The Impacts of US Macroeconomic Announcements on Thai Bond Markets

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An Independent Study Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Finance
Department of Banking and Finance
FACULTY OF COMMERCE AND ACCOUNTANCY
Chulalongkorn University
Academic Year 2019

ผลกระทบของการประกาศตัวเลขเศรษฐกิจสหรัฐต่อตลาดตราสารหนี้ไทย

นายจตุรภัทร ทนาบุตร

สารนิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการเงิน ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2562

Independent Study Title	The Impacts of US Macroeconomic Announcements on Thai Bond Markets
By	Mr. Jaturapat Thanaboot
Field of Study	Finance
Thesis Advisor	Assistant Professor Dr. ANIRUT PISEDTASALASAI

Accepted by the FACULTY OF COMMERCE AND ACCOUNTANCY, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Science

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This study investigates the impact of US macroeconomic announcements both in terms of announcement day and surprise on Thai bond markets. More specifically, this paper analyses the different impacts of 16 US macroeconomic announcements on Thai bond markets. Using daily total returns on short- and long-term government bonds including investment-grade bond, I find that the overall US macroeconomic announcement days lower subsequent volatility in Thai bond markets while US macroeconomic announcement surprises raise volatility. Furthermore, after separating between types of US macroeconomic announcements, US inflation announcement days seem raise Thai bond market volatility while most of the negative US macroeconomic announcement surprises which imply weak US economic growth lower Thai bond volatility particularly long-term government bond.

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Jaturapat Thanaboot : The Impacts of US Macroeconomic Announcements on Thai Bond Markets. Advisor: Asst. Prof. Dr. ANIRUT PISEDTASALASAI

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Field of Study:	Finance	Student's Signature .....
Academic Year:	2019	Advisor's Signature .....

ACKNOWLEDGEMENTS

I would like to acknowledge MSF program, enabling me to enhance my knowledge and skills related Economics and Finance fields.

This special project will be not completed if without the assistance of the following contributors. My gratitude is given to Assistant Professor Anirut Pisedtasalasai, Ph.D., my special project advisor, thank you for generously and friendly giving me suggestions, yielding encouragement, and provide guideline through the completion of this special project. Thanks are also given to this special project committee, Associate Professor Vimut Vanitcharearnthum, Ph.D. and Narapong Srivisal Ph.D.

I would like to express my special gratitude to my family for understanding and encouragement at all times including thank my many friends in MSF program for providing me with friendship.

Jaturapat Thanaboot

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1. Introduction

1.1 Background and problem review

There are many factors that have impact on stock and bond markets. Macroeconomic announcements affect different types of bonds in various ways depending on each bond's exposure to interest rate risk. As interest rate increases, the price of the bond decreases. When the economy is strong that imply from various macroeconomic announcements with positive news, the demand for cash to finance projects is higher, since higher economic activities. Higher demand will drive up interest rates. In addition, strong economic growth makes inflation more likely. In high inflation environment, the Monetary Policy Committee is likely to hike interest rates to slow down the economic growth and to curb high inflation. Most bond investors see government bonds as the safe investment. As a result, strong economic growth can be a negative for government bonds whereas it is more likely to be positive for corporate bonds where the issuer’s creditworthiness or credit risk is a primary concern for bond investors. Therefore, bond investors usually monitor closely on macroeconomic announcement in order to revise their trading strategies or adjust their portfolio together with risk management following the arrival of new information. There is different impact on bond market when comparing actual macroeconomic announcement against the market expectation data called that positive/negative news. In other words, market reaction will be difference on the

announcement of macroeconomic and better understanding of market reaction should provide investors to adjust portfolio together with risk management.

US macroeconomic news is global factor. Given the fact that US is the largest economy in the world and a dominant trading partner of several open economies, shocks transmitted from the US economy are expected to have significant impact on the behavior of asset returns in these economies. However, the importance of US macroeconomic announcements can be expected to vary across economic regions.

The impacts of US macroeconomic announcements to security market on return and volatility have been well documented in the empirical literature that most study the effect of US macroeconomic news on stock market. Furthermore, the previous empirical literature includes the impacts of US news to domestic bond. For example, (Fleming & Remolona, 1999) find that macroeconomic conditions are the main factor of government bond curve. (Goeij & Marquering, 2006) find that volatility and covariance are much higher on US macroeconomic announcement days while volatility on announcement days doesn't persist for US bonds. For US news spillover to developed bond markets, there are empirical evidences of US macroeconomic announcement to developed markets as well. For instance, (Goldberg & Leonard, 2003) found the evidence that both the yield curve in US and German bond markets respond to US announcements. Moreover, there are also empirical literature that investigate the impacts of US shock announcement on Emerging bond markets given the importance of the US economy and the extent of the global trade linkage and bond investors are interested in Emerging bond markets for risk diversification

opportunities. For example, (Nowak, Andritzky, Jobst, & Tamirisa, 2011) find that volatility in external emerging bond markets respond to macroeconomic news is more pronounced than price. Using high-frequency intraday data, (Moura & Gaião, 2014) find that the unexpected announcement about strong US economy would imply higher Brazilian nominal, real yields and inflation expectation.

1.2 Objective and Conceptual Framework

Given the growing the integration in terms of economic linkages and financial markets between US and Asian, including Thailand, the US macroeconomic news is very important. There are empirical evidences which show that US macroeconomic news spillover to other countries' security markets and especially affects bond prices. For this paper, there are three objectives.

Firstly, I investigate how US announcement day has impact on Thai bond markets. Because there is previous literature (Brenner, Pasquariello, & Subrahmanyam, 2009) suggesting that US macroeconomic releases provide signal of the state of US economy available and lead to the resolution of uncertainty or disagreement among market participants. However, with limited empirical evidences about the impact of US macroeconomic on Asia emerging market bonds. Thus, I examine the impact of US macroeconomic announcements on Thai short- and long-term government bonds including Thai investment-grade bond. The methodology for capturing the impact of US announcements on bond markets are based on GARCH framework.

Secondly, I examine how US announcement surprises have impact on Thai bond markets. This is because bond price is expected to respond to unexpected information (in this case is US announcement surprise). Unexpected information is matter and normally increases uncertainty in markets more than anticipated information (Ederington & Lee, 1996). Furthermore, I measure US announcement surprises by standardizing difference between actual data and Bloomberg consensus in line with practice in literature (Balduzzi, Elton, & Green, 2001).

Lastly, I investigate that how each types of US announcement have different impacts on bond market as generally each US announcement is expected that there has different impact on financial markets. For US macroeconomic announcements included a total of 16 variables in aspects of seven groups; monetary policy, inflation, labor market, housing market, consumption, manufacturing and international trade.

My paper contributes to the relevant existing literature in three ways. Firstly, this is the first paper which study the impacts of US macroeconomic announcements on Thai bond markets. Secondly, this paper investigates how each US announcements have different impacts on short- and long-term government bonds including investment-grade bond in order to help identify which types of US announcements should be focused by investors. I find that US inflation announcement effect seem raise Thai bond volatility but there is difference from the previous literature as lower than expected US inflation should create more stable trading environment and lower volatility. For some explanation is investors may doubt about Fed credibility in fighting inflation and may disagree on consequence of US inflation announcement.

Lastly, this paper helps us to understand more about the change in bond volatility which are driven by US macroeconomic announcement surprises as this paper finds that lower than expected most US announcements which signal weak US economic growth will lower all Thai bond volatility particularly long-term government bond.

2. Literature review

Researches related to macroeconomic announcements

Macroeconomic announcements can affect financial market returns by offering insight into economic fundamentals and shaping market expectations about future policymaker decisions. In addition, public announcements such as macroeconomic news increase information asymmetry because market participants have different skills in digesting macroeconomic news. Thus, volatility effect dominates price effect (O. Kim & Verrecchia, 1997).

2.1 Stock market

There are empirical evidences of the impact of macroeconomic news on stock market especially spillover effects, (S.-J. Kim, 2003) explores the effects of US and Japan scheduled announcements in the advanced Asia-Pacific stock markets. His results show that both US and Japanese news releases significantly impact on the mean and volatility on other markets. Furthermore, there is some evidence that markets respond differently to bad news compared to overall news and bad news produces positive spillover effects on volatility. (Nguyen, 2011) finds US real economic news has spillover effect on Vietnamese stock returns in line with (S.-J.

Kim, 2003). For investigating the speed of news absorption, (Nguyen & Ngo, 2014) analyze the effects of US key macroeconomic news on 12 stock market in Asian over three-time horizon (calendar, overnight and intraday). Their main findings are as follows. First, most of persistence in volatility occurs in calendar day. Second, the results show that US news has higher impacts on variance than that of mean. Third, Asian Emerging market seem to respond higher than US news than Asian Developed market. Using high-frequency intraday data, (Wongswan, 2006) finds a significant relation between volatility and trading volume and developed-economy announcements at short-time horizons.

For the evidence of the impact of announcement on correlation, (Vallsa & Chuliáb, 2014) study the impact of US macroeconomic news on stock market return and volatility of 10 Asian financial markets and their correlations with US market. He finds that financial crisis hasn't changed response of Asian market returns, volatility and correlation to US macro news.

2.2 Bond market

There are number of literatures suggesting macroeconomic releases provide unanticipated information about economic activity and investor generally reach quite quickly consensus on what macroeconomic news implies for direction of policy rates and taking interest rate risk.

There are many empirical evidences aimed at investigating the impact of US macroeconomic announcement on US bond markets. Using daily data, (Jones, Lamont, & Lumsdaine, 1998) find that announcement shocks have weaker effect.

(Christiansen, 2000) shifts focus both volatility pattern and covariance of bond returns. Consistent with (Jones et al., 1998), he finds that announcement shocks do not persist and not asymmetric. Other daily evidences, (Goeij & Marquering, 2006) analyze the impact of US macroeconomic news announcements on volatility of US bond returns especially an asymmetric response in announcement days and with large surprise. Their main findings are as follows. First, variance and covariance are much higher on US announcement days, and FOMC news is important for short-term bond, while for long-term bond, the employment report is important announcement. Second, consistent with (Jones et al., 1998); (Christiansen, 2000), volatility on announcement days doesn't persist for bond market. Third, negative announcement on US macroeconomic mainly hasn’t larger impact on volatility than that of the positive one. This is in contrast with the previous literature about the asymmetric effect in equities, where bad announcement has a larger impact on volatility than good announcement.

Using high-frequency intraday data, (Fleming & Remolona, 1999) suggest that macroeconomic conditions are the main factor of government bond curve and macroeconomic news induces a sharp and nearly instantaneous price change while bond price volatility is often found to remain elevated for a longer period in response to news. Other intraday evidences in US treasury market, (Balduzzi et al., 2001) examine the impact of U.S. macroeconomic announcements on Treasury prices. Their results can be summarized as follows. First, most news releases have impact on the price level. Second, these effects vary significantly according to maturity. Third,

macroeconomic surprises explain price volatility while the effect of news on volatility persistence is exhausted very quickly.

There are empirical evidences aimed at assessing the impact of US macroeconomic announcement on matured bond markets, especially on country in Europe. (Goldberg & Leonard, 2003) find the evidence that both the short-and long-ends of US Treasury and German yield curve respond to many US macroeconomic announcements, with strong effects occur at the short-end. The effects of each announcement are not identical across yield curve of both US and German as the largest moves in yields are associated with US announcement on labor market conditions.

When compare to matured bond markets, there are limited empirical evidences about the role of macroeconomic on bond markets in emerging countries. (Andritzky, Bannister, & Tamirisa, 2007) analyze the effect of various types of macroeconomic and policy announcements on change and volatility of emerging market bond spread. They find evidence that announcements have asymmetric effects on the level of emerging market bond spread. (Nowak et al., 2011) examine how price and volatility in external emerging bond markets respond to macroeconomic news. They find that the evidence that volatility response is much more pronounced than price respond in line with previous evidences in mature markets. However, volatility dynamic in Emerging bond markets remain at elevated level and longer than in matured bonds. (Moura & Gaião, 2014) investigate how unexpected announcements in Brazilian and US macro indicators affect the term structure of nominal interest rates, and implicit

inflation expectations and real interest rates. The result shows that the unexpected news of an overheated US economy would imply higher nominal, real yields and inflation expectation. In addition, impact of Global financial crisis of 2007-2009 is found statistically significant.

2.3 Research conducted in Thailand

There is little evidence of macroeconomic announcement effect on Thai bond market, (Booncharoenwattana, 2005) investigates the impact of Thai macroeconomic announcements on risk premium and volatility of Thai government bonds and stocks. The results can be summarized as follows. First, Thai government bond market variance indicates significance increase on the day prior to announcement release while Thai stock market variance exhibits significant increase on Thai macroeconomic announcement days. Second, Thai government bond market exhibits significant positive risk premium to conditional covariance on Thai macroeconomic announcement day while Thai macroeconomic announcements cannot explain time-varying risk premium of Thai stock market. Third, covariance between Thai stock and government bond markets exhibits a significant decrease on macroeconomic announcement dates. This finding can be explained by the flight-to-quality pattern as when risk aversion increases, market participants tend to include more safe assets (government bonds) and fewer risky assets (equities).

3. Data

3.1 Bond market data

To investigate the impact of US announcements on Thai bond markets, I choose Government Bond and Corporate Bond Indices that are net total return indices which are calculated by applying the withholding tax rates to accrued interest and coupon payments on all coupon bonds. For *Thai government bond*, I use daily data on Group 1 (short-term bonds: 1 year < time to maturity < 3 years) and Group 4 (long-term bonds: time to maturity > 10 years) Government Bond Indices. For *Thai corporate bond*, I use BBB- up (investment grade bonds: all maturities) Corporate Bond Index. Thai bond market data are obtained from The Thai Bond Market Association (ThaiBMA). My data cover the period from September 1, 2006, through December 23, 2019, with 3,333 observations. Furthermore, I use Bloomberg Barclays US Aggregate Bond Index that represents US bond markets to control indirect effect of US bond markets on Thai bond markets. The index is total return US dollar-denominated, fixed-rate taxable bond market that includes both treasuries and corporate bonds. The US bond market data are obtained from Bloomberg. The data cover period from September 1, 2006, through December 23, 2019 (depending on Thai bond data).

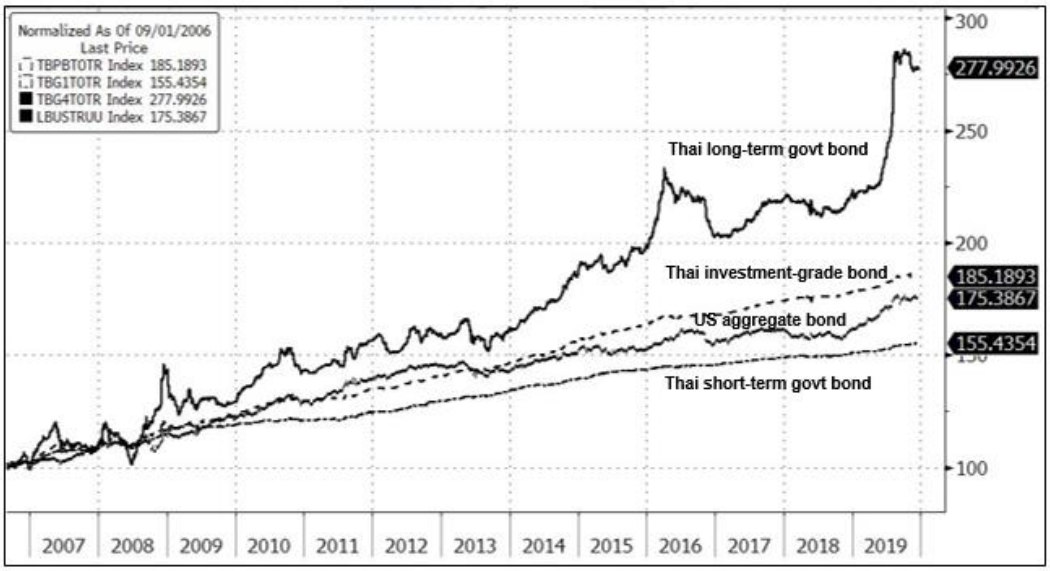
I present summary statistics of daily bond returns of each bond index in Table 1. Thai short-term government bond market mean daily return is 3.28% per annum (pa) lower than long-term government bond market at 7.81% pa since long-term

government bond has higher interest rate risk relative with short-term bond. Although Thai investment-grade bond market has default risk, investment-grade bond market has mean daily return less than long-term government bond market at 5.04% pa. This is because Thai corporate bond Index has component tilt toward short-term maturity bond which has lower return. The highest standard deviation is long-term government bond and the lowest standard deviation is short-term government bond in line with the previous mean return ranking. All Thai bond markets have excess kurtosis and positive skewness. Furthermore, each variable of bond return can be concluded that are stationary time series. According to, the results from unit root test show that the hypothesis of unit root is rejected at 1%-significance level for all bond markets. For illustrative purpose, the comparison among all bond market indices is provided in Figure 1.

Table 1: Descriptive statistics of daily total bond index returns in bond markets

	Short-term bond	Long-term bond	Investment-grade bond	US aggregate bond
Mean	0.00013	0.00031	0.00020	0.00017
Maximum	0.00813	0.04532	0.00985	0.01326
Minimum	-0.00469	-0.02763	-0.00786	-0.01262
Std. Dev.	0.00054	0.00382	0.00086	0.00228
Skewness	1.164	0.617	0.367	-0.119
Kurtosis	26.894	18.922	18.919	4.858
Observations	3333	3333	3333	3333

Figure 1: Comparison among all bond indices



3.2 US macroeconomic data

The main data source is Bloomberg and the sample period relies on the bond. I classify US macroeconomic announcements included a total of 16 variables, providing fairly complete characterization of US economy wide in aspects of seven groups: monetary policy, inflation, labor market, housing market, consumption, manufacturing and international trade. Strong US economic growth should be negative for government bonds, while it should be positive for corporate bonds due to lower default risk. The units of each indicator and their release frequency and time are provided in Table 2. I also provide Bloomberg definition on all economic variables (seven groups) including implication on bond market as follows:

Monetary policy: Fed Funds (FOMC) or the federal funds rate is the short-term interest rate targeted by the Federal Reserve's Federal Open Market Committee (Fed)

as part of its monetary policy strategy. For relation between monetary policy and bond price should be negative as prospective increase in federal funds rate is interpreted by markets as signal of future tightening by Fed and result in higher short-term market interest rate that is the discount rate for bond (Hardouvelis, 1988). Furthermore, when unexpected fed interest rate hike occurs, some degree of homogeneity view among investor may evaporate and then leads to unusually high transaction volumes and result in high bond volatility (S.-J. Kim & Nguyen, 2009).

Inflation: Core Consumer price index (CCPI) or CPI Urban Consumers Less Food & Energy is a measure of prices paid by consumers for a market basket of consumer goods and services; Core consumption expenditure index (PCE) or personal consumption expenditure deflators track overall price changes for goods and services purchased by consumers. For relation between inflation and bond price should be negative as the Fed may counteract increase in inflation rate. An increase in the core CPI increases in interest rate and bond yield (bond price falls) as market participants may expect a higher price level in the future, cause the demand for money to rise and raise market interest rate. In other words, increase in demand for money due to higher expected inflation may cause interest rate and bond yield to rise (Roley & Troll, 1983). Another explanation for this relation is the Fed maybe expected to counteract increase in the rate of inflation and result in higher discount rate (bond price falls). Furthermore, unexpected high US inflation likely cause higher uncertainty as market participant expect the Fed policy response to unexpected high inflation and result in higher market volatility (S.-J. Kim, McKenzie, & Faff, 2004).

Table 2: Macroeconomic announcement

Macroeconomic announcement	Abbreviations	Frequency	Unit	Time (US)	Time (Thai)
US					
Fed funds	FOMC	Monthly	%	14:15	1:00-2:00
Core consumer price	CCPI	Monthly	YoY%	8:30	19:30-20:30
Core consumption expenditure	PCE	Monthly	YoY%	8:30	19:30-22:00
Nonfarm payrolls	NFRM	Monthly	Variation in thousands	8:30	19:30-20:30
Unemployment rate	UEMP	Monthly	%	8:30	19:30-20:30
Capacity utilization	CAPU	Monthly	%	9:15	20:15-21:15
Initial jobless claims	IJC	Weekly	Thousands	8:30	19:30-20:30
Durable goods orders	DGO	Monthly	MoM%	8:30	19:30-22:00
Housing starts	HST	Monthly	Millions	8:30	19:30-20:30
Existing home sales	EHS	Monthly	Millions	10:00	21:00-22:00
New home sales	NHS	Monthly	Millions	10:00	21:00-22:00
Retail sales	RSL	Monthly	MoM%	8:30	19:30-20:30
Personal spending	PS	Monthly	MoM%	8:30	19:30-20:30
Personal income	PI	Monthly	MoM%	8:30	19:30-20:30
ISM manufacturing	ISM	Monthly	Point	10:00	21:00-22:00
Trade balance	TB	Monthly	USD, billions	8:30	19:30-20:30
Thai					
Policy rate	BOT	Monthly	%		14:05
CPI	CPI	Monthly	YoY%		10:30
Current account	CA	Monthly	USD, millions		14:30

Source: Bloomberg

Labor market: Nonfarm payrolls (NFRM) measures the number of jobs that are created within the private and public sector; Unemployment rate (UEMP) rate tracks the number of unemployed persons as a percentage of the labor force (the total number of employed plus unemployed); Initial jobless claims (IJC) track the number of people who have filed jobless claims for the first time during the specified period with the appropriate government labor office. This number represents an inflow of people receiving unemployment benefits. For the relation between labor market and bond price can be both positive and negative. Because good sign in labor market may encourage economic expansion, which lead to higher firm cash flow and higher

inflation. The latter may induce the Fed raise policy rate to fight against inflation. However, some explanation for the negative relation is increase in the level of unemployment rate signals a future decrease in aggregate demand (lower income and demand for money) and causes interest rate and bond yield to decrease (bond price rises) (Roley & Troll, 1983); (Hardouvelis, 1988). Furthermore, US labor market announcements seem to contain more information about US economic outlook and are more likely to reduce information asymmetry. Therefore, investor views tend to converge to uniform assessment and then lead to lower volatility (Andritzky et al., 2007).

Housing market: Housing starts (HST) track the number of new housing units (or buildings); Existing home sale (EHS) is total existing home sales include single-family homes, townhomes and condominiums; New home sales (NHS) track sales of newly constructed homes during the reference period. For relation between housing market and bond price is ambiguous. There is some explanation for the negative relation is an increase in new home sales increase bond yield (bond price falls) as the Fed maybe expected to counteract increase in the rate of housing inflation and overheated economy risk. Furthermore, the precision of US housing market announcements is so large. Disclosure of these announcements are more likely to dominate most investors' belief. So, there are few opportunities to trade and then lead lower volatility (O. Kim & Verrecchia, 1991).

Consumption: Retail sales (RSL) tracks the resale of new and used goods to the general public, for personal or household consumption and this variable is based on

the value of goods sold; Personal spending (PS) tracks consumer expenditures on goods and services; Personal Income (PI) tracks all income received by households. For relation between consumption and bond price is ambiguous. This is because changes in personal income are interprets as a persistent change in aggregate supply due to income to the factors of production. So, an increase in personal income causes a decrease in long-term bond yield (bond price rises). While increases in retail sales signal a future increase in aggregate demand and causes the bond yield to increase (bond price falls) (Hardouvelis, 1988). Furthermore, weak US retail sales may lead to consensus view for most investors to fight to quality by increase bond holdings and thereby, result in higher bond price and lower volatility (S.-J. Kim et al., 2004).

Manufacturing: Capacity utilization (CAPU) tracks the extent to which the installed productive capacity of a country is being used in the production of goods and services; Durable goods orders (DGO) tracks the value of new orders received during the reference period; ISM Manufacturing Index (ISM) is calibrated so that 50 should be the breakeven point for manufacturing growth. For relation between manufacturing and bond price should be negative. Manufacturers' order of durable goods is interpreted as a persistent change in aggregate demand since presence of inventories drives a wedge between production and demand, and item such as order of durable goods is more directly related to demand movements. Therefore, increases in durable goods signal a future increase in aggregate demand and causes the bond yield to increase (bond price falls) (Hardouvelis, 1988).

International trade: Trade balance (TB) measures the difference between the movement of merchandise trade and/or services leaving a country (exports) and entering a country (imports). For relation between trade balance and bond price should be negative as when US trade deficit occur markets may expect contraction in the foreign demand for US goods in the future and then lead to large trade deficit and lower interest rate (bond price rises) (Hardouvelis, 1988). However, larger US trade deficit may raise the probability of trade conflict between US and trade partners and then lead to higher market volatility (S.-J. Kim, 2003).

In addition, I also use Thai macroeconomic announcements to control indirect effect of domestic announcements on Thai bond markets. Thai macroeconomic announcements include a total of 3 variables and each variable defined by Bloomberg as follows:

Monetary policy: Thai policy rate (BOT) is target interest rate set by the central bank in its efforts to influence short-term interest rates as part of its monetary policy strategy.

Inflation: Thai consumer price index (CPI) are a measure of prices paid by consumers for a market basket of consumer goods and services.

International trade: Thai current account (CA) is part of the balance of payments. Major components include trade in goods, trade in services, income and current transfers.

Measures of surprise

To test whether announcement shocks cause asymmetry effects following announcement releases, I use macro announcement data on markets' expectations of these releases from Bloomberg survey with sample of analysts' expectation. Bloomberg data are the most commonly used data in many studies of economic announcements. In line with practice in literature (Balduzzi et al., 2001); (Nowak et al., 2011); (Moura & Gaião, 2014), I calculate standardized surprise as

$$S_{K,t} = \frac{Actual_{k,t} - Expectation_{k,t}}{\sigma_k} \quad \text{(a)}$$

Positive surprise announcements are the magnitudes of announced data above market expectations (consensus) for the most economic activity variables (greater than 1 standard deviation) and represent good economic news. Negative surprise announcements are the magnitudes of announced data below market consensus (lower than -1 standard deviation) for the most economic activity variables and represents bad news. For inflation, unemployment rate, initial jobless claims and policy rate above market consensus are represented to be bad news.

The number of surprises during the sample period is lower for all announcements except announcements concerning core consumer price and core consumer expenditure. Positive big US announcement surprises are more common regarding inflation whereas negative big US announcement surprises are more frequent in the case of inflation and trade balance. Details of surprised announcement surprise are shown in Table 3

Table 3: Summary of news announcement surprises

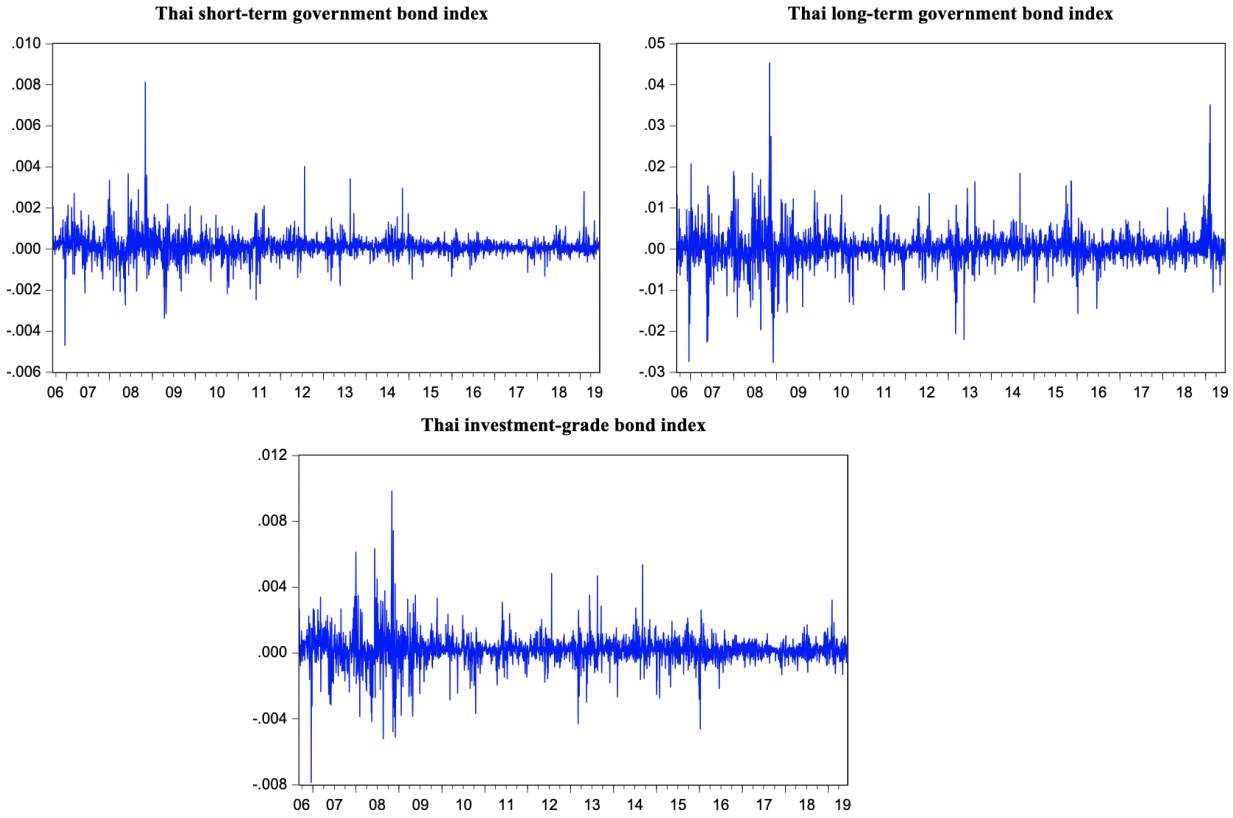
Macroeconomic indicator	Total number of announcement	No. of big surprises	No. of big positive surprises	No. of big negative surprises
US				
Fed funds	110	10	3	7
Core consumer price	160	94	43	51
Core consumption expenditure	160	67	27	40
Nonfarm payrolls	160	52	23	29
Unemployment rate	160	45	15	30
Initial jobless claims	694	160	85	75
Capacity utilization	160	41	16	25
Durable goods orders	160	34	12	22
ISM manufacturing	160	54	30	24
Existing home sales	160	39	19	20
New home sales	160	43	20	23
Housing starts	160	45	17	28
Personal spending	160	51	24	27
Personal income	160	27	14	13
Retail sales	160	39	19	20
Trade balance	160	61	33	28
Thai				
Policy rate	104	17	7	10
CPI	161	26	8	18
Current account	159	43	30	13
	3468	948	445	503

Source: Bloomberg

4. Methodology

Graphs in Figure 2. imply that model including heteroskedasticity is required as there are sign of volatility clustering in the total returns. So, in this paper, I choose exponential GARCH (EGARCH) model for modelling the conditional variance. This model has two interesting features. First, it allows me to investigate the impact of macroeconomic announcements on bond volatility. Second, it captures asymmetric effect of positive and negative shocks.

Figure 2. Daily total returns on Thai bond market indices



For the conditional mean equation is shown in equation (1a) below;

$$r_t = \mu + \propto r_{t-1} + \varepsilon_t \quad \text{(1a)}$$

Where r_t denotes the return on Thai bond in period t and ε_t is a normally distributed stochastic error term with zero mean and represents the unexpected return.

For the conditional variance equation can be written as;

$$\ln(h_t^2) = \omega + b\ln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right)$$

(1b)

For estimated "a", this coefficient captures asymmetric response in bond market return. If a is positive and significant, it will indicate that positive shocks increase subsequent variance more than negative shocks. While estimated "b" and "g" coefficients capture GARCH effect and ARCH effect, respectively, on variance equation. These imply that news about variance from the past period dominates on current variance.

4.1 Investigating effect of US macroeconomic announcement days on Thai bond markets

I investigate the effect on mean and variance associated with announcement days. Following prior studies (Jones et al., 1998); (Christiansen, 2000); (S.-J. Kim, 2003); (Goeij & Marquering, 2006), I use announcement-day dummy (I_{t-1}^a) which captures the impacts of announcements on bond returns. I_{t-1}^a is lagged by one period for take into account time difference between 2 markets. Furthermore, other macroeconomic announcements made by Thai authorities and US bond market movement may affect indirectly Thai bond market. As a result, I apply the approach proposed by (Nguyen, 2011) by including US aggregate bond index ($USAg_{t-1}$) and Thai macroeconomic announcement dummy variable ($News_t^{TH}$) in both mean and variance equations in order to control for US bond market and Thai macroeconomic announcement indirect

effect, respectively, on Thai bond market. For $News_t^{TH}$ take the value of one if actual figure announced is different from the market expectation in both conditional mean and variance equations to control for Thai macroeconomic announcement indirect effect on Thai bond market. Additionally, I include QE period announcement dummy variable (QE_{t-1}) that takes the value of one during US quantitative easing period (November 2008 to November 2014) in order to control indirectly the impact of US QE on Thai bond markets. This is because the excess liquidity through the Fed's balance sheet expansion have spillover effect on bond markets. The models are shown below;

$$r_t = \mu + \propto r_{t-1} + \gamma_a I_{t-1}^a + \rho_{qe} QE_{t-1} + z_{th} News_t^{TH} + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (2a)$$

$$\ln(h_t^2) = \omega + b\ln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \delta_a I_{t-1}^a + \tau_{qe} QE_{t-1} + v_{th} News_t^{TH} + \theta_{us}|USAg_{t-1}| \quad (2b)$$

γ_a and δ_a capture the impact of US announcement days on mean and variance of Thai bond market, respectively. If δ_a is negative and significant, US announcement will lower subsequent Thai bond variance. The negative relation between overall US announcement day and bond volatility in line with the previous literature (Andritzky

et al., 2007) which suggest US macroeconomic announcements can help reduce uncertainty (volatility) in emerging bond market.

Furthermore, σ_{us} and θ_{us} are used for controlling indirect effect of US aggregate bond return on mean and variance of Thai bond market respectively. If σ_{us} is positive and significant, US bond markets will have positive effect on mean equations. This will be consistent with previous literature (Pérignon, Smith, & Villa, 2007) which find that US bond returns share one common factor with foreign bond returns and link this to changes in the level of interest rates given global market linkage and global leadership of US.

Additionally, z_{th} and v_{th} are used for controlling indirect effect of Thai macroeconomic announcements on mean and variance of Thai bond market respectively. If v_{th} is significant, Thai macroeconomic announcement has impact on subsequent Thai bond variance. The result in line with (S.-J. Kim & Nguyen, 2009) which find macro announcements, irrespective of type of news, can influence market volatility in similar fashion.

4.2 Investigating effect of US announcement surprises on Thai bond markets

In this part I will investigate whether there are effects on bond markets associated with US announcement surprise. Following previous studies (Balduzzi et al., 2001); (Nowak et al., 2011); (Moura & Gaião, 2014), I calculate unexpected component of announcements as standardized difference between the disclosed data and the survey's median on the macroeconomic announcements (surprises). In order to make

comparison with the same standard, I divide the surprises by the standard deviation of all surprises. Type of shocks has different effect on bond return, and big surprises tend to increase volatility. Thus, dummy for positive big surprises (I_t^{b+}) take the value of one for surprises that are greater than 1 standard deviation and dummy for negative big surprises (I_t^{b-}) take the value of one for surprises that are lower than -1 standard deviation. I_{t-1}^{b+} and I_{t-1}^{b-} are lagged by one period. Therefore, to investigate the impacts of announcement surprises on bond returns, I follow (Goeij & Marquering, 2006) approach by replacing announcement-day dummy with dummy capturing large announcement surprises in the equations (2a) and (2b). The models are shown below;

$$r_t = \mu + \propto r_{t-1} + \varphi_{pos} I_{t-1}^{b+} + \varphi_{neg} I_{t-1}^{b-} + \rho_{qe} QE_{t-1} + z_{th} News_t^{TH} + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (3a)$$

$$\ln(h_t^2) = \omega + b\ln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \delta_{pos} I_{t-1}^{b+} + \delta_{neg} I_{t-1}^{b-} + \tau_{qe} QE_{t-1} + v_{th} News_t^{TH} + \theta_{us} |USAg_{t-1}| \quad (3b)$$

φ_{pos} and φ_{neg} capture the impact of positive and negative US announcement surprises, respectively, on mean of Thai bond market. If φ_{neg} is positive and significant, it will imply that negative all US announcement surprises have positive impact on Thai bond mean return. This result will be consistent with most financial presses which suggest that weak US economic growth should be positive for government bonds as market participants flight to quality.

For δ_{pos} and δ_{neg} capture the impact of positive and negative US announcement surprises, respectively, on variance of Thai bond market. If δ_{neg} is positive and significant, negative US announcement surprise (e.g. lower than expected on US economic announcement) will raise subsequent Thai bond variance. This result will be line with (Ederington & Lee, 1996) which suggest that the unexpected news (announcement surprise), especially bad news, increase the level of uncertainty (volatility). In other words, macroeconomic announcement may have influence on bond markets if there are new information.

4.3 Investigating effect of each US macroeconomic announcements on Thai bond market

My previous methodology is based on concept that 16 different US announcements have same impact on bond market. However, many studies and most financial presses suggest that short-term bond market is more impacted by policy rate such as Fed funds rate changes than that of long-term bond, whereas labor market announcements affect long-term bond. Thus, it will be more appropriate to distinguish among different announcements that how each types of US announcement have different impacts on Thai bond variance.

To examine the different announcements on the conditional variance, First, I include each new dummy variable of 16 different US announcements in EGARCH model. The dummies take value of one on the announcement day and zero otherwise. The conditional variance;

$$\ln(h_t^2) = \omega + b\ln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \delta_{fomc-a} I_{t-1,FOMC}^{a} +$$

$$\delta_{ccpi-a} I_{t-1,CCPI}^{a} + \cdots + \delta_{tb-a} I_{t-1,TB}^{a} + \tau_{qe} QE_{t-1} + v_{th} News_t^{TH} +$$

$$\theta_{us} |USAg_{t-1}| \qquad (4)$$

Each of estimated δ_{tb-a} coefficients (m = FOMC, CCPI,.., TB) captures the impact of each US announcement days on variance of Thai bond market. If δ_{ccpi-a} is positive and significant, core consumer price announcement will lower Thai bond variance. This suggests that US inflation announcement day will induce uncertainty in bond markets as market participant expect the policymaker respond to inflation announcement. In addition, the public announcements (e.g. macro news) may increase information asymmetry and raise market volatility because market participant have varying degrees of skill in interpreting news (Nowak et al., 2011).

In order to investigate the different US announcement surprises on the conditional variance, Following (S.-J. Kim, 2003), I include each new dummy variable of 16 different US announcement surprises. The dummies for positive big surprises ($I_{t-1,x}^{b+}$) take the value of one for surprises that are greater than 1 standard deviation, The dummies for negative big surprises ($I_{t-1,x}^{b-}$) take the value of one for surprises that are lower than -1 standard deviation. The variance equation;

$$\ln(h_t^2) = \omega + b\ln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) +$$

$$\varphi_{fomc-pos} I_{t-1,FOMC}^{b+} + \varphi_{ccpi-pos} I_{t-1,CCPI}^{b+} + \cdots + \varphi_{tb-pos} I_{t-1,TB}^{b+} +$$

$$\varphi_{fomc-neg} I_{t-1,FOMC}^{b-} + \varphi_{fomc-ccpi} I_{t-1,CCPI}^{b-} + \cdots + \varphi_{tb-neg} I_{t-1,TB}^{b-} + \tau_{qe} QE_{t-1} +$$

$$v_{th} News_t^{TH} + \theta_{us}|USAg_{t-1}| \qquad (5)$$

Each of estimated φ_{m-pos} coefficients (m = FOMC, CCPI,.., TB) captures the impact of each US positive announcement surprise on variance of Thai bond market while each estimated φ_{m-neg} coefficient captures the impact of each US negative announcement surprise on variance of Thai bond market. If δ_{FOMC}^{b+} is positive and significant, positive fed funds rate announcement surprise (higher than expected FOMC) will raise subsequent Thai bond variance. The result will be consistent with (S.-J. Kim & Nguyen, 2009) which find that unexpected hikes in Fed's target rates increased volatility in most of Asia markets.

5. Empirical results

5.1 US announcement day effect on Thai bond

In this section I examine how US macroeconomic announcement days affect conditional Thai government bond market. Table 4 presents the estimation result for specification in which include US announcement days (Ann days). The results in variance equation show that asymmetry-term captured via "a" coefficient is positive (0.0176) and significantly different from zero at 1%-level for long-term government

bond market. In other words, there are asymmetric response in daily long-term government bond returns. It indicates that positive shocks increase volatility more than negative shocks. GARCH- and ARCH-term captured via “b” and “g” coefficients respectively are positive and significant for all Thai bond market. This implies that news about volatility from the past period explains or dominates on current volatility. Table 4 further shows that the estimated coefficients for dummies on US announcement days in conditional variance (δ_a) are negative and significant for short- and long-term government bond markets. In other words, US announcement days lower conditional variance by -0.1522 and -0.0872 in short-term bond and long-term bond, respectively. The result in line with (Goeij & Marquering, 2006); who find that bond volatility does not persist after US macroeconomic announcement days, in consistent with the immediate

Table 4 Estimation results: effect of US announcement days on Thai bond

	Short-term bond		Long-term bond		Investment-grade bond	
	Ann days		Ann days		Ann days	
	Estimate		Estimate		Estimate	
Conditional Mean Equations						
μ	4.05×10^{-5}	***	2.33×10^{-4}	***	1.06×10^{-4}	***
$\propto$	0.1715	***	0.1867	***	0.2715	***
γ_a	3.8×10^{-5}	***	-1.8×10^{-4}	**	-4.99×10^{-6}	
ρ_{qe}	4.91×10^{-5}	***	8.79×10^{-5}		5.36×10^{-5}	**
z_{th}	4.02×10^{-5}	*	2.11×10^{-4}		5.86×10^{-5}	*
σ_{us}	0.0245	***	0.2708	***	0.0609	***
Conditional Variance Equations						
ω	-0.7502	***	-0.6688	***	-0.5615	***
b	0.3198	***	0.2535	***	0.2320	***
a	-0.0031		0.0176	***	-0.0030	
g	0.9627	***	0.9592	***	0.9749	***
δ_a	-0.1522	***	-0.0872	***	-0.0171	
τ_{qe}	0.0100	**	0.0130	***	0.0193	***
v_{th}	0.2275	***	0.3275	***	0.2545	***
θ_{us}	7.0730	**	19.9366	***	8.4766	***
Diagnostics						
$Q^2(12)$	3.8906		5.4112		10.8570	
ARCH-LM	0.2840		1.3431		1.1750	

$$r_t = \mu + \propto r_{t-1} + \gamma_a I^a_{t-1} + \rho_{qe} QE_{t-1} + z_{th} News^{TH}_t + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (2a)$$

$$\ln(h^2_t) = \omega + b\ln(h^2_{t-1}) + a\frac{\varepsilon_{t-1}}{\sqrt{h^2_{t-1}}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h^2_{t-1}}} - \sqrt{2/\pi}\right) + \delta_a I^a_{t-1} + \tau_{qe} QE_{t-1} + v_{th} News^{TH}_t + \theta_{us}|USAg_{t-1}| \quad (2b)$$

Notes: Where r_t denotes the return on Thai bond in period t, h^2_t is conditional variance of r_t. I^a_t refers to dummy variable having the value of 1 on US announcement day, I^a_{t-1} is lagged by one period. Significance at: *10, **5, and ***1 percent, respectively

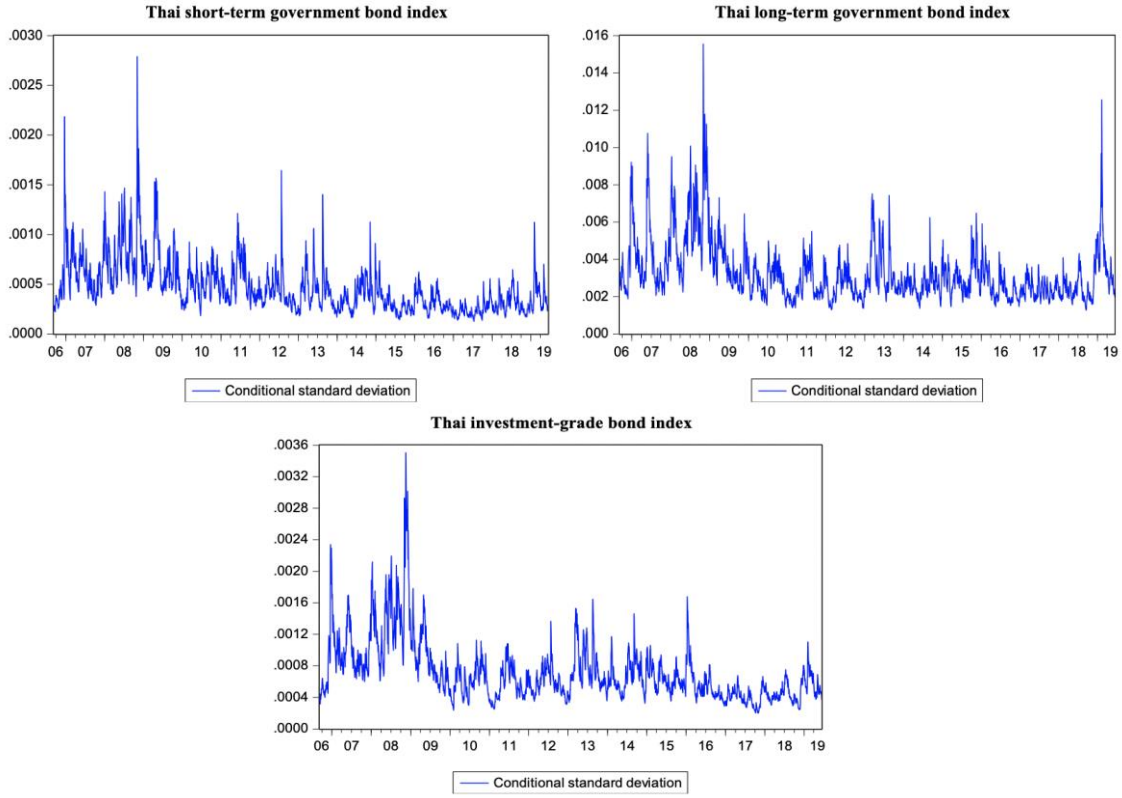
incorporation of US macroeconomic information into bond prices. Whereas the estimated coefficients for dummies in conditional mean (γ_a) are positive for short-term government bond and negative for long-term government bond. In other words, US announcement days raise short-term bond mean but lower long-term bond mean. However, the magnitude of US announcement day effects on short- and long-term bond means is quite low. It implies that impact of both good and bad news from US announcement day on mean equation almost offset each other as pointed out by

(Nguyen & Ngo, 2014). Another explanation for these results is mature bond prices may not exhibit adjustment in response to macroeconomic news releases (Balduzzi et al., 2001) and bond prices tend to adjust quickly to macroeconomic news, most of them within trading day (Nowak et al., 2011).

For the estimated coefficients for Thai announcement dummy variable (v_{th}) in variance equation are positive and significant for all Thai bond market. It points out that Thai macroeconomic announcements have positive impact on all Thai bond market variances. Finally, the estimated σ_{us} coefficient in mean equation and θ_{us} coefficient in variance equation are positive and significant for all Thai bond markets. Thus, US bond market have positive effect on both mean and variance of all Thai bond markets. Additionally, these results in Table 4 do not have serial correlation problem in the standardized residuals because p-values of all Q-statistics at lag 12 are insignificant, as a result, it signifies that mean and variance equations are correctly specified. I find that no remaining ARCH effect are left in the standardized residuals for the results because chi-square p-values for ARCH-LM test are insignificant and result in fail to reject the null hypothesis of homoscedasticity.

In Figure 3, I present graphs of their conditional standard deviations related these results. The graphs show that the conditional standard deviation of Thai bond price tends to be highly persistent and be disturbed by the arrival of US macroeconomic announcement days.

Figure 3: Conditional standard deviation: effect of US announcement days on Thai bond



5.2 US announcement surprise effect on Thai bond

In this section I examine how US announcement surprises affect Thai bond market. Table 5 presents the estimation result for specification in which I consider US announcement surprises (Ann surpr). All the individual estimates considering positive announcement surprise dummies in conditional variance (δ_{pos}) are positive and significant for all bond market. In other words, positive announcement surprises raise conditional variance by 0.2890, 0.0774 and 0.1060 in short-term, long-term government bond and investment-grade bond, respectively. For the estimated coefficients of negative announcement surprise dummies in conditional variance

(δ_{neg}) are positive and significant in short-term government bond and investment-grade bond. Negative surprises raise conditional variance by 0.0657 and 0.0866 in short-term government and investment-grade bonds, respectively. Possible explanation for higher variance caused by both positive and negative announcement surprises is the unanticipated announcements increase uncertainty as pointed out by (Ederington & Lee, 1996). Furthermore, (O. Kim & Verrecchia, 1997) suggest that market participants have different skills in digesting public announcements and will trade actively if the released data differ from market consensus and result in volatility remains at elevated levels after announcement surprises.

For the graphs in Figure 4 related these results show that the conditional standard deviation of Thai bond tends to be persistent and be disturbed by the arrival of US announcement surprises.

Table 5 Estimation results: effect of US announcement surprises on Thai bond

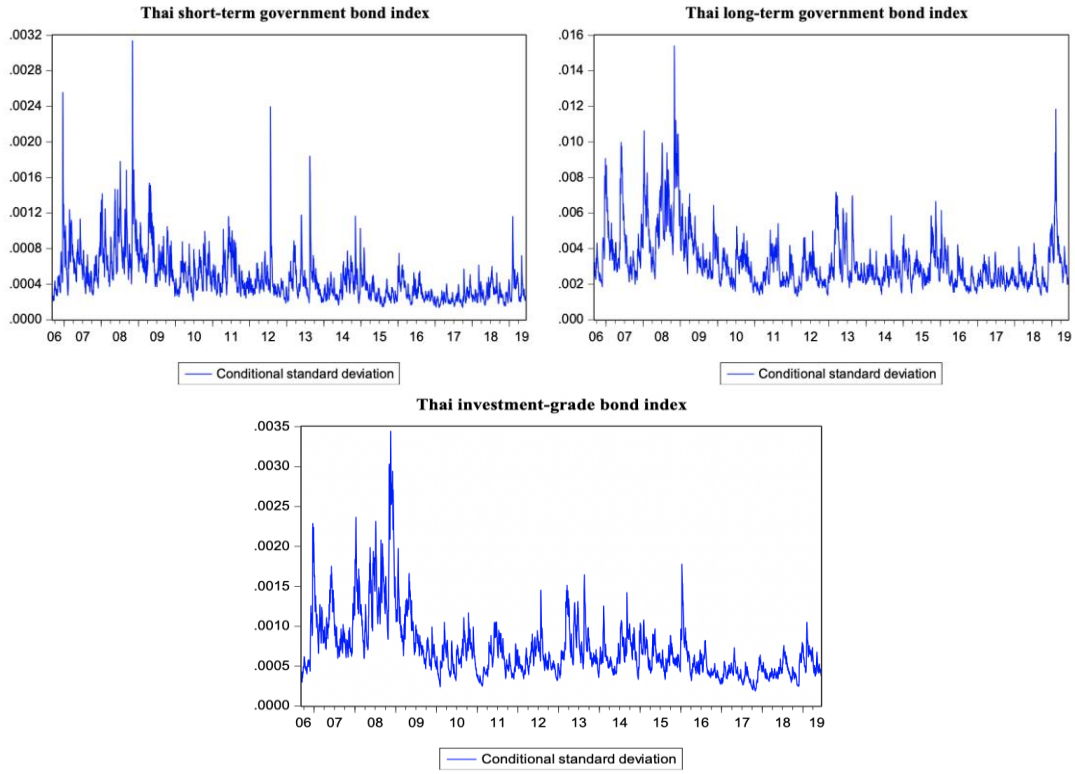
	Short-term bond		Long-term bond		Investment-grade bond	
	Ann surpr		Ann surpr		Ann surpr	
	Estimate		Estimate		Estimate	
Conditional Mean Equations						
μ	5.48×10^{-5}	***	1.39×10^{-4}	**	9.68×10^{-5}	***
$\propto$	0.1483	***	0.1872	***	0.2720	***
φ_{pos}	4.31×10^{-5}	*	8.92×10^{-5}		3.85×10^{-5}	
φ_{neg}	4.5×10^{-5}	**	-4.73×10^{-5}		5.32×10^{-5}	*
ρ_{qe}	5.13×10^{-5}	***	5.29×10^{-5}		4.93×10^{-5}	**
z_{th}	4.83×10^{-5}	*	2.39×10^{-4}	*	6.04×10^{-5}	*
σ_{us}	0.0228	***	0.2703	***	0.0610	***
Conditional Variance Equations						
ω	-1.2287	***	-0.7218	***	-0.6445	***
b	0.3613	***	0.2448	***	0.2319	***
a	-0.0062		0.0176	***	-0.0055	
g	0.9420	***	0.9587	***	0.9713	***
δ_{pos}	0.2890	***	0.0774	***	0.1060	***
δ_{neg}	0.0657	***	0.0337		0.0866	***
τ_{qe}	0.0161	**	0.0119	***	0.0192	***
v_{th}	0.2904	***	0.3225	***	0.2651	***
θ_{us}	10.8559	***	18.0161	***	8.7470	***
Diagnostics						
$Q^2(12)$	3.2106		5.3065		11.1610	
ARCH-LM	0.0016		1.1490		1.2067	

$$r_t = \mu + \propto r_{t-1} + \varphi_{pos} I_{t-1}^{b+} + \varphi_{neg} I_{t-1}^{b-} + \rho_{qe} QE_{t-1} + z_{th} News_t^{TH} + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (3a)$$

$$ln(h_t^2) = \omega + b ln(h_{t-1}^2) + a \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \delta_{pos} I_{t-1}^{b+} + \delta_{neg} I_{t-1}^{b-} + \tau_{qe} QE_{t-1} + v_{th} News_t^{TH} + \theta_{us} |USAg_{t-1}| \quad (3b)$$

Notes: Where r_t denotes the return on Thai bond in period t, h_t^2 is conditional variance of r_t. Dummy for positive big surprises (I_t^{b+}) takes the value of 1 for surprises that are greater than 1 standard deviation and dummy for negative big surprises (I_t^{b-}) takes the value of 1 for surprises that are lower than -1 standard deviation, I_{t-1}^{b+} and I_{t-1}^{b-} are lagged by one period. Significance at: *10, **5, and ***1 percent, respectively.

Figure 4 Conditional standard deviation: effect of US announcement surprises on Thai bond



5.3 Each US announcement day effect on Thai bond

In this section I distinguish among 16 different US announcements that how each types of announcement have different impacts on conditional all bond market variance. Table 6 presents the estimation result of the conditional variance models, using 16 different US announcement days. For short-term government bond, each types of US announcement show evenly distributed sign coefficients (7 positive and 6 negative coefficients) e.g. core consumer price (CCPI) and trade balance (TB) announcement days raise subsequent short-term bond government variance

Table 6 Estimation results: effect of each US announcement day on Thai bond

	Short-term bond		Long-term bond		Investment-grade bond	
	Ann days		Ann days		Ann days	
	Estimate		Estimate		Estimate	
Conditional Mean Equations						
μ	6.43×10^{-5}	***	1.35×10^{-4}	**	1.2×10^{-4}	***
∝	0.1572	***	0.1731	***	0.2199	***
zth	4.97×10^{-5}	**	1.27×10^{-4}		2.38×10^{-7}	
σus	0.0223	***	0.2555	***	0.0526	***
ρqe	4.78×10^{-5}	***	1.09×10^{-4}		3.42×10^{-5}	*
Conditional Variance Equations						
ω	-0.6628	***	-0.6047	***	-0.7673	***
b	0.2582	***	0.2207	***	0.2396	***
a	0.0064		0.0232	***	0.0042	
g	0.9695	***	0.9600	***	0.9630	***
δfomc-a	0.0533		0.0836		0.0909	
δccpi-a	0.1463	**	0.0927		0.1615	*
δpce-a	0.2324	***	0.4431	***	0.3626	***
δnfrm-a	0.4480	***	0.2361	***	0.4011	***
δuemp-a	-0.1823	**	-0.3685	***	-0.0771	
δcapu-a	0.3282	***	0.2333	***	0.2316	**
δijc-a	-0.3208	***	-0.3484	***	-0.2145	***
δdgo-a	-0.1809	***	-0.1370	**	-0.1212	
δhst-a	-0.5732	***	-0.4922	***	-0.4215	***
δehs-a	0.3852	***	0.3838	***	0.4676	***
δnhs-a	-0.1138	*	-0.1640	**	-0.2073	**
δrsl-a	0.4322	***	0.1728	***	0.2543	***
δps-a	-0.2407	***	-0.0746		-0.3000	***
δpi-a	0.1227		-0.1717	**	0.1004	
δism-a	-0.3124	***	-0.0960		-0.0765	
δtb-a	0.1750	**	-0.0641		-0.0366	
Diagnostics						
$Q^2(12)$	8.4432		8.3636		8.3122	
ARCH-LM	2.2405		2.3628		0.4776	

$$r_t = \mu + \propto r_{t-1} + \gamma_a I^a_{t-1} + \rho_{qe} QE_{t-1} + z_{th} News^{TH}_t + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (2a)$$

$$ln(h_t^2) = \omega + bln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \delta_{fomc-a} I^a_{t-1,FOMC} + \delta_{ccpi-a} I^a_{t-1,CCPI} + \cdots + \delta_{tb-a} I^a_{t-1,TB} + \tau_{qe} QE_{t-1} + v_{th} News^{TH}_t + \theta_{us} |USAg_{t-1}| \quad (5)$$

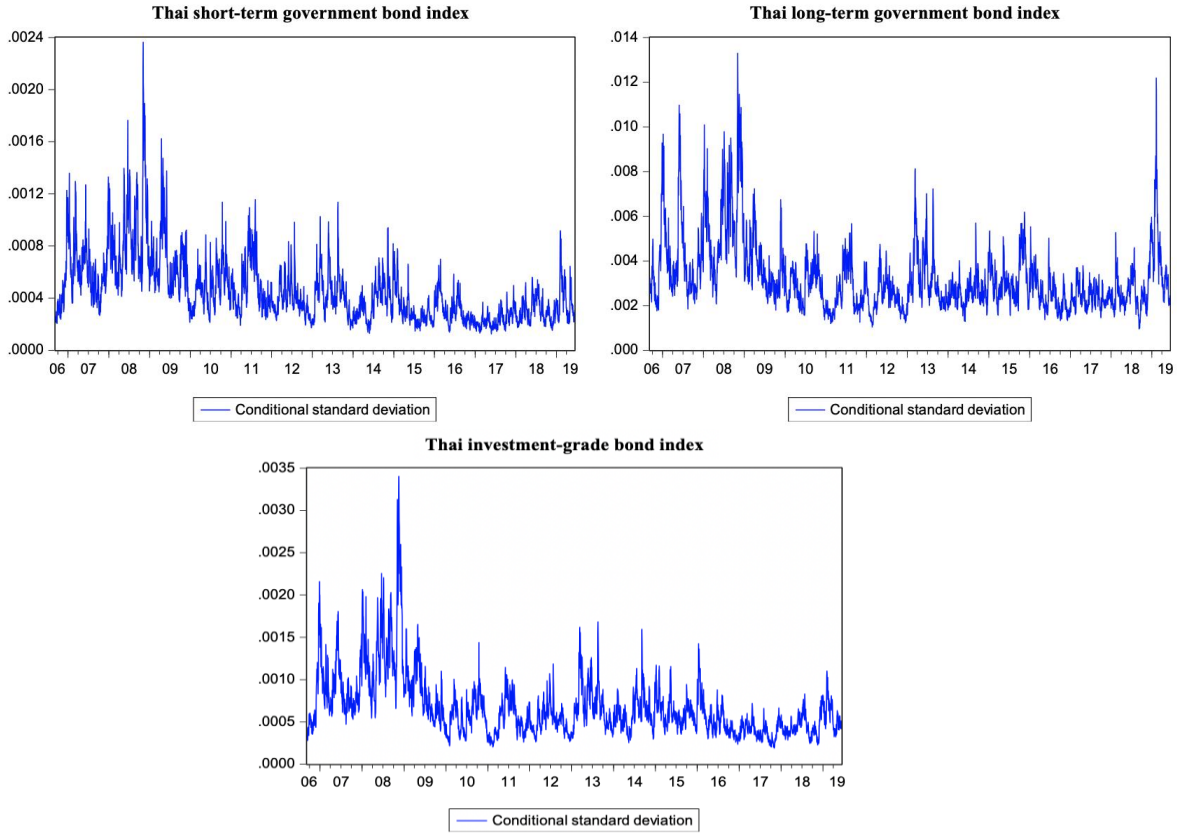
Notes: $I^a_{t,m}$ (m = FOMC, CCPI,.., TB) refer each dummy variable of 16 different US announcements having the value of 1 on US announcement day, otherwise zero. Significance at: *10, **5, and ***1 percent, respectively.

by 0.1463 and 0.1750, respectively whereas unemployment rate (UEMP) and initial jobless claims (IJC) announcement days lower variance by -0.1823 and -0.3208, respectively. Furthermore, there are also not clear patterns of responses to each US announcement day on long-term government bond (5 positive and 6 negative coefficients) and investment-grade bond (5 negative and 4 positive coefficients) e.g. housing starts (HST) and new home sales (NHS) announcement days lower long-term government and investment-grade bond variance while capacity utilization (CAPU) and core consumption expenditure (PCE) announcement days raise bond variance. The overall US inflation announcement days have positive effect on all Thai bond markets because US inflation announcement will affect market participant expectations of monetary policy to react the inflation. As a result, it raises level of uncertainty about policymaker action effect thus having bond market volatility boosting impact. However, the magnitude of positive effect on long-term bond and investment-grade bond are larger than short-term bond and these results are in consistent with the previous literature (Brenner et al., 2009) who find that shorter-maturity bonds are less sensitive to fluctuations of inflation expectations potentially induced by that news. Most of US announcement days about labor market and housing market seem to lower bond market volatility. This suggests that these announcement days inject more information to reduce the level of uncertainty among market participants about US economic outlook as pointed out by (S.-J. Kim, 2003). In addition, (Andritzky et al., 2007) suggest that investors generally have similar views about overall US economic growth prospect. Thus, US labor market and

housing market announcement which contain more information regarding the health of the US economy will not trigger a controversy. View of market participants will converge to uniform assessment after these announcement days, and market volatility subsides.

In Figure 5, I present graphs of conditional standard deviations related these results. The graphs show that the conditional standard deviation of Thai bond price tends to be highly persistent and be disturbed by the arrival of each US macroeconomic announcement day.

Figure 5 Conditional standard deviation: effect of each US announcement day on Thai bond



5.4 Each US announcement surprise effect on Thai bond

In this section I investigate how each US announcement surprises affect conditional Thai bond market variance. The results and summary are shown in Table 7 and 8 respectively. For short-term government bond, lower than expected each US announcements (negative surprises) as good news show positive sign coefficients. Lower than expected core consumer price (CCPI) and core PCE (PCE) raise short-term bond variance by 0.1391 and 0.4188 respectively. This result is contrast to (S.-J. Kim et al., 2004) who find that lower than expected inflation create more stable trading environment which may be attributed to allay the fear of Fed rate hike. Possible explanation for higher variance caused by negative inflation surprises may be the weak stability of inflation expectations and doubt about the Fed credibility stance in fighting inflation over sample period. While the spillover effects of negative surprises as bad news seem negative on short-term bond (3 negative and 1 positive coefficients). Lower than expected nonfarm payrolls (NFRM), existing home sale (EHS) and personal income (PI) lower short-term bond variance by -0.3543, -0.6493 and -0.8686 respectively. For long-term government bond, negative surprises associate with good news show evenly distributed sign coefficients (2 positive and 1 negative coefficients) while negative surprises that imply bad news seem lower long-term bond variance (5 negative and 2 positive coefficients) similar to the result of

short-term government bond. These results are in consistent with the previous literature (S.-J. Kim, 2003) who find that

Table 7 Estimation results: effect of each US announcement surprise on Thai bond

	Short-term bond		Long-term bond		Investment-grade bond	
	Ann surpr		Ann surpr		Ann surpr	
	Estimate		Estimate		Estimate	
Conditional Mean Equations						
μ	6.35×10^{-5}	***	1.53×10^{-4}	***	1.22×10^{-4}	***
∝	0.1538	***	0.1752	***	0.2190	***
zth	6.38×10^{-5}	***	3.1×10^{-4}	**	-8.78×10^{-7}	
σus	0.0215	***	0.2425	***	0.0529	***
ρqe	5.13×10^{-5}	***	6.99×10^{-5}		3.23×10^{-5}	
Conditional Variance Equations						
ω	-0.4383	***	-0.5925	***	-0.5225	***
b	0.1377	***	0.2037	***	0.1585	***
a	0.0130	***	0.0316	***	0.0149	**
g	0.9797	***	0.9658	***	0.9753	***
φfomc-neg	0.0194		-0.2294		-0.1659	
φccpi-neg	0.1391	**	0.3630	***	0.3005	***
φpce-neg	0.4188	***	0.3394	***	0.3274	***
φnfrm-neg	-0.3543	***	-0.3457	***	-0.0247	
φuemp-neg	-0.0009		-0.2415	**	-0.1559	
φcapu-neg	-0.0109		-0.2736	**	0.0921	
φijc-neg	-0.0636		-0.0035		0.0816	
φdgo-neg	0.9875	***	0.3567	***	0.4775	***
φhst-neg	0.1287	*	0.0309		-0.0737	
φehs-neg	-0.6493	***	-0.1696		-0.3276	**
φnhs-neg	0.0118		-0.4838	***	-0.2449	
φrsl-neg	0.0763		-0.1505		-0.3909	***
φps-neg	-0.1336		-0.4845	***	-0.3848	***
φpi-neg	-0.8686	***	-0.4172	***	-0.2434	
φism-neg	-0.1262		0.4981	***	0.4603	***
φtb-neg	-0.0448		0.1169		0.0048	

$$r_t = \mu + \propto r_{t-1} + \gamma_a I^a_{t-1} + \rho_{qe} QE_{t-1} + z_{th} News^{TH}_t + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (2a)$$

$$ln(h_t^2) = \omega + bln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \varphi_{fomc-pos}I_{t-1,FOMC}^{b+} + \varphi_{ccpi-pos}I_{t-1,CCPI}^{b+} + \cdots + \varphi_{tb-pos}I_{t-1,TB}^{b+} + \varphi_{fomc-neg}I_{t-1,FOMC}^{b-} + \varphi_{fomc-ccpi}I_{t-1,CCPI}^{b-} + \cdots + \varphi_{tb-neg}I_{t-1,TB}^{b-} + \tau_{qe}QE_{t-1} + v_{th}News_t^{TH} + \theta_{us}|USAg_{t-1}| \quad (6)$$

Notes: $I_{t,m}^{b+}$ (m = FOMC, CCPI,.., TB) refer each dummy variable of 16 different US announcements having the value of 1 for surprises that are greater than 1 standard deviation, $I_{t,m}^{b-}$ (m = FOMC, CCPI,.., TB) refer each dummy variable of 16 different US announcements having the value of 1 for surprises that are lower than -1 standard deviation. Significance at: *10, **5, and ***1 percent, respectively.

the unexpected US economic downturn may clear a lot of doubt about possible US policy response and then lead to lower the level of uncertainty in Asia markets. For investment-grade bond, negative surprises as good news shows positive effect on investment-grade bond variance (2 positive coefficients) similar to the result of short-term bond while negative surprises as bad news does not have clear pattern of responses on Thai investment-grade bond (3 positive and 2 negative coefficients). Furthermore, I find that negative surprise in US consumption lower all Thai bond variance. The result in line with (S.-J. Kim et al., 2004) who find that lower US bond market volatility in response to lower than expected US retail sales due to most investors may have consensus view to increase bond holdings.

On the part of higher than expected each US announcements (positive surprises) as good news do not have clear pattern of responses on short- and long-term bonds. However, spillover effects of positive surprises as bad news on short-term bond seem positive. Higher than inflation, unemployment rate and initial jobless claims raise short-term bond market variance. The result is in consistent with the previous literature (S.-J. Kim et al., 2004) which suggest that suggests higher than expected inflation causes uncertainty in the market possibly as a result of some flow related to expectation about the Fed's policy response to the unexpected high inflation and

(Cakan, Doytch, & Upadhyaya, 2015) where positive surprise for US unemployment rate raises volatility in Thai stock market. For long-term government bond, positive surprises that imply bad news seem raise long-term bond variance (3 positive and 1 positive coefficients) similar to the result of short-term bond. Higher than expected fed funds rate, core PCE and unemployment rate

Table 7 (Continued) effect of each US announcement surprise on Thai bond

	Short-term bond		Long-term bond		Investment-grade bond	
	Ann surpr		Ann surpr		Ann surpr	
	Estimate		Estimate		Estimate	
Conditional Variance Equations						
φfomc-pos	0.3040		0.8472	***	0.6036	*
φccpi-pos	0.1643	**	-0.1728	**	-0.0756	
φpce-pos	0.2420	**	0.3401	***	0.2460	*
φnfrm-pos	-0.0075		-0.0079		-0.0609	
φcapu-pos	0.6912	***	0.1903		0.3600	**
φuemp-pos	0.3774	***	0.3175	**	0.1292	
φijc-pos	0.2563	***	-0.1041	*	0.0566	
φdgo-pos	0.1483		-0.1002		0.0163	
φhst-pos	-0.2120	*	-0.0746		-0.2263	
φehs-pos	-0.0610		0.6510	***	0.1291	
φnhs-pos	-0.5227	***	0.1227		-0.1976	
φrsl-pos	0.6261	***	0.5387	***	0.5112	***
φps-pos	-0.6819	***	-0.7106	***	-0.6295	***
φpi-pos	-0.4624	***	-0.1218		-0.1488	
φism-pos	-0.0919		-0.1660		-0.3658	***
φtb-pos	0.0417		0.0765		-0.0583	
νth	0.2307	***	0.3575	***	0.2493	***
θus	-3.8411		10.8039	***	7.9525	*
τqe	0.0045		0.0012		0.0040	
Diagnostics						
$Q^2(12)$	8.6293		10.8530		11.0100	
ARCH-LM	3.0964		3.0685		1.5849	

$$r_t = \mu + \propto r_{t-1} + \gamma_a I^a_{t-1} + \rho_{qe} QE_{t-1} + z_{th} News^{TH}_t + \sigma_{us} USAg_{t-1} + \varepsilon_t \quad (2a)$$

$$ln(h_t^2) = \omega + bln(h_{t-1}^2) + a\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}^2}} + g\left(\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}^2}} - \sqrt{2/\pi}\right) + \varphi_{fomc-pos} I_{t-1,FOMC}^{b+} + \varphi_{ccpi-pos} I_{t-1,CCPI}^{b+} + \cdots + \varphi_{tb-pos} I_{t-1,TB}^{b+} + \varphi_{fomc-neg} I_{t-1,FOMC}^{b-} + \varphi_{fomc-ccpi} I_{t-1,CCPI}^{b-} + \cdots + \varphi_{tb-neg} I_{t-1,TB}^{b-} + \tau_{qe} QE_{t-1} + v_{th} News_t^{TH} + \theta_{us} |USAg_{t-1}| \quad (6)$$

Notes: $I_{t,m}^{b+}$ (m = FOMC, CCPI,.., TB) refer each dummy variable of 16 different US announcements having the value of 1 for surprises that are greater than 1 standard deviation, $I_{t,m}^{b-}$ (m = FOMC, CCPI,.., TB) refer each dummy variable of 16 different US announcements having the value of 1 for surprises that are lower than -1 standard deviation. Significance at: *10, **5, and ***1 percent, respectively.

Table 8 Summary of variance impact of positive and negative US surprises on Thai bond

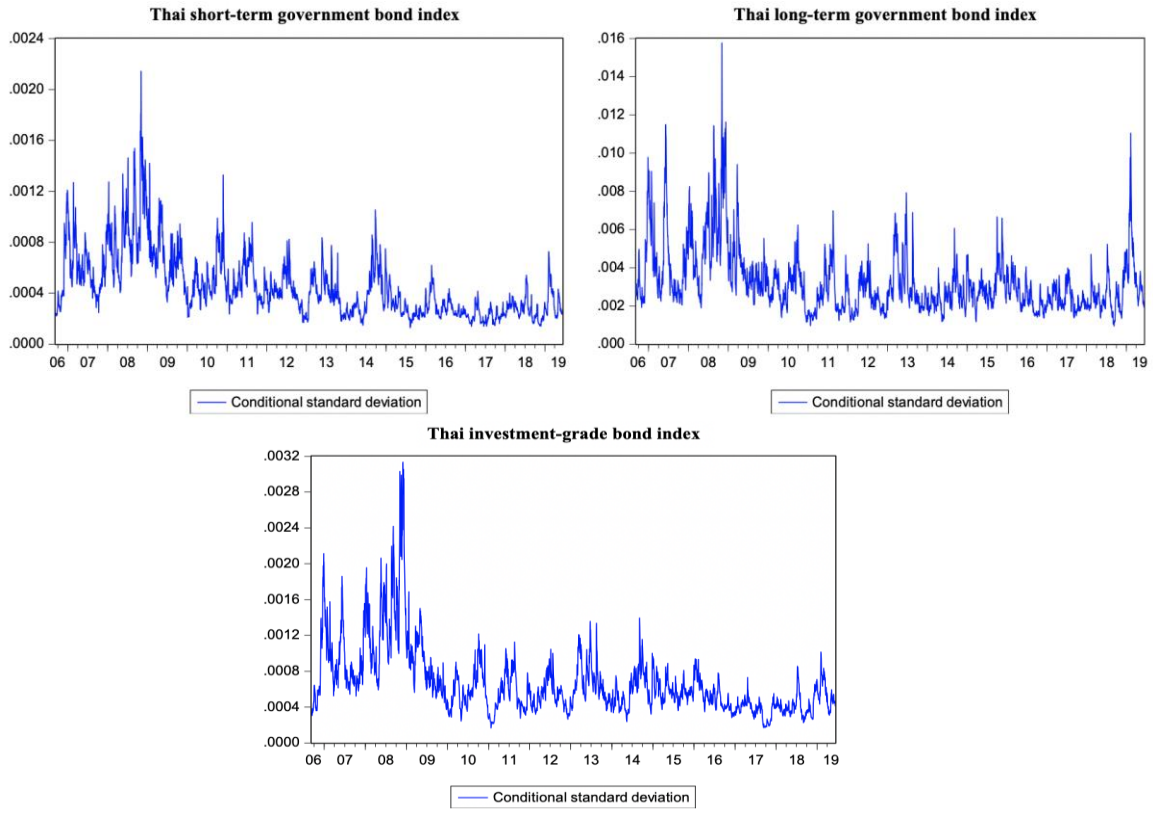
This table report summary of pattern of significant impacts (down to 5% level of significance) observed across all Thai bond markets – (1) short-term, long-term government bond and investment-grade bond; (2) across 16 different types of US announcement – fed funds (FOMC), core consumer price index (CCPI), core consumption expenditure index (PCE), unemployment rate (UEMP), initial jobless claims (IJC), nonfarm payrolls (NFRM), capacity utilization (CAPU), durable goods orders (DGO), housing starts (HST), existing home sale (EHS), new home sales (NHS), Retail sales (RSL), Personal spending (PS), Personal Income (PI), ISM Manufacturing Index (ISM) and Trade balance (TB); (3) investigating variance effects; and (4) across positive and negative US macroeconomic announcement surprises.

	Short-term bond Variance		Long-term bond Variance		Investment-grade bond Variance	
	Pos surpr Bad news	Neg surpr Good news	Pos surpr Bad news	Neg surpr Good news	Pos surpr Bad news	Neg surpr Good news
FOMC			+			
CCPI	+	+	-	+		+
PCE	+	+	+	+		+
UEMP	+		+	-		
IJC	+					
	Pos surpr Good news	Neg surpr Bad news	Pos surpr Good news	Neg surpr Bad news	Pos surpr Good news	Neg surpr Bad news
NFRM		-		-		
CAPU	+			-	+	
DGO		+		+		+
HST						
EHS		-	+			-
NHS	-			-		
RSL	+		+		+	-
PS	-		-	-	-	-
PI	-	-		-		
ISM				+	-	+
TB						

raise long-term bond variance. The result in line with (S.-J. Kim & Nguyen, 2009) which find that the unexpected Fed rate hike increase volatility in markets as it raises to some degree of heterogeneity in investors view about the impact of these surprises and results in higher trading activities. For investment-grade bond, positive surprises that represent good news show evenly disturbed sign coefficient.

For the graphs in Figure 6 related these results show that the conditional standard deviation of Thai bond price tends to be highly persistent and be disturbed by the arrival of each US announcement surprises.

Figure 6: Conditional standard deviation: effect of US announcement surprise on Thai bond

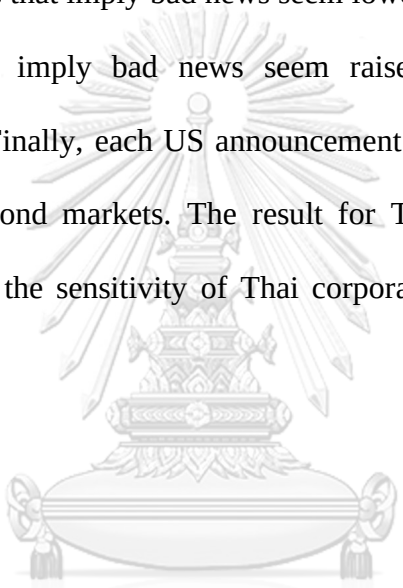


6. Conclusions

This paper investigates the interaction between US announcements and Thai bond market returns, whether US announcements still affect Thai bond markets after US announcement days and surprises. I use EGARCH model with dummy for US announcement day and surprise. I use daily total returns on short- and long-term government bonds including investment-grade bond for the period September 2006-December 2019.

The results show that US announcement days lower subsequent variance in Thai bond markets while US announcement surprises raise variance. This is consistent with (Ederington & Lee, 1996) suggest that unexpected news (surprise) increase

uncertainty. There is asymmetric response especially in long-term government bond market according to positive shocks increase variance more than negative shocks. When I separate each US announcement in order to examine the different 16 US announcement days and surprises on Thai bond variance. US inflation announcement days seem raise Thai bond variance while most of US announcement days about labor market and housing market seem to lower bond variance. For most of the negative US announcement surprises that imply bad news seem lower all Thai bond variance while positive surprises that imply bad news seem raise short- and long-term bond government variance. Finally, each US announcement surprise seems less influential for investment-grade bond markets. The result for Thai investment-grade bond is quite surprising, given the sensitivity of Thai corporate bond to the business cycle related to credit risk.



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