of equity flows among all sample emerging market countries



# (2) Contagions of debt flows among all sample emerging market countries



# (3) Contagions of total portfolio flows among all sample emerging market countries

Shocks Impulse responses	Korea	China	Taiwan	Philippines	Thailand	Indonesia	Vietnam	India	South Africa	brazil
Korea	297.1773*	27.8962	37.9298	51.8964*	12.4535	28.2835	7.1871	-12.9705	-35.4519	25.3554
China	43.2119*	290.8202*	-10.6637	15.0688	9.2442	4.5243	11.0439	6.271	-40.7531*	30.7813
Taiwan	181.1865*	70.4931*	276.0997*	37.3933*	45.4775	40.6623	-11.9141	-31.2636	-47.9664*	51.5337*
Philippines	8.4583*	1.4653	4.9619	33.7797*	1.4112	6.4117*	-0.024	-6.8534*	-0.2554	2.1449
Thailand	30.1314*	3.2952	40.8315*	10.8585	80.355*	15.0225*	-6.6595	-6.4472	-9.8038	18.7759*
Indonesia	33.739*	3.6047	33.4088*	1.6751	14.5976*	79.9569*	2.6861	-4.6264	-6.5706	4.7109
Vietnam	-2.9388	4.8282	-4.0401	-2.8265	-7.496	-0.4325	56.9703*	2.0684	-7.8383*	-9.431*
India	84.6777*	22.9381	89.2406*	29.7362*	49.7767*	23.0871	10.5848	177.1909*	-14.9334	7.4459
South Africa	19.1454 $ riangle$	0.7332	10.0008	16.7508	-7.1301	-3.9041	10.6447	4.0787	139.6091*	11.586
brazil	32.6144*	26.8699*	40.3099*	13.3091	38.5624*	3.297	-20.1145	-25.785*	-14.7864	158.7154*

Appendix 8. The magnitudes of impulse responses in models for contagions of equity flows among emerging market countries

(1) Contagions of equity flows among all sample emerging market countries

Note: the values in this table show the magnitudes of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "." represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

(2) Contagions of equity flows among all sample emerging market countries (with consideration of interest rates in the United States and global risk aversion)

Shocks Impulse responses	FF futures	VIX	Brazil	Korea	China	Taiwan	Philippines	Thailand	Indonesia	Vietnam	India	South Africa
FF futures	0.0202*	0.0009	0.0007	-0.0026*	-0.0018	0.0013	-0.0001	0.0003	0.0003	-0.0001	0.0002	-0.0008
VIX	0.0012	0.0543*	0.005	-0.0092*	-0.0058△	-0.0085*	-0.0013	-0.0041	-0.0035	0.0009	0.0038	0.008*
Brazil	17.5185	-62.793*	139.5217*	32.2068*	17.548△	37.5216*	13.0148	31.6076*	9.9299	-20.6099*	-18.3053*	-14.6674
Korea	28.4022	-79.9846*	-12.8434	284.8543*	17.0547	34.8976	48.9815*	8.8912	25.8755	8.6126	-10.5894	-37.5188
China	30.0773	-89.4502*	-2.5904	21.4257	273.7929*	-13.1578	11.9078	6.9057	6.3043	11.6894	11.2583	-41.8888*
Taiwan	32.3441	-76.8157*	2.8575	166.256*	55.4167*	270.7691*	34.4264*	41.7298△	40.0571	-9.9048	-27.1919	-47.0802*
Philippines	2.7491	-5.3137*	0.0537	7.2472*	0.0903	4.5699	33.6177*	1.1353	6.3752*	-0.0182	-6.6197*	-0.3777
Thailand	10.9108	-13.3256*	11.0073*	27.7477*	-0.2123	39.7554*	10.3533	79.5429*	16.5413*	-6.5516	-4.9391	-8.6558
Indonesia	2.6237	-13.7456*	-9.4204	30.2169*	-0.5809	32.4865*	0.8287	13.7823	79.3494*	3.5526	-3.3811	-5.6252
Vietnam	1.2084	2.3416	-4.8625*	-2.9861	5.7696	-3.5748	-2.8116	-7.1031*	-0.1665	56.666*	1.3334	-8.5176*
India	2.385	-9.2038	-18.1611	81.1285*	20.3336	86.6703*	29.1549*	50.0781*	22.3687	13.4664	178.6628*	-12.4164
South Africa	-10.6928	-17.0538*	10.2572	19.6063*	-0.3711	8.5728	17.2591	-7.8583	-4.3117	10.6412	3.6698	139.0452*

Note: the values in this table show the magnitudes of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

# Appendix 9. The magnitudes of impulse responses in models for contagions of debt flows among emerging market countries

Shocks Impulse responses	Thailand	Indonesia	India	Hungary	South Africa	Mexico
Thailand	264.0822*	30.3343*	13.6691	8.8303	26.8145	-11.4673
Indonesia	105.7289*	215.4573*	48.9895*	16.6946	15.1481	-9.102
India	54.4056*	33.8215	256.2579*	1.2416	25.0933	8.0391
Hungary	8.842	-5.8597	15.1864*	85.2966*	1.4966	-2.7074
South Africa	19.6493	14.6969	18.8105	19.5086*	162.3648*	-8.2008
Mexico	42.2438	-12.092	-55.4227	44.7365	6.4963	481.9054*

(1) Contagions of debt flows among all sample emerging market countries

Note: the values in this table show the magnitudes of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

(2) Contagions of debt flows among all sample emerging market countries (with consideration of interest rates in the United States and global risk aversion)

Shocl Impulse responses	FF futures	VIX	Mexico	Thailand	Indonesia	India	Hungary	South Africa
FF futures	0.0175*	0	0.0001	0.0011	0.0005	-0.0016	-0.0032*	-0.0007
VIX	0.0013	0.0483*	-0.0013	-0.0015	0.0052	0.0047	-0.004*	-0.0032
Mexico	-21.648	40.9047	487.5669*	44.4235	-29.6441	-32.7945	38.8516*	-14.8752
Thailand	40.4856*	-32.8828*	-3.2643	260.6435*	31.5452*	10.9645	5.7877	26.4757
Indonesia	6.5584	-49.9469*	-0.337	102.0101*	210.7335*	42.3557*	16.821	14.873
India	10.6392	-16.3306	0.2038	51.2102*	35.2681	257.4812*	-1.7527	23.8426
Hungary	-3.5266	-2.9966	-2.4476	9.1593	-5.586	15.2764*	85.3148*	1.6475
South Africa	6.4503	-11.6589	-16.6685	17.3674	15.053	18.7323	18.2855	162.5899*

Note: the values in this table show the magnitudes of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

# Appendix 10. The magnitudes of impulse responses in models for contagions of total portfolio flows among emerging market countries

Shocks Impulse responses	Thailand	Indonesia	Malaysia	India	South Africa
Thailand	294.0768*	37.4246*	67.6186*	14.5352	35.2561
Indonesia	133.3519*	233.9286*	70.9419*	40.885*	17.3728
Malaysia	28.2973*	14.809*	79.8293*	7.1655	9.0701
India	106.2109*	62.1021*	176.5476*	372.7327*	28.9579
South Africa	25.8697	3.9628	75.6388*	12.0455	221.5711*

(1) Contagions of total portfolio flows among all sample emerging market countries

Note: the values in this table show the magnitudes of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.

(2) Contagions of total portfolio flows among all sample emerging market countries (with consideration of interest rates in the United States and global risk aversion)

Shocks Impulse responses	FF futures	VIX	Thailand	Indonesia	Malaysia	India	South Africa
FF futures	0.0174*	0.0003	0.0006	0	-0.0025	-0.0004	-0.0003
VIX	-0.0041	0.0489*	-0.0009	0.0048	-0.0055△	0.0032	-0.0023
Thailand	63.9013*	-47.2172*	285.4519*	40.5593*	61.1114*	15.4193	34.4727
Indonesia	23.3412	-64.0648*	123.9097*	230.2008*	59.1203*	39.483*	15.0509
Malaysia	13.9728*	-21.1122*	24.5555*	15.1382*	76.9451*	7.6187	9.1118
India	33.4041	-34.8132	99.158*	71.8995*	173.0307*	375.2007*	30.064
South Africa	6.3891	-20.2132△	24.1472	6.9831	74.9914*	12.2926	222.6833*

Note: the values in this table show the magnitudes of accumulated impulse responses in 20 days of VAR models. Country names in this table show the daily capital flows of emerging market countries. "+" / "-" represents positive/negative impulse responses. "\*" represents statistical significance within confidence bands of  $\pm 2$  S.E. " $\Delta$ " represents an instantaneous shock rather than a permanent shock.