HETEROGENEITY OF THAI STOCK REACTION TO U.S. FEDERAL RESERVE AND EUROPEAN CENTRAL BANK MONETARY POLICY ANNOUNCEMENTS

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กิ่งไผ่ คู่สกุลนิรันดร์ : ความแตกต่างของการตอบสนองของหุ้นไทยต่อการประกาศนโยบายการเงินของธนาคารกลางสหรัฐอเมริกาและธนาคารกลางยุโรป. (HETEROGENEITY OF THAI STOCK REACTION TO U.S. FEDERAL RESERVE AND EUROPEAN CENTRAL BANK MONETARY POLICY ANNOUNCEMENTS) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : อ. ดร.พรพิชยา กุวลัยรัตน์, อ. ที่ปรึกษาวิทยานิพนธ์ร่วม : อ. ดร.อนิรุต พิเสฏฐศลาศัย, 72 หน้า.

บทวิจัยนี้ศึกษาถึงผลกระทบของการประกาศนโยบายการเงินของธนาคารกลางสหรัฐฯ (Fed) และธนาคารกลางยุโรป (ECB) ที่มีต่อหลักทรัพย์ของไทย ผลการศึกษาพบว่าเมื่อมีการลดอัตราดอกเบี้ยนโยบายของธนาคารกลางสหรัฐฯ 1% โดยที่ตลาดไม่คาดคิด จะมีผลให้ดัชนีตลาดหลักทรัพย์แห่งประเทศไทยเพิ่มขึ้นโดยเฉลี่ย 4.25% ผลการศึกษาต่อมาพบว่าหุ้นแต่ละภาคอุตสาหกรรมและหุ้นแต่ละกลุ่มลักษณะมีการตอบสนองในระดับที่แตกต่างกันต่อการประกาศนโยบายการเงิน โดยหุ้นในกลุ่มธุรกิจการเงินตอบสนองต่อการเปลี่ยนแปลงดอกเบี้ยโดยไม่คาดคิดของธนาคารกลางสหรัฐฯ มากที่สุด ตามด้วยกลุ่มสินค้าอุตสาหกรรม กลุ่มทรัพยากร และกลุ่มอสังหาริมทรัพย์และก่อสร้าง สาเหตุที่กลุ่มธุรกิจการเงินตอบสนองมากที่สุดนั้นน่าจะเป็นเพราะหุ้นในกลุ่มอุตสาหกรรมเหล่านี้มีความผันผวนตามเศรษฐกิจและต้องใช้เงินลงทุนสูง ซึ่งความต้องการของสินค้าและที่มาของเงินทุนมีความอ่อนไหวต่อการเปลี่ยนแปลงของอัตราดอกเบี้ย ส่วนลักษณะของหลักทรัพย์ส่งผลต่อความแตกต่างในการตอบสนองมากที่สุดคือ CAPM beta โดยกลุ่มที่ CAPM beta ต่ำจะตอบสนองต่ำกว่าค่าเฉลี่ย โดยผลที่พบอาจอธิบายได้ว่านโยบายของธนาคารกลางสหรัฐฯนั้นส่งผลต่อความเสี่ยงที่เป็นระบบ (systematic risk) ของตลาดหลักทรัพย์ไทย นอกจากนี้ บทวิจัยนี้ยังได้ศึกษาถึงความแตกต่างของการตอบสนองนี้ในช่วงสภาพเศรษฐกิจที่ต่างกัน พบว่าหุ้นไทยนั้นตอบสนองอย่างมีนัยสำคัญต่อการประกาศดอกเบี้ยนโยบายเฉพาะในช่วงที่สหรัฐประสบภาวะเศรษฐกิจถดถอยเท่านั้น สำหรับผลกระทบจากธนาคารกลางยุโรปนั้น จากผลการศึกษาในระดับดัชนีและกลุ่มอุตสาหกรรม ไม่พบผลที่มีนัยสำคัญ ลักษณะของหลักทรัพย์เพียงอย่างเดียวที่ส่งผลต่อการตอบสนองคือการส่งออก โดยกลุ่มส่งออกตอบสนองไปในทางบวกต่อการลดดอกเบี้ยมากกว่ากลุ่มที่ไม่เกี่ยวข้องกับส่งออก เหตุผลอาจเป็นเพราะการลดดอกเบี้ยทำให้อุปสงค์ของสินค้าในตลาดโลกมากขึ้น ซึ่งทำให้ความต้องการสินค้าส่งออกเพิ่มขึ้น

ภาควิชา การธนาคารและการเงิน ลายมือชื่อนิสิต.....

สาขาวิชา การเงิน ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

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KINGPAI KOOSAKULNIRUND: HETEROGENEITY OF THAI STOCK REACTION TO U.S. FEDERAL RESERVE AND EUROPEAN CENTRAL BANK MONETARY POLICY ANNOUNCEMENTS. ADVISOR : PORNPITCHAYA KUWALAIRAT, Ph.D., CO-ADVISOR : ANIRUT PISEDTASALASAI, Ph.D., 72 pp.

This paper analyzes the impact of Fed's and ECB's monetary policy announcements on Thai stocks. For the Fed's effect, I find that a 1% unexpected cut of Fed fund rate associates with 4.25% increase in SET index. Further evidence also shows substantial degree of heterogeneity in reaction of stocks in different sector and stocks with different characteristic. The most sensitive sector to Fed's surprise is the financial sector, followed by industrials, resources, and property and construction. These sectors' reaction is highly responsive because they are cyclical and capital-intensive sector, in which their product demand and source of fund are interest-sensitive. For the stock characteristic, CAPM beta is a factor of heterogeneity in reaction; the low-beta group is less responsive than the middle-beta group. This finding suggests that U.S. monetary policy is a risk factor in Thai equity market. Furthermore, the reaction of Thai stock market to Fed's surprise is not asymmetry across different state of U.S. economy. Thai stock reacts to Fed's surprise only in the period of U.S. recession. For the ECB, I find no significant reaction on SET index, neither on sector level. The only characteristic that seems to affects stock reaction is the export dummy. In comparison to the none-export firms, export firms reacts in more negative way to unexpected increase in ECB's policy rate. As a decrease in interest rate stimulate world aggregate demand, demand for export also increase.

Department : Banking and Finance	Student's Signature
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Contents

List of Tables

List of Figures

CHAPTER I
INTRODUCTION

1.1 Background and Problem Review

Central banks announcements and their monetary policies are one of the most important policy actions. The news, especially the unexpected ones, such as unexpected increase or decrease in the policy rate, would have a profuse effect on the economy and one of the most apparent effects is the effect on capital markets. There are many studies that document the effect of monetary policy announcements on domestic equity markets and its mechanism such as Ehrmann and Fratzscher (2004) and Bernanke and Kuttner (2005) for US market, and Bohl, Siklos, and Sondermann (2008) for European market. They find that stock markets react negatively to unexpected increase in policy rate.

However, the effect does not limit to only domestic equity market. The monetary policies of major central banks such as Fed and ECB also have spill-over effect to other countries' equity market as well. Johnson and Jensen (1993), Hausmann and Wongswan (2006), Ehrmann and Fratzscher (2006), Wongswan (2009) and Kim and Nguyen (2009) document that there are cross-country effect of both Fed and ECB monetary policies on foreign equity. On average, all stock market falls when there is an unexpected increase in Fed and ECB policy rate.

Some papers also study in more detail the differences in reaction to monetary policy between different stocks. The most recent study is Ehrmann and Fratzscher (2004), documents heterogeneity of U.S. stocks reaction to Fed monetary policy and reports that stocks with different characteristics such as size, industry affiliation and Tobin's q response differently to monetary policy announcement. For the cross-country studies, most researches focus on overall market indexes effect rather than investigate the effect in detail of sector and individual stock heterogeneity. To my knowledge, there has been only one research, Ehrmann and Fratzscher (2006) that studies the cross-country monetary policy effect in the sector level and none of the research studies this cross-country effect for heterogeneity of the reaction between different stock characteristics.

In addition, reaction of market index to monetary policy could also vary across different states of economy. Basistha and Kurov (2008) finds that there is significant cyclical variation in reaction of stock price to the monetary policy. They document that the size of U.S. stock market reaction to Fed's monetary news is larger in recession in comparison to the reaction in good economic times. However, the study documents this cyclical variation only on domestic stock. There is no study that examines this variation on foreign stock market.

Although there are a number of studies that document the reaction of stock market on monetary policy shock, there are only a few evidences that document the effect across country. Also in most of the cross-country studies, they only document the effect on overall market reaction. However, different stocks do not react to the monetary policy surprise in the same level. Some stock is highly responsive to the monetary surprise, whereas others do not react to such news. The question is that which kind of characteristics or industries that causes the stock to react more or less than other stocks. There had been no paper that examines this heterogeneity in reaction of monetary policy surprise effect to stocks market across countries. By investigating the source of heterogeneity, we could also have better understanding of how the monetary transmission across country takes path.

In this paper, I use Thai stock data as a subject of the study for cross-country monetary policy effect. As one of the emerging economies, Thailand significantly depends on the world markets; both in the good market and capital market. Thailand economy is often characterized as export-driven economy with the export of goods and service rising steadily from 58 % to 76 % of GDP in the 1999 to 2008 period[1]. Thus, its economy is highly dependent on the world economy. During that period, the US and EU were consistently being the major export markets of Thailand. In the capital market, Thailand depends on funds from other countries to finance domestic investment. In the same period, foreign direct investment increased steadily from 6.1 to 8.5 billion USD as measured in current USD. Net inflow for portfolio equity are mostly positive and rising from 0.9 billion USD in 1999 to 4.3 billion USD in 2007 with only net outflow of 3.2

[1] Source: The World Bank website: http://www.worldbank.org

billion USD in year 2008 due to the sub-prime crisis. All the indicators signify that Thailand does indeed depend and been much influenced by the world financial market. Therefore, the economic situations and monetary policies of the U.S. and EU would be major and vital factors for Thai economy and equity market. Ehrmann and Fratzscher (2006), Hausmann and Wongswan (2006), Kim and Nguyen (2009), and Wongswan (2009) document that unexpected increase in Fed policy rate of 100 basis point lead to a decrease of SET index of about 4.5%-6%.

This paper aims to contribute to this subject by further investigating how each stock in different sectors and different characteristics would react differently to Fed and ECB monetary policy shock using Thailand data. I divide the study of Fed and ECB monetary effect on Thai stocks into three levels; overall market level, sector level, and individual stock level. First, on the overall market level, I test for the magnitude of overall Thai stock market reaction to the shock of Fed and ECB policy announcement. Second, I test how each sector reacts differently, and find which sectors react more or less than others. Third, I test how the differences in individual stock reaction can be attributed to differences in stock characteristics such as size, foreign holdings, export revenue, and CAPM beta. Lastly, I also test for the asymmetry of stock reaction to Fed monetary policy between different economic situations.

1.2 Objectives of the Study

To investigate the impact of Fed and ECB's policy rate surprises on foreign stocks. This paper aims to answer the following questions;

1. To test whether unexpected changes in Fed and ECB's policy rate have a significant impact on SET index's return.
2. To test whether each sector react differently to the unexpected changes in Fed and ECB's policy rate and find which sector react more or less than others.
3. To test whether stocks with different characteristics react differently to the unexpected changes in Fed and ECB's policy rate as follows;
    3.1 To test whether stock of export firms react more than stock of non-export firms.

3.2 To test whether high-beta stocks react more than low-beta stocks.

3.3 To test whether stocks with high foreign holding react more than stocks with low foreign holding.

3.4 To test whether large stocks react more than small stocks.

4. To test whether there is any economic-cycle variation of the SET index's reaction to the unexpected changes in Fed's policy rate.

1.3 Research Hypotheses

Hypothesis 1

The foreign stock market react to the unexpected change in Fed's and ECB's policy rate through two channels; foreign asset price reaction and U.S./European asset price reaction, stated Ehrmann and Fratzscher (2006). For the effect from the foreign asset price reaction, the foreign country is affected from change in global interest rate. When there is an unexpected cut in Fed's or ECB's policy rate, global interest rate decrease. Kim (2001) explains that drop in the real interest rate increases the demand for current goods, current consumption and investment. As a result, foreign stock price is higher due to increase in cash flows and decrease in discount rates. For the U.S./European asset price reaction, when Fed's or ECB's policy rate unexpectedly decrease, there is a drop in domestic interest rate, therefore the demand for investment and consumption of U.S./European countries is higher. As a result, demand for foreign goods would also increase and the foreign stock market would react positively to an unexpected cut in Fed's or ECB's policy rate. Thus, I expect that the SET index return should increase when there is unexpected cut in Fed's or ECB's policy rates.

Hypothesis 2

As stocks in each sector are exposed to different risk factors, each sector should react differently to the monetary policy shock. Ehrmann and Fratzscher (2006) studies effect of U.S. monetary policy on foreign stocks and documents that technology stocks react most negatively to monetary policy surprises than stocks in other sectors whereas utility stocks react least negatively. The main explanation is that

capital intensive and cyclical sectors are affected more by the monetary policy as their products and source of fund are interest-sensitive. The result of Thai stock on sector reaction should be consistent with the result of Ehrmann and Fratzscher (2006) that cyclical and capital-intensive sector should react strongly to the monetary surprises. Note that in the case of Thai stock market, resource stocks are quite cyclical and capital intensive as their products not only serve basic facility for individual customers but also industries production. Moreover, technology sector in Thailand should not be classified as cyclical because the sector mainly includes communication stocks which are basic infrastructure and sales are not affected much from business cycle. Therefore, I hypothesize that cyclical and capital-intensive sectors, which are resources, industrials, property and construction should react more strongly to Fed and ECB's monetary policy surprises. I also expect that financial sector should also react strongly to the Fed and ECB's monetary surprises as the sector is highly sensitive to the interest rate level.

Hypothesis 3

To further clarify that stock with differences characteristics react in heterogeneity manner, I test for difference in reaction of stocks for each different level of stock characteristics.

3.1 Kim (2001) finds that a cut in Fed's policy rate leads to a decrease in global interest rate thus stimulates the world aggregate demand of goods and services for both U.S. and non-U.S. firms. Both exports and imports of both the U.S. and non-U.S. countries also increase. This would signal positive increase in cash flows of firms that their business involves export or receive revenue from foreign customers. Therefore, I hypothesize that stocks that are related to export and foreign revenues should react more positively to Fed and ECB's monetary policy rate cut than stocks that are non-export and foreign revenue related.

3.2 Wongswan (2009) shows that Fed monetary policy is one of the risk factors in foreign equity valuation. For foreign investors, when there is a decrease in Fed or ECB's policy rate, the expected domestic excess return (risk premiums) would increase. The higher CAPM beta would cause the effect to be larger. Therefore, I

hypothesize that high beta firms should react more positively to unexpected decrease in Fed and ECB's interest rate announcement than low beta firms.

3.3 A number of investors in Thai equity market are foreigners who are affected by monetary policy in their own countries. Thus, the change of monetary policy in the U.S. or Europe affects the amount and availability of their funds and subsequently the amount of funds invested in Thai equities. For instance, a cut in policy rate decrease real interest rate. The current investment demand is boosted up by lowering the opportunity cost of current investment. Therefore, investment in both the U.S. and non-U.S. countries may increase since the real interest rate fall in both the U.S. and non-U.S. countries. So I hypothesis that stocks with high level of foreign equity holding should response more positively to a surprise cut in Fed and ECB's interest rate announcement than stocks with low level of foreign equity holding.

3.4 Furthermore, the market capitalization of stocks is also important. McQueen, Pinegar, and Thorley (1996) documents that, comparing to large stocks, small stocks tend to have delay in reaction to news. In my study, I use daily stock return on the day after the announcement to examine the impact of foreign monetary policy news. As the period of study is quite short, the news might be better captured by large stock reaction. Therefore, I hypothesize that large stocks should response more negatively to a surprise increase in Fed or ECB's interest rate announcement than small stocks.

Hypothesis 4

Although McQueen and Roley (1993) and Andersen, Bollerslev, Diebold and Vega (2005) do not find that firm's reaction to monetary policy news is economic-state dependent, Basistha and Kurov (2008) who use longer period of study find that there is significant cyclical variation in reaction of stock price to the monetary policy. As there is reduction in availability of credit and adverse effect of balance sheet during the recession, the reaction of stock price to monetary news is stronger during recession. In addition, Lim, Brooks and Kim (2008) finds that investor react more strongly not only to local news, but also to news in other market, (i.e. monetary news) during the crisis. Therefore, I expect that for Thai stock, the heterogeneity of Thai stock reaction may also

exist for different state of economy, and the reaction should be stronger during the recession.

1.4 Scope of the Study

This study use the daily stock returns data from the Stock Exchange of Thailand and the monetary policy announcements from Fed and ECB during 2002 to 2009 to examine the reaction of stocks in three level; overall market level, sector level, and individual stock level. The monetary policy announcements include 63 announcements from Fed, and 96 announcements from the ECB.

1.5 Contribution

To the best of my knowledge, this paper is the first one that studies the cross-country monetary policy effect in all three levels; overall market level, sector level, and individual stock level. There has been no previous study that documents the heterogeneity of domestic stock reactions to foreign monetary policy before. By looking at this heterogeneity in stock reaction and finding out what are the stock main characteristics that create this asymmetry in reaction, I can contribute to the gap in the literature about the effect of foreign monetary policy on domestic equities. Each characteristics point to different transmission mechanism, therefore by identifying the major factors, I can also shed more light to the important question about how the monetary policy transmit across country.

Moreover, as the study is on cross-country effect of Fed and ECB policy on Thai stock market which is considered as an emerging market and its stock market also depends much on foreign fund flows, I expect that the heterogeneity of the effect on sectors and characteristics would be able to explain mainly by those factors that are related to foreign fund flows. Therefore, I include the percentage of foreign holding as one of the major stock characteristics that may cause the heterogeneity. In addition, Thai economy also relies much on international trade, so I also include the percentage of foreign export to total revenue as another characteristic. To the best of my knowledge, these characteristics have never been used in other studies.

CHAPTER II

LITERATURE REVIEW

Monetary policy is the process by which the monetary authority of a country controls the supply of money, often targeting a rate of interest for the purpose of promoting economic growth and price stability. When there is a change on policy, interest rate moves, and thus transmitted to stock prices. Smirlock and Yawitz (1985) identify two stock valuation components which are affected by rate changes, and thus, may alter stock price through the change of investor expectations; 1) Rate changes may impact cash flow component of stock valuation as the cash flow projections change; and, 2) Rate changes may alter discount rate component as interest rate expectations change, and differ the rate used in discounting expected cash flows. The change in policy rate of major central banks such as Fed and ECB has effect on both domestic equity market and foreign equity market, but the effect pass through different channels. For the domestic market, Bernanke and Kuttner (2005) shows that the response of stock prices is driven by the impact on expected future excess returns, as well as expected future dividends. For cross-country market, Wongswan (2009) shows that the reaction mainly passes through discount rate component.

There are two strands of the literature that study the effect of monetary policy; first, the literature on domestic market effect, and second, the literature on cross-country market effect.

2.1 Monetary Policy Effects on Domestic Stock Markets

Bernanke and Blinder (1992), and Kashyap, Stein and Wilcox (1993) explain that when the central bank tightens its monetary policy, banks reduce their overall supply of credit. Thus, firms that are highly bank dependent are strongly affected. Bernanke and Gertler (1989), and Kiyotaki and Moore (1997) give further argument that, as credit market condition is worsen, present value of firms collateral also falls with rising interest, so obtaining external funds becoming more difficult. In this case, firms have to cut their investments and working capital. As a result, expected future

cash flows would be diminished because supply of their goods is in constraints. This channel of monetary policy transmission is called credit channel. Another way that stock prices response to monetary policy is related to the response of the demand for firms' products. Ehrmann and Fratzscher (2004) explain that firms whose products are highly cyclical or interest-sensitive would be largely impacted by changes in policy rate. This transmission channel is called interest rate channel. Both credit channel and interest rate channel link the change in policy rate to the cash flow component of stock valuation. For the discount rate component, the tightening monetary policy causes the required rate of return of investors to increase, and finally also have negative effect on stock price.

The degree of monetary policy effect on domestic stock market is documented in several studies. In the U.S., recent researches included Ehrmann and Fratzscher (2004) which analyses the effect of Fed's monetary policy on U.S. equity market during 1994 to 2003. They find that a surprise monetary tightening of 100 basis points lower equity market returns by 5.5%. This is similar to the finding of Bernanke and Kuttner (2005) who finds the effect to be 5.3%, and Rigobon and Sack (2004) who estimates a 6.2% effect, using similar indices and time periods. One of the latest studies, Wongswan (2009) who measures index return using intraday instead of daily data, also document similar result of 4.26% effect during 1998 to 2004. In Europe, the finding of Bohl, Siklos, and Sondermann (2008) also indicate a significant negative response of European stock returns to monetary policy shocks induced by ECB. European stock markets fall between 5.69% and 9.17% on the day when an unanticipated interest rate hike of 100-basis points.

2.2 Monetary Policy Effects on Foreign Stock Markets

Further to the domestic impact, monetary policy of one country, especially from those major central banks such as Fed and ECB, could also spillover to other countries' financial market. Johnson and Jensen (1993) suggest that Fed has a significant influence on economic condition not only in the U.S., but also in foreign countries. In principle, there are many ways to explain the linkage between Fed and ECB monetary policy and foreign stock prices. Ehrmann and Fratzscher (2006) link the

effect from Fed's policy on foreign equity market through two paths; via U.S. asset price reaction and foreign asset price reaction.

For the U.S. asset price reaction, the effect depends on how the U.S. asset prices themselves react to Fed's monetary policy shock. For example, a tightening monetary policy effect on U.S. equity market may impact foreign equity in case that foreign firms' earning are highly correlated to U.S. equity returns. Another case could be that, a rise in U.S. interest rates raises borrowing costs for firms financing themselves directly in U.S. market. Through this credit channel, their equity value is lower.

For the effect from foreign asset reaction, the way that a country is affected from change in global interest rates (in this case, because of monetary policy surprises) depends on the exchange rate regime. In the case that the exchange rate can be fully adjusted to changes in global interest rates, and assume that uncovered interest rate parity holds, an unanticipated increase of U.S. interest rates, which leads to an increase in global interest rates, will lead to dollar appreciation against other foreign currencies. As a consequence, foreign exports to the U.S. should be enhanced, and thus, increase stock price of foreign export firms, but at the same time, it also hurts foreign imports, and thus lower stock price of foreign import firms. The channel that the effect passes through in this consequence can be called exchange rate channel. In other case that only uncovered interest parity holds but the exchange rate cannot adjust to changes in global interest rates, an unanticipated increase of U.S. interest rate should make foreign interest rates higher. This would affect domestic equity through both interest rate channel and discount rate component, and thus lower foreign stock prices.

From several studies, the net effects of Fed and ECB monetary policy tightening on foreign stocks are shown to be negative. Johnson and Jensen (1993) find that the increase in U.S. discount rate results in negative response of all 15 foreign stock indexes. More recent studies that use Fed's policy surprises instead of changes to measure the effect on stock market also indicate consistent results. All of them document that global equity indexes falls as there is positive shock on Fed's fund rate. Hausmann and Wongswan (2006) find the average effect of 3.228% for 49 countries during 1994 to 2005 using daily data. Ehrmann and Fratzscher (2006) measure the effect with intraday return and find the average effect of 3.8%. Wongswan (2009)

documents that the response of equity index is between 1.89% and 9.78%. Kim and Nguyen (2009)'s study on both Fed and ECB policy effect also document similar result.

Since most research focus on net overall market effect of monetary policy and cross-country variation, only a few study the effect in detailed components of transmission channel. One of the papers that break down the cross-country effect into different transmission channel is Ehrmann and Fratzscher (2006). They find that U.S. and foreign short-term interest rates, as well as the exchange rate are important cross-country transmission channels. The foreign equity markets reaction from U.S. monetary policy shock is found to be quite strong when the U.S. short-term interest rates react strongly, as well as when the reaction of the exchange rate is large.

2.3 Monetary Policy Effects on Specific Industries and Firms

Some researches on domestic monetary policy effect study the heterogeneity of individual stock's reaction that arises from the differences in industry affiliation and stock characteristics. Studies find that the effect of monetary policy on stock market returns differs across industries. The evidence includes Dedola and Lippi (2000) which use data from OECD, Peersman and Smets (2002) and Angeloni and Ehrmann (2003) in euro area countries, Genley and Salmon (1997) in UK, and Hayo and Uhlenbrock (2000) in Germany, as well as Ehrmann and Fratzscher (2004) and Bernanke and Kuttner (2005) in the U.S.

Ehrmann and Fratzscher (2004) explain reasons that cause the effect of monetary policy to be different across industries. First, under the credit channel, capital-intensive industries should be more affected from changes in cost of capital that induces by monetary policy. Second, under the interest rate channel, the impact of monetary policy on cyclical industries that product demands are interest-sensitive should be stronger than those with less interest-sensitive product demand. Their study result supports the explanation. They find that stock returns of firms in technology, communication and cyclical consumer goods industries are more responsive than the average stock, whereas non-cyclical consumer goods, energy, and utilities are industries that response below average. Ehrmann and Fratzscher (2006), which study

the sector heterogeneity of foreign stock reaction to Fed's policy shocks, document that the result of sector effect is the same as the result found for the U.S. stocks.

For firm-specific effect, the channel that the effect would pass through is the credit channel. Firms that are in financial constraints are likely to be affected more than those that are less constrained. Perez-Quiros and Timmermann (2000) use firm size as a proxy for the level of firm's financial constraint. They find that smaller firms' returns are much more affected by monetary policy tightening than those of larger firms. Ehrmann and Fratzscher (2004) add more direct measures, includes cash flow to income ratio, debt to capital ratio, and Moody's credit rating, to measure financial constraint. They find that low cash flow to income, and low credit rating firms are more negatively react to an increase in policy rate than those with medium and high level. However, the effect on debt to capital ratio is not linear, as firms with high and low level of debt response more than firms with medium debt level.

2.4 Economic Cycle Variation in Monetary Surprise Effect

Another strand of the research on the relationship stock market reaction to monetary policy is the group that studies the variation on this effect in different state of economy. The past results have been mixed; McQueen and Roley (1993) shows that stock market's response to economic news depends on the state of economy. Unanticipated increases in economic activity raise expectation about future economy and firm's cash flow in bad economy but not in good economy. However, they do not find that firm's reaction to monetary policy news is economic-state dependent. Andersen, Bollerslev, Diebold and Vega (2005) also document the same result. In contrast, Basistha and Kurov (2008) find that there is significant cyclical variation in reaction of stock price to the monetary policy. As there is reduction in availability of credit and adverse effect of balance sheet during the recession, the reaction of stock price to monetary news is stronger.

2.5 Monetary Policy Shock Measurement

Although many literatures simply use changes of policy rates on day of announcement to study for the monetary policy effect on stock market, there is

shortcoming on this methodology. Kuttner (2001) documents that on announcement dates, market react mostly not to the change in policy rate, but rather the unexpected component that is not already priced into the market. The argument is based on the efficient market hypothesis theory, which states that asset prices should reflect all information available at any point in time.

There are many ways to identify the unexpected component of monetary policy. Some of the earlier studies employed market survey expectations to proxy for expected target rate announcements (e.g. Reinhart and Simin, 1997). However, most recent studies have instead relied on market price-based proxies.

Krueger and Kuttner (1996) find that the Fed funds futures rate is an efficient predictor of the Fed funds target rate and therefore an appropriate market-based measure of policy expectations. This finding is later confirmed by Gürkaynak, Sack and Swanson (2002). Kuttner (2001) uses the Fed funds futures rates to separate the target rate changes into anticipated and unanticipated components. He finds that the responses of the U.S. Treasury bill, note and bond yields to anticipated changes in the target rate are small, while the responses to unanticipated changes are large and significant. Bomfim (2003) extends Kuttner (2001) to asset return volatilities and finds that asset returns are more volatile following announcements containing unexpected rate changes.

The early literature on the ECB's news employed price-based proxies to gauge the market expectations on the ECB's target rate announcements. However, the choice of market instruments differs across researchers. Gaspar, Perez-Quiros and Sicilia (2001) use EONIA (Euro Over Night Index Average, the effective overnight reference rate for the Euro) to gauge the probability attached to a change in the ECB's target interest rate before the governing council's meeting. Perez-Quiros and Sicilia (2002) propose a principal components approach that utilizes the daily changes of different money market interest rates including the EONIA, the 1-week, 1-, 2- and 3-month EONIA swap rates and the closest 3-month EURIBOR futures rates. Their approach is to extract the key common component that shapes the evolution in all the above rates. Würtz (2003) measures the interest rate change expectations from the forward rate implied by the 1- and 2-month EONIA swap rates. However, due to the high

volatility and the impacts of liquidity considerations rather than the monetary policy considerations as identified by Bindseil (2002) in underbidding scenarios, it seems that the EONIA is not the best proxy for the market expectation on the ECB's upcoming interest rate announcements. More recently, Ehrmann and Fratzscher (2003, 2005) utilize the Reuters's survey of 25–30 market participants conducted on the Friday before each meeting of the ECB's governing council as a proxy for the market expectations on the upcoming interest rate decision. However, Bernoth and Von Hagen (2004) find that the 3-month EURIBOR futures rate is an unbiased predictor of the euro area policy rate changes. Thus, the literature suggests that a market-based approach using futures rates would provide the market's unbiased expectations on the upcoming interest rate announcements.

CHAPTER III

DATA AND METHODOLOGY

3.1 Data and Sample

The sample covers 63 announcements from Fed and 96 announcements from the ECB during 2002 to 2009. Daily stock returns data from the Stock Exchange of Thailand is used to examine the reaction of stocks to monetary policy announcement in three level; overall market level, sector level, and individual stock characteristic level. Prior to the explanation of the methodology for hypothesis testing, I discuss the data measurement on monetary policy surprises, stock returns, stock characteristics, and economic cycle in the following sub-sections.

3.1.1 Monetary Policy Surprise Measurement

Since 1994, the Federal Open Market Committee (FOMC) in the U.S. has been announcing the Fed funds target rate after its regularly scheduled (eight meetings a year) and *ad hoc* meetings at 2:00 pm U.S. Eastern Standard Time (EST, GMT-5) unless otherwise specified. For the ECB, the interest rate on the main refinancing operations (MRO) is perceived to be the target policy interest rate as it plays a pivotal role in pursuing the ECB's open market operations. Although the governing council meets twice a month, it normally makes a monetary policy decision at the first meeting, after which a press release announcing the decision on the key ECB interest rate is made at 1:45pm Central European Time (CET, GMT+1). The announcement dates and the policy rate changes of the two central banks were obtained from their respective websites, http://www.federalreserve.gov and http://www.ecb.int.

In panel A of table 1a and 1b reports the breakdown of target rate announcements into rate rise, rate falls and unchanged. For the monetary policy announcements of Fed and ECB, the sample includes 63 and 96 announcements from January 2002 through December 2009, respectively. Fed had 26 announcements with rate changes (9 rate cuts and 17 rate rises) and 37 announcements with no changes. ECB had 18 announcements with rate changes (10 rate cuts and 8 rate rises) and 78

announcements with no changes. Most of the time, Fed and ECB made no change to the policy rates (59% of no policy rate change for Fed and 81% for the ECB).

To study for the effect of monetary policy rate on stock markets, the unexpected component must be extracted from the component that market is already anticipated. As shown in Kuttner (2001), markets react mostly not to the policy rate change announcement itself, but to their unexpected component that is not already priced into the market.

There are number of ways to extract this policy rate surprises as stated in previous literature review section. In this paper, I use market price-based approach that is used in Kuttner (2001) to measure monetary policy surprises. The surprises are measured from the changes in future interest rates to generate the unexpected components of the two central banks' target rate announcements. The current-month Fed funds futures contracts traded on the Chicago Board of Trade (CBOT) is used to extract the Fed's surprises, and the 3-month EURIBOR futures contracts traded on the EUREX is used to extract the ECB's surprises.

The unexpected component of the Fed's target interest rate announcement on day *d* of month *m* can be derived from the implied change in the price of the Fed fund futures contract. Since the Fed funds futures settlement price is based on the monthly average of the spot Fed funds rate, it is necessary to account for the number of days affected by the announcement in that particular month as in equation (1).

$$s_{Fed,t} = \frac{D}{D-d}\left(f^0_{m,d} - f^0_{m,d-1}\right) \quad (1)$$

where $s_{Fed,t}$ is Fed's unexpected target rate change; $f^0_{m,d}$ is the current month Fed fund futures rate for the Fed on announcement date; $f^0_{m,d-1}$ is the Fed Fund futures rate on the day prior to the announcement; *D* is the number of days in the month; and *D-d* is the number of days in the month affected by the announcement.

For the unexpected component of the ECB's target interest rate announcement, I use 3-month EURIBOR futures settlement price, which is based on the reference interest rate (EURIBOR) for 3-month euro term deposits on the last trading

day, and so the surprise of the ECB's target interest rate announcement is calculated without the scaling factor $D/(D-d)$. The equation is shown in the following equation (2).

$$s_{ECB,t} = f^0_{m,d} - f^0_{m,d-1} \quad (2)$$

where $s_{ECB,t}$ is ECB's unexpected target rate change; $f^0_{m,d}$ is the 3-month EURIBOR future rate on the ECB on announcement date; $f^0_{m,d-1}$ is the futures rate on the day prior to the announcement.

The summary statistics of Fed and ECB monetary surprise are provided in panel B of table 1a and 1b. During the period, 40% of Fed' interest rate announcements were correctly expected but only 7% of the ECB's interest rate announcements were correctly anticipated. There is more negative than positive surprises for Fed (35% compared to 25%), whereas ECB's surprise is more positive than negative (49% compared to 44%). On average, Fed's target interest rate change announcements were lower than market expectation by 1.466 basis points. However ECB's target interest rate change announcements were higher than market expectation by 0.646 basis points. The standard deviation of Fed's surprise is higher than that of the ECB's (8.798 compare to 5.345). The mean of Fed's surprise is lower than the median, the surprises are observed to be negatively skewed. For the ECB's surprise, the mean is higher than the median, and the surprises are observed to be positively skewed.

Figure 1a and 1b shows graphs of Fed and ECB's surprise over the period of study. Fed's surprises are seems to be more volatile than ECB's surprises. Market usually makes correct expectation for Fed's policy rate announcements, but when the expectation is not correct, the surprises from Fed policy announcements are usually quite high in comparison to that of the ECB. For the ECB, market mostly expects the policy rates incorrectly but the surprises are not as high. Surprises of both Fed and ECB are more cluster and higher during 2007 to 2009 as that period is in sub-prime crisis. There is more uncertainty in financial market and interest rate surprises are higher.

Table 1a: Summary Statistics of Fed's Monetary Policy Surprise

Panel A. Target Interest Rate Announcements				
	Fed Funds Rate Announcements			
	Total	Rate Cut	Rate Rise	No change
Number of Announcements	63	9	17	37
Proportions	100%	14%	27%	59%

Panel B. Target Interest Rate Surprises				
	Fed Funds Rate Surprises			
	Total	Negative Surprises	Positive Surprises	No Surprise
Number of Observations	63	22	16	25
Proportions	100%	35%	25%	40%
Descriptive Statistics				
Mean	-1.466	-8.183	5.478	
Median	0.000	-4.133	4.060	
Standard Deviation	8.789	10.864	5.734	
Minimum	-40.000	-40.000	0.500	
Maximum	19.286	-0.500	19.286	

Note: The table shows summary statistics for Fed fund rate changes and Fed's surprise in basis points. The sample include Fed's announcement from January 2002 through December 2009, outliers are excluded. Data of Fed fund futures rate is obtained from Datastream; and Fed announcement dates from Fed's website, http://www.federalreserve.gov. The numbers of surprises shown in Panel B are different from the actual rate change announcements from the FOMC. This is because even when there was no rate change announcement, market might have expected a rate rise or fall and so the surprise component is non-zero.

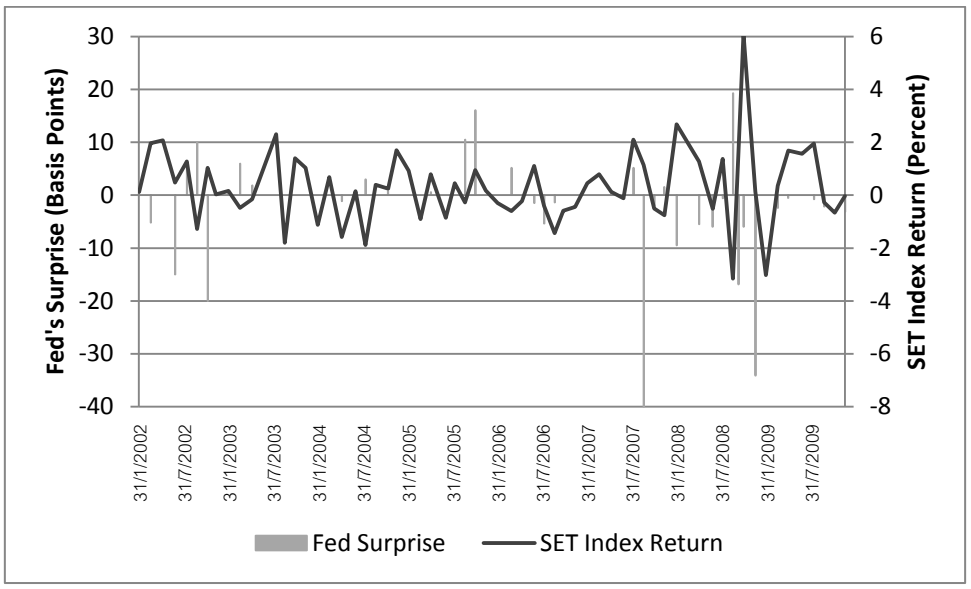
Table 1b: Summary Statistics of ECB's Monetary Policy Surprise

Panel A. Target Interest Rate Announcements				
	ECB Target Rate Announcements			
	Total	Rate Cut	Rate Rise	No change
Number of Announcements	96	10	8	78
Proportions	100%	11%	8%	81%

Panel B. Target Interest Rate Surprises				
	ECB Policy Surprises			
	Total	Negative Surprises	Positive Surprises	No Surprise
Number of Observations	96	42	47	7
Proportions	100%	44%	49%	7%
Descriptive Statistics				
Mean	0.646	-3.226	4.202	
Median	0.000	-2.000	2.500	
Standard Deviation	5.345	2.855	5.007	
Minimum	-12.500	-12.500	0.500	
Maximum	29.500	-0.500	29.500	

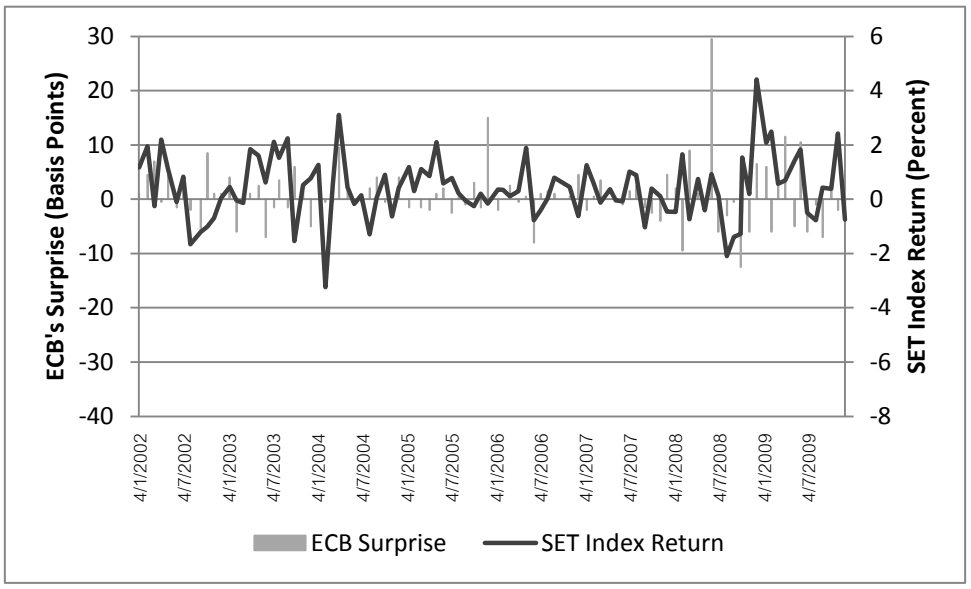
Note: The table shows summary statistics for ECB policy rate changes and ECB's surprise in basis points. The sample include ECB's announcement from January 2002 through December 2009. Data of EURIBOR is obtained from Datastream; and ECB announcement dates from ECB's website, http://www.ecb.int. The numbers of surprises shown in Panel B are different from the actual rate change announcements from the ECB. This is because even when there was no rate change announcement, market might have expected a rate rise or fall and so the surprise component is non-zero.

Figure 1a: Unexpected Change in Fed's Policy Rate and SET Index Return



Note: The figure shows daily SET index return and Fed's monetary policy shocks based on changes of current month Fed fund future rates between the day of the announcement and the day prior to the announcements of the FOMC.

Figure 1b: Unexpected Change in ECB's Policy Rate and SET Index Return



Note: The figure shows daily SET index return and ECB's monetary policy shocks based on changes of 3-months EURIBOR futures settlement price between the day of the announcement and the day prior to the announcements of the ECB.

3.1.2 Stock Market Return, Sector Return, and Individual Stock Return Measurement

Regarding the stock returns measurement, there are several choices of frequencies to be chosen, i.e., monthly, daily, or intraday return. In this paper, I choose to use a daily frequency for several reasons. First, the lower frequencies data might be subjected to endogeneity problem between stock returns and monetary policy, as argued by Rigobon and Sack (2003, 2004) that the causality between interest rates and stock prices runs in both directions. Second, the higher frequency data might capture overshooting effects that quickly disappear, stated Ehrmann and Fratzscher (2004). Therefore, the effects found on daily basis could reflect the longer-run impacts in a more reliable way.

For the measure of the overall stock market returns, I use the daily returns of the SET price index, calculated as log-difference of the daily closing quotes. The data is obtained from Datastream. Table 2 provides summary statistics of SET index return during the period of study. I report SET index return separately for Fed's announcement dates and ECB's announcement dates, as Fed and ECB do not announce their policy rates on the same day. On average, SET index return is positive during the period of study. On announcement dates, the mean and median of SET index return is higher than that of non-announcement dates. For Fed's announcements, the average of SET index return is 0.307% during dates of announcement, in comparison to the mean of 0.036% on non-announcement dates. For the ECB's announcements, the average of SET index return is 0.412% during dates of announcement, in comparison to 0.026% on non-announcement dates. The standard deviation of SET index return is lower during the announcement dates of both central banks (1.420 comparing to 1.485 for Fed, and 1.160 and 1.495 for ECB). The return of SET index is negatively skewed on non-announcement dates but positively skewed on announcement dates.

For the measure of sector and individual stock returns, I use the daily returns from 100 individual stocks which are in the SET100 at the end of 2009. Only stocks in the SET100 are used because the SET100 do not include stocks with low turnover, therefore this could mitigate the illiquidity problem and non-synchronous trading problem. Moreover, stocks in suspended list, REITs, close-end mutual funds,

ETFs, and warrants are also excluded from the sample. The sector returns are calculated using market value weighted average method of stocks that are in each sector. Sector classification is based on the broad classification used by the SET which classified stocks into eight sectors which are agriculture and food, consumer products, financials, industrials, property and construction, resources, services, and technology. Data on stock returns are obtained from Datastream. Table 3a and 3b provides summary statistics of each industry returns. Average of industry returns highly vary across industries, range from -0.015 to 0.487 on Fed's announcements, and 0.306 to 0.673 on ECB's announcements. Most industries have positive returns except for industrials sector return on Fed's announcement dates. During Fed's announcement dates, financials sector has the highest average return and Industrials sector has the lowest average return. During ECB's announcement dates, consumers sector return is the highest and the services sector return is the lowest. For both announcements, industrials sector return has the highest volatility (2.295 and 2.016 during Fed's and ECB's announcements, respectively). The sector return that has the lowest volatility is Agricultural and Food (with the standard deviation of 1.258) on Fed's announcements, and Services sector (with the standard deviation of 0.957) on ECB's announcement. Most sector returns has higher mean than median, thus, the data on sector returns are mostly positively skewed.

Table 2: Summary Statistics of SET Index Return

	SET Index Return			
	Overall	exclude Fed Announcement Dates	exclude ECB Announcement Dates	exclude Fed and ECB Announcement Dates
Descriptive Statistics				
Mean	0.045	0.036	0.026	0.017
Median	0.053	0.047	0.036	0.025
Standard Deviation	1.482	1.485	1.495	1.497
Minimum	-16.063	-16.063	-16.063	-16.063
Maximum	10.577	10.577	10.577	10.577
Observations	1956	1890	1860	1796
	SET Index Return on Fed Announcement Dates			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.307	0.828	-0.176	0.157
Median	0.165	0.751	-0.017	0.179
Standard Deviation	1.420	1.618	1.255	1.228
Minimum	-3.159	-1.579	-3.159	-3.023
Maximum	6.099	6.099	2.095	2.304
Observations	63	22	16	25
	SET Index Return on ECB Announcement Dates			
	Total	with Negative ECB's Surprise	with Positive ECB's Surprise	with No ECB's Surprise
Descriptive Statistics				
Mean	0.412	0.261	0.579	0.206
Median	0.376	0.249	0.448	0.304
Standard Deviation	1.160	1.259	1.126	0.591
Minimum	-3.237	-3.237	-1.543	-0.634
Maximum	4.409	2.495	4.409	1.270
Observations	96	42	47	7

Note: The table shows summary statistics for daily SET index return in percent; and Fed and ECB's surprise in basis points. The sample include Fed and ECB's announcement from January 2002 through December 2009, outliers are excluded. Data of SET index return is obtained from Datastream; and Fed announcement dates from Fed's website, http://www.federalreserve.gov and ECB announcement dates from ECB's website, http://www.ecb.int.

Table 3a: Summary Statistics of Industry Return on Fed's Announcement Dates

	Agricultural and Food Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.173	0.374	-0.093	0.167
Median	0.153	0.109	0.063	0.310
Standard Deviation	1.258	1.164	1.464	1.215
Minimum	-3.770	-1.362	-3.770	-1.548
Maximum	4.089	4.089	1.874	3.336
Number of Stocks in Sector	7	7	7	7
Observations	63	22	16	25
	Consumer Products Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.324	0.609	0.000	-0.521
Median	0.000	0.389	0.000	0.000
Standard Deviation	1.418	1.493	.	1.229
Minimum	-1.924	-0.964	0.000	-1.924
Maximum	4.218	4.218	0.000	0.362
Number of Stocks in Sector	1	1	1	1
Observations	14	10	1	3

Note: The table shows summary statistics for industry return in percent. Samples include industry return on Fed's announcement dates from January 2002 through December 2009. Data is obtained from Datastream. Consumer Products sector has only 14 observations because the sector contains only one stock that established in 2008.

Table 3a (con't): Summary Statistics of Industry Return on Fed's Announcement Dates

	Financials Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.487	1.276	-0.505	0.428
Median	0.618	1.136	-0.643	0.357
Standard Deviation	1.871	1.732	2.001	1.640
Minimum	-4.858	-1.004	-4.858	-3.079
Maximum	6.451	6.451	2.258	4.239
Number of Stocks in Sector	14	14	14	14
Observations	63	22	16	25
	Industrials Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	-0.015	0.724	-0.087	-0.620
Median	-0.370	-0.260	-0.326	-0.375
Standard Deviation	2.259	2.740	1.726	1.965
Minimum	-5.740	-3.062	-2.725	-5.740
Maximum	6.825	6.825	3.219	2.065
Number of Stocks in Sector	8	8	8	8
Observations	63	22	16	25

Note: The table shows summary statistics for industry return in percent. Samples include industry return on Fed's announcement dates from January 2002 through December 2009. Data is obtained from Datastream.

Table 3a (con't): Summary Statistics of Industry Return on Fed's Announcement Dates

	Property and Construction Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.392	0.830	-0.265	0.427
Median	0.267	0.686	-0.105	0.267
Standard Deviation	1.637	1.755	1.464	1.556
Minimum	-3.489	-1.659	-2.887	-3.489
Maximum	5.919	5.919	1.994	4.153
Number of Stocks in Sector	26	26	26	26
Observations	63	22	16	25
	Resources Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.372	1.031	-0.312	0.229
Median	0.042	0.582	-0.149	0.042
Standard Deviation	2.083	2.308	1.920	1.874
Minimum	-5.062	-2.002	-5.062	-4.207
Maximum	8.519	8.519	4.303	4.879
Number of Stocks in Sector	14	14	14	14
Observations	63	22	16	25

Note: The table shows summary statistics for industry return in percent. Samples include industry return on Fed's announcement dates from January 2002 through December 2009. Data is obtained from Datastream.

Table 3a (con't): Summary Statistics of Industry Return on Fed's Announcement Dates

	Services Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.349	0.642	0.131	0.229
Median	0.347	0.425	0.278	0.438
Standard Deviation	1.742	1.553	1.473	2.061
Minimum	-3.731	-2.516	-3.731	-3.280
Maximum	7.746	5.135	3.043	7.746
Number of Stocks in Sector	19	19	19	19
Observations	63	22	16	25
	Technology Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.410	0.712	0.122	0.329
Median	0.153	0.607	-0.151	-0.129
Standard Deviation	2.040	2.336	1.141	2.241
Minimum	-2.962	-2.699	-2.193	-2.962
Maximum	8.747	8.747	2.330	5.991
Number of Stocks in Sector	11	11	11	11
Observations	63	22	16	25

Note: The table shows summary statistics for industry return in percent. Samples include industry return on Fed's announcement dates from January 2002 through December 2009. Data is obtained from Datastream.

Table 3b: Summary Statistics of Industry Return on ECB's Announcement Dates

	Agricultural and Food Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.308	0.241	0.347	0.458
Median	0.250	0.026	0.273	0.579
Standard Deviation	1.109	1.156	1.142	0.510
Minimum	-2.348	-2.282	-2.348	-0.537
Maximum	2.952	2.356	2.952	1.081
Number of Stocks in Sector	7	7	7	7
Observations	96	42	47	7
	Consumer Products Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.673	0.668	0.684	.
Median	0.336	0.315	0.357	.
Standard Deviation	1.546	1.583	1.601	.
Minimum	-1.549	-1.465	-1.549	.
Maximum	4.740	4.740	3.610	.
Number of Stocks in Sector	1	1	1	1
Observations	20	13	7	0

Note: The table shows summary statistics for industry return in percent. Samples include industry return on ECB's announcement dates from January 2002 through December 2009. Data is obtained from Datastream. Consumer Products sector has only 20 observations because the sector contains only one stock that established in 2008.

Table 3b (Con't): Summary Statistics of Industry Return on ECB's Announcement Dates

	Financials Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.587	0.238	0.877	0.739
Median	0.462	0.118	0.446	0.803
Standard Deviation	1.774	1.811	1.831	0.434
Minimum	-4.924	-4.924	-2.095	-0.036
Maximum	6.469	4.424	6.469	1.331
Number of Stocks in Sector	14	14	14	14
Observations	96	42	47	7
	Industrials Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.313	0.376	0.305	-0.014
Median	0.098	0.178	0.182	-0.224
Standard Deviation	2.016	2.513	1.622	0.933
Minimum	-4.649	-4.649	-3.475	-1.480
Maximum	9.680	9.680	3.160	1.268
Number of Stocks in Sector	8	8	8	8
Observations	96	42	47	7

Note: The table shows summary statistics for industry return in percent. Samples include industry return on ECB's announcement dates from January 2002 through December 2009. Data is obtained from Datastream.

Table 3b (Con't): Summary Statistics of Industry Return on ECB's Announcement Dates

	Property and Construction Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.490	0.154	0.796	0.457
Median	0.333	0.090	0.596	0.031
Standard Deviation	1.478	1.359	1.585	1.083
Minimum	-3.234	-3.234	-1.446	-0.686
Maximum	7.644	3.210	7.644	2.523
Number of Stocks in Sector	26	26	26	26
Observations	96	42	47	7
	Resources Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.671	0.694	0.750	0.005
Median	0.499	0.580	0.659	-0.159
Standard Deviation	1.667	1.953	1.451	1.105
Minimum	-3.755	-3.755	-1.910	-1.361
Maximum	5.127	4.355	5.127	2.260
Number of Stocks in Sector	14	14	14	14
Observations	96	42	47	7

Note: The table shows summary statistics for industry return in percent. Samples include industry return on ECB's announcement dates from January 2002 through December 2009. Data is obtained from Datastream.

Table 3b (Con't): Summary Statistics of Industry Return on ECB's Announcement Dates

	Services Industry Return			
	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.306	0.192	0.450	0.025
Median	0.344	0.203	0.414	0.109
Standard Deviation	0.957	0.954	1.003	0.464
Minimum	-2.227	-2.227	-2.062	-0.810
Maximum	3.886	1.899	3.886	0.690
Number of Stocks in Sector	19	19	19	19
Observations	96	42	47	7

	Total	with Negative Fed's Surprise	with Positive Fed's Surprise	with No Fed's Surprise
Descriptive Statistics				
Mean	0.350	0.113	0.533	0.548
Median	0.063	-0.240	0.158	0.089
Standard Deviation	1.626	1.527	1.721	1.594
Minimum	-2.785	-2.785	-2.730	-1.188
Maximum	5.483	3.108	5.483	3.096
Number of Stocks in Sector	11	11	11	11
Observations	96	42	47	7

Note: The table shows summary statistics for industry return in percent. Samples include industry return on ECB's announcement dates from January 2002 through December 2009. Data is obtained from Datastream.

3.1.3 Stock Characteristic Data

The stock-specific characteristics that I used to test for the heterogeneity of stock reaction include percentage of foreign holding, market capitalization, export and foreign revenue, and CAPM beta. Data on foreign holding, market capitalization, and CAPM beta are obtained from Datastream on a daily basis. Export and foreign revenue data is a dummy variable, equal to 1 if the firm's source of revenue comes from export or foreign customers, otherwise equal to 0. The export and foreign revenue data is hand-collected from 56-1 form of each firm on a yearly basis. 56-1 form is obtained from the SEC website, www.sec.or.th. Table 4a and 4b provides summary statistics of firm-specific characteristic variables. For export dummy, mean of the variable is shown to be 0.553 for both Fed's and ECB's announcement dates. The number indicates that about half of the firms in the sample are firms that have source of revenue from export and foreign customers. For the CAPM beta, the sample stocks have CAPM beta of 0.942 and 0.938 on Fed's and ECB's announcements, respectively. CAPM beta is the variable that captures the sensitivity of stock returns to the market returns. Both samples have CAPM beta close to 1 (market beta), means that stock returns in the sample generally follow the market returns. For the foreign holding percentage, the average is around 27% during both central banks' announcements. The number is quite low as there are many stocks that have limited foreign holding restriction. For the market value, the average size of stocks has market value of 38 billion baht. The market value is highly varied across stocks and is also distorted by a few extremely large stocks, as shown that the median is only 13 billion baht.

In order to ensure that the multiple regression model containing these four variables do not have multicollinearity problem; each of the variable must not be highly correlated with each other. I provide correlation table of each pair of characteristic in table 5a and 5b to show that there is no significant correlation between any pair of the variables. The highest correlated pair is the pair of CAPM beta and market value with the correlation coefficient of 0.1423 and 0.1467 during Fed's and ECB's announcements, respectively. Even the highest correlated pair, the correlation coefficient is still very low. Therefore, all variable can be included in the model.

Table 4a: Summary Statistics of Stock Characteristics on Fed's Announcement Dates

	Export Dummy	CAPM Beta	Foreign Holding	Market Value
Descriptive Statistics				
Mean	0.553	0.942	27.542	38,019
Median	1.000	0.923	24.734	12,646
Standard Deviation	0.497	0.478	19.501	81,118
Minimum	0.000	-0.249	0.000	106
Maximum	1.000	3.426	100.000	1,171,311

Note: The table shows summary statistics for stock-specific characteristics. Export Dummy is dummy variable equal to 1 if the firm's source of revenue comes from export or foreign customers, otherwise 0. CAPM Beta is calculated using return of market and stock in one year length. Market Value is report in million baht, and Foreign Holding is reported in percent.

Table 4b: Summary Statistics of Stock Characteristics on ECB's Announcement Dates

	Export Dummy	CAPM Beta	Foreign Holding	Market Value
Descriptive Statistics				
Mean	0.553	0.938	27.682	38,155
Median	1.000	0.919	24.822	12,660
Standard Deviation	0.497	0.498	19.515	81,584
Minimum	0.000	-0.205	0.000	106
Maximum	1.000	3.443	100.000	1,126,261

Note: The table shows summary statistics for stock-specific characteristics. Export Dummy is dummy variable equal to 1 if the firm's source of revenue comes from export or foreign customers, otherwise 0. CAPM Beta is calculated using return of market and stock in one year length. Market Value is report in million baht, and Foreign Holding is reported in percent.

Table 5a: Correlation of Stock Characteristic Variables on Fed's Announcement Dates

	Export Dummy	CAPM Beta	Foreign Holding	Market Value
Export Dummy	1			
CAPM Beta	-0.0213	1		
Foreign Holding	0.0492	-0.0336	1	
Market Value	0.1078	0.1423	0.0212	1

Table 5b: Correlation of Stock Characteristic Variables on ECB's Announcement Dates

	Export Dummy	CAPM Beta	Foreign Holding	Market Value
Export Dummy	1			
CAPM Beta	-0.0265	1		
Foreign Holding	0.0500	-0.0346	1	
Market Value	0.1076	0.1467	0.0221	1

3.1.4 Economic Cycle Measurement

To investigate whether the monetary policy effect on stock market is economic state-dependent, the proxy for the economic cycle is required. There are number of proxies that can be used to capture the economic cycle, i.e. U.S. coincident index, interest-rate yield curve spread. I found that both proxies; coincident index and yield spread indicate the U.S. expansion and recession cycle in the same period as the cycle announced by the National Bureau of Economic Research (NBER)[2]. Therefore, in this study, I use the business cycle as announced by the NBER to study the economic-cycle variation on Fed monetary policy surprise effect. The data is obtained from NBER website, http://www.nber.org. During the period of study, from January 2002 through December 2009, there is only one period of recession. The recession period, which known as subprime crisis[3], started from December 2007 until June 2009. This section of my study focus only on the effect of Fed's surprise and U.S. economic cycle because the observation of U.S. business cycle is more prevalent and easier to capture than for the European economy.

Table 6 provides summary statistics of SET index return, Fed's policy rate surprises and Fed's rate changes, breaking down into expansion and recession period. There are 13 announcements that take place during the recession and 50 announcements during the expansion. During the recession, Fed's policy action was either maintained or cut the policy rate, while raise or maintain the policy rate during the expansion. The average of Fed's rate change is 6.5 basis points during the expansion

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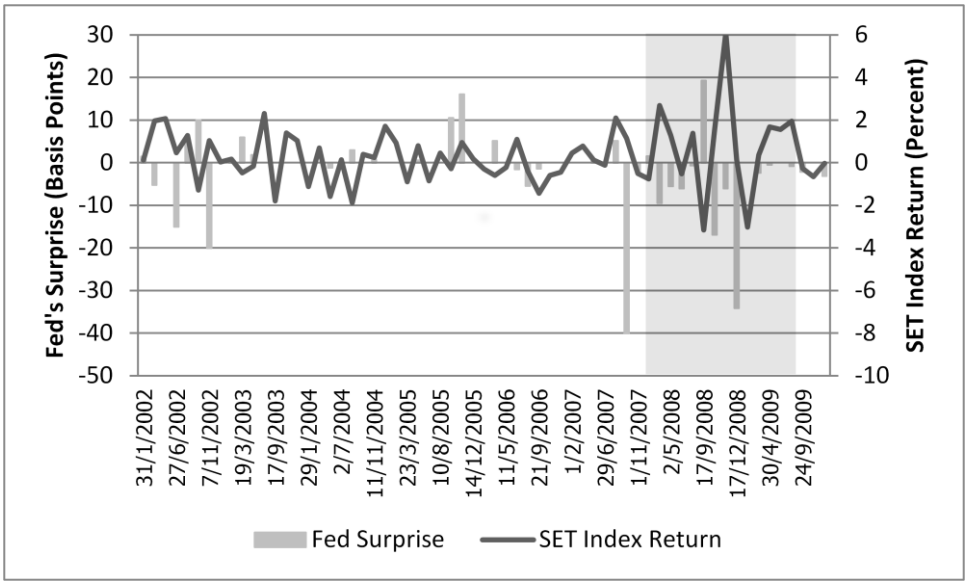
2 The NBER is the U.S. nonprofit economic research organization, concentrate on four types of empirical research: developing new statistical measurements, estimating quantitative models of economic behavior, assessing the economic effects of public policies, and projecting the effects of alternative policy proposals.
According to the NBER, a recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. Source: http://www.nber.org.

3 The U.S. subprime crisis was started due to borrowers being approved for loans that they could not afford. As a result, there is a significant rise in foreclosures, and then, led to the collapse of many lending institutions and hedge funds. The financial crisis in the mortgage industry affected the global credit market, and resulting in higher interest rates and reduced availability of credit.

and -21.154 basis points during the recession. The surprise during the recession is much higher than that during the expansion (-4.661 comparing to -0.635). The higher negative surprise means that, during the recession, Fed usually cuts its interest rate more than market expected. SET index return is shown to be positive on average, 0.202% and 0.712% during the expansion and recession, respectively. The standard deviation of SET index return, Fed's surprise, and Fed's rate change are much higher in recession, indicates that during the period of recession, the uncertainty in financial market increase. Figure 2 also shows Fed's monetary policy surprise, SET index return, and the period of recession in the shaded area. Both SET index return and Fed's surprise is shown to be highly volatile during the recession.

Figure 2: Fed's Policy Surprise, SET Index Return, and Economic Cycle



Note: The figure shows Fed's monetary policy shocks, SET index return, and economic cycle period. The shaded area is the U.S. recession period obtained from the NBER, http://www.nber.org.

Table 6: Summary Statistics of SET Index Return, Fed's Surprise and Fed's Rate Change on Fed's Announcement Dates during Expansion and Recession Period

Panel A. Expansion			
	SET Index Return	Fed's Surprise	Fed's Rate Change
Descriptive Statistics			
Mean	0.202	-0.635	6.500
Median	0.136	0.000	0.000
Standard Deviation	1.042	7.673	15.819
Minimum	-1.886	-40.000	-50.000
Maximum	2.304	16.034	25.000
Number of Observations	50	50	50
Panel B. Recession			
	SET Index Return	Fed's Surprise	Fed's Rate Change
Descriptive Statistics			
Mean	0.712	-4.661	-21.154
Median	1.277	-2.385	0.000
Standard Deviation	2.399	12.032	26.705
Minimum	-3.159	-34.100	-75.000
Maximum	6.099	19.286	0.000
Number of Observations	13	13	13

3.2 Methodology

The empirical methodology that I employ in this paper follows the standard event study literature. I examine equity returns in a narrow window around Fed and ECB announcement. Due to the time-zone differences, the announcement of both Fed and ECB are usually be released in the evening time of Thailand when Thai stock market is closed. The reaction of Thai stock market, therefore, can be observed from the return in the day follow the announcement. If the day after the announcement is weekend or holiday, then the stock return would be observed on the next business day. For all the following analyses, I test the effect of monetary policy surprises separately for each central bank.

3.2.1 Monetary Policy Surprise Effect – Overall Market Level

As a starting point, I test for the overall effect, whether and how the SET index responds to surprises. The model is formulated as follows:

$$r_t = \alpha + \beta s_{a,t} + \gamma AR(1) + \varepsilon_t \quad (3)$$

where r_t denotes the daily stock market return on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; and $AR(1)$ denotes the daily market return on the day t-1, included to capture the autocorrelation of daily returns.

In this equation, β show the effect of the monetary policy surprises on the SET index returns. If the β is positive (negative), it implies that unexpected increase in policy rate will lead to higher (lower) market returns. If β equals to zero, it means that the monetary policy surprises has no effect on market returns. In general, the coefficient estimate is expected to be negative as stated previously in the hypothesis 1.

3.2.2 Monetary Policy Surprise Effect – Sector Level

After observing the reaction in overall market level, the next step is to investigate whether there is heterogeneity in stock reaction at the sector level and find which sector is more or less sensitive to the monetary surprise than others. As stocks in different sectors are exposed differently to risk factors, each of the sectors should react to the monetary policy surprise in heterogeneous way. It is expected that capital-

intensive and cyclical industries should be more sensitive to the monetary policy surprise than the average of other industries as explained in the hypothesis 2.

In order to test for this heterogeneity in stock reaction at the sector level, I group the 100 stocks into eight sectors, which are agriculture and food, consumer products, financials, industrials, property and construction, resources, services, and technology. Then, I compute daily returns for each sector separately using market value-weighted approach. After that, I use the following equation to find the effect of monetary policy surprises for each sector.

$$r_{b,t} = \alpha + \beta s_{a,t} + \gamma AR(1) + \varepsilon_{b,t} \quad (4)$$

where $r_{b,t}$ denotes the daily return for each sector on day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB and $AR(1)$ denotes the daily return of each sector on day t-1, included to capture the autocorrelation of daily returns.

In this equation, β show the effect of the monetary policy surprises on each sector returns. If the β is positive (negative), it implies that unexpected increase in policy rate will lead to higher (lower) sector returns. If β equals to zero, it means that the monetary policy surprises has no effect on sector returns.

Then, to further test if any sector is more responsive to the unexpected policy rate change than the average of other sectors, I employ the mean-difference test as of the following equation;

$$r_{i,t} = \alpha + \beta_1 s_{a,t} + \beta_2 s_{a,t} x_{i,t} + \gamma x_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $r_{i,t}$ denotes the daily return for each stock on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; and $x_{i,t}$ denotes industry affiliation of each stocks.

The difference-from-average in reaction of each sector can be observed from β_2. For instance, if β_2 is significantly different from zero and have a negative (positive) sign, it means that the sector significantly reacts more negatively (positively) than average of other sectors.

3.2.3 Monetary Policy Surprise Effect – Individual Stock Level

Next, as each individual stocks do not react to the monetary surprises in the same level, the question is raised up, why each stock reaction to the monetary

surprise is so different across stocks, and whether the different in the level of reaction can be attributed to the different in characteristics. In this section, I will investigate that which types of stocks are affected primarily strongly by Fed and ECB monetary policies. I choose four characteristics to study for this heterogeneity in reaction; the four characteristics include export dummy, CAPM beta, market value, and the percentage of foreign holding. It is expected that export firms, high CAPM beta stocks, large stocks, and high percentage of foreign holding stocks should react more strongly to the monetary surprises as stated in the hypothesis 3.

I use two approaches to test for the heterogeneity in reaction of stocks with each different characteristics; conventional approach which is employed in most literatures and data pooling approach which is used in Ehrmann and Fratzscher (2004). Each approach has different advantages and disadvantages as stated in the explanations below.

Conventional Approach

There are some benefits by using the conventional approach. First, it allows for the presence of fixed effect that might cause from pooling the cross-sectional data. Second, any potential collinearity between independent variables can be easily observed from the result in case that it exists.

First step of this approach is estimating the reaction of stocks to monetary surprises on a stock by stock basis, and then explaining the coefficients in a cross-sectional regression as employed in many literatures. The following time-series regression model is used to obtain the β_i estimate of each stock.

$$r_{i,t} = \alpha + \beta_i s_{a,t} + \varepsilon_{i,t} \quad (6)$$

where $r_{i,t}$ denotes the daily return for each individual stock on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB.

After I obtain β_i, which is the estimated level of sensitivity of each individual stock returns to the monetary surprises, then, I run cross-sectional multiple regression by setting the computed β_i of each stock as the dependent variable with average characteristics of that stock x_k as the independent variable. The characteristics

include market capitalization, percentage of foreign holding, export dummy and CAPM beta as in the following regression.

$$\beta_i = \alpha + \sum_k \gamma_k x_k + \varepsilon_i \quad (7)$$

where β_i denotes the level of sensitivity of each individual stock returns to the monetary surprises, obtained from the previous regression; x_k denotes the stock characteristics, include market capitalization, percentage of foreign holding, export dummy and CAPM beta.

The analysis is done by testing the significance of each γ_k for each variable. The estimated γ_k indicates the relationship between stock characteristics and the level of stock reaction to monetary surprises. If the γ_k is significant, it would mean that the asymmetry in reaction between stocks can be attributed to specific characteristic k. For instance, if γ_k is negative, it implies that stocks with higher value of that characteristic react more negatively to the unexpected increase in policy rate, and vice versa.

Data Pooling Approach

Another alternative approach to test for heterogeneity in reaction between different stock characteristic is to use the data pooling approach used in Ehrmann and Fratzscher (2004). They describe that there are two reasons to pool the data for this analysis. First, many of firm-specific characteristics are time-varying. In a cross-sectional regression, it is not possible to account for changes in these characteristics over time. Second, pooling allows them to take into account a potential cross-sectional correlation of residuals, which is considered to be a realistic assumption for stock market data: a high residual in one stock is likely to be accompanied by high residuals in other stocks.

However, before using the data pooling approach, I have to test whether the cross-sectional fixed-effect exists. Fixed-effect occurs when the difference in reaction of stock price comes from other unobserved stock characteristics; the dependent variable (stock returns) is mainly explained by the variation between each stock. When the fixed-effect exists, pooling of data across different stocks is not appropriate for the analysis. Therefore, I have to test whether the fixed-effect is

significantly exists in the data. If there is no fixed-effect in the data, then, I can follow the data pooling approach.

Data pooling approach analyzes data in a panel framework of all stocks, using panel regressions of the form;

$$r_{i,t} = \alpha + \beta_1 s_{a,t} + \sum_{z=1,2} \beta_{z,2} s_{a,t} x_{z,i,t} + \sum_{z=1,2} \gamma_z x_{z,i,t} + \varepsilon_{i,t} \quad (8)$$

where $r_{i,t}$ denotes the daily return for each stock on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; and $x_{z,i,t}$ denotes firm-specific characteristic which are market value, percentage of foreign holding, export and foreign revenue dummy, CAPM beta. Note that for market value, which varies with the stock price, I use one lag to avoid problem with endogeneity of the regressor.

Each characteristic,x, is categorized into three groups; low, medium, and high. The categorization is made according to the following specification: each firm's respective variable is defined to be "low" if it is in the bottom 33%, "high" if it is in the top 33%, and "medium" otherwise. $x_{1,i,t}$ $(x_{2,i,t})$ are dummy variables which takes value of 1 if the stock is in low (high) group. In the equation, the sum of β_1 and $\beta_{z,2}$ show the level of characteristic-specific stock reaction to the monetary policy surprises.

To account for the dependence across observations, I estimate Equation (8) via OLS using panel-corrected standard errors (PCSE). This estimator corrects for heteroskedasticity and assumes that residuals are contemporaneously correlated across panels, and estimates the covariance of the OLS coefficients as

$$\hat{V} = (X'X)^{-1} X' \Omega X (X'X)^{-1} \quad (9)$$

where Ω is the covariance matrix of the residuals: $\Omega = \Sigma_{m \times m} \otimes I_{T_i \times T_i}$; I is an identity matrix and Σ the $m \times m$ panel-by-panel covariance matrix of the residuals, formulated as

$$\hat{\Sigma}_{ij} = \frac{\varepsilon_i' \varepsilon_j}{T_{ij}} \quad (10)$$

where ε_i and ε_j are the residuals for panels i and j from Equation (8) and T_{ij} is the number of residuals between the panels that can be matched by time period.

For the analysis, firms have been divided into three groups according to their position in the cross-sectional distribution of each variable, which has been calculated on a daily basis. For firms to be included in the low group, they have to be in

the bottom third of the distribution of each respective variable. For the medium group and high group, they must be in the middle third and the top third of the distribution respectively. I test each variable in the equation (8) separately from each other.

To find for the effect of each variable, the sum of β_1 and $\beta_{z,2}$ are calculated, this number capture the size of the reaction of a specific-characteristic group of stock to the monetary policy surprise. Finally, I test whether the different in stock reaction to monetary policy is related to the different in level of each characteristics, so I find whether the coefficient of low level and high level groups is different from the medium level group by examine whether $\beta_{z,2}$ is significantly different from zero.

3.2.4 Economic Cycle Variation in Monetary Surprise Effect

The last analysis focuses on the heterogeneity in reaction of stock market during different state of economy. During, different state of economy, market participants might react to the news in dissimilar way. This section is to investigate whether the market reacts in the same way during each state of economy, and which state of economy that market react more or less than other. It is expected that the market should react more strongly during the recession than during the expansion, as explained in the hypothesis 4. I analyze the economic cycle variation in reaction of stock index to monetary surprise by using the following regression form;

$$r_t = \alpha + \beta_1 s_{Fed} Rec + \beta_2 s_{Fed} Exp + \gamma AR(1) + \varepsilon_t \quad (11)$$

where r_t denotes the daily stock market return on the day after the announcement; s_{Fed} denotes the monetary policy surprises for Fed; Rec denotes recession dummy obtained from NBER, equal to 1 if the economy is in recession, otherwise 0; Exp denotes expansion dummy, equal $1 - Rec$; and $AR(1)$ denotes the daily market return on day t-1, included to capture the autocorrelation of daily returns.

β_1 and β_2 capture the reaction of the stock market return to monetary surprise during the period of recession and expansion, respectively. To tell whether the reaction of stock market to Fed's surprise is state-dependent, I compare the coefficient β_1 and β_2. If both coefficients are significantly different from each other, it indicates that stock reactions to the monetary policy shock vary across economic cycle.

CHAPTER IV
EMPIRICAL RESULTS AND RESULT DISCUSSION

This chapter shows statistical results and discussion for all hypotheses on the impact of Fed and ECB's monetary policy shock on Thai stock market. I start with the result for overall SET index, and then discuss the result in sector level, stock characteristic level, and economic-cycle variation of the effect.

4.1 Effects of Monetary Policy on Overall SET Index

SET index is higher 4.25%, on average, in response to 1% unexpected decrease in Fed fund policy rate, as the result shown in table 7. The scatter plot in figure 3a also shows that negative relationship exists between Fed's monetary policy surprise and SET index return. This is consistent to my hypothesis 1 that SET index should response negatively to unexpected change in policy rate. The result is in line with the past literatures that study the monetary effect on Thai stock index in prior period, such as Ehrmann and Fratzscher (2006), Hausmann and Wongswan (2006), Kim and Nguyen (2009), and Wongswan (2009) which find that an unexpected cut in Fed policy rate of 100 basis point lead to a higher SET index about 4.5%-6%.

The explanation is given by Ehrmann and Fratzscher (2006) that the foreign stock market react to the unexpected change in Fed's policy rate through two paths; foreign asset price reaction and U.S. asset price reaction. First, for the effect of foreign asset price reaction, the foreign country is affected from change in global interest rate. Since the U.S. is a large open economy, the decrease in the U.S. real interest rate leads to the decrease in the world real interest rate if the world capital market is integrated to some extent. Kim (2001) explains that when the real interest rate is lower, the demand for current goods and current consumption increase because a lower in real interest rate implies that current goods become relatively cheaper compare to future goods. The current investment demand is also higher as the opportunity cost of current investment is lower. Therefore, the decrease in the world real interest rate raises the world demand for consumption and investment. Consumption and investment (therefore, output) in both the U.S. and non-U.S. countries may increase since the real

interest rate fall in both the U.S. and non-U.S. countries. In addition, the decrease in world interest rate would also cause the discount rate to be lower. Thus, the stock price is higher due to increase in cash flows and decrease in discount rates. Another monetary transmission passes through the U.S. price reaction, when Fed's policy rate is unexpectedly decreased, there is a drop in domestic interest rate, therefore the demand for investment and consumption of U.S. countries is higher. As a result, demand for foreign goods also increase and the foreign stock market react positively to an unexpected cut in Fed's policy rate. As a result, both U.S. and foreign stock price is higher. From all explanation on both paths of monetary transmission, Thai stock increase when there is unexpected cut in Fed's policy rates.

For the result of the ECB monetary surprise reaction, the result is not statistically significant, see table 7. The scatter plot between ECB surprise and SET index return in figure 3b also shows no relationship. Although the result is not consistent with my hypothesis, it is similar with past literature. Kim and Nguyen (2009) finds no significant reaction of Thai stock market, as well as most of Asia-Pasific stock markets, to the ECB surprise. They hypothesized that investors in the Asia-Pacific stock markets were less clear on the information contents of the ECB's news.

The coefficient on lagged market return that I add to capture the correlation of past returns appears insignificant. Therefore, I conclude that in this model, the daily return is not autocorrelated for either Fed or ECB result. The estimated parameter for the intercept is insignificant for Fed but significant for ECB. This can be interpreted that when the ECB policy surprise is equal to zero, the SET index generally increases on the day after the announcement by 0.40% at 1% significant level. However, the estimated parameter is very low, so it is not economically significant.

Table 7: The Reaction of SET Index to Fed and ECB's Monetary Policy Surprise

	Estimates	
	Fed	ECB
Intercept	0.0024	0.0040
	(1.36)	(3.38)***
Monetary Policy Surprise	-0.0425	0.0295
	(-2.10)**	(1.32)
Lagged Market Return	-0.0301	-0.0685
	(-0.28)	(-0.90)
R-Square	0.0722	0.0254
N	63	96

Note: The table reports coefficients of the regression: $r_t = \alpha + \beta s_{a,t} + \gamma AR(1) + \varepsilon_t$ where r_t denotes the daily stock market return on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; and $AR(1)$ denotes the daily market return on the day t, included to capture the autocorrelation of daily returns. The numbers in the parenthesis are the t-statistics. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively.

Figure 3a: Scatter Plot of Daily SET Index Returns and Unexpected Change in Fed's Monetary Policy

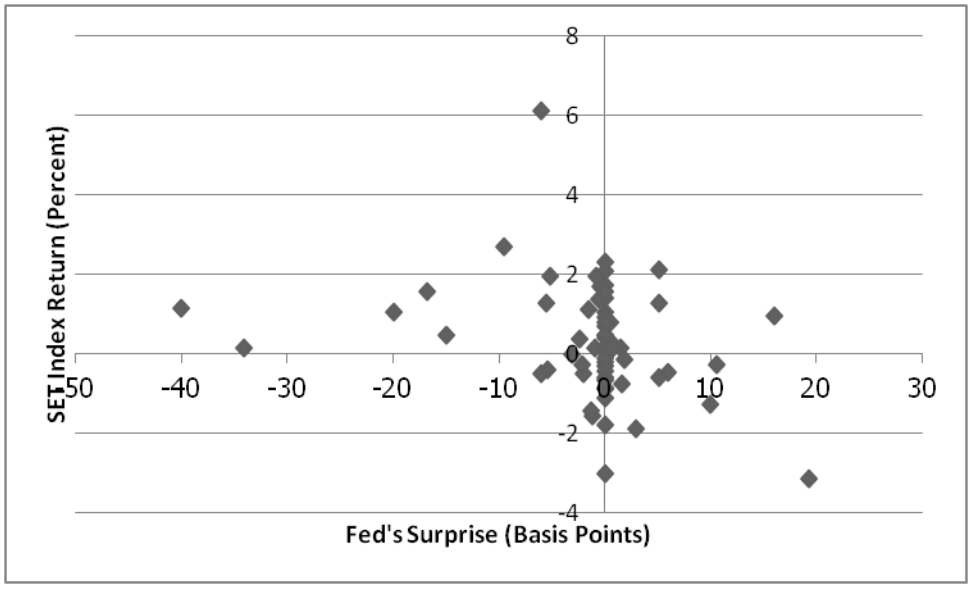
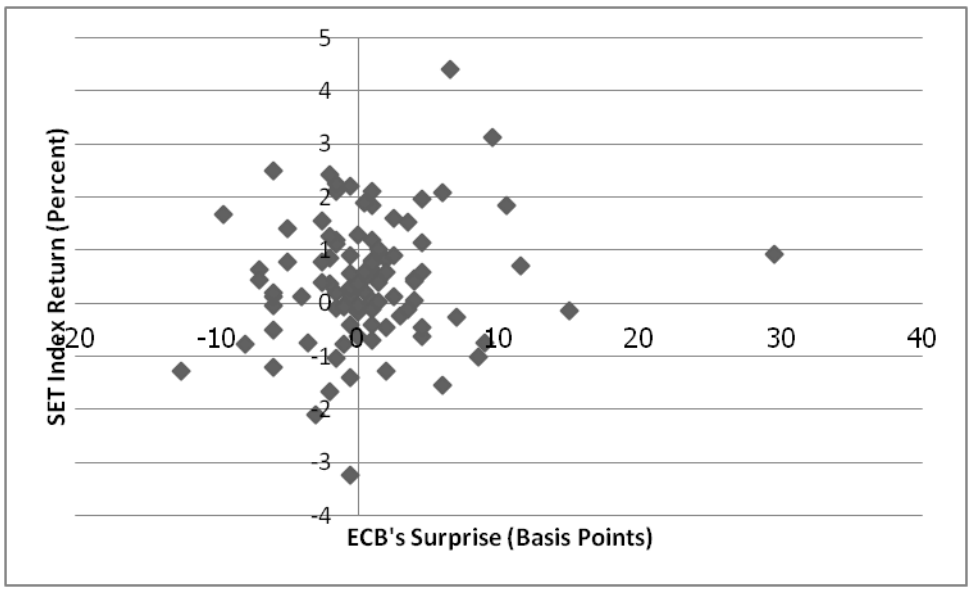


Figure 3b: Scatter Plot of Daily SET Index Returns and Unexpected Change in ECB's Monetary Policy



4.2 Effects of Monetary Policy by Sector

The result of heterogeneity in sector reaction on Fed and ECB monetary policy surprises is shown in table 8a and 8b. The sector that reacts most to Fed's monetary policy surprise is the financial sector, followed by industrials sector, resources sector, and property and construction sector. On average, financial sector, industrials sector, resources sector, and property and construction sector decrease 6.20%, 5.51%, 5.47%, and 4.99% respectively, when Fed unexpectedly increase its policy rate by 1%. Furthermore, the financial sector also reacts significantly higher than average to Fed's policy surprise.

This is consistent with my hypothesis 2 that financial and cyclical and capital-intensive sector should react significantly and stronger than other sectors. The result is also similar to Ehrmann and Fratzscher (2006)'s study of U.S. monetary policy effect on foreign stocks and Ehrmann and Fratzscher (2004)'s study of U.S. monetary effect on U.S. stocks that finds higher sensitivity of reaction for cyclical and capital intensive sector.

However, the result in this study might raise a question whether some sector can be defined as cyclical. First, for the resources sector which is generally defined as defensive, but for the case of Thai market, resources is rather cyclical than defensive as major revenue of this group of firms are from industrial producer firms whom their demand is cyclically swing with economic cycle. In contrast, the technology sector in Thailand is rather defensive than cyclical. Because major stocks in technology sector include communication stocks which are basis infrastructure, sales and revenue are rather stable and do not change much with the economic cycle. Therefore, I still conclude that the result in this study is consistent with the hypothesis.

The reason that stocks in each sector react differently to the monetary surprise could be that each sector is exposed to different risk factors. Ehrmann and Fratzscher (2004) explain reason that capital intensive and cyclical sectors are affected more by the monetary policy is that their products and source of fund are interest-sensitive. First, under the credit channel, capital-intensive industries should be more affected from changes in cost of capital that induces by monetary policy. Second, under the interest rate channel, the impact of monetary policy on cyclical industries that

product demands are interest-sensitive should be stronger than those with less interest-sensitive product demand. As the increase in U.S. policy rate leads the global interest rate to be higher, the result of sector reaction for Thai stock market is consistent with the above argument of Ehrmann and Fratzscher (2004).

For the ECB's monetary policy effect, the result shows no significant reaction on sector level. This is consistent with the result of overall SET index reaction in previous section. If investors in the Asia-Pacific stock markets were in fact less clear on the information contents of the ECB's news, it is not surprising that there is no significant difference in each sector return.

Table 8a: The Reaction each Sector to Fed's Monetary Policy Surprise

	Overall effect		Difference from average		
Sector	β	t-stat	β_2	t-stat	R^2
Financials	-0.0620	-2.37**	-0.0368	-1.98**	0.0980
Industrials	-0.0550	-1.80	0.0058	0.23	0.1491
Resources	-0.0547	-1.88	-0.0029	-0.14	0.1006
Property & Construction	-0.0499	-2.36**	-0.0077	-0.52	0.2294
Services	-0.0235	-0.93	0.0293	1.77	0.0293
Agri & Foods	-0.0182	-1.00	0.0076	0.30	0.0254
Consumer Products	-0.0182	-1.00	0.0384	0.36	0.4058
Technology	0.0060	0.22	0.0061	0.29	0.2068

Table 8b: The Reaction each Sector to ECB's Monetary Policy Surprise

	Overall effect		Difference from average		
Sector	β	t-stat	β_2	t-stat	R^2
Financials	0.0469	1.38	0.0237	1.61	0.0304
Industrials	-0.0092	-0.23	-0.0323	-1.64	0.0014
Resources	0.0366	1.15	-0.0119	-0.77	0.0303
Property & Construction	0.0368	1.29	0.0205	1.75	0.0317
Services	0.0190	1.03	-0.0104	-0.79	0.0125
Agri & Foods	0.0179	0.84	-0.0048	-0.24	0.0109
Consumer Products	-0.0288	-0.73	-0.0573	-0.88	0.0613
Technology	0.0057	0.18	-0.0111	-0.67	0.0054

Note: The tables report coefficients from the regression: $r_{b,t} = \alpha + \beta s_{a,t} + \gamma r_{b,t-1} + \varepsilon_{b,t}$ where $r_{b,t}$ denotes the daily return of each sectors on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; and $AR(1)$ denotes the daily return of each sector on day t, included to capture the autocorrelation of daily returns. For the difference from average is calculated from $r_{i,t} = \alpha + \beta_1 s_{a,t} + \beta_2 s_{a,t} x_{i,t} + \gamma x_{i,t} + \varepsilon_{i,t}$ where $r_{i,t}$ denotes the daily return of each stock on the day after the announcement; and $x_{i,t}$ denotes the dummy variable which takes value of 1 for stocks of sector b, and 0 otherwise. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively.

4.3 Effects of Monetary Policy by Stock Characteristic

Before investigating the characteristics, first, I would like to point out that the reaction of each individual stock to the monetary policy is highly heterogeneous. The result is obtained from the regression between Fed's and ECB's monetary surprise and the individual stock returns using the previous equation (6).

$$r_{i,t} = \alpha + \beta_i s_{a,t} + \varepsilon_{i,t} \quad (6)$$

where $r_{i,t}$ denotes the daily return for each individual stock on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB.

Figure 4a and 4b provide the distribution of individual stock response to the monetary policy shock. The reaction of each stocks are highly asymmetry, range from -0.11 to 0.09 for Fed's reaction, and -0.13 to 0.17 for ECB's reaction.

Figure 4a: Distribution of Fed's Surprise Effects across SET100 Stocks

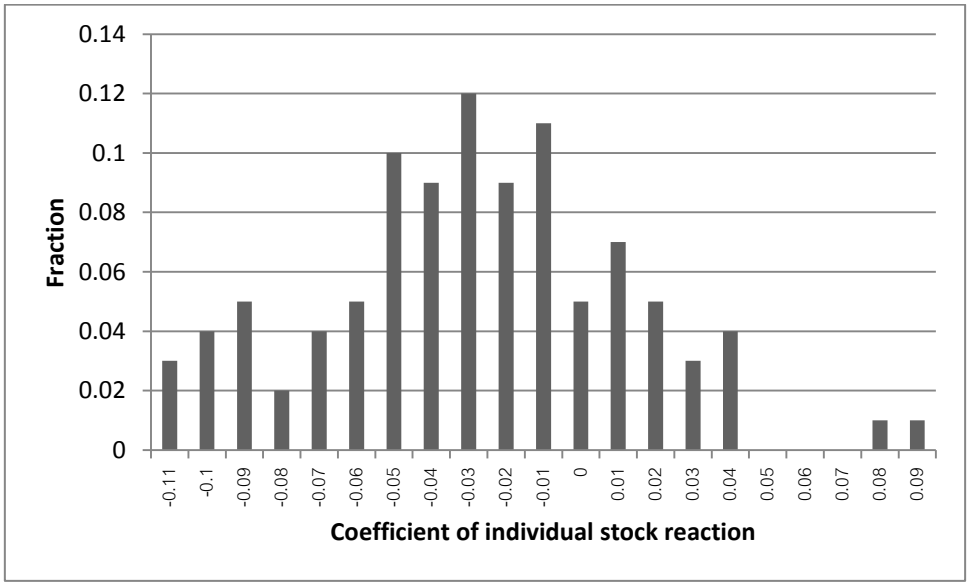
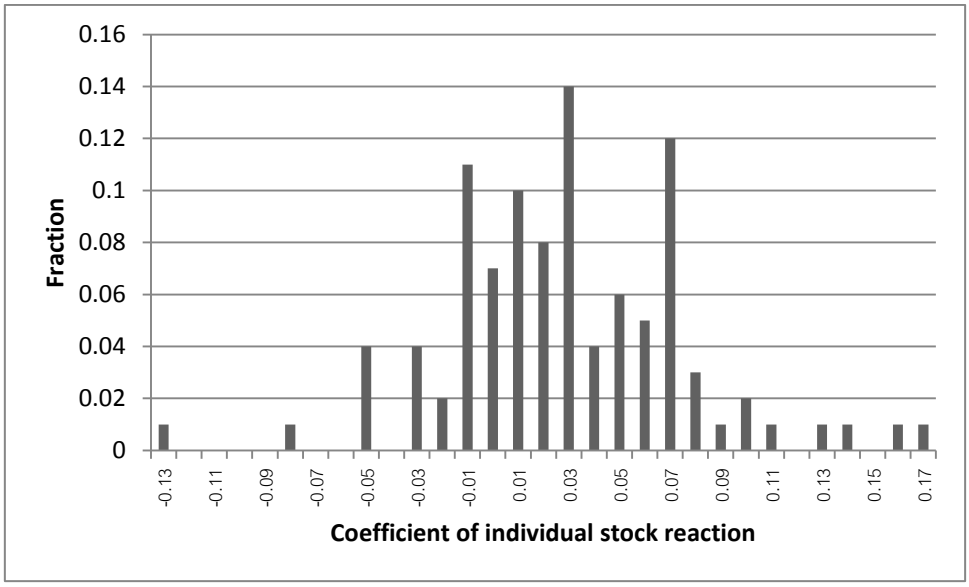


Figure 4b: Distribution of Fed's Surprise Effects across SET100 Stocks



To find the stock characteristics that drive the heterogeneity in stock reaction, I use two approaches; conventional approach and data pooling approach. Both methods offer some unique benefits and drawbacks. Therefore, I decide to use both methods. The conventional approach allows for the presence of fixed effect in the data and it is easier to observe any potential collinearity between independent variables from the result. Though, I have to assume that stock characteristics are time-invariant and this method does not allow for any possible cross-sectional correlation of residuals. The data pooling approach allows stock characteristics to be time-varying and it also take into account a potential cross-sectional correlation of residuals, which is considered to be a realistic assumption for stock market data. Nevertheless, I have to make two strong assumptions that there is no fixed-effect and no collinearity between independent variables.

Before testing for heterogeneity in stock reaction by data pooling method, the data must be tested for the fixed-effect, whether the difference in reaction of stock price actually comes mostly from other unobserved stock characteristics. The result of fixed-effect test is shown in table 10a and 10b. For Fed announcement dates, the p-value for cross-sectional overall fixed-effect test is 0.37. For ECB announcement dates, the p-value for cross-sectional overall fixed-effect test is 0.88. The results show

no significant p-values for both Fed and ECB samples. This implies that variation in the dependent variable (stock returns) is not solely explained by the variation between each stock. Thus, this enables the use of the data pooling regression method.

The results of both conventional and data pooling approach are discussed below by characteristics. Although, each method does not give exactly the same result but the result is quite comparable.

1. Export and Foreign Revenue

For the Fed monetary surprise result, in table 9a, the coefficients of export are not significant in all models with value ranging from 0.007 to 0.011. In table 10a, the sum of $\beta_1 + \beta_{z,2}$ coefficients of stocks in non-export and export groups are -0.0346, and -0.0248, respectively. The reaction between non-export and export group is not significantly different with p-values of 0.2290. The result does not show any differences between export and non-export firms reaction on Fed surprise. However, from table 9b and 10b, for ECB surprise, stocks of export firms react in more negative way than stocks of non-export firms as the coefficients of export dummy in table 9b are about -0.024 in all models which are significant at 5% and 1%. In table 10b, $\beta_1 + \beta_{z,2}$ coefficients of stocks in non-export and export groups are -0.0387, and -0.0178, respectively. The reaction between non-export and export group is significantly different from each other with p-values of 0.0190.

Only the result on ECB surprise reaction supports the hypothesis 3.1 that stocks that are related to export and foreign revenues should react more positively to Fed or ECB's monetary policy rate cut than stocks that are non-export and foreign revenue related. The explanation that export firms and firms that have foreign revenue react more positively to ECB interest rate cut is given by Kim (2001). He explains that a cut in major countries policy rates leads to a decrease in global interest. This would stimulate the world aggregate demand of goods and services for domestic and foreign firms. As a result, both exports and imports of all countries also increase. This would signal positive increase in cash flows of firms that their businesses involve export or receive revenue from foreign customers. The reason that the result for Fed surprise is not significant might come from the fact that, in our data, the major negative surprises for Fed happened during the recession. In the recession, world demand decreased

which mitigates the increase in demand from policy rate cut. Therefore, these two opposite effects could crowd out each other and then make the result insignificant.

2. CAPM Beta

For effect of Fed monetary policy shock, table 9a and 10a shows that stocks with different level of CAPM beta react differently. In table 9a, the coefficients of CAPM beta in every model are in negative sign (about -0.03) which are also significant at 1%. In table 10a, $\beta_1 + \beta_{z,2}$ tells the level of reaction for each level of the characteristic. The coefficients of stocks with low, medium, and high CAPM beta are -0.0133, -0.0370, and -0.0395, respectively. Also, the reaction of low CAPM beta group to Fed's monetary policy surprise is significantly less responsive than the medium CAPM beta group at 1% significant level with p-value of 0.0073. However, the reaction of high CAPM beta group is not significantly different from the medium CAPM beta group with p-value of 0.8148. For effect of ECB monetary policy shock, in table 9b, the coefficients of CAPM beta in every model are not significant (they are from 0.005 to 0.01). In table 10b, $\beta_1 + \beta_{z,2}$ tells the level of reaction for each level of the characteristic. The coefficients of stocks with low, medium, and high CAPM beta are 0.0224, 0.0158, and 0.0499, respectively. The reaction of low CAPM beta stocks to ECB monetary policy surprise is not significantly different from the reaction of medium CAPM beta stocks with p-values of 0.5013. While the reaction of high CAPM beta stocks to ECB monetary policy surprise is significantly different from the reaction of medium CAPM beta stocks with p-values of 0.0104.

The result is consistent with the hypothesis 3.2 for Fed result that high beta firms should react more negatively to unexpected increase in Fed interest rate announcement than low beta firms. The result implies that the Fed monetary policy is one of the systematic risk factor for Thai stock market, consistent with the argument of Wongswan (2009). When there is a decrease in U.S. policy rate, the expected domestic excess return (risk premiums) would increase. Therefore, stocks that are more responsive to the market movement (as captured by CAPM beta) would react more strongly to the monetary policy surprise. However, the result on ECB surprise is not statistically significant for CAPM beta. It could be because that the overall market reaction is not found, therefore, the effect of different in CAPM beta might not persist.

3. Percentage of Foreign Holding

The result for Fed monetary policy shock in table 9a shows that, for the percentage of foreign holding, the coefficients in all models are all equal to -0.0005 which are significant at 5%. However, the parameter estimator is very low, therefore, it is not economically significant. In table 10a, the sum of $\beta_1 + \beta_{z,2}$ coefficients of stocks with low, medium and high percentage of foreign holding are -0.0228, -0.0348, and -0.0316, respectively. Both the reactions of low and high percentage of foreign holding stocks to Fed monetary policy surprise are not significantly different from the reaction of medium group with p-values of 0.2926 and 0.7206 respectively. For the result of ECB, the results from neither approach, in table 9b and 10b, show significant difference in reaction of firms with different level of foreign holding. In table 9b, the coefficients are 0.0004 in every model which is not significant. In table 10b, the sum of $\beta_1 + \beta_{z,2}$ coefficients of stocks with low, medium and high percentage of foreign holding are 0.0241, 0.0248, and 0.0364, respectively. Both the reactions of low and high percentage of foreign holding stocks to ECB monetary policy surprise are not significantly different from the reaction of medium group with p-values of 0.9539 and 0.2649 respectively.

The result is inconsistent with the hypothesis 3.3. Therefore, I conclude that stocks with different level of foreign equity holding do not response differently to a surprise change in Fed and ECB's interest rate announcement. The reason could be that the percentage of foreign holding is subjected to the SEC regulation that some stocks cannot be held by foreign investors by more than certain percentages (usually 50%). Thus, the demand to buy some stocks is capped by this limit and stock could not react as the hypothesis predict, as the hypothesis assume no regulation on foreign holding exists.

4. Market Value

For the Fed surprise result, the result from conventional approach in table 9a show that the coefficients of firm size (market value) is significant at 5% significant level only in the models that exclude CAPM beta with value of about -0.12. In the models with CAPM beta, the coefficients are approximately -0.09 and are not significant. This indicates that this variable, market value, is dominated by CAPM beta variable. For the data-pooling approach in table 10a, the sum of $\beta_1 + \beta_{z,2}$ coefficients for low, medium,

and high market value are -0.0209, -0.0294, and -0.0386 respectively. Both the reactions of low and high market value groups to Fed monetary policy surprise are not significantly different from the reaction of medium group with p-values of 0.3747 and 0.3117 respectively. For the result of ECB, the results from both approach, in table 9b and 10b, do not show significant difference in reaction of firms with different level of market capitalization. In table 9b, the coefficients for market value are not significant in all models. In table 10b, the sum of $\beta_1 + \beta_{z,2}$ coefficients for low, medium, and high market value are 0.0314, 0.0258, and 0.0286 respectively. Both the reactions of low and high market value groups to ECB monetary policy surprise are not significantly different from the reaction of medium group with p-values of 0.6369 and 0.7739.

The result does not strongly support that hypothesis 3.4 is true, that large stocks should response more negatively to a surprise increase in Fed and ECB's interest rate announcement than small stocks. Since I hypothesize that large stocks should response more negatively to a surprise increase in Fed or ECB's interest rate announcement than small stocks as small stocks tend to have delay in reaction to news. The result does not support the hypothesis might be because that in my samples, I use only the 100 highest capitalized stocks to avoid the illiquidity issue. All the stocks in this group might be large enough that the delay in reaction is not significantly different across sample of stocks. It should also be noted that the coefficient of market value is not significant when the CAPM beta variable is included into the model. The result seems to indicate that there is no direct effect of market value to stocks reaction to Fed's monetary policy surprise but there is an indirect effect through the CAPM beta.

Table 9a: Fed's Surprise Effects by Stock Characteristic – Conventional Approach

Model	Intercept	Export	Beta	% Foreign Hldg.	MV (milBaht)	N	R^2
(1)	0.0116	0.0081	-0.0305	-0.0005	-0.0885	100	0.18
	(0.95)	(1.05)	(-2.98)***	(-2.14)**	(-1.58)		
(2)	0.0005	0.0081	-0.0313		-0.0911	100	0.14
	(0.04)	(1.03)	(-3.00)***		(-1.60)		
(3)	0.0120	0.0069	-0.0335	-0.0005		100	0.16
	(0.96)	(0.89)	(-3.31)***	(-2.14)**			
(4)	-0.017	0.0117		-0.0005	-0.1200	100	0.11
	(-2.04)**	(1.48)		(-2.24)**	(-2.10)**		
(5)	0.017		-0.0322	-0.0005	-0.0830	100	0.17
	(1.51)		(-3.18)***	(-2.14)**	(-1.49)		
(6)	0.001	0.0069	-0.0345			100	0.12
	(0.05)	(0.87)	(-3.34)***				
(7)	-0.020	0.0106		-0.0005		100	0.06
	(-2.49)**	(1.32)		(-2.18)**			
(8)	-0.011			-0.0005	-0.1143	100	0.09
	(-1.52)			(-2.24)**	(-1.99)**		
(9)	0.006		-0.0330		-0.0856	100	0.13
	(0.56)		(-3.22)***		(-1.51)		
(10)	-0.029	0.0119			-0.1236	100	0.06
	(-4.96)***	(1.47)			(-2.12)**		
(11)	0.016		-0.0348	-0.0005		100	0.15
	(1.46)		(-3.48)***	(-2.14)**			
(12)	-0.033	0.0107				100	0.02
	(-5.85)***	(1.31)					
(13)	0.005		-0.0358			100	0.11
	(0.50)		(-3.51)***				
(14)	-0.024				-0.1180	100	0.04
	(-5.17)***				(-2.02)**		
(15)	-0.015			-0.0005		100	0.05
	(-2.10)**			(-2.18)**			

Note: The table reports coefficients from the regression $\beta_i = \alpha + \sum_k \gamma_k x_k + \varepsilon_i$. β_i is computed for each stocks using the regression $r_{i,t} = \alpha + \beta_i s_{a,t} + \varepsilon_{i,t}$ where $r_{i,t}$ is the daily stock return on the day after the announcement; $s_{a,t}$ is the monetary policy surprises for Fed or ECB; and x_k is average characteristics of each stock which are market capitalization, percentage of foreign holding, percentage of export to total revenue and CAPM beta as in The following regression. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively.

Table 9b: ECB's Surprise Effects by Stock Characteristic – Conventional Approach

Model	Intercept	Export	Beta	% Foreign Hldg.	MV (milBaht)	N	R^2
(1)	0.0249	-0.0235	0.0049	0.0004	0.0025	100	0.09
	(1.69)	(-2.52)**	(0.39)	(1.48)	(0.04)		
(2)	0.0343	-0.0237	0.0057		0.0047	100	0.07
	(2.55)**	(-2.52)**	(0.45)		(0.07)		
(3)	0.0249	-0.0235	0.0050	0.0004		100	0.09
	(1.70)	(-2.54)**	(0.41)	(1.48)			
(4)	0.0294	-0.0240		0.0004	0.0076	100	0.09
	(3.12)***	(-2.62)**		(1.52)	(0.12)		
(5)	0.0100		0.0095	0.0004	-0.0135	100	0.03
	(0.72)		(0.75)	(1.52)	(-0.19)		
(6)	0.0343	-0.0236	0.0058			100	0.07
	(2.56)**	(-2.54)**	(0.48)				
(7)	0.0296	-0.0240		0.0004		100	0.09
	(3.23)***	(-2.63)***		(1.58)			
(8)	0.0182			0.0004	-0.0040	100	0.02
	(2.10)**			(1.56)	(-0.06)		
(9)	0.0195		0.0103		-0.0114	100	0.01
	(1.56)		(0.82)		(-0.16)		
(10)	0.0396	-0.0243			0.0107	100	0.07
	(5.92)***	(-2.63)***			(0.16)		
(11)	0.0099		0.0090	0.0004		100	0.03
	(0.72)		(0.74)	(1.52)			
(12)	0.0400	-0.0242				100	0.07
	(6.34)***	(-2.63)***					
(13)	0.0194		0.0099			100	0.01
	(1.57)		(0.80)				
(14)	0.0286				-0.0010	100	0.00
	(5.32)***				(-0.01)		
(15)	0.0180			0.0004		100	0.02
	(2.18)**			(1.56)			

Note: The table reports coefficients from the regression $\beta_i = \alpha + \sum_k \gamma_k x_k + \varepsilon_i$. β_i is computed for each stocks using the regression $r_{i,t} = \alpha + \beta_i s_{a,t} + \varepsilon_{i,t}$ where $r_{i,t}$ is the daily stock return on the day after the announcement; $s_{a,t}$ is the monetary policy surprises for Fed or ECB; and x_k is average characteristics of each stock which are market capitalization, percentage of foreign holding, percentage of export to total revenue and CAPM beta as in The following regression. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively.

Table 10a: Fed's Monetary Policy Surprise Effects by Stock Characteristic

Data Pooling Approach

	$\beta_1+\beta_{z,2}$	t-stat	$\beta_{z,2}$	t-stat
Export				
Non-export and foreign revenue	-0.0346	-5.66***	-	-
Export and foreign revenue	-0.0248	-4.68***	0.0098	1.21
CAPM beta				
Low	-0.0133	-2.03**	0.0238	2.74***
Medium	-0.037	-6.35***	-	-
High	-0.0395	-4.54***	-0.0025	-0.23
Percentage of foreign holding				
Low	-0.0228	-2.57**	0.012	1.06
Medium	-0.0348	-5.28***	-	-
High	-0.0316	-4.85***	0.0032	0.36
Market value				
Low	-0.0209	-2.74***	0.0085	0.89
Medium	-0.0294	-4.95***	-	-
High	-0.0386	-5.64***	-0.0093	-1.02
	Cross-section Chi-square		p-value	
Fixed Effect Test	103.1		0.37	

Note: The table report coefficients from the regression $r_{i,t} = \alpha + \beta_1 s_{a,t} + \sum_{z=1,2} \beta_{z,2} s_{a,t} x_{z,i,t} + \sum_{z=1,2} \gamma_z x_{z,i,t} + \varepsilon_{i,t}$ where $r_{i,t}$ denotes the daily return for each stock on announcement dates; $x_{z,i,t}$ denotes firm-specific characteristic which are market value, percentage of foreign holding, export and foreign revenue dummy, CAPM beta. Each characteristic,x, is categorized into three groups; low, medium, and high. The categorization is made according to the following specification: each firm's respective variable is defined to be "low" if it is in the bottom 33%, "high" if it is in the top 33% and "medium" otherwise. $x_{1,i,t}$ $(x_{2,i,t})$ are dummy variables which takes value of 1 if the stock is in low (high) group, otherwise 0. The regression equation can also be rewritten into the form $r_{i,t} = \alpha + s_{a,t}\,(\beta_1 + \sum_{z=1,2} \beta_{z,2} x_{z,i,t}) + \sum_{z=1,2} \gamma_z x_{z,i,t} + \varepsilon_{i,t}$ In the equation, the sum of β_1 and $\beta_{z,2}$ show the reaction of stock in the specific characteristic to the monetary policy surprises and $\beta_{z,2}$ tell whether the stock in low and high characteristic react differently from the medium group. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively. The bottom part of the table reports the test-statistics for fixed-effect,

Table 10b: ECB's Monetary Policy Surprise Effects by Stock Characteristic

Data Pooling Approach

	$\beta_1+\beta_{z,2}$	t-stat	$\beta_{z,2}$	t-stat
Export				
Non-export and foreign revenue	0.0387	-6.08***	-	-
Export and foreign revenue	0.0178	-2.72***	-0.0209	-2.39**
CAPM beta				
Low	0.0224	-4.09***	0.0067	0.67
Medium	0.0158	-2.01**	-	-
High	0.0499	-5.05***	0.0341	2.61**
Percentage of foreign holding				
Low	0.0241	-2.57**	-0.0007	-0.06
Medium	0.0248	-3.28***	-	-
High	0.0364	-5.38***	0.0115	1.12
Market value				
Low	0.0314	-3.41***	0.0056	0.47
Medium	0.0258	-3.47***	-	-
High	0.0286	-4.26***	0.0029	0.29
	Cross-section Chi-square		p-value	
Fixed Effect Test	82.92		0.88	

Note: The table report coefficients from the regression $r_{i,t} = \alpha + \beta_1 s_{a,t} + \sum_{z=1,2} \beta_{z,2} s_{a,t} x_{z,i,t} + \sum_{z=1,2} \gamma_z x_{z,i,t} + \varepsilon_{i,t}$ where $r_{i,t}$ denotes the daily return for each stock on announcement dates; $x_{z,i,t}$ denotes firm-specific characteristic which are market value, percentage of foreign holding, export and foreign revenue dummy, CAPM beta. Each characteristic,x, is categorized into three groups; low, medium, and high. The categorization is made according to the following specification: each firm's respective variable is defined to be "low" if it is in the bottom 33%, "high" if it is in the top 33% and "medium" otherwise. $x_{1,i,t}$ $(x_{2,i,t})$ are dummy variables which takes value of 1 if the stock is in low (high) group, otherwise 0. The regression equation can also be rewritten into the form $r_{i,t} = \alpha + s_{a,t}\,(\beta_1 + \sum_{z=1,2} \beta_{z,2} x_{z,i,t}) + \sum_{z=1,2} \gamma_z x_{z,i,t} + \varepsilon_{i,t}$ In the equation, the sum of β_1 and $\beta_{z,2}$ show the reaction of stock in the specific characteristic to the monetary policy surprises and $\beta_{z,2}$ tell whether the stock in low and high characteristic react differently from the medium group. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively. The bottom of the table shows the chi-square statistics. The bottom part of the table reports the test-statistics for fixed-effect,

4.4 Effects of US Monetary Policy during Different US Economic Cycle

This section extends the study further to examine for the heterogeneity in SET index reaction to the monetary policy during different economic cycle. I choose to study for this variation of effect Fed surprise reaction in different U.S. economic cycle as there is data on U.S. economic cycle available from the NBER. Table 11 shows that during the US recession, the coefficient of SET index reaction is -0.0733 at a significant of 5%. However, the reaction of SET index is not statistically significant during the US economic expansion. The result indicates that Thai market participants react asymmetrically to the U.S. monetary news. They react significantly only during the recession but not during the expansion. This is consistent to my hypothesis 4 that there is significant cyclical variation in reaction of stock prices to Fed monetary policy.

The explanation for reaction variation during different economic cycle can be argued in two ways; on the credit channel of monetary policy transmission and efficient market theory. First, on the credit channel transmission, the argument is given by Basistha and Kurov (2008) who also find that there is significant cyclical variation in reaction of stock price to the monetary policy. The argument is that a tightening monetary policy action might cause reduction in availability of credit and adverse effect of balance sheet during the recession, and as the financial is integrated at some level, the effect could transmit from one country to another.

In addition, the explanation could also be relies on market efficiency empirical result. Lim, Brooks and Kim (2008) finds that investor reacts more strongly not only to local news, but also the news in other market, (i.e. monetary news) during the crisis. In the result shows that during the crisis, SET index reaction is stronger when there is recession (with the coefficient of -0.0733) in comparison to the average reaction (with the coefficient of -0.0425, shown in table 7). Therefore, I can also conclude that Thai market participants are more sensitive to the monetary news during economic crisis.

Table 11: The Reaction of SET Index to Fed's Monetary Policy Surprise during Different U.S. Economic Cycle

	Estimates
Intercept	0.0022
	(-1.25)
Recession (β_1)	-0.0733
	(-2.35)**
Expansion (β_2)	-0.0212
	(-0.82)
Lagged Market Return	-0.0434
	(-0.40)
R-Square	0.0976
N	63

Note: The table reports coefficients of the regression: $r_t = \alpha + \beta_1 s_{Fed} Rec + \beta_2 s_{Fed} Exp + \gamma AR(1) + \varepsilon_t$ where r_t denotes the daily stock market return on announcement dates; s_{Fed} denotes the monetary policy surprises for Fed; Rec denotes recession dummy obtained from NBER, equal to 1 if the economy is in recession, otherwise 0; Exp denotes expansion dummy, equal to $1 - Rec$; and $AR(1)$ denotes the daily market return on day t-1, included to capture the autocorrelation of daily returns. The numbers in the parenthesis are t-statistics. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively.

4.5 Robustness Test

Over all Fed Result after exclude Extreme Surprises

This last section is the robustness check to test whether the result is still robust after excluding the extreme surprises out of the sample. In the data, I observe that Fed's surprises are highly volatile over time. As shown in Figure 1a, there are some announcements that the surprises are extremely higher than others. The previous results are questioned, whether effects found in previous sections are actually driven by only a few extreme surprises. To examine this question, I cut out two extreme Fed's surprises (with the value of 34 and 40 basis points), and then, test for the SET index reaction once again. If the coefficient still be significant, then the result is quite robust.

Table 12 illustrates the reaction of SET index to Fed's surprise after removing the two extreme surprises. I find that, the result is quite robust with the previous result in table 7, as the coefficient of monetary surprise in both table 7 and table 12 are significantly negative. After removing the extreme surprises, in table 12, the coefficient of monetary surprise is -0.0852 with significant level of 1% comparing to -0.0425 with significant level of 5% in table 7. Meanwhile, the AR(1) term is still insignificant. The result suggests that the effects found in previous sections are not driven by only a few extreme surprises.

Table 12: The Reaction of SET Index to Fed's Monetary Policy Surprise after Removing Extreme Surprises

	Estimates
Intercept	0.0027
	(1.55)
Monetary Policy Surprise	-0.0852
	(-2.77)***
Lagged Market Return	0.0316
	(0.28)
R-Square	0.1202
N	61

Note: The table reports coefficients of the regression: $r_t = \alpha + \beta s_{a,t} + \gamma AR(1) + \varepsilon_t$ where r_t denotes the daily stock market return on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; and $AR(1)$ denotes the daily market return on the day t-1, included to capture the autocorrelation of daily returns. The numbers in the parenthesis are the t-statistics. **, *** indicate that the coefficient is statistically significant at 5%, and 1%, respectively. Sample is the same as used in Fed's surprise effect in table 7, but exclude two extreme Fed's surprises which have the value of 34 and 40 basis points.

Overall Fed Result after Controlling for Economic Crisis

I also perform another robustness test to check whether the SET index reaction to Fed's announcement is still robust after controlling by other factors. As the result could be driven by factors other than Fed's announcement surprises, therefore, controlling for these factors is important. One of the factors that could possibly drive the stock return is the economic crisis. The period of economic crisis in my sample period cover the subprime financial crisis which range from December 2007 through June 2009. I test for the SET index reaction to Fed's surprise with the control variable, dummy of economic crisis, to examine whether the coefficient of Fed's surprise is still significant.

Table 13 illustrates the reaction of SET index to Fed's surprise after controlling for economic crisis event. I find that, the result is quite robust with the previous result in table 7, as the coefficient of monetary surprise in both table 7 and table 13 are significantly negative. After controlling for financial crisis period, in table 13, the coefficient of monetary surprise is -0.0396 with significant level of 10% comparing to -0.0425 with significant level of 5% in table 7. Meanwhile, the AR(1) term is still insignificant. The result suggests that the effects found in previous sections are still reliable after controlling for economic crisis period factor.

Table 13: The Reaction of SET Index to Fed's Monetary Policy Surprise after Controlling for Economic Crisis

	Estimates
Intercept	0.0018
	(0.89)
Monetary Policy Surprise	-0.0396
	(-1.92)*
Economic Crisis Dummy	0.0034
	(0.78)
Lagged Market Return	-0.0259
	(-0.24)
R-Square	0.0817
N	63

Note: The table reports coefficients of the regression: $r_t = \alpha + \beta_1 s_{a,t} + \beta_2 Rec + \gamma AR(1) + \varepsilon_t$ where r_t denotes the daily stock market return on the day after the announcement; $s_{a,t}$ denotes the monetary policy surprises for Fed or ECB; Rec denotes recession dummy equal to 1 if the economy is in recession, otherwise 0; and $AR(1)$ denotes the daily market return on the day t-1, included to capture the autocorrelation of daily returns. The numbers in the parenthesis are the t-statistics. *, **, *** indicate that the coefficient is statistically significant at 10%, 5%, and 1%, respectively. Sample is the same as used in Fed's surprise effect in table 7, but exclude two extreme Fed's surprises which have the value of 34 and 40 basis points.

CHAPTER V

CONCLUSION

This paper analyzes the reaction of Thai stock markets to Fed and ECB's monetary policy surprise in the period 2002 to 2009. Particularly, the paper focuses on the heterogeneity the reaction; whether stocks in different sectors and stocks with different characteristics react in dissimilar manner. Also, this paper investigates further on whether there is any heterogeneity in stock reaction during different state of economy.

In the results of this paper, I find that 1% unexpected cut in Fed's policy rate increase SET index on average by 4.25% which is in line with past researches. Further evidence shows that there is a substantial degree of heterogeneity in the effect of U.S. monetary policy on individual stocks. For the sector level, only four out of eight sectors react significantly to Fed's monetary policy surprises. The four sectors are financial sector, industrials sectors, resources sectors, and property and construction sectors. These sectors are sensitive to the Fed's monetary policy because they are cyclical and capital-intensive sectors, and also for financial sector, in which their product demand and source of funds are interest-sensitive. For the heterogeneity in reaction between different stock characteristics, I find that high-beta stocks are more responsive to Fed's policy surprise than low-beta stocks. This result is in line with Wongswan (2009), and the result implies that US monetary policy is a systematic risk factor for Thai stock market. I also find that the Thai stock market reaction to Fed's policy rate announcements depends on the state of economy. The market only reacts to Fed's announcements during the U.S. recession but not during the expansion. The result suggests that tightening monetary policy action might cause the reduction in availability of credit and adverse effect of balance sheet during the recession, and also market participants are more sensitive to the new during the crisis.

For the ECB's policy surprise, there is no significant reaction of Thai stock in both overall and sector level. However, in the stock characteristic level, I find that stocks that are related to export and foreign revenue react less positive than non-export and foreign revenue related (note that the positive relationship is found between SET index and ECB's surprise, however, not significant). The reason could be that a decrease in interest rate stimulates world aggregate demand for domestic and foreign firms. Thus, the demand for export also increases and firms that their businesses involve export or receive revenue would have positive increase in cash flows.

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Biography

I graduated from BBA - Accounting (international program), Faculty of Commerce and Accountancy, Chulalongkorn University in 2008. During my bachelor degree, I received a scholarship for attending an exchange program at the University of Mannheim, Germany, where I started taking my first finance course. Since then, I have been interested in finance subjects, so I enrolled in the Master of Science in Finance Program at Chulalongkorn University in 2009. During the study, I have participated in many financial competitions, such as Young Financial Research Competition, CFA Global Investment Research Competition, and Rotman International Trading Competition.