Heterogeneity in Reactions to Monetary Policy of Thai Stock Returns

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สิรภพ สวิงทอง : ความหลากหลายของการตอบสนองต่อนโยบายการเงินของผลตอบแทนของหุ้นไทย. (Heterogeneity in Reactions to Monetary Policy of Thai Stock Returns) อ.ที่ปรึกษาหลัก : อ. ดร.นราพงศ์ ศรีวิศาล

งานวิจัยนี้ศึกษาถึงผลกระทบของผลตอบแทนในหุ้นไทยที่ได้รับจากนโยบายการเงินของประเทศไทยและสหรัฐฯ ที่ตลาดไม่คาดคิดทั้งสามระดับได้แก่ ดัชนี อุตสาหกรรม และหุ้นรายตัว ตั้งแต่ มิถุนายน พ.ศ. 2543 ถึง ธันวาคม พ.ศ. 2561 งานวิจัยนี้ยังศึกษาลงไปถึงลักษณะของหลักรัพย์ที่เป็นสาเหตุให้เกิดความหลากหลายในการตอบสนองของผลตอบแทนในระดับหุ้นรายตัวและระดับอุตสาหกรรมต่อนโยบายการเงิน งานวิจัยนี้ได้ใช้แบบจำลอง Structural Vector Error Correction โดยยึดสมมติฐานตาม Kim & Roubini (1999) and Ivrendi & Gulogu (2010) ในการตั้งอัตลักษณ์ของนโยบายการเงินที่ไม่คาดคิด ผลการศึกษาพบว่าดัชนีตลาดหลักทรัพย์แห่งประเทศไทยปรับตัวลดลง 1.12 percentage point เมื่ออัตราดอกเบี้ยนโยบายของธนาคารแห่งประเทศไทยปรับตัวเพิ่มขึ้นหนึ่งส่วนเบี่ยงเบนมาตรฐานโดยที่ตลาดไม่คาดคิด ผลการศึกษายังพบความหลากหลายของการตอบสนองของอุตสาหกรรมไทยต่อนโยบายการเงิน โดยเฉพาะอุตสาหกรรมธุรกิจการเงินที่ตอบสนองติดลบสูงที่สุดต่อนโยบายการเงินแบบเข้มงวดที่ไม่คาดคิดเมื่อเปรียบเทียบกับอุตสาหกรรมอื่น โดยสามารถอธิบายได้จาก capital intensive ratio, return on asset, financial leverage ratio, coverage ratio and foreign sale to total sale และยิ่งไปกว่านั้นหุ้นที่อยู่ในระดับต่ำกว่ายี่สิบเปอร์เซ็นไทล์นั้นล้วนอยู่ในภาคเงินทุนและ ในระดับผลตอบแทนของหุ้นรายตัว งานวิจัยนี้ค้นพบว่า ความหลากหลายของการตอบสนองของหุ้นรายตัวต่อนโยบายการเงินประเทศไทยและสหรัฐที่ไม่คาดคิด ยิ่งไปกว่านั้นงานวิจัยนี้พบว่า capital intensive ratio, return on asset and financial leverage ratio เป็นปัจจัยที่อธิบายความหลากหลายของการตอบสนองของหุ้นรายตัวต่อนโยบายการเงินไม่คาดคิด

สาขาวิชา การเงิน ลายมือชื่อนิสิต

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ปีการศึกษา 2562 ลายมือชื่อ อ.ที่ปรึกษาหลัก

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This paper investigates the effect of Thailand and U.S. monetary policy shock on stock market in Thailand for three level; market, industries and firm level from June 2000 to December 2018. In addition, this paper studies which firm characteristic cause the heterogeneity effect of stock and industry return on monetary policy innovation. Structural Vector Error Correction model follows Kim & Roubini (1999) and Ivrendi & Gulogu (2010) is applied to identify monetary policy shock.This paper finds that SET index return is statistically decrease 1.12 percentage point, on average in reaction to one standard deviation of unexpected increase in Thailand monetary policy shock. This paper also finds the heterogenous reaction of industry level to monetary policy shock. In particular, financial industry reacts outstanding negatively to tightening Thailand monetary policy compared to other industries which can be explained by capital intensive ratio, return on asset, financial leverage ratio, coverage ratio and foreign sale to total sale. Moreover, stock in bottom 20 percentile of financial industry that react to monetary policy shock are all listed in finance & securities sector. In firm level, this paper finds the heterogenous reaction of stock return on Thailand and U.S. monetary policy innovation. Moreover, capital intensive ratio, return on asset and financial leverage ratio explain the heterogenous reaction of stock return on tightening monetary policy shock.

Field of Study:	Finance	Student's Signature
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INTRODUCTION

Background and main problems

Bernanke & Blinder, 1992; Christiano, Eichenbaum, & Evans, 1996 show that monetary policy has a crucial role in stimulating real sector of economy. However, monetary policy action, for example, changes in policy rate, is indirect and delay effect on macroeconomic variables. The direct and instantaneous effect of monetary policy change is through financial market. Understanding the link between monetary policy action and financial assets is important, since changes in financial assets play an important role in several monetary policy transmission channels.

There are many literatures that study the effect of monetary policy on domestic stock market. Bernanke and Kuttner (2005) find a tightening monetary policy shock of 100 basis points lower U.S. equity market returns by 5.5%. Voradat (2010), find a -2.99% response of SET index returns to Thailand tightening monetary policy shock of 100 basis points. Bernanke and Blinder (1992); Ehrmann and Fratzscher (2004) explain that the unexpected monetary tightening lower equity market returns through credit market channel and interest rate channel.

In addition, the monetary policy effect from advanced country such as United States also have spill-over effect on the equity market of other countries. Ehrmann and Fratzsher (2006) find 100 basis points tightening of US monetary policy shock reduces equity returns from 50 countries on average by 3.8%. Koosakulnirund (2011) find the increasing in U.S. policy rate reduces Thailand stock market return by 4.25%. In 2006, Ehrmann and Fratzsher explain that credit channel and exchange rate channel are the transmission channel that link Fed monetary policy on other countries equity market.

Some studies focus on the heterogeneity reaction of stock return to monetary policy shock. From the literature, it can conclude that monetary policy transmission channel, particularly, credit channel and interest rate channel, are the reason behind the heterogenous response of stock market on monetary policy.

For credit channel, Bernanke and Gertler (1989) states that that tightening monetary policy affect commercial banks respond to a tightening monetary policy by shrinking their supply of credit, and thus affect firm that highly depend on bank loan Moreover, the firm's collateral present value also decreases due to increasing in interest rate. As a result, financing external funds, especially for financial constrained firms, is

become more difficult. Another heterogenous response of stock price to monetary policy is related to the response of demand in firm's products. Produced goods which have high sensitivity demand to business cycle, called cyclical firm, is strongly response to monetary policy changes due to high interest sensitivity. This channel is called interest rate channel. Consistent with Dedola and Lippi (2000) and Peersman and Smets (2005) who use durability of the goods as the proxy of investment intensity and find stronger response on investment intensity firm.

Estimating response of asset price on monetary policy effect is complicated from the fact that capital market only response to unanticipated policy action. To solve the problem, Thorbecke (1997) use vector autoregression (VAR) to identify monetary policy shocks and find the response of 8% decreasing in stock return to 100 basis point contractionary monetary policy. Rigobon and Sack (2002, 2003) introduced heteroskedasticity approach to solve this problem and find the lower 6.2% response of asset price on tightening of 100 basis points. Kuttner (2001) and Bernanke and Kuttner (2003) use future federal fund rated combined with event study approach to separated monetary policy shock and find -5.3% effect on stock price return on tightening monetary policy shock.

Although there are many literatures that study the response of stock market on monetary policy innovations, the study in heterogeneity reaction of stock market to U.S. and Thailand monetary policy shock in all three level; overall market, industries and firm level, is still lacking. Moreover, in Thailand context, Varadat (2010) use future policy rate as a proxy of monetary policy shock. However, there are other methodology than event study to examine the reaction of stock market on monetary policy shock, heteroskedasticity approach and Vector autoregression model.

In this paper, I first estimate the U.S. and Thailand monetary policy shock by using a structural vector error correction model (SVECM). The identification restriction of monetary policy shocks follows Kim and Roubini (1999) and Ivrendi and Guloglu (2010). The reasons to follow that particular paper identification restriction is that their identification restriction result is consistent with economic intuition in many countries. After obtaining both Thailand and U.S. monetary policy shock from SVECM, next step is to test the reaction of Thailand stock market on monetary policy shock in all three levels; overall, industry and firm level. Moreover, I investigate which firm

characteristic, namely; capital intensive ratio, return on asset, firm market value, employees, leverage ratio, coverage ratio, foreign revenue to total revenue, create heterogeneity reaction of stock return and industry return on monetary policy shock.

Objective

1. To estimate the unexpected changes in Fed and Thailand policy rate on SET index's return, Thailand industry index return and firm level return.
2. To estimate the heterogeneity reaction of Thailand industry on changes in U.S. and Thailand monetary policy shock on.
3. To use capital intensive ratio and return on asset as a proxy for the firm's investment intensity level, to estimate the effect of interest rate channel and test whether firm and industry with high investment intensity react stronger to Fed and Thailand monetary policy shock compared with low investment intensity.
4. To use firm size, financial leverage, coverage ratio as a proxy for the firm's financial constraint level, to estimate the effect of credit channel and test whether firm and industry with high financial constraint react stronger to Fed and Thailand monetary policy shock compared with low financial constraint firm.
5. To use foreign sale to total sale as a proxy for the firm's degree of openness level, to estimate the effect of exchange rate channel and test whether firm and industry with high degree of openness react stronger to Fed monetary policy shock compared with low degree of openness.

Research hypothesis

Hypothesis 1: Both Thailand and United States tightening monetary policy shock leads to decreasing to domestic stock return.

The domestic stock reacts to domestic monetary shocks through two main channels; interest rate and credit channels. For interest rate channel, according to Ehrmann and Fratzscher (2006), when tightening monetary policy, it directly impacts domestic interest rate to increase, which also increase cost of capital for firms, decreasing the expected cash flow of the firms and thus decrease domestic stock prices.

Credit channel, on the other hand, according to Bernanke and Gertler (1995) states that there are two channels of monetary transmission arise from a result of asymmetry information in credit markets: bank lending channel and balance-sheet channel. The bank lending channel has the assumption that banks act as an important factor in the financial system that certain borrowers have banks as the only source of fund. Therefore, in contractionary domestic monetary policy scenario, will decrease bank reserves and bank deposits, then impact the investment opportunity of borrowers through banks tighten their credit standard. In balance-sheet channel, however, focus on financial position of borrower. In contractionary domestic monetary policy scenario, result in worsen in borrowers' financial statement according to increasing in interest rate which decrease the ability of borrowers to pay back from the lower cash flow. As a result, negatively impact to domestic stocks.

However, domestic stock reacts to the international monetary shocks through four main channels. First, domestic asset price is affected by earning of domestic firm that are highly dependent on return of U.S. equity. Hence, when U.S. monetary tightening is occurred, U.S. asset price negatively react, as well as domestic asset price. Second, credit channel, when U.S. policy rate rises, domestic firm's borrowing cost that financing in U.S. dollar also rise, leading to a decline in the expected cash flow, and thus decrease in domestic stock price. Third, in exchange rate channel, tightening U.S. monetary policy lead to dollar appreciation compared to other currencies. As a result, domestic export to U.S. are increasing, leading to higher revenue for export firm, and hence increasing in stock price. However, when dollar appreciation compared to other currencies, it lead to decrease in domestic import to U.S, which will decrease revenue of domestic import firm, and hence decrease in stock price. Lastly, U.S. spending and investment are declining from rising U.S. policy rate, leading to a decline in domestic exports, the company's expected cash flow, and consequently a decline in stock price.

Although there are many channels that international monetary shock can transmit to domestic stock, the empirical studies consistency finds that the net effects of tightening monetary policy in U.S. on domestic stock are shown to be negative. According to Johnson and Jensen (1993), increasing in U.S. policy rate result in negative response to fifteen equity market. Recently, Ehrmann and Fratzsher (2006)

find that on average across fifty equity markets worldwide, return falling around 2.7% in response to a 100- basis point contractionary of US monetary policy.

Hypothesis 2: There are heterogeneous reactions of returns across industries to U.S. and Thailand monetary policy shock

The monetary policy shocks effect on industry return is likely to vary across industries. The main explanation is that the different in interest rate sensitivity of the demand for industry's produced goods. Moreover, cost of capital change through monetary policy fluctuation also important to capital-intensive industries. Because of these reasons, implied that expected future earning across industries are affected in heterogeneous way which leads to heterogeneous in industry return. I also expect that financial industries react stronger than other industries to monetary policy shock. The main reason is that financial industries, which consisted of bank sector, finance & securities sector, and insurance sector, have main net profit from the spread between the interest rate they pay for the deposits and the rate they receive from borrower or investing, in other words, financial industries have both cost and revenue involved with interest rate change, which different from others industries that only have cost that involved with interest rate. Therefore, I expect financial industries to have high impact on monetary policy shocks.

Hypothesis 3: Investment intensity firm (High capital intensive ratio, return on asset) are react stronger to Thailand and U.S. monetary policy surprises than non-investment intensity firm (Low capital intensive ratio, return on asset)

In interest rate channel, when tightening monetary policy, it directly impacts domestic interest rate to increase, which also increase cost of capital for firms, decreasing the expected cash flow of the firms and thus decrease domestic stock prices. Firm's variable that directly impact from interest rate change is firm with high investment intensity. Therefore, I expect higher sensitivity of monetary policy effect on firm that have high capital intensive ratio, return on asset.

Hypothesis 4: Financial constraint (Low firm size and coverage ratio, high leverage ratio) firm in Thailand are react stronger to Thailand and U.S. monetary policy surprises than non- financial constraint firm (High firm size and coverage ratio, low leverage ratio)

According to credit channel, when policy rate rises, will decrease bank reserves and bank deposits, then impact the investment opportunity of borrowers through banks tighten their credit standard, leading to a decline in the expected cash flow and thus decrease in domestic stock price. As a result, it become more difficult to financing external funds, especially for financial constrained firms. Therefore, I expect higher sensitivity of monetary policy effect on firm that have high financial leverage ratio, coverage ratio and low firm size.

Hypothesis 5: High degree of openness firm (high foreign sale to sale) are react stronger to Thailand and U.S. monetary policy shock than low degree of openness firm

In exchange rate channel, tightening U.S. monetary policy lead to dollar appreciation compared to other currencies. As a result, domestic export to U.S. are increasing, whereas domestic import to U.S. are decreasing, leading to higher volatility to stock price. Therefore, firm that directly impact from change in economic openness, which proxied by foreign revenue to total revenue are expected to have higher sensitivity on monetary policy effect that lower degree of openness firm.

Contribution

To the best of my knowledge, this paper is the first to estimate the effect of Thailand stock return on U.S. and Thailand monetary policy, which estimated from SVECM. Moreover, this is the first paper to estimate response of Thailand stock market on Thailand monetary policy in three levels; overall level, industry level, and firm level. This paper also investigates heterogeneity reaction in industry and firm level to understand what are the main characteristics that create heterogeneity reaction.

LITERATURE REVIEW

Background of Thailand Monetary policy

Pegged exchange rate regimes was used from November 1984 until June 1997. The baht's values were pegged to either gold or currency basket. Moreover, the baht value against the U.S. dollar were protected by the Exchange Equalization Fund (EEF). However, after financial crisis in 1997, Thailand monetary policy strategy has been changed to managed-float exchange rate regime and set a new policy anchor to

monetary targeting. In this regime, to ensure macroeconomic consistency, Bank of Thailand targeted domestic money supply by setting daily and quarterly monetary base targets. Daily liquidity management was primarily focused on ensuring interest rates and liquidity in economy against excessive volatility. After May 2000, Bank of Thailand has decided to change from monetary targeting regime to flexible inflation targeting regime. The main explanation is that money supply and production growth became less steady overtime, and thus, is less effective than inflation targeting. The main objective in flexible inflation targeting regime is to holding inflation and balancing the economic growth. The Bank of Thailand use 1-day repurchase rate to control and balance economic activity.

Monetary Policy Effect on Stock Market

Many literatures focus on overall level of impact of monetary policy on stock market, particularly in advanced economy like U.S. For example, Thorbecke (1997) uses federal funds rate shock as a proxy of monetary policy innovation. The results suggest that contractionary monetary policy decrease stock returns. Ehrmann and Fratzsher (2004) find a 5.5% response on lower equity market return to Fed's monetary policy tightening shock of 100 basis points. The result is consistent to the finding of Rigobon and Sack (2004) who find a -6.2% effect of U.S. stock return on 100 basis points of U.S. tightening monetary policy. In Euro area, Kholodilin et al. (2009) studies the impact of monetary policy shock on stock price using heteroskedasticity approach proposed by Rigobon and Sack (2004). They find that tightening monetary policy innovation by 25 basis point result in decreasing in stock market level of one percent. Bohl, Siklos, and Sondermann (2008) also find a significant fall between 5.7% and 9.18% on the European stock market reaction to tightening monetary policy of 100-basis points. Varadat (2010) find a -2.99% response of Thailand stock returns to Thailand monetary policy tightening of 100-basis points.

The main explanation of decreasing in stock return on tightening monetary policy can be explain into two channels; interest channel and credit channel. In interest rate channel, Ehrmann and Fratzscher (2004) state that when tightening monetary policy, it directly impacts domestic interest rate to increase, which also increase cost of capital for firms, decreasing the expected cash flow of the firms and thus decrease stock

prices. Bernanke and Blinder (1992), states that in credit channel, when tightening monetary policy will both decrease firm's financial position and bank supply loan credit, and leads to decreasing in expected cash flow of the firms and thus decrease stock prices.

International Monetary Policy Effects on Domestic Stock Return

Most literature on monetary policy effect on stock return primarily focused on domestic monetary policy effect on domestic equity market. However, monetary policy effect of one country, especially from advanced countries like U.S. or Euro area, can also impact on equity market in other countries called spillover effect. Nevertheless, only a few empirical studies have investigated on this area. For example, Conover et al. (1999) investigated the impact of US monetary policy shock on equity market in 16 OECD countries, the result shows that US monetary policy innovation have stronger effect than domestic monetary policy on domestic equity market. Ehrmann and Fratzsche (2006) analyzing fifty equity global market and find that on average global equity market return decrease 3.8 percent response to tightening monetary policy shock 100 basis point. Koosakulnirund (2011) find the increase in U.S. policy rate results in -4.25% response of Thailand stock market.

The main explanation in spillover effect of foreign monetary policy shock on domestic equity market can be explained in four ways. First, domestic asset price is impacted through domestic firm's earning that highly correlated to U.S. equity returns. Therefore, when U.S. tightening monetary policy is introduced, U.S. asset price react negatively and as well as domestic asset price. Second, in credit channel, when U.S. policy rate increase, the borrowing costs of domestic firm that financing in U.S. dollar also increase which leads to decreasing in expected cash flow, and thus lower domestic stock price. Third, increasing in U.S. policy rate also leads to dollar appreciation compared to other currencies. As a consequence, domestic exports to U.S. is increased, leading to increase in the revenue of export firm and thus rise in stock price, However, when dollar appreciation compared to other currencies, it lead to decrease in domestic import to U.S, will also reduce revenue of import firm and thus decrease in stock price, this mechanism is called exchange rate channel. Fourth, U.S. spending and investing is

decreased from increasing in U.S. policy rate, which leads to decrease in domestic's export, expected cash flow of the firm, and thus decrease in stock price.

In conclusion, from the empirical studies, the net effects of tightening monetary policy in U.S. on domestic stock are shown to be negative. According to Johnson and Jensen (1993), increasing in U.S. policy rate result in negative response to fifteen equity market. Recently, Ehrmann and Fratzsher (2006) find that on average across fifty equity markets worldwide, return falling around 2.7% in response to a 100- basis point contractionary of US monetary policy.

Industry-specific effects

The effect of monetary policy on stock return is heterogenous across industries. The main explanation is that the different in interest rate sensitivity of the demand for industry's produced goods. In addition, if exchange rates change through monetary policy, industries that have high degree of openness are likely to be more strongly affected. Moreover, cost of capital change through monetary policy fluctuation also important to capital-intensive industries. Because of these reasons, implied that expected future earning across industries are affected in heterogeneous way which leads to heterogeneous in stock return. Therefore, cyclical industries, capital-intensive industries, and industries that have high degree of openness are expected to strongly affect to monetary policy changes. Consistent with the following empirical studies, are Dedola and Lippi (2000) find that the monetary policy impact is stronger in cyclical industries in five OECD countries. Peersman and Smets (2002) also find the same result for seven countries in euro area. Ehrmann and Fratszsher (2014) find that, in US equity market, stock returns in technology, communication and cyclical consumer goods industries are response stronger than non-cyclical consumer goods, energy, and utilities industries at a 1% significance level.

Monetary Policy and Firms Stock Return: Heterogeneity Evidence

The monetary policy transmission channel, namely, credit channel and interest channel are the reason of heterogeneity of equity market response on monetary policy shock which can be explained as the following. In interest rate channel, when tightening monetary policy rate shock is introduced, it directly linked to an increasing in domestic interest rate, as well as cost of capital of the firm. Therefore, firm with high investment

intensity will react stronger to monetary policy rate changes. In credit channel, Bernanke and blinder (1995) states that there are two sub channel of monetary policy transmission arise from a result of asymmetry information; bank lending channel and balance-sheet channel. For bank lending channel, assumes that banks act a special role in financing external funds to the economy. Bernanke and Blinder (1992) and Kashyap et al. (1993) state that tightening monetary policy affect firm that highly depend on bank loan, as commercial banks respond to a tightening monetary policy by shrinking their supply of credit. For balance sheet channel, under asymmetric information and imperfect capital markets, when credit market condition is in difficult situation, the firm's collateral present value also decrease due to increasing in interest rate. As a result of both channels, it become more difficult to financing external funds, especially for financial constrained firms, and thus, decreasing in investment in the firm as well as expected cash flows. Consistent with Ehrmann and Fratzscher (2004) found the heterogeneous response of stock price on US monetary policy shock. Particularly, firm which have financial constraint, particularly firm that have high Tobin's Q, low cash flow, small firm, low debt to capital ratio, response stronger to monetary policy shocks than large firm. Basistha and Kurov (2008) also confirm the heterogeneous response of firm stock to monetary innovation depends on the individual characteristics of firms, especially, financial constraint firm are likely response more strongly to monetary shocks in tight credit market and in recession, compared to non-financial constraint firm.

Measurement of monetary policy shock

"Federal funds rate is extremely informative about future movements of real macroeconomic variables" and also a "good indicator of monetary policy action", Bernanke and Blinder (1992). However, using federal funds rate to measure the monetary effect on stock price implied a strong assumption, that is, monetary policy is exogenous. In fact, the policy rate is set by monetary authorities after considering the economic variables. Therefore, estimating the monetary policy effect on equity prices is complicated due to the fact that market will not respond to policy actions that already anticipated, in other word, market only respond to policy action that unanticipated or shock. For this reason, distinguishing anticipated and unanticipated policy actions is important to estimate the monetary policy effect on stock price. To solve

the problem, identifying monetary policy shock has been introduced by many empirical studies. In this paper, I conclude that there are three main strands for identification of monetary policy shocks; vector autoregression (VAR), event study and heteroskedasticity approaches. Vector autoregression approach depend on identifying assumptions that relate structural shocks with reduced form error. Example of mainstream research that using this approach are Christiano et al. (1996), Thorbecke (1997) and Patelis (1997). In event study methodology, measure the stock price impact in a narrow window around policy rate announcement. This method makes it possible to analyze higher frequency data compared to VAR literature. Example of mainstream research that using this approach are Kuttner (2001), Ehrman and Fratzscher (2004), Bernanke and Kuttner (2003). Heteroskedasticity approach, which is closely related to event study approach, states that the monetary policy effect on asset prices can be determined based on an increase in the variance of policy shock that occurs on the policy announcement date. The main paper that used this approach is Rigobon (2003), Rigobon and Sack (2004).

Review on VAR, SVAR and SVEC Model

In time series analysis, it assumed that data from the past contain information about the future development of a variable, then, it reasonable to use past data for forecasting purpose. Suppose that, in forecasting the monthly consumption rate, from past experience, in Thailand, a high consumption in the last month tends to be followed by a high consumption in the next month, which can be expressed as follow

$$y_{t+h} = f(y_t, y_{t-1}, y_{t-2},\ldots) \quad (1)$$

or

$$y_{t+h} = v + a_1 y_t + a_2 y_t + \ldots \quad (2)$$

In the reality, the value of one variable is not only related to its variables in time but also depends on value of others variables. Moreover, value of other variables also depends on its past, then, the forecasting form can be expressed as

$$y_{t+h} = f(y_{1,t}, y_{1,t-1},\ldots,y_{2,t}, y_{2,t-1}\ldots) \quad (3)$$

However, to identify relationship between monetary policy and asset prices and construct a model, has three main problems. First, suppose that, asset prices are impacted by the policy rate, the policy rate is also impacted by asset prices through their

influence on monetary policy expectations, called causality problem. Second, it is important to consider economic intuition according to relationship between interested variables which sometimes including many variables in model. As a result, the model not only become difficult to capture the relation between variables but also degrees of freedom will decrease. Third, the result of the model could be spurious from exogenous variable that likely to influence on both policy rate and asset prices.

To solve the problems, vector autoregression model (VAR) is introduced. VAR model is a general framework to describe dynamic interrelationship between variables, shown in equation (4)

$$\begin{aligned} y_t &= ß_{10} + ß_{11}y_{t-1} + ß_{12}x_{t-1} + v_t^y \\ x_t &= ß_{10} + ß_{21}y_{t-1} + ß_{22}x_{t-1} + v_t^y \end{aligned} \tag{4}$$

However, vector autoregression model has been criticized from the economic profession. Cooley and Roy (1985) criticized that the ordering imposed by a Cholesky decomposition in VAR, which is used to identify macroeconomic variables shock, is not consistent with economic intuition and the estimated shocks are not pure shock but rather linear combinations of structural disturbance. Therefore, the impulse response function by VAR have no economic interpretation. According to this criticism, SVAR approach is developed and introduced by Christopher Sims in 1980. According to Stock and Watson (2001), structural VAR uses economic theory to determine the contemporaneous link among the variables and also require identifying assumption that allow correlation to be interpreted causally. In order to identify structural parameters, it has not yet converged on a specific set of assumptions for identifying the effects of monetary shock, however, the identification restriction has to broadly consistent with the economic theory and empirical research finding. Even though the SVAR approach is a standard model in dynamic interrelationship macroeconomic analysis. However, the SVAR approach have issue regards to non-stationary variables. The non-stationary variables in the model implied that the residual term will also nonstationary and result in heteroscedasticity problem. However, if y_t and x_t variables are nonstationary I(1) variables but linear combination of them is a stationary I(0) process. In this case y_t and x_t are called cointegrated, and can be used in SVEC model.

The SVEC model is developed by King, Plosser, Stock and Watson (1991). The

main difference of SVEC and SVAR is that SVEC requires both short-run and long-run restriction, whereas, SVAR requires only short-run restriction.

DATA

Structural Vector Error Correction Model

In SVEC models data are estimated using monthly frequencies from June 2000 to December 2018, consistent with Flexible inflation targeting regime period in Thailand. The variables that used in model are ordered as follows; policy rate (PR); monetary aggregate (M), inflation (P), real output (Y); real effective exchange rates (ER) and trade balance (TB).

The policy rate (PR) is measured by federal fund rate and 1-day bilateral repurchase rate for United States monetary policy and Thailand monetary policy, respectively. Money aggregate is measured by monetary aggregate M2. Inflation is measured by consumer price index. Real output is measured by Manufacturing Production Index.

All variables are in logarithms except for policy rate, which are in percentage. Since trade balance, which is calculated as export minus import can have negative values, which it is impossible to be logarithmic form. Therefore, trade balance in this paper is measured in term of logarithms of the ratio of real exports to real imports as suggested by Ivrendi, M., Guloglu, (2010). All data variables are collected from Thompson Reuter Datastream.

Stock return measurement

For measuring the overall stock market returns, industry return, individual stock returns this paper uses average monthly returns of SET index, collected from Thompson Reuter Datastream. The main explanation is to consistency with monetary policy innovation frequency, which in monthly form. The industries return are grouped from all stock listed in Stock Exchange of Thailand into eight industry, which classified by Stock Exchange of Thailand; namely, agriculture and food, consumer products, financials, industrials, property and construction, resources, services, and technology

For measuring individual stock returns, I use all stocks that listed in Stock Exchange of Thailand. The main reason is that cross-sectional study has been used to

identify what are the main characteristics that create heterogeneity reaction. Therefore, it required large sample size in the model.

Firm characteristic measurement

In this section, firm characteristic variables are used to identify heterogeneity response of firm-level stock returns to monetary policy innovations. The firm characteristics are categorized into three groups according to monetary policy transmission channels. In interest rate channel, high investment intensity firms tend to sensitive to cost of capital of each project, in other words, interest rate. Therefore, authors expect high investment intensity firms strongly response to monetary policy shocks. In this paper use the following variables as a proxy of investment intensity. First, capital intensive ratio, measured by total assets over revenue. Since capital intensive ratio is the amounts of capital or investment needed to generate revenue. Second, return on asset, measured by net income over assets. Since return on asset estimate the efficiency of firm's managements of using its assets to generate return. Both ratios are well direct indicator to estimate investment of the firm.

In credit channel, Financial constraints firm tend to find it more difficult to raise funds for financial investments. Therefore, authors expect financial constraint firms strongly response to monetary policy shocks. In this paper use the following variables as a proxy of financial constraint. Firm size, measured by market value of the firm and number of employees. Firm size is used as an indicator to estimate degree of asymmetric information in credit market. Because of economy of scale in information processing and gathering, agency costs are higher for small firm. Therefore, small firm is difficult to finance themselves, and more dependent on commercial banks. Second, financial leverage ratio measured by total debt over total assets, which used to estimate the amount of debt compared to firm's asset. High financial leverage firm tend to indicate the indebtedness capacity of the firm. Therefore, high financial leverage firm response weaker to monetary policy shocks. Third, coverage ratio, measured by gross operating profits over total interest payment, which used to estimate the amount of cash flow compared to financial cost. Firm with low coverage ratio or low cash flow generated in the firm are expected to have high sensitivity to monetary policy shock. The main explanation is that firm can finance by internal funds of external funds. Cash

flows generated from the firm is considered as an internal fund, and therefore, firm with low coverage ratio have to rely on external funds and thus have high sensitivity to interest rate.

In exchange rate channel, high degree of openness firms tend to sensitive to economic openness. Therefore, I expect that higher sensitivity of monetary policy effect on firm that have high degree of openness. In this paper use the foreign revenue to total revenue as ap proxy of degree of openness of the firm.

METHODOLOGY

Identifying monetary policy shock

In our empirical analysis, to investigate the response of the stock return on monetary policy shock, the first step is to investigate the properties of time series variables. For the stationary properties, the augmented Dickey-Fuller (ADF) tests are used. For the lag length in the SVECM, I first use Akaike information criteria, Schwartcz information criterion, Hannann-Quinn criterion, Final Prediction criteria to select lag lengths. The second step is to use Structural Vector Error Correction Model (SVECM) approach with contemporaneous and long run restriction to identify the monetary policy shock.

Considering a structural VAR model

$$A(L)y_t = c + e_t \quad (5)$$

Where $y_t = (y_{1t},\ldots,y_{kt})'$ is a (K x 1) vector, $e_t = (e_{1t},,,e_{kt})'$ is an n x 1 vector of mean zero structural innovations that $E(e_t) = 0$, $E(e_t e_s') = \Omega$ and $E(e_t e_s') = 0$ A(L) is a square matrix polynomial in the lag operator L and and A_t are fixed (K x K) coefficient matrices = $\begin{bmatrix} \alpha_{11,t} & \cdots & \alpha_{1k,t} \\ \vdots & \ddots & \vdots \\ \alpha_{K1,i} & \cdots & \alpha_{KK,i} \end{bmatrix}$

The variables that used in model are ordered as follows; policy interest rate (PR); monetary aggregate (M), inflation (P), real output (Y); exchange rates (ER) and trade balance (TB), which can be summarized as the set of the following:

$$Y_t = (PR_t, M_t, P_t, Y_t, ER_t, TB_t) \quad (6)$$

Assuming that all variables are in I(1), the VEC model can be represented with cointegration rank of the following form;

$$\Delta y_t = \alpha\beta' y_{t-1} + \Pi_1 \Delta y_{t-1} + ... + \Pi_{t-1}\Delta y_{t-p+1} + e_t \quad (7)$$

Where $\alpha\beta'$ matrix has reduced rank ($r<n$) and the term $\alpha\beta' y_{t-1}$ represents the error correction term. The dimensions of both α and β matrices are $n \times r$. In particular, α and β contain the coefficients and the cointegration vectors, respectively. The Π represent $n \times n$ reduced form short run coefficient matrices.

The structural VECM can be represented by

$$H\Delta y_t = \Gamma y_{t-1} + \Phi_1 \Delta y_{t-1} ... + \Phi_{p-1}\Delta y_{t-p+1} + u_t \quad (8)$$

Where H are (K x K) matrix represents the contemporaneous coefficients, Φ represents the structural form short run coefficient matrix, u_t represent structural innovations.

In the SVEC model, the reduced form innovation (e_t) are linearly related to the structural innovations (u_t) as the following;

$$e_t = H^{-1}u_t \quad (9)$$

Suppose that the process y_t is affected by disturbances of permanent effect and transitory effect. According to Granger's representation theorem (Johansen, 1995), the process y_t can be written in Vector Moving Average (VMA) as the following

$$y_t = \eta(1)\sum_{i=1}^{t} \varepsilon_I + \eta(L)\, \varepsilon_t + y_0 \quad (10)$$

or

$$y_t = A\varepsilon_i + B\varepsilon_i + y_0$$

Where $A\varepsilon_i$ is permanent shock, $B\varepsilon_t$ is transitory shocks and y_0 is initial conditions. Therefore, to identify the monetary policy shock, I impose restriction on permanent matrix (A) and transitory matrix (B), so that I can get a shock that satisfies and consistent with the meaning of monetary policy shock. This study use SVEC model impose both long-run and short-run restriction follow the identification scheme of Kim and Roubini and Ivrendi and Guloglu as the following;

$$LR = \begin{bmatrix} 0 & * & * & * & * & * \\ 0 & * & * & * & * & * \\ 0 & * & * & * & * & * \\ 0 & * & * & * & * & * \\ 0 & * & * & * & * & * \\ 0 & * & * & * & * & * \end{bmatrix} \qquad SR = \begin{bmatrix} * & 0 & * & 0 & 0 & 0 \\ * & * & * & * & 0 & 0 \\ * & * & * & 0 & 0 & 0 \\ * & * & * & * & 0 & 0 \\ * & * & * & * & * & 0 \\ * & * & * & * & * & * \end{bmatrix}$$

Effect of monetary policy shock on stock return

Monetary policy effect on overall market level

In order to derive the overall equity market response on effect of monetary policy, I test whether and how SET index responds to monetary surprise. The econometric model used in this paper is as follows

$$r_t = \beta_0 + \beta_1 TMP_t + \beta_2 r_{t-1} + \beta_3 C_t + \varepsilon_t \quad (11)$$

$$r_t = \alpha_0 + \alpha_1 UMP_t + \alpha_2 r_{t-1} + \alpha_3 C_t + \varepsilon_t \quad (12)$$

$$r_t = \gamma_0 + \gamma_1 UMP_t + \gamma_2 TMP_t + \gamma_3 r_{t-1} + \gamma_4 C_t + \varepsilon_t \quad (13)$$

Where r_t represent the monthly SET index return on time t. TMP_t is Thailand monetary policy shock, UMP_t is United states monetary policy shock. r_{t-1} represents the monthly Thailand stock market return on t-1 month, included to capture the autocorrelation of monthly returns. C is control variables consisted of DJIA, Nikkei225, Hang Seng index, SES009, Taiwan stock index. ε_t is residual.

When tightening U.S. monetary policy shock, Thailand monetary policy can either adjusted to U.S. monetary policy changed or not adjusted to U.S. monetary policy changed. In equation 11 and 12, there is no TMP_t variables in the regression, implied that Thailand monetary policy can either adjusted to U.S. monetary policy changed or not adjusted to U.S. monetary policy changed. However, in equation 13, I add TMP_t variables in the regression, implying there is no adjusted in Thailand monetary policy shock after change in U.S. monetary policy. In this regression, β_1 and γ_2 show the effect of Thailand monetary policy innovation on the SET index return α_1 and γ_1 show the effect of U.S. monetary policy innovation on the SET index returns. In general, this estimated coefficient is expected to have negative sign and significant, which implied the unexpected increase in policy rate will lead to lower market equity returns, as stated in the hypothesis 1.

Monetary policy effect on firm level

After observing the overall stock market level reaction to monetary policy shock, next step is to estimate in the heterogeneity of stock reaction in firm level to monetary policy shock. This paper estimates the reaction of stock to monetary policy shock on a stock by stock basis with the following equations;

$$r_t^i = \beta_0^i + \beta_{1,i}TMP_t + \beta_2^i r_{t-1}^i + \beta_3^i C_t + \varepsilon_t^i \quad (14)$$

$$r_t^i = \alpha_0^i + \alpha_{1,i}UMP_t + \alpha_2^i r_{t-1}^i + \alpha_3^i C_t + \varepsilon_t^i \quad (15)$$

$$r_t^i = \gamma_0^i + \gamma_{1,i}UMP_t + \gamma_2^i TMP_t + \gamma_3^i r_{t-1}^i + \gamma_4^i C_t + \varepsilon_t^i \quad (16)$$

Where C is control variables consisted of DJIA, Nikkei225, Hang Seng index, SES009, Taiwan stock price risk premium, net profit, book to market.

Monetary policy effect on industry level

After I obtain $\beta_{1,i}$, $\alpha_{1,i}$ and $\gamma_{1,i}$ which is the estimated level of sensitivity of each stock return to monetary policy shock. Next step, I run cross-sectional multiple regression by setting $\beta_{1,i}$, $\alpha_{1,i}$ and $\gamma_{1,i}$ and $\gamma_{2,i}$ of each firm as dependent variable and firm characteristic as independent variables to identify the effect of monetary policy shock on industry level

$$\beta_{1,i} = \alpha_1 CAP_i + \alpha_2 ROA_i + \alpha_3 MV_i + \alpha_4 EMP_i + \alpha_5 LEV_i + \alpha_6 COV_i + \alpha_7 FREV_i + \alpha_8 C_i + \sum_{k=1}^{7} \alpha_i^k INDUSTRY_i + \varepsilon_i \quad (17)$$

Where CAP_i is firm's capital intensive ratio, ROA_i is firm's return on asset, MV_i is firm's market value, EMP_i is firm's employees, LEV_i is firm's leverage ratio, COV_i is firm's coverage ratio, $FREV_i$ is firm's foreign revenue over total revenue, $INDUSTRY_i$ is an industry dummy variable. C is control variables consisted of net profit, book to market. ε_i is residual.

The analysis can be estimated by focusing on the coefficient of industry dummy variables. For example, if the coefficient of financial industry has negative sign, it means that tightening monetary policy shock leads to decreasing in financial industry return. In addition, if the coefficient of financial industry has stronger negative sign compared to technology industry, it implied that financial industry reacts more negative compared to technology industry to tightening monetary policy shock.

Moreover, this paper also set $\beta_{1,i}$, $\alpha_{1,i}$ and $\gamma_{1,i}$ and $\gamma_{2,i}$ as dependent variable and industry dummy as independent variables and run cross-sectional multiple regression to identify the effect of monetary policy shock on industry level.

$$\beta_{1,i} = \alpha_1 Consumer\ product_i + \alpha_2 Financial_i + \alpha_3\ Industrial_i + \alpha_4 Property_i + \alpha_5 Resources_i + \alpha_6 Services_i + \alpha_7 Technology_i + \alpha_8 Agri_i + \varepsilon_i \quad (18)$$

where the independent variables are the industry dummy which equal to one if it is the specific industry, 0 for otherwise. To be more specific, consumer $product_i$ is the consumer product industry dummy, $financial_i$ is the financial industry dummy, $industrial_i$ is the industrial industry dummy, $property_i$ is the property and construction industry, $resource_i$ is the resources industry dummy, $services_i$ is the services industry dummy, $technology_i$ is the technology industry dummy, $agri_i$ is the agriculture and foods industry and ε_t is residual.

In general, this estimated coefficient is expected to have negative sign and significant, which implied the unexpected increase in policy rate will lead to lower industry returns.

The heterogenous reaction of firm level to monetary policy shock

To find the heterogenous reaction of firm level to monetary policy shock, in this paper also use equation 17. However, the analysis rather focuses on testing the significance of each firm characteristic variables. For example, if α_1 is significant, it means that the heterogeneity reaction between firm can be explained by capital intensive ratio and if α_1 is negative, it means that stock with higher value of capital intensive ratio react more negatively to the unexpected increase in policy rate.

The heterogenous reaction of industry level to monetary policy shock

After I estimate the heterogeneity response of each firm level to monetary policy shock, next step, I group the estimated level of sensitivity of each stock return to monetary policy shock into eight group industries in order to estimate whether there is heterogeneity reaction in each industry and which firm characteristic can explain the

heterogenous in each industry reaction. To answer both questions, the econometric model used in this paper is as follows

$$\beta_{1,i} = \alpha_1 CAP_i + \alpha_2 \mathrm{ROA}_i + \alpha_3 \mathrm{MV}_i + \alpha_4 \mathrm{EMP}_i + \alpha_5 \mathrm{LEV}_i + \alpha_6 \mathrm{COV}_i + \alpha_7 \mathrm{FREV}_i + \alpha_8 C_i + \alpha_9 \mathrm{INDUSTRY} + \alpha_{10} \mathrm{INDUSTRY} * CAP_i + \alpha_{11} \mathrm{INDUSTRY} * \mathrm{ROA}_i + \alpha_{12} \mathrm{INDUSTRY} * \mathrm{MV}_i + \alpha_{13} \mathrm{INDUSTRY} * \mathrm{EMP}_i + \alpha_{14} \mathrm{INDUSTRY} * \mathrm{LEV}_i + \alpha_{15} \mathrm{INDUSTRY} * \mathrm{COV}_i + \alpha_{16} \mathrm{INDUSTRY} * \mathrm{FREV}_i + \sum \alpha_{16} C_i * \mathrm{INDUSTRY} + \varepsilon_i \quad (19)$$

Where CAP_i is firm's capital intensive ratio, ROA_i is firm's return on asset, MV_i is firm's market value, EMP_i is firm's employees, LEV_i is firm's leverage ratio, COV_i is firm's coverage ratio, FREV_i is firm's foreign revenue over total revenue, $\mathrm{INDUSTRY}_i$ is an industry dummy variable equal to one if it is specefic industry, 0 for otherwise. C is control variables consisted of net profit, book to market. ε_i is residual.

The analysis can be estimated by testing the sum of coefficient between firm variable and interaction term. For example, if $\alpha_1 + \alpha_{10}$ is significant, it means industry with high capital intensive ratio would affect the specific industries to react more negative to Thailand monetary policy shock than other industries.

Empirical Results

This chapter shows the statistical results for all hypothesis and attempt to explain the impact of Thailand and U.S. monetary policy shock on Thailand equity return in three levels; index level, industries level, and firm level. This paper first investigates time-series properties for SVEC model, then discuss the result of impulse response function of monetary policy shock, and lastly the result of Thailand and U.S. monetary policy shock on Thailand equity return in three levels.

Time-series properties test

In our empirical analysis, the first step is to analyze the univariate time series properties of variables. The augmented Dickey-Fuller (ADF) is used in this study. The results states that all variables have a unit root in a level form except Thailand trade balance. However, the ADF tests indicate that first differentiation in variables are sufficient to remove non-stationarity, in other word, all variables except Thailand trade balance are I(1). The second step is to determine the lag length from Akaike information

criterion. The AIC tests indicate 10 and 6 lag length for Thailand SVEC and U.S. SVEC model, respectively.

Impulse Response Functions

Impulse responses function offers a helpful summary of the relationships from the estimated coefficients in SVEC model. In this paper, the estimated impulse response function for Thailand and U.S. model to policy interest rate are shown in Figure 1 and 2, respectively. The main focus in this section is to analyze the effect of Thailand and U.S. monetary policy shock on macroeconomic variables, whether it consistent with economic intuition.

In Fig.1 and 2 show the response of increasing in monetary policy rate on the inflation, monetary aggregate, real output, and exchange rate variables for Thailand and U.S. model. In response to the monetary policy shock, the inflation, monetary aggregate, and real output initially fall and revision to their initial baselines for both Thailand and U.S. model. These results are consistent with theoretical expectation, in other word, there are no puzzles. In the case of exchange rate, the effect of contractionary policy initially appreciates and fall to initial baselines, which also consistent with economic intuition for both Thailand and U.S. model. These result shows that identification of monetary policy shock from Kim and Roubini (1999) and Ivrendi and Guloglu (2010) are also valid to identify Thailand and U.S. monetary policy shock.

Monetary policy effect on overall market level

SET index return is statistically decrease 1.12 percentage point, on average in reaction to one standard deviation of unexpected increase in Thailand monetary policy shock, as shown in table 1. The result is consistent to hypothesis 1 and consistent with the past literature that study the effect of Thailand monetary policy shock on SET index return.

The explanation is stated by Ehrmann and Fratzscher (2004, 2006) that the domestic stock returns react to domestic monetary policy shock through two main channels; interest rate channel and credit channel.

Figure 1: Impulse Response Function of Thailand policy rate to monetary aggregate, inflation, real output, real effective exchange rates and trade balance.

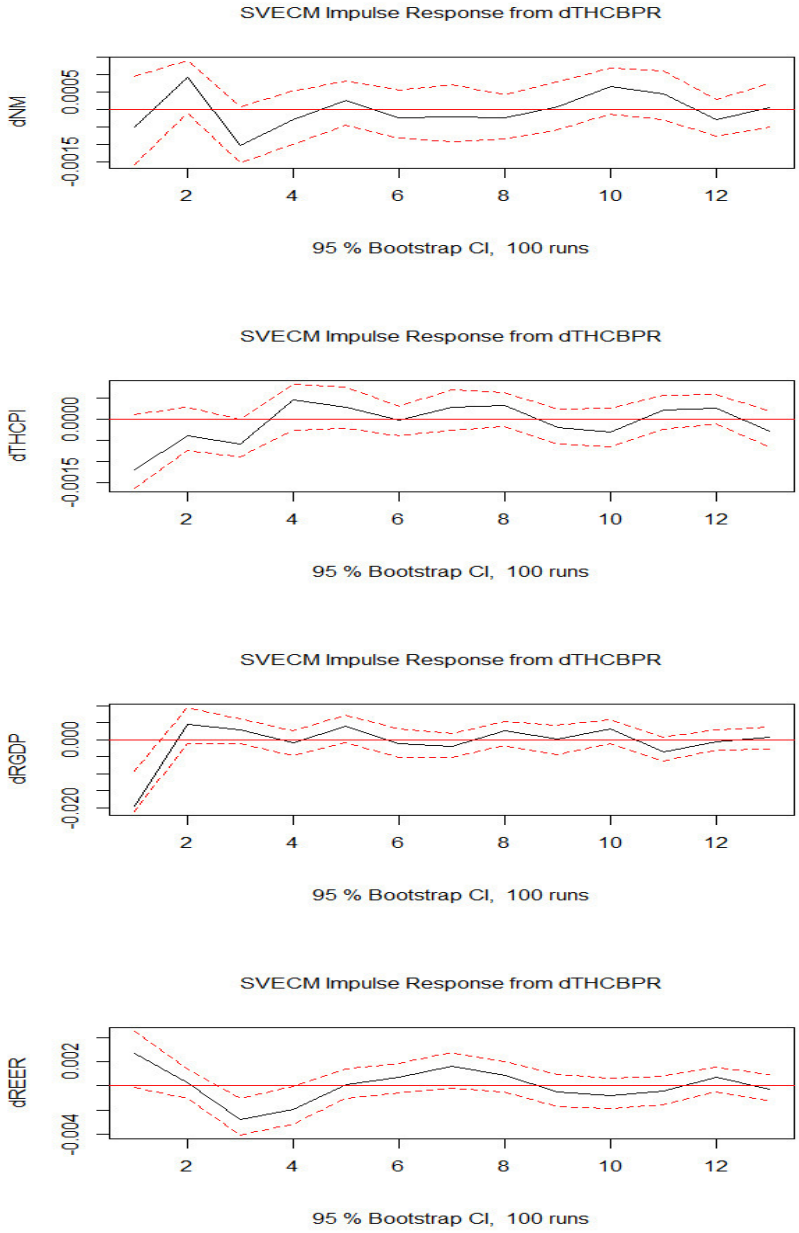
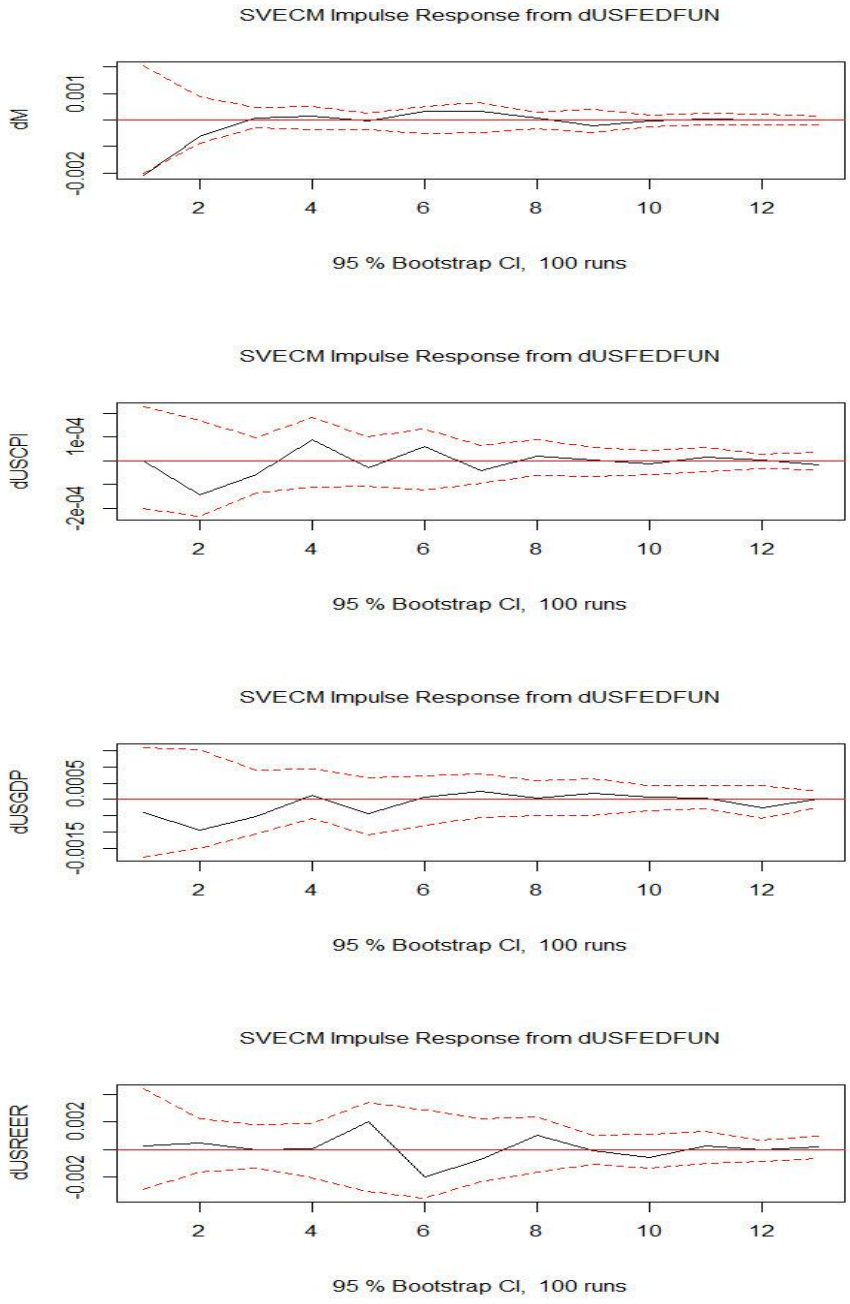


*Figure 2: **Impulse Response Function of U.S. policy rate to monetary aggregate, inflation, real output, real effective exchange rates and trade balance.***



For interest rate channel, tightening monetary policy directly affect domestic interest rate to increase, which also increase cost of capital for firms, decreasing the expected cash flow of the firms and thus decrease domestic stock prices. In credit channel, when policy rate increase, bank reserves and bank deposits will decrease, then impact the investment opportunity of borrowers through banks tighten their credit standard, it also worsens in borrowers' financial statement according to increasing in interest rate which decrease the ability of borrowers to pay back from the lower cash flow. As a result, tightening monetary policy shock leads to decrease in domestic stocks.

For U.S. monetary policy, the one standard deviation of unexpected increase of U.S. monetary policy leads to 0.992 percentage point decrease in SET index return, however the result is not statistically significant and thus not consistent with hypothesis 1 as shown in table 1. The possible explanation is that, in some scenario, an increasing in U.S. monetary policy shock may be taken as a sign of greater optimism about the strength of U.S. economy, and thus increasing expected cash flow of the firm. However, this effect will offset the effect of increasing in policy rate and thus there are no response in stock market reaction.

Monetary policy effect on industry level

The heterogenous response of industry return in Thailand on increasing Thailand and U.S. monetary policy shock is shown in table 2. For Thailand monetary policy shock, financial industry is the industry that react the most negatively to tightening monetary policy of Thailand, followed by property & construction and industrial industry. For the U.S. monetary policy effect, agriculture and foods is the industry that react the most negatively to tightening monetary policy of U.S., followed by services and consumer products industries. For Thailand monetary policy shock, where U.S. monetary policy is controlled, financial industry is the industry that react the most negatively to tightening monetary policy of Thailand, followed by industrial industry and technology industry. For U.S. monetary policy shock, where Thailand monetary policy is controlled, agriculture and food industry is the industry that react

the most negatively to tightening monetary policy of U.S. followed by resources and services industry.

Moreover, this paper also set $\beta_{1,i}$, $\alpha_{1,i}$ $\gamma_{1,i}$ and $\gamma_{2,i}$ as dependent variable and industry dummy as independent variables to identify the effect of monetary policy shock on industry level as stated in equation 18. The result finds that on average, only financial industry return that response significantly negative to Thailand tightening monetary policy and Thailand tightening monetary policy, while U.S. monetary policy is controlled as shown in table 3

Table 1: Monetary policy effect on overall market level

The table reports coefficients of the regression: $r_t = \beta_0 + \beta_1 TMP_t + \beta_2 r_{t-1} + \beta_3 C_t + \varepsilon_t$, $r_t = \alpha_0 + \alpha_1 UMP_t + \alpha_2 r_{t-1} + \alpha_3 C_t + \varepsilon_t$ and $r_t = \gamma_0 + \gamma_1 UMP_t + \gamma_2 TMP_t + \gamma_3 r_{t-1} + \gamma_4 C_t + \varepsilon_t$, respectively. Where r_t represent the monthly SET index return on time t. TMP_t is Thailand monetary policy shock, UMP_t is United states monetary policy shock. r_{t-1} represents the monthly Thailand stock market return on t-1 month, included to capture the autocorrelation of monthly returns. C is control variables consisted of DJIA, Nikkei225, Hang Seng index, SES009, Taiwan stock index. ε_t is residual. The numbers in the parenthesis are the robust standard errors. ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

VARIABLES	TH	U.S.	BOTH
Thailand monetary policy shock	-1.120*		-1.104*
	(0.598)		(0.594)
U.S. monetary policy shock		-0.992	-1.165
		(0.776)	(0.795)
Lagged Set Index return	-0.00479	-0.00981	-0.00578
	(0.0140)	(0.0137)	(0.0139)
DJIA	0.297	0.258	-0.468
	(3.010)	(3.088)	(3.128)
Nikkei225	1.111	0.296	0.848
	(1.982)	(1.896)	(1.953)
Hang Seng Index	0.277	-0.430	0.0507
	(2.032)	(1.924)	(2.087)
SES009	1.487	1.124	1.675
	(1.942)	(1.872)	(1.974)
Taiwan Stock Index	4.754	7.401**	5.846*
	(3.345)	(3.354)	(3.506)
Risk premium	0.895***	0.895***	0.895***
	(0.0202)	(0.0198)	(0.0198)
Intercept	1.918***	1.930***	1.920***
	(0.0663)	(0.0650)	(0.0660)

Observations	208	215	208
Adjusted R-squared	0.966	0.966	0.966

Table 2: The reaction of industry returns to monetary policy shocks

The table reports coefficients of the regression $\beta_{1,i}=\alpha_0+\alpha_1 CAP_i+\alpha_2 ROA_i+\alpha_3 MV_i+\alpha_4 EMP_i+\alpha_5 LEV_i+\alpha_6 COV_i+\alpha_7 FREV_i+\alpha_8 C_i+\sum_{k=1}^{7}\alpha_i^k INDUSTRY_i+\varepsilon_i$. Where CAP_i is firm's capital intensive ratio, ROA_i is firm's return on asset, MV_i is firm's market value, EMP_i is firm's employees, LEV_i is firm's leverage ratio, COV_i is firm's coverage ratio, $FREV_i$ is firm's foreign revenue over total revenue, $INDUSTRY_i$ is an industry dummy variable which have Agri & Foods industries as base industries. C is control variables consisted of DJIA, Nikkei225, Hang Seng index, SES009, Taiwan stock price risk premium, net profit, book to market. ε_i is residual. The numbers in the parenthesis are the standard errors ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

VARIABLES	TH shock	U.S. shock	Both (TH)	Both(U.S.)
Capital intensive ratio	-0.279	-0.0817	-0.429*	0.0883
	(0.212)	(0.284)	(0.220)	(0.297)
Return on Asset	-1.52e-05	5.37e-06	2.02e-05**	-2.13e-06
	(1.15e-05)	(1.07e-05)	(9.12e-06)	(5.21e-06)
Market value	-9.04e-06	1.40e-05	2.81e-05	-7.66e-06
	(2.54e-05)	(2.92e-05)	(3.97e-05)	(3.00e-05)
Employee	-2.07e-05	4.79e-05	-6.71e-05	0.000104
	(0.000108)	(0.000125)	(0.000112)	(9.53e-05)
Financial leverage ratio	0.846	-0.298	1.120**	0.0704
	(0.625)	(0.583)	(0.497)	(0.286)
Coverage ratio	0.00364	-0.00133	0.0255	-0.0123
	(0.0267)	(0.0440)	(0.0304)	(0.0370)
Foreign sale to total sale	-0.0161	0.0112	-0.00462	-0.0314
	(0.0232)	(0.0279)	(0.0167)	(0.0240)
Consumer products	1.047	-0.109	0.679	0.0141
	(1.422)	(1.962)	(1.451)	(1.626)
Financial	-7.601**	2.387	-7.742**	-0.0889
	(3.845)	(3.592)	(3.863)	(2.766)
Industrial	-0.204	1.637	-1.376	1.926
	(1.143)	(1.423)	(1.190)	(1.194)
Property and construction	-1.578	0.0795	-0.262	-0.270
	(1.183)	(1.484)	(1.586)	(1.535)
Resources	1.151	0.537	0.753	-0.605
	(2.054)	(2.180)	(1.957)	(1.663)
Services	-0.707	-0.668	-0.127	-0.414
	(1.936)	(1.605)	(1.775)	(1.347)

Technology	-0.360	0.503	-1.157	0.210
	(1.241)	(2.254)	(1.367)	(1.748)
Agriculture and Foods	-0.147	-1.222	-0.955	-0.635
	(1.693)	(2.305)	(1.712)	(1.784)
Net income	1.83e-08	-1.56e-07	-4.03e-07	4.35e-08
	(2.86e-07)	(3.17e-07)	(4.53e-07)	(3.35e-07)
Book to market value	0.245	0.330	0.246	0.522**
	(0.423)	(0.204)	(0.404)	(0.213)
Observations	415	415	415	415
Adjusted R-squared	0.012	0.034	0.017	0.020

Table 3: The average reaction of industry returns on monetary policy shock

The table reports coefficients of the regression $\beta_{1,i} = \alpha_1 Consumer\ product_i + \alpha_2 Financial_i + \alpha_3\ Industrial_i + \alpha_4 Property_i + \alpha_5 \text{Resources}_i + \alpha_6 Services_i + \alpha_7 \text{Technology}_i + \alpha_8 \text{Agri}_i + \varepsilon_i$ where $\beta_{1,i}$ is the estimated level of sensitivity of each firm return to monetary policy shock from the regression, the independent variables is the industry dummy where equal to one if it is that specific industry, 0 for otherwise. To be more specific, consumer product_i is the consumer product industry dummy, financial_i is the financial industry dummy, industrial_i is the industrial industry dummy, property_i is the property and construction industry, resource_i is the resources industry dummy, services_i is the services industry dummy, technology_i is the technology industry dummy, agri_i is the agriculture and foods industry and ε_t is residual. The numbers in the parenthesis are the standard errors. ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

VARIABLES	TH shock	U.S. shock	Both (TH)	Both(U.S.)
Consumer products	-0.193	1.114	0.0610	0.451
	(1.699)	(1.895)	(1.819)	(1.852)
Financial	-2.942**	0.0735	-3.008*	-0.919
	(1.490)	(1.662)	(1.596)	(1.625)
Industrial	-0.275	2.185*	-0.866	1.972
	(1.163)	(1.297)	(1.246)	(1.268)
Property and construction	-1.437	0.552	0.154	-0.367
	(1.034)	(1.153)	(1.107)	(1.127)
Resources	0.637	0.293	1.318	-1.693
	(1.530)	(1.706)	(1.638)	(1.668)
Services	-0.685	-0.527	0.344	-0.343
	(0.970)	(1.082)	(1.039)	(1.058)
Technology	-0.665	1.274	-0.675	-1.310
	(1.699)	(1.895)	(1.819)	(1.852)
Agriculture and Foods	-1.243	-0.302	-1.658	0.152
	(1.436)	(1.601)	(1.538)	(1.565)

Observations	415	415	415	415
Adjusted R-squared	0.001	0.009	0.005	0.008

The result in both methods are consistent with hypothesis 2 that there are heterogeneous reactions of returns across industries to Thailand monetary policy shock. The main explanation is the interest rate sensitivity of the demand for industry's produced goods, implied that expected future earning across industries are affected in heterogeneous way which leads to heterogeneous in industry return. Moreover, the result also consistent regards to financial industries react stronger to Thailand monetary policy shock compared to other industry. The main reason is that financial industries, have both cost and revenue involved with interest rate change, which different from others industries that only have cost that involved with interest rate.

Nevertheless, the response of each industries in both methods do not have the exact result but it comparable, especially, the result of financial industry. Financial industry reacts most negative to tightening monetary policy of Thailand monetary policy as shown in table 2. Moreover, Financial industry is the only industry that average return reacts negatively significant on Thailand tightening monetary policy shock as shown in table 3. Therefore, this paper further focusses on financial industry, whether there is pattern in heterogeneity distribution of sensitivity in financial industry to monetary policy shock and which firm characteristic explain the heterogeneity reaction of financial industry.

To find the pattern in heterogeneity reaction of financial industry to monetary policy shock. This paper group the estimate level of sensitivity of firm return that listed in financial industry to monetary policy shock and find the average response of financial industry to monetary policy by the following regression.

$$\beta_{1,i} = \beta_0 + u_i \quad (20)$$

$$\alpha_{1,i} = \alpha_0 + u_i \quad (21)$$

$$\gamma_{1,i} = \gamma_0 + u_i \quad (22)$$

Where β_0 , α_0 and γ_0 is a constant term, which can be interpreted as the average response of industry level to monetary policy shock.

For pattern in heterogeneity distribution of sensitivity in financial industry to monetary policy is shown in figure 3 and 4. This paper finds that stock in bottom 20 percentile of financial industry that react to monetary policy shock, in other words, stock in financial industry that have high negative to monetary policy shock, are all consisted of finance & securities sector or non-bank financial institutions. The main explanation is that, non-bank financial institutions have firm with lowest credit quality as a borrower, whereas banking institution have firm with medium credit quality as a borrower, Denis and Mikov (2003). Moreover, the revenue and cost of banking institution is flexible based on monetary policy shock. However, the revenue from non-bank financial institutions is regularly fix as a constant percentage. For these reasons, non-bank financial institutions encounter with higher probability of default and thus react more to monetary policy shock.

The heterogenous reaction of industry level to monetary policy shock

There are only two industry; namely property and construction industry and financial industry, that firm characteristics can explain the heterogenous reaction of industry level to tightening monetary policy shock.

Figure 3: Distribution of sensitivity in financial industry to Thailand tightening monetary policy shock (left) and U.S. tightening monetary policy. (right)

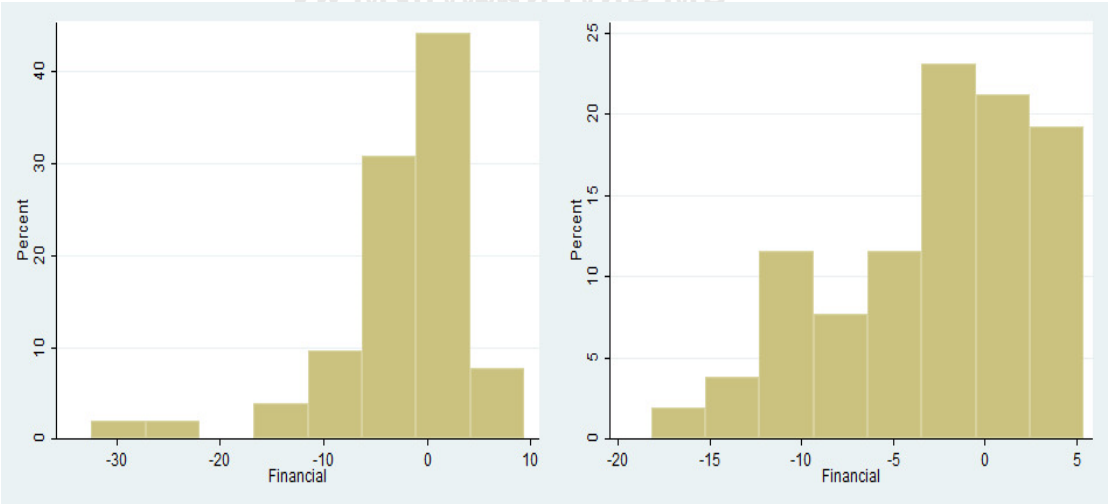
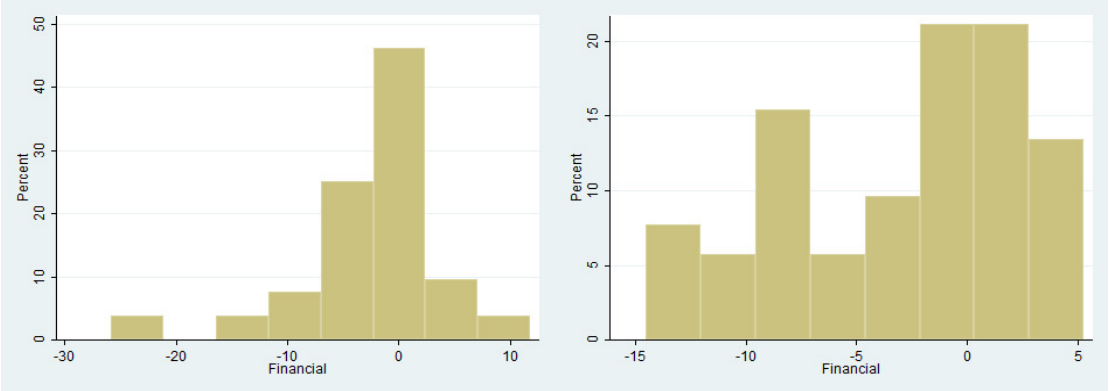


Figure 4: Distribution of sensitivity in financial industry to Thailand tightening monetary policy shock, while U.S. monetary policy is controlled (left) and U.S. tightening monetary policy, while Thailand monetary policy is controlled. (right)



In table 4 and 5 shows the result of heterogenous reaction of property and construction to monetary policy shock. This paper finds that in tightening monetary policy shock scenario, market value, financial leverage ratio, coverage ratio and foreign sale to sale can explain the heterogenous reaction of property and construction industry. To be more specific, in Thailand tightening monetary policy shock, firm that listed in property and construction industry which have high financial leverage ratio response less negative to tightening monetary policy shock.

In U.S. tightening monetary policy shock firm that listed in property and construction industry which have high market value response less negative to tightening monetary policy shock, whereas property and construction firm that have high foreign sale to total sale response more negative to tightening monetary policy shock. In Thailand tightening monetary policy shock, while U.S. monetary policy is controlled, market value, financial leverage ratio, coverage ratio can explain the heterogenous reaction of the industry. In U.S. tightening monetary policy shock, while Thailand monetary policy is controlled, market value and foreign sale to sale can explain the heterogenous reaction of the industry.

In table 6 and 7 shows the result of heterogenous reaction of financial industry to monetary policy shock. This paper finds that in tightening monetary policy shock scenario, capital intensive, return on asset, financial leverage ratio, coverage ratio and

foreign sale to total sale can explain the heterogenous reaction of financial industry. To be more specific, firm that listed in financial industry which have high return on asset, financial leverage ratio and coverage ratio response less negative to Thailand tightening monetary policy shock. However, firm that listed in financial industry which have high foreign sale to total sale response more negative to Thailand tightening monetary policy shock. For tightening U.S. monetary policy, employee can explain the heterogenous reaction of financial industry. Moreover, firm that listed in financial industry which have high employees react less negative to tightening U.S. monetary policy. For Thailand tightening monetary policy shock, while U.S. monetary policy is controlled, return on asset, financial leverage ratio, coverage ratio, and foreign sale to sale can explain the heterogenous reaction of financial industry. For U.S. tightening monetary policy shock, while Thailand monetary policy is controlled, capital intensive, return on asset, employees, coverage ratio and foreign sale to sale can explain the heterogenous reaction. The result also confirms that only financial industry that response significantly negative to Thailand tightening monetary policy shock and Thailand tightening monetary policy shock, while U.S. monetary policy is controlled compared to other industry.

In conclusion the heterogenous response of property and construction return on monetary policy shock is transmits through credit channel and exchange rate channel, whereas, interest rate channel, credit channel and exchange rate channel are the transmission channel of heterogenous response of financial industry return on monetary policy shock.

Monetary policy effect on firm level.

Before exploring which stock characteristics can explain the heterogeneity reaction of monetary policy shock, the reaction of individual stock to monetary policy shock is first observed. Figure 5 shows the distribution of $\beta_{1,i}$, $\alpha_{1,i}$ and $\gamma_{1,i}$ which are the estimated level of sensitivity of each firm return to monetary policy shock.

Table 4: The heterogenous reaction of property & construction industry to monetary policy shock

The table reports coefficients of the regression $\beta_{1,i}=\alpha_0+\alpha_1 CAP_i+\alpha_2 ROA_i+\alpha_3 MV_i+\alpha_4 EMP_i+\alpha_5 LEV_i+\alpha_6 COV_i+\alpha_7 FREV_i+\alpha_8 C_i+\alpha_9 PROP_i+\alpha_{10} PROP_i\, CAPEX_i+\alpha_{11} PROP_i\, RoA_i+\alpha_{12} PROP_i\, MV_i+\alpha_{13} PROP_i\, EMP_i+\alpha_{14} PROP_i\, LEV_i+\alpha_{15} PROP_i\, COV_i+\alpha_{16} PROP_i\, FREV_i+\varepsilon_i$. Where CAP_i is firm's capital intensive ratio, ROA_i is firm's return on asset, MV_i is firm's market value, EMP_i is firm's employees, LEV_i is firm's leverage ratio, COV_i is firm's coverage ratio, $FREV_i$ is firm's foreign revenue over total revenue, $FINANCIAL_i$ is an industry dummy variable equal to one if it is financial industry, 0 for otherwise. C is control variables consisted net profit, book to market. ε_i is residual. The numbers in the parenthesis are the standard errors ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

VARIABLES	TH shock	U.S. shock	Both (TH)	Both (U.S.)
Capital intensive ratio	0.000348	-0.0946	0.0217	-0.193
	(0.159)	(0.188)	(0.168)	(0.164)
Return on asset	5.40e-05	2.75e-05	5.25e-05	1.46e-05
	(3.61e-05)	(4.26e-05)	(3.81e-05)	(3.72e-05)
Market value	-8.01e-06	-2.06e-05	3.60e-06	-3.12e-05
	(2.79e-05)	(3.29e-05)	(2.94e-05)	(2.87e-05)
Employee	3.11e-05	8.87e-05	1.45e-06	0.000159
	(0.000158)	(0.000186)	(0.000166)	(0.000162)
Financial leverage ratio	-2.928	-1.519	-2.842	-0.852
	(1.959)	(2.311)	(2.068)	(2.017)
Coverage ratio	-0.0419	-0.0344	-0.0340	-0.0228
	(0.0357)	(0.0421)	(0.0377)	(0.0368)
Foreign sale to sale	-0.0113	0.0274	-0.00745	-0.0217
	(0.0209)	(0.0247)	(0.0221)	(0.0216)
Property & Construction	-2.847	0.831	-3.246	-2.859
	(2.805)	(3.310)	(2.961)	(2.888)
Prop*Capital intensive	0.803	0.0964	0.288	0.356
	(0.560)	(0.661)	(0.591)	(0.577)
Prop*Market value	-0.000128	0.000395***	0.000294**	0.000321***
	(0.000108)	(0.000128)	(0.000114)	(0.000111)
Prop*RoA	-0.00849	-0.136**	-0.0105	-0.0739
	(0.0498)	(0.0588)	(0.0526)	(0.0513)
Prop*Employee	5.59e-05	-0.000388	-4.03e-05	-0.000202
	(0.000391)	(0.000462)	(0.000413)	(0.000403)
Prop*Financial leverage ratio	4.905**	1.606	4.685**	0.912
	(2.072)	(2.445)	(2.187)	(2.133)
Prop*Coverage ratio	0.108	0.0264	0.158*	0.0497
	(0.0768)	(0.0907)	(0.0811)	(0.0791)

Prop*Foreign sale to total sale	-0.00989	-0.193***	-0.0267	-0.125**
	(0.0603)	(0.0712)	(0.0637)	(0.0621)
Prop*Net income	1.34e-06	-4.17e-06***	-3.42e-06***	-3.44e-06***
	(1.25e-06)	(1.47e-06)	(1.32e-06)	(1.29e-06)
Prop*BMV	-3.412***	-0.251	-2.570**	1.960*
	(1.103)	(1.301)	(1.164)	(1.135)
Net income	3.46e-08	2.26e-07	-9.63e-08	2.97e-07
	(3.22e-07)	(3.81e-07)	(3.40e-07)	(3.32e-07)
Book to market value	0.506	0.344	0.480	0.277
	(0.327)	(0.386)	(0.345)	(0.337)
Constant	0.826	1.290	0.826	1.094
	(1.333)	(1.574)	(1.408)	(1.373)
Observations	407	407	407	407
Adjusted R-squared	0.015	0.033	0.032	0.053

Table 5 : The sum of coefficient between firm characteristics and interaction terms of property & construction industry

The table reports coefficients of the regression $\beta_{1,i}=\alpha_0+\ \alpha_1\ CAPEX_i\ +\ \alpha_2\ ROA_i + \alpha_3\ MV_i\ +\ \alpha_4 EMP_i + \alpha_5 LEV_i + \alpha_6 COV_i + \alpha_7 FREV_i + \alpha_8 C_i + \alpha_9\ PROP_i + \alpha_{10} PROP_i\ CAP_i + \alpha_{11}\ PROP_i\ RoA_i + \alpha_{12}\ PROP_i\ MV_i + \alpha_{13} PROP_i\ EMP_i + \alpha_{14}\ PROP_i\ LEV_i + \alpha_{15}\ PROP_i\ COV_i + \alpha_{16}\ PROP_i\ FREV_i + \varepsilon_i$. Where CAP_i is firm's capital intensive ratio, ROA_i is firm's return on asset, MV_i is firm's market value, EMP_i is firm's employees, LEV_i is firm's leverage ratio, COV_i is firm's coverage ratio, $FREV_i$ is firm's foreign revenue over total revenue, $FINANCIAL_i$ is an industry dummy variable equal to one if it is financial industry, 0 for otherwise. ε_i is residual. The numbers in the parenthesis are p-value from one sided test. ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

Property and construction	TH shock	U.S. shock	Both (TH)	Both (U.S.)
CAP + PROP*CAP	0.803348	0.0018	0.3097	0.163
	(0.93235)	(0.50115)	(0.70715)	(0.6159)
MV+ PROP*MV	-1.36e-04	3.74e-04***	2.98e-04***	2.90e-04***
	(0.9029)	(0.00125)	(0.0037)	(0.0037)
RoA+ PROP*RoA	-0.008436	-0.1359725	-0.0104475	-0.0738854
	(0.5672)	(0.9893)	(0.57855)	(0.92465)
EMP+ PROP*EMP	0.000087	-0.0002993	-0.00003885	-0.000043
	(0.4041)	(0.7604)	(0.5409)	(0.54625)
LEV+ PROP*LEV	1.977***	0.087	1.843***	0.06
	(0.0018)	(0.45635)	(0.00505)	(0.4656)
COV+ PROP*COV	0.0661	-0.008	0.124***	0.0269
	(0.1677)	(0.5396)	(0.0419)	(0.35045)

FREV+ PROP*FREV	-0.02119	-0.1656***	-0.03415	-0.1467***
	(0.3543)	(0.0067)	(0.28385)	(0.0062)
Observations	407	407	407	407
Adjusted R-squared	0.015	0.033	0.032	0.053

Table 6: The heterogenous reaction of financial industry to monetary policy shock

The table reports coefficients of the regression $\beta_{1,i}=\alpha_0+\alpha_1 CAP_i+\alpha_2 ROA_i+\alpha_3 MV_i+\alpha_4 EMP_i+\alpha_5 LEV_i+\alpha_6 COV_i+\alpha_7 FREV_i+\alpha_8 C_i+\alpha_9 FINANCIAL_i+\alpha_{10} FINANCIAL_i CAP_i+\alpha_{11} FINANCIAL_i RoA_i+\alpha_{12} FINANCIAL_i MV_i+\alpha_{13} FINANCIAL_i EMP_i+\alpha_{14} FINANCIAL_i LEV_i+\alpha_{15} FINANCIAL_i COV_i+\alpha_{16} FINANCIAL_i FREV_i+\varepsilon_i$. Where CAP_i is firm's capital intensive ratio, ROA_i is firm's return on asset, MV_i is firm's market value, EMP_i is firm's employees, LEV_i is firm's leverage ratio, COV_i is firm's coverage ratio, $FREV_i$ is firm's foreign revenue over total revenue, $FINANCIAL_i$ is an industry dummy variable equal to one if it is financial industry, 0 for otherwise. C is control variables consisted net profit, book to market. ε_i is residual. The numbers in the parenthesis are the robust standard errors ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

VARIABLES	TH shock	U.S. shock	Both (TH)	Both (U.S.)
Capital intensive ratio	-0.170	-0.0896	-0.154	-0.150
	(0.132)	(0.200)	(0.176)	(0.256)
Return on asset	-1.65e-05	3.44e-06	1.86e-05*	-5.27e-06
	(1.13e-05)	(8.90e-06)	(9.66e-06)	(4.80e-06)
Market value	-1.96e-05	9.14e-06	2.03e-05	-1.69e-05
	(2.40e-05)	(2.67e-05)	(3.57e-05)	(2.79e-05)
Employee	-3.68e-05	-1.74e-05	-7.48e-05	8.94e-05
	(9.42e-05)	(0.000110)	(9.85e-05)	(8.98e-05)
Financial leverage ratio	0.915	-0.185	1.035**	0.243
	(0.613)	(0.484)	(0.526)	(0.262)
Coverage ratio	-0.00934	-0.0262	0.0113	-0.0184
	(0.0259)	(0.0426)	(0.0299)	(0.0349)
Foreign sale to sale	-0.00839	0.00138	-0.00386	-0.0405*
	(0.0202)	(0.0267)	(0.0166)	(0.0231)
Financial	-12.13***	0.719	-12.24***	-3.968
	(2.287)	(3.384)	(2.314)	(5.938)
Financial * Capital intensive ratio	0.418**	-0.0629	0.403*	-0.376
	(0.201)	(0.575)	(0.231)	(0.430)
Financial * Market value	-0.185*	-0.781**	-0.202*	-0.628***
	(0.108)	(0.365)	(0.104)	(0.223)
Financial * Return on asset	7.36e-05*	-0.000238	3.13e-05	3.56e-05
	(4.21e-05)	(0.000148)	(4.98e-05)	(4.49e-05)
Financial * Employee	-0.000139	0.00164***	-9.51e-05	0.000867*
	(0.000283)	(0.000629)	(0.000280)	(0.000450)

Financial * Financial leverage ratio	10.43***	6.969	10.64***	10.78
	(3.347)	(7.173)	(3.295)	(10.74)
Financial * Coverage ratio	0.116**	0.115	0.0986*	0.170
	(0.0483)	(0.104)	(0.0507)	(0.106)
Financial * Foreign sale to sale	-0.297***	0.431**	-0.314***	-0.421***
	(0.0489)	(0.172)	(0.0466)	(0.0703)
Financial * Net income	-5.39e-07	1.19e-06	-5.79e-08	-7.11e-07
	(4.05e-07)	(1.35e-06)	(5.06e-07)	(5.00e-07)
Financial * Book to market value	2.205***	-2.584**	2.230***	-0.174
	(0.562)	(1.183)	(0.555)	(0.657)
Net income	1.51e-07	-7.34e-08	-3.06e-07	1.40e-07
	(2.70e-07)	(2.87e-07)	(4.05e-07)	(3.11e-07)
Book to market value	-0.0990	0.759**	-0.127	0.735*
	(0.404)	(0.376)	(0.403)	(0.421)
Constant	0.0627	0.749	-0.00173	0.613
	(1.071)	(1.253)	(1.129)	(1.111)
Observations	407	407	407	407
Adjusted R-squared	0.005	0.023	0.005	0.001

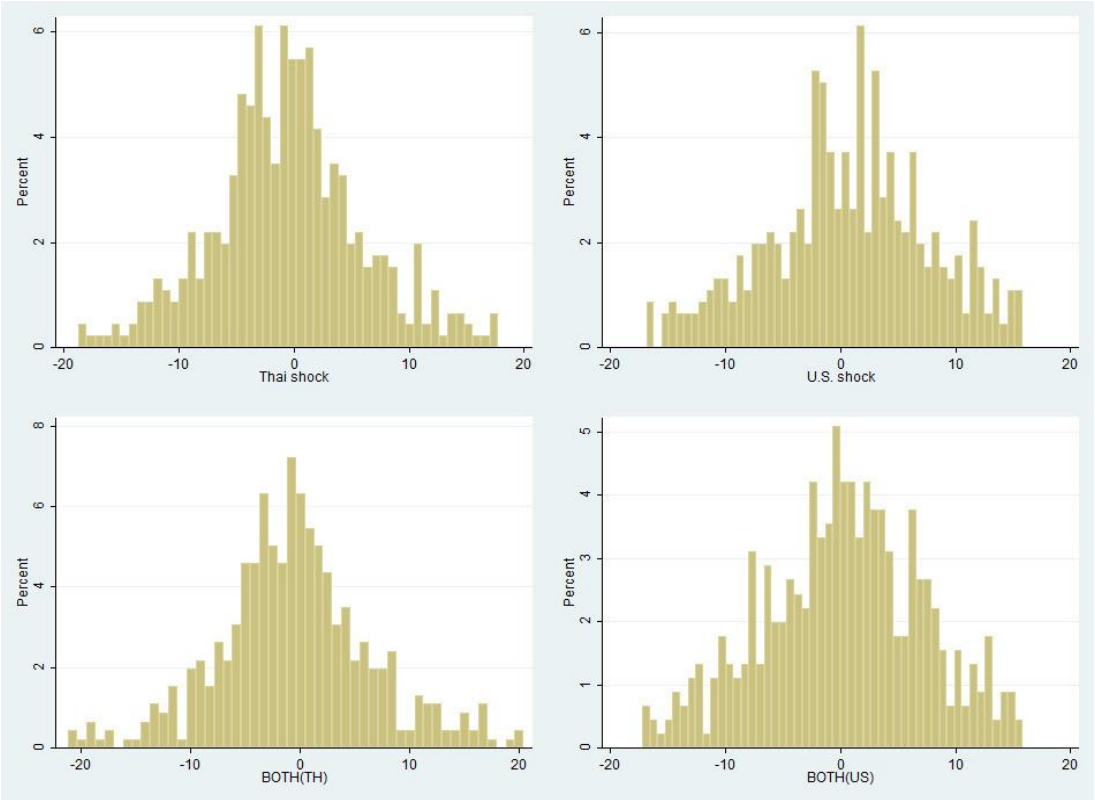
Table 7 : The sum of coefficient between firm characteristics and interaction terms of financial industry

The table reports coefficients of the regression $\beta_{1,i}=\alpha_0+\alpha_1 CAP_i+\alpha_2 ROA_i+\alpha_3 MV_i+\alpha_4 EMP_i+\alpha_5 LEV_i+\alpha_6 COV_i+\alpha_7 FREV_i+\alpha_8 C_i+\alpha_9$ FINANCIAL$_i+\alpha_{10}$FINANCIAL$_i\,CAP_i+\alpha_{11}$ FINANCIAL$_i\,RoA_i+\alpha_{12}$ FINANCIAL$_i\,MV_i+\alpha_{13}$FINANCIAL$_i\,EMP_i+\alpha_{14}$ FINANCIAL$_i\,LEV_i+\alpha_{15}$ FINANCIAL$_i\,COV_i+\alpha_{16}$ FINANCIAL$_i\,FREV_i+\varepsilon_i$. Where CAP$_i$ is firm's capital intensive ratio, ROA$_i$ is firm's return on asset, MV$_i$ is firm's market value, EMP$_i$ is firm's employees, LEV$_i$ is firm's leverage ratio, COV$_i$ is firm's coverage ratio, FREV$_i$ is firm's foreign revenue over total revenue, FINANCIAL$_i$ is an industry dummy variable equal to one if it is financial industry, 0 for otherwise. C is control variables consisted net profit, book to market. ε_i is residual. The numbers in the parenthesis are p-value from one sided test. ***, **, * indicate that the coefficient is statistically significant at 10%, 5%, and 1% level, respectively.

Financial industry	TH shock	U.S. shock	Both (TH)	Both (U.S.)
CAP + FIN*CAP	0.248	-0.1525	0.249	-0.526*
	(0.94755)	(0.3886)	(0.9507)	(0.06425)
MV+ FIN*MV	-0.1850196	-0.78099086	-0.2019797	-0.6280169
	(0.9404)	(0.9419)	(0.931)	(0.70115)
RoA+ FIN*RoA	5.71e-05**	-2.35e-04	4.99e-05**	3.03e-05***
	(0.0434)	(0.98355)	(0.02635)	(0.00255)
EMP+ FIN*EMP	-0.0001758	0.0016226***	-0.0001699	0.0009564**
	(0.7449)	(0.0047)	(0.74155)	(0.0154)
LEV+ FIN*LEV	11.345***	6.784	11.675***	11.023

	(0.0003)	(0.17185)	(0.0002)	(0.1527)
COV+ FIN*COV	0.10666***	0.0888	0.1099***	0.1516***
	(0.000465)	(0.17535)	(0.00385)	(0.06565)
FREV+ FIN*FREV	-0.30539***	0.43238	-0.31786***	-0.4615***
	(0)	(0.99945)	(0)	(0)
Observations	407	407	407	407
Adjusted R-squared	0.005	0.023	0.005	0.001

Figure 5: Distribution of sensitivity of each stock to Thailand and U.S. monetary policy shock



The heterogenous reaction of firm level to monetary policy shock

For the stock characteristics that explain the heterogeneity in stock reaction, the result shows that, for Thailand monetary policy shock, where the U.S. monetary policy shock is controlled, capital intensive ratio, return on asset and financial leverage ratio are the main reason of heterogenous of stock return on monetary policy shock as shown in table 2.

Capital intensive ratio, as a proxy of investment intensity, has negative sign and statistically significant which mean the heterogeneity reaction between firm can be

explained by capital intensive ratio. In addition, stock with higher value of capital intensive react more negative to the unexpected increase in policy rate. The result is consistent with hypothesis 3.

For return on asset and financial leverage ratio, as a proxy of investment intensity and financial constraint, respectively, has positive sign and statistically significant indicate that the heterogeneity reaction between firm can be explained by both variables, in addition, stock with higher value of return on asset and financial leverage ratio react less negatively to the unexpected increase in policy rate.

In conclusion the heterogenous response of stock return on monetary policy shock is transmits through interest rate channel and credit channel.

The result is consistent with hypothesis 3 and 4 that in interest rate channel, high investment intensity firms tend to sensitive to cost of capital of each project, in other words, interest rate. Therefore, high investment intensity firms strongly response to monetary policy shocks. For credit channel, financial constraints firm tend to find it more difficult to raise funds for financial investments. High financial leverage firm tend to indicate the indebtedness capacity of the firm. Therefore, high financial leverage firm response weaker to monetary policy shocks.

Conclusion

This paper analyzes the impact of Thailand and U.S. monetary policy shock on stock market in Thailand for three level; overall market, industries and firm level from June 2000 to December 2018. Moreover, this paper also investigates which firm characteristic create heterogeneity reaction of stock return on monetary policy shock. Using Structural Vector Error Correction model follows Kim & Roubini (1999) and Ivrendi & Gulogu (2010) to identify monetary policy shock.

The main findings are summarized as follows. First, SET index return is statistically decrease 1.12 percentage point, on average in reaction to one standard deviation of unexpected increase in Thailand monetary policy shock. However, SET index return is not statistically significant react on the one standard deviation of unexpected increase of U.S. monetary policy shock. The possible explanation is that, in some scenario, increasing in U.S. monetary policy shock may be taken as a sign of greater optimism about the strength of U.S. economy, and thus increasing expected cash flow of the firm. However, this effect will offset the effect of increasing in policy rate and thus there are no response in stock market reaction.

Second, this paper finds the heterogenous reaction of industry level to monetary policy shock. In particular, financial industry response most negative to Thailand tightening monetary policy shock compared to other industries. Moreover, this paper finds that stock in bottom 20 percentile of financial industry that react to monetary policy shock are all consisted of finance & securities sector. The main explanation is that, non-bank financial institutions have firm with low credit quality and revenue is regularly fix as a constant percentage. Therefore, finance & securities sector encounter with higher probability of default and thus react more negative to tightening monetary policy shock. Third, this paper finds that firm characteristics in property and construction industry and financial industry can explain the heterogenous reaction to monetary policy shock. To be more specific, market value, financial leverage ratio, coverage ratio and foreign sale to sale can explain the heterogenous reaction of property and construction industry to tightening monetary policy shock. Capital intensive ratio, return on asset, financial leverage ratio, coverage ratio and foreign sale to total sale can explain the heterogenous reaction of financial industry to tightening monetary policy. In conclusion the heterogenous response of property and construction return on

monetary policy shock is transmits through credit channel and exchange rate channel, whereas, interest rate channel, credit channel and exchange rate channel are the transmission channel of heterogenous response of financial industry return on monetary policy shock

Fourth, the distribution of sensitivity of each firm return to monetary policy shock is heterogenous. Fifth, for Thailand monetary policy shock, where the U.S. monetary policy shock is controlled, the result shows that capital intensive ratio, return on asset and financial leverage ratio are the main reason of heterogenous reaction of stock return. Particularly, firm with high capital intensive ratio response more negative to tightening Thailand monetary policy shock, whereas, firm with high return on asset and financial leverage ratio, react less negative to tightening Thailand monetary policy shock. In conclusion the heterogenous response of stock return on monetary policy shock is transmits through interest rate channel and credit channel.

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