

# **Impact of FOMC Announcement on Stock Price Index in Southeast Asian Countries**

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## **ABSTRACT**

This paper examines the impact of Federal Open Market Committee (FOMC) announcements, which includes information about the targeted Federal fund rate and revision to the future path of monetary policy on Southeast Asian stock market performance. It compares these effects in two periods: the 1997 Asian financial crisis and the subprime mortgage crisis. To do this, a sample of five national equity market indexes is analysed over the period 1997-2013 covering 132 scheduled FOMC meetings. The results first show that all the stock markets examined do respond to information in FOMC announcements. Second, the target Federal fund rate has more impact on Southeast Asian stocks performance than information about the future path of monetary policy does. Third, different Southeast Asian equity markets respond similarly to targeting the Federal fund rate, while the responses to monetary policy differ from each other. Fourth, the response of each country to the FOMC announcement is not statistically different in the two periods of financial crisis.

JEL Classification: E52, E58, E65, G14

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## **1. Introduction**

As an element of monetary policy making in the U.S, Federal Open Market Committee (FOMC thereafter) announcements have become an increasingly important news source for investor decisions. The target Federal Fund rate set by the FOMC serves as a benchmark for other rates. A change in the Federal fund rate that the lending rate banks charge each other for the use of overnight funds translates through to all other interest rates from Treasury bonds to mortgage loans. Along with determining the short-term interest rate, the FOMC announcement includes a brief revision of future monetary policy. For weeks in advance, market participants speculate about the possibility of an interest rate change in these meetings. If the outcome is significantly different from the expectations, then the impact on the market can be dramatic and far-reaching (Glic and Leduc, 2011).

Developed markets such as France, Italy, the United Kingdom and Germany are considered as having high correlation with U.S monetary policy because they are large trading partners. Their response is even higher than the reaction of S&P 500 does (Wongswan, 2009). Japan is an exception among developed markets and some findings show that Japanese equity index does not respond to U.S interest rate shocks (Wongswan, 2009; Valente, 2009). Meanwhile, Latin American and the U.S equity market have the same reaction to the Federal fund rate shocks because of the similarity in market structure and time zone (Tillmann, 2011). Although the effect of Federal fund rate shocks has been widely discussed, the impact of FOMC's revision of the future path of monetary policy is still not clear. According to Kurov (2012), the optimistic orientation of U.S monetary policy is not a good signal for investors because the U.S is the largest economy in the world. This results in optimistic predictions about the world economy as well as an increase inflow into global equity index. In the meantime, Nikkinen and Sahlstrom (2004) state that when the U.S economy becomes pessimistic, the investors will seek investment opportunities in oversea markets, which leads to an increase inflow into foreign equity markets.

This paper examines the impact of FOMC announcements on stock market performance in five selected Southeast Asian countries; Thailand, Indonesia, Malaysia, Singapore and the Philippines, over the period 1997 to 2013. In the last two decades, the Association of Southeast Asian Nations (ASEAN) has witnessed a considerable growth in market capitalisation. There have been many studies of the determinants of these emerging markets performance. Phan and Vo (2012), Fabian and Lee (2014), Francesco and Rakesh (2012) assert that internal factors, such as income growth rate, saving rate, financial development and stock market liquidity, have a positive effect on the Southeast Asian stock markets. However, the concern as to whether

these stock markets respond to FOMC announcements, which is an element of U.S monetary policy, still exists. Goeij and Marquering (2006) argue that this is because the financial markets in Southeast Asia, except for Singapore, are not efficient. Therefore, information about U.S monetary policy would have no effect on the performance of these stock markets. In the meanwhile, Fischer and Ranaldo (2011) state that important news other than FOMC announcement, such as the unemployment rate and GDP growth, could produce a bias in the result. Due to the lack of high frequency data, these findings give no clear conclusion about the reaction of Southeast Asian stock markets to U.S macroeconomics policies. Besides, since the 1990s, Southeast Asia has experienced two financial crises - the 1997 Asian and recent subprime financial crisis. One more purpose of this study is to examine whether the impact of the FOMC announcement on Southeast Asian equity indexes has been different between the two crises.

This paper will contribute to the literature on the impact of the FOMC announcement on Southeast Asian stock markets on several grounds. First, in comparing the volatility of stock overnight return on days with and without an FOMC statement, one of the main findings shows that Southeast Asian markets do respond to an FOMC announcement. The Singapore stock market is more sensitive to U.S monetary announcement than other markets in the region. Second, information about target Federal fund rate has more impact on all five stock markets in Southeast Asia, including Thailand, Malaysia, Indonesia, Singapore and the Philippines, than revisions to U.S future monetary policy do. Third, different Southeast Asian equity markets respond similarly to the target Federal fund rate, while the responses to monetary policy differ each other. Fourth, the impact of the FOMC announcement on Southeast Asian equity indexes was not statistically different between the two crises.

This paper applies the quantification model developed by Wongswan, (2009) and Farka and Fleissig (2012). The two proxies used are target surprise and path surprise. The target surprise captures the adjustment in the target Federal Fund rate. This is the difference between market prediction about Federal fund rate and the current target rate stated in FOMC official statement. The path surprise captures the future expected path of monetary policy that investors have learnt from the FOMC announcement. It is defined as the component of change in the one-year-ahead Eurodollar interest rate future that is uncorrelated with target surprise. Unlike previous studies that focus on the following day's return after the FOMC announcement, this study only analyses overnight return, calculated from the change in closing price prior to FOMC announcement and the thirty-minute opening price on the next day. High frequency intraday data of equity index from 01/Jan/1997 to 30/Jun/2013 in Thailand, Malaysia,

Indonesia, Singapore and the Philippines has been used to conduct this analysis. By performing this calculation, the effect will be eliminated of other important news that might occur on the day of the FOMC announcement .

The remainder of this study is structured as follows. The next section presents a literature review of the influence of the FOMC announcement on global equity markets. Sections 3 and 4 describe the data and methodology used in the analysis. Section 5 presents empirical results and discussion, while Section 6 concludes the study.

## **2. Background on impact of FOMC announcement on equity markets**

When global financial market becomes more and more interconnected, international asset prices respond not only to their domestic monetary shocks, but also to changes in U.S monetary policy because of the leading role of the U.S economy in the world. Generally, the transmission of U.S monetary policy to global equity market can be divided into two channels: U.S assets price and foreign assets prices (European Central Bank, 2006). First, the transmission of U.S monetary policy to the global equities market can be explained by the reaction of U.S assets themselves. This is the case of foreign firms borrowing from the U.S market. Therefore, an increase in interest rate, which means that the cost of financing increases, will lower firm equity value.

Second, the U.S monetary policy could affect the equity market through the foreign assets price transmission channel. If a contractionary U.S monetary policy is implemented, then there should be an increase in U.S interest rate. The domestic interest rate will be higher than the foreign interest, which will then lead to an increase in capital from abroad. Thus, there would be an appreciation in U.S dollar, resulting in foreign commodities becoming cheaper in comparison to the U.S. and this benefits foreign exporting firms. As a result, the value of a foreign firm is expected to increase.

The response of an international equity market to the FOMC announcement varies across countries and regions. According to Herwartz and Arias (2010), this difference can be explained by the monetary framework, laws and financial integration of each country. In the meanwhile, Chen (2007) gives the reason for the asymmetric reaction as the market conditions of a bear or bull market. Laeven and Tong (2010) have explained that the depth of effect is caused by the business cycle of a country and different sectors may therefore have different responses to the announcement of FOMC. Although there are many perspectives about the manner in which U.S. monetary policy affects global equity market, while monetary authorities around the world should have comprehensive knowledge about U.S monetary policy in order

to take better decisions and here, the FOMC announcement, is a highlighted example (Laeven and Tong, 2010).

With regard to the relationship between FOMC announcements and the performance of Southeast Asian stock markets, some authors have come to the same conclusion that the main channel in which information in the Federal Open Market Committee meetings affect equities market is through the foreign assets price, while the impact through U.S assets price channel is inconsiderable. Research by Wongbanpo and Sharma (2002) shows that, because economies in Southeast Asia rely mainly on exports with the United State as their main partner, any Federal Fund rate adjustment will affect the stock value of exporting companies. These authors also give the example of the depreciation of the Indonesian rupiah and Malaysian ringgit in 1999 following a U.S monetary policy announcement that resulted in a sharp increase in the price of Southeast Asian exporting companies.

Izquierdo and Lafuente (2004) state that U.S interest rate adjustments have an impact on many of the outputs of the economies of Southeast Asia, but the exchange rate is the main factor which has an impact on the equities markets. Information about the target Federal fund rate would affect their economic condition at first, while this consequence will influence stock markets., There is thus a delay in the response of equity markets to U.S monetary policy. Owing to high inflation in Southeast Asian economies, it is difficult to compare the reaction to U.S interest rate shocks of Southeast Asian market with other countries in the same region (Miniane and Rogers, 2007). Most of the previous studies have explained the impact through the target Federal Fund rate adjustment. However, due to lack of high frequency data, these findings give no clear conclusion about the reaction. In the meanwhile, information about the future path of U.S monetary policy has been less paid attention, even though the Southeast Asian market is becoming more integrated with the world and the U.S economy.

Moreover, there is concern over whether the response of Southeast Asian equity market to the FOMC announcement is different between two crises - the 1997 Asian financial crisis and current sub-prime financial crisis. Therefore, in this study, three questions are raised for examining: 1. Does the FOMC announcement affect stock performance in Southeast Asian countries? 2. To what extent does the Federal Fund rate adjustment and future path of monetary policy in FOMC announcement affect stock markets? 3. Is the effect of the FOMC announcement on the Southeast Asian markets different for the 1997 Asian financial crisis and the current sub-prime financial crisis?

The next section will present both the sample data and our methodology to explore these above questions.

### 3. Data and sample selection

#### 3.1. Time of FOMC announcement

FOMC meetings usually take place 8 times per year. The sample is from 01/Jan/1997 to 30/Jun/2013 that covers all 132 scheduled FOMC meetings. All the FOMC statements are released around 2:15 pm Eastern Time on the meeting day. However, at the time when the FOMC announces the statement, the Asian market are closed. This lag-time effect should be taken into account in calculating Southeast Asian equity market return and it will be discussed later in the equity market data.

#### 3.2. Equity market data.

Equity market data is taken from the DataStream database. The five equity market indexes analysed in national currencies are the Jakarta Composite Index (Indonesia), the Kuala Lumpur Stock Exchange Composite Index (Malaysia), the Stock Exchange of Thailand Index (Thailand), the MSCI Singapore (Singapore) and the Philippines SE Index (Philippines). The reasons for choosing these indexes are, firstly, that they have a maximum amount of comparability across countries. Secondly, they cover a broad sample of stocks and small firms are also included. Moreover, FOMC announcements are released when Asian markets are closed. There may be other important news than the FOMC announcement affecting the equity market indexes (Refet et al., 2005). For this reason, the high frequency intraday equity index is used instead of daily index in order to maximise the accuracy of calculations. To examine the response of Southeast Asian equity markets to FOMC announcement, the overnight return is computed from the closing price index prior to FOMC announcement and the thirty-minute opening price index on the following day.

$$\text{Overnight Return} = \frac{(\text{thirty minute opening price} - \text{Previous closing price})}{\text{Previous closing price}} \quad (3.1)$$

Table 1 panel A shows the descriptive statistics of overnight return across five chosen indexes in Southeast Asia. It compares both the mean and standard deviation of overnight return on the days with and without FOMC announcement. The standard deviation of overnight return on days without FOMC announcement is less than on days with the announcement. Regarding the mean overnight return, this number is higher on days with the announcement in Thailand and the Philippines. However, overnight returns in Singapore, Malaysia and Indonesia are lower when the FOMC release the announcement.

---INSERT TABLE 1 HERE---

Overnight return distribution on days following FOMC announcement is described in Table 2. Generally, the shape of distribution in almost all the countries of Southeast Asia is symmetrical with a single central peak at the mean of the data. However, there is an exception where Malaysia's overnight return distribution concentration is around mean +/-5%. In order to simplify the analysis, a loose assumption is made that all the overnight return distributions are bell-shaped with the graph falling off evenly on either side of the mean, complying with the Central limit theorem.

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### **3.3. Volatility of Southeast Asian equity return on the day following the FOMC announcement**

We provide statistical analysis in terms of the volatility of Southeast Asian equity return. Table 1 shows the standard deviation of overnight return in Thailand, Malaysia, Singapore, Indonesia and the Philippines on the days with and without the FOMC announcement. Generally, the volatility of overnight return index on days with FOMC announcement is higher than ones on non-FOMC announcement days. This is the assumption previously mentioned that overnight returns are normally distributed. Therefore, the F-test of significance can be executed in order to compare overnight return volatility on days with and without FOMC announcement in five selected markets.

The hypothesis tested is that the variance of overnight return on FOMC announcement days are equal to non-FOMC days. The  $H_0$  is  $\sigma_1^2 = \sigma_2^2$ . Table 1 Panel B shows result of the F-test of significance. At a level of significance of 5% we can reject the null hypothesis that the variance of overnight return on FOMC announcement days are equal to non-FOMC days in all five selected Southeast Asian markets. In other words, the volatility of overnight return on FOMC announcement days is statistically different from ones on non-FOMC days. This preliminary analysis indicates that FOMC announcement have an impact on the 30-minute opening price indexes on the following day of stock markets in Thailand, the Philippines, Singapore, Malaysia and Indonesia.

## 4. Empirical model and variable specification

### 4.1. Variables specification

The two proxies that are used to quantify information in the FOMC announcement are the *target surprise* representing an adjustment in the target Federal fund rate, while the *path surprise* captures the future path of U.S. monetary policy.

First, we use the quantification method of Wongswan (2009) that determines *target surprise* as the difference between prediction of Federal fund rate derived from the current month Federal fund future contract, as traded on the Chicago Board of Trade (CBOT market), and the current target rate stated in the FOMC official statement. This reveals the short run shock in monetary policy. From the DataStream database, high frequency intraday Federal Fund future contract price is derived on the days when the FOMC releases its announcement. To compute the target surprise, a thirty-minute window is opened close to the time in which the FOMC statement released (ten minutes before and twenty minutes after). The implied rate of the Federal future contract is calculated by 100 minus the current month Federal future contract price. The change in the implied rate in this thirty-minute window is the *unadjusted target surprise*.

$$\mathbf{Implied\ rate} = 100 - \mathbf{Federal\ Fund\ future\ contract\ price} \quad (4.1)$$

$$\mathbf{Unadjusted\ target\ surprise} = (\mathbf{Implied\ rate\ } t+20 - \mathbf{Implied\ rate\ } t-10) \quad (4.2)$$

However, because the pay out of the Federal fund future contract is based on the weighted average days over the month contract, the unadjusted target surprise need to be scaled by numbers of the day in month affected by the change in the Federal fund rate. The target surprise of FOMC announcement on day  $d$  in  $D$  – day month is shown in formula (4.3):

$$\mathbf{Target\ surprise} = \frac{D}{D-d} \times \mathbf{Unadjusted\ target\ surprise} \quad (4.3)$$

Besides, there are some exceptions when the FOMC meeting takes place in the last seven days of the month. In this case, to avoid the extreme values of target surprise as the denominator close to zero in equation (4.3), the target surprise is calculated as the unadjusted change in the implied rate from the next month's Federal fund future contract.



Secondly, path surprise is used as a proxy to capture the revision to the future path of U.S. monetary policy that investors have learnt from the FOMC announcements. We use the quantification method of Wongswan (2009) and Kontonikas et al. (2013) which measures the future path of U.S. monetary policy by looking at the yield curve generated by the Eurodollar future contract. Eurodollar future contracts are financial future contracts based upon time deposits denominated in U.S dollar at banks outside of the United States. The payoff to Eurodollar futures is determined by the three-month Libor rate at contract expiry. This feature makes it necessary to adjust for the expected difference between the three-month Libor and the effective federal funds rates when constructing a market-implied path of future policy. From the Datastream database, a high frequency intraday Eurodollar future price is derived on the days that the FOMC releases announcements. The implied rate of Eurodollar future is calculated by 100 minus the one-year-ahead Eurodollar future price. The change in this rate in the thirty-minute window around FOMC announcement (ten minutes before and twenty minutes after) is **Path surprise I**.

$$\textit{Implied rate} = 100 - \textit{one-year ahead Eurodollar future price} \quad (4.4)$$

$$\textit{Path surprise I} = \textit{Implied rate } t+20 - \textit{Implied rate } t-10 \quad (4.5)$$

However, unlike target surprise, the correlation between path surprise and stock performance is emphasised more than the coefficient. Moreover, the adjustment in the Federal fund rate is also a signal that investors have learnt from FOMC announcements to predict U.S future monetary policy. To eliminate this effect, path surprise II is derived by running a regression Path surprise I on the target surprise and a constant; thus, path surprise II is the residue,  $ei$ , from this regression. By doing the above, path surprise II is intended to capture the future path of monetary policy that is uncorrelated with the target surprise. In this study, all the analysis uses path surprise II instead of path surprise I to refer to the path surprise.

$$\textit{Path Surprise } I_t = \omega_0 + \omega_1 TS_t + ei \quad (4.6)$$

Then  $ei$  is replaced by Path surprise II:

$$\textit{Path Surprise } I_t = \omega_0 + \omega_1 TS_t + \textit{Path surprise II} \quad (4.6. a)$$

The results of regression model (4.6) is shown in Table 3 panel A. The basic statistics of target surprise and path surprise are shown in Table 3 panel B. Table 3 panel C illustrates the target surprise and path surprise together on the dates of FOMC announcement from 01/Jan/1997 to 30/Jun/2013. The largest target surprise occurs on 16/December/2008 while the two largest path surprises were at the end of 2008. However, from November 2009, the target surprise becomes smaller, reflecting the fact that the FOMC-targeted Federal fund rate was stable around 0.00 to 0.25 during this period and market participants expected that the FOMC would not change this target rate. In the meanwhile, , the path surprise has still experienced large fluctuation since 2009.

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#### 4.2. Model

We will first address the question as to whether stock markets in Southeast Asia respond to information in the FOMC announcement by looking at the volatility of overnight return in section 3.3. In this section, we will use the regression model to estimate the numerical impact of FOMC announcements on the stock markets in five selected Southeast Asian countries. The overnight return is regressed on target surprise and path surprise

$$\mathbf{Overnight\ Return} = \alpha + \beta_1 TS_t + \beta_2 PS_t + \varepsilon_i \quad (4.7)$$

The time-series data of five nations is regressed separately. Being that the main purpose of this study is to examine whether overnight return depends on target surprise and path surprise on the FOMC announcement dates, some estimation methods such as OLS, GLS, and ARCH/GARCH should therefore be under consideration. At the starting point, the Ordinary least square (OLS) is used to estimate model (4.7). This estimation method has also been employed in the previous studies of Craine and Martin (2003), Bernanke and Kuttner (2005), Farka and Fleissig (2012). However, further testing of the assumptions of the Classical Linear Regression Model will then be conducted to examine whether the OLS is more appropriate than the GLS and ARCH/GARCH methods.

In order to analyse cross-country variation to Federal fund rate adjustment, observations from two countries have been pooled together to regress model (4.8).

$$\mathbf{R}_t = \alpha + \beta_1 TS + \beta_2 D_{i,t} + \beta_3 D_{i,t} TS + \varepsilon_i \quad (4.8)$$

$D_{i,t}$  as the dummy variable is equal to one for the observation of country  $i$  and zero otherwise. We can see that the difference in response of equity index to target surprise between two countries comes from  $\beta_3$ . Therefore, in order to test whether the response of a country to target surprise is statistically different from another, a null hypothesis is tested, where  $H_0: \beta_3 = 0$  and  $H_1: \beta_3 \neq 0$ .

Likewise, observations from the two countries are pooled together to regress model (4.9) to test whether the response of equity index to path surprise between two countries differs.

$$\mathbf{R}_t = \alpha + \beta_1 PS + \beta_2 D_{i,t} + \beta_3 D_{i,t} PS + \varepsilon_i \quad (4.9)$$

Lastly, we will test whether there is any statistically difference in impact of the FOMC announcement on Southeast Asian stock price indexes between two recent crises since 1990's by undertaking the following. For the 1997 Asian financial crisis and recent sub-prime financial crisis, the data sample of each country is divided into three sub-sample: data from 01/1997 to 12/1998 represents the period of the 1997 Asian financial crisis, while the period from 08/2007 to June/2013 represents data for the recent sub-prime financial crisis. The remaining data is from 01/1999 to 07/2007.

This dividing sample is based on some important milestones in Southeast Asian stock market. The first crisis is marked from Jan/1997, when the Thai baht started to depreciate sharply, until 01/1999, when tax revenue increased in some Southeast Asian countries, allowing these countries to balance their budget and repay their debt to the IMF (Chakrabarti and Roll, 2012). In the meantime, the current sub-prime crisis affects Southeast Asia market with a milestone on August 9, 2007, when BNP Paribas terminated withdrawals from three hedge funds, leading to a crash-effect in Southeast Asian markets (Fidrmuc and Korhonen, 2010).

Here, two dummy variables,  $D_1$  and  $D_2$ , are used.  $D_1$  is equal to one if the announcement in the period from 01/01/1997 to 31/12/1998 and zero otherwise.  $D_2$  is equal to one if the announcement in the period from 30/09/2008 to June/2013 and zero otherwise. The regression model for target surprise is performed as follow:

$$\mathbf{R}_t = \alpha + \beta_1 D_1 + \beta_2 D_2 + \beta_3 TS + \beta_4 D_1 TS + \beta_5 D_2 TS + \varepsilon_i \quad (4.10)$$

Likewise, the regression model for the path surprise is performed:

$$R_t = \alpha + \beta_1 D_1 + \beta_2 D_2 + \beta_3 PS + \beta_4 D_1 PS + \beta_5 D_2 PS + \varepsilon_i \quad (4.11)$$

In each model, a null hypothesis is tested in order to compare the response of each market in two crises, where  $H_0: \beta_4 = \beta_5$  and  $H_1: \beta_4 \neq \beta_5$ . If the null hypothesis is rejected, we can conclude that the impact of FOMC announcement is statistically different between the two crises.

## 5. Empirical result and discussion

### 5.1. Response of equity index to target surprise and path surprise

Equation (4.7) tests numerically whether stock markets in Southeast Asia respond to the information in FOMC announcement. Table 4 shows the results of this regression. All the coefficients estimated for target surprise are negative. A 100-basis point increase in the Federal fund rate leads to a 13.7 percent decrease in overnight return in Singapore stock indexes. These numbers in Malaysia and the Philippines are 8.6 and 9.4 percent, respectively. In the meanwhile, the Stock Exchange of Thailand Index and Jakarta Composite Index respond at the least with around a 6 percent decline following an unanticipated 100-basis point increase in Federal fund rate. However, in terms of path surprise coefficient from the regression model, there is no common trend. In Malaysia and the Philippines, a hypothetical 100-basis-point surprise downward revision on the future path of monetary policy is associated with a 1.3 and 2.8 percent decrease, respectively, in overnight return. On the other hand, a 5.4 percent increase in overnight return follows a 100-basis-point surprise downward of expected monetary policy in Singapore's stock markets. The Thai and Indonesian markets have a weaker response to path surprise, with 1.4 and 0.4 percent increase, respectively, follows 100-basis-point path surprise downward.

Then P-value of both target surprise and path surprise are then examined across all five Southeast Asian markets to test the significance of independent variables in equation (4.7). At a level of significance 5%, it is concluded that all five Southeast Asian markets do respond statistically to Federal Fund rate shocks. On the other hand, the null hypothesis that Southeast Asian markets do not respond to path surprise cannot be rejected, except for the Singapore market. It can be concluded that any shocks in the Federal fund rate will immediately affect Southeast Asian equity overnight return, while the effect of path U.S future monetary policy is fuzzy. Overall, doing regression of five samples of stock index in model (4.7), the R-square

value ranges from 9.8 percent to 24.06 percent. In comparison with previous similar models of studies about response of Global stock index to FOMC announcement (Wongswan, 2009; Farka and Fleissig, 2012), these values are a good fit for a stock regression analysis. As explained by Jon (2005), the stock return on a day can be explained by many determinants and macroeconomic policy is only one of these. In order to examine the response of stock return to FOMC announcement, it should concentrate on the statistical significance of predictors, rather than looking at the R-square value.

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### **5.1.1. Robustness of the result**

Some tests are then conducted to investigate the robustness of the OLS method used in regression (4.7). The two important assumptions of the Classical Linear Regression Model should be concerned in data sample are Homoskedasticity and Serial Independence.

Firstly, White's test is executed for Heteroskedasticity. Table 5 shows the F statistic of the test and Prob. F (5,126) value. At level  $\alpha = 1\%$ , the hypothesis of heteroscedasticity existence can be rejected in all five countries.

Secondly, the Breusch–Godfrey test is executed for autocorrelation. The F statistics and Prob. F (5,126) are shown in table 5. The table shows that all the p – values are greater than 5%, except for Singapore. Therefore, we see no autocorrelation in the data sample of Thailand, Malaysia, Indonesia and the Philippines.

Finally, testing for ARCH effects is executed to determine whether volatility clustering exists in the data sample. The F statistics and Prob. F(5,121) are shown in table 5. The p – values of the five nations are greater than 5%, so ARCH(5) effects are not present.

To conclude, homoskedasticity and serial independence assumptions are satisfied in almost all the data samples, except for heteroskedasticity in the Thailand data and autocorrelation in the Singapore data. However, the purpose of this study is only to examine whether there are relationships between overnight return on FOMC announcement dates and target surprise and path surprise. Hence, the OLS estimation is still an appropriate method over GLS and ARCH.

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## 5.2 Analyse cross-countries variation to the surprises

The results from previous analysis raise the question as to whether the response of one country to target surprise and path surprise are statistically different than other countries. In other words, are there cross-country response differences? To do this, the Ordinary least square (OLS) is used to estimate equation (4.8) and (4.9). Each pair of countries data is pooled together to run the model. If  $\beta_3$  is statistically significant, it can be concluded that these two countries do respond statistically differently to the FOMC announcement because this study includes 5 Southeast Asian markets, while there are 10 pairs of countries examined. Table 6 shows that the result of cross-countries responds to target surprise and path surprise. Table 6 panel A indicates that, at a level of significance 5%, there is no statistically difference in the response of each pairs of countries to target surprise because the p-value of  $\beta_3$  is greater than 0.05.

However, an exception can be observed in the pairs Singapore and the Philippines, where the  $\beta_3$  p-value is 0.006. On the other hand, from Table 6 panel B, we can see that almost every country's responses to path surprise are statistically different from each other. There are 9 out of 10 pairs having a p-value of  $\beta_3$  less than 0.05. Singapore and Indonesia are only two markets that respond similarly to path surprise.

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## 5.3. Response of Southeast Asian markets to FOMC announcement in two financial crises

The last analysis section examines the response of Southeast Asian equity index to the FOMC announcement during the two financial crises: the 1997 Asian financial crisis and the recent sub-prime financial crisis. Table 6 illustrates t-test for hypothesis  $H_0: \beta_4 = \beta_5$  and  $H_1: \beta_4 \neq \beta_5$  of regression model (4.10) and (4.11) across five countries. If absolute value of  $t = \frac{\beta_4 - \beta_5}{\sqrt{\text{var}(\beta_4) + \text{var}(\beta_5) - 2\text{COV}(\beta_4, \beta_5)}}$  is greater than t-critical value, then the null hypothesis will be rejected, or we can conclude that the response to surprise was different between the two crises. From Table 7 panel A, it can be seen that at a level of significance 5%, almost Southeast Asia markets do response not statistically different to target surprise in two crises. The absolute t-value in Thailand, Singapore, Malaysia and the Philippines are less than critical t-value 1.96. However, there is an exception; the Jakarta Composite Index in Indonesia responds to target surprise differently between two crises. The absolute t-value of Indonesia is 1.975. In terms of the path surprise, Table 7 panel B shows the comparison of stock markets respond to this

surprise in two crises. From the t-test in Table 7B, it is concluded that at the level of significance 5%, the path surprise affects Southeast Asian equity index, not statistically differently between the 1997 Asian financial crisis period and the current sub-prime financial crisis period. The absolute t value shown in Table 7B ranges from 0.006 to 0.86 and it is less than the critical t-value 1.96.

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#### **5.4. General discussion of the result**

By looking at the volatility of equity return on days with and without FOMC announcements, we have documented that Southeast Asian market did respond to the FOMC announcement. This result is also supported by the other literature. According to Fischer and Ranaldo (2011), although Southeast Asian equity was formed later than other markets in the world, the U.S capital is currently highly mobile across this region. Therefore, all the information about the U.S interest rate included in the FOMC announcement will affect their equity market. Tillmann (2011) has come to the same conclusion that the FOMC announcement affects the Southeast Asian equity index and has explained this effect through foreign assets price channel.

We have confirmed that target surprise, Federal fund rate adjustment will immediately affect Southeast Asian equity overnight return, while the effect of the path of U.S. future monetary policy is fuzzy. This finding may be due to the reality that each country's interest rate is related to its central bank's policy rate, while the policy rate is linked to the general global business cycle in which the U.S. economy plays an important role (Wongswan, 2009). Moreover, Southeast Asian economies are increasingly interconnected to the world economy. Therefore, an increase in target Federal fund rate means that the target surprise is positive, leading the interest rate in Southeast Asian countries to go up and resulting in devaluating the firm's value.

However, regarding the impact of path surprise, there is no unified explanation of its transmission. According to Kurov (2012), when the future path of monetary policy is optimistic, then the world economy prediction is also optimistic. In this case, the Eurodollar future rate will increase, resulting in a positive path surprise. This will lead to an increase in the global stock index. Thus, the coefficient between path surprise and equity index performance must be positive. The Malaysian and the Philippines stock market performance supports this perspective.

On the other hand, Nikkinen and Sahlstrom (2004) state that when the future path of monetary policy is pessimistic, this means that path surprise is negative and investors will seek other investment opportunities in other markets; therefore, the overseas stock index there will go up. This results in a negative coefficient between equity index performance and path surprise. Thailand, Singapore and Indonesia are examples of this phenomenon. In addition, while target Federal fund rate affect short-run macroeconomics variables, the effect of the path of monetary policy is in the long-run and there is a delay of equity markets' responses to path surprise. This supports our finding that information about the target Federal fund rate has more impact on all five stock markets than the revision about the U.S. future monetary policy.

Following the analysis of the cross-countries' variation in the surprises, different Southeast Asian equity markets respond similarly to the target Federal fund rate, while the responses to monetary policy differ from each other. According to Stefano (2002), the degree of economic integration with the U.S. economy determines the effect of path surprise on domestic equity, while the degree of financial integration with the U.S financial markets influences the response of domestic equity to target surprise. This suggests that financial markets in Southeast Asia have the same degree of integration with the U.S financial markets.

However, the degree of economics integration varies across countries. Singapore might be an example to highlight where the equity index is more sensitive to both surprises than other markets do. A hypothetical 100-basis-point path surprise downward leads an increase of 5.4 percent in Singapore index, but the response of other markets is less than +/-2.5percent. In Southeast Asia, Singapore is considered the most dynamic and integrated economy in the region (Kang, 2009). Singapore is a member of numbers of regional economic blocs such as ASEAN, AFTA, NAFTA and APEC, which has facilitated the economic integration of Singapore with the region and the world and the U.S. Singapore is ranked first for having the most open economy for international trade and investment (World Economic Forum, 2010). It is the best business environment worldwide (World Bank, 2010) and the world's third easiest place to do business (IMD, 2011). This evidence supports the empirical result indicating the most sensitive response of Singapore index to the U.S economy compared with other countries in the region.

The last analysis compares the response of the Southeast Asian equity price indexes to the FOMC announcement in the two financial crises: the 1997 Asian financial crisis and the recent sub-prime financial crisis. The way these two crises affect Southeast Asian stock markets are not the same. In the 1997 Asian financial crisis, contractionary monetary and fiscal policies are implemented in almost all the nations of Southeast Asia together to support the



exchange rate. On the other hand, in the recent sub-prime financial crisis, most central banks actions are providing liquidity in financial markets to prevent disruption and contagion among financial institutions. Although these two crises affect Southeast Asian stocks markets through different transmission channels and different macro-policies are implemented, the impact of target surprise and path surprise is not statistically different between the two periods.

## **6. Conclusions**

The study of the effect of the Federal Open Market Committee (FOMC) announcements, which include information about the target Federal fund rate and the revision to the future path of monetary policy on Southeast Asian stock price indexes has been largely ignored in the literature. The understanding of the response of the Southeast Asian stock markets to target surprise and path surprise, and the impact of each surprise in different time periods, would be important to investors and encourage further discussion amongst academics in Southeast Asia, where stock markets have been emerging in recent years.

This paper has used a sample of five national equity market indexes over the period 1997-2013 that covers 132 scheduled FOMC meetings. We have developed the model of Wongswan (2009) and Kontonikas et al. (2013) to quantify target surprise and path surprise. The main questions raised have examined the following. First, does the FOMC announcement affect stock performance in Southeast Asian countries? Second, to what extent does Federal Fund rate adjustment and the future path of monetary policy in FOMC announcement affect stock markets? Third, is the effect of FOMC announcement on Southeast Asian markets different between the 1997 Asian financial crisis and the current sub-prime financial crisis?

The empirical results lead us to conclude with four findings. First, all the stock markets examined do respond to information in the FOMC announcements. Second, the target Federal fund rate has more impact on Southeast Asian stocks performance than information about the future path of monetary policy. Third, different Southeast Asian equity markets respond similarly to the target Federal fund rate, yet the responses to monetary policy differ from each other. Finally, the response is not statistically different in the two periods of financial crisis.

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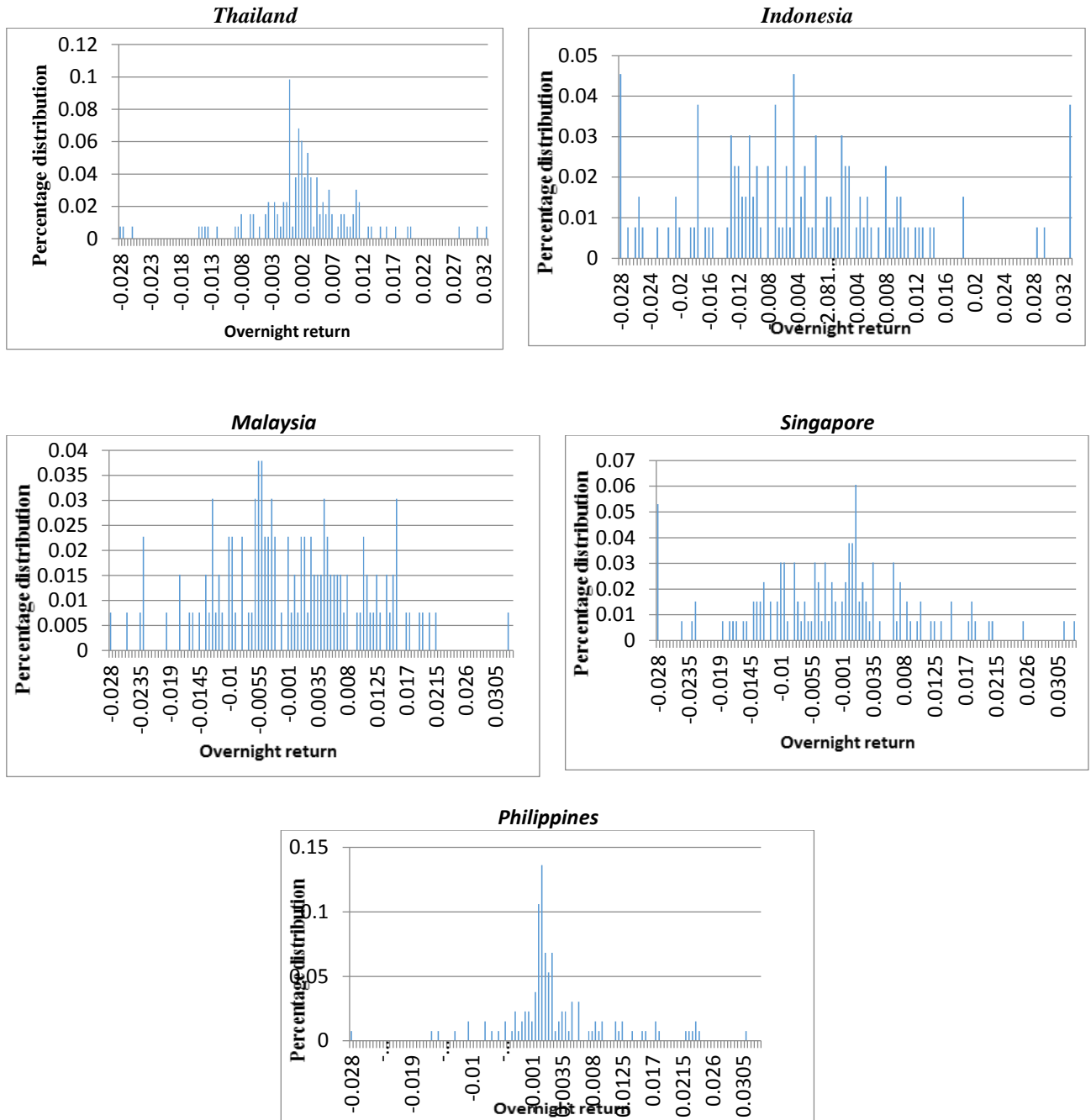
**Table 1: Summary statistics of overnight return**

The table reports mean and standard deviation of overnight return in five selected Southeast Asian stock markets from 01/Jan/1997 to 30/Jun/2013. All data is derived from Data Stream software. Overnight return is computed from the closing price index prior to FOMC announcement and thirty-minute opening price index on the following day. Panel A compare those return on the days FOMC announces statement and on days without FOMC announcements. Panel B test statistically difference of volatility. The hypothesis tested is that the variance of overnight return on FOMC announcement days are equal to non FOMC days. At a level of significance 5% and F critical value is 1.24, we can reject the null hypothesis.

Statistics	Country				
	Thailand	Indonesia	Malaysia	Singapore	Philippines
<b>Panel A: Statistics of overnight return</b>					
FOMC announces day					
<i>Mean</i>	0.002128	-0.004164	-0.000683	-0.003356	0.002351
<i>Standard deviation (<math>\sigma_1</math>)</i>	0.008826	0.016226	0.011095	0.013281	0.008199
Non – FOMC days					
<i>Mean</i>	0.001322	-0.000790	0.000249	0.000386	0.000233
<i>Standard deviation (<math>\sigma_2</math>)</i>	0.007156	0.013248	0.008456	0.008214	0.005925
<b>Panel B: Test statistically difference of volatility</b>					
$\sigma(1)^2 / \sigma(2)^2$	1.520937	1.499942	1.721215	2.613894	1.914639
Observations (FOMC, non –FOMC)	(132, 4169)	(132, 4160)	(132, 3925)	(132, 4056)	(132, 4158)
Critical F (5% level of significance)	1.24	1.24	1.24	1.24	1.24
Hypothesis $\sigma(1)^2 = \sigma(2)^2$	Reject	Reject	Reject	Reject	Reject

**Table 2:** Distribution of overnight return on FOMC announcement days

This table illustrates distribution of overnight return on FOMC announcement days in Thailand, Singapore, Malaysia, Indonesia and the Philippines, from 01/Jan/1997 to 30/Jun/2013. Generally, the shape of distribution in almost Southeast Asian countries is symmetrical with a single central peak at the mean of the data. However, there is an exceptional where Malaysia overnight return distribution concentration is around mean  $\pm 5\%$ .



**Table 3: Summary of target surprise and path surprise**

Table 3 reports summary of target surprise and path surprise. Target surprise is the change in implied rate of Federal future contract between 10 minutes before and 20 minutes after FOMC releasing statement. Path surprise I is quantified as the change in implied rate of one-year ahead Eurodollar future between 10 minutes before and 20 minutes after FOMC releasing statement. All data is derived from Data Stream software. Path surprise II is innovation derived by running a regression Path surprise I on the target surprise and a constant. Panel A shows result of regression path surprise I on target surprise. (\*) is standard error. Panel B shows summary statistics of target surprise, path surprise I and path surprise II. Panel C illustrate path surprise and target surprise together on FOMC announcement days.

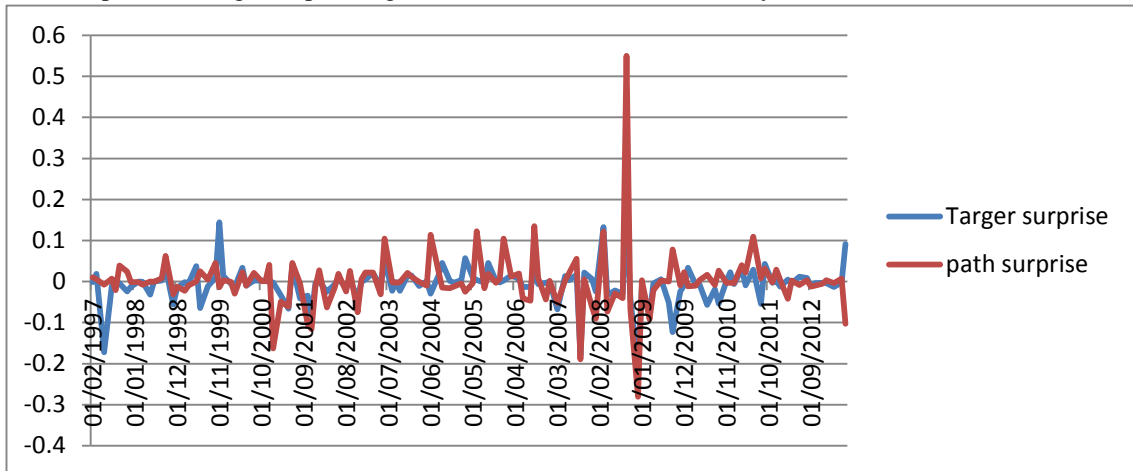
**Panel A: Regression result of path surprise I on Target surprise**

Variables	Intercept	Target surprise	R - square
	0.031 (0.0064)*	0.4815 (0.0955)*	0.1633

**Panel B: Summary statistics of target surprise, path surprise I and path surprise II**

Variables	Target surprise	Path surprise I	Path surprise II
Mean	0.005846	-0.003412	-1.682.E-18
Standard deviation	0.045995	0.078458	0.071765
Median	-0.002671	-0.001253	-0.000834
Range	0.382355	.0907525	0.831111
Minimum	-0.207128	-0.372145	-0.281026
Maximum	0.175221	0.537514	0.550084

**Panel C: Path surprise and target surprise together on FOMC announcement days**



**Table 4: Regression results**

The sample covers 132 scheduled FOMC meetings from 01/Jan/1997 to 30/Jun/2013. Overnight return (dependent variable) is computed from the closing price index prior to FOMC announcement and thirty-minute opening price index on the following day. Target surprise is the change in implied rate of Federal future contract between 10 minutes before and 20 minutes after FOMC releasing statement. Path surprise is quantified as the change in implied rate of one-year ahead Eurodollar future between 10 minutes before and 20 minutes after FOMC releasing statement. All data is derived from DataStream. Ordinary least square (OLS) is used to estimate model, p-values in parenthesis. \*, \*\*, and \*\*\* denotes 10, 5 and 1 percent significant levels.

<i>Variables</i>	<i>Country</i>				
	Thailand	Singapore	Malaysia	Indonesia	Philippines
Intercept	0.0017** (0.017)	-0.0042*** (0.000)	-0.0012 (0.207)	-0.0045*** (0.001)	0.0018*** (0.007)
Target Surprise	-0.0661*** (0.000)	-0.1371*** (0.000)	-0.0856*** (0.001)	-0.0592* (0.094)	-0.0945*** (0.000)
Path Surprise	-0.0142 (0.235)	-0.0549** (0.016)	0.0136 (0.387)	-0.0049 (0.775)	0.0287*** (0.010)
Adj. R-square	0.177	0.241	0.098	0.133	0.193

**Table 5: Testing assumption**

<i>Test</i>	<i>Country</i>				
	Thailand	Singapore	Malaysia	Indonesia	Philippines
<i>White's test:</i>					
F statistics	2.9573	0.3489	0.4783	0.6738	0.0944
Prob. F (5,126)	0.0147	0.8821	0.7918	0.6440	0.9929
<i>Breusch–Godfrey:</i>					
F statistics	0.5914	3.7581	1.5632	0.8357	0.8526
Prob. F(5,124)	0.7065	0.0033	0.1754	0.8228	0.8407
<i>Arch (5) test:</i>					
F statistics	0.1784	0.8780	0.8374	0.1183	1.5812
Prob. F(5,121)	0.9702	0.4981	0.5256	0.9881	0.1704

Table 5 shows the results of White's test, Breusch-Godfrey and Arch (5) test to assess whether autocorrelation, Heteroskedasticity, and Arch effect exists in regression model (4.7).

**Table 6: Test of cross-countries variation to the surprises**

Table reports test of cross-countries variation to the surprises. Each pairs of countries data is pooled together to run model (4.8) and (4.9). If  $\beta_3$  is statistically significant, it can be concluded that these two countries do response statistically differently to surprises in FOMC announcement. Panel A reports P-value of  $\beta_3$  in testing cross-countries variation to target surprise. Panel B reports P-value of  $\beta_3$  in testing cross-countries variation to path surprise.

<b>Panel A: P – value of <math>\beta_3</math> of regression model (4.8) test cross-countries variation to target surprise</b>					
	Thailand	Malaysia	Indonesia	Singapore	The Philippines
Thailand		0.8430	0.3782	0.2000	0.6537
Malaysia	0.8430		0.3367	0.2376	0.3956
Indonesia	0.3782	0.3367		0.3618	0.2380
Singapore	0.2000	0.2376	0.3618		0.0064
The Philippines	0.6537	0.3956	0.2380	0.0064	

<b>Panel B: P – value of <math>\beta_3</math> of regression model (4.9) test cross-countries variation to path surprise</b>					
	Thailand	Malaysia	Indonesia	Singapore	The Philippines
Thailand		0.0220	0.0445	0.0375	0.0235
Malaysia	0.0220		0.0110	0.0403	0.0010
Indonesia	0.0445	0.0110		0.3737	0.0010
Singapore	0.0375	0.0403	0.3737		0.0082
The Philippines	0.0235	0.0010	0.0010	0.0082	

**Table 7: Test of stock response in two financial crises**

Table reports t-test for hypothesis  $H_0: \beta_4 = \beta_5$  and  $H_1: \beta_4 \neq \beta_5$  of regression model (4.10) and (4.11) across five countries. Data sample of each country is divided into three sub – sample: data from 01/1997 to 12/1998 represents period of 1997 Asian financial crisis, period from 08/2007 to June/2013 represents data for the recent sub-prime financial crisis. The remaining is data from 01/1999 to 07/2007. If absolute value of  $t = \frac{\beta_4 - \beta_5}{\sqrt{\text{var}(\beta_4) + \text{var}(\beta_5) - 2\text{COV}(\beta_4, \beta_5)}}$  is greater than t-critical value, null hypothesis will be rejected, or we can conclude that response to surprise is different between two crises. Panel A shows result of t-test in response of each country to target surprise in different time period. Panel B shows result of t-test in response of each country to path surprise.

	<b>Panel A: Response to target surprise</b>		<b>Panel B: Response to path surprise</b>	
	Adj. R <sup>2</sup>	$t = \frac{\beta_4 - \beta_5}{\sqrt{\text{var}(\beta_4) + \text{var}(\beta_5) - 2\text{COV}(\beta_4, \beta_5)}}$	Adj. R <sup>2</sup>	$t = \frac{\beta_4 - \beta_5}{\sqrt{\text{var}(\beta_4) + \text{var}(\beta_5) - 2\text{COV}(\beta_4, \beta_5)}}$
Thailand	0.1839	-1.1160	0.0911	-0.8587
Indonesia	0.1704	-1.4659	0.0398	0.7826
Malaysia	0.1487	-1.9750	0.0950	0.7269
Singapore	0.2537	0.5281	0.0865	-2.3836
Philippines	0.1742	0.2219	0.0459	-0.7421