Are Central Banks Heard When Guns are Speaking?☆

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Abstract

This study examines the effectiveness of central bank communication during times of high-intensity adverse shocks. In particular, we explore how the National Bank of Ukraine (NBU) regulated foreign exchange (FX) markets during the Russian-Ukrainian war in 2022. Using data collected from both the black and authorized FX markets, this study suggests that the content of the NBU announcements has a significant impact on the FX market agents. Notably, the announcements aimed to maintain a fixed (floating) FX rate lead to an increase (decrease) in the black market premium. Furthermore, the response to fixed-rate announcements is greater compared to floating rate announcements. Additionally, the NBU announcements have a stronger influence on the selling side of foreign currency, where the black market holds near monopolistic power.

Keywords: Russia-Ukraine war, central bank communication, black market premium, forex, ChatGPT
JEL: D83, E44, E58, F31

1. Introduction

Central bank communication is one of the most important policy tools, through which a central bank supports its objectives and manages public expectations (Woodford, 2001). A common and straightforward way to evaluate its effectiveness is by examining the reaction of the economy and financial markets to its developments. For instance, Rosa (2011) investigates the effect of Federal Reserve's decisions and statements on the U.S. stock market indices, and find the latter has a greater significance. Gorodnichenko et al. (2023) and Hayo and Zahner (2023) demonstrate that sentiment conveyed in central bank announcements and even the voice of the speaker has the ability to influence financial markets. Başkaya et al. (2012) suggest that a combined implementation of tight monetary policy and effective communication strategies by the Central Bank of Turkey was able to mitigate the volatility of inflation expectations. Leombroni et al. (2021) argue that monetary policy in the form of central bank communication can shape long-term interest rates by altering the risk premium.

During times of significant exogenous shocks to the economy, assessing the impact and effectiveness of central bank communication becomes increasingly challenging. Hayo and Neuenkirch (2015) and Vayid (2013) investigate the role of central bank communication during subprime crisis. Cieslak and Schrimpf (2019) find that the non-monetary policy announcements related to economic growth and financial risks significantly drive the stock market during the financial crisis periods. Égert and Kočenda (2014) assess the effect of central bank communication on the exchange rates of three currencies in Central and Eastern European (CEE) countries during before and after the 2008 crisis. They find that the currencies respond to central bank verbal interventions only during the crisis periods. Unsal and Garbers (2021) study the effects of COVID-19 on world economies, and find that it has forced central banks to

resort to using unconventional and extraordinary measures such as quantitative easing, foreign exchange intervention, or even debt monetization.

While all of the above are examples of significant economic shocks, none have had as severe an impact on the economy and financial markets as a military conflict with a superpower. However, it is during these times of non-functioning financial markets, extreme volatility and uncertainty, it becomes especially important to understand how (and if) central bank communications remain effective. To the best of our knowledge, this issue has not been previously investigated. This study aims to fill this gap and examine the effectiveness of central bank communication under extreme stress by looking at Ukraine during the Russian-Ukrainian war. Specifically, we study the responses of the black market for foreign currency to FX-related announcements of the National Bank of Ukraine (NBU) in 2022.

We focus on the reaction of Ukraine's black FX market and not, for instance, its stock market to NBU communication for several reasons. First is the dollarization of Ukraine, which creates significant demand for foreign currencies. Prior to the war, Ukraine was a small open economy with a flexible exchange rate and a freely convertible currency, hryvnia (UAH). It was not uncommon for everyday goods being priced in hryvnia, while major purchases such as a car or a house to be advertised in US dollars.

Second, in response to the Russian invasion on February 24, 2022, the NBU implemented a major shift in its monetary policy by fixing the UAH/USD exchange rate at the latest pre-war level. This was done to preemptively stabilize the economy and financial markets that were under a lot of stress. The Russian invasion of Ukraine has caused widespread anxiety and financial market responses (Aliu et al., 2022; Neely, 2022). The crisis affected all sectors of the economy: the banking system became constrained by monetary restrictions (Druhov and Druhova, 2022), international commodity trade got interrupted by the increasing geopolitical risks (Wang et al., 2022), and so was agricultural production (Ben Hassen and El Bilali, 2022).

Third, the interplay of dollarization of the economy, fixed exchange rate, and general negative expectations about the prospect of the war decreased the demand for UAH relative to USD. This created a downward pressure on its exchange rate, fueling the black market for USD. For individuals, converting USD to UAH at the official exchange rate approved by the NBU became unattractive. The mirror transaction, purchasing foreign currency for hryvnia from an authorized agent, became next to impossible as commercial institutions weren't willing to part with their foreign reserves at below market-clearing prices. In response, a black market for foreign currency emerged, as individuals sought more favorable exchange rates for their USD holdings (Fardmanesh and Douglas, 2008). Anyone wanting to convert their cash holding of USD into UAH, would receive there a more favorable, relative to the official, exchange rate. Additionally, the black market also offered a rare possibility to purchase foreign currency for UAH, albeit at a hefty markup. These markups constitute the black market FX premium (BMP) which we use as the main response (dependent) variable in our analysis.

The black market premium (or parallel market premium) in the FX market is not a Ukraine-only phenomenon. In the literature, it refers to the percentage difference in exchange rates between the official exchange rate set by the authority and the rate at which foreign currency can be obtained in the black market (Bahmani-Oskooee, 2002). The existence of BMP is often a signal of restrictions on the availability of foreign exchange, as individuals might be willing to pay a premium to obtain access to foreign currencies through unofficial channels (Fishelson, 1988). Several factors have been identified as contributing to the emergence of a BMP such as a currency control policy and foreign exchange restrictions. For instance, Fardmanesh and Douglas (2008) find that the foreign exchange controls and expansionary monetary policy have a positive effect on BMP. Similarly, Cerra (2016) find that the capital control policy could lead to a shortage of foreign currency supply and drive up its price on the black market. Acharyya (2001) examine the link between exchange rate policies and BMP through the income effect and export quality channels, and find them to work in opposite directions.

In this paper, we examine the impact of NBU communication and its FX policy on the movements of the BMP in the FX market. To calculate the BMP, we take advantage of the unique situation in Ukraine that resulted in the co-existence of three different USD/UAH exchange rates, and as a result, of three datasets. The first is the official interbank exchange rate, which is directly set by the NBU. It got fixed at 29.2549 on February 24, 2022. As of February, 2023 when this paper is written, the NBU has adjusted the UAH/USD rate only once to 36.5686 on July 21, 2022. The second source consists of buy and sell quotes from 35 authorized bank and 49 non-bank institutions operating in 20

Ukrainian cities.[4] These institutions have an NBU license to trade foreign currencies in cash transactions.[5] The third resource consists of the median daily black market buy and sell quotes from 23 Ukrainian cities. The black market data are collected from a website where private FX dealers post their quotes. Consequently, we measure the BMP on the agent-city-time level as the difference between agent prices and the black market price medians in the same city where the agent is located.

Our main policy (independent) variable are the National Bank of Ukraine FX-related announcements, which have been widely used as a common measure of central bank communication. For instance, Cieslak and Schrimpf (2019) use the news released by the central bank to proxy the central bank communication. There are several advantages to taking this approach. First, the official announcements published by the NBU give an accessible open resource in which policy actions and news are updated in real-time. Second, the consistently formatted announcements archive allows us to measure the sentiment of communication in a consistent pattern, providing a systematic structure to analyze and learn how central bank communication can affect the black market. Specifically, we use a commonly used textual analysis method (Baker et al., 2016) as well as ChatGPT to quantify the sentiment (content) embedded in the textual announcements released by the NBU. Between February 24 and December 20, 2022, the NBU made 25 announcements mentioning FX issues. As a result, we divide them into those that intended to make the exchange rate of UAH more fixed, more flexible, or neither.

Our result suggest that central bank communication remains an effective tool even in times of heightened distress. Our findings indicate that the FX market closely follows the NBU's announcements, and responds particularly strongly to those announcements that aim to fix the exchange rate. For example, the movement of the BMP for the "sell" quotes in response to a "fix" announcement is 2.9 percentage points, whereas the reaction to a "float" announcement is only 0.9 percentage points. These results suggest that the "fix" content of announcements has higher influence to the FX market, compared to the "float"-sentiment content. Perhaps, this indicates that the market views "fix" announcements as more credible, and therefore, responds to them stronger. Indeed, since the NBU has not returned to the float since the beginning of the war, all fixed-intended announcements are technically backed up by the NBU's actions: It continues maintaining the fixed rate. When it comes to the "buy" quotes, the results are qualitatively similar, although the response coefficients are smaller in magnitude. This can be attributed to the fact that during the war, when the official exchange rate is lower than the market-clearing equilibrium, the black market remains the only option for those seeking to buy USD.

Our paper also makes contributions across several other dimensions. It discusses the consequences of central bank regulation on the FX market and highlights some of its successes and failures. Secondly, this study contributes to the literature on the consequences of war, with the black market and black market premium being among its economic artifacts. Finally, the paper makes a methodological contribution to the central bank communication literature by employing ChatGPT to evaluate the sentiment of NBU announcements.

The rest of this paper is organized as follows. Section 2 provides a detailed discussion of the data used in this study. Section 3 outlines our empirical methodology, while 4 presents our findings. 5 offers a range of robustness checks to support our results. Finally, in 6, we conclude our study by discussing the policy implications of our findings.

2. Data

We collect data from three sources: `finance.ua`, `minfin.ua` and `bank.gov.ua`, covering the period between February 24, 2022 to December 20, 2022. These data include (1) the public announcements from bank.gov.ua, released by the National Bank of Ukraine, (2) authorized market data from finance.ua, which include all sell and buy quotes from 83 agents in 20 Ukrainian cities, and (3) black market data from minfin.ua, which contain information about daily median of sell and buy quotes in 23 major Ukrainian cities.

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[4]Here and below, when we identify the side of the market as "buy" or "sell", we are looking at it from agency's point of view, not the private individual, seeking to exchange currency.

[5]Note that, the authorized agents must adhere to exchange rate limits that cannot deviate from the official interbank NBU rate by more than 10%.

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2.1. Central bank communication data

Whether the exchange rate of UAH should maintain the fixed regime or return to float has been discussed in the media throughout the entire year. The NBU has been an active participant in this conversation. To gain the understanding of the central bank position and the way it communicated it to the markets, we collect the NBU public announcements from the official website of the NBU (`bank.gov.ua`). From there, we have downloaded 220 individual announcements. Among them, we manually selected those announcements that focus on the FX-related policies. Specifically, we label the announcements contains words such as "FX market, foreign currency, foreign residence, abroad payment, FX account, FX transaction, exchange rate" as the FX announcements. As a result, we ended up with 23 policy announcements related to the FX issues. The dates and titles of the announcements are gathered in Table A2 in the Appendix. An example of such an announcement could be the 14 April, 2022 NBU publication titled "NBU Allows Banks to Sell FX Cash to People, Clarifies Rules for Loan Repayment by Banks to Nonresidents."

2.2. FX data and the black market premium (BMP)

When it comes to the FX market, there are several different nominal exchange rates that co-exist in Ukraine on a given date in a given location: the official interbank foreign exchange rate set by the NBU, the exchange rate provided by numerous authorized financial institutions (with prices partially regulated by the NBU), and the exchange rate provided by the black market traders (not regulated by anyone). The last two serve the general public and regularly preform cash transaction, for instance, by exchanging USD into UAH. For that reason, they are in direct competition with each other. However, while the authorized financial institutions (banks and currency exchange shops) are currently allowed to only set their prices within 10 percent of the NBU prices, the black market traders are free of that requirement.

Central bank communication is one piece of the puzzle and it serves as our main policy variable. The other piece is foreign exchange (FX) data on the UAH/USD exchange rate and in particular the black market premium, which is our main response variable. The data sources for the FX market are discussed in the next section.

Authorized FX market

The data on daily quotes from the authorized actors comes from `www.finance.ua`, which allows financial institutions authorized by the NBU to list their sell and buy prices on the FX currency platform.[6] The website contains buy and sell quotes provided by 84 authorized agents in 20 Ukrainian cities. It is worth to note that the National Bank of Ukraine allows not only banks, but also non-bank financial institutions (such as foreign currency shops) to participate in the FX market. In the dataset, nearly half of those authorized agents are non-bank institutions. Consequently, we constructed the authorized market dataset that contains the price quotes for USD on the agent-city-day level. Table 1 presents descriptive statistics for the price indicators in the authorized market. The average buying price in the authorized market is 35.95 UAH per one USD. In contrast, the selling price of 1 USD is approximately 36.84 UAH.

Black FX market

The black market data is collected from `www.minfin.ua`.[7] It allows private non-institutional traders to post advertisements which contain offers to privately buy or sell USD. The quotes listed on the website are not authorized by the currency authority, all transactions between sellers and buyers are not traced or recorded by the website. Since the black market is not regulated in any way, the black market quotes could reflect the market clearing UAH/USD exchange rate in Ukraine. From this website, we collected the archived historical median buy and sell quotes for USD for each day in 23 Ukraine cities. From Table 1, the average median buying price in the black market is 36.94 UAH, and the selling price is 37.29. Not surprisingly, both prices exceed their authorized market counterparts. Figure 1 plots the time series for the three FX rates that exist in Ukraine since February 24, 2022. One can see that there is almost no gap (black market premium) between the authorized market rate and black market rate before 24 February,

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[6]Founded in 2000, finance.ua is one of the leading comprehensive financial medias in Ukraine. Aiming to build a "financial online supermarket" for Ukrainian individuals, finance.ua provides financial news, financial advice service, currency exchange rates and personal credit rating service.

[7]Since founded in 2008, minfin.ua has been providing economic news, advice, and posts reviews of financial institutions. Registered users are allowed to use its forum and posting boards.

Table 1 Forex markets descriptive statistics. The table represents the descriptive statistics on the price indicators for all 83 agents over 20 February 2022 and 20 December 2022.

	Mean	Std.Dev.	p25	p50	p75	Obs
Black Market						
Buy	37.660	3.559	35.250	39.600	40.550	14308
Sell	38.031	3.369	35.500	39.850	40.700	14298
Midpoint	37.847	3.446	35.325	39.700	40.615	14298
Authorized Market						
Buy	36.603	4.012	34.000	38.000	40.000	14308
Sell	37.534	3.961	35.360	39.700	40.700	14308
Midpoint	37.068	3.959	34.750	39.000	40.325	14308
Black Market Premium						
Buy Premium	3.138	4.131	0.568	1.489	3.927	14308
Sell Premium	1.596	4.580	-0.495	0.049	1.566	14298

the start of the war and the date when the NBU decided to end the float. Since then, the black market rate has increase dramatically. In contrast, the authorized market rate remained close to the interbank rate due to the NBU price limitation restriction. This regulation was partially lifted on April 14, 2022 as the NBU allowed authorized agents to trade foreign currencies for prices that are within 10% from the official rate. As a result, the authorized and black market rates converged in late May 2022, until the NBU devalued the official Hryvnia by 25% on July 21, 2022. Both rates increased again and peaked at mid September at about 43 UAH/USD. After that, both authorized and black market prices eased off and remained around 40 UAH through the rest of 2022.

3. Methodology

3.1. Calculating the announcement sentiment index S_t

The central bank communication is not directly perceptible. Therefore, one important question for empirical analyses which focuses on examining the role of central bank communication on financial markets is how to quantify the communication information. When it comes to exchange rates, there are two directions that an FX announcement could take: to impose (or maintain) the fixed FX rate for Hryvnia; or signal an intent to return to the floating FX rate. To classify them as one or the other, we follow Neuhierl and Weber (2019) who uses the "search and count" approach to label the text sentiment as either fix or float.[8] Specifically, we first created a dictionary which contains the list of words that signal 'fix' or 'float' intent. Examples of the words with the 'fix' intent could be "cease", "prohibit", "limit", "suspend", "ban." Conversely, examples of the words with the 'float' indent are "ease", "allow", "lift", "simplify", "relieve", "permit", "simplified." The complete dictionary is shown in Table A1. Then, we used this dictionary to count the number of occurrence of 'fix' and 'float' words in the announcement to calculate the fix/float announcement sentiment S_t as:

$$S_t = 100 \times \frac{\sum \overline{words_t} - \sum \widetilde{words_t}}{\sum \overline{words_t} + \sum \widetilde{words_t}} \tag{1}$$

Here, $\overline{words}$ is the number of 'fix' words in the announcement and $\widetilde{words}$ is the number of 'float' words in the announcement on date t. The result is a continuous index that ranges from -1 (float exchange rate sentiment) to +1 (fixed exchange rate sentiment). For example, on May 25, 2022, the NBU issued a statement titled "NBU to Retain Current Fixed Exchange Rate." The text of the analysis contains six 'fix' words and two 'float' words. This results in the sentiment index S being equal to +0.5, which shows a moderate to strong 'fix' intent.

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[8]We also used ChatGPT to classify the announcements into 'fix' and 'float'-intended. These results are discussed in Section 5.2.
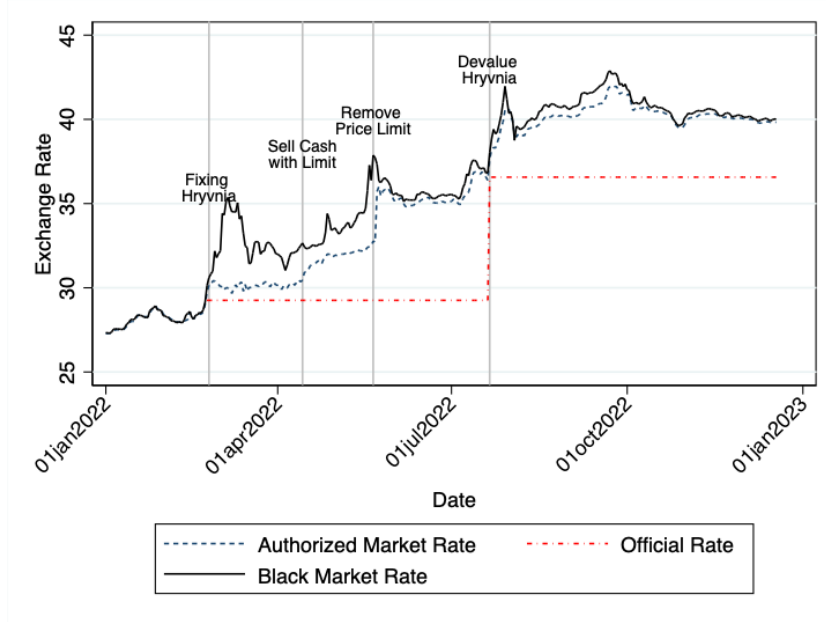
Fig. 1. Evolution of three exchange rates in Ukraine throughout 2022. The green line represents the black market midpoint for selling / buying prices. The dashed-blue line represents the authorized market buy / sell midpoints. The red line (dash-doted) represents the official rate regulated by the NBU since 24 February 2022. The Y-axis represents the forex exchange rate (UAH/USD). The X-axis represents the date throughout 2022. The grey vertical lines represents 4 direct fx rate intervention of NBU.

3.2. Calculating the black market premium, $BMP_{ic,t}$

We calculate the black market premium separately for both sell and buy sides. Due to data availability, the black market data in our sample is the city-median dealers' prices. Therefore, we used the difference between the authorized agent quotes and black market medians in the same city to proxy the black market premium. In particular, the *BMP* is defined as:

$$BMP_{ic,t} = 100 \times \frac{P_{c,t}^{BM} - P_{ic,t}^{A}}{P_{ic,t}^{A}}, \tag{2}$$

where i represents the agent ID, c is the city, and t is the date. $P_{c,t}^{BM}$ represents the buy (or sell) median price on the black market in the same city c where the agent i locates. $P_{ic,t}^{A}$ represents the buy (or sell) quote provided by the particular agent i in city c on date t.

Figure 2 shows the evolution of the black market premium for both sell and buy sides of the market. Now that we have defined both the dependent and independent variables, we can proceed to setting up the econometric specification.

3.3. Econometric specification

To estimate the effect central bank announcements have on the FX market and in particular on the black market premium (BMP), we estimate the following model:

$$BMP_{ic,t+j}^{B,S} = \beta S_t + \gamma X_{it} + \alpha_i + \eta_c + \delta_t + \epsilon_{ic,t} \tag{3}$$

Here, the dependent variable $BMP_{ic,t+j}^{B,S}$ is the black market buy (B) or sell (S) premium for agent i in city c on date $t + j$ which is calculated according to Equation 2. Index $j \in [-2, -1, ..., 7]$.

The premium is being explained by our main independent variable which is central bank announcement sentiment S, calculated according to Equation 1. The sentiment S is positive if the announcement suggests the NBU is favoring the fixed exchange rate, and is negative if it points at the possibility of returning to the float. It is equal to zero on the dates when there were no FX related announcements made by the NBU. The first two possible values for j (-2 and -1)
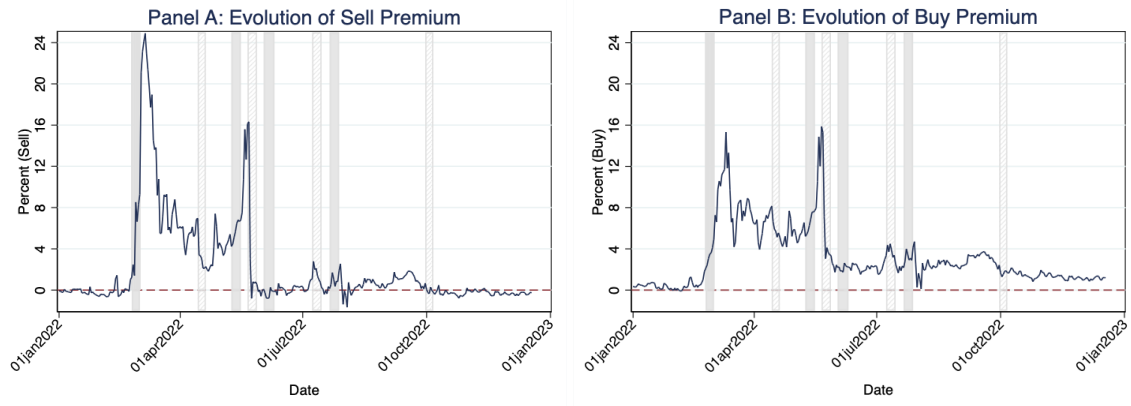
Fig. 2. Evolution of the BMP on the sell (Panel A) and buy (Panel B) sides. The Y-axis represents the black market premium (BMP), in percent. The X-axis represents the date. The grey solid bars represent the one-week periods at the beginning of which the fix-sentiment announcements are released; the patterned grey bars represent the one-week periods at the beginning of which the float-sentiment announcements are released.

correspond to the leads of S. If the model is specified correctly and there's no leakage of information, they should not affect the BMP, resulting in β being insignificant. The positive values of j on the other hand allow us to estimate how quickly the black market responds to news, which are the announcements released by the National Bank of Ukraine. The sentiment S is expected to be positively related to the BMP for both sell and buy sides. That is, announcements intended to make the Hryvnia exchange rate more fixed would enlarge the BMP.

The vector of controls, X_{it}, contains market characteristics which previous research has shown to affect the black market premium. To capture the market momentum, we control for the average buy and sell prices of USD in the authorized market. To take into account the size and competitiveness of the local markets, we control for the number of authorized FX traders in each city.

Our model also includes agent α_i and city η_c fixed effects that control for their time invariant characteristics, and monthly and weekday time effects δ_t to account for the general macroeconomic situation and the weekend effect.

4. Results

4.1. Baseline specification

The evolution results for the sentiment coefficient, β, from Equation 3 as a function of the lag length j are plotted on Figure 3.[9] The time shift parameter j varies from -2 (two days before) to +7 (a week after) the announcement date. The estimates for the rest of the coeffients could be seen in Table 2.

The role of communication.

By looking at Figure 3, one can see that regardless of whether we look at the buy or sell sides, we find that the NBU announcements are positively related to the BMP. Starting with one day following the announcement ($j = 1$), the response is positive and generally statistically significant. This means that if the NBU issues a fix-intended FX announcement, the black market raises prices and the premium increases. Similarly, it goes down in response to a float-intended announcement.

The response builds up over time and after 7 days, if we use the sell-side as an example, increases by approximately 1.8 percentage points following a strong fix-intended FX announcement (when sentiment S switches from 0 to +1), while remaining statistically significant. It is worth to note that the changes in the BMP before the announcement release date (for $j = -2$ or -1) are weak and statistically insignificant, just as expected.

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[9]The Ukrainian foreign exchange market has two main foreign currencies, USD and EUR, both of which are traded in the authorized market and black market. The baseline estimation focuses on USD because the exchange rate of Hryvnia is anchored to USD. The results of estimating Equations (3) and (5) using the EUR-based BMP are qualitatively and quantitatively similar, and available upon request.
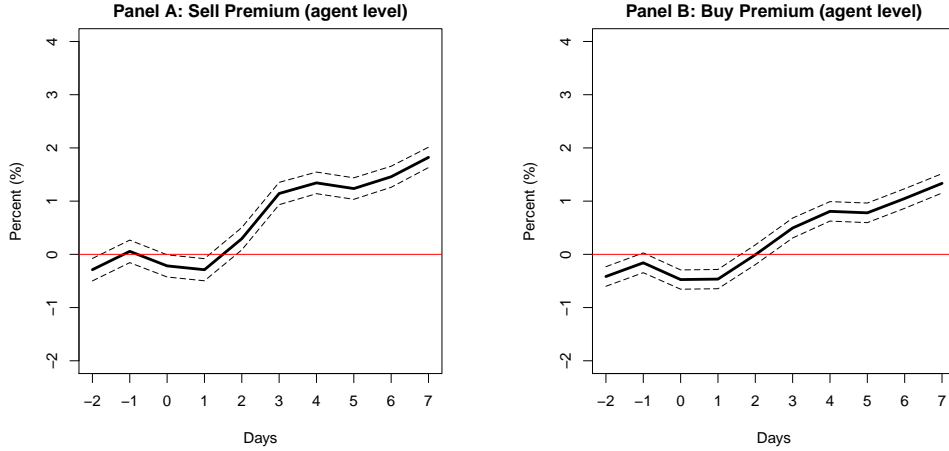
Fig. 3. Evolution of the sentiment response coefficient for the sell (Panel A) and buy (Panel B) sides. This figure shows the results of estimating the sentiment coefficient β from Equation 3 for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.

Comparing the impact response between Panels A and B of Figure 3, it appears that the NBU's fix-intended announcements have a larger effect on the BMP for the sell side of the market. When compared to the buy side, the sell-side response is larger in magnitude, is immediate (the BMP responds on the same day), and it continues to increase with time for at least seven more days. For the buy side, on the other hand, it takes six days for the premium to respond and become positive, and by the end of the week, it levels off.

This finding that the sell side responds stronger that the buy side is expected. Although the NBU allows private individuals to purchase USD (and for the agents – to sell USD) from the authorized institutions, their supply of cash holdings of USD is very limited. Anecdotal evidence suggests that in 2022, it was next to impossible to purchase foreign currency in the authorized market. The fact that the average sell USD price in the authorized market is lower than the average buy price in the black market (Table 1) supports it. Hence, the black market remained the only viable option that gained significant market power. In contrast, all the authorized institutions were ready to purchase foreign currency from the public. While the black market does offer more competitive rates, it is not the only option out there. For this reason, it is natural to expect the black market sell quotes to be more elastic and respond more aggressively to the news than the buy quotes.

The role of FX market indicators.

The numerical estimation results for Equation 3 are shown in Table 2. When it comes to the FX market related controls $X_{c,t}$, the signs of the estimated coefficients are as expected. The number of authorized dealers on the market, No. of Dealers, is negatively related to the BMP for the sell side at short horizons, while being insignificant for the buy side regardless of the horizon. The sell-side result is consistent with the existing literature (Elbadawi, 1997). Quantitatively, it implied that over the first several days following the announcement, 10 extra quotes in a particular city is associated with a 0.21 to 0.39 percentage points decrease in the black market premium. Considering the average number of sellers in a city is approximately 30 and the average BMP for both sides is 1.32 percent, this effect is nontrivial. The fact that the buy side does not depend much on the number of dealers might reflect the fact that that side of the FX market is already very competitive, due to both the authorized and black market buyers competing for the private sellers of USD. When it comes to the market momentum, both Average Buy and Average Sell variables are negatively related to the BMP, which is a common result in the literature (Subrahmanyam, 2018).

4.2. Asymmetrical specification

The baseline specification in Equation 3 has one potential drawback. It restricts the BMP response to be the same in magnitude regardless of whether the NBU announces it's planning to further extend the fixed rate regime or is considering returning to the float. If the market considers the former announcements to be more credible than

Table 2 Results of estimating equation (3) for different lag length values of the parameter j for the sell (Panel A) and buy (Panel B) sides of the market.

Time Lag j	-2	-1	0	1	2	3	4	5	6	7
	Panel A: The sell side of the market									
Fix Sentiment	-0.680***	-0.343**	0.372***	0.466***	0.107	0.675***	0.997***	0.780***	1.121***	1.621***
	(0.000)	(0.002)	(0.001)	(0.000)	(0.328)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. of Dealers	0.001	0.002	-0.003	0.003	0.010	0.010	0.022**	0.031***	0.036***	0.037***
	(0.915)	(0.814)	(0.713)	(0.714)	(0.203)	(0.180)	(0.004)	(0.000)	(0.000)	(0.000)
Average Sell	-0.752***	-0.747***	-0.726***	-0.726***	-0.732***	-0.722***	-0.711***	-0.746***	-0.754***	-0.747***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Square	0.529	0.525	0.519	0.525	0.527	0.526	0.531	0.538	0.549	0.569
Sample size	12992	13332	14051	13386	13089	12980	12898	12788	12848	12987
	Panel B: The buy side of the market									
Fix Sentiment	-0.764***	-0.320***	-0.025	0.116	-0.097	0.188	0.617***	0.517***	0.849***	1.180***
	(0.000)	(0.001)	(0.791)	(0.215)	(0.311)	(0.051)	(0.000)	(0.000)	(0.000)	(0.000)
No. of Dealers	0.001	0.006	0.014*	0.012	0.015*	0.012	0.017*	0.021**	0.024***	0.026***
	(0.897)	(0.373)	(0.038)	(0.061)	(0.031)	(0.072)	(0.014)	(0.002)	(0.001)	(0.000)
Average Buy	-0.576***	-0.592***	-0.596***	-0.569***	-0.550***	-0.551***	-0.542***	-0.550***	-0.568***	-0.581***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Square	0.563	0.555	0.552	0.557	0.558	0.557	0.558	0.559	0.558	0.561
Sample size	12998	13339	14060	13391	13094	12985	12905	12796	12856	12995

the latter, it might respond to them more aggressively. And vice versa. To account for this possibility, we split the sentiment variable, S, into those expressing the fixed sentiment $\bar{S}$ and those expressing the float $\tilde{S}$ sentiments as in:

$$\bar{S} = S \times I(S > 0)$$
$$\tilde{S} = -S \times I(S < 0) \tag{4}$$

where $I(\cdot)$ is a true-false indicator variable. Notice that unlike the previous case, both fix and float announcements now result in a positive value of the corresponding index. The next step is adding them to the equation and estimating it:

$$BMP_{ic,t}^{B,S} = \bar{\beta}\bar{S}_{t-j} + \tilde{\beta}\tilde{S}_{t-j} + \gamma X_{it} + \alpha_i + \eta_c + \delta_t + \epsilon_{ic,t} \tag{5}$$

Figure 4 shows the evolution of the coefficients $\bar{\beta}$ and $\tilde{\beta}$ associated with the fix-related announcements ($\bar{S}$) as well as the float-related announcements ($\tilde{S}$) for the sell (Panel A) and buy (Panel B) sides of the market.[10] We find the market response to fix-sentiment to be stronger than the reaction to float-intended announcements, regardless of the side. For instance, for the sell side, the BMP response to a fix announcement increases the BMP by approximately 2.9 percent points over the following week, whereas the response to the float sentiments is only 0.9 percent points over the same horizon. This finding suggests that, the market participants are more sensitive to the news intended to maintain or strengthen the fixed exchange rate of Hryvnia, compared to the announcements related to moving back to the float. One reason could be that they consider the former to be more credible given the circumstances.

4.3. City-level estimation and segmented markets results

Agent-level vs. city-level estimation.

To further understand the response of the black market premium to central bank announcements, we reestimate Equations 3 and 5 using the data collapsed to the city-day level. This means that in the cities where we have multiple agents operating in the authorized market, we calculate authorized city-specific median buy and sell quotes. Then, to find the BMP, we subtract the result from the black market quotes, which are already available on the city-level basis. Figure 5 shows the evolution of the coefficients β associated with symmetric (Panels A and B) and asymmetric (Panels C and D) sentiment S. Generally, the impact response for both sides of the market on the city-level is similar to that at

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[10] The estimates for the rest of the coefficients are available in the appendix, Table A3.
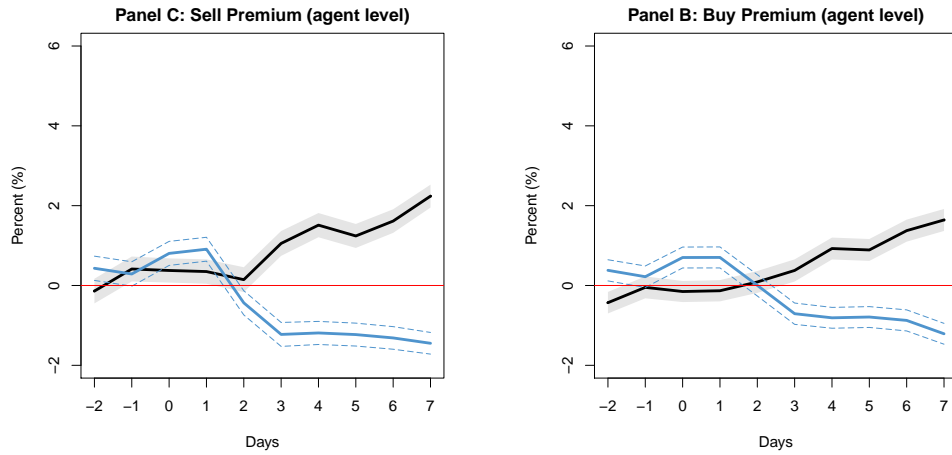
Fig. 4. Evolution of the 'fix' and 'float' sentiment response coefficients for the sell (Panel A) and buy (Panel B) sides. This figure shows the results of estimating the sentiment coefficient β from Equation 5 for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.
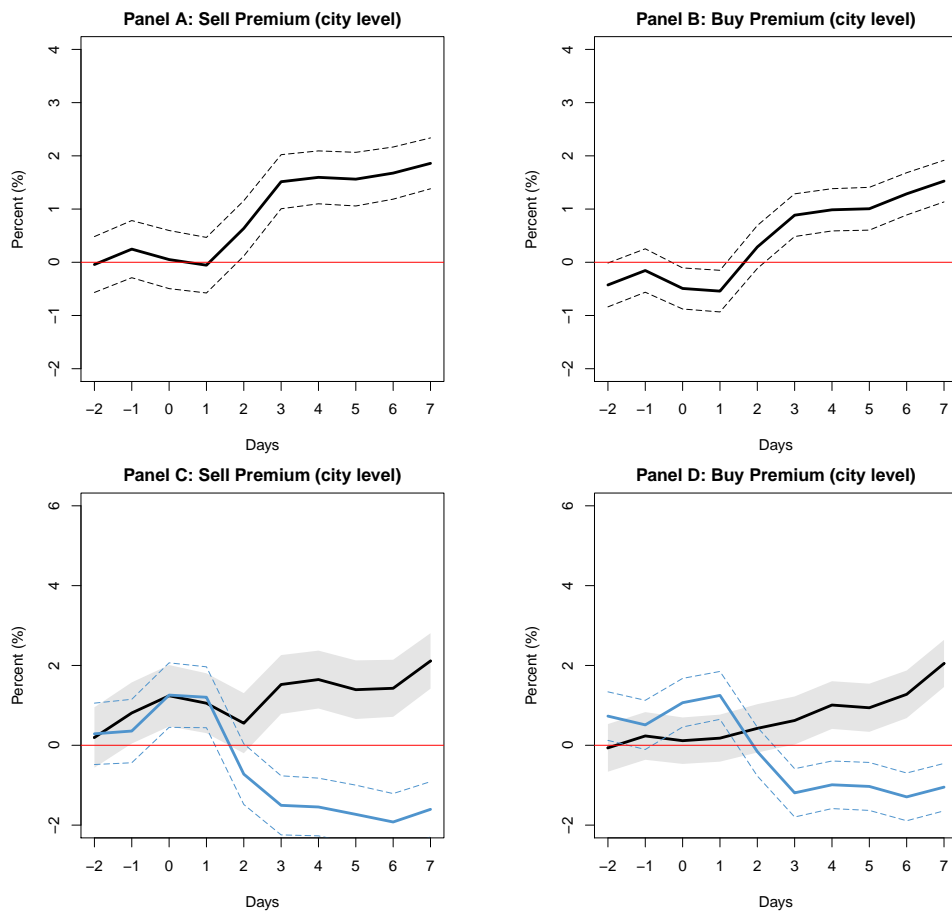

Fig. 5. Evolution of the sentiment response coefficients. This figure shows the results of estimating the sentiment coefficient β from Equation 3 (Panels A and B) and Equation 5 (Panels C adn D) for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed and shaded lines shows the 95% confidence interval.

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the agent-level. There are, however, two notable differences. The first are larger standard errors for the city-level data, which is expected due to the decreased sample size. Indeed, there are cities with multiple agents operating within them. Another notable difference is the magnitude of the coefficients which appear to be somewhat larger on the buy side for the case of city-level estimation. Since 75% of the agents in our sample are located in the capital, Kyiv, we hypothesise that this difference is driven by the Kyiv agents. To verify that, we estimate our model over two different subsamples.

Kyiv vs. non-Kyiv samples.

The results are presented in Figure A1. Comparing the estimates of the slope coefficients between Panels A and B and Panels C and D, we observe that the fix-intended NBU announcements create a larger black market premium among the agents based outside of Kyiv. This is expected since Kyiv, being the capital of Ukraine, is one of the most competitive markets in the country. This point should hold even if we consider the informal black market. The more semi-legal buyers and sellers operate in this market, the lower are the markups at which black traders sell USD to the public.

Banks vs. non-bank institutions.

We also examine whether the institutional characteristics could influence the effect of communication. Besides the authorized banks, NBU allows authorized non-bank institutions to operate in the FX market. Therefore, we re-estimate Model (3) using subsamples that only include the bank or non-bank agents. The results can be see in Figure A4. For the sell side, we find that the BMP for the bank agents is more sensitive to the NBU announcements and responds faster after an announcement is released. For the buy side, the responses are very similar between bank and non-bank agents. When it comes to the magnitude, rather than timing, we do not see any statistically significant differences between the two groups of agents.

Price Dispersion

Collapsing the data by city gives us an opportunity to explore other aspects of our dataset. Specifically, since we have data on multiple quotes from the authorized agents within each city, we can study how the dispersion, rather than the level, of prices changes in response to NBU announcements.

Price dispersion refers to the degree to which prices vary across different sellers or locations. It occurs when different sellers offer different prices for the same commodity in a particular marketplace. In our case, it's the US dollar. In general, price dispersion could be measured by the deviations in provided prices from the daily mean (Lach, 2002). Price dispersion is a common phenomenon in many markets, including the insurance market (Hun Seog, 2002), mortgage market (Bhutta et al., 2020), and energy market (Noel and Qiang, 2019). The authorized FX market in Ukraine is not an exception.

Therefore, we reestimate Equation 3 while replacing the black market premium (BMP) with price dispersion as the dependent variables. We calculate dispersion as the standard deviation of buy (sell) prices of authorized agents, expressed in UAH, within a city on a given day. The results are shown in Figure 6. It could be seen from Figure 6 that there is no significant short term effect of an announcement on the dispersion of prices, regardless of the side of the market. However, we do find that eventually, a fix-intended announcement increases the sell price dispersion (Panel A). The point estimate of the effect is around 1.2 UAH. Since the within-city average dispersion of selling prices for USD is one UAH, this impact is considerable. It means that within a week following the announcement, the dispersion of prices doubles. One might interpret this finding as a fix-intended announcement leading to a more "fixed" Hryvnia, which further narrows the availability of foreign currency in the authorized market and increases the associated search costs. It could also means that the professional authorized agents (banks) change their prices more often and/or faster than non-professional authorized agents (currency shops), thus contributing to within-city price dispersion. We do not find a similar effect for the buy-side of the market.

5. Robustness checks

While our results remain consistent between various specifications and setups, there remain two possibilities that could have lead to spurious results, which we haven't accounted for. First, it could be the "luck" factor and the choice
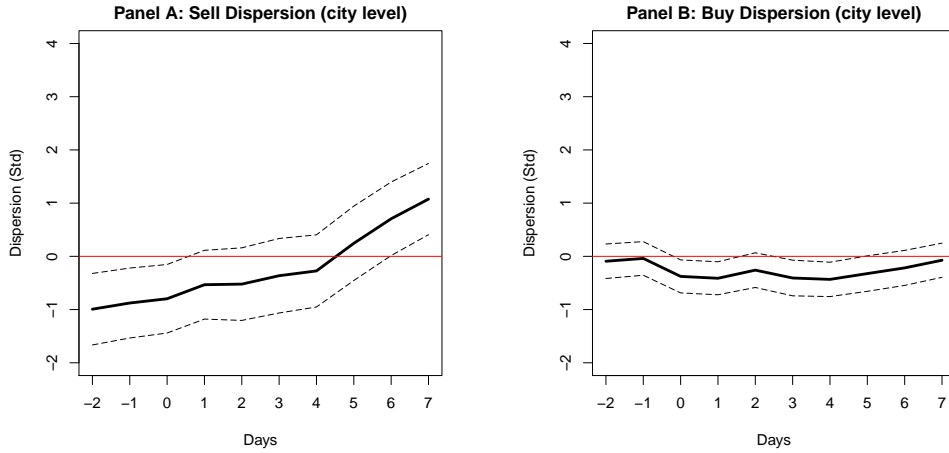
Fig. 6. Evolution of the sentiment response coefficient for the sell (Panel A) and buy (Panel B) sides when the dependent variable if Price Dispersion. This figure shows the results of estimating the sentiment coefficient β from Equation 3 with the dependent variable being Price Dispersion, for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the standard deviation of prices, in UAH. The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.

of our particular sample that makes our results appear significant no matter what. Second, the specific choice of the words that went into the dictionary that consequently was used to quantify the sentiment in the NBU announcements biased the results. In this section we verify the two hypotheses.

5.1. Placebo experiment

In the baseline specification (Equations 3), we estimate the response of the FX market to the NBU FX-related announcements. To make sure we are not obtaining spurious results due to the choice of the sample, we replace the BMP in 2022 with its values on the same calendar dates one year ago, in 2021. All the right-hand-side variables and controls remain as they were before, i.e. correspond to 2022.

The results of estimating this placebo regression are shown in Figure A5. They are in line with our expectation, as the impact response is statistically insignificant regardless of the horizon, j. First, both sell and buy-side BMP are not affected by the announcement proxies in Panels A and B. Second, the black market premium does not respond neither to the fix sentiments nor the float sentiments, as can be seen in Panels C and D. These results suggest that the effectiveness of NBU announcements is not driven by particular seasonal factors.

5.2. ChatGPT announcement classification

In the baseline estimation, we use a dictionary to identify whether an announcement shows 'fix' or 'float' sentiment. In this section, we instead employ an advanced machine learning tool, ChatGPT, to read, evaluate, and quantify the announcement sentiments. To achieve that, we split each announcement into paragraphs. Then, we created a conversation in ChatGPT and asked it whether this particular paragraph of the announcement would make the exchange rate of Hryvnia more fixed or flexible. ChatGPT gave one of the three answers: The announcement means the NBU would like to 1) make the exchange rate more fixed; 2) make the exchange rate float; 3) neither. Then, we aggregated the AI responses at the announcement level. Note that the sentiments of all the segments for each announcement do not contradict each other.

In our analysis, we use the November 30, 2022 version of ChatGPT that is trained using pre-2022 data and therefore is not "aware" of the war. Nor can it analyze the market response to the NBU announcements or account for policies adopted at time $t + 1$ while evaluating the sentiment of a communication released at time t. In a sense, ChatGPT produces its fare assessment of the text, just as a live person would do in real time.

To compare the sentiment index value we obtained from using the dictionary method to the one produced by ChatGPT, we can refer to Table A2. The correlation between the two measures is 0.7439, significant at 99 percent. The estimation results for Equations 3 and 5 are presented in Figure A6. We can see that all our main conclusions remain intact, and our results appear to be robust to the AI-based sentiment measure.

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6. Conclusions

Central bank announcements are a crucial means of communicating policy decisions and updating the financial system's status. This type of communication is especially important during extreme periods such as financial crises, natural disasters, and wars. It is during those time when central bank credibility is under pressure, while at the same time swift and effective measures are required to quickly stabilize the economy.

In Ukraine, the Russian invasion triggered a wide-ranging economic and financial crisis, prompting the central bank to issue a series of announcements to maintain financial system operations. This study aims to examine the relationship between the National Bank of Ukraine's (NBU) communication and the FX market's reaction during the Russian invasion period.

To gather data for the study, we collected FX buy and sell quotes from both authorized and black markets. We focused on the black market premium, which is determined by the difference between authorized market prices and black market prices. To evaluate the NBU's communication, we analyzed the announcements released by the bank, using text-based analysis methods and an open AI bot ChatGPT to evaluate the content (sentiment) of each announcement.

This study contributes to the existing literature in several ways. Firstly, it highlights the significance of the sentiment conveyed in central bank announcements, showing that a carefully worded announcement (even in the absence of an action) has a real effect on the market even during highly-volatile times. For instance, while not followed by a change in the exchange rate regime, fix-intended announcements resulted in an increase in BMP, while float-intended announcements lead to a narrowing of BMP. Second, we show that the public likely considers some announcements to be more credible than the others. For instance, fix-sentiment FX announcements tend to have a greater effect on the market than float-sentiment announcements. Finally, we show that despite what anecdotal evidence suggests, general public and non-institutional agents listen to central banks. Both the semi-legal black market traders and authorized small currency shops update their prices in the right direction following the corresponding NBU announcements.

References

Acharyya, R. (2001). Exchange rate policy and black market premium on foreign exchange: Theory and evidence. *Economic and Political Weekly*, pages 1984–1990.

Aliu, F., Hašková, S., and Bajra, U. Q. (2022). Consequences of russian invasion on ukraine: evidence from foreign exchange rates. *The Journal of Risk Finance*, (ahead-of-print).

Bahmani-Oskooee, M. (2002). Does black market exchange rate volatility deter the trade flows? iranian experience. *Applied Economics*, 34(18):2249–2255.

Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, 131(4):1593–1636.

Başkaya, Y. S., Gülşen, E., and Kara, H. (2012). Inflation expectations and central bank communication in turkey. *Central Bank Review*, 12(2):1–10.

Ben Hassen, T. and El Bilali, H. (2022). Impacts of the russia-ukraine war on global food security: towards more sustainable and resilient food systems? *Foods*, 11(15):2301.

Bhutta, N., Fuster, A., and Hizmo, A. (2020). Paying too much? price dispersion in the us mortgage market.

Cerra, M. V. (2016). *Inflation and the black market exchange rate in a repressed market: A model of Venezuela*. International Monetary Fund.

Cieslak, A. and Schrimpf, A. (2019). Non-monetary news in central bank communication. *Journal of International Economics*, 118:293–315.

Druhov, O. and Druhova, V. (2022). Banking system in ukraine 2022: Before and in the wartime. *Bezpieczny Bank*, 86(1):33–48.

Égert, B. and Kočenda, E. (2014). The impact of macro news and central bank communication on emerging european forex markets. *Economic Systems*, 38(1):73–88.

Elbadawi, I. A. (1997). The parallel market premium for foreign exchange and macroeconomic policy in sudan. *Parallel Exchange Rates in Developing Countries*, pages 221–246.

Fardmanesh, M. and Douglas, S. (2008). Foreign exchange controls and the parallel market premium. *Review of Development Economics*, 12(1):72–89.

Fishelson, G. (1988). The black market for foreign exchange: An international comparison. *Economics Letters*, 27(1):67–71.

Gorodnichenko, Y., Pham, T., and Talavera, O. (2023). The voice of monetary policy. *American Economic Review*, 113(2):548–584.

Hayo, B. and Neuenkirch, M. (2015). Central bank communication in the financial crisis: Evidence from a survey of financial market participants. *Journal of International Money and Finance*, 59:166–181.

Hayo, B. and Zahner, J. (2023). What is that noise? analysing sentiment-based variation in central bank communication. *Economics Letters*, 222:110962.

Hun Seog, S. (2002). Equilibrium price dispersion in the insurance market. *Journal of risk and Insurance*, 69(4):517–536.

Lach, S. (2002). Existence and persistence of price dispersion: an empirical analysis. *Review of economics and statistics*, 84(3):433–444.

Leombroni, M., Vedolin, A., Venter, G., and Whelan, P. (2021). Central bank communication and the yield curve. *Journal of Financial Economics*, 141(3):860–880.

Neely, C. J. (2022). Financial market reactions to the russian invasion of ukraine. *Federal Reserve Bank of St. Louis Review*.

Neuhierl, A. and Weber, M. (2019). Monetary policy communication, policy slope, and the stock market. *Journal of Monetary Economics*, 108:140–155.

Noel, M. D. and Qiang, H. (2019). The role of information in retail gasoline price dispersion. *Energy Economics*, 80:173–187.

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

Subrahmanyam, A. (2018). Equity market momentum: A synthesis of the literature and suggestions for future work. *Pacific-Basin Finance Journal*, 51:291–296.

Unsal, F. and Garbers, H. (2021). Central bank communication through covid-19-focusing on monetary policy. *IMF Special Series on COVID*, 19.

Vayid, I. (2013). Central bank communications before, during and after the crisis: from open-market operations to open-mouth policy.

Wang, Y., Bouri, E., Fareed, Z., and Dai, Y. (2022). Geopolitical risk and the systemic risk in the commodity markets under the war in ukraine. *Finance Research Letters*, 49:103066.

Woodford, M. (2001). Monetary policy in the information economy.

Appendix

Table A1 Sentiment dictionary file. This table lists the dictionary of 'fix' and 'float' words in the NBU announcements related to the FX issues.

Topic of action	Fix words	Float words
single action	cease, prohibit, limit, suspend, ban, forbidden, prevent, restricts	ease, allow, lift, simplify, relieve, permit, simplified, expand, ensure
allowance	shall not, not allow, cannot use	be able to, be allowed to, can be used
restriction	introduce restriction, introduce moratorium	remove restriction, abolish restriction, without restriction, simplify restriction
fx cash	limit fx cash withdraw, limit fx cash supply, ban fx transfer	allow fx cash withdraw, increase fx cash supply, allow fx transfer
supervision	under supervision	without supervision
fix or float	stay fixed rate, no precondition for float, not ready for float, maintain fixed rate, support fixed rate, effective fixed rate	move to float rate, back to float rate, return to float rate,
exception	no exception, without exception	add to list of exception, expand exception

Table A2 The titles and dates of the NBU announcements, related to the FX market.

Date	Title	Fix Words	Float Words	ChatGPT Fix	ChatGPT Float
24/02/2022	How Ukraineâs Banking System and FX Market Will Work from 24 February 2022 Under Martial Law Throughout Ukraine	10	6	1	0
24/02/2022	NBU Makes Changes to Resolution No. 18 On the Operation of the Banking System Under Martial Law Dated 24 February 2022	7	0	1	0
02/03/2022	NBU Lifts Some Bans on FX Transactions	14	14	0	0
03/03/2022	Setting Prices in Foreign Currency in Ukraine Is Illegal and Immoral	2	0	1	0
04/03/2022	NBU Allowed Ukrainian Citizens to Take Abroad Currency Valuables Without Source Documents	6	4	0	0
06/03/2022	On Foreign Currency Purchases and Cross-Border Transfers to Pay for Critical Imports	9	7	1	0
08/03/2022	NBU Eases Multiple FX Market Restrictions	10	10	0	0
21/03/2022	NBU Raises Limit on Cash Withdrawals from FX Accounts in Ukraine, Clarifies Some Restrictions on Cross-Border Transaction	8	13	1	0
14/04/2022	NBU Allows Banks to Sell FX Cash to People, Clarifies Rules for Loan Repayment by Banks to Nonresidents	3	9	0	1
09/05/2022	NBU Eases and Clarifies Some FX Restrictions	4	1	1	0
15/05/2022	NBU Governor Kyrylo Shevchenkoâs Interview with The Asahi Shimbun	8	3	1	0
21/05/2022	NBU Improves Operating Conditions of Cash FX Market and Reduces Limit for Hryvnia Cash Withdrawals Abroad	6	17	0	1
30/05/2022	NBU Governor Kyrylo Shevchenko talks about the need for a policy shift to a new stage with a focus on economic recovery	4	7	0	1
02/06/2022	NBU Raises Key Policy Rate to 25%	17	12	1	0
13/06/2022	Summary of Key Policy Rate Discussion by NBU Monetary Policy Committee on 1 June 2022	30	30	1	0
08/07/2022	NBU Simplifies FX Restrictions on Imports and Extends Settlement Deadlines for Export and Import Transactions	2	9	0	1
21/07/2022	NBU Fixes Official UAH/USD Exchange Rate at a New Level	15	6	1	0
27/07/2022	NBU to Facilitate Higher Supply in FX Cash Market	2	6	0	1
01/08/2022	Summary of Key Policy Rate Discussion by NBU Monetary Policy Committee on 20 July 2022	22	15	1	0
05/09/2022	NBU Continues to Take Action to Increase FX Cash Supply	7	10	0	1
19/09/2022	Summary of Key Policy Rate Discussion by NBU Monetary Policy Committee on 7 September 2022	12	24	0	1
30/09/2022	The National Bank of Ukraine is taking measures to ease demand in the FX marketâs cash segment	8	17	0	1
20/10/2022	NBU does not see preconditions for return to floating Hryvnia rate	11	8	1	0
08/12/2022	Speech by NBU Governor Andriy Pyshnyy at Press Briefing on Monetary Policy Decisions	6	12	0	1

Table A3 Results of asymmetrical model estimation for equation (5) for different lag length values of the parameter j for the sell (Panel A) and buy (Panel B) sides of the market

| Time Lag j	-2	-1	0	1	2	3	4	5	6	7
Panel A: The sell side of the market										
Fix Sentiment	-0.832***	-0.052	0.303*	0.476**	0.485**	1.384***	1.936***	1.205***	1.662***	2.419***
	(0.000)	(0.741)	(0.049)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Float Sentiment	0.527***	0.635***	-0.443**	-0.457**	0.271	0.034	-0.072	-0.377*	-0.614***	-0.891***
	(0.001)	(0.000)	(0.005)	(0.004)	(0.090)	(0.833)	(0.642)	(0.014)	(0.000)	(0.000)
No. of Dealers	0.001	0.002	-0.003	0.003	0.011	0.012	0.024**	0.031***	0.036***	0.037***
	(0.909)	(0.749)	(0.721)	(0.722)	(0.167)	(0.124)	(0.002)	(0.000)	(0.000)	(0.000)
Average Sell	-0.753***	-0.744***	-0.724***	-0.725***	-0.739***	-0.736***	-0.731***	-0.751***	-0.761***	-0.751***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Square	0.529	0.525	0.519	0.525	0.527	0.527	0.533	0.538	0.549	0.571
Sample size	12992	13332	14051	13386	13089	12980	12898	12788	12848	12987
Panel B: The buy side of the market										
Fix Sentiment	-1.054***	-0.137	-0.148	-0.062	0.252	0.579***	1.171***	0.786***	1.243***	1.540***
	(0.000)	(0.321)	(0.269)	(0.645)	(0.069)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Float Sentiment	0.442**	0.420**	-0.220	-0.339*	0.419**	0.222	-0.001	-0.137	-0.358**	-0.688***
	(0.001)	(0.002)	(0.109)	(0.013)	(0.003)	(0.113)	(0.991)	(0.315)	(0.009)	(0.000)
No. of Dealers	-0.008	-0.003	0.003	0.003	0.006	0.004	0.009	0.012	0.014*	0.015*
	(0.271)	(0.676)	(0.601)	(0.685)	(0.346)	(0.551)	(0.199)	(0.073)	(0.038)	(0.027)
Average Sell	-0.452***	-0.449***	-0.440***	-0.434***	-0.451***	-0.451***	-0.449***	-0.466***	-0.474***	-0.467***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Square	0.560	0.551	0.547	0.554	0.556	0.555	0.557	0.558	0.556	0.559
Sample size	12998	13339	14060	13391	13094	12985	12905	12796	12856	12995
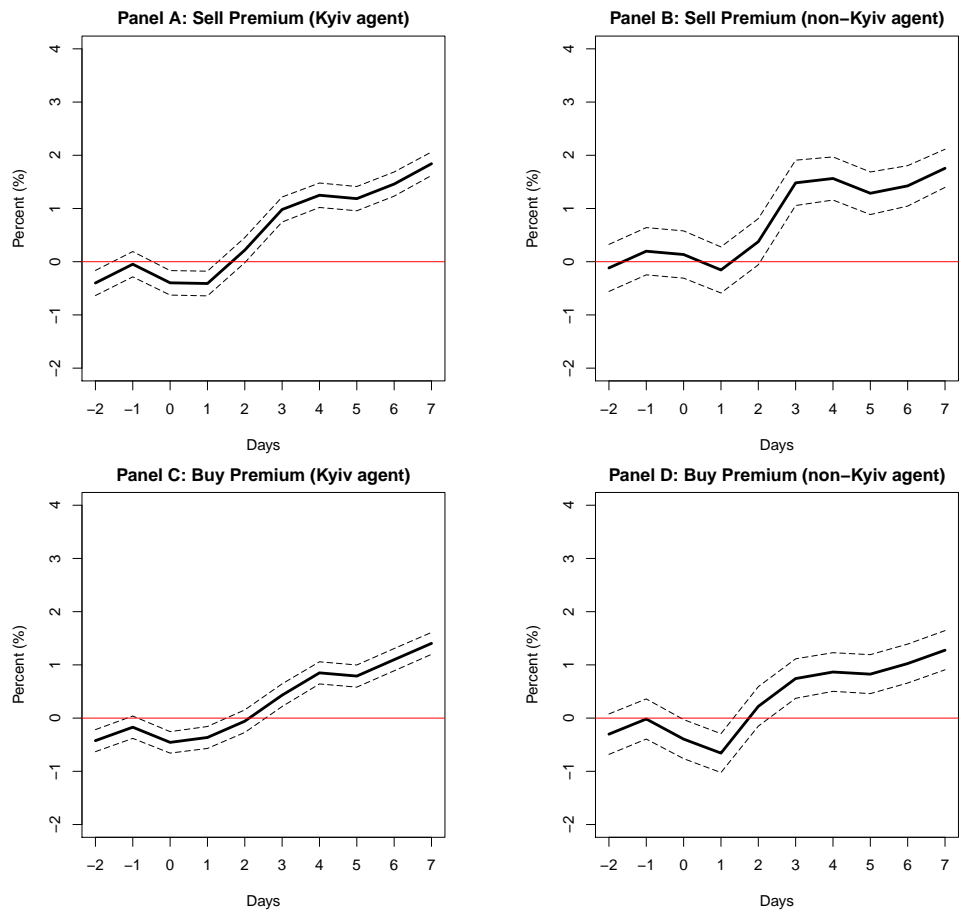
Fig. A1. Evolution of the sentiment response coefficient for the sell sides, for the Kyiv and non-Kyiv agents. This figure shows the results of estimating the sentiment coefficient β from Equation 3 for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.
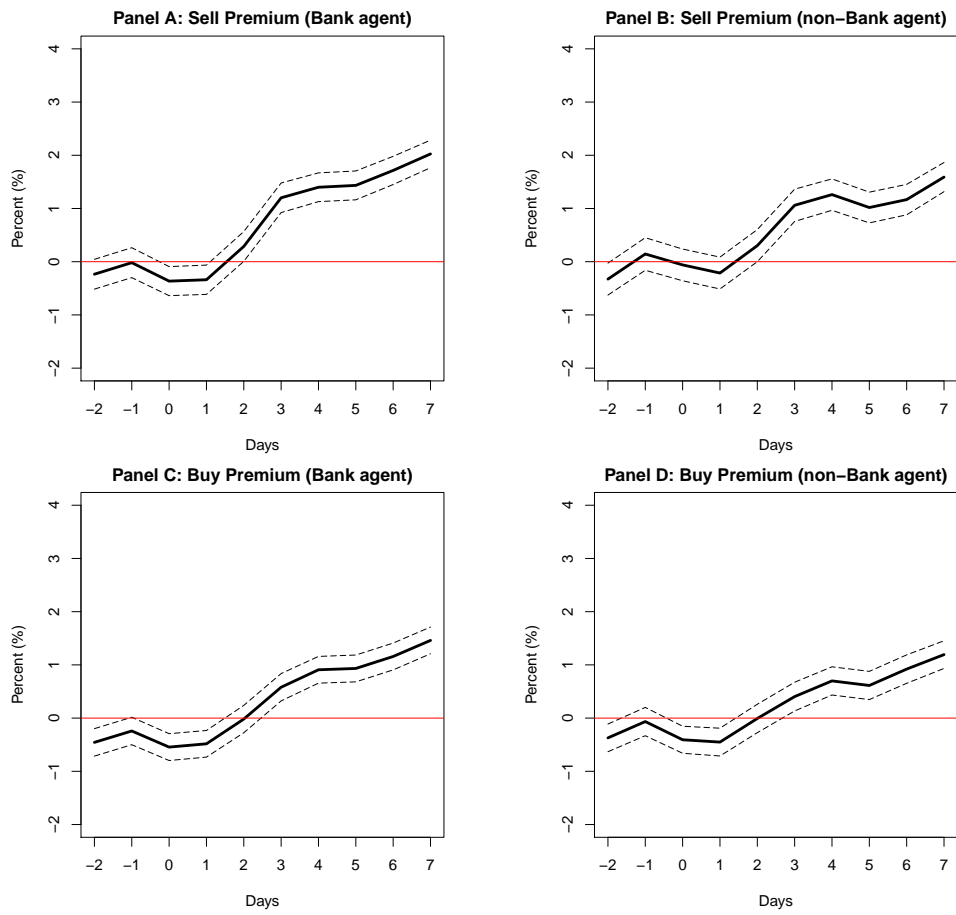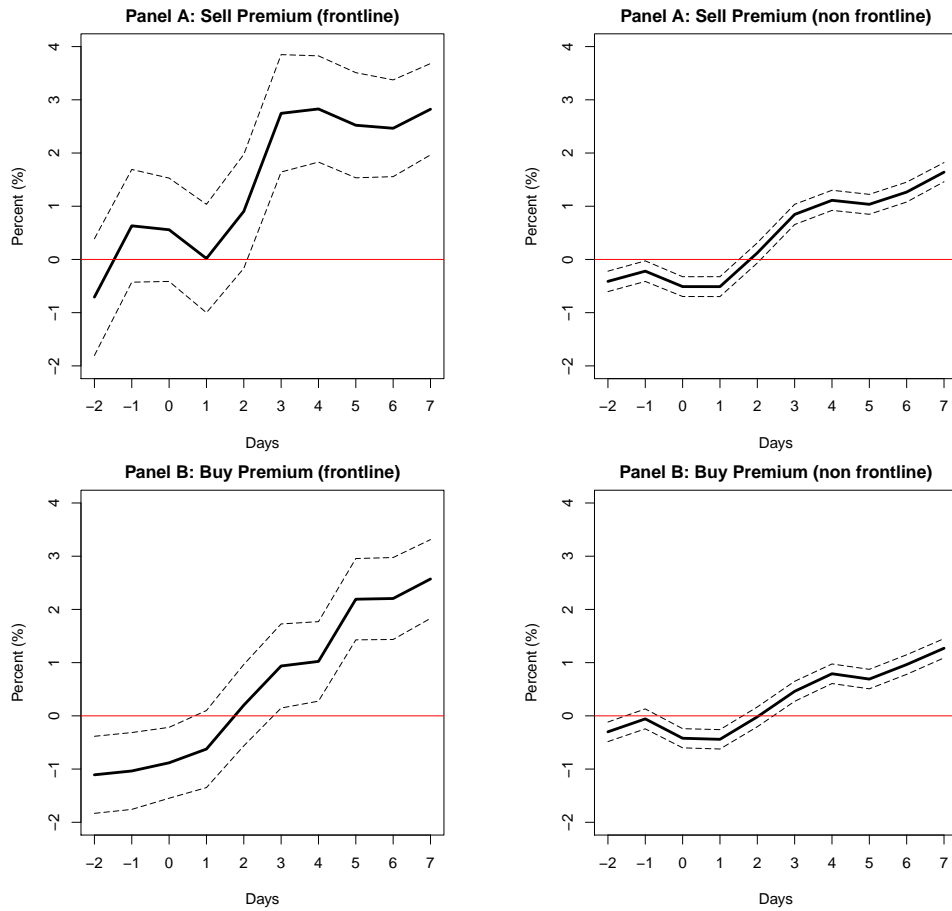
Fig. A2. Evolution of the sentiment response coefficient for the sell sides for the bank and non-bank agents. This figure shows the results of estimating the sentiment coefficient β from Equation 3 for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.

Fig. A3. Evolution of the sentiment response coefficient for the sell sides for the agents in frontline and non-frontline cities. In particular, the *Frontline* is a dummy variable which captures a particular city under ground battles at a certain t, the artillery and missile strikes are not included. This figure shows the results of estimating the sentiment coefficient β from Equation 3 for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.
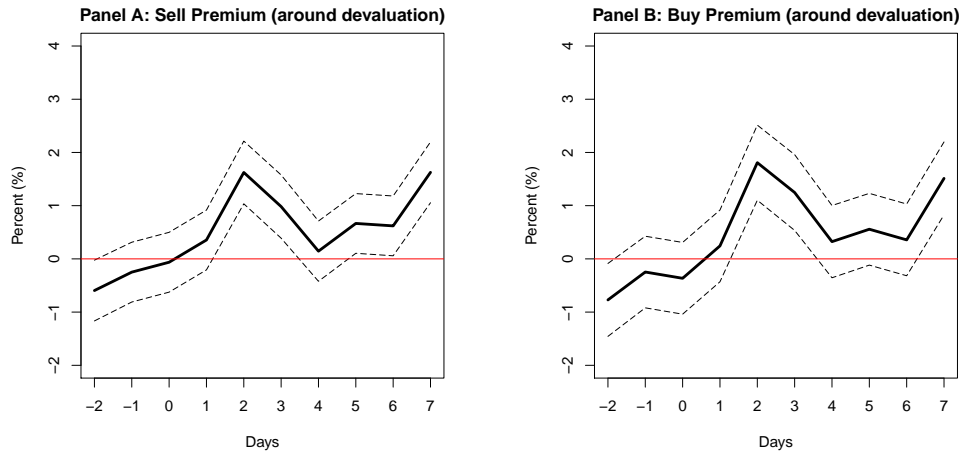
Fig. A4. Evolution of the black market premium around the devaluation issued at 21 July 2022. The Y-axis is the black market premium (BMP). This estimation only includes subsample which covers 1 week before and after the devaluation. We replace the sentiment variable using date dummies. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.
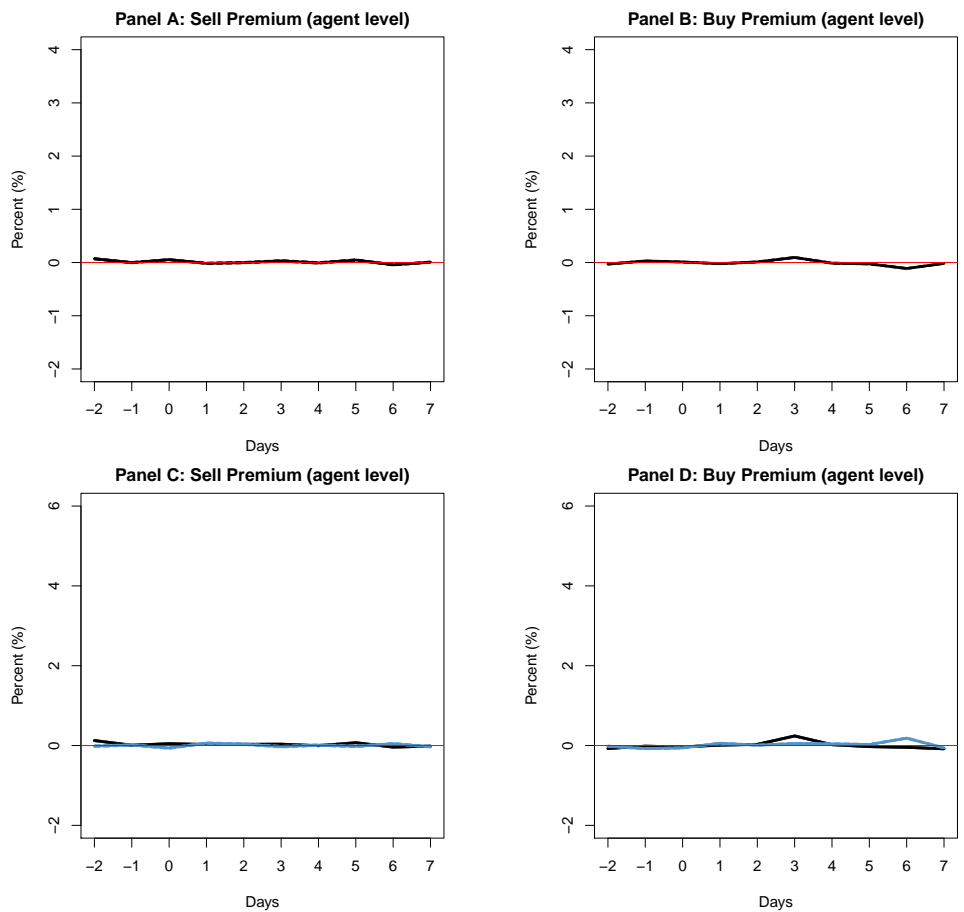

Fig. A5. Placebo regression results. This figure shows the results of estimating the sentiment coefficient β from Equation 3 for the time shift j varying between 2-days before and 7-days after the announcement. The dependent variable is from 2021, while the independent variables are from 2022. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed lines shows the 95% confidence interval.
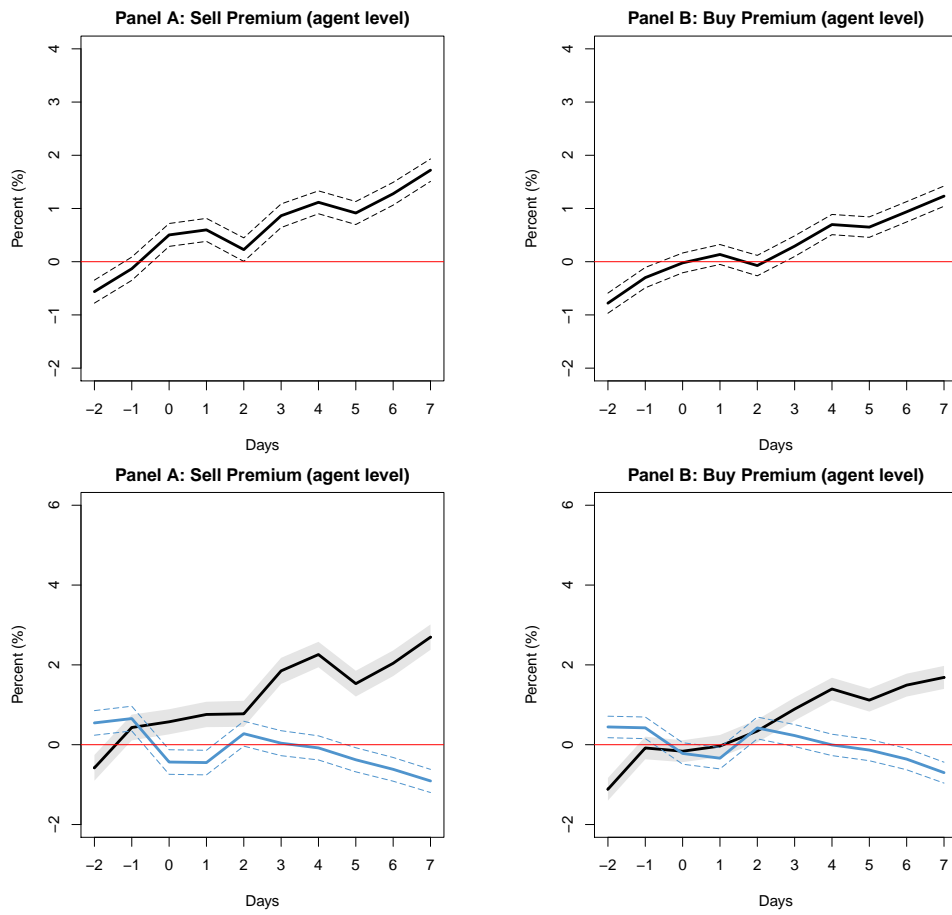
Fig. A6. Evolution of the textual-based sentiment response coefficient for the sell and buy sides. This figure shows the results of estimating the sentiment coefficient β from Equations 3 and 5 for the time shift j varying between 2-days before and 7-days after the announcement. The Y-axis is the black market premium (BMP). The X-axis, is the time shift parameter. The dashed and shaded lines are the 95% confidence interval.