Decoding the Communication of
the Bank of Mongolia
through the Text Mining Analysis of
Monetary Policy Committee Statements
/July 2010 – March 2023/

by

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Abstract

This paper uses text-mining techniques to examine the Bank of Mongolia (BoM) 's communication strategy by analyzing the Monetary Policy Committee (MPC) statements. The dataset consists of 52 MPC statements issued by the BoM from July 2010 to March 2023, comprising 14,453 words. Various approaches, including regular and tidy versions in R programming and Excel analysis, are employed to enhance the effectiveness of data interpretation. The findings reveal a rising trend in word count over time, often correlated with significant policy concerns. However, MPC statements' readability index has declined, suggesting that the word and sentence structures have become more complex. Furthermore, sentiment analysis shows a shift from predominantly positive expressions in the first half of the sample period to a decrease in positivity in the latter half. Moreover, we discovered five key topics within the MPC statements through the LDA topic modeling approach. Finally, additional event study results indicate a slight decrease in USD exchange rate market volatility following the MPC announcement day. Moreover, the volatility was significantly higher when the decision was made to raise the policy rate, which is consistent with the central bank's tendency to raise policy rates during increased market volatility.

Keywords: central bank communication, text-mining, monetary policy committee statement

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1. INTRODUCTION

1.1. Overview of Central Bank Communication

Central bank communication can be defined as the provision of any written or verbal information made by the central bank (Blinder et al., 2008). Moreover, central bank communication aims to manage public expectations and enhance policy decisions (Vayid, 2013). Effectively managing expectations requires a clear and concise communication approach, where every word must be chosen carefully. Even the wrong facial expressions can lead to unintended consequences for central banks (Sauter, 2013, p. 180). Therefore, the objective of every modern central bank should be to manage these expectations through a careful communication strategy (Woodford, 2005). The growing body of literature and empirical studies have investigated the impact of central bank communication, for example, anchoring inflation expectations, reducing market volatility, and affecting asset prices (Blinder et al., 2008; Geraats, 2009; Bulir et al., 2012).

Figure 1
Central Bank Communication Approach
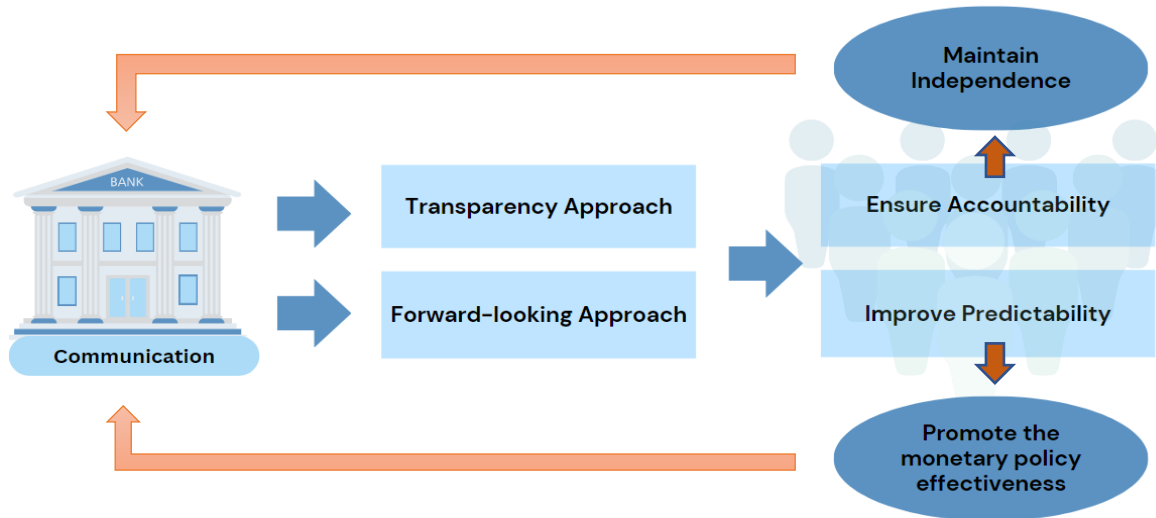
Note. Author's compilation.

There can be two main approaches to central bank communication, as illustrated in Figure 1: *the transparency approach* and *the forward-looking approach*. The transparency approach refers to the availability and accessibility of information that the public can rely on to assess the central bank's performance, such as annual reports and financial statements. By adopting the transparency approach, central banks ensure accountability, which, in turn, helps maintain their independence (Briault et al., 1997, p. 299). On the other hand, the forward-looking approach provides information on current and future monetary policy decisions, as reflected in MPC

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statements and inflation reports. This type of communication improves the predictability of monetary policymaking and future economic prospects. As a result, it promotes the overall effectiveness of monetary policy. Ultimately, central bank communication functions as a cycle, where both approaches mutually influence the effectiveness of central bank policymaking.

1.2 Evolutionary Milestones in Central Bank Communication (see Appendix A)

<u>Early Foundations of Central Banking (1668 -1970):</u> To fully comprehend the development of central bank communication, it is crucial to acknowledge the origins of central banking itself—establishing the Swedish Riksbank in 1668 marks an early milestone in central banking history. Subsequently, the Bank of England was founded in 1694, while the Federal Reserve System (Fed) emerged in 1913. The significance of institutional arrangements related to central banks became prominent when economic theory began emphasizing their role in influencing macroeconomic outcomes, particularly during the New Classical Revolution (Masciandaro & Romelli, 2016). This revolution in economic thought highlighted the importance of central bank design and governance in shaping monetary policy. During the early stages, the primary role of central banks revolved around facilitating government finance and commercial transactions, functioning as vital clearinghouses (Bordo, 2007). Furthermore, until 1970, central bank communication was not deemed essential, with policies often shrouded in secrecy. The secretive approach in central bank communication can be attributed to the historically closed nature of their operations and the relatively narrower scope of their policies at that time. Furthermore, the conventional view embraced the element of "surprise" as a strategic approach to enhance the effectiveness of monetary policy (Vavid, 2013).

<u>The Rise of Central Bank Communication (1970 – 1990):</u> The emergence of central bank communication unfolded at different times and varying degrees across countries. However, it gained recognition in the late 1970s due to stagflation—a combination of stagnant economic growth and high inflation rates. Central banks faced the challenges of stagflation and recognized the need to communicate their policies and decisions effectively. Notably, in 1979, Governor Paolo Baffi of the Bank of Italy highlighted the importance of abandoning secrecy and embracing transparency in central bank actions to maintain independence (Masciandaro & Romelli, 2016). This early recognition by Governor Baffi underscored the growing awareness of effective communication in central banking. Many central banks also began implementing explicit inflation targets and providing more comprehensive information about their policy decisions. For example,

the Federal Reserve in the United States introduced the Beige Book in 1970, a summary of the country's economic conditions, which became publicly available in 1983 (Fabry, 2016). These initiatives marked the beginning of central bank communication, aiming to enhance transparency and improve public understanding of central bank policies.

Expansion of Central Bank Communication as "*managing expectations*" (1990 -2007): Central Bank communication has experienced a significant surge since the early 1990s, primarily driven by the adoption of the inflation-targeting regime (Bernanke et al., 1999, p. 26). The Reserve Bank of New Zealand (RBNZ) was at the forefront of this movement, adopting inflation targeting in 1990. Subsequently, numerous central banks across advanced, emerging, and developing economies embraced the inflation-targeting approach, such as the Bank of England, the Bank of Canada, and the Swedish Riksbank (Vayid, 2013). In the context of inflation targeting, market expectations regarding future actions of the central bank hold immense importance in shaping both short-term and long-term interest rates. The central bank's ability to effectively communicate its objectives and policy intentions to the market becomes crucial in influencing these expectations and guiding interest rate dynamics (Blinder, 1999). Furthermore, central bank independence has played a crucial catalyst in increasing the role of its communication. As central banks have gradually gained greater independence in their decision-making processes, they have recognized the necessity of their communication efforts by explaining their policy decisions to some extent (Briault et al., 1997).

Central Bank Communication as "*a policy tool*" (2008 – 2019)*:* The Global Financial Crisis (GFC) of 2008-09 profoundly impacted the next milestone of central bank communication. During the crisis, central banks in most advanced economies faced limitations in traditional monetary policy tools as their short-term policy rates reached or approached zero percent. Central banks turned to unconventional monetary policy measures like large-scale asset purchases (LSAPs) to address this challenge, stimulate the economy, and promote recovery. Furthermore, the effectiveness of these unconventional measures depended on practical communication from central banks. With policy rates at historically low levels, it became crucial for central banks to communicate their policies and expectations for future interest rates, where communication emerged as "*a policy tool*" (Bernanke et al., 2004; Ehrmann & Fratzscher, 2007).

Central Banks Engaging with the "*general public*" (2020 - Present): The final milestone in central bank communication can be characterized by engagement with a broader audience. Moreover, Blinder et al. (2022) suggested that improving central bank communication with the *general public* will contribute to increased accountability. The rapid rise of internet users and social media platforms, which significantly accelerated in response to the COVID-19 pandemic, broadened the central bank's audience (Enkhtur, 2022). A survey conducted by GlobalWebIndex in July 2020 revealed a 10.5% increase in social media users compared to the previous year, reaching over half of the world's population for the first time (Kemp, 2020). This transition allowed central banks to adapt to the changing communication landscape and utilize social media platforms to establish direct communication channels with a broader audience. Consequently, there has been a steady increase in the average number of social media accounts maintained by central banks. While central banks primarily utilize social media for providing information, there are initial signs that they are also starting to engage in more interactive forms of communication, such as conducting question-and-answer sessions on platforms like Twitter (Plekhanov, 2020).

In the context of Mongolia, however, there has been limited research on central bank communication, despite the BoM's efforts to enhance its communication strategy in the past decade. Consequently, this study aims to fill this research gap by evaluating the effectiveness of the BoM's communication practices by applying text-mining - a natural language processing technique. This approach enables the analysis of the large-volume text that would be challenging for human readers, as well as ensuring the extraction of meaning from the text without any bias (Blei et al., 2003.) The additional analysis conducted using the event study approach provides insights into the actual effects of the MPC announcements on the exchange rate volatility.

The remaining part of the paper is organized as follows: Section 2 provides a literature review of text mining in central bank communication and an overview of BoM's communication practices, Section 3 introduces the data used and methodology, Section 4 examines the results and estimates obtained from the analysis, and Section 5 concludes the paper and discusses its policy implications.

2. LITERATURE REVIEW

2.1. Overview of the Bank of Mongolia and its communication practices

The Bank of Mongolia (BoM) has a long history that dates back to 1924, when it was established as a joint bank between Mongolia and the former Soviet Union. Ownership of the bank was transferred to the State of Mongolia in 1954. Moreover, Mongolia underwent a democratic revolution in 1990, leading to the current two-tiered banking system in 1991. Furthermore, according to Taguchi and Erdenchuluun (2018), the monetary policy framework in Mongolia has undergone distinct phases since the 1990s:

1) 1995-2006: a period of monetary aggregate targeting.
2) 2007-2011: a transition towards inflation-targeting approach.
3) In 2011: the adoption of an inflation-targeting framework with a forward-looking approach.

According to the existing Law of the Central Bank (Article 3, 1996), the BoM is the primary institution for developing and implementing the State Monetary Policy. The core objective of the BoM is to ensure the stability of the national currency, the togrog. In addition to this primary objective, the BoM must promote the balanced development of the national economy by maintaining stability in financial markets and the banking system (Article 4, 1996). Furthermore, operating under the inflation targeting regime, the BoM establishes an annual target inflation rate approved by the Parliament of Mongolia. For 2023, the current inflation target is set as a single-digit rate, with a medium-term goal of 6 percent, allowing for a margin of +/- 2 percentage points.

Over the past decade, the BoM has significantly advanced its communication strategies. In 2010, the BOM established its first Communication Unit as part of its commitment to transparency. However, it initially faced limitations in terms of staff and operational capacity (Kh, 2017, para. 9). The Unit went through a significant restructuring in 2016 that expanded its capabilities and became the Public Education and Information Center. Moreover, the BoM has made its official website more informative by providing reports such as the Inflation Report, Financial Stability Report, research papers, financial education content, and interviews of BoM officials. These reports offer valuable insights to their readers. Additionally, the BOM recognized the importance of reaching a wider audience and created official social media accounts such as Twitter and YouTube page. Furthermore, strengthening communication has become a crucial objective for the BoM's operations, as highlighted in the 2022 Monetary Policy Guidelines. As followed by the Guidelines, BOM requested technical assistance from the International Monetary Fund (IMF) in

August 2022 to improve its communication framework. An IMF report by Das et al. (2023) suggests areas for improvement, such as ensuring consistency in communication regarding MPC decisions and conducting impact assessments of the communication efforts.

Furthermore, speeches, interviews, and press releases are highly sensitive forms of communication, where every word in the official statements of a central bank carries significance. BoM regularly publishes various reports and publications; among these, the Monetary Policy Committee (MPC) statements following each meeting of the MPC hold immense importance and attract considerable attention from news agencies and financial actors. The MPC meets every quarter according to a schedule but may also hold additional meetings depending on economic conditions. The structure of the MPC decisions, as outlined by the Bank of Mongolia (2018), includes:

1) Announcement of the embargo and the decision made during the meeting.
2) Examination of inflation and general economic conditions, including any changes since the last meeting and their impact on the decision.
3) Justifying the decision taken and evaluating the expected outcomes.
4) Future policy actions deemed necessary.

2.2. Text-mining in Central Bank Communication

Various methods have been employed to assess central bank communication, but a globally recognized methodology still needs to be improved. However, given the growing importance of central bank communication and advancements in information and technology, text-mining provides a practical approach to analyzing valuable textual data sources in evaluating central bank communication. Text-mining involves analyzing large amounts of text data to gain deeper insights into their meaning and underlying significance that surpasses human capacity to uncover. Additionally, text-mining ensures the extraction of meaning without inherent biases. Despite its widespread use in other fields, text-mining has been less utilized in economics, particularly among central bank studies (Bholat et al., 2015). One reason can be the abundance of quantitative data sources, such as economic indicators and financial market data. Additionally, a lack of familiarity with the tools and techniques involved in text-mining has been a limiting factor.

Text-mining approaches in central bank communication studies started about a decade ago. As one of the early studies, Hendry and Madeley (2010) examined the Bank of Canada's

communication statements using Latent Semantic Analysis[1] (LSA). Using this approach, they investigated the impact on returns and volatility in interest rate markets for 2002-2008. The finding reveals that discussions such as geopolitical risk, external and internal shocks, and forward-looking statements significantly influence market returns and volatility. Also, in a study of the Bank of Canada and the Reserve Bank of Australia, Masawi et al. (2014) investigated whether central bank speeches become financial news using both speeches published by central banks and news reported by Reuters during 1995-2009. Using the Leximancer [2] text mining software, the study demonstrated that central bank speeches become part of market information through the news arena.

Further, in 2015, the Centre for Central Banking Studies at the Bank of England released a Handbook titled "Text mining for central banks" (Bholat et al., 2015). This handbook provides a comprehensive introduction to text-mining and offers a step-by-step guide, which helps apply textual data insights into central bank studies. Moreover, Bholat et al. (2015) analyzed the thematic content of MPC speeches and minutes in the last year of Mervin King's Governorship and the first year of Mark Carney's Governorship at the Bank of England. This study shed light on where the committee "as a whole" conveys one message while individual members deliver mixed messages. Following the year in 2016, Kawamura et al. (2016) applied the text-mining approach to study the relationship between the Bank of Japan's Monthly Report and the business cycle. Their findings revealed that the difference between positive and negative expressions in the reports predicts the leading index of the economy for around three months.

In 2018, Oshima and Matsubayashi applied text-mining to analyze the published minutes of the Bank of Japan. They found that the estimated topics significantly impacted market reactions, especially on the days the minutes were published. Finally, some studies used text mining to investigate the readability of monetary policy documents. For example, Binette and Tchebotarev (2019) conducted a study on the communication of the Bank of Canada. They assessed the readability of the bank's monetary policy report and found that it was moderately challenging for the average Canadian to understand.

Effective communication plays a vital role in shaping public understanding and confidence in the policies and operations of central banks. However, research on assessing central bank

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[1] A technique developed into a theory of knowledge representation by Landauer and Dumais (1997).
[2] See details about Leximancer software in the Leximancer manual (2010)

communication in Mongolia remains limited. Existing studies, such as the survey commissioned by the Bank of Mongolia (BoM) titled "Evaluating the Communication of the Bank of Mongolia," conducted by the research organization SICA in 2017, have shed light on the need for improved public understanding and awareness of the objectives and functions of the BoM. Additionally, a subsequent survey conducted by the consulting company DoBiChi in 2021 evaluated the impact of the BoM's enhanced communication efforts, revealing an improved public understanding of central bank policies and activities, along with increased availability of information (Annual Report, 2022, pp. 65-66).

While these studies have provided valuable insights, they primarily adopted a subjective approach, focusing on gathering public opinions and understanding central bank policies and operations. In contrast, this study aims to adopt an objective approach by analyzing and evaluating the communication practices employed by the Bank of Mongolia. By taking a more comprehensive and objective perspective, this research seeks to provide a deeper understanding of the effectiveness of the BoM's communication strategies, identify areas of improvement, and contribute to the existing body of knowledge on central bank communication.

3. DATA AND METHODOLOGY

3.1. Data

The dataset used in this study consists of 52 MPC statements issued by the BoM between July 2010 and March 2023. These statements were publicly available on the BoM's official website in the [Monetary Policy Statements](#) section. Each MPC statement from the same year was consolidated into single .txt files, resulting in 14 documents serving as the main corpus for our analysis (see Appendix B). The preprocessing of the documents was carried out to prepare them for further analysis:

a) All words were converted to lowercase to avoid double counting.
b) Unnecessary white spaces, punctuation, and numbers were removed.
c) Common English stop words such as "for," "in," "about," and "therefore" were excluded as they do not carry significant meaning in the analysis.
d) Word stemming was applied to reduce words to their base form, such as converting "expectation" to "expect" and "inflation" to "inflat."

Preprocessing is a crucial step in identifying the critical meaning of documents (Gefen et al., 2017). After preprocessing, 7,557 words were eliminated from 14,942 words, resulting in 7,385 words available for our analysis.

3.2 The frequency of terms

We start by analyzing our corpus using a Document Term Matrix (dtm), which shows how often terms appear in the document (Imai, 2018, p. 194). The result is a rectangular matrix that displays (i, j) terms representing each document and unique terms, respectively. "dtm" is used for two main reasons, to show the frequent unique terms in each document and to prepare our data for further analysis. As shown in Equation (1), we are using a default weighting function, term frequency (*tf*), which counts how many times each word appears (Benchmol et al., 2022).

$$\mathrm{tf}(t) = \frac{\text{Number of times term } t \text{ appears in a document}}{\text{Total number of terms in the document}} \tag{1}$$

Next, we evaluate the term frequency-inverse document frequency (tf-idf) by measuring how often a word appears in a document and adjusting for how frequently it appears in the entire corpus. This balances out the effect of common words that generally appear more frequently. The *idf*(t) shows how common words appear in many documents, as indicated in (2). A term appearing less frequently within a corpus is deemed significant and assigned a higher score. However, if a

term appears in numerous documents within a corpus, it is not considered unique and receives a lower score.

$$idf(t) = \ln \left(\frac{\text{Total number of documents}}{\text{Number of documents with term } t \text{ in it}} \right) \quad (2)$$

Combining these two functions results in the *tf-idf weighting* method, as shown in (3). It is a way to weigh the importance of terms in a document based on how frequently they appear across multiple documents.

$$tf - idf(t) = tf(t) \times idf(t) \quad (3)$$

3.3 Readability Analysis

To assess the clarity of the MPC statements, we employed the Coleman-Liau Readability Index technique (1975). This approach is a widely used tool for evaluating the complexity and readability of a text. As shown in Equation (4), CLI considers two main factors: the average number of letters per 100 words (L) and the average number of sentences per 100 words (S) in the text. The difficulty level of understanding the text is estimated based on these factors. A lower CLI value suggests that the text is easier to read and comprehend, while a higher value indicates a more complex and challenging text. By calculating the CLI for each MPC statement, we can gain insights into the overall readability of the BoM's statements.

$$CLI = 0.0588L - 0.296S - 15.8$$

3.4 Sentiment Analysis

(4)

In this study, we used a basic approach to identify sentiments for MPC statements during the study period. Miner et al. (2012) state that sentiment analysis is a tool for analyzing people's emotions and opinions by examining their written content. First, we utilized the "Bing" lexicon with a tidy approach, as explained in Silge and Robinson's book (2017). Moreover, we analyzed the document's structure and identified positive or negative words using a pre-existing sentiment model in R.

Secondly, we used the "Syuzhet" sentiment analysis algorithm developed by Matthew Jockers (Isasi, 2023) to analyze the sentiment across the documents and understand the emotional tone conveyed in the text data. This algorithm, along with the NRC lexicon, helped us assign emotions such as anticipation, fear, surprise, and trust to each word. By analyzing the general emotions associated with each word in the corpus, we aimed to understand the direction of changes in economic conditions (Binette & Tchebotarev, 2019) and identify keywords that indicated the emotional state of the MPC statements.

3.5 Topic Modeling

Topic modeling is a method used to discover hidden themes in a collection of texts. This technique is practical in identifying relevant topics within a corpus. The Latent Dirichlet Allocation (LDA) modeling approach, developed by Blei et al. (2003), will be used in this paper to classify texts in the MPC statements into relevant topics. The model assumes that each document comprises multiple topics, and a specific set of words represents each topic. Topic modeling provides two main results: the list of words associated with each topic with high probability and the classification of each document into topics. The process of LDA topic modeling can be broken down into three steps:

1. We establish a word distribution for each topic by utilizing a Dirichlet distribution. A high β value indicates that a topic contains numerous words, while a low β value suggests that a topic comprises fewer words.
2. We determine the ratios of various topics for each document using a Dirichlet distribution. A high α value signifies that a document contains a blend of many topics, whereas a low α value points to a document focusing on fewer topics.
3. We allocate each word in the document to a topic based on the topic proportions and select a word from the corresponding topic's word distribution.

4. RESULT

4.1 Basic analysis

Figure 2 illustrates the yearly average word count of the MPC statements between 2010 - 2023. The trend shows that there has been an effort to improve transparency in communication by increasing the number of words used. In 2011, the average word count was 212 words, which increased to 433 in 2022 (since data for 2010 and 2023 were insufficient for comparison, those years were excluded). Moreover, under Purevdorj L's governorship, the average word count was gradually decreasing; however, from Zoljargal Naidansuren's governorship, the average word count has continuously increased each year, reaching an average of over 400 words in 2022.

Figure 2

Average Word Count of Monetary Policy Committee Statements, 2010-2023 (Annual)
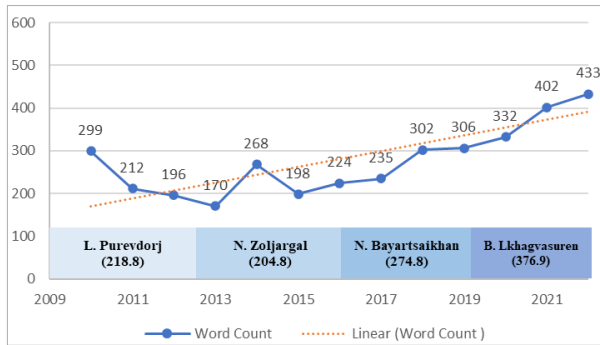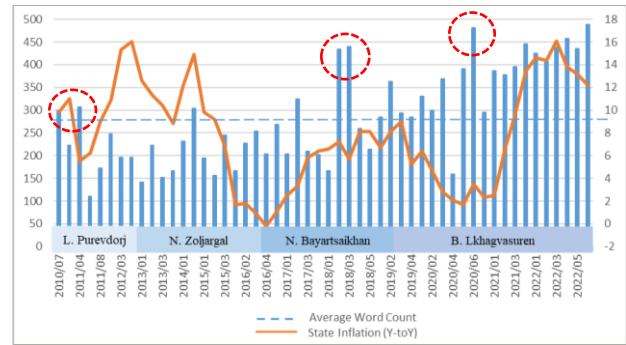

Figure 3

Word Count of Monetary Policy Committee Statement, 2010 – 2023 (each)

In Figure 3, a detailed analysis of the word counts in each statement is presented. The average word count across all documents is around 283, as indicated by the blue dashed horizontal line. The highest word count of MPC statements occurred in November 2020, during an unscheduled meeting held amidst the challenging backdrop of the COVID-19 pandemic. During this meeting, the Bank of Mongolia (BoM) made four significant decisions, including reducing the policy rate by two percentage points to a historically low level of 6% to help alleviate the financial burden individuals, businesses, and financial institutions faced during the pandemic.

Additionally, Figure 3 highlights three clusters marked by red dotted circles, where the number of words in the Monetary Policy Committee (MPC) statements was significantly higher than the sample's average. The first cluster can be attributed to the BoM's increased communication after the Global Financial Crisis (GFC) of 2008-09 and mid-term macroeconomic overheating, where the BoM tightened monetary policy to prevent economic instability.

The second circle corresponds to the period when the Law on the Central Bank was being revised, and the Monetary Policy Committee's regulations were being approved. Moreover, Mongolia experienced an upturn in economic activity in 2018, with increased FDI in the mining sector. However, this phenomenon brought potential risks to the balance of payment, financial sector stability, and household debt levels. To address these concerns, the BoM decided to maintain a policy rate of 10% while setting a ceiling of 70% on debt service-to-income ratios, which may have required further communication.

Finally, the third circle is related to the COVID-19 pandemic, which led to some unscheduled meetings by the Bank of Mongolia (BoM). To stabilize the financial market, the BoM made a few decisions, such as introducing a new long-term refinancing instrument, extending the maturity of consumer loans, and reducing reserve requirements for private banks (Bank of Mongolia, Annual Report, 2020). Under uncertainty and sudden lockdowns, there was a need for Central bank communication on its decisions. These findings indicate that BoM has used more words in their MPC statements over time, especially during significant macroeconomic events and policy concerns. The result aligns with the findings of Luangaram and Wongwachara (2017), which showed that central banks tend to communicate more during challenging times.

4.2 The frequency of terms

In this section, we analyzed the key terms utilized in the MPC statements throughout the study period. The detailed results of this analysis can be found in Appendix C. Figure 1 in Appendix C displays the 25 most frequently used terms within our corpus. Notably, "inflation" and "rate" emerged as the most frequently mentioned terms, occurring over 180 times each. The substantial presence of "inflation" underscores its significance, while the term "rate" suggests the central bank's utilization of the policy rate as a vital tool. These findings contribute to a comprehensive understanding of the central bank's objectives and the factors influencing its decision-making processes.

Furthermore, the BoM has a secondary objective of promoting balanced development in the national economy while maintaining stability in financial markets and the banking system. Hence, other frequently used terms such as "economy," "bank," "percent," "monetary," "increase," "expect," "price," "domestic," "external," "meet," and "growth" are aligned with the BoM's policy objectives and reflect the key focus areas in their communication statements, encompassing

economic analysis, monetary policy, price stability, domestic and external factors, and economic growth.

Moreover, Figure 2 in Appendix C presents a word cloud that visually represents the most frequent terms in our corpus. The word cloud further reinforces our earlier observations, featuring prominent terms like "inflation," "rate," "economy," "bank," "monetary," "percent," "increase," and "price." Additionally, in Figure 3 of Appendix C, we provide a more detailed analysis by creating word clouds for each year MPC statement, highlighting how the policy concerns of the MPC have evolved over the years. This approach offers a comprehensive view of the changing priorities within the BoM's communication and policy considerations throughout the analyzed period. Overall, the frequency analysis of terms provides valuable insights into the relative importance of specific concepts in the MPC statements, shedding light on the central themes and focuses of the BoM's communication and policy considerations within the analyzed period.

4.3 Readability Analysis

Our subsequent evaluation focused on assessing the readability of the MPC statements by applying the Coleman and Liau (1975) index to each statement in our corpus. A lower index value indicates that the content is easier to read and comprehend. The results in Figure 4 reveal a gradually increasing trend indicated by the blue dashed line. During the sample period, the readability of MPC statement has become more challenging for the average reader to comprehend. The average readability score was 14.9, equivalent to that of a university student or someone with a higher education background. The orange line shows the average word count per statement for comparison.

Figure 4 *Coleman and Liau (1975) Readability Index for MPC Statements of BoM*

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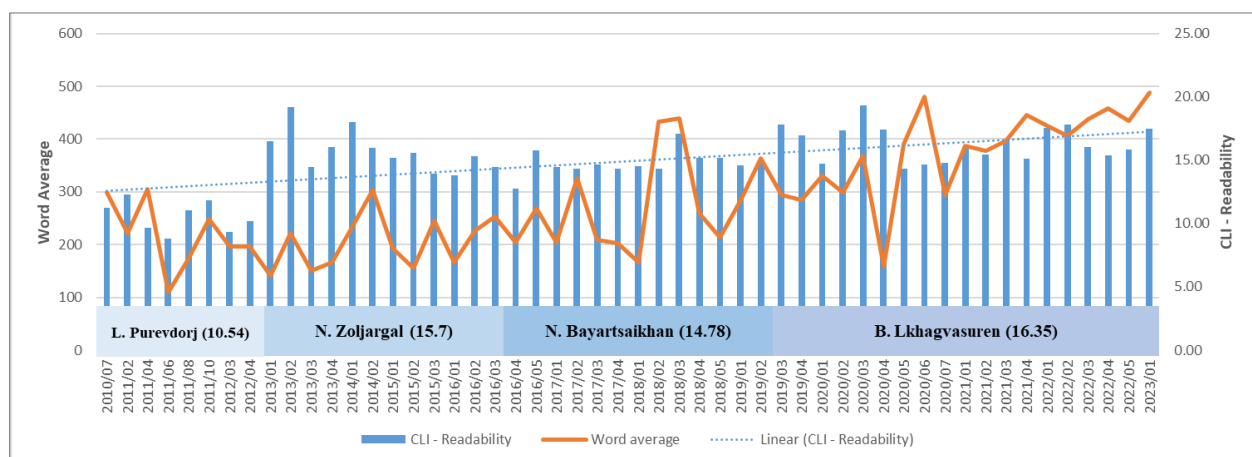
To examine how readability scores capture the complexity of the text, we have included two examples in Appendix E. The first example, 2012/3, represents the most readable statement. It consists of 18 sentences with 182 words, clearly conveying the Bank of Mongolia's (BoM) intention to tighten the policy rate in response to inflation resulting from negative supply-side effects. Conversely, the second example, from 2020/03, represents the least readable statement during the study period. It comprises 11 sentences with 327 words, reflecting a relatively complex policy decision and expressing uncertainties arising from the COVID-19 pandemic (see details in Appendix D). Moreover, if the MPC statement is less readable, the target audience may have trouble understanding the conveyed information. This can lead to misinterpretation or confusion among readers, ultimately hindering effective communication. Therefore, it is crucial to ensure that the language used is easily comprehensible and accessible to the intended audience.

4.4 Sentiment analysis

Based on the overall sentiment score calculated using the Bing lexicon, the analysis reveals that the positivity of the statements outweighs the negative sentiment (see Appendix E). Several positive words such as "stability," "effectiveness," "consistent," "support," and "recovery" significantly contribute to the positive sentiment score. However, there are certain words, namely "risk," "negative," "inflationary," and "debt," contribute predominantly to the negative sentiment score. These words indicate areas of concern or potential challenges within the context of the MPC statements.

Furthermore, the "Syuzhet" sentiment analysis revealed patterns in the emotional content of the MPC statements (See Appendix F, Figure 2). Among the eight emotions in the NRC lexicon, "trust" emerged as the highest-scoring emotion, suggesting that the central bank aims to establish and maintain trust in its communication. The second highest scoring sentiment was "anticipation," indicating that the central bank recognizes the importance of creating expectations and preparing stakeholders for upcoming events or decisions. Additionally, the emotion "fear" also emerged as a significant sentiment, possibly indicating concerns or anxieties related to economic conditions or challenges the central bank faces.

In contrast, the emotion "surprise" scored the lowest among all the measured sentiments within the corpus. This implies that the central bank's communication strategy may be focused on minimizing unexpected or surprising announcements. Overall, this analysis provides insights into the emotional aspects of the MPC statements, highlighting the prominence of "trust" and

"anticipation" while shedding light on the potential economic-related "fears" expressed within the central bank's communication. Moreover, the Syuzhet plot in Figure 1 illustrates the emotional trajectory or sentiment patterns observed in the overall MPC statements. In the first half of the plot, the overall sentiment remained above zero, indicating predominantly positive sentiment. However, in the second half of the plot, the sentiment dropped below zero, indicating a shift toward negative sentiment, which continued towards the end of the analyzed period.

Figure 5 *Syuzhet Plot and Simplified Macro Shape from the NRC lexicon*
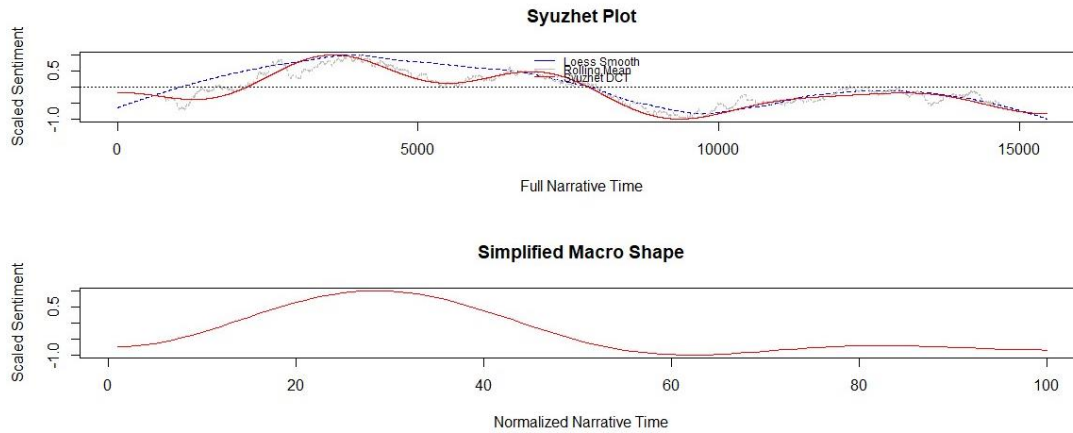
A plot fluctuating between positive and negative sentiment scores suggests emotional shifts or contrasts within the text. In this case, the changing sentiment patterns in the MPC statements may reflect varying emotional tones or shifts in communication over time. If we examine the plot in conjunction with the actual state of Mongolia's economy, we can draw some insights. In the first half of the analyzed period (2010-2013), Mongolia experienced rapid economic growth primarily driven by its mining sector. Notably, in 2011, the country achieved its highest economic growth rate of 17.5%. However, economic growth declined due to lower commodity prices, particularly affecting the mining industry. This decline in economic growth led to increased budget deficits, and Mongolia sought financial assistance from the International Monetary Fund (IMF) to address its financial vulnerability. From 2017 onwards, the economy showed signs of recovery with increased foreign direct investment in the mining sector and improved commodity prices. However, in 2020, the COVID-19 pandemic hit Mongolia's economy hard, resulting in numerous difficulties. The plot's fluctuations reflect the overall changing economic conditions in Mongolia.

4.5 Topic Modeling

Finally, we employed the simple approach of estimating LDA (*Latent Dirichlet Allocation*) models to analyze our dataset for topic modeling. Following this methodology, we

assumed heuristically that the MPC statements could be classified into five distinct topics. These topics significantly influence the linguistic content within the MPC statements throughout the sample period. To provide clarity and interpretation, we constructed Table 1, which displays the top 20-22 words associated with each of the five topics (see figure in Appendix F). In order to assign labels to these topics, we followed the guidance provided by Debortoli et al. (2016) and carefully examined the most probable terms within each topic.

Table 1 *Identification of Topics and their Probable Terms*

№	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
1	rate	inflation	rate	economy	inflation
2	percent	domestic	monetary	measure	increase
3	bank	increase	foreign	covid	mongolia
4	price	sector	inflation	domestic	supply
5	inflation	extern	interest	support	pressure
6	expectation	outlook	meet	pandemic	demand
7	economy	economy	bank	impact	nation
8	monetary	well	decision	finance	bank
9	committee	main	will	instrument	statistics
10	keep	intern	invest	financial	cpi
11	growth	mpc	mongolia	loan	core
12	unchange	liability	mpc	spread	board
13	target	market	point	heading	unit
14	stability	take	balance	repo	public
15	environment	state	two	longterm	product
16	activity	price	release	half	director
17	extern	foreign	exchange	stability	price
18	finance	supply	increase	recovery	rate
19	sector	risk	percentage	due	economy
20	outlook	level	minute	continue	budget
21	meet	import	-	-	also
22	-	higher	-	-	
23	-	mongolia	-	-	
Assigned topics	"central bank's role in maintaining price stability"	"inflation dynamics and economic outlook"	"monetary policy and financial decision making"	"assessing the impact of the COVID-19 pandemic"	"supply&demand factors and statistics in Mongolia"

Source: Author's compilation

For Topic 1, the most frequent terms included "rate," "percent," "bank," "price," "inflation," "expectation," and "economy." Considering the collection of the words in Topic 1, we determined that this topic relates to the "*central bank's role in maintaining price stability* " as these terms are often associated with discussions on monetary policy and its impact on the economy. Moving on

to Topic 2, we identified words such as "inflation," "domestic," "increase," "sector," "extern," "outlook," "economy," and "market" as the most prominent. These terms collectively point towards discussions on "*inflation dynamics and economic outlook*," indicating an exploration of various economic factors, both domestic and external, and their influence on the overall economic outlook. Moreover, words such as "rate," "monetary," "foreign," "inflation," "interest," "meet," "bank," and "decision" are commonly associated with Topic 3. These words align with the theme of "monetary policy and financial decision making," emphasizing discussions and considerations related to interest rates and the decision-making process of the central bank.

Shifting to Topic 4, we observed the presence of words like "economy," "measure," "COVID," "domestic," "support," "pandemic," "impact," and "finance" with high probabilities. These terms strongly indicate a focus on "*assessing the impact of the COVID-19 pandemic*," reflecting discussions on the economic consequences of the pandemic, the measures taken to mitigate its impact, and the financial aspects associated with these measures. Finally, Topic 5 centers around "*supply&demand factors and statistics in Mongolia*." The most probable terms include "inflation," "increase," "Mongolia," "supply," "pressure," "demand," "nation," "bank," "statistic," and "CPI." This topic highlights discussions specific to Mongolia's inflation dynamics, economic indicators, supply and demand factors, and their statistics. By categorizing the MPC statements into these five topics, we gain a deeper understanding of the key themes and areas of focus within the statements throughout the analyzed period.

5. CONCLUSION

5.1 Conclusion

The central bank recognizes the importance of clear, simple, and understandable communication to enhance the effectiveness of its policies (Vayid, 2013). While there is no globally approved approach for assessing central bank communication, this study contributes to the growing field of research utilizing text-mining techniques to extract insights and evaluate the effectiveness of central bank communication. Specifically, we analyzed the Bank of Mongolia's Monetary Policy Committee Statements from July 2010 to March 2023. Using a text mining approach, we examined word count and frequency to understand trends and key terms in the MPC statements. The findings indicate a rising trend in communication over time, with frequent terms aligned with the central bank's policy objectives and concerns. However, the readability index reveals that the statements have become less understandable during the study period.

Regarding sentiment analysis, we classified expressions in the MPC statements and found that positivity decreased in the second half of the sample period, reflecting changing economic conditions in Mongolia. Analyzing emotions using the NRC lexicon, "trust" emerged as the most expressed emotion, while "surprise" was the least expressed. Furthermore, our topic modeling identified five key themes within the statements, which provides valuable insights into the main subjects discussed in the MPC decisions. Additionally, we conducted an event study analysis to examine the actual effect of MPC statements on USD exchange rate volatility (see details in Appendix G). The results indicate higher volatility before the MPC announcement day and a slight reduction after the announcement, particularly when the MPC decision was made to raise the policy rate.

In conclusion, this study contributes to the field of studying central bank communication in Mongolia by employing a text-mining approach. It has the potential to inspire future investigations into the empirical relationship between text-based indicators of central bank communication and key macroeconomic variables.
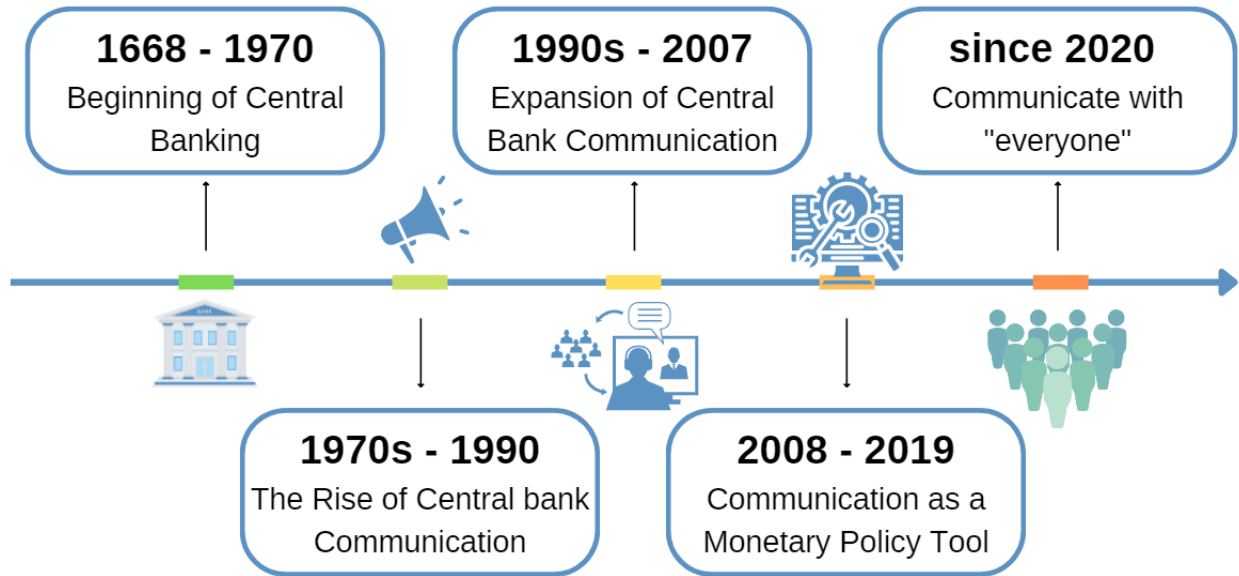
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Figure 1: Evolution of Central Bank Communication

Note. Author's compilation

Appendix B

Table 1: BoM's MPC Statements Word Count, July 2010 – March 2023

№	Reference number	Meeting month	Word Count	№	Reference number	Meeting month	Word Count
1	2010/07	Jul-10	299	27	2018/01	Mar-18	166
2	2011/02	Feb-11	222	28	2018/02	Jun-18	433
3	2011/04	Apr-11	306	29	2018/03	Sep-18	440
4	2011/06	Jun-11	110	30	2018/04	Nov-18	259
5	2011/08	Aug-11	173	31	2018/05	Dec-18	214
6	2011/10	Oct-11	248	32	2019/01	Mar-19	284
7	2012/03	Mar-12	196	33	2019/02	Jun-19	363
8	2012/04	Apr-12	196	34	2019/03	Sep-19	294
9	2013/01	Jan-13	141	35	2019/04	Dec-19	284
10	2013/02	Feb-13	222	36	2020/01	Mar-20	331
11	2013/03	Apr-13	151	37	2020/02	Apr-20	299
12	2013/04	Jun-13	166	38	2020/03	Jun-20	369
13	2014/01	Feb-14	232	39	2020/04	Aug-20	159
14	2014/02	Jul-14	304	40	2020/05	Sep-20	391
15	2015/01	Jan-15	194	41	2020/06	Nov-20	481
16	2015/02	Apr-15	156	42	2020/07	Dec-20	295
17	2015/03	Jul-15	245	43	2021/01	Mar-21	387
18	2016/01	Jan-16	167	44	2021/02	Jun-21	378
19	2016/02	May-16	227	45	2021/03	Sep-21	396
20	2016/03	Jul-16	253	46	2021/04	Dec-21	446
21	2016/04	Aug-16	204	47	2022/01	Jan-22	425
22	2016/05	Dec-16	269	48	2022/02	Mar-22	407
23	2017/01	Mar-17	204	49	2022/03	Jun-22	438
24	2017/02	Jun-17	325	50	2022/04	Sep-22	458
25	2017/03	Sep-17	209	51	2022/05	Dec-22	435
26	2017/04	Dec-17	202	52	2023/01	Mar-23	489
	Total words						**14,942**

Note. Author's compilation

Result of Document Term Matrix (Frequency Terms)

Figure 1: *Top 25 Frequency Terms in the Document Term Matrix, July 2010 – March 2023*

Figure 2: *Word cloud of the Document Term Matrix, July 2010 - March 2023*

Note. Author's Compilations

Figure 3: *Word Cloud Analysis for MPC statements Across Each Year*

Note. Author's Compilations

Appendix D

Comparison of MPC Statements with the Lowest and the Highest CLI Readability Scores

Figure 1: *Actual Statements in Figure*

Ref No: 2012/3 **Valid from: March 19, 2012** **Embargo: Not for publication or broadcast before 1100 hours on Friday, 19 March 2012.** *March 19, 2012* - BoM Board of Directors decided to increase the policy rate by 0.5 unit percent to 12.75%. The National Statistical Office of Mongolia reported that the national CPI increased to 12.5% and the Ulaanbaatar CPI was to 13.3% in February 2012. The economy of Mongolia is being affected by the inflation activating negative effects of supply in 2012. The price of meat was increased by 29.6% and it was the 58% of inflation in first two months. The cost of fuel was increased by 15.6%. Therefore, the price of non-food products was increased by 2.4%. These indexes prove that the inflation on demand does not decrease. The budget amendment is raising the excess demand and enhancing the inflation on demand and supply. Thus the Bank of Mongolia is tightening the policy rate to slow down the inflation and decrease the pressure on MNT rate against foreign exchanges. In the future, the Bank of Mongolia stands ready to take all the proper actions in urgent times.	**Number: 2020/03** **Date: 26th of June 2020** At the scheduled meeting held on 26th of June 2020, the Monetary Policy Committee decided to: 1) Keep the policy rate unchanged, considering the current macroeconomic and financial market developments, their prospects, and uncertainties in the domestic and external environment; 2) Reduce remuneration on MNT reserve requirements issued to banks by the amount corresponding to the ratio of foreign currency-denominated (FX) deposits with relatively higher rates and FX current accounts charging any rate to total FX deposits and current accounts. It will promote financial stability in the banking system by discouraging bank deposit dollarization and maintaining relative returns on the domestic currency. In accordance with "Law on preparedness, response to the COVID-19 pandemic and mitigation of its socioeconomic impact", under collaborative initiatives with the international financial institutions, the Bank of Mongolia has been taking a set of policy measures to support financial stability and domestic demand. Annual headline inflation reached 3.3 percent nationwide and 3.5 percent in Ulaanbaatar city as of May 2020. Inflation is expected to stay below the target level as a result of demand-driven inflationary pressure remaining subdued, reflecting economic activities slowing down, domestic fuel prices declining in line with oil price developments in the international market and in a case of not emerging supply-related price volatilities.

Table 1: *Comparison of the MPC Statements with Lowest and Highest Scores*

Comparison	Statement with Low Score	Statement with High Score
Number of Characters	1074	2365
Total number of words	182	327
Total number of sentence	18	11
Commas	4	13
Number of letters per 100 words	477	614
The number of sentences per 100 words	10	3

The Result of Sentiment Analysis
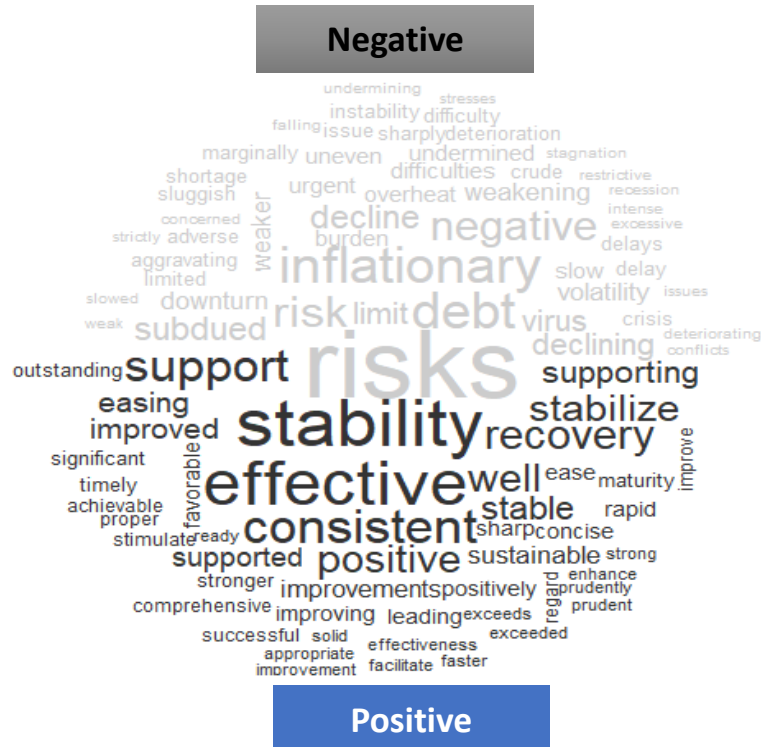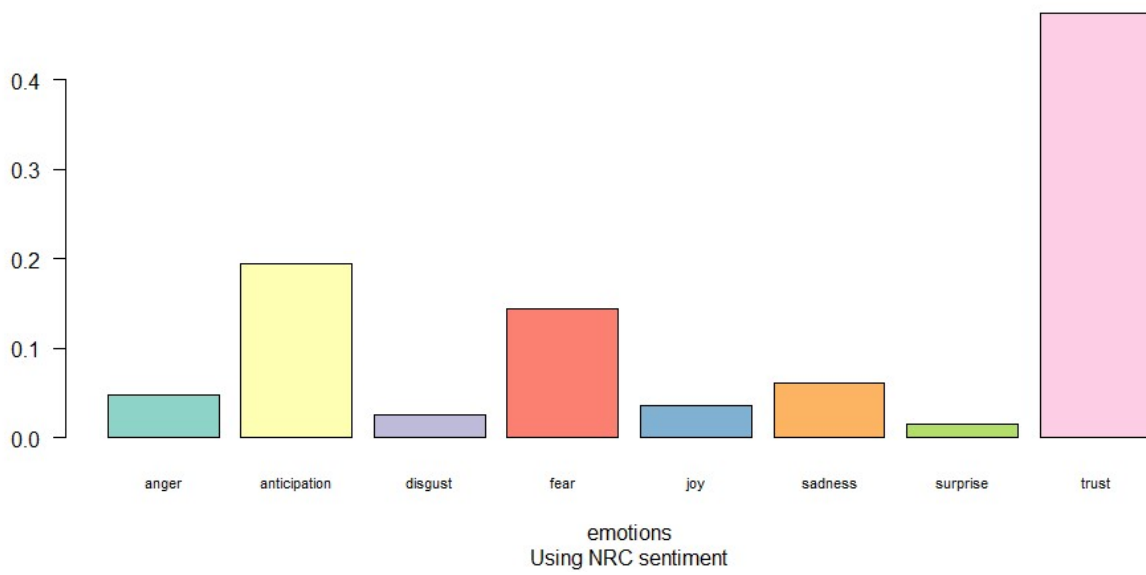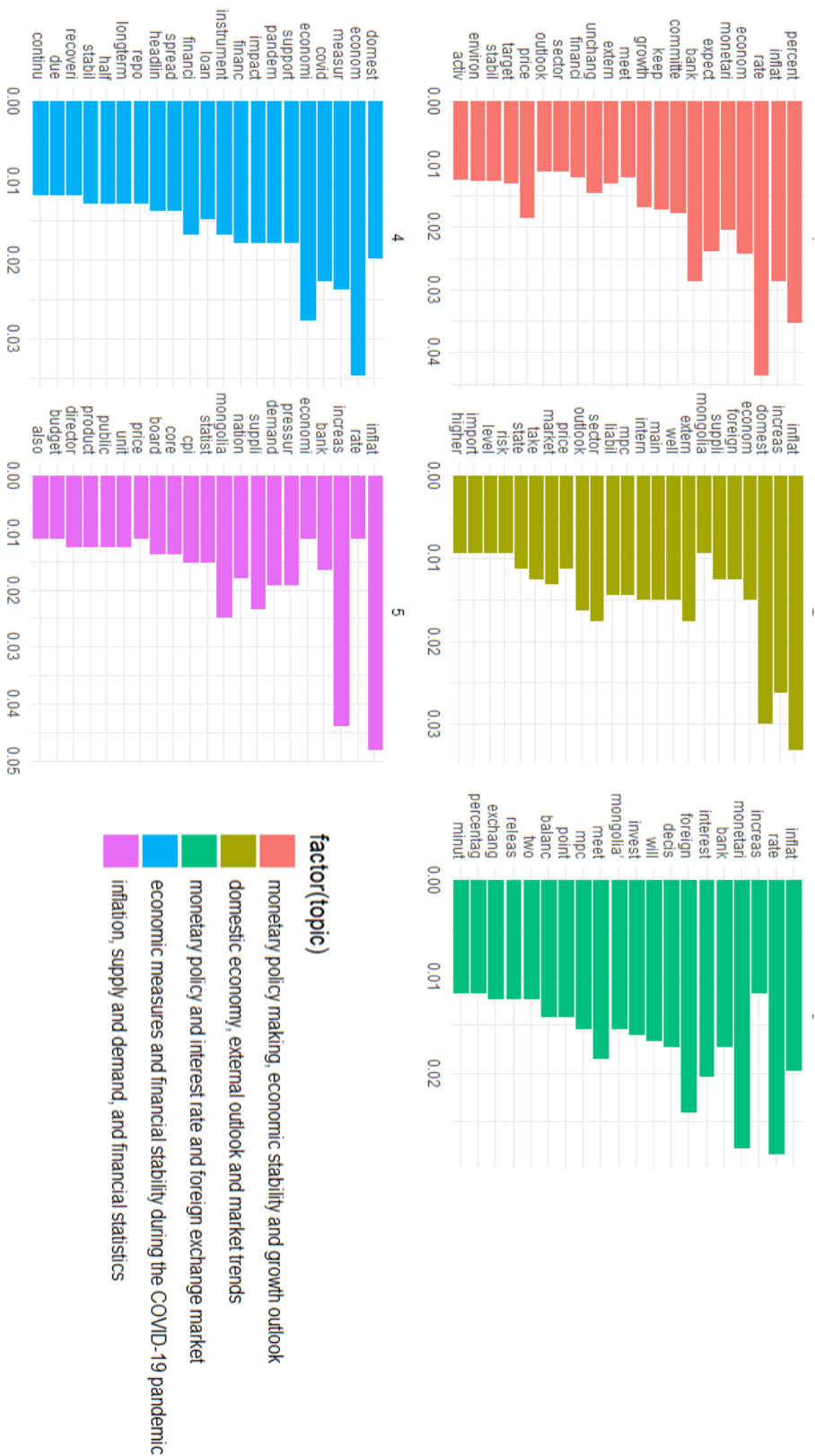
Figure 1: *Result of Bing Lexicon*

Figure 2: *Result of NRC Sentiment Lexicon*

Note. Author's Compilation

Appendix F

Figure 1: *The Result of Topic Modeling*

factor(topic)

monetary policy making, economic stability and growth outlook
domestic economy, external outlook and market trends
monetary policy and interest rate and foreign exchange market
economic measures and financial stability during the COVID-19 pandemic
inflation, supply and demand, and financial statistics

Appendix G

Event Study

An additional event study was conducted to examine the daily responses of market USD exchange rates to MPC announcements dates using the event-study approach. Figure 1 shows the average abnormal change in the USD exchange rate for each governorship and the total average abnormal change in the USD exchange rate in the market data within a moving window of (-/+5) days. The graph in Fig. 1 indicates that the trend lines were initially higher but then decreased after the announcement date. This suggests there was more volatility before the announcement, which slightly decreased afterward. As a result, this could explain the positive impact on the exchange rate market.

Figure 1 Cumulative average abnormal change for each governor and total average of USD exchange rate (market)
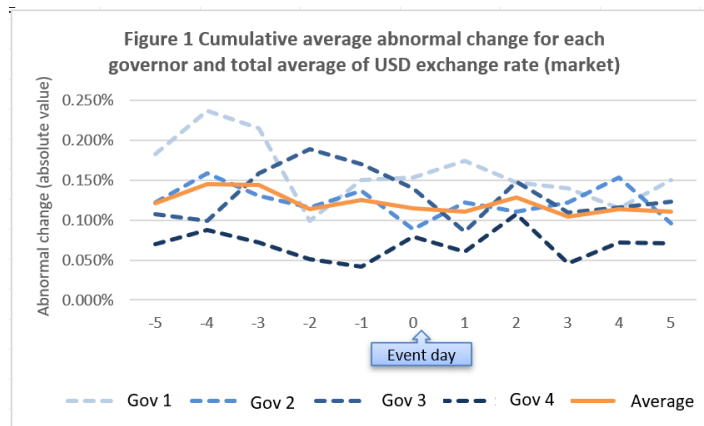
Figure 2 illustrates the cumulative average abnormal change of the USD exchange rate concerning the MPC's policy rate decisions. The graph shows that the market volatility is higher when the policy rate increases, suggesting that the central bank raises the rate during periods of increased market volatility. Conversely, when the rate is constant or decreases, there is less market volatility. Furthermore, there was a significant increase in volatility on the second day following a policy rate increase, which then decreased in the following days. In contrast, when the policy rate is maintained or lowered, the effects are noticeable on the fourth or fifth day after the event, indicating a slower reaction than a policy rate increase decision.

Figure 2 Cumulative average abnormal change of USD exchange rate for each MPC decision on policy rate