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Impact of the Central Bank's Communication on Macrofinancial Outcomes

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Impact of the Central Bank's Communication on Macrofinancial Outcomes[1]

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Abstract

This study explores the impact of central bank communications on a range of macrofinancial indicators. Specifically, we examine whether information posted on the National Bank of Ukraine (NBU) website influences foreign exchange (FX) markets and the inflation expectations of experts. Our main results suggest that the NBU's statements and press releases on monetary policy issues do indeed matter. For instance, we find that exchange rate movements and volatility are negatively correlated with the volumes of publications of the NBU on its official website. However, this effect is noticeably larger for volatility than for exchange rate changes. The impact of communication on FX developments is strongest a week after a news release, and it persists further. Furthermore, the inflation expectations of financial experts, though indifferent to NBU updates overall, turn out to be sensitive to monetary policy announcements. The latter reduce the level of expectations and interest rate movement.

JEL Classification Codes: E58, E71, C55.

Keywords: central bank communications, monetary policy, FX market, text analysis.

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The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the National Bank of Ukraine.

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1. Introduction

The role of central bank communication has rapidly grown in recent decades. Today, central banks (CBs) use various communication tools widely to better manage expectations and achieve policy objectives (Casiraghi, 2022). Communication works through building greater trust in CB decisions and reducing uncertainty in the market, particularly about the future direction of monetary policy. Being more predictable to the markets, CBs make market reactions more predictable to themselves, and thereby strengthen their influence on economic developments (Blinder et al., 2008). Unsurprisingly, a wide strand of literature has already been devoted to the impact of communication on macrofinancial outcomes and expectations. However, most studies so far have focused on the markets of advanced economies with stable macroeconomic environments and developed financial infrastructure. Our study aims to answer whether CB communication may effectively steer market behavior in the compound and turbulent environment of an emerging market – such as that of Ukraine.

To evaluate the impact of CB communications, researchers typically examine financial market reactions. There is abundant evidence that CB communication has a significant impact on asset prices and yield moves. For instance, it has been proved that the Fed's communication through statements, minutes, and speeches affects both the volatility of U.S. asset prices and trading volumes (Hayo et al., 2008; Rosa, 2011). Monetary policy announcements may also explain variations in asset prices in other advanced markets, like the Euro area (Leombroni et al., 2021) or the UK (Mumtaz et al., 2023). However, asset market responses may be weak and uncertain in emerging markets with undeveloped or illiquid securities markets (Eklou, 2023; Kamin et al., 1998). Therefore, bond and stock price moves would be a poor proxy for the estimation of CB communication in these cases. Taking into account the insufficient level of development of the Ukrainian securities market, in our study we primarily focused on the reactions of the FX market.

CBs keep a close eye on FX developments, which are extremely important for achieving policy goals. The exchange rate channel is considered to be a very powerful link of monetary transmission in emerging countries (Stone et al., 2009), and Ukraine is no exception (Zholud et al., 2019). Excessive ER volatility may be an issue of high concern, as it negatively affects a range of macroeconomic variables, including inflation, trade, and investments (Weber, 2019). Moreover, the negative impact of exchange rate volatility is exacerbated during currency crises (Brouwer, 2004), which are rather common in emerging markets. In contrast, lower ER volatility improves monetary transmission and reinforces confidence in the local currency, contributing to low and stable inflation (Velarde and Montoro, 2022). For this reason, CBs try to shape necessary reactions by the FX market through using both actual and verbal interventions. Many CBs use communication as a primary policy instrument for reducing excessive market fluctuations (Fratzscher, 2005). Several empirical studies have shown the smoothing impact of communication on ER volatility in the Czech Republic (Fišer and Horváth, 2009), India (Goyal and Arora, 2012),

China (Ning et al., 2016), and Poland (Brzeszczyński et al., 2017). We also studied whether monetary policy communication smooths sentiments on the currency market in Ukraine.

Recent scientific papers on Ukraine have already shown that there is a distinct connection between the NBU's communications and FX market behavior (Gao et al., 2023; Ivanytskyi, 2022). In particular, this research highlights the power of communication sentiment and its impact on overall ER volatility and the black market premium during the full-scale russian invasion of Ukraine. We extend these findings by discovering a significant correlation between the volumes of NBU publications on its official website and ER movements and volatility. Our results clearly suggest that the NBU's communication efforts contribute to smoothing sentiment on the currency market. The impact of these efforts peaks within a week of publication, and persists throughout the observed horizon. Communications related to monetary policy have a greater impact on both ER movements and volatility compared to other messages. However, the general effect of communication on ER volatility turned out to be much more tangible than that on ER changes. This insight suggests that market factors may have a greater impact on ER fluctuations, while behavioral factors may play a larger role in determining volatility.

Another finding of our paper concerns references to the governor in the NBU's communications. Although mentioning the governor does not appear to have a clear-cut impact on volatility or ER movements, it is likely to enhance the smoothing effect on the FX market during the first week. this means that markets attribute additional weight to the chairman's voice. This finding echoes the results of some other papers, which demonstrate heightened attention to market-related speeches and remarks by the governors of the ECB (Istrefi et al., 2022) and Fed (Biefang-Frisancho Mariscal and Howells, 2007). The additional weight of high-ranking communication is also confirmed by other researchers. For instance, in the United States, the financial markets react more strongly to the statement of the chairman compared to other Fed officials (Ehrmann and Fratzscher, 2005), while the vice chairman's voice has more influence compared to other Board members, and voting regional Fed presidents affect markets more than non-voting ones do (Hayo et al., 2008). While the influence of the governors' words depends greatly on their personality (Narain and Sangani, 2023), their potential to attract more market attention is undisputed, and should be used judiciously in communications.

Our analysis extended the primary findings by examining the responses of lower-frequency data, specifically the inflation expectations of financial experts and interest rates on bank products. Financial experts' inflation expectations are largely independent of general NBU publications on the website. However, monetary policy announcements appear to be important in reducing the level of such expectations. Regarding interest rates, general NBU publications only affect rates in the short term (up to one month), while monetary policy publications have a more lasting impact, extending up to three months. Household lending rates exhibit a unique trend, with monetary

policy announcements initially increasing rates within the first month, but this effect is gradually offset over time. These insights offer a more nuanced understanding of the intricate relationship between central bank communications and financial indicators.

The findings presented here have significant implications for both policymakers and financial market participants. Policymakers can use this insight to strategically craft and disseminate communications – particularly those related to monetary policy – to mitigate potential fluctuations in the currency market. In addition, the varying effects of different communication themes on the inflation expectations of financial experts highlight the importance of clear and targeted messaging, as monetary policy announcements are crucial in shaping these expectations. Furthermore, the study's results propose straightforward and practical measures to enhance the effectiveness of central bank communications. Specifically, the NBU should publish monetary policy news more frequently at the start of the week if they are not linked to the Monetary Policy Committee's decision schedule. In addition, including references to the governor in the messages would augment the impact of the communications.

The paper is organized as follows. Section 2 briefly describes communications in the NBU. Section 3 covers data exploration and the methodology applied to assess the impact of communications on macrofinancial variables. Empirical results on this impact are provided in section 4. Section 5 summarizes.

2. NBU Communication Insights

Since the adoption of inflation targeting and the transition to a floating exchange rate in 2015, the NBU has seen communications as an important instrument for achieving policy goals. Transparency, consistency, proactivity, and clarity of communications have been integral principles of the NBU's strategy. Given that, the NBU's communication toolkit has been significantly improved and expanded in recent years. The current arsenal includes monthly *Macroeconomic and Monetary Reviews*, quarterly *Inflation Reports*, semiannual *Financial Stability Reports*, *Annual Reports*, press briefings on key decisions, monetary policy releases, *Summaries of MPC discussions*, commentaries on inflation and GDP, and other publications. The NBU also holds regular meetings with experts, market participants, the business community, and foreign investors. Interviews and columns by Board members and experts of the NBU, and off-record meetings with journalists are widely used for better transmission of key messages to key audiences. Educational outreach is conducted through seminars for university professors, lectures, and contests for students. The NBU maintains a strong presence on social media platforms (Facebook, Twitter, Instagram, YouTube, Telegram) and makes layered communications to tailor content to the needs of diverse audiences. A Transparency Award from *Central Banking* marked the progress of the NBU's communication system in 2019.

Through this multifaceted approach, the NBU strives to reduce market uncertainty and promote informed decision-making. This is crucial in the turbulent and rapidly changing economic

landscape of Ukraine. The last decade alone brought the annexation of Crimea, subsequent russian aggression in eastern Ukraine, the COVID-19 crisis, and a full-scale russian invasion. Each of these events struck a huge blow to the Ukrainian economy. Despite these challenges, the NBU has remained committed to openness. Following the russian invasion, the NBU made some modifications to its monetary regime, but maintained consistent communication practices. Consistent proactive communication was required to ease the unprecedented level of uncertainty during the war. External research has proved the effectiveness of this approach. The Semantic Index developed by Morgan Stanley shows high consistency between the words used and policy moves of the NBU during wartime (Slyusarchuk et al, 2023). For its part, congruous communication by the NBU and correct wording helped to mitigate the shocks of war, in particular by smoothing the reactions of the Ukrainian FX market (Gao et al, 2023). The NBU's broad communication toolkit and its successful implementation in a fast-changing economic environment make it a valuable case study for studying the potential of CB communications.

3. Data and Methodology

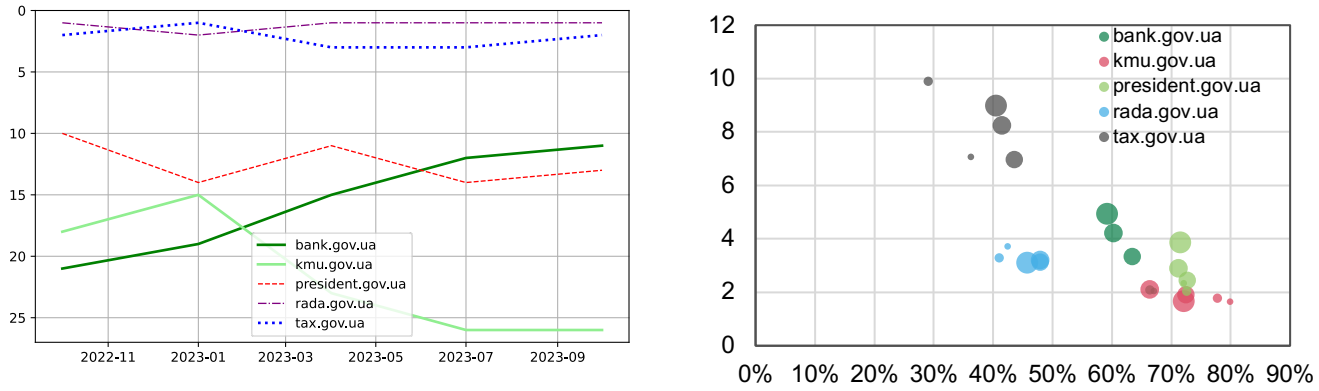
3.1. Data Overview

The NBU maintains a strong online presence through its official website and social media platforms, providing essential information to the public. The Wayback Machine shows that the NBU website was launched in the 1990s, initially containing limited information on banking legislation, the NBU's structure, exchange rates, etc. In 2019, the NBU launched a new website with improved functionality and expanded content. Most of the important information messages were transferred to the News section, but a significant part remains in the archive and can only be accessed through a website search.

Similarweb.com suggests that the NBU's website receives 1.4-2 million monthly users. Time spent on the NBU website increased from 100 seconds in 2022 to 200 seconds in 2023. However, 60% of visitors leave the site after viewing the first page. This could be due to the nature of the information of interest to visitors, such as the exchange rate, which is located on the home page. Thus, the one-third of the visitors who are more interested in other information viewed an average of 10 pages (up from 4.2 pages in 2022). When compared to the other state organizations' websites (figure 1), such as those of the President, the Government, and the Parliament, this website has higher results, except for the Tax Service website, which can be explained by the fact that it gives access to its electronic services through its website.

With such a large audience, central banks' websites provide new tools for communicating monetary policy messages to a wide range of audiences, while at the same time improving the public's access to central bank information.

The study analyzes the online presence, website traffic, and social media engagement of the NBU using Google Analytics, website data, and Twitter (X) as independent external variables in our study.



Panel A Panel B

Figure 1. Ranking of Sites in Category Government in Ukraine (*panel A*) and Bounce Rate and Average Pages visited (*panel B*)

Note: The *y* axis on *panel A* represents the rank of the website based on the number of visits, while the *x* axis represents the date. The *y* axis on *panel B* represents the number of pages opened by a single visitor per visit. The *x* axis shows the bounce rate, which indicates the percentage of visitors who view only one page per visit. The bigger size of the markers denotes the latest data.

Source: similarweb.com.

Google Analytics is a web analysis service provided by Google that allows website owners to track and analyze various aspects of their online presence. This service anonymously collects and processes information about website visitors, including their geographic location, devices and browsers used, traffic sources, and specific actions taken on the website. Attempts have been made to use Google Analytics data to measure the impact of CB communication on the public's information demand, which in turn affects inflation expectations. For instance, Jung and Kühl (2021) used European Central Bank (ECB) website traffic as a proxy for visitors' engagement with its communications.

This research utilized a unique Google Analytics dataset, which includes daily views of the NBU website from January 2014 to December 2022. The dataset focuses on the *News and Official Announcements* sections of the NBU website. Data points were filtered to exclude days and pages with less than 10 views, resulting in a sample of 158,000 data points. Further refinement addressed duplication issues caused by variations in URLs. A dataset of 142,000 data points representing 7,098 news items in Ukrainian was ultimately obtained after data cleaning. The primary analysis indicates that each page received an average of 20 days of visits and was viewed approximately 3,500 times. Notably, page views experienced a surge in February 2022. Thus, specific pages related to supporting the Armed Forces of Ukraine and humanitarian aid garnered a significant portion of website views. As this topic is specific and remote from traditional central bank functions, this section will be excluded from the study.

We collected textual data for almost every news item by using links to publications on the NBU website from Google Analytics data. Unfortunately, after the transition to the new version of the website, some of the data became unavailable in the archive. However, the share of these articles is only 5.6%, which is sufficient for the purposes of the research.

Various forms of communication, including their content and tone, can significantly impact assessment results. Gorodnichenko et al. (2023) found that even nonverbal communication can affect various financial indicators. To investigate heterogeneity, we evaluated different types of central bank communications, depending on the topic, references to the governor in the text, the popularity of articles on the website among visitors, the stage of monetary policy, and so on. The new site features numerous articles with tags, which are specific words or phrases used in search queries to find relevant information on a particular topic or subject. These keywords include monetary policy, financial stability, numismatics, payments, and more (see Appendix B). In total, we identified 40 keywords, including monetary policy, financial stability, numismatics, and payments. Some articles have two or more tags, which makes it possible to trace the relationships between topics and identify more aggregated groups. In the end, we have implemented a binary classification based on the proposed tags (monetary/non-monetary) to focus on monetary publications.

However, nearly 3K articles lack tags. To fix this, we utilized the BERT model (Devlin, 2019) to classify the remaining data. Due to the morphological complexity of the Ukrainian language, the text required thorough cleaning before further analysis. Therefore, the text of each article was lemmatized using the pymorphy2 library (Korobov, 2015). Pymorphy2 returns the normal form of a word, including the nominative singular for nouns and adjectives, and the indefinite present tense for verbs. In addition, prepositions and particles were removed from the text, along with the most frequently used words using a list of stopwords. On average, articles on the NBU website contain 302 words (the median is 252 words).

The model was trained on existing data with the following characteristics: maxlen=200, max_features=100000, preprocess_mode='bert'. The validation sample size was 20%. The model appears to perform reasonably well even considering the non-uniformity of the sample (see table 1). Additionally, the validation accuracy is slightly higher than the training accuracy, indicating that the model is generalizing well to new, unseen data. The low loss values suggest that the model's predictions closely match the true values, both in the training and validation sets. Our model classified 94 additional publications, in addition to the 472 already identified.

We also used a dictionary-based approach to distinguish articles that mention the governor.

Table 1. Model Results of NBU Messages Classification Using BERT

	Precision	Recall	F1-score	Support
Monetary	0.71	0.56	0.63	87
Non-monetary	0.95	0.98	0.96	808
Accuracy			0.94	895
Accuracy (training)			0.91	3580
Loss			0.16	895
Loss (training)			0.24	3580
Macro avg	0.83	0.77	0.80	895
Weighted avg	0.93	0.94	0.93	895

Examining social media content can be a valuable tool for policymakers to assess the effectiveness of communications in shaping beliefs, offering insights on how to refine communication strategies to more precisely anchor expectations and influence beliefs, especially among non-expectant individuals (Masciandaro et al., 2023). In this study, we collected data from **Twitter (now X)** using the Python tool snscrape, capturing tweets that mention the NBU. Tweets were scraped in both the Ukrainian and russian languages, as well as English and other languages. In total, more than 1 million tweets were collected. The dataset was cleaned by filtering out irrelevant data particularly related to the central banks of other countries. The resulting dataset spans from 2012 to early 2023 and contains over 900,000 tweets about the NBU (figure 2 and table 2). The tweets were mostly posted from 2014 to 2017, which coincided with Ukraine's economic recovery after significant geopolitical events. Among other things, this can also be explained by the large number of bots that posted malicious information (Elmas, 2023). The dataset reveals a shift in language usage, with a decline in the share of russian tweets and an increase in Ukrainian tweets in recent years. In total, nearly 96K users tweeted about the NBU, and 60% of the tweets were written by only 1% of the users.

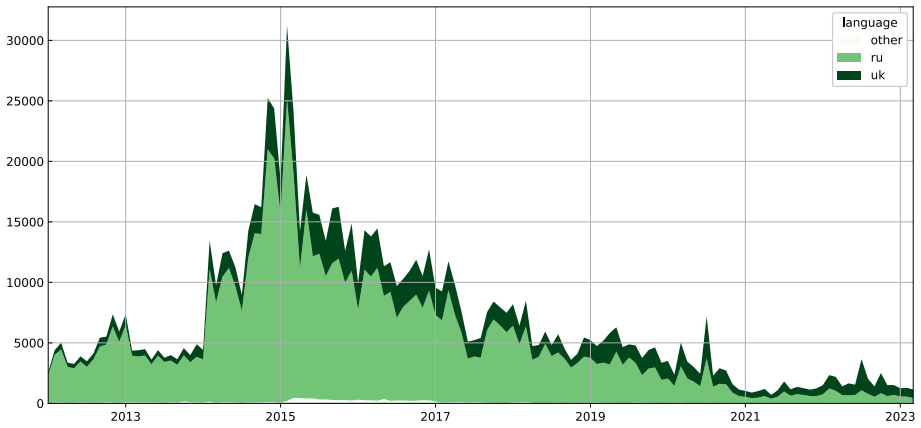


Figure 2. Number of Tweets About the NBU by Language per Month

Note: The *y* axis represents the number of tweets per month, the *x* axis represents a date. The colors of the stacked area denote languages automatically detected by Twitter.

Table 2. Main Characteristics of Twitter (X) Data about the NBU for the Period from January 2012 to March 2023

	Replies	Retweets	Likes	Quotes	Symbols
Mean	0.078	0.477	0.589	0.019	98.681
Std	0.938	6.155	18.318	0.357	41.992
25%	0.000	0.000	0.000	0.000	70.000
50%	0.000	0.000	0.000	0.000	93.000
75%	0.000	0.000	0.000	0.000	123.000

In addition to the classical macroeconomic indicators, we investigated whether the NBU's communications have an impact on social media opinions, specifically seven-day sentiment on Twitter about the NBU. Determining public sentiment is crucial for assessing their reactions. To achieve this, we utilized off-the-shelf solutions, specifically, the Zero-shot text classification model (multilingual version) trained with self-supervised tuning (Liu et al., 2023). The backbone of the model is xlm-roberta-base and it can be used in different languages. The model can be used for zero-shot text classification, such as sentiment analysis, without the need for further fine-tuning. It turned out that the majority of the tweets about the NBU were negative (roughly 85%). However considering the dynamic nature of the economy, exchange rate fluctuations, and various events, this outcome is reasonable. Based on the tweet sentiment data, we calculated the NBU tweet sentiment index using the following formula (2). Figure 3 shows the evolution of this index over time.

$$Sentiment = \frac{\sum Positive - \sum Negative}{\sum Total} \quad (1)$$

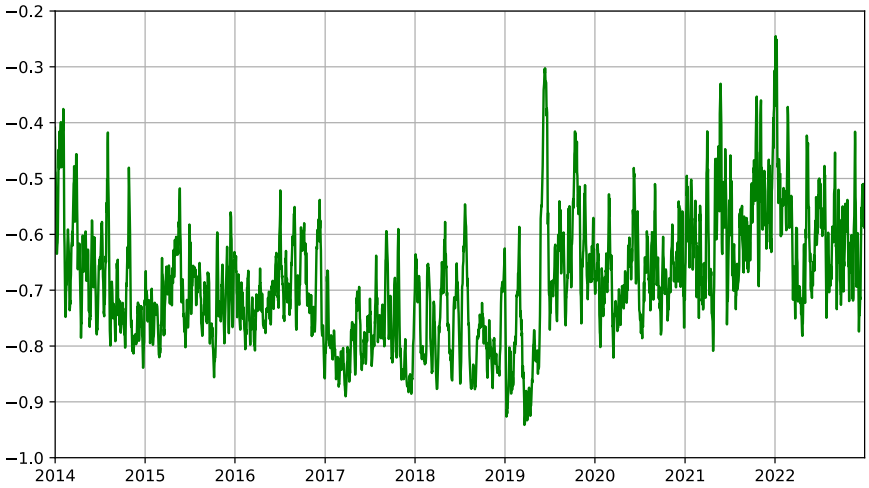


Figure 3. NBU Tweet Sentiments (seven-day average)

Note: The *y* axis represents the seven-day rolling sentiment index calculated using formula (2). The *x* axis represents the date.

3.2. Econometric Specification

Local projections (Jorda, 2005) are linear regressions that project observations of an endogenous variable at different periods over a chosen horizon onto observed exogenous variables. This method is well suited for capturing the heterogeneous effects of economic variables over time, and offers a nuanced and dynamic perspective. In the context of our research objectives, this methodology allows for a granular examination of the impact of central bank communications on macroeconomic outcomes. Local projections provide the flexibility to incorporate short-term and long-term effects, capturing the multifaceted nature of economic relationships across varying temporal scales. The sensitivity of local projections to changes in the economic landscape enhances the model's ability to reflect evolving dynamics, making it an ideal choice for studying the dynamic economic system. Local projections are commonly used in economic research due to their advantages. For example, Gao et al. (2023) used local projections to prove that NBU's announcements significantly impacted FX market agents; Carrière-Swallow et al. (2023) estimated the variance of the rate of pass-through from the exchange rate to domestic prices across states of the economy.

To evaluate the effect of central bank communications on macroeconomic outcomes, we created the subsequent local projections model:

$$y_{t+h} = \theta_h \, CB_t + \gamma_h \, y_t + \varepsilon_{t+h};\ h = 0, 1, \dots, H; \tag{2}$$

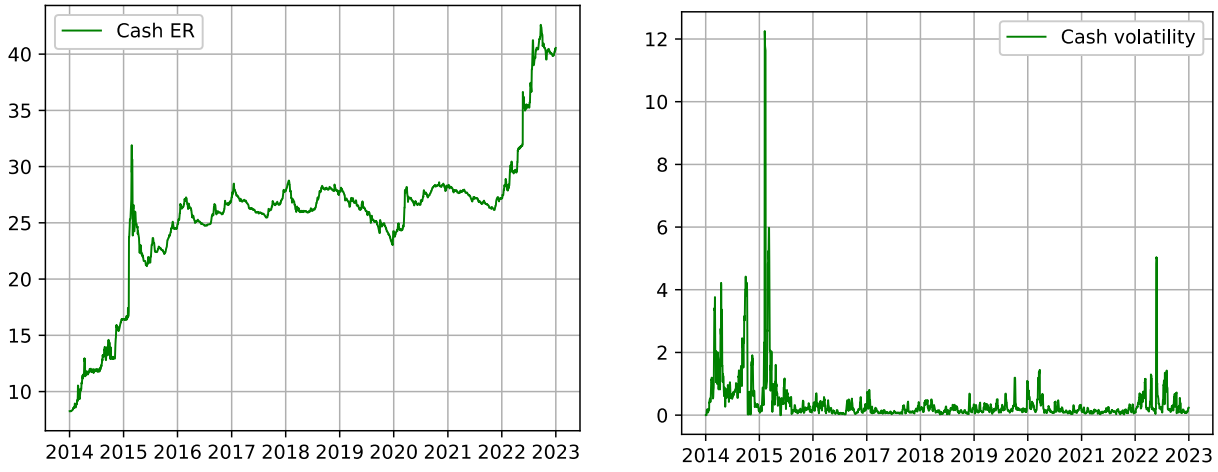
where y is the dependent variable (macroeconomic outcome being studied), CB – publications of the central bank measured as the number of released messages on the website, ε is a residual, h – horizon, and t is a point of time. θ is a coefficient vector which according to the local projections' method is interpreted as a sequence of impulse response for a structural shock.

We used the volume of publications on the NBU's website (in natural logarithm) as an exogenous variable. Given the significant volatility of this indicator and dependence on its popularity on the day of the week (see Appendix A for more details), we use the sum of publications for seven days. The time series successfully passed stationarity tests, affirming the stability and constant statistical properties of the data over time.

The study aims to understand the intricate connections between central bank communications and economic variables. Traditional macroeconomic indicators, such as inflation or GDP, are published infrequently, either on a monthly or quarterly basis, and exhibit a considerable lag in their release. This temporal discrepancy poses challenges in isolating the distinct influence of individual central bank events on the overall indicators. Furthermore, the transient nature of interest in central bank news complicates this task. Local projections are also most justified on high-frequency data.

Therefore, the focus of the investigation shifts to macroeconomic indicators with higher frequency. As the Ukrainian stock market remains in its early stages of development, the exchange rate of the hryvnia against foreign currencies, particularly the US dollar, is used. Following Ukraine's departure from the fixed exchange rate system in 2014, a gradual relaxation of currency constraints and a shift towards inflation targeting ensued. Nonetheless, the NBU reinstated the fixed exchange rate mechanism in late February 2022 due to the large-scale military intervention by russia in Ukraine. Taking into account the most volatile nature of the grey cash exchange rate, we use it in our study (see figure 4). The analysis utilized the change in the hryvnia/dollar exchange rate on the cash market and the seven-day volatility of the hryvnia exchange rate. The use of these variables instead of the exchange rate is also justified from the point of view of statistical properties. The volatility of the exchange rate and its change passed the stationarity tests, unlike the exchange rate indicator.

Additionally, we analyzed the impact of communications on indicators with a lower frequency. Professional financial analysts are one of the main stakeholders of the information published on the NBU website. The NBU conducts surveys of financial forecasters – monthly until 2019, and then prior to the announcement of monetary policy decisions (figure 5). However, the number of professional forecasters varies over time. We attempted to evaluate whether interest rates on deposits or loans (figure 6) are affected.



Panel A Panel B

Figure 4. Cash ER (*panel A*) and ER volatility (*panel B*)

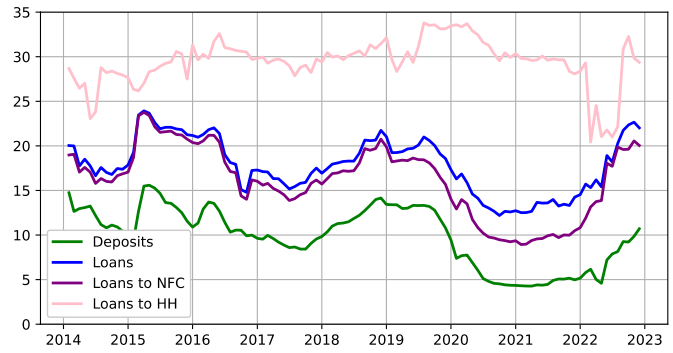
Note: *Panel A* Shows the evolution of the UAH/USD exchange rate. After the transition to a floating exchange rate in 2014, the cash and official exchange rates were virtually identical. However, the forced fixing of the exchange rate in February 2022 due to russia's full-scale invasion led to a widening of the spread. *Panel B* shows the evolution of the seven-day volatility of the UAH/USD exchange rate. Source: NBU, minfin.com.ua.

Stats	Value
N	90
mean	10.429
std	4.096
min	5.344
25%	7.150
50%	8.919
75%	13.346
max	21.887

Figure 5. 12-Month Ahead Inflation Expectations of Financial Analysts

Note: The *y* axis represents the expected percentage change in consumer prices in the next 12 months. The *x* axis represents the date.

Source: NBU.



	Deposits	Loans	Loans_NFC	Loans_HH
N	107	107	107	107
mean	9.839	17.816	16.142	29.416
std	3.297	3.097	3.944	2.660
min	4.271	12.186	8.929	20.422
25%	7.531	15.574	13.867	28.436
50%	10.362	17.754	16.864	29.701
75%	12.768	20.433	19.021	30.639
max	15.583	23.928	23.756	33.795

Figure 6. Interest Rates for Bank Products

Note: The *y* axis represents annual interest rates in %. The *x* axis represents the date.

Source: NBU.

For these purposes, we have converted the frequency of publications to this level, in particular, the indicator of the number of publications now includes data for the previous month.

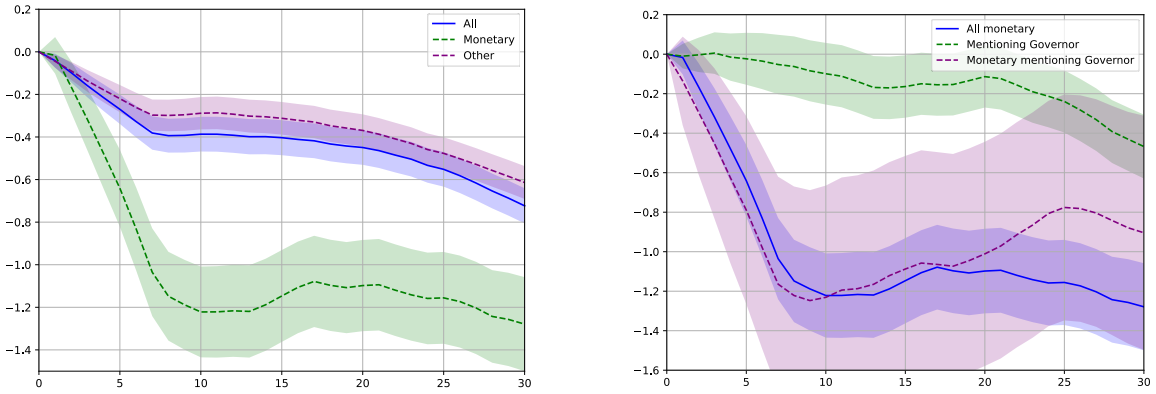
We estimated impulse responses by using local projections on the sample from 1 January 2014, to 31 December 2022 for all indicators except inflation expectations, which have only been available since July 2014.

4. Estimation and Results

4.1. Effects on FX Indicators

The evolution of the results for the impulse response coefficient θ_h from equation 2 on ER indicators as a function of the lag length *h* is plotted in figure 7. The lag parameter *h* ranges from 0 to 30 days after the publication date.

The publications of the NBU on its official website have a negative correlation with both exchange rate movements and volatility. The coefficient's negative sign indicates an inverse relationship between the natural logarithm of the number of CB messages on its website and ER volatility. This suggests that a 1% increase in the natural logarithm of the number of any messages by the CB is associated with a 0.4% decrease in ER volatility in one week. Publications on monetary policy have a stronger impact on both indicators than other messages. A 1% increase in the natural logarithm of the number of monetary policy messages leads to a 1.2% decrease in ER volatility in 7-10 days. This effect reaches a maximum in about a week, and persists throughout the entire observed horizon. Therefore, the communications published by the NBU may smooth sentiment on the currency market to a noticeable extent. This can be attributed to the characteristics of the audience reading each particular news item, and to other events occurring in the economy. In particular, people who are responsible for setting the trend in trading volumes in the forex market are more likely to read specialized news rather than news in general.



Panel A Panel B

Figure 7. Daily Evolution of the Impulse Response Coefficient for ER Volatility (*panel A*) and ER Change (*panel B*) to Central Bank Messages

Note: This figure shows the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between publication day (0) and 30 days after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.1.

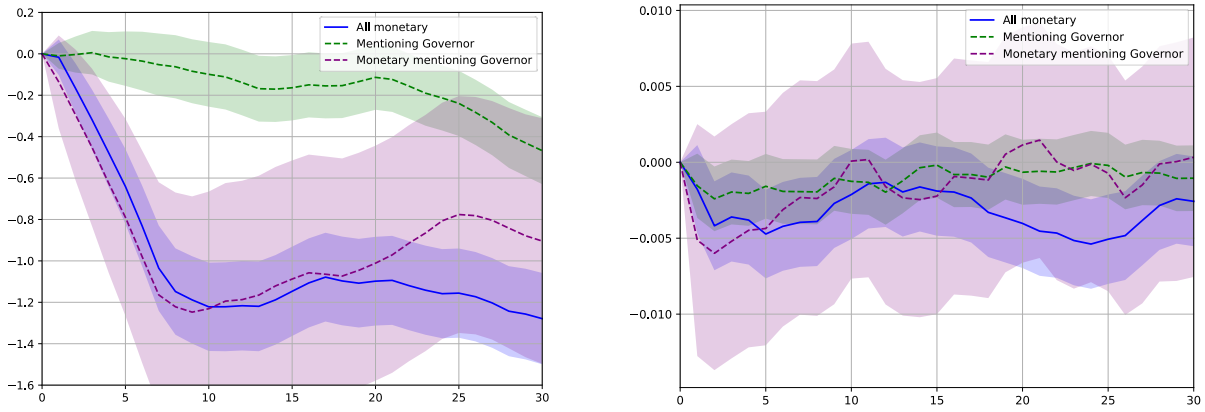
On the other hand, the effect on exchange rate changes is much smaller than for volatility, and not as significant. Within 3-5 days after publication, an increase of 1% in the number of news items (in logarithms) will only reduce the exchange rate by 0.002%, and monetary policy news by 0.004%. This may suggest that exchange rate changes are more dependent on market factors, while volatility is more often determined by behavioral factors. This could be interpreted as

increased transparency or effective communication by the central bank, leading to greater stability in exchange rates and reducing the impact of speculative or panic-driven behavior.

The study aims to identify patterns and properties of publications that may affect the impact of communications on macroeconomic indicators. These properties may include the content or the level of reader attention.

It was assumed that the central bank governor's authority and attention to specific events could affect the assessment's results. The publications were divided into two categories using a dictionary approach: those that mention the NBU governor's name and those that do not. The NBU website contains 762 messages that mention the governor, 74 of which are related to monetary policy.

Figure 8 demonstrates that, in general, references to the governor in NBU communications do not have an impact on volatility or exchange rate movements. However, if the governor is mentioned in monetary policy news, it is likely to enhance the smoothing effect on the FX market during the first week. It is important to note that the maximum effect on volatility is achieved several days earlier, which may indicate greater attention and trust in such messages. Meanwhile, the coefficients for monetary publications that mention the governor have a high degree of uncertainty. This uncertainty is due to the limited number of observations. Nevertheless, we believe that it is a good idea to mention the chairman in such publications for enhanced precision and impact. During periods of significant shocks, time can be important in offsetting the negative impact on the economy.



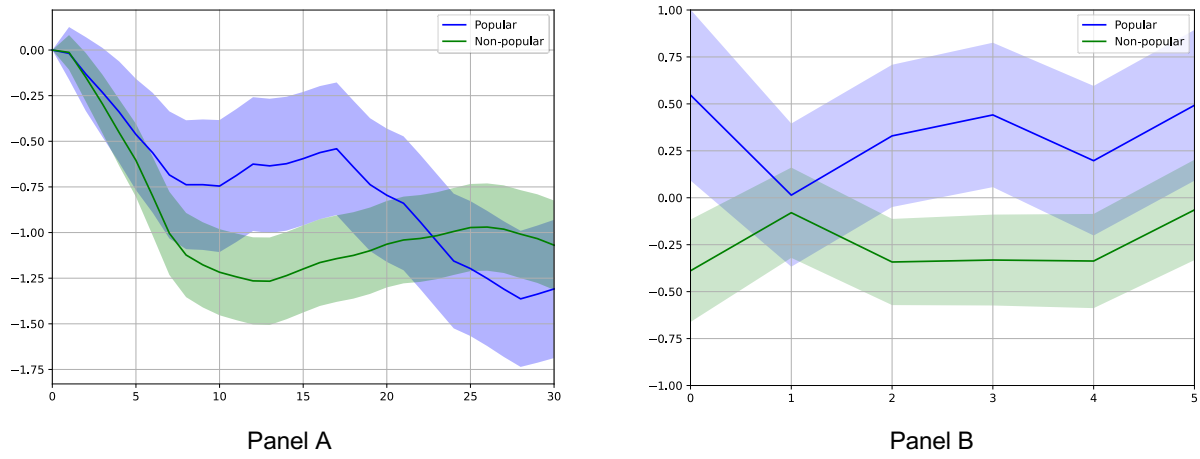
Panel A. ER volatility

Panel B. ER change

Figure 8. Daily Evolution of the Impulse Response Coefficient on CB Messages in Which the Governor is Mentioned or Not Mentioned

Note: *Panel A* shows the reaction of cash ER volatility and panel B shows the reaction of change in ER. These figures show the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between publication day (0) and 30 days after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.4.

The news has been divided into two categories based on the number of views, below and above the median, based on Google Analytics data. On average, monetary policy news is viewed less frequently (refer to Appendix A, figure A.7). It was discovered that news with a larger number of views had a lower impact on FX market volatility (figure 9, *panel A*). A 1% increase in the natural logarithm of the number of popular messages leads to only a 0.75% decrease in ER volatility in the first week. 1% more non-popular news converts to a 1.25% drop in volatility. This may be because monetary policy news, which as we have already noted is more likely to reduce volatility, receives fewer views.



Panel A Panel B

Figure 9. Evolution of the Impulse Response Coefficient to CB Messages by Popularity

Note: *Panel A* shows the reaction of cash ER volatility and *panel B* shows the reaction of inflation expectations. These figures show the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between publication day (0) and 30 days after the announcement or surveying month (0) and 5 months after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.5.

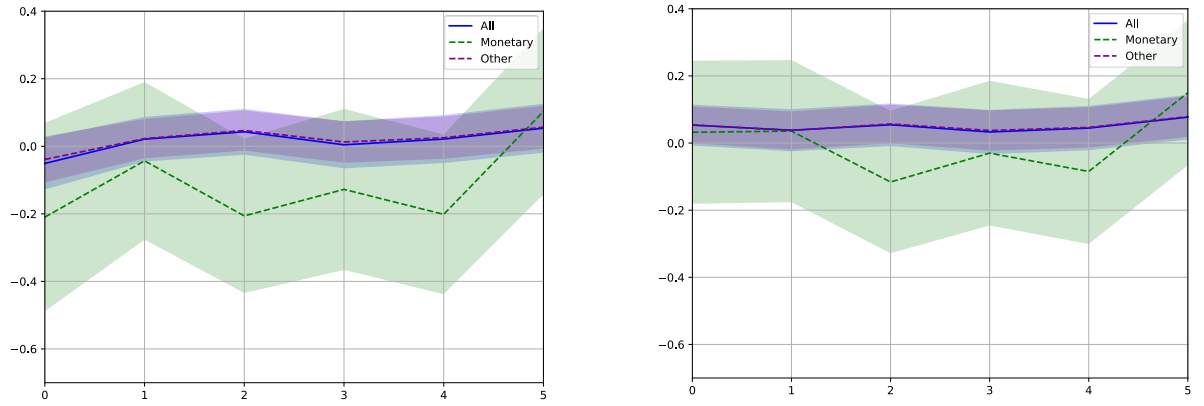
4.2. Effects on Other Indicators

Similarly, we calculated coefficients for impulse responses of data with a lower frequency, such as the inflation expectations of financial experts and deposit and loan rates.

Figure 10 displays the evolution of results for the impulse response coefficient θ_h from equation 1 on the inflation expectations of financial experts and its change. The lag parameter here h ranges from 0 to 5 observations (months). This way, we can check whether financial experts really take into account NBU information.

The inflation expectations of financial experts are largely unaffected by the general NBU publications on the website, as the coefficients are close to zero and insignificant. However,

monetary policy announcements seem to play a significant role in reducing these expectations. Specifically, a 1% increase in the natural logarithm of the number of monetary policy messages results in a 0.2% decrease in the inflation expectations of professional forecasters during the first four months. This highlights the peculiarities of professional analysts' approaches to making inflation forecasts. Professional forecasters heavily rely on the factors that determine inflation, particularly utility tariffs and exchange rates, according to Yukhymenko's (2022) research. Additionally, our findings indicate that professional analysts can differentiate the impact of various types of communication on their expectations. Meanwhile, the inflation expectations of professional forecasters tend to rise as the amount of popular or monetary policy news on the NBU website increases (figure 9, *panel B*). This suggests that financial analysts are discerning and more cautious in assessing the impact of headline news.



Panel A Panel B

Figure 10. Monthly Evolution of the Impulse Response Coefficient for Inflation Expectations (*panel A*) and Its Change (*panel B*) to Central Bank Messages

Note: Daily evolution of the impulse response coefficient for ER volatility and ER change to central bank messages: This figure shows the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between surveying month (0) and five months after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.2.

Figure 11 shows that central bank publications can influence interest rates on bank products. General publications have a short-term impact of only up to one month, while monetary policy publications can have a longer-lasting impact of up to three months. A 1% increase in the natural logarithm of the number of messages by CB is associated with a 0.1% decrease in deposit rates immediately, and for monetary publications a 0.2% decrease in three months. This is quite logical, as monetary policy publications often contain a key policy rate forecast or forward guidance on future monetary conditions. The patterns of impulse response coefficients for deposit and lending rates are similar, as these indicators are interconnected.

Household lending rates exhibit a reverse trend, while monetary policy announcements tend to increase rates within the first month of their publication. A 1% increase in the natural logarithm of

the number of monetary policy messages by CB is associated with a 0.4% increase in loan rates However, this effect is completely offset over time (figure 12).

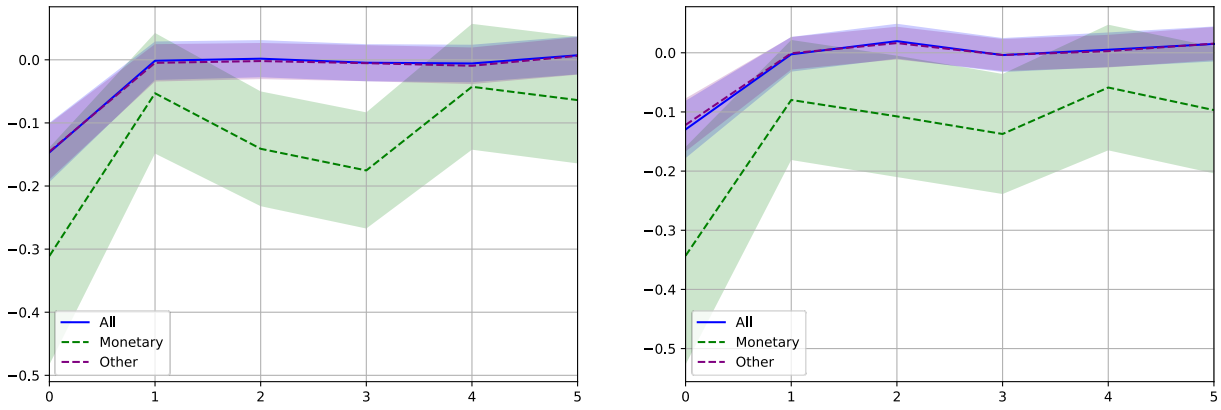


Figure 11. Monthly Evolution of the Impulse Response Coefficient for Interest Rates to Central Bank Messages

Note: *Panel A* shows the reaction of deposit rates and *panel B* shows the reaction of loan rates. These figures show the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between surveying month (0) and five months after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.3.

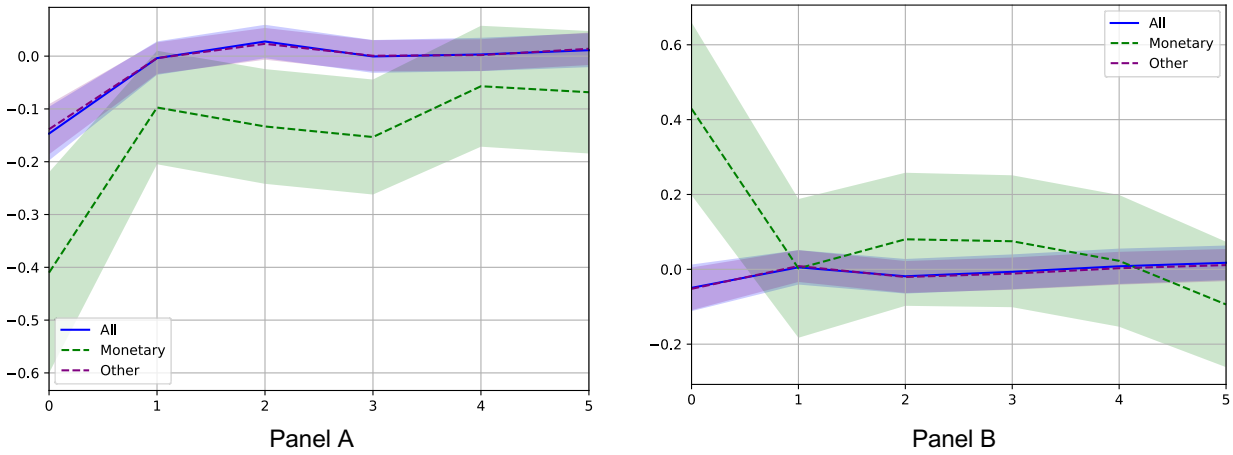


Figure 12. Monthly Evolution of the Impulse Response Coefficient for the Lending Rates to Central Bank Messages

Note: *Panel A* shows the reaction of lending rates for non-financial corporations and *panel B* shows the reaction of lending rates for households. These figures show the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between the observed month (0) and five months after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.3.

We also investigated the impact of NBU on non-financial indicators such as general opinion on social networks. Figure 13 shows a positive correlation between NBU communications and the overall index of NBU perceptions on Twitter. Specifically, a 1% increase in the natural logarithm of the number of messages by the CB is associated with a 0.02% increase in overall Twitter sentiments. Publications on monetary policy have an even greater effect, as they are associated with a 0.1% increase in Twitter sentiments in three weeks. That is, the NBU's communications on monetary policy can improve social media sentiment concerning the institution. This suggests that social media may act as a transmission channel for information from the central bank to financial markets, including the foreign exchange market.

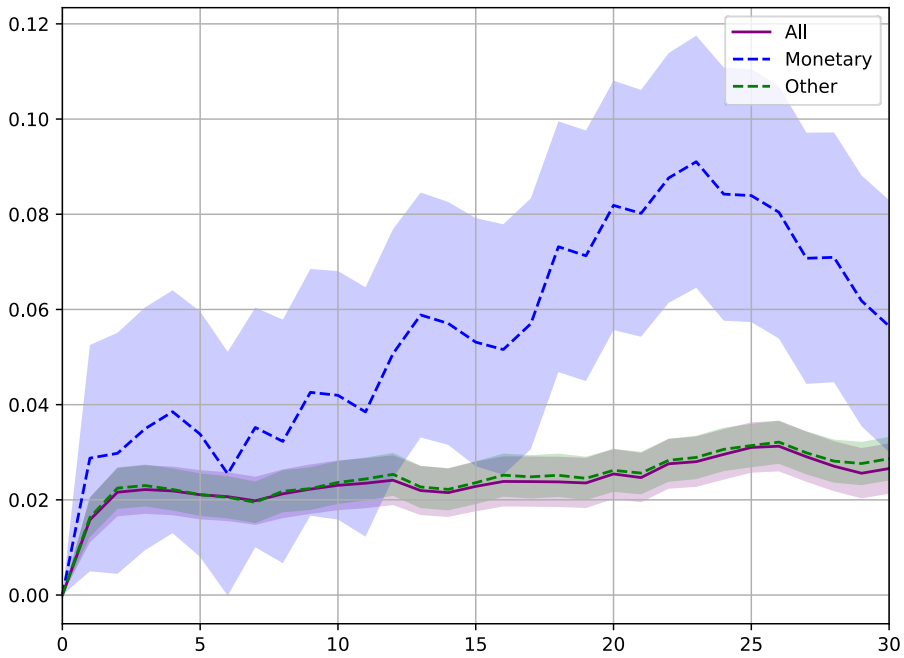


Figure 13. Daily Evolution of the Impulse Response Coefficient Twitter (X) Sentiments to CB Messages

Note: This figure shows the results of estimating the sentiment coefficient θ from equation 1 for the time shift h varying between publication day (0) and 30 days after the announcement. The y axis is the response to a number of publications (in logs). The x axis is the time shift parameter. The dotted lines, as well as the shaded fields, show the 95% confidence interval. The dark-solid line represents the coefficients for all publications, the light-dotted line represents the coefficients for monetary publications, and the dark-dotted line represents the coefficients for monetary publications. The estimates of the coefficients can be seen in Appendix C.6.

5. Discussion and Conclusions

This study examines the impact of central bank communications, specifically those published on the NBU website, on a range of macro-financial indicators. Local projections, a method that captures both short-term and long-term effects, were used to identify nuanced patterns in the impact of central bank communications on various indicators. The study shows a clear correlation between NBU's statements and press releases on monetary policy issues and the behavior of the FX market, as well as the inflation expectations of financial experts. The negative correlation between exchange rate movements, volatility, and the volume of NBU publications suggests that

an increase in the central bank's communication activity is associated with a decrease in FX market volatility. Notably, monetary policy announcements have a more pronounced impact compared to overall publications, resulting in a larger decrease in FX volatility within 7-10 days.

The analysis showed that while exchange rate changes are minimally affected in the short term, volatility experiences a more substantial reduction. We also examined the role of specific communication characteristics, such as references to the governor and message popularity, on macro-financial outcomes. Emphasizing the importance of key figures in central bank communications, mentioning the governor in monetary policy news was found to enhance the smoothing effect on the FX market. In particular, the effect of such messages seems to be faster.

Additionally, our study examined the effects of NBU communications on indicators beyond the FX market, including inflation expectations and interest rates on deposits and loans. We found that monetary policy announcements play a significant role in reducing inflation expectations, underscoring the importance of communications in shaping professional analysts' forecasts. The study found that Twitter, in particular, can serve as a transmission channel for information from the central bank to financial markets, as indicated by the positive correlation between NBU communications and overall Twitter sentiments. Taken together, our research provides valuable insights into the complex relationship between central bank communications and macroeconomic outcomes.

Our research not only confirms the results of previous studies that communication is important and can influence the behavior of financial market participants, but also provides empirical insights into the complex relationship between central bank communications and macro-financial indicators dynamics. The implications of our findings are significant for policymakers and financial market participants. Policymakers can strategically shape and disseminate communications, especially those related to monetary policy, to mitigate currency market fluctuations. This is especially important in times of crisis or other shocks, when it is necessary to react quickly and accurately. The importance of clear and targeted messaging is underscored by the differential influence of communication themes on inflation expectations, with monetary policy announcements playing a pivotal role. Practical measures to enhance the effectiveness of NBU communications include the more frequent publication of monetary policy news early in the week, and incorporating references to the governor in messages. These recommendations aim to improve the precision and impact of central bank communications.

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APPENDICES

Appendix A. Google Analytics

Before the full-scale invasion, page views rarely exceeded 200K per month. However, in February 2022, the uncertainty and open communication policy of the NBU prompted people to visit the site more often. In addition, a significant share of the views were collected by two pages "*Special Account*" and "*Special Account for Humanitarian Aid*" containing account details to support the Armed Forces of Ukraine and humanitarian aid to Ukrainians. In the 311 days from the launch of this page until the end of 2022, it was viewed almost 11 million times, which is about 43% of all views of the NBU website over nine years.

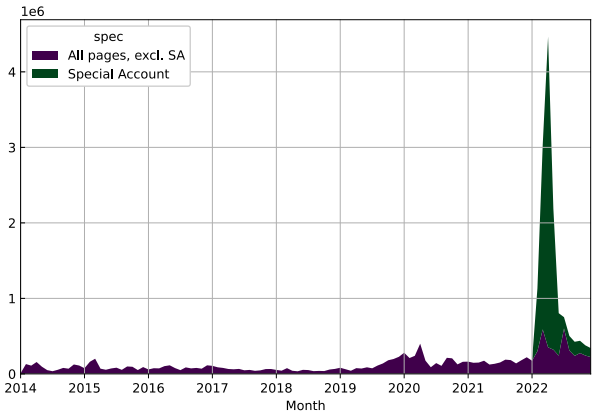

Figure A.1. Total Number of Views per Month, millions

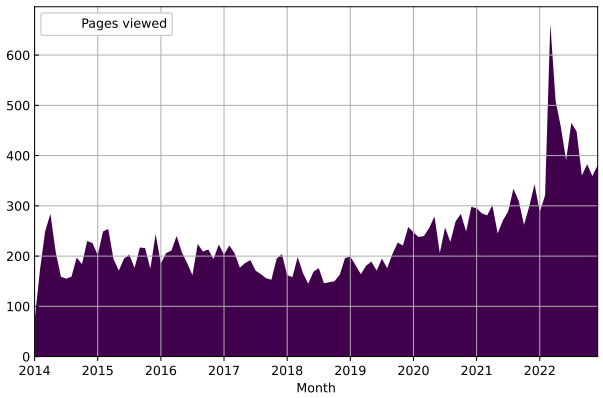

Figure A.2. Pages Viewed per Month

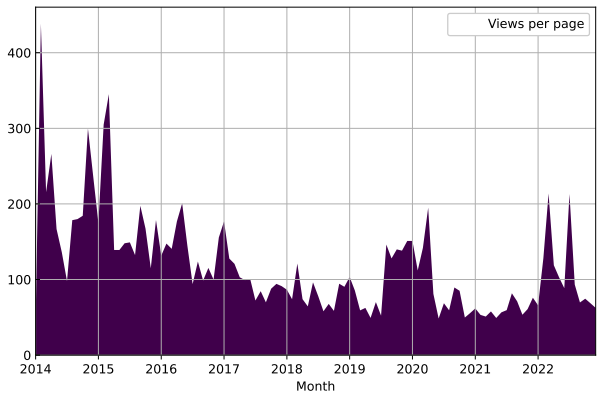

Figure A.3. Average Page Views per Month (excl. Special Account Page)

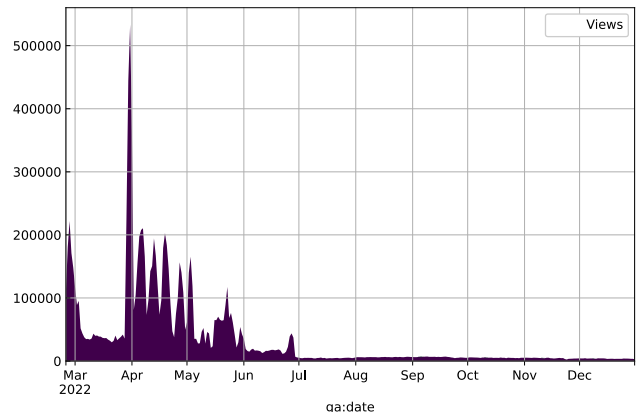

Figure A.4. Views of Special Account Page per Day

Views of the NBU's pages are expected to be highest in the first days after publication on the website. Interestingly, on average, the next day after the publication there is a significant increase in views compared to the first day. However, this is explained by 39% of articles whose views are significantly shifted to the next day. Among other things, this can be explained by the time of publication during the day – evening news is likely to be viewed more the next day. Unfortunately, the exact date and time of publication is not available for most articles, so the issue of the exact time will not be considered in this study. Therefore, the study will be based on daily data.

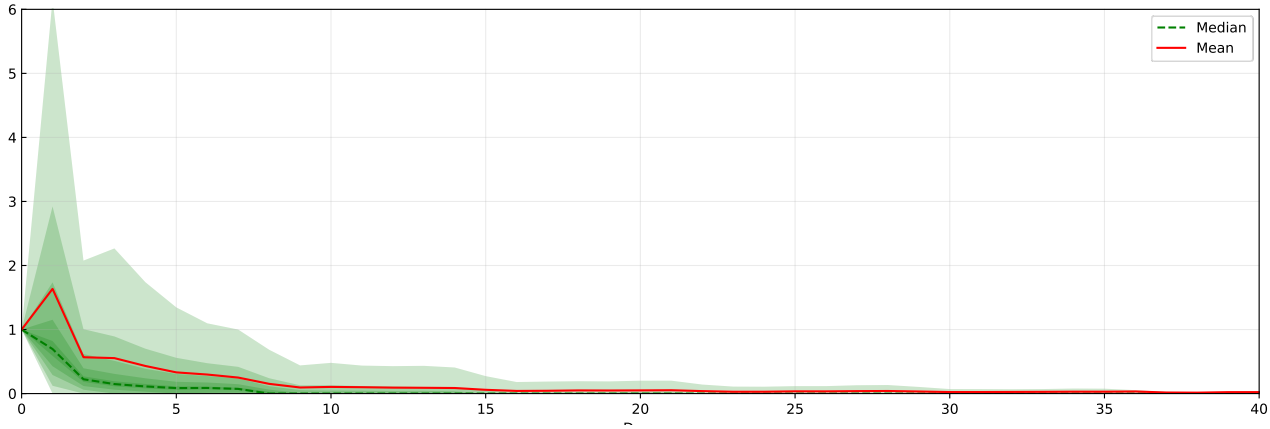

Figure A.5. Average Interest on Pages by Days (publication day = 1)

Page views largely depend on the day of the week. First, on weekends, the NBU website published much less news. Second, the number of visitors on weekends drops sharply.

We looked at the difference between the trajectory of views of all news on the NBU website and news related to monetary policy only. On average, monetary policy news is viewed less frequently, and views drop sharply two days after publication. This can be explained by the fact that very often monetary policy news is published on Thursday, in conjunction with meetings of the monetary policy committee and the announcement of decisions. As shown in figure A.6, on weekends, views are much lower for all news.

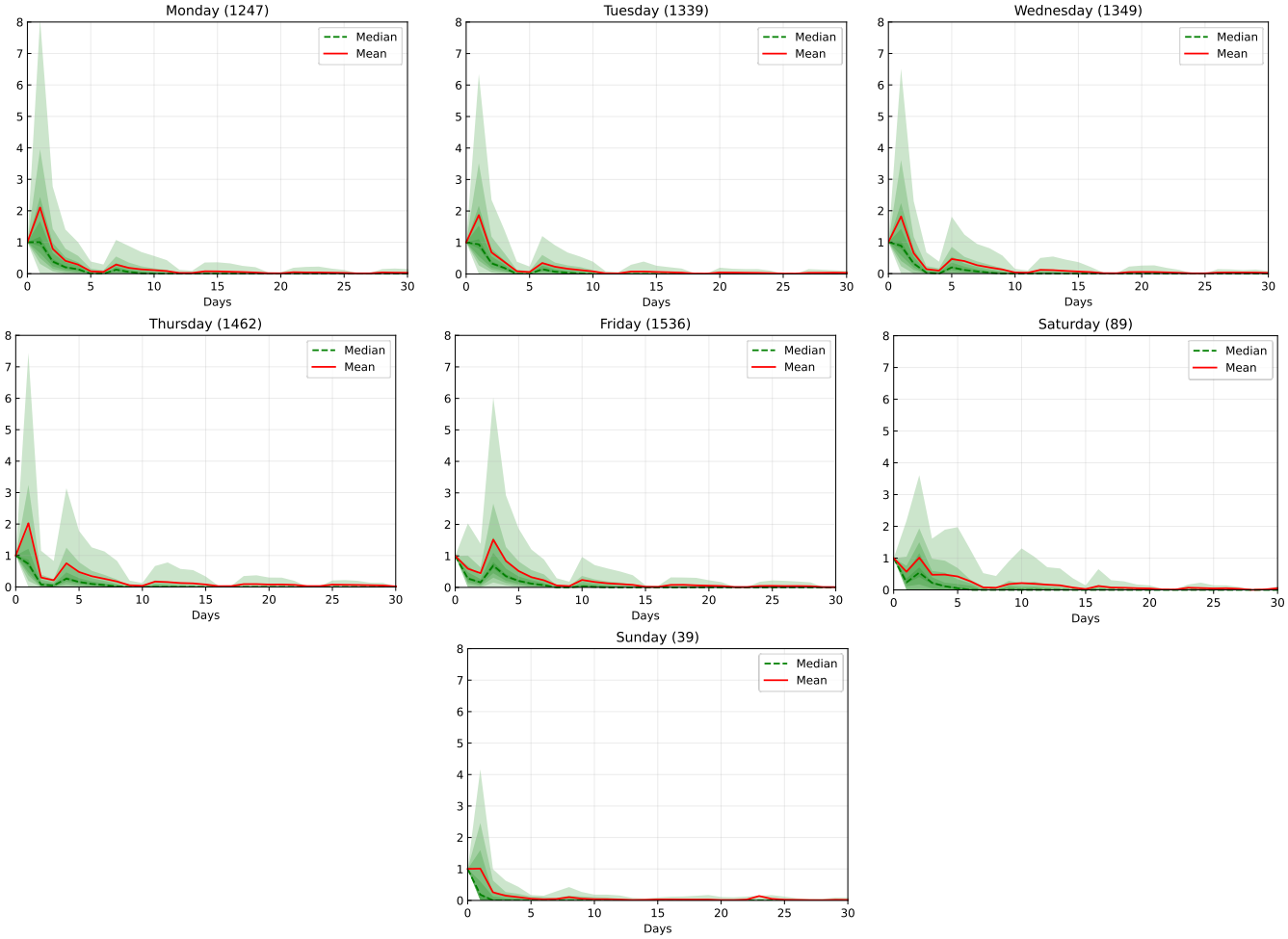

Figure A.6. Average Interest in Pages by Days (publication day = 1) Depending on Day of the Week when the News was Published (number of published news in parentheses)

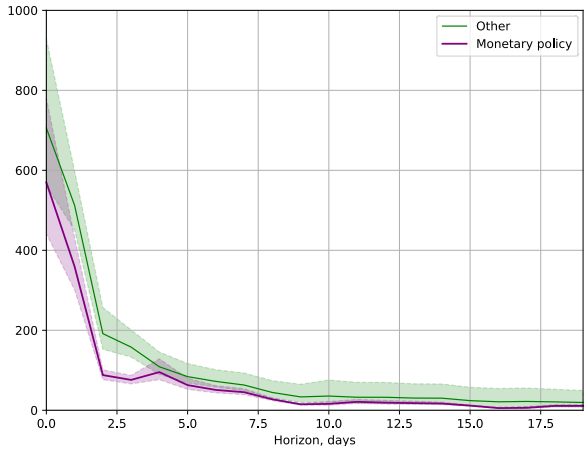

Figure A.7. Average Interest in Pages by topic, views per page

Appendix B. What the NBU Says

Some keywords are very similar and occur for the same news, so we have combined them into groups (for example, monetary policy and monetary policy decisions). Nevertheless, there are significant interconnections between different topics, as shown in figure 9.

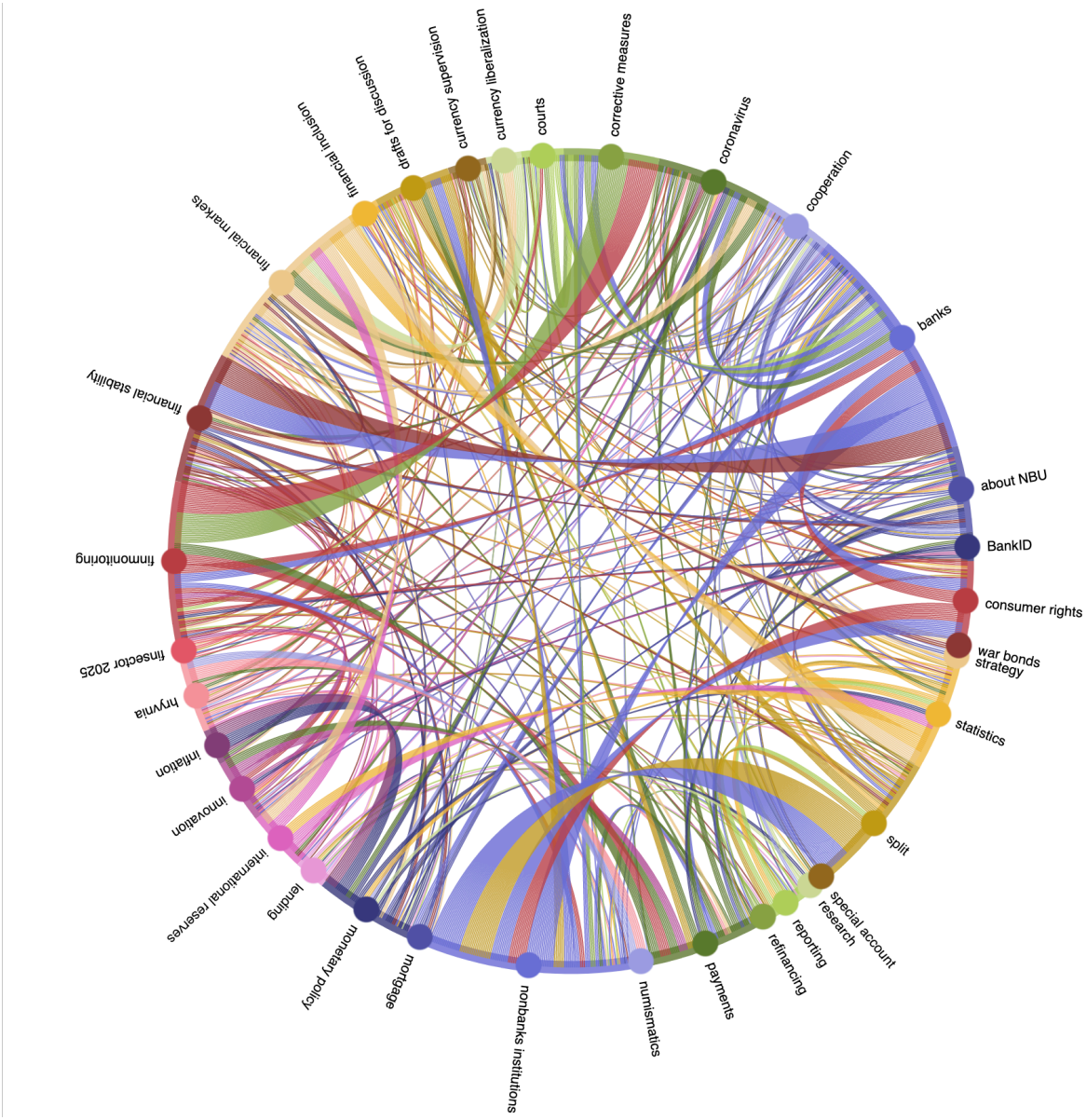

Figure B.1. Chord Diagram for Keyword Interlinks between News on the NBU Website (width of the lines corresponds to the number of shared news items). An interactive version of this diagram can be downloaded here: https://github.com/taniaghub/CB_communications/blob/main/Figure_B1.html.

If central bank communications are written in complex and convoluted language, it might lead to confusion or misinterpretation. A clear and readable communication style can help prevent confusion and ensure that the central bank's policy messages are accurately received and acted

upon. Readability indicators can help central banks assess whether their communications are clear and accessible to a wide range of audiences, including the general public, investors, policymakers, and journalists, and identify opportunities to improve the clarity and transparency of their communications. In essence, readability indicators help central banks bridge the gap between their technical expertise and the broader public's understanding. A reading ease indicator is a measure used to assess the readability of a written text. It aims to quantify how easy or difficult a piece of writing is to understand for its intended audience. The indicator provides a numerical score that reflects the complexity of the language, sentence structure, and vocabulary used in the text.

One of the most well-known readability indicators is the Flesch Reading Ease formula, which was developed by Rudolf Flesch in 1948. The formula takes into account the average number of words per sentence and the average number of syllables per word in a text to calculate a readability score. The higher the score, the easier the text is to understand. This indicator has been developed for the English language, but with amendments can be applied to other languages, including Ukrainian (Cherednichenko, 2021).

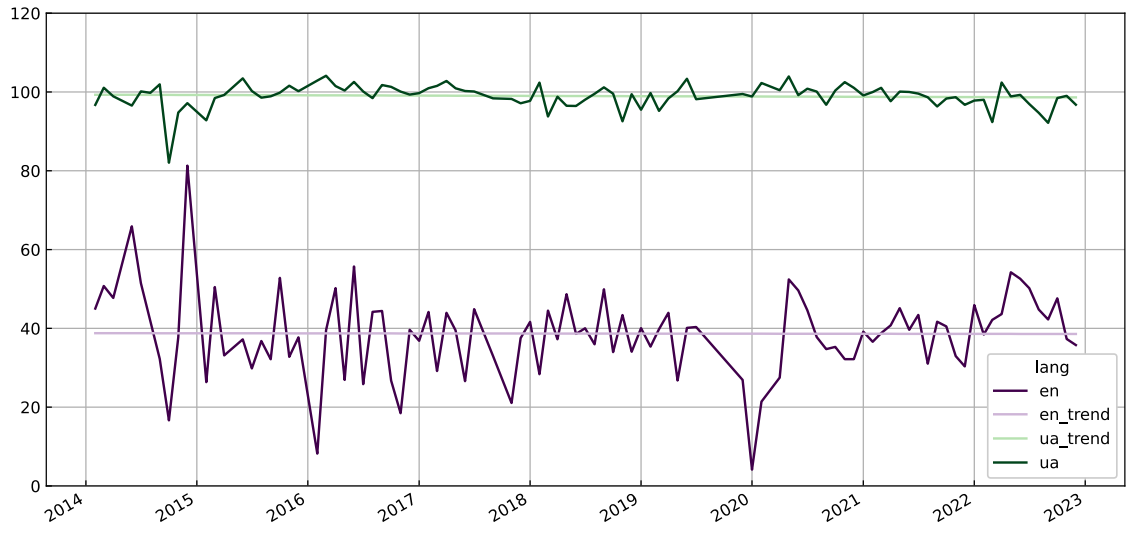

Figure B.2. Flesch Reading Ease Indicator for NBU News

Interestingly, over time, the texts in Ukrainian on the NBU's website have become more complex. This can be explained by the widening of the topics of publications, the acceleration of the central bank's response, and the expected improvement in the perception of information by stakeholders due to increased financial literacy. However, this should be a signal to the NBU to simplify the texts for greater coverage and better understanding by the public.

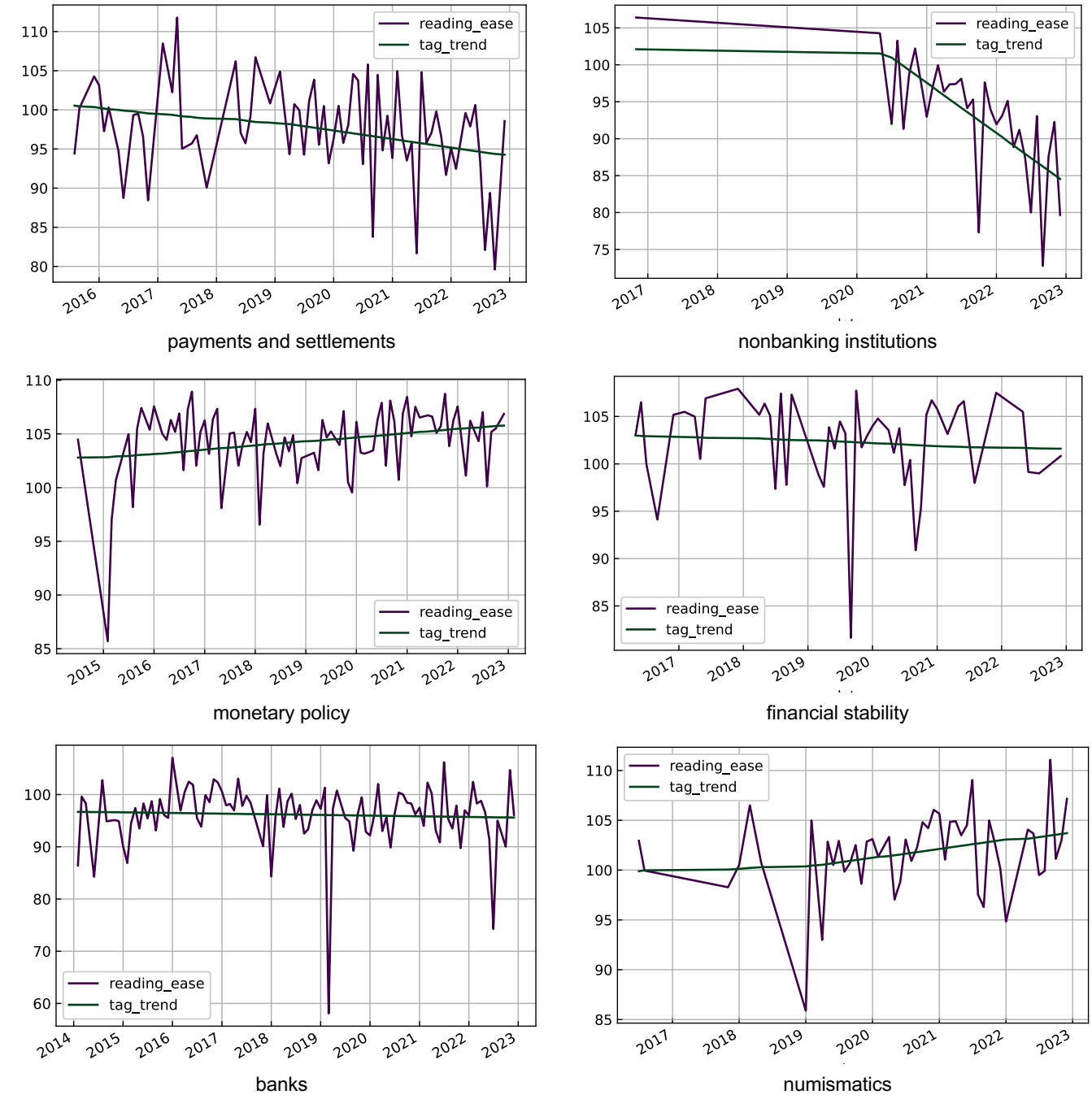

Figure B.3. Flesch Index for the Most Popular Topics on the NBU Website in Ukrainian

Appendix C. Impulse Responses by Local Projections

Table C1.A. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Cash Volatility

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total publications																															
publications	0.000***	-0.042**	-0.098***	-0.159***	-0.216***	-0.270***	-0.328***	-0.381***	-0.394***	-0.392***	-0.387***	-0.387***	-0.392***	-0.399***	-0.398***	-0.403***	-0.411***	-0.418***	-0.433***	-0.442***	-0.449***	-0.464***	-0.485***	-0.504***	-0.533***	-0.552***	-0.582***	-0.616***	-0.654***	-0.687***	-0.723***
p-value	(0.000)	(0.037)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash_volatility	1.000***	0.928***	0.852***	0.775***	0.696***	0.616***	0.529***	0.439***	0.413***	0.389***	0.365***	0.350***	0.335***	0.327***	0.336***	0.345***	0.352***	0.361***	0.363***	0.365***	0.366***	0.359***	0.356***	0.355***	0.354***	0.350***	0.345***	0.335***	0.324***	0.303***	0.282***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.733	0.613	0.501	0.399	0.304	0.220	0.199	0.179	0.159	0.148	0.138	0.133	0.139	0.146	0.152	0.160	0.163	0.165	0.167	0.163	0.164	0.165	0.168	0.168	0.169	0.166	0.164	0.156	0.149
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	3256
Monetary publications																															
publications	0.000	-0.017	-0.166**	-0.319***	-0.479***	-0.641***	-0.831***	-1.035***	-1.148***	-1.188***	-1.222***	-1.221***	-1.217***	-1.219***	-1.188***	-1.147***	-1.106***	-1.078***	-1.097***	-1.108***	-1.098***	-1.094***	-1.119***	-1.142***	-1.158***	-1.156***	-1.173***	-1.203***	-1.243***	-1.257***	-1.279***
p-value	(0.351)	(0.750)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash_volatility	1.000***	0.929***	0.853***	0.776***	0.697***	0.616***	0.528***	0.437***	0.409***	0.385***	0.361***	0.345***	0.331***	0.323***	0.332***	0.341***	0.350***	0.360***	0.362***	0.364***	0.365***	0.359***	0.356***	0.355***	0.355***	0.352***	0.348***	0.338***	0.328***	0.308***	0.288***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.733	0.612	0.499	0.398	0.303	0.221	0.202	0.184	0.166	0.155	0.144	0.139	0.144	0.149	0.153	0.159	0.161	0.163	0.164	0.159	0.158	0.158	0.159	0.157	0.154	0.149	0.143	0.131	0.119
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	3256
Other publications																															
publications	0.000***	-0.045**	-0.090***	-0.137***	-0.179***	-0.220***	-0.261***	-0.297***	-0.299***	-0.296***	-0.288***	-0.287***	-0.293***	-0.302***	-0.305***	-0.312***	-0.322***	-0.330***	-0.347***	-0.358***	-0.369***	-0.387***	-0.409***	-0.430***	-0.459***	-0.477***	-0.502***	-0.529***	-0.557***	-0.585***	-0.614***
p-value	(0.000)	(0.016)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash_volatility	1.000***	0.928***	0.853***	0.776***	0.698***	0.618***	0.532***	0.442***	0.417***	0.393***	0.369***	0.354***	0.339***	0.331***	0.340***	0.348***	0.356***	0.365***	0.367***	0.369***	0.369***	0.362***	0.359***	0.358***	0.357***	0.354***	0.349***	0.339***	0.328***	0.308***	0.287***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.733	0.612	0.500	0.397	0.301	0.215	0.193	0.173	0.154	0.142	0.132	0.128	0.134	0.141	0.147	0.155	0.158	0.160	0.162	0.159	0.159	0.161	0.164	0.164	0.164	0.161	0.157	0.148	0.139
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	3256

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C1.B. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Cash Volatility

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total publications																																
publications		0.000*	-0.002**	-0.002***	-0.002***	-0.002***	-0.002***	-0.002**	-0.001*	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	-0.001	-0.001	-0.001*	-0.001*	-0.002**	-0.002**	-0.002***	-0.002***	-0.002***	-0.002***	-0.002**	-0.002***	-0.002***
p-value		(0.066)	(0.014)	(0.000)	(0.001)	(0.004)	(0.004)	(0.027)	(0.093)	(0.175)	(0.368)	(0.329)	(0.442)	(0.199)	(0.250)	(0.317)	(0.273)	(0.185)	(0.472)	(0.130)	(0.169)	(0.066)	(0.080)	(0.021)	(0.028)	(0.005)	(0.006)	(0.001)	(0.010)	(0.013)	(0.004)	(0.003)
ER change		1.000***	0.126***	-0.059***	0.002	0.049***	-0.090***	0.083***	0.059***	-0.038**	-0.057***	0.053***	-0.001	-0.025	0.066***	0.078***	-0.010	-0.026	0.089***	0.028	-0.017	-0.084***	0.071***	0.026	0.000	-0.059***	-0.071***	-0.141***	0.028	0.143***	0.009	-0.017
p-value		(0.000)	(0.000)	(0.001)	(0.929)	(0.005)	(0.000)	(0.000)	(0.001)	(0.031)	(0.001)	(0.002)	(0.973)	(0.149)	(0.000)	(0.000)	(0.574)	(0.141)	(0.000)	(0.112)	(0.327)	(0.000)	(0.000)	(0.131)	(0.983)	(0.001)	(0.000)	(0.000)	(0.114)	(0.000)	(0.616)	(0.326)
R squared		1.000	0.018	0.007	0.003	0.005	0.010	0.009	0.005	0.002	0.003	0.003	0.000	0.001	0.005	0.006	0.000	0.001	0.008	0.002	0.001	0.008	0.006	0.002	0.001	0.006	0.007	0.022	0.003	0.023	0.003	0.003
Sample size		3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	3256
Monetary publications																																
publications		0.000	-0.002	-0.004**	-0.004**	-0.004**	-0.005***	-0.004**	-0.004**	-0.004**	-0.003	-0.002	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002	-0.002	-0.003*	-0.004**	-0.004**	-0.005**	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.004**	-0.003	-0.002	-0.003
p-value		(0.226)	(0.315)	(0.019)	(0.044)	(0.033)	(0.008)	(0.018)	(0.027)	(0.029)	(0.129)	(0.234)	(0.428)	(0.460)	(0.273)	(0.362)	(0.289)	(0.273)	(0.187)	(0.065)	(0.041)	(0.024)	(0.011)	(0.009)	(0.004)	(0.003)	(0.005)	(0.007)	(0.033)	(0.110)	(0.181)	(0.153)
ER change		1.000***	0.127***	-0.058***	0.003	0.050***	-0.090***	0.084***	0.060***	-0.038**	-0.057***	0.053***	0.000	-0.025	0.066***	0.078***	-0.010	-0.025	0.089***	0.028	-0.017	-0.084***	0.071***	0.027	0.001	-0.058***	-0.070***	-0.140***	0.028	0.144***	0.010	-0.016
p-value		(0.000)	(0.000)	(0.001)	(0.869)	(0.004)	(0.000)	(0.000)	(0.001)	(0.031)	(0.001)	(0.002)	(0.982)	(0.157)	(0.000)	(0.000)	(0.585)	(0.147)	(0.000)	(0.109)	(0.329)	(0.000)	(0.000)	(0.124)	(0.970)	(0.001)	(0.000)	(0.000)	(0.104)	(0.000)	(0.566)	(0.365)
R squared		1.000	0.017	0.005	0.001	0.004	0.010	0.009	0.005	0.003	0.004	0.003	0.000	0.001	0.005	0.006	0.000	0.001	0.009	0.002	0.002	0.008	0.007	0.003	0.003	0.006	0.007	0.022	0.002	0.022	0.001	0.001
Sample size		3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	3256
Other publications																																
publications		0.000**	-0.002**	-0.002***	-0.002***	-0.002**	-0.001**	-0.001	-0.001	-0.001	0.000	0.000	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	-0.001	-0.001	-0.001	-0.001	-0.001*	-0.001*	-0.001**	-0.001**	-0.002***	-0.001**	-0.001**	-0.002***	-0.002***
p-value		(0.012)	(0.011)	(0.001)	(0.003)	(0.017)	(0.020)	(0.109)	(0.259)	(0.354)	(0.576)	(0.502)	(0.580)	(0.198)	(0.255)	(0.284)	(0.271)	(0.197)	(0.527)	(0.147)	(0.205)	(0.107)	(0.203)	(0.067)	(0.084)	(0.020)	(0.022)	(0.005)	(0.027)	(0.030)	(0.007)	(0.004)
ER change		1.000***	0.126***	-0.059***	0.002	0.050***	-0.090***	0.083***	0.060***	-0.038**	-0.057***	0.053***	0.000	-0.025	0.066***	0.078***	-0.010	-0.026	0.089***	0.028	-0.017	-0.084***	0.071***	0.027	0.001	-0.059***	-0.071***	-0.141***	0.028	0.143***	0.009	-0.017
p-value		(0.000)	(0.000)	(0.001)	(0.928)	(0.005)	(0.000)	(0.000)	(0.001)	(0.032)	(0.001)	(0.002)	(0.978)	(0.147)	(0.000)	(0.000)	(0.572)	(0.140)	(0.000)	(0.113)	(0.327)	(0.000)	(0.000)	(0.128)	(0.974)	(0.001)	(0.000)	(0.000)	(0.113)	(0.000)	(0.619)	(0.323)
R squared		1.000	0.018	0.007	0.003	0.004	0.009	0.008	0.004	0.002	0.003	0.003	0.000	0.001	0.005	0.007	0.000	0.001	0.008	0.001	0.001	0.008	0.006	0.002	0.001	0.005	0.006	0.022	0.002	0.022	0.002	0.003
Sample size		3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	3256

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C2. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Inflation Expectations

	Panel A. Inflation expectations						Panel B. Change in inflation expectations					
	0	1	2	3	4	5	0	1	2	3	4	5
Total publications												
total_publications	-0.051	0.021	0.043	0.004	0.021	0.054	0.053	0.038	0.054	0.033	0.045	0.077*
p-value	(0.277)	(0.598)	(0.297)	(0.917)	(0.618)	(0.224)	(0.147)	(0.315)	(0.157)	(0.408)	(0.265)	(0.057)
IE	0.836***	0.957***	0.971***	0.949***	0.958***	0.974***	-0.089	-0.088	-0.087	-0.085	-0.086	-0.105
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.424)	(0.437)	(0.439)	(0.460)	(0.453)	(0.357)
R squared	0.739	0.829	0.831	0.828	0.829	0.831	0.031	0.018	0.030	0.014	0.022	0.053
Sample size	86	85	84	83	82	81	84	83	82	81	80	79
Monetary publications												
monetary_publications	-0.210	-0.043	-0.206	-0.128	-0.202	0.103	0.032	0.036	-0.116	-0.030	-0.085	0.150
p-value	(0.215)	(0.760)	(0.137)	(0.376)	(0.160)	(0.487)	(0.802)	(0.781)	(0.366)	(0.817)	(0.516)	(0.252)
IE	0.826***	0.938***	0.912***	0.924***	0.910***	0.963***	-0.068	-0.074	-0.071	-0.076	-0.077	-0.073
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.550)	(0.512)	(0.532)	(0.511)	(0.500)	(0.524)
R squared	0.740	0.829	0.833	0.830	0.832	0.829	0.006	0.006	0.016	0.006	0.011	0.024
Sample size	86	85	84	83	82	81	84	83	82	81	80	79
Other publications												
other_publications	-0.039	0.023	0.047	0.013	0.025	0.057	0.054	0.037	0.057	0.038	0.047	0.079**
p-value	(0.343)	(0.517)	(0.195)	(0.731)	(0.503)	(0.143)	(0.104)	(0.276)	(0.103)	(0.301)	(0.202)	(0.033)
IE	0.842***	0.958***	0.973***	0.954***	0.960***	0.975***	-0.097	-0.091	-0.090	-0.091	-0.090	-0.111
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.387)	(0.422)	(0.422)	(0.430)	(0.432)	(0.327)
R squared	0.738	0.829	0.832	0.828	0.829	0.832	0.037	0.020	0.039	0.019	0.027	0.065
Sample size	86	85	84	83	82	81	84	83	82	81	80	79

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C3. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Interest Rates

	Deposits						Loans						Loans NFC						Loans HH					
	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5
Total publications																								
publications	-0.133***	-0.003	0.001	-0.005	-0.007	0.007	-0.130***	-0.003	0.020	-0.004	0.005	0.015	-0.147***	-0.004	0.028	-0.001	0.003	0.011	-0.050	0.005	-0.019	-0.007	0.008	0.017
p-value	(0.000)	(0.834)	(0.964)	(0.776)	(0.671)	(0.683)	(0.000)	(0.885)	(0.272)	(0.825)	(0.772)	(0.406)	(0.000)	(0.843)	(0.150)	(0.974)	(0.868)	(0.563)	(0.190)	(0.849)	(0.507)	(0.813)	(0.776)	(0.531)
rates	0.748***	0.957***	0.970***	0.963***	0.960***	0.973***	0.662***	0.954***	0.971***	0.959***	0.965***	0.972***	0.750***	0.967***	0.990***	0.973***	0.975***	0.981***	0.398***	0.785***	0.786***	0.780***	0.780***	0.765***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	0.825	0.942	0.945	0.945	0.944	0.943	0.688	0.903	0.904	0.907	0.908	0.909	0.803	0.937	0.938	0.939	0.939	0.939	0.321	0.618	0.620	0.617	0.614	0.622
Sample size	107	106	105	104	103	102	107	106	105	104	103	102	107	106	105	104	103	102	107	106	105	104	103	102
Monetary publications																								
publications	-0.285***	-0.055	-0.130***	-0.162***	-0.051	-0.053	-0.343***	-0.080	-0.107*	-0.137**	-0.059	-0.097	-0.410***	-0.097	-0.133**	-0.153**	-0.057	-0.068	0.429***	0.002	0.080	0.075	0.023	-0.094
p-value	(0.003)	(0.281)	(0.009)	(0.001)	(0.345)	(0.329)	(0.003)	(0.195)	(0.085)	(0.027)	(0.361)	(0.136)	(0.001)	(0.136)	(0.044)	(0.022)	(0.411)	(0.330)	(0.003)	(0.982)	(0.456)	(0.481)	(0.832)	(0.354)
rates	0.814***	0.951***	0.945***	0.934***	0.955***	0.953***	0.675***	0.944***	0.938***	0.934***	0.948***	0.939***	0.774***	0.955***	0.947***	0.945***	0.961***	0.959***	0.312***	0.785***	0.768***	0.766***	0.776***	0.778***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	0.797	0.943	0.948	0.950	0.944	0.944	0.660	0.904	0.905	0.912	0.908	0.910	0.786	0.938	0.939	0.942	0.939	0.940	0.368	0.618	0.620	0.618	0.614	0.624
Sample size	107	106	105	104	103	102	107	106	105	104	103	102	107	106	105	104	103	102	107	106	105	104	103	102
Other publications																								
publications	-0.133***	-0.006	-0.003	-0.005	-0.010	0.006	-0.122***	-0.001	0.016	-0.004	0.003	0.016	-0.138***	-0.004	0.023	0.001	0.002	0.014	-0.052	0.009	-0.021	-0.011	0.003	0.011
p-value	(0.000)	(0.696)	(0.872)	(0.737)	(0.530)	(0.734)	(0.000)	(0.962)	(0.327)	(0.817)	(0.870)	(0.359)	(0.000)	(0.833)	(0.202)	(0.968)	(0.913)	(0.454)	(0.132)	(0.733)	(0.426)	(0.660)	(0.913)	(0.663)
rates	0.727***	0.953***	0.966***	0.961***	0.955***	0.973***	0.653***	0.956***	0.971***	0.958***	0.963***	0.975***	0.741***	0.967***	0.990***	0.974***	0.975***	0.985***	0.399***	0.786***	0.785***	0.780***	0.780***	0.766***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	0.829	0.942	0.945	0.945	0.944	0.943	0.689	0.903	0.903	0.907	0.908	0.909	0.804	0.937	0.938	0.939	0.939	0.939	0.325	0.618	0.620	0.617	0.613	0.621
Sample size	107	106	105	104	103	102	107	106	105	104	103	102	107	106	105	104	103	102	107	106	105	104	103	102

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C4.A. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Cash ER Volatility Depending on Governor Mentions in Text

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Monetary publications																														
publications	0.000	-0.017	-0.166**	-0.319***	-0.479***	-0.641***	-0.831***	-1.035***	-1.148***	-1.188***	-1.222***	-1.221***	-1.217***	-1.219***	-1.188***	-1.147***	-1.106***	-1.078***	-1.097***	-1.108***	-1.098***	-1.094***	-1.119***	-1.142***	-1.158***	-1.156***	-1.173***	-1.203***	-1.243***	-1.257***
p-value	(0.351)	(0.750)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ER volatility	1.000***	0.929***	0.853***	0.776***	0.697***	0.616***	0.528***	0.437***	0.409***	0.385***	0.361***	0.345***	0.331***	0.323***	0.332***	0.341***	0.350***	0.360***	0.362***	0.364***	0.365***	0.359***	0.356***	0.355***	0.355***	0.352***	0.348***	0.338***	0.328***	0.308***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.733	0.612	0.499	0.398	0.303	0.221	0.202	0.184	0.166	0.155	0.144	0.139	0.144	0.149	0.153	0.159	0.161	0.163	0.164	0.159	0.158	0.158	0.159	0.157	0.154	0.149	0.143	0.131
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257
Governor publications																														
publications	0.000**	-0.010	-0.003	0.006	-0.015	-0.023	-0.035	-0.052	-0.062	-0.084	-0.099	-0.112	-0.139	-0.168*	-0.171*	-0.164*	-0.150	-0.155	-0.154	-0.134	-0.114	-0.123	-0.156	-0.190**	-0.213**	-0.239**	-0.283***	-0.331***	-0.392***	-0.430***
p-value	(0.020)	(0.794)	(0.948)	(0.931)	(0.839)	(0.771)	(0.684)	(0.567)	(0.501)	(0.371)	(0.297)	(0.243)	(0.150)	(0.082)	(0.077)	(0.088)	(0.118)	(0.104)	(0.107)	(0.159)	(0.233)	(0.196)	(0.103)	(0.047)	(0.026)	(0.012)	(0.003)	(0.001)	(0.000)	(0.000)
ER volatility	1.000***	0.930***	0.856***	0.781***	0.704***	0.626***	0.541***	0.452***	0.427***	0.403***	0.379***	0.364***	0.349***	0.341***	0.350***	0.359***	0.367***	0.376***	0.378***	0.381***	0.382***	0.375***	0.373***	0.372***	0.372***	0.370***	0.366***	0.356***	0.347***	0.328***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.732	0.610	0.496	0.392	0.292	0.205	0.182	0.163	0.144	0.133	0.123	0.117	0.123	0.130	0.135	0.142	0.144	0.145	0.146	0.141	0.140	0.140	0.140	0.138	0.136	0.130	0.124	0.112
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257
Monetary governor publications																														
publications	0.000	-0.136	-0.294	-0.453*	-0.625**	-0.790***	-0.979***	-1.164***	-1.222***	-1.248***	-1.231***	-1.194***	-1.187***	-1.165***	-1.121***	-1.088***	-1.058***	-1.064***	-1.073***	-1.046***	-1.011***	-0.971***	-0.915***	-0.865**	-0.807**	-0.776**	-0.782**	-0.804**	-0.842**	-0.879**
p-value	(0.664)	(0.320)	(0.125)	(0.051)	(0.018)	(0.006)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)	(0.008)	(0.013)	(0.020)	(0.026)	(0.025)	(0.022)	(0.017)	(0.014)
ER volatility	1.000***	0.929***	0.855***	0.779***	0.702***	0.623***	0.537***	0.448***	0.423***	0.399***	0.375***	0.359***	0.345***	0.337***	0.346***	0.355***	0.363***	0.372***	0.375***	0.377***	0.378***	0.372***	0.370***	0.369***	0.369***	0.367***	0.363***	0.353***	0.343***	0.324***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.732	0.611	0.497	0.393	0.295	0.208	0.186	0.166	0.147	0.135	0.125	0.120	0.125	0.131	0.137	0.144	0.146	0.147	0.148	0.143	0.141	0.140	0.140	0.138	0.135	0.128	0.122	0.109
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C4.B. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Cash ER Change Depending on Governor Mentions in Text

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Monetary publications																														
publications	0.000	-0.002	-0.004**	-0.004**	-0.004**	-0.005***	-0.004**	-0.004**	-0.004**	-0.003	-0.002	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002	-0.003*	-0.004**	-0.004**	-0.005**	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***	-0.004**	-0.003	-0.002	0.000***
p-value	(0.226)	(0.315)	(0.019)	(0.044)	(0.033)	(0.008)	(0.018)	(0.027)	(0.029)	(0.129)	(0.234)	(0.428)	(0.460)	(0.273)	(0.362)	(0.289)	(0.273)	(0.187)	(0.065)	(0.041)	(0.024)	(0.011)	(0.009)	(0.004)	(0.003)	(0.005)	(0.007)	(0.033)	(0.110)	(0.181)	(0.000)
ER change	1.000***	0.127***	-0.058***	0.003	0.050***	-0.090***	0.084***	0.060***	-0.038**	-0.057***	0.053***	0.000	-0.025	0.066***	0.078***	-0.010	-0.025	0.089***	0.028	-0.017	-0.084***	0.071***	0.027	0.001	-0.058***	-0.070***	-0.140***	0.028	0.144***	0.010	0.000***
p-value	(0.000)	(0.000)	(0.001)	(0.869)	(0.004)	(0.000)	(0.000)	(0.001)	(0.031)	(0.001)	(0.002)	(0.982)	(0.157)	(0.000)	(0.000)	(0.585)	(0.147)	(0.000)	(0.109)	(0.329)	(0.000)	(0.000)	(0.124)	(0.970)	(0.001)	(0.000)	(0.000)	(0.104)	(0.000)	(0.566)	(0.000)
R squared	1.000	0.017	0.005	0.001	0.004	0.010	0.009	0.005	0.003	0.004	0.003	0.000	0.001	0.005	0.006	0.000	0.001	0.009	0.002	0.002	0.008	0.007	0.003	0.003	0.006	0.007	0.022	0.002	0.022	0.001	0.000
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	0
Governor publications																														
publications	0.000	-0.002	-0.002*	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.002	-0.001	0.000	0.000	-0.001	-0.001	-0.001	0.000	-0.001	-0.001	-0.001	0.000	0.000	0.000	-0.001	-0.001	-0.001	-0.001	0.000***
p-value	(0.135)	(0.229)	(0.063)	(0.132)	(0.114)	(0.222)	(0.138)	(0.136)	(0.133)	(0.416)	(0.333)	(0.311)	(0.131)	(0.348)	(0.783)	(0.886)	(0.535)	(0.536)	(0.453)	(0.814)	(0.614)	(0.650)	(0.624)	(0.788)	(0.951)	(0.875)	(0.455)	(0.608)	(0.582)	(0.419)	(0.000)
ER change	1.000***	0.127***	-0.058***	0.003	0.051***	-0.089***	0.084***	0.060***	-0.037**	-0.057***	0.054***	0.000	-0.025	0.066***	0.078***	-0.009	-0.025	0.089***	0.029	-0.016	-0.083***	0.072***	0.028	0.002	-0.057***	-0.069***	-0.139***	0.029*	0.144***	0.010	0.000***
p-value	(0.000)	(0.000)	(0.001)	(0.855)	(0.004)	(0.000)	(0.000)	(0.001)	(0.033)	(0.001)	(0.002)	(0.981)	(0.154)	(0.000)	(0.000)	(0.599)	(0.151)	(0.000)	(0.103)	(0.350)	(0.000)	(0.000)	(0.113)	(0.924)	(0.001)	(0.000)	(0.000)	(0.097)	(0.000)	(0.556)	(0.000)
R squared	1.000	0.017	0.004	0.001	0.003	0.008	0.008	0.004	0.002	0.003	0.003	0.000	0.001	0.005	0.006	0.000	0.001	0.008	0.001	0.000	0.007	0.005	0.001	0.000	0.003	0.005	0.019	0.001	0.021	0.000	0.000
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	0
Monetary governor publications																														
publications	0.000	-0.005	-0.006	-0.005	-0.004	-0.004	-0.003	-0.002	-0.002	-0.002	0.000	0.000	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	0.001	0.001	0.001	0.000	-0.001	0.000	-0.001	-0.002	-0.001	0.000	0.000	0.000***
p-value	(0.470)	(0.270)	(0.200)	(0.267)	(0.339)	(0.351)	(0.504)	(0.621)	(0.612)	(0.731)	(0.987)	(0.969)	(0.734)	(0.619)	(0.602)	(0.637)	(0.843)	(0.825)	(0.804)	(0.911)	(0.809)	(0.757)	(0.997)	(0.909)	(0.979)	(0.878)	(0.619)	(0.753)	(0.982)	(0.993)	(0.000)
ER change	1.000***	0.127***	-0.058***	0.003	0.051***	-0.089***	0.084***	0.060***	-0.037**	-0.057***	0.054***	0.000	-0.025	0.066***	0.078***	-0.009	-0.025	0.090***	0.029	-0.016	-0.083***	0.072***	0.028	0.002	-0.057***	-0.069***	-0.139***	0.029*	0.144***	0.011	0.000***
p-value	(0.000)	(0.000)	(0.001)	(0.856)	(0.004)	(0.000)	(0.000)	(0.001)	(0.034)	(0.001)	(0.002)	(0.996)	(0.159)	(0.000)	(0.000)	(0.593)	(0.152)	(0.000)	(0.102)	(0.353)	(0.000)	(0.000)	(0.111)	(0.923)	(0.001)	(0.000)	(0.000)	(0.097)	(0.000)	(0.547)	(0.000)
R squared	1.000	0.017	0.004	0.000	0.003	0.008	0.007	0.004	0.001	0.003	0.003	0.000	0.001	0.004	0.006	0.000	0.001	0.008	0.001	0.000	0.007	0.005	0.001	0.000	0.003	0.005	0.019	0.001	0.021	0.000	0.000
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257	0

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C5.A. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the ER Volatility Depending on the Popularity of Messages

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Popular publications (views>median)																														
publications	0.000	-0.018	-0.131	-0.232	-0.340**	-0.463**	-0.563***	-0.684***	-0.738***	-0.738***	-0.745***	-0.688***	-0.625***	-0.635***	-0.623***	-0.595***	-0.562**	-0.541**	-0.641***	-0.738***	-0.796***	-0.840***	-0.942***	-1.049***	-1.156***	-1.197***	-1.251***	-1.310***	-1.363***	-1.337***
p-value	(0.151)	(0.836)	(0.285)	(0.117)	(0.044)	(0.013)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.005)	(0.005)	(0.005)	(0.007)	(0.011)	(0.014)	(0.004)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash_volatility	1.000***	0.930***	0.855***	0.780***	0.703***	0.624***	0.539***	0.450***	0.425***	0.401***	0.377***	0.362***	0.347***	0.339***	0.348***	0.357***	0.365***	0.374***	0.376***	0.378***	0.379***	0.373***	0.370***	0.369***	0.369***	0.366***	0.362***	0.353***	0.342***	0.324***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.732	0.610	0.496	0.393	0.294	0.207	0.185	0.166	0.147	0.135	0.124	0.119	0.125	0.131	0.136	0.143	0.145	0.148	0.149	0.145	0.144	0.144	0.146	0.144	0.142	0.136	0.130	0.116
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257
Unpopular publications (views<median)																														
publications	0.000***	-0.013	-0.149*	-0.296***	-0.453***	-0.605***	-0.801***	-1.004***	-1.123***	-1.177***	-1.217***	-1.242***	-1.265***	-1.267***	-1.236***	-1.200***	-1.164***	-1.143***	-1.125***	-1.099***	-1.064***	-1.041***	-1.032***	-1.017***	-0.994***	-0.973***	-0.970***	-0.982***	-1.009***	-1.033***
p-value	(0.000)	(0.820)	(0.066)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash_volatility	1.000***	0.929***	0.854***	0.777***	0.699***	0.618***	0.531***	0.440***	0.413***	0.389***	0.364***	0.349***	0.334***	0.326***	0.335***	0.344***	0.352***	0.362***	0.365***	0.367***	0.369***	0.362***	0.360***	0.360***	0.360***	0.358***	0.353***	0.344***	0.334***	0.315***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.864	0.733	0.611	0.498	0.396	0.300	0.217	0.198	0.180	0.162	0.152	0.142	0.137	0.141	0.147	0.151	0.158	0.159	0.160	0.160	0.154	0.152	0.151	0.151	0.148	0.145	0.139	0.133	0.120
Sample size	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258	3257

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C5.B. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Inflation Expectations Depending on the Popularity of Messages

	0	1	2	3	4	5
Popular publications (views>median)						
publications	0.547**	0.014	0.330	0.441*	0.197	0.492**
p-value	(0.049)	(0.952)	(0.152)	(0.060)	(0.412)	(0.045)
IE	0.853***	0.945***	0.939***	0.937***	0.939***	0.930***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	0.748	0.828	0.833	0.836	0.830	0.836
Sample size	86	85	84	83	82	81
Unpopular publications (views<median)						
publications	-0.389**	-0.080	-0.342**	-0.332**	-0.337**	-0.065
p-value	(0.020)	(0.583)	(0.015)	(0.025)	(0.028)	(0.688)
IE	0.795***	0.929***	0.882***	0.878***	0.874***	0.929***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	0.752	0.829	0.840	0.839	0.838	0.828
Sample size	86	85	84	83	82	81

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.

Table C6. Results of Model Estimation for Equation (1) for Different Lag Length Values of the Parameter *h* for the Twitter Sentiments Depending on the CB Messages

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Total publications																														
publications	0.000***	0.016***	0.022***	0.022***	0.022***	0.021***	0.021***	0.020***	0.021***	0.022***	0.023***	0.023***	0.024***	0.022***	0.022***	0.023***	0.024***	0.024***	0.024***	0.024***	0.025***	0.025***	0.028***	0.028***	0.030***	0.031***	0.031***	0.029***	0.027***	0.026***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Twitter	1.000***	0.460***	0.326***	0.306***	0.306***	0.273***	0.298***	0.345***	0.302***	0.258***	0.232***	0.218***	0.224***	0.277***	0.300***	0.230***	0.191***	0.182***	0.175***	0.180***	0.199***	0.242***	0.188***	0.137***	0.112***	0.116***	0.132***	0.168***	0.194***	0.179***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.229	0.129	0.117	0.116	0.095	0.109	0.139	0.113	0.088	0.076	0.070	0.074	0.098	0.112	0.075	0.059	0.055	0.052	0.054	0.065	0.084	0.064	0.047	0.042	0.046	0.051	0.059	0.066	0.057
Sample size	3287	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258
Monetary publications																														
publications	0.000***	0.029**	0.030*	0.035**	0.039**	0.034**	0.025	0.035**	0.032**	0.043***	0.042***	0.038**	0.051***	0.059***	0.057***	0.053***	0.052***	0.057***	0.073***	0.071***	0.082***	0.080***	0.088***	0.091***	0.084***	0.084***	0.080***	0.071***	0.071***	0.062***
p-value	(0.001)	(0.047)	(0.053)	(0.024)	(0.013)	(0.031)	(0.102)	(0.021)	(0.038)	(0.007)	(0.008)	(0.016)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Twitter	1.000***	0.471***	0.341***	0.322***	0.321***	0.288***	0.313***	0.358***	0.317***	0.273***	0.248***	0.234***	0.240***	0.292***	0.315***	0.246***	0.207***	0.198***	0.191***	0.196***	0.216***	0.259***	0.207***	0.157***	0.133***	0.137***	0.153***	0.189***	0.214***	0.197***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.222	0.117	0.105	0.105	0.084	0.098	0.129	0.101	0.076	0.063	0.056	0.060	0.089	0.102	0.063	0.046	0.043	0.043	0.044	0.054	0.074	0.052	0.034	0.026	0.027	0.031	0.041	0.051	0.043
Sample size	3287	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258
Other publications																														
publications	0.000	0.016***	0.022***	0.023***	0.022***	0.021***	0.021***	0.019***	0.022***	0.022***	0.024***	0.024***	0.025***	0.023***	0.022***	0.024***	0.025***	0.025***	0.025***	0.025***	0.026***	0.026***	0.028***	0.029***	0.031***	0.031***	0.032***	0.030***	0.028***	0.028***
p-value	(0.135)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Twitter	1.000***	0.453***	0.317***	0.297***	0.297***	0.265***	0.291***	0.337***	0.293***	0.249***	0.222***	0.208***	0.213***	0.268***	0.291***	0.220***	0.180***	0.171***	0.164***	0.170***	0.188***	0.232***	0.177***	0.126***	0.100***	0.104***	0.119***	0.156***	0.183***	0.167***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R squared	1.000	0.231	0.135	0.123	0.121	0.099	0.113	0.142	0.118	0.093	0.082	0.077	0.081	0.104	0.117	0.081	0.067	0.062	0.060	0.061	0.072	0.092	0.073	0.056	0.053	0.056	0.062	0.069	0.075	0.067
Sample size	3287	3286	3285	3284	3283	3282	3281	3280	3279	3278	3277	3276	3275	3274	3273	3272	3271	3270	3269	3268	3267	3266	3265	3264	3263	3262	3261	3260	3259	3258

Note: ***, **, * indicate statistical significance levels at 1%, 5%, and 10% levels.