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Do Words in Central Bank Press Releases Affect Thailand's Financial Markets?*

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Abstract

The study investigates how financial markets respond to a shock to tone and semantic similarity of the Bank of Thailand press releases. The techniques in natural language processing are employed to quantify the tone and the semantic similarity of 69 press releases from 2010 to 2018. The corpus of the press releases is accessible to the general public. Stock market returns and bond yields are measured by logged return on SET50 and short-term and long-term government bonds, respectively. Data are daily from January 4, 2010, to August 8, 2019. The study uses the Structural Vector Auto Regressive model (SVAR) to analyze the effects of unanticipated and temporary shocks to the tone and the semantic similarity on bond yields and stock market returns. Impulse response functions are also constructed for the analysis. The results show that 1-month, 3-month, 6-month and 1-year bond yields significantly increase in response to a positive shock to the tone of press releases and 1-month, 3-month, 6-month, 1-year and 25-year bond yields significantly increase in response to a positive shock to the semantic similarity. Interestingly, stock market returns obtained from the SET50 index insignificantly respond to the shocks from the tone and the semantic similarity of the press releases.

Keywords: Central Bank Communication, Financial Markets, Text Mining

JEL Classification Code: E50, E52, E58, G10

1. Introduction

During the period of the Zero Lower Bound (ZLB), major central banks have adopted the central bank communication as one of the monetary policy toolkits. Recent studies have shown that the central bank communication has a considerable influence on financial markets. Particularly, the surprise component of the central bank statements and forward guidance matter for financial market participants (Rosa, 2011; Hansen & McMahon, 2016). The literature suggests that the content of the central bank statements has significant impacts on financial markets (Hayo & Neuenkirch, 2010; Apel & Grimaldi, 2012; Hansen & McMahon, 2016). However, previous studies examined major central banks, such as the European Central Bank, the Federal Reserve System, and the Bank of England.

The question, how does the content of central bank press releases affect financial markets in Thailand? is explored in the study. The content of the central bank press releases is measured through the tone and the semantic similarity of the paragraphs in the documents. To the best of my knowledge, this is the first study that explores the dynamic effects of the semantic similarity on bond yields and equity returns. Of course, the semantic similarity is studied by others. Ehrman and Talmi (2020) study the effect of semantic similarity of the Bank of Canada on the volatility of financial market variables. Acosta and Meade (2015) emphasize the importance of the semantic similarity. Acosta (2015) uses the semantic similarity measured by the latent semantic analysis (LSA) to study the central bank transparency. At least, this paper attempts to contribute to the pertinent literature by investigating a case of a central bank in emerging markets.

The Bank of Thailand (BOT) regularly holds eight scheduled meetings in one year and the Monetary Policy

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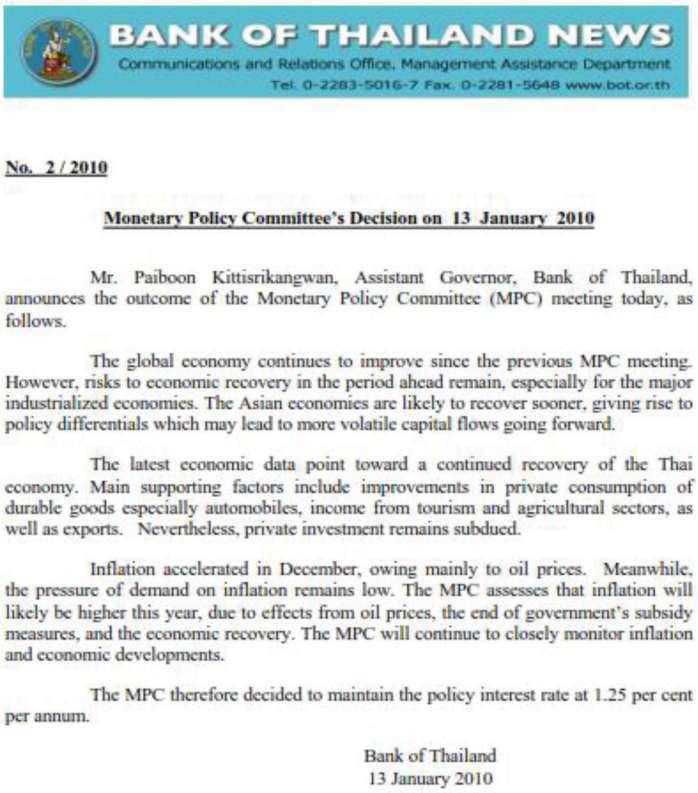

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Monetary Policy Committee's Decision on 13 January 2010

Mr. Paiboon Kittisrikangwan, Assistant Governor, Bank of Thailand, announces the outcome of the Monetary Policy Committee (MPC) meeting today, as follows.

The global economy continues to improve since the previous MPC meeting. However, risks to economic recovery in the period ahead remain, especially for the major industrialized economies. The Asian economies are likely to recover sooner, giving rise to policy differentials which may lead to more volatile capital flows going forward.

The latest economic data point toward a continued recovery of the Thai economy. Main supporting factors include improvements in private consumption of durable goods especially automobiles, income from tourism and agricultural sectors, as well as exports. Nevertheless, private investment remains subdued.

Inflation accelerated in December, owing mainly to oil prices. Meanwhile, the pressure of demand on inflation remains low. The MPC assesses that inflation will likely be higher this year, due to effects from oil prices, the end of government's subsidy measures, and the economic recovery. The MPC will continue to closely monitor inflation and economic developments.

The MPC therefore decided to maintain the policy interest rate at 1.25 per cent per annum.

Bank of Thailand
13 January 2010

Figure 1: The Monetary Policy Committee's Press Release on 13 January 2010

Committee (MPC)'s press releases are publicly available on the official website after the meeting. Hence, financial market participants can access to these press releases. Figure 1 is an example of the MPC press release. The MPC meeting unarguably comprises of leading economists and research economists in Thailand. This makes MPC press releases contain important information. In this study, the dictionary technique and the cosine similarity are used to measure the aspect of the central bank communication from 69 press releases from 2010 to 2018. These techniques are made popular by Bholat, Hansen, Santos, and Schonhardt-Bailey (2015), Acosta and Meade (2015), Hansen and McMahon (2016), and Loughran and McDonald (2016). The tone represents the content of the central bank press releases while the cosine similarity measures the similarity of the content between two consecutive press releases (Alzahrani, 2016; Martinez-Gil, 2012). The main underlying assumption of this paper is that market participants perceive the tone and the semantic similarity as the public information and make the decision when observing these signals. For the similarity, investors observe the similarity between the current press releases and make a decision. Dynamic effects of the ~~net~~ tone and the semantic similarity on bond yields and stock market returns are analyzed within the Structural Vector Auto Regressive framework.

The main findings of the study are that 1-month, 3-month, 6-month, and 1-year bond yields rise in response to an exogenous shock to the tone of the central bank press releases. The positive shock to the tone can be interpreted as improving in economic and financial conditions. Thus, the investors may sell the short-term bonds and, as a result, the short-term bond yields increase. With regard to the semantic similarity of the content, findings show that 1-month, 3-month, 6-month, 1-year, and 25-year bond yields increase at the same time as the semantic similarity responds to an exogenous shock. This can be interpreted that the content of the current press release is unexpectedly similar to the previous press release. Consequently, investors may sell short-term bonds and some of the long-term bonds. However, stock market returns insignificantly respond to the shock to both the tone and the semantic similarity of the content of the press releases. Central bank communication may have an influence on bond markets rather than stock markets during the 2010–2018 period in Thailand.

2. Literature Review

Traditional monetary policy shocks and their effects on macroeconomic aggregates are comprehensively studied

in Christiano, Eichenbaum, and Evans (1999). They study the effects of exogenous monetary policy shocks on key macroeconomic variables, such as output and inflation, with different monetary policy instruments through different identification assumptions in the structural economic model. They also study the identification schemes in the literature. Understanding what happens after the monetary policy shock is crucial in many countries. For the Eurozone, Murgia (2020) uses macroeconomic forecasts and the narrative approach to construct the new measurement of the monetary policy shock and analyzes the effects of this novel variable on macroeconomic aggregates. Empirical findings indicate that output and inflation decline in response to the positive monetary policy shock, which is equivalent to tightening monetary policy even though the inflation respond weakly to the shock. For developing countries, the allocation of monetary policy shocks is investigated in Kandil (2014). The study finds that the effect of the monetary policy when the elasticity of the aggregate demand increases and some effects of monetary fluctuations on output and inflation variability. For G-7 countries, Kim (1999) examines the monetary policy shock during the post war. The study aims to analyze the source of output fluctuations and find that the main source of output fluctuations in G-7 during the post war period is not the monetary policy shocks even though the shocks are significant for the output. Additionally, there are other aspects of the study of monetary policy on macroeconomic variables such as bond yields (Anwar & Suhendra, 2020) and other aspects of monetary policy itself such as independence and transparency of the central bank (Nurbayev, 2015).

In addition to the effects of the monetary policy shocks on key macroeconomic variables, the monetary policy shock also affects income inequality in advanced and emerging countries. Furceri, Loungani, and Zdzienicka (2018) construct the novel measurement of the monetary policy shock from the changes in the short-term rates that are uncorrelated to the changes in inflation and growth news. They find that tightening monetary policy increases income inequality and there exists the asymmetric effects of the monetary policy shocks on income inequality. In Auer (2019), the effects of monetary policy shocks in the U.S. and Canada on foreign investment are also analyzed along with domestic aggregates, exchange rates and trade flows through a Bayesian Vector Autoregression. With regard to the asymmetric effects of the monetary policy shock, Claus and Nguyen (2020) find that, after the monetary policy shock, expectations respond differently to the contractionary and the expansionary monetary policy. The adjustment of inflation expectations exhibits the Delphic effect of monetary policy. In addition, Mumtaz and Theodoridis (2020) study the effects of the monetary policy shocks on macroeconomic volatility of output and inflation. An increase in the monetary policy leads to the increase in the volatility of unemployment and inflation. This can be explained by the New Keynesian model augmented by Epstein-Zin preferences and search and matching frictions. For some certain characteristics of the data, such as the long memory, Lovcha and Perez-Laborda (2018) take into account the persistence of inflation into the model.

The pertinent literature tends to concentrate on the effects of monetary policy shocks on output and inflation in many respects. As for the financial conditions, Castelnuovo (2013) employs the DSGE model to analyze the influence of monetary policy shocks on financial conditions and finds that financial conditions negatively respond to the contractionary monetary policy. In bond markets, Roush (2007) finds that if the expectations theory is conditional on the identified monetary policy shock, the theory works in this setting.

In this paper, the effects of the shock to the content of the monetary policy on bond yields are examined. The main contribution of the paper to the literature is that the dynamic effects of the tone and the semantic similarity on bond yields and stock markets in Thailand are analyzed. The paper is closely related to Christiano, Eichenbaum, and Evans (1999) and Hansen and McMahon (2016). Unlike Christiano, Eichenbaum, and Evans (1999), here the monetary policy shock affects the content of central bank press releases, not the conventional monetary policy instrument. This is consistent with the practice of monetary policy after the great recession that central banks turn to the central bank communication as an unconventional monetary policy tool. The study of the dynamic effects of the semantic similarity makes the study different from Hansen and McMahon (2016).

3. Data

3.1. Financial Market and Central Bank Communication Data

Using daily data of bond yields and stock market returns from 2010 to 2018, there are 2,100 observations, bond yields are obtained from the Thai Bond Market Association (ThaiBMA) and SET50 index is from the Stock Exchange of Thailand (SET).

All financial market data are the continuously-compounded returns, $\ln\left(\frac{X_t}{X_{t-1}}\right)\times 100$. The calculation of logged return follows Khantavit (2020). The methodology that is used to obtain tone and semantic similarity variables are explained in section 3.2.

Financial market data pass the unit root test at 1% significant level. The purpose of the unit root test is to examine whether the time series data are stationary.

If time series data are nonstationary, the problem of spurious relationship is likely to occur.

3.2. Central Bank Communication Data

3.2.1. Textual Analysis: Analytical Preprocessing

Textual analysis extracts the information from a corpus of press releases. However, text is unstructured data. Before analyzing the content of textual data, data cleaning process, which is the analytical pre processing, is inevitable. The ultimate goal of the analytical preprocessing is to remove noises from a corpus. In the computational linguistics, the procedure reduces dimensions of a term-document matrix. When it comes to the analytical preprocessing, the following procedures are employed.

- Download the press releases from the Bank of Thailand's website. There are 69 press releases ranging from in this study.
- Lowering the string of characters and removing the white space.
- Eliminating the English stop words.
- Stemming text with Porter stemmer.
- Tokenization.
- A bag-of-words model.

The row of the term-document matrix corresponds to the number of terms in the corpus, and the column of the matric corresponds to the number of press releases, which is 69.

Figure 2 illustrates the Bag of Words. In the word cloud representation, the thickness of stemmed words shows the frequency of word occurrence in the corpus of financial conditions. For example, the word 'economi' has the highest occurrence as it is the thickest. To reduce the existing noises in the corpus, I employ the term frequency-inverse document frequency (TF-IDF) weighting scheme to reduce some words that contribute little information in the corpus. For instance, the word 'committee' occurs in every press release, but it contributes little information to the reader. The term-document matrix after trimming is the 69×906 sparse matrix.

3.2.2. Tone Analysis with Dictionary Method

The tone variable is computed from the term-document matrix in which its rows correspond to the number of stemmed words in the corpus and its columns correspond to

Table 1: Financial Market Data Description

Data	Description
1M	1-month bond yield
3M	3-month bond yield
6M	6-month bond yield
Y1	1-year bond yield
Y5	5-year bond yield
Y10	10-year bond yield
Y15	15-year bond yield
Y20	20-year bond yield
Y25	25-year bond yield
Tone	Tone variable
SIM	Semantic similarity variable

Table 2: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Standard deviation	Observations
M1	0.01	0.00	6.77	–9.80	0.68	2099
M3	0.01	0.00	7.70	–10.23	0.67	2099
M6	0.01	0.00	4.58	–10.56	0.62	2099
Y1	0.00	0.00	5.17	–9.18	0.59	2099
Y5	–0.02	–0.02	6.86	–8.30	1.07	2099
Y10	–0.02	–0.02	7.66	–8.29	1.11	2099
Y15	–0.02	–0.02	5.41	–6.37	0.74	2099
Y20	–0.02	–0.01	6.38	–4.41	0.69	2099
Y25	–0.02	0.00	4.00	–6.32	0.52	2099
TONE	0.00	0.00	0.07	–0.09	0.01	2099
SIM	0.99	1.00	1.00	0.53	0.05	2099

Table 3: Unit Root Test

Data	*t*-statistic	*p*-value
DSET50	–44.4914	0.0001
1M	–19.1769	0.0000
3M	–19.06712	0.0000
6M	–14.93362	0.0000
Y1	–20.27181	0.0000
Y5	–35.30848	0.0000
Y10	–34.12380	0.0000
Y15	–32.89047	0.0000
Y20	–31.54691	0.0000
Y25	–23.82181	0.0000
Tone	–46.16437	0.0001
SIM	–47.10158	0.0001

Figure 2: Word Cloud After TF-IDF Weighting

each press release. The dictionary technique is applied with a list of directional words in Hansen and McMahon (2016). Table 4 shows the list of directional words. Positive tone is derived from words associated with expansion and words associated with the contraction indicate negative tone. The predetermined word list is the user defined dictionary and the list is used to count the number of expansionary and contractionary words in each document. After that, the net tone variable is calculated in equation (1).

$$\text{Tone}_t = \frac{m_{d,t}^{\text{up}} - m_{d,t}^{\text{down}}}{m_{d,t}} \quad (1)$$

Table 4: The Dictionary of Directional Words

Expansion		Contraction	
Acceler	increase	collaps	Lower
Boom	rise	contract	Lowest
Expand	risen	cool	Moder
Fast	strength	deceler	Slow
Faster	strong	decrease	Slower
Fastest	stronger	fall	Slowest
Foster	strongest	fell	Soften
Gain	expands	lose	Subdu
High		loss	Weak
Higher		lost	Weaken
Highest		low	Weaker
Improve			Weakest

"*t*" is a date on which the press release was released on the web site. $Tone_t$ is the tone of the paragraph of financial markets. $m_{d,t}^{\text{up}}$ is the number of expansionary words in a document *d* at date "*t*". $m_{d,t}^{\text{down}}$ is the number of contractionary words in a document *d* at date "*t*". $m_{d,t}$ is the total number of words in the document. Issues of words with multiple meanings and multiple sentences with single meaning may arise at the first glace. However, these issues may naturally arise in a corpus of newspapers rather than the document from the central bank.

The net tone is the blue line in Figure 3. From document 1 to document 45, the net tone fluctuates and is more stable after that. Negative/Positive values represent the negative/positive tone of press releases. From 4/01/2010 to 8/8/2018, there are 69 MPC press releases in total. From 69 press releases, the net tone of 48 press releases is negative and the net tone of 21 press releases is positive. In this study, on announcement days, the value of the net tone are equal to the value computed by the dictionary technique and values of the net tone are set to equal zero on other dates. The public information occurs only on the announcement date.

3.2.3. Textual Semantic Similarity

The semantic similarity between any two press releases is computed by a technique called cosine similarity as presented in equation (2). It is a value of an angle between two column vectors in a term-document matrix. The value of the cosine is between 0 and 1. Suppose that the cosine is 0, it indicates that two documents are orthogonal. In other words, the contents in both press releases are completely irrelevant. However, when the value of the cosine is equal to 1, it indicates that two documents are exactly the same.

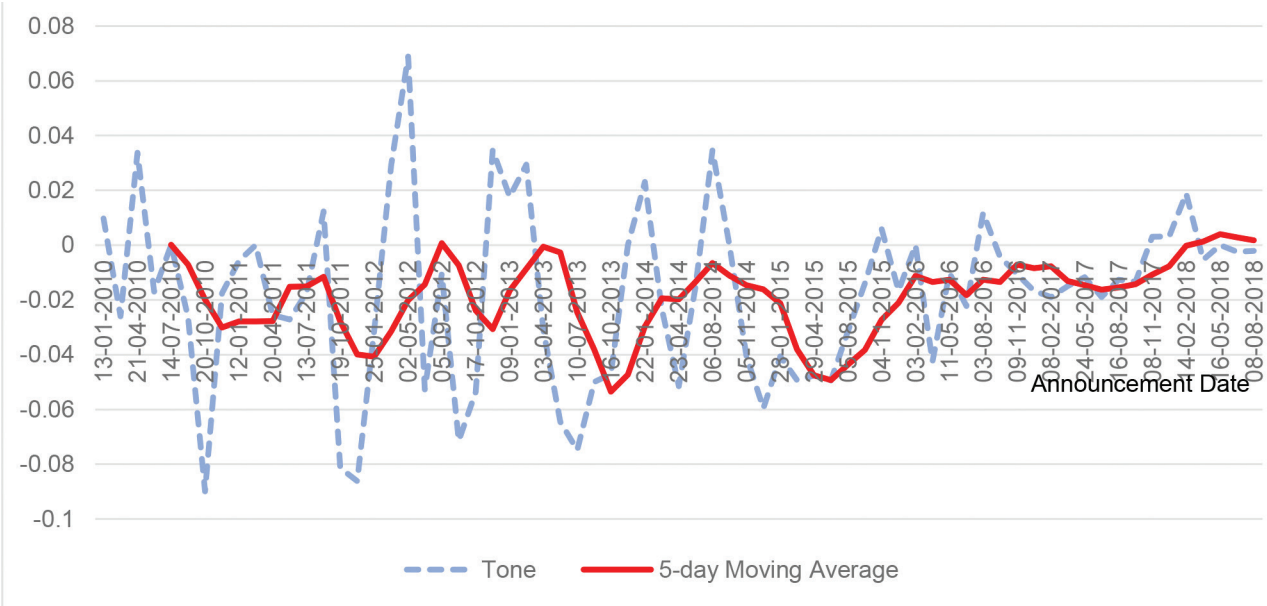

Figure 3: Tone of the Bank of Thailand's Press Releases

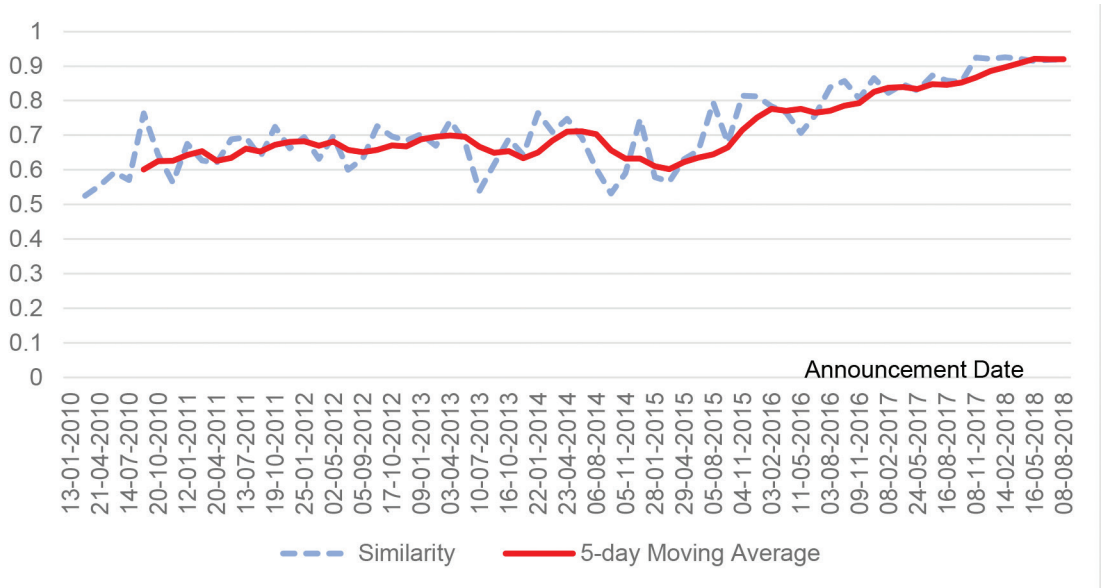

Figure 4: Semantic Similarity of the Bank of Thailand's Press Releases

$$\mathrm{SIM}_i = \frac{\sum P_i P_{i-1}}{\sqrt{\sum P_i^2}\sqrt{\sum P_{i-1}^2}} \quad (2)$$

i is an index of a press release. P_i is a vector of words in a current press release and P_{i-1} is a vector of words in a previous press release. $\mathrm{SIM}_i \in [0,1]$ is the value of semantic similarity and there are 68 values of the semantic similarity, which is depicted in Figure 4.

The mean value of the semantic similarity variable is 0.73. If the value of the semantic similarity of two documents is 1, it means that two consecutive documents share the same content. Thus, the mean value indicates that press releases have relatively similar contents. In Figure 4, the diagram shows that the semantic similarity is increasing to 1, which is perfectly similar. Thus, this can be interpreted that the Bank of Thailand has published more similar contents of press releases. In this study, the value of

Table 5: Correlation of Financial Market and Central Bank Communication Data

Correlation	DSET50	M1	M3	M6	Y1	Y5	Y10	Y15	Y20	Y25	TONE	SIM
DSET50	1.00											
M1	–0.01	1.00										
M3	–0.01	0.87	1.00									
M6	0.00	0.77	0.86	1.00								
Y1	0.03	0.63	0.69	0.82	1.00							
Y5	–0.01	0.23	0.25	0.29	0.33	1.00						
Y10	–0.04	0.15	0.16	0.21	0.26	0.81	1.00					
Y15	–0.03	0.16	0.17	0.22	0.26	0.76	0.83	1.00				
Y20	–0.02	0.17	0.17	0.21	0.24	0.66	0.77	0.83	1.00			
Y25	–0.01	0.20	0.20	0.24	0.27	0.63	0.73	0.80	0.85	1.00		
TONE	0.01	0.15	0.16	0.17	0.15	0.01	0.00	0.02	0.01	0.02	1.00	
SIM	–0.01	0.14	0.15	0.18	0.17	0.03	0.03	0.04	0.04	0.05	0.52	1.00

the semantic similarity on announcement day is equal to the value calculated from the cosine similarity.

Table 2 reports the descriptive statistics of both tone and semantic similarity and Table 3 shows that tone and the semantic similarity pass the unit root test at 1% significant level while Table 5 gives the correlation of all financial market data and central bank communication data.

4. Research Methodology

The central bank makes a monetary policy decision based on the following feedback rule in (3).

$$M_t = f\left(\omega_t\right) + \sigma_s \epsilon_t \tag{3}$$

Unlike the pertinent literature, this study aims to examine the effects of central bank communication on bond yields. Thus, M_t is a variable associated to the central bank communication, which is the tone and the semantic similarity variable. The aspects of central bank communication are measured from the central bank press releases. Thus, we analyze the situation in which the central bank uses the communication as an alternative tool to monetary policy instruments, such as the policy rate or other relevant monetary policy aggregates.

ω_t is the information set at time *t* that contains the lagged and current variables available to central bankers. In the context of the study, the information set is a set of bond yields with different maturities and the stock market return because the objective of the study is to analyze the effects of communication on financial markets. Here, *f*() is a function that explains the mapping of variables to the communication variable. One can think of the function as the rule that the central banker uses to associate the variables in the information set to the variables of monetary policy communication.

ϵ_t is regarded as the shock to the central bank communication and has a unit variance. These shocks are uncorrelated and can be obtained through the recursiveness assumption from the Structural Vector Autoregressive model and the recursiveness assumption. σ_s is the standard deviation of the shock.

4.1. Effects of the Content of Central Bank Communication on Financial Markets: SVAR Approach

The contents of central bank press releases are classified into the tone of the press releases and the semantic similarity of the press releases. The study separately examines the effect of the tone and the similarity on financial market variables.

Structural Vector Auto Regressive model (SVAR) is employed to analyze dynamic effects of the shock to both the net tone and the semantic similarity on bond yields and equity returns because the system allows for the study of the impulse response function of the uncorrelated shocks to financial market variables. Therefore, there are two SVAR systems in the study, one for the tone and another for the semantic similarity. Unlike the residuals from reduced-form vector autoregressive (VAR), the residuals from the SVAR methodology helps disentangle the effects of the exogenous shock. That is, one can examine effects of uncorrelated shocks (or pure shocks) and their dynamic effects associated with these shocks on financial market variables. The methodology in this paper is closely related to Christiano, Eichenbaum, and Evans (1999). The column vector of the SVAR system with the tone variable is defined as $Y_t^{[1]}$ and the vector of the SVAR system with the semantic similarity variable is $Y_t^{[2]}$. Both vectors are stacked as follows. The lag

length is chosen based on the Akaike Information Criterion (AIC). The number of lag length is 4. That is, the AIC value of the system with the tone variable is 5.8189 and 10.0088 for the system with the semantic similarity.

$$Y_t^{[1]} = [\text{TONE} \quad 1M \quad 3M \quad 6M \quad Y1 \quad Y5 \quad Y10 \quad Y15 \quad Y20 \quad Y25 \quad \text{DSET50}]^T$$

$$Y_t^{[2]} = [\text{SIM} \quad 1M \quad 3M \quad 6M \quad Y1 \quad Y5 \quad Y10 \quad Y15 \quad Y20 \quad Y25 \quad \text{DSET50}]^T$$

The order of both vectors is consistent to the recursiveness assumption. That is, financial market variables contemporaneously respond to the change of the central bank communication variables. From the methodology, financial market data are variables in the information set.

The SVAR representation is depicted as follows.

$$A_0 Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_p Y_{t-p} + \varepsilon_t, \mathrm{I}_{\varepsilon_t} = E\left(\varepsilon_t \varepsilon_t^T\right) \quad (4)$$

$$Y_t = A_0^{-1} A_1 Y_{t-1} + A_0^{-1} A_2 Y_{t-2} + ... + A_0^{-1} A_p Y_{t-p} + A_0^{-1} \varepsilon_t \quad (5)$$

From equation (4) and (5), the SVAR system can be written in terms of the Reduced-form vector auto regressive (VAR) as in (6).

$$Y_t = \psi_1 Y_{t-1} + \psi_1 Y_{t-2} + ... + \psi_1 Y_{t-p} + u_t \quad (6)$$

In this study, the OLS method is used to estimate (6). The Akaike Information Criterion (AIC) indicates that the number of the optimal lag is 4 in both SVAR systems. ε_t is recovered from the variance-covariance matrices of reduced-form VAR. Residuals of the reduced-form VAR cannot be used to analyze uncorrelated effects of the exogenous shock to the net tone and the semantic similarity because shocks are correlated in the reduced-form VAR. In addition, SVAR allows the researcher to impose the structural relationship to the VAR system. Therefore, the study employs the SVAR in order to investigate the effects of uncorrelated and structural shocks on financial market variables.

4.2. Recursiveness Assumption

$$u_t = A_0^{-1} \varepsilon_t \quad (7)$$

$$\Sigma_{u_t} = E\left(u_t u_t^T\right) = E\left(A_0^{-1} \varepsilon_t \left(A_0^{-1} \varepsilon_t\right)^T\right) = A_0^{-1} \left(A_0^{-1}\right)^T \quad (8)$$

From equation (7)–(8), in order to disentangle the shock, one can write an error term of reduced-form VAR in terms of an error of SVAR. Thus, from equation (4) and (5), the error term of SVAR can be recovered from the reduced-form equation.

We recover the matrix, A_0, by employing the method of Cholesky decomposition of the variance-covariance matrix of reduced-form residuals, Σ_{u_t}. This procedure is compatible with the recursiveness assumption as presented in Christiano, Eichenbaum, and Evans (1999). For example, in the vector, $Y_t^{[1]}$, an unanticipated and temporary shock to the net tone has no contemporaneous effects on other financial market variables. That is, in a stack of $Y_t^{[1]}$, the shock to a variable above contemporaneously affects a variable below. On the contrary, the shock to a variable below has no contemporaneous effects on a variable above.

4.3. Structural Identification

From the reduced-form VAR in equation (6), equation (8) is a variance-covariance matrix of residuals. To recover A_0 in SVAR, Cholesky decomposition is applied to (8). A_0 is a lower triangular matrix and is consistent with the recursiveness assumption. The relationship between the reduced-form shocks and the structural shocks is showed in equation (9).

$$A_0 u_t = B \varepsilon_t \quad (9)$$

B is a 11-by-11 identity matrix.

After the Cholesky decomposition and the inverse of the variance-covariance matrix, the matrix A_0 is obtained. $A_0^{[1]}$ and $A_0^{[2]}$ are lower triangular matrices that are consistent with the recursiveness assumption. Hence, we can analyze the effect of unanticipated and temporary shocks to the tone and the semantic similarity.

$A_0^{[1]} =$

154.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–26.96	1.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–7.36	–2.68	3.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–8.38	–0.44	–2.20	3.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–2.57	–0.12	0.17	–2.43	3.11	0.00	0.00	0.00	0.00	0.00	0.00
6.34	–0.09	0.04	–0.12	–0.46	1.02	0.00	0.00	0.00	0.00	0.00
2.49	–0.07	0.23	–0.09	–0.06	–1.32	1.60	0.00	0.00	0.00	0.00
–2.44	–0.03	0.03	–0.08	0.03	–0.44	–1.08	2.65	0.00	0.00	0.00
1.45	–0.09	–0.04	0.03	0.04	0.03	–0.41	–1.62	2.81	0.00	0.00
0.23	–0.10	0.05	–0.13	–0.05	0.02	–0.23	–0.53	–1.89	4.24	0.00
–1.90	0.05	0.08	0.02	–0.16	–0.10	0.13	0.08	–0.03	–0.13	0.92

$A_0^{[1]}$ is the lower triangular matric of the first SVAR(4). Matrix $A_0^{[1]}$ is used in the analysis of the shock to the tone variable.

$A_0^{[2]} =$

18.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–2.93	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–1.24	–2.68	3.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–1.96	–0.44	–2.20	3.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
–0.73	–0.14	0.18	–2.43	3.12	0.00	0.00	0.00	0.00	0.00	0.00
0.53	–0.08	0.05	–0.13	–0.47	1.02	0.00	0.00	0.00	0.00	0.00
–0.12	–0.07	0.23	–0.08	–0.06	–1.32	1.60	0.00	0.00	0.00	0.00
–0.30	–0.02	0.02	–0.07	0.03	–0.44	–1.07	2.65	0.00	0.00	0.00
–0.34	–0.09	–0.04	0.03	0.05	0.03	–0.41	–1.62	2.81	0.00	0.00
–0.34	–0.09	0.05	–0.12	–0.06	0.02	–0.23	–0.53	–1.89	4.24	0.00
0.11	0.06	0.08	0.02	–0.17	–0.10	0.13	0.08	–0.03	–0.12	0.92

$A_0^{[2]}$ is the lower triangular matric of the first SVAR(4). Matrix $A_0^{[2]}$ is used in the analysis of the shock to the semantic similarity.

5. Empirical Results

5.1. The Effects of Tone on Financial Market Variables

In Figure 5, the responses of government bond yields and stock market returns to the unanticipated and temporary shock (Shock 1) to the tone of central bank press releases are analyzed through the impulse response function of SVAR (4). From the accumulated response of the tone to shock 1 diagram, a positive 1 unit of uncorrelated shock to the tone is translated to 0.0065 unit. The effect of the shock gradually declines since period 1 and levels off at period 5. That is, the tone increases in response to the positive shock. This may reflect the positive tone in press releases.

As for the bond yields, it seems that the shock to the tone affects bond yields with different maturities differently. For the bond with the maturity less than and equal 1 year, 1-month, 3-month, 6-month, and 1-year bond yields contemporaneously increase together with the positive shock to the tone. The contemporaneous effects are consistent with the order of the variables in SVAR (4) system. The responses of the short-term bond yields are significant and persistent, especially, the response of the 1-month and 1-year bond yields to the shock. When the shock dies down, all short-term bond yields are in the positive region. Unlike the 1-month bond yields, the impulse response diagrams of 3-month, 6-month and 1-year bond yields exhibit the hump shape around period 4 after the shock. On the contrary, for the bonds with the maturity greater than 1 year, the effects of the shock are insignificant. This can be seen from the error bands generated from the impulse response function.

In the equity market, the effect of the shock to the tone of press releases is insignificant. The tone of the content may have no effect on SET50 returns during the period of the study.

5.2. The Effects of Semantic Similarity

In Figure 6, from the accumulated response of the semantic similarity to shock 1, a 1 unit of the positive exogenous shock to the semantic similarity of the central bank press releases is equal to 0.0533 unit. The impulse response diagram of semantic similarity can be interpreted that the content in the current press release is unexpectedly similar to the previous press release. The effect of the shock to the semantic similarity lasts for 5 periods before remaining

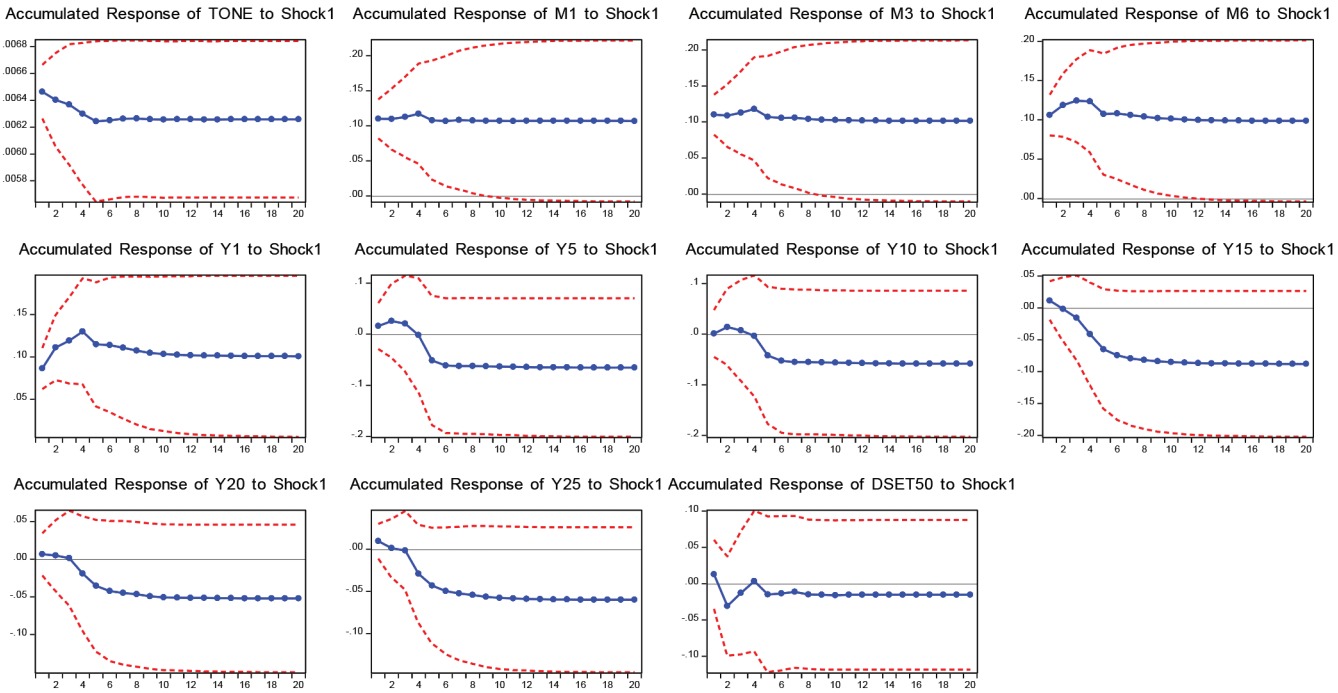

Figure 5: The Diagram Depicts the Accumulated Response of Bond Yields and Stock Market Returns to the Unanticipated and Temporary Shock to the Tone of the Press Releases

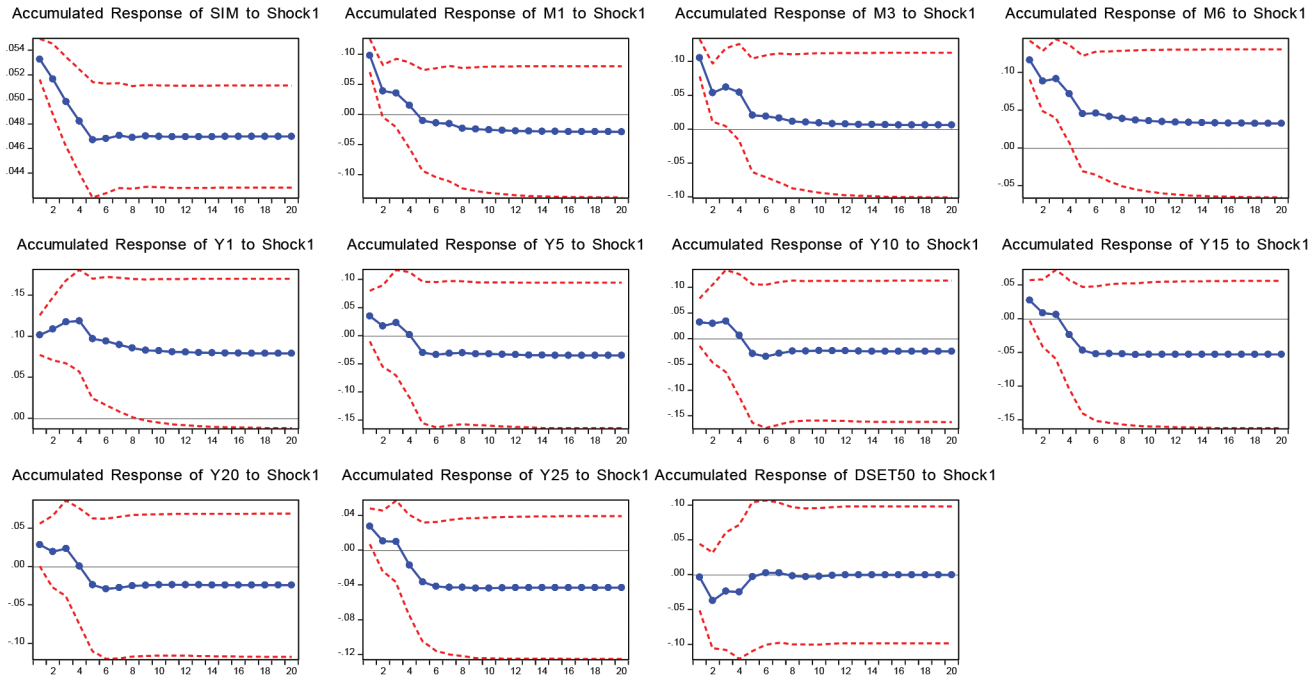

Figure 6: The Diagram Depicts the Impulse Responses of Bond Yields and Stock Market Returns to the Unanticipated and Temporary Shock to the Semantic Similarity of Press Releases

stable somewhere around 0.0047 after period 5. Therefore, even though the degree of similarity reduces after the shock, its effect is persistent after that.

For the responses of bond yields with different maturities to the semantic similarity, all short-term bond yields, 1-month, 3-month, 6-month, and 1-year bond yields increase contemporaneously when the content of the current press release is surprisingly similar to the previous one. Short-term bond yields gradually decrease over time. Unlike the findings in the analysis of the tone variable, the effects of semantic similarity shock on 1-month yields are significant until period 2 while the effects on 3-month and 6-month yields are significant until.

period 4. The impulse response of the 1-year bond yields seems to be more persistent comparing with other short-term bonds as the effects are significantly until period 8. For the long-term bond, semantic similarity effects are not significant on the long-term bond yields. However, this is not likely to be the case of 25-year bond yields. The exogenous shock to the semantic similarity leads to a significant increase in the 25-year bond yields and the effects on the yields is significant until period 2. Like the effects of the shock to the tone, the shock to semantic similarity is insignificant for the returns of SET50.

From the findings, it seems that short-term bond yields (less than or equal to 1 year) significantly respond to the exogenous shock to the content of the central bank press releases while the effects of the shock on the long-term bond yields and stock market returns are insignificant during the period of the study.

6. Discussion

6.1. Press Release Tone and Dynamics of Government Bond Yields and Stock Market Returns

In this study, a positive shock to the tone of the press releases can be interpreted that the central bank delivers the positive tone of the monetary policy content to the general public. For example, the overall economic and financial conditions are improving. The effect of the shock has gradually reduced until period 4. Following by its declining, the positive tone of the central bank communication fades away from the market and remains stable at the new steady state.

From the impulse response diagrams of bond yields, when the bond yields increase in response to the tone shock, investors may reduce the demand for the short-term bonds and invest in other assets. The lower the demand for bond, the higher bond yields are. As we can see from Figure 5, that 1-month, 3-month, 6-month and 1-year bond yields

contemporaneously increase in response to an unexpected increase in the positive tone of the content. In the period of the study, the tone shock does not significantly influence bond yields with the maturity greater than 1 year. Thus, the effect of the shock to the content of the press releases is important to the short-term bond yields.

Interestingly, from the impulse response function, the shock to the tone does not influence the stock market returns calculated from SET50. There may be other factors that are crucial to investors than the content from the central bank.

6.2. Dynamic Effects of the Textual Semantic Similarity

Semantic similarity of MPC press releases make investors easy to digest the content (Ehrman & Talmi, 2020). However, the degree of investors' risk aversion is more intense while facing with the temporary and unanticipated shock to the content of statements. This can be seen in the responses of bond yields.

In the market for bonds, when investors are surprised by the unexpectedly similar content between the current and the previous press releases, investors have a lower demand for government bonds, especially the short-term bonds. This leads to the increase of short-term bond yields even though the shape and the persistence of the impulse response diagrams are different.

The investors may perceive that there are no surprising factors for the future course of the monetary policy and the overall economic and financial conditions are relatively similar to the previous period. The investors feel confident and sell short-term bonds and some long-term bond. Selling bonds causes the increase in the bond yields.

In the equity market, the effects of the shock to the similarity of the contents are insignificant. The aspects of central bank communication may not be pronounced in the equity market. In addition, from the finding, this study shows that the consistency of the similarity of the press releases is an important factor that a policy maker should be aware of because the shocks to the aspects of central bank communication significantly affect bond markets.

7. Conclusion

This study poses the question: do words in the central bank press releases move the financial markets? With techniques in the natural language processing, the tone and the textual semantic similarity are constructed from 69 MPC press releases from 2010 to 2018. The tone and the semantic similarity are the aspects of central bank communication that the paper aims to analyze.

Findings show that the positive shock to the tone has significant effects on the impulse response of short-term bond yields. That is, 1-month, 3-month, 6-month, and 1-year bond yields increase in response to a shock to the tone of central bank press releases. The shock to the tone does not significantly affect the stock market returns. As for the similarity of the content, short-term bond yields significantly respond to the unexpectedly similar content. Moreover, the study finds the significant response of the 25-year bond yields to the similarity shock. However, the impulse response of the equity returns to the similarity is not significant. From the findings, this can be concluded that short-term bond yields significantly respond to the shock to the tone and the semantic similarity of the content of central bank press releases. Thus, the tone and the consistency of the content play a crucial role in determining short-term bond yields.

References

Acosta, M., & Meade, E. (2015). Hanging on every word: Semantic analysis of the FOMC 's post meeting statement. *FEDS Notes*. Retrieved from https://www.federalreserve.gov/econresdata/notes/feds-notes/2015/semantic-analysis-of-the-FOMCs-postmeeting-statement-20150930.html

Acosta, M. (2015). *FOMC responses to calls for transparency* (Finance and Economics Discussion Series 2015–060), Washington: Board of Governors of the Federal Reserve System. http://dx.doi.org/10.17016/FEDS.2015.060

Alzahrani, S. (2016). Cross-language semantic similarity of Arabic-English short phrases and sentences. *Journal of Computer Science, 12*(1), 1–18. https://doi.org/10.3844/jcssp.2016.1.18

Anwar, C. J., & Suhendra, I. (2020). Monetary Policy Independence and Bond Yield in Developing Countries. *Journal of Asian Finance, Economics and Business, 7*(11), 23–31. https://doi.org/10.13106/JAFEB.2020.VOL7.NO11.023

Apel, M., & Grimaldi, M. (2012). The information content of central bank minutes. *The Riksbank Research paper Series*.

Auer, S. (2019). Monetary policy shocks and foreign investment income: Evidence from a large Bayesian VAR. *Journal of International Money and Finance, 93*, 142–166. https://doi.org/10.1016/j.jimonfin.2018.12.013

Bholat, D., Hansen, S., Santos, P., & Schonhardt-Bailey, C.(2015). Text mining for central banks. Central for Central Banking Studies Handbook, *33*, 1–19.

Castelnuovo, E. (2013). Monetary policy shocks and financial conditions: A Monte Carlo experiment. *Journal of International Money and Finance, 32*, 282–303. https://doi.org/10.1016/j.jimonfin.2012.04.011

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary policy shocks: what have we learned and to what end? *Handbook of Macroeconomics, 1*, 65–148. https://doi.org/10.1016/S1574-0048(99)01005-8

Claus, E., & Nguyen, V. H. (2020). Monetary policy shocks from the consumer perspective. *Journal of Monetary Economics, 114*, 159–173. https://doi.org/10.1016/j.jmoneco.2019.03.012

Ehrmann, M., & Talmi J. (2020). Starting from a blank page? Semantic similarity in central bank communication and market volatility. *Journal of Monetary Economics, 111*, 48–62. https://doi.org/10.1016/j.jmoneco.2019.01.028

Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The effects of monetary policy shocks on inequality. *Journal of International Money and Finance, 85*, 168–186. https://doi.org/10.1016/j.jimonfin.2017.11.004

Hansen, S., & McMahon, M. (2016). Shocking language: understanding macroeconomic effects of central bank communication. *Journal of International Economics, 99*, 114–133. https://doi.org/10.1016/j.jinteco.2015.12.008

Hayo, B., & Neuenkirch, M. (2010). Do Federal Reserve communications help predict federal funds target rate decisions? *Southern Economic Journal*, *78*(3), 1041–1056. https://doi.org/10.1016/j.jmacro.2010.06.003

Kandil, M. (2014). On the effects of monetary policy shocks in developing countries. *Borsa Istanbul Review, 14*(2), 104–118. https://doi.org/10.1016/j.bir.2014.04.001

Khanthavit, A. (2020). Foreign Investors' Abnormal Trading Behavior in the Time of COVID-19. *Journal of Asian Finance, Economics and Business, 7*(9), 63–74. https://doi.org/10.13106/JAFEB.2020.VOL7.NO9.063

Kim, S. (1999). Do monetary policy shocks matter in the G-7 countries? Using common identifying assumptions about monetary policy across countries. *Journal of International Economics, 48*(2), 387–412. https://doi.org/10.1016/S0022-1996(98)00052-X

Loughran, T., & McDonald, B. (2016). Textual analysis in accounting and finance: a survey. *Journal of Accounting Research, 54*(4). https://doi.org/10.1111/1475-679X.12123

Lovcha, Y., & Perez-Laborda, A. (2018). Monetary policy shocks, inflation persistence, and long memory. *Journal of Macroeconomics, 55*, 117–127. https://doi.org/10.1016/j.jmacro.2017.10.006

Mumtaz, H., & Theodoridis, K. (2020). Dynamic effects of monetary policy shocks on macroeconomic volatility. *Journal of Monetary Economics, 114*, 262–282. https://doi.org/10.1016/j.jmoneco.2019.03.011

Murgia, L. M. (2020). The effect of monetary policy shocks on macroeconomic variables: Evidence from the Eurozone. *Economics Letters, 186*. https://doi.org/10.1016/j.econlet.2019.108803

Nurbayev, D. (2015). Independence and transparency of the central bank of Kazakhstan. *Journal of Asian Finance, Economics and Business, 2*(4), 31–38. https://doi.org/10.13106/jafeb.2015.vol2.no4.31

Rosa, C. (2011). Words that shake traders: The stock market's reaction to central bank communication in real time. *Journal of Empirical Finance, 18*(5), 915–934. https://doi.org/10.1016/j.jempfin.2011.07.005