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Working Paper

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Suggested Citation: Barrie, Mohamed Samba (2024) : Decoding Bank of Sierra Leone's Monetary Policy Communications: A Text Mining Analysis., ZBW - Leibniz Information Centre for Economics, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/283289>

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Decoding Bank of Sierra Leone's Monetary Policy Communications: A Text Mining Analysis.

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Abstract

This research paper presents the results of a text mining analysis conducted on the quarterly monetary policy statements published by the Bank of Sierra Leone. This study examines the effectiveness and readability of monetary policy communication by the Bank of Sierra Leone. The research focuses on evaluating the clarity and simplicity of the Bank's communication efforts from 2019Q1 to 2023Q1. Utilizing techniques such as word cloud extraction, keyword density analysis, and text readability metrics assessment, we analyzed 17 quarterly monetary policy statements, our corpus consist of 43 pages of text data. The findings reveal insights into the prominent themes, and linguistic characteristics embedded within the Bank's monetary policy statements. Through an examination of keyword frequency and thematic trends, the research shows that the Bank of Sierra Leone's monetary policy statements place emphasis on inflation management, economic growth, and consideration of exogenous factors affecting monetary policy implementation, with language and structure varying across quarters. Moreover, the analysis suggests that understanding these statements typically requires a college-level education, posing accessibility challenges for a significant portion of Sierra Leone's population. The policy implications drawn from this analysis accentuate the importance of stakeholder engagement, transparency, adoption of digital outreach tools, local language communication, continuous monitoring and evaluation of the Bank's communication strategy. This research contributes empirical evidence on monetary policy communication in Sierra Leone, offering insights for policymakers on how best to improve its communication strategies to financial market participants and the general public.

Keywords: Text mining, monetary policy, communication, Bank of Sierra Leone, Effectiveness, Readability, Clarity, Comprehensibility.

JEL Codes: E52, E58, G14, G28, C88

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Introduction

Effective communication of monetary policy is essential for central banks to achieve their objectives of price stability, economic growth, and financial stability. The Bank of Sierra Leone, like many central banks globally, disseminates monetary policy communications to inform various stakeholders about its policy decisions and economic outlook. These communications, including press releases, speeches, reports, and public statements, target financial markets, businesses, policymakers, and the general public. While traditional channels like press releases have been used for policy communication, advancements in technology and text mining techniques offer new opportunities to analyze the effectiveness and readability of central bank communications. Text mining, a subfield of natural language processing (NLP), which itself is a branch of artificial intelligence (AI) enables the extraction of insights from large volumes of textual data, facilitating assessments of clarity, transparency, and comprehensibility.

Hansen and McMahon (2016) conducted a comprehensive review of the literature on sentiment analysis in the context of monetary policy communication. They emphasized the crucial role of central bank communication in modern monetary policy. The review covered various methods used to measure sentiment in monetary policy communication, such as dictionary-based approaches, topic modeling, and machine learning techniques. Additionally, the authors discussed empirical studies that utilized sentiment analysis to investigate the impact of central bank communication on financial markets and economic activity. Gürkaynak, Sack, and Swanson (2005) made a seminal contribution to the literature on monetary policy communication. Their research focused on the effect of communication on inflation expectations in the United States. The authors employed diverse methods and revealed that clear and consistent communication can significantly influence inflation expectations. The work by Bernanke and Gertler (1999) also holds seminal importance in the study of monetary policy communication. The authors argued that effective communication can enhance the efficacy of monetary policy by reducing uncertainty about the central bank's intentions. This increased clarity and confidence in the central bank's actions can result in lower interest rates and aid in managing inflation effectively.

By synthesizing these key studies, we observe that the complexity and the underlying sentiment of the language used, including academic and technical terms, unfamiliar vocabulary, and diverse sentence structures, and invoking emotive words can hinder clear interpretation and analysis.

Despite the critical role of effective communication, empirical research on the effectiveness and readability of monetary policy communications from the Bank of Sierra Leone remains limited. This research gap raises concerns about the clarity and accessibility of the central bank's communications to its intended audience. Moreover, the readability of these communications may influence stakeholders' understanding of monetary policy decisions and future actions.

This study aims to address these gaps by investigating the effectiveness and readability of the Bank of Sierra Leone's monetary policy communications through text mining. Specifically, it seeks to: Firstly, evaluate the clarity, readability and comprehensibility of the Bank's monetary policy statements. Secondly, identify key themes and topics in the Bank's communications, examining their alignment with monetary policy objectives. Finally, assess the accessibility of language used in these communications for diverse audiences. The research questions guiding this study are tailored to align with these objectives. They probe the clarity, comprehensibility, and thematic focus of the Bank's monetary policy communications.

This study contributes to the literature on central bank communication by providing empirical evidence on the effectiveness and readability of monetary policy communications in Sierra Leone. Its findings can inform stakeholders about the clarity and accessibility of central bank communications, thus enhancing understanding and support for monetary policy objectives.

The remainder of this paper is structured as follows: Chapter Two reviews relevant literature on central bank communication and text mining techniques. Chapter Three outlines the data and methodology used in the study. Chapter Four presents empirical analysis and results of monetary policy communications from the Bank of Sierra Leone. Finally, Chapter Five discusses conclusions, key findings, policy implications, limitations, and suggestions for future research.

2.0 Literature Review

Sherman's groundbreaking work in 1893 marked the beginning of readability studies and computational linguistics. He advocated for the application of statistical analysis in the study of English literature, highlighting the impact of shorter sentences and concrete terms on readability. He also observed that spoken language tends to be more efficient than written language. Sherman even made a prediction that written language would evolve to resemble spoken language over time. Building on Sherman's work, subsequent studies aimed to develop formulae for measuring readability. Vogel and Washburne (1928) created an equation to predict reading grades on the Stanford Achievement Test, considering factors such as the number of different words, prepositions, uncommon words, and simple sentences. Lorge's Index (1944, 1948) proposed a formula that took into account average sentence length, prepositional phrases per 100 words, and words not on the Dale list of easy words. Lorge's work laid the foundation for readability research and set the stage for the widely known Flesch Reading Ease formula (Flesch, 1948).

The updated Flesch Reading Ease formula, often cited for measuring readability, calculates a score on a scale of 0 to 100, with higher scores indicating easier readability. It considers average sentence length and average number of syllables per word. Kincaid et al. (1975) introduced the Flesch-Kincaid grade (FK), which determines the grade level suitable for the evaluated passage based on words per sentence and

syllables per word. FK is frequently referenced in studies on central bank communication. These readability measures primarily attribute readability to syntactic structure and vocabulary, a common approach in linguistic analyses of central bank communication. For example, Jansen (2011) applied Flesch scores and FK grades to the testimony of the Federal Reserve Chairman, revealing the potential impact of clarity on financial markets. Bulř et al. (2013) examined readability variations among seven central banks' inflation reports and press statements, finding distinct trends specific to each institution.

These findings align with previous research, including Fracasso et al. (2003), which identified persistent differences in the quality of central bank writing based on independent evaluations. Kedan and Stuart (2014) also found substantial diversity in communication frameworks among 10 central banks in advanced economies. Overall, these studies emphasize the importance of readability and clarity in central bank communication, suggesting that effective communication practices can contribute to reducing volatility and improving financial market outcomes. There is a significant body of research that focuses on central bank communication, both from theoretical and empirical perspectives. Geraats (2006) and Eusepi and Preston (2010) have conducted model-based evaluations of central bank communication strategies. On the empirical front, Kohn and Sack (2003) and Gürkaynak et al. (2005) have measured the impact of monetary policy surprises on financial markets using multiple factors. Gürkaynak et al. (2005) specifically used high-frequency event-study analysis to examine the movements of bond yields and stock prices following central bank announcements. They identified two factors: a monetary policy action factor and a statements factor, and concluded that statements have a significant effect on longer-term Treasury yields and investor expectations.

Previous studies have demonstrated that the release of monetary policy information by the Bank of Japan (BOJ) affects market expectations. For instance, Honda and Kuroki (2006) found that changes in the monetary policy target significantly impact intermediate and long-term interest rates. Nakajima and Hattori (2009) suggested that the release of economic outlook reports or minutes from Monetary Policy Meetings (MPMs) decreases volatility, while changes in monetary policy and an increase in dissenting votes during MPMs increase volatility.

Several empirical studies have examined the content of central bank communications, with a focus on language analysis. Romer and Romer (1989) manually analyzed Federal Open Market Committee (FOMC) minutes to identify anti-inflationary stances based on specific words, introducing subjectivity issues. To overcome this, other studies, such as Fligstein et al. (2014), utilized computational linguistics tools like Latent Dirichlet Allocation (LDA) on FOMC transcripts. Hansen et al. (2014) employed LDA to assess transparency in FOMC monetary policymakers' statements. Text-mining tools were applied by Hendry and Madeley (2010) and Hendry (2012) to measure the impact of Bank of Canada communication on financial markets. Jegadeesh and Wu (2015) used LDA to extract content from FOMC meeting minutes, identifying

topics related to economic outlook and monetary policy stance. Hansen and McMahon (2016) decomposed FOMC communications into multidimensional aspects, revealing that forward guidance had a more substantial impact on financial markets than current economic conditions.

Since, no such study exist on the Bank of Sierra Leone, this study makes a valuable contribution to the existing literature by employing a textual mining analysis approach specifically focused on the Bank of Sierra Leone's quarterly monetary policy communication statement. By utilizing this approach, the study enables a systematic analysis of the clarity and readability, offering insight into the tone and effectiveness of the communication.

3.0 Methodology

3.1.0 Educational Testing Service (ETS) Text Evaluator Framework

The Educational Testing Service (ETS) Text Evaluator Framework is a tool designed to assess the quality of written text. It's primarily used for evaluating the effectiveness, clarity, coherence, and overall quality of written content, such as essays, articles, reports, and other textual materials. The framework employs various linguistic and text analysis techniques to provide insights into the readability, comprehension level, and coherence of written text.

3.1.2 Application in Assessing Clarity and Readability

The ETS Text Evaluator Framework will be utilized to evaluate the clarity and comprehensibility of the monetary policy documents issued by the Bank of Sierra Leone. Through linguistic and text analysis techniques provided by the framework, the clarity of the Bank's communications, including the transparency of policy decisions and rationale, will be assessed.

3.1.2 Evaluation Across Stakeholder Groups

Furthermore, the framework will facilitate the assessment of readability and comprehensibility across various stakeholder groups, including policymakers, financial market participants, and the general public. By analyzing readability metrics and linguistic features, the framework will provide insights into how easily the Bank's communications can be understood by different audiences, thus shedding light on their accessibility and potential impact on stakeholders' comprehension of monetary policy matters.

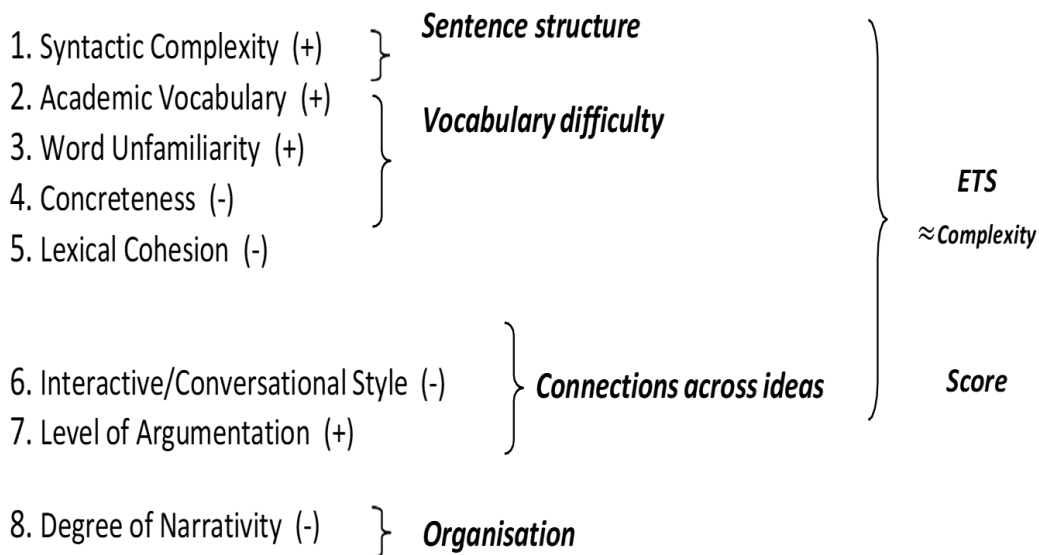
3.1.3 Identification of Themes and Topics

Moreover, the ETS Text Evaluator Framework will aid in identifying the predominant themes and topics discussed in the Bank of Sierra Leone's monetary policy communications. By employing text mining techniques provided by the framework, the thematic focus of the communications will be analyzed, examining their alignment with the Bank's stated monetary policy objectives and goals.

3.2 Step-by-step explanation of the ETS Text Evaluator framework:

The ETS Text Evaluator, developed by the Educational Testing Service (ETS) in the United States, is an automated web tool designed to assess the complexity of reading passages and provide an "ETS Complexity Score" as a comprehensive measure of readability. This score, ranging from 100 to 2000, reflects the overall difficulty of understanding a given text, with higher values indicating greater complexity. The ETS Complexity Score is determined through the evaluation of eight distinct Component Scores, each addressing different aspects of readability. These components collectively contribute to the assessment of the text's clarity and comprehension difficulty.

Figure 1: ETS Text Evaluator Framework – Various Dimensions of Complexity



1. *Syntactic Complexity*: This factor examines the number of words and clauses within a sentence. A sentence with high syntactic complexity demands more effort to understand due to the need to process additional information.
2. *Academic Vocabulary*: This pertains to the usage of words commonly found in academic contexts. A sentence with a high academic vocabulary is more challenging to grasp as readers may not be familiar with the terms.

² Note: This figure 1 above illustrates the conceptual framework of ETS Text Evaluator. The overall ETS Complexity Score is based on eight Component Scores which measure different aspects of readability. The +/- signs indicate the contribution of each Component Score to the overall score. For instance, higher Syntactic Complexity contributes positively to the overall score

3. *Word Unfamiliarity*: This reflects the use of words not commonly employed in everyday speech. A sentence with high word unfamiliarity is harder to understand since readers may not know the meanings of these words.
4. *Concreteness*: This considers the use of words describing tangible objects or concepts perceivable through the senses. Sentences with high concreteness are easier to comprehend, as readers can mentally visualize what is being described.
5. *Lexical Cohesion*: This refers to the employment of words with related meanings. Sentences with high lexical cohesion are simpler to understand, as the words establish clear and logical connections between ideas.
6. *Interactive/Conversational Style*: This involves using words and phrases typical of conversations. Sentences with a high interactive/conversational style are easier to understand since they are familiar to readers.
7. *Level of Argumentation*: This considers the use of words and phrases aimed at persuading or convincing readers. Sentences with a high level of argumentation are more intricate to comprehend, requiring readers to critically evaluate the presented information.
8. *Degree of Narrativity*: This looks at the use of words and phrases for storytelling. Sentences with a high degree of narrativity are simpler to understand as readers are more accustomed to this style.

The overall complexity of a sentence results from the interplay of these factors. A sentence with high complexity is more challenging to grasp due to the need to process more information. Nonetheless, a sentence with high complexity can also be more captivating and engaging to read.

3.3 Data Description:

The dataset comprised of text data that ranged from the first quarter of 2019 Q1 2023Q1. In total, 17 distinct monetary policy statements were amassed, forming the core dataset for analysis. These statements collectively comprised approximately 43 pages of textual content, forming the corpus of the dataset used. The acquisition of these monetary policy statements was conducted through the official releases provided by the Bank of Sierra Leone. These statements, which represent the official communication of the central bank regarding its monetary policy decisions and strategies, are made publicly available on a quarterly basis. With nearly 19,176 words analyzed, the decision to limit the dataset to this timeframe is primarily due to the availability of archival materials. The research was unable to find publications older than these that formed a complete set of four quarters, reflecting the research's commitment to utilizing the most current and relevant data available for comprehensive analysis and insights.

4.0 Results and Discussions

4.1 Word Cloud Extraction

Figure 2: Word Cloud of Common Words Published from 2022- 2023

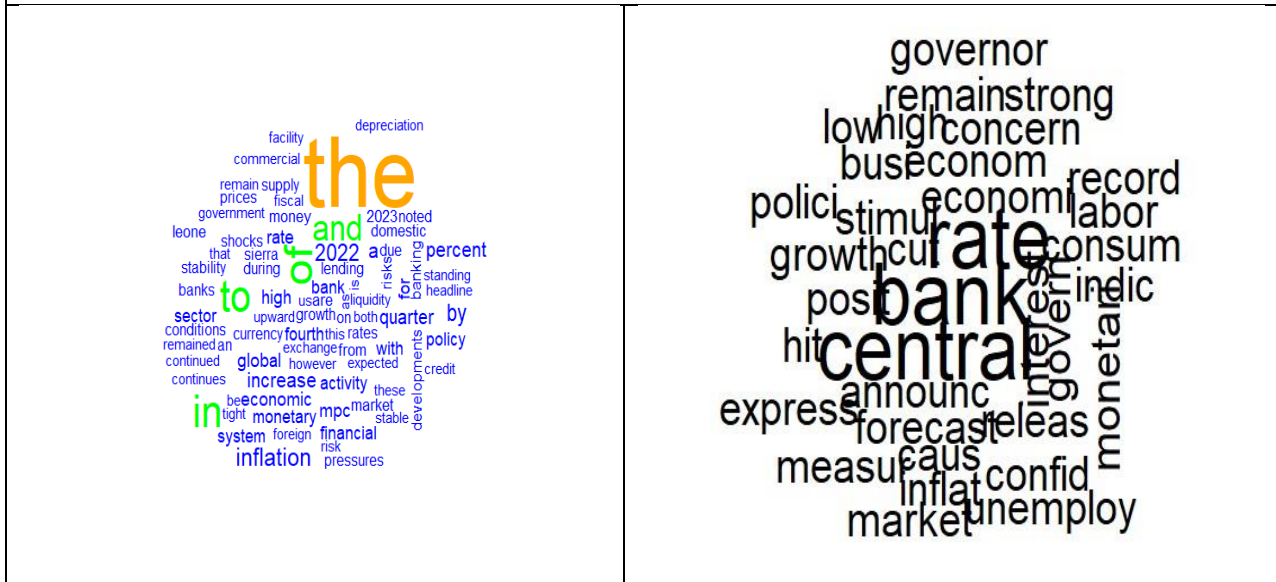


Figure 2 presents word clouds generated from text mining analysis of Monetary Policy Communication Statements over the past two years. These clouds visually encapsulate prevalent terms, offering insights into prominent themes and prevailing tone. Specific words' prominence indicates their frequency in the statements, acting as indicators of subjects and sentiments. This textual analysis reveals patterns and associations, unveiling interconnected topics and concepts. These visual representations serve as descriptive and diagnostic tools, aiding in identifying shifts, changes, and emerging trends over time, enabling a deeper understanding of the Bank's communication strategy and economic landscape.

4.2 Text Summary Analysis Discourse

Table 1: Text Analysis Summary	
Details	Average per statement
Words	1128
Unique Words	46
Characters	7472
Characters (no spaces)	6362
Sentences	49
Longest Sentence(words)	134
Shortest Sentence words	6
Average Sentence (words)	24
Average Sentence (characters)	153
Average Words Length	5.6
Paragraphs	30
Pages	2.5

Syllables	2075
Lines	101
Reading Level	College Graduate
Reading Time	4 minutes 6 seconds
Speaking Time	6 minutes 16 seconds

Table 2 displays the density analysis of the most common words found in the Bank of Sierra Leone's monetary policy statement. The research found that the published statement comprises an average of 1,128 words, with 463 unique words, and spans across 7,472 characters (6,362 characters excluding spaces). It consists of 49 sentences, ranging from the shortest containing only 6 words to the longest containing 345 words. On average, each sentence consists of 24 words and 153 characters. The average word length is 5.6 characters. The text is divided into 30 paragraphs, which take up approximately 2.5 pages. The analysis indicates a total of 2,075 syllables and 101 lines. In terms of readability, the text is deemed suitable for college graduates. The estimated reading time for this text is 4 minutes and 6 seconds, while the estimated speaking time is 6 minutes and 16 seconds.

The average length of a statement being 2.5 pages and containing 1128 words, with sentences averaging 24 words in length, suggests that the communication may be too lengthy and complex for many individuals in Sierra Leone. High illiteracy rates and a low reading culture imply that a significant portion of the population may struggle to engage with and comprehend such lengthy and complex documents.

The relatively low number of unique words per statement (46) and the average word length of 5.6 characters indicate that the vocabulary used may not be overly complex. However, this does not necessarily guarantee readability, especially for individuals with limited education. The "College Graduate" reading level suggests that the communication may be tailored to a more educated audience, potentially excluding a large portion of the population from fully understanding the content.

The estimated reading time of 4 minutes and 6 seconds per statement and speaking time of 6 minutes and 16 seconds indicate that engaging with the communication requires a significant time investment. In a context where time may be limited and attention spans short, lengthy communications could lead to reduced engagement and comprehension, particularly among individuals with low literacy levels.

Given the low percentage of graduates within the total population, the effectiveness of monetary policy communication by the Bank of Sierra Leone hinges on its accessibility to individuals with varying levels of education. While the communication may cater to more educated stakeholders, efforts should be made to ensure that it is also accessible and comprehensible to a broader audience, including those with lower levels of education.

Table 2: Words Density Analysis

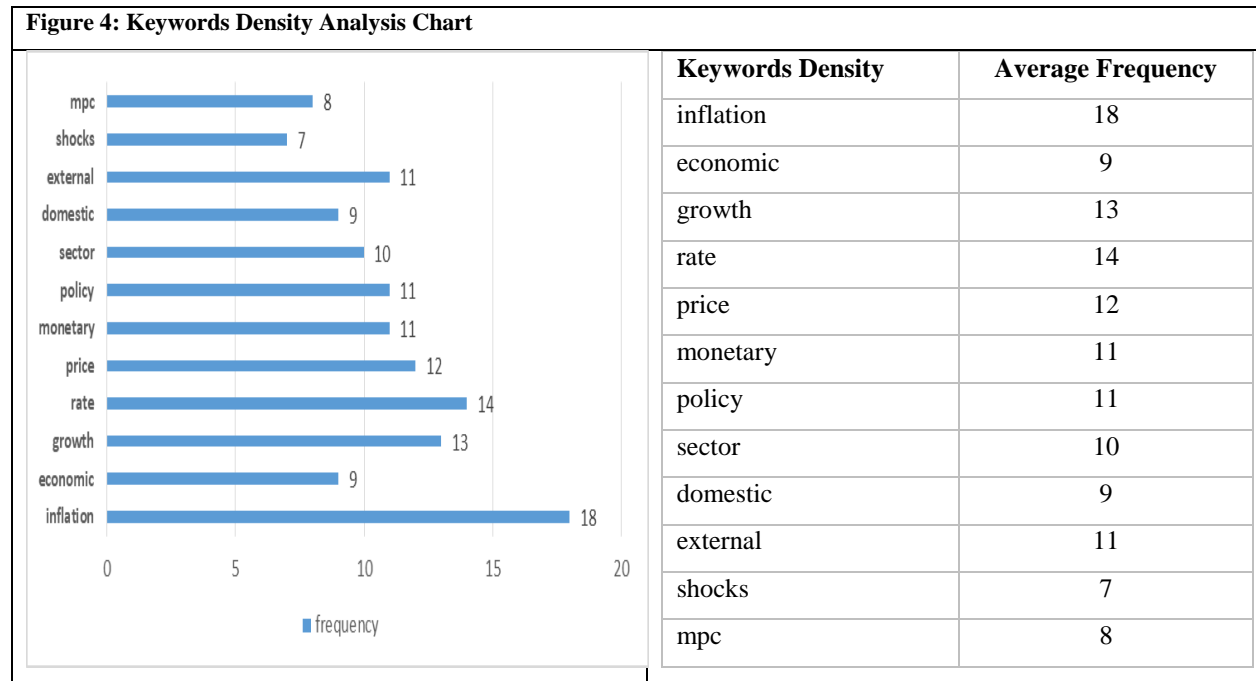


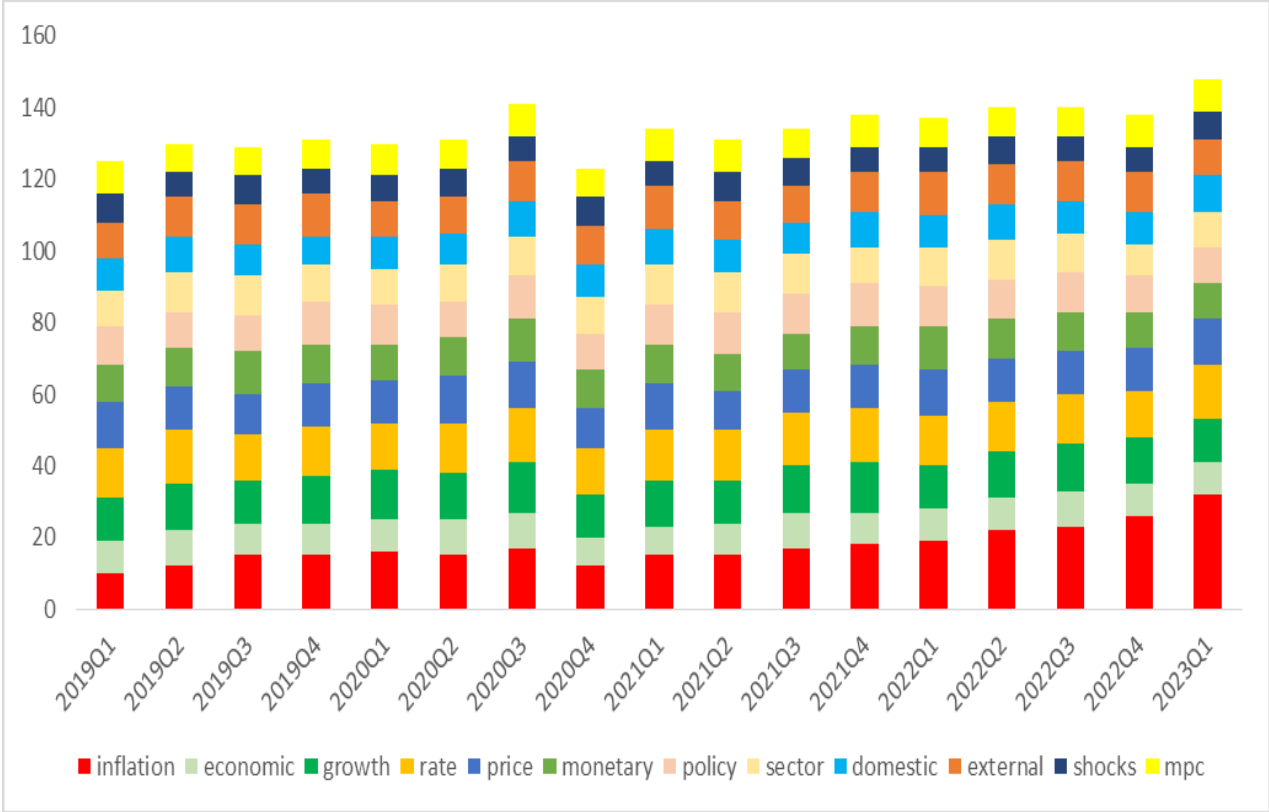
Table 2 provides an analysis of keyword density extracted from the monetary policy statements of the Bank of Sierra Leone over the specified timeframe. The keyword density represents the average frequency of occurrence of key terms within the corpus of communication statements, shedding light on the salient topics and themes emphasized by the central bank in its communication strategy. The analysis reveals that certain terms recur with notable frequency, indicating their significance within the discourse of monetary policy in Sierra Leone. For instance, the term "inflation" emerges as the most prominent keyword, with an average frequency of 18 occurrences across the communication statements. This underscores the central bank's keen focus on monitoring and addressing inflationary pressures within the domestic economy, a critical consideration in formulating monetary policy decisions.

Similarly, keywords such as "economic," "growth," "rate," and "price" also feature prominently, each with average frequencies ranging from 9 to 14 occurrences. These terms reflect the central bank's attention to broader economic indicators and performance metrics, encompassing aspects such as economic growth rates, price stability, and interest rate dynamics. Such emphasis underscores the multifaceted nature of monetary policy formulation, which seeks to balance various macroeconomic objectives and considerations.

Furthermore, the analysis reveals a notable emphasis on the "sector" aspect, with an average frequency of 10 occurrences. This suggests a specific focus on sectoral developments and their implications for monetary policy, reflecting the central bank's efforts to tailor policy responses to sector-specific challenges and opportunities. Additionally, terms such as "domestic," "external," and "shocks" underscore the central

bank's consideration of both domestic and external factors influencing the economic landscape. This highlights the interconnectedness of the Sierra Leonean economy with global economic trends and the importance of a holistic approach to monetary policy formulation.

Figure 4: Keywords Density Analysis Distribution Chart over the study Horizon



4.3 Inflation Vs Economic Growth Discourse

From figure 4 above, the findings indicate a notable focus on inflation discussions compared to economic growth in the monetary policy statements. The research reveals that the monetary policy statements from the Bank of Sierra Leone place greater emphasis on addressing inflation-related matters throughout the study horizon. This signifies the central bank's recognition of the significance of managing inflationary pressures and maintaining price stability as essential components of their monetary policy objectives. By prioritizing inflation discussions, the bank aims to provide transparent and informative insights into its evaluation of inflation trends, the policy measures implemented to manage inflation, and the projected impact on the overall economy.

Furthermore, the analysis highlights a gradual increase in the attention given to external economic developments in the monetary policy statements, surpassing discussions on domestic economic development. This shift indicates the Bank of Sierra Leone's acknowledgement of the growing

interconnectedness between the Sierra Leonean economy and global forces, along with the potential influence of international events on domestic economic conditions. By incorporating discussions on global economic developments, the central bank demonstrates its awareness of external factors, such as international trade dynamics, commodity price fluctuations, exchange rate movements, and global economic trends. This recognition reflects the bank's commitment to incorporating these external influences into its decision-making process for monetary policy formulation.

5.0 Conclusion

In conclusion, this research sheds light on the effectiveness and readability of monetary policy communication by the Bank of Sierra Leone, utilizing a text mining approach to analyze quarterly monetary policy statements over a five-year period. Through techniques such as word cloud extraction, keyword density analysis, and text metrics assessment, we have gained valuable insights into the clarity, simplicity, and comprehensibility of the Bank's communication efforts.

Our analysis of 17 quarterly monetary policy statements from 2019Q1 to 2023Q1 revealed consistent themes revolving around critical economic indicators, notably "inflation" and "economic growth." We observed variations in language and structure across quarters, indicative of fluctuations in sentiment, polarity, and clarity. Furthermore, our study uncovered accessibility challenges posed by the length and complexity of these communications, particularly for individuals with lower levels of financial literacy and education.

By examining keyword frequency and thematic trends, we highlighted the central bank's emphasis on inflation management, economic growth, and consideration of external economic factors. These findings underscore the necessity of enhancing communication strategies to improve stakeholder engagement and understanding of monetary policy decisions.

The findings contribute valuable empirical evidence to the existing literature on central bank communication, particularly within the context of Sierra Leone. By providing insights into the effectiveness and readability of monetary policy communications, this study offers actionable guidance for policymakers, central bank officials, financial market participants, and the general public. Moreover, our research highlights the importance of continuous improvement in the design and delivery of central bank communications to enhance stakeholder understanding and support for monetary policy objectives.

While this study provides significant insights, it is not without limitations. The analysis primarily focused on textual data, and future research could incorporate other data sources to provide a more comprehensive understanding of central bank communication dynamics. Additionally, the study's findings are contingent on the specific context of Sierra Leone and may not be directly generalizable to other countries or central banks.

5.1 Policy Implications

1. *Stakeholder Engagement & Transparency:* The findings suggest a need for the Bank of Sierra Leone to refine its communication strategies to ensure clarity, simplicity, and accessibility of its monetary policy statements. This may involve policymakers to prioritize efforts to enhance stakeholder engagement by making monetary policy communications more accessible and understandable. This could involve targeted outreach initiatives, public education campaigns, and fostering dialogue with diverse stakeholders and major influential business communities to ensure a broader understanding of policy decisions and their implications. The study accentuates the importance of transparency and accountability in the Bank of Sierra Leone's communication. Policymakers should strive to provide clear and comprehensive explanations of monetary policy decisions, including the rationale behind key economic indicators and their implications for the economy. This transparency can help build trust and credibility with the public, financial markets, and other stakeholders
2. *Digital Outreach:* Given the increasing mobile phone penetration in Sierra Leone, the Bank should consider using verifiable social media handles, utilize SMS, to deliver concise updates and information about its monetary policy decisions and tailored to the needs of the population, providing access to relevant economic data and policy explanations. This outreach should feature interactive tutorials, videos, and infographics explaining key economic concepts in easy-to-understand language. Subscribers to the Bank media channels can receive real-time updates on policy changes, inflation rates, and economic indicators, helping them stay informed about the country's financial landscape. Additionally, incorporate a feature allowing users to submit questions or feedback, fostering engagement and enabling the Bank of Sierra Leone to address concerns directly
3. *Local Language Communication:* Communicate monetary policy information in local languages to ensure better comprehension among the population. This may involve simplifying language, having radio talk shows on the Bank's quarterly monetary policy communications decisions in Krio and some local languages, streamlining content, and employing visual aids to improve comprehension, especially for individuals with lower levels of education. By expanding local language communication strategies, the Bank of Sierra Leone can bridge the communication gap and effectively engage with diverse segments of the population, fostering greater awareness, understanding, and participation in monetary policy matters.
4. *Continuous Monitoring and Evaluation:* The research highlights the dynamic nature of monetary policy communication, with language and structure varying across quarters. Therefore, policymakers should adopt a systematic approach to monitoring and evaluating communication

effectiveness over time. This may involve regular assessments of readability, clarity, and stakeholder feedback to identify areas for improvement and ensure ongoing refinement of communication strategies. Given the accessibility challenges identified in the study, policymakers should prioritize investment in financial literacy initiatives to empower key individuals with the knowledge and skills needed to understand monetary policy communications. This could include educational programs, workshops, and resources designed to improve financial literacy levels across different but relevant segments of the population.

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