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Federal Reserve Communication and the COVID-19 Pandemic*

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Jonathan Benchimol, Sophia Kazinnik and Yossi Saadon

Abstract

Have the content, sentiment, and timing of the Federal Reserve (Fed) communications changed across communication types during the COVID-19 pandemic? Did similar changes occur during the global financial and dot-com crises? We compile dictionaries specific to COVID-19 and unconventional monetary policy (UMP) and utilize sentiment analysis and topic modeling (LDA) to study the Fed's communications and answer the above questions. We show that the Fed's communications regarding the COVID-19 pandemic concern matters of financial volatility, contextual uncertainty, and financial stability, and that they emphasize health, social welfare, and UMP. We also show that the Fed's communication policy changes drastically during the COVID-19 pandemic compared to the GFC and dot-com crisis in terms of content, sentiment, and timing. Specifically, we find that during the past two decades, a decrease in the financial stability sentiment conveyed by the Fed's interest rate announcements and minutes precedes a decrease in the Fed's interest rate.

תקשורת הפדרל ריזרב ופנדמיה קורונה

יונתן בן שימול, סופיה קזיניק ויוסי סעדון

תקציר

האם התוכן, הסנטימנט והתזמון של תקשורת הפדרל ריזרב (פד) השתנו בין סוגי התקשורת במהלך המגיפת הקורונה? האם התרחשו שינויים דומים במדיניות התקשור של הפד במהלך המשברים העולמיים הקודמים? אנו מרכיבים מילונים ספציפיים המזוהים עם מגפת הקורונה ומדיניות מוניטרית לא שגרתית (UMP) ומשתמשים בניתוח סנטימנטים ובמודל ניתוח נושאים (LDA) כדי ללמוד את התקשורת של הפד ולענות על השאלות שלעיל. אנו מראים שהתקשורת של הפד בנוגע למגפת הקורונה עסקה בתנודתיות במחירי הנכסים ובסוגיות של יציבות פיננסית וכן בנושאי בריאות, רווחה חברתית ובמדיניות מוניטרית לא קונבנציונלית. אנו גם מראים שמדיניות התקשורת של הפד השתנתה באופן דרסטי במהלך מגפת הקורונה בהשוואה למשבר הפיננסיים הקודמים מבחינת התוכן, הסנטימנט והתזמון. באופן ספציפי, אנו מוצאים כי בשני העשורים האחרונים, להורדות ריבית על ידי הפד קדמה ירידה בסנטימנט כלפי היציבות הפיננסית כפי שנשקף בהודעות הריבית ובפרוטוקולים של הפד.

1. Introduction

At the outbreak of COVID-19, most central banks declared that they would take “all necessary steps” to mitigate the impact of the pandemic on their economies and decreased their interest rates to the zero-lower bound. Although conventional monetary policy tools have proven almost ineffective in the ensuing unprecedented economic crisis, unconventional monetary policy (UMP) tools have drastically changed both within and between central banks. At the same time, the content, sentiment, and timing of the central banks’ communications regarding their UMP measures and sentiments have changed as well.

However, there are no studies on how the content, sentiment, and timing of the communications of the Federal Reserve (Fed) change. In this paper, we study such changes across three different communication types (namely, Fed fund rate announcements, Federal Open Market Committee minutes, and Fed chairman speeches) during the past two decades and three different economic crises (namely, the GFC, dot-com, and COVID-19 crises). We pay particular attention to the Fed’s communications regarding financial stability and conventional and unconventional monetary policies.

Using state-of-the-art text-mining methodologies, we first analyze the Fed’s communications throughout 2020 to show they were uncertain⁴ and heterogeneous during the COVID-19 crisis over time and across communications types. We then analyze how the Fed’s communications relate to the outbreak of the pandemic and subsequently derive potential policy implications from this analysis. Finally, we show that the Fed’s communications and actions have been more reactive to the COVID-19 crisis than to the global financial crisis (GFC) and the dot-com crisis. Indeed, some of the Fed’s communications and UMP-related actions appear to have anticipated the spread of COVID-19. Taken together, our findings show that the Fed’s communication policy has been drastically different during the COVID-19 pandemic than during the GFC and dot-com crises.

Central banks communicate on a variety of topics, through different channels, and with well-defined objectives (Hansen et al., 2019; Benchimol et al., 2020a). Central bank communication aims to inform (e.g., current and future policy objectives and decisions), explain (e.g., past, current, and future economic outlook and decisions), and influence (e.g., current and future uncertainty and financial decisions). These communications are usually published and stored as text (Haldane and McMahon, 2018).

The COVID-19 pandemic has affected all sectors of the global economy (Chetty et al., 2020). In particular, the effect of the pandemic on financial markets and social welfare has led to changes in monetary policy and threatened financial stability (Daly, 2020; Craig et al., 2021). Naturally, central banks have played an influential role during the COVID-19 crisis, and have adapted their communication policies to the current global economy. As in the GFC, central banks have managed the COVID-19 crisis using UMP tools (e.g., forward guidance, quantitative easing, funding and lending

⁴ Communications are “uncertain” in the sense that they use nonspecific word such as “approximate,” “contingent,” “indefinite,” and “uncertain.”

facilities, adjustments to market operations, negative or dual interest rates, etc.). Their objective has been to decrease uncertainty and increase financial stability.

In this paper we examine the Fed’s communications on conventional and unconventional monetary policies during the COVID-19 crisis by focusing on the most significant types of communications. Specifically, we look at Fed fund rate (FFR) announcements, Federal Open Market Committee (FOMC) minutes (policy decision discussions and deliberations), and speeches given by the Fed chairman. Like most central banks whose primary policy instrument (the nominal interest rate) has a zero or negative lower bound, the Fed’s policy stance and subsequent expectation shaping is implemented through other channels, including communications, quantitative easing (QE), balance sheet policies, lending facilities, fiscal and money drops, forward guidance, and other market operations.⁵ Although these decisions are undeniably related to global economic stability, which may involve monetary policy, credibility, and independence risks, the COVID-19 pandemic has led to unprecedented central bank monetary policy decisions. We examine the Fed’s communications related to these decisions over the past two decades. This analysis allows us to study whether the Fed successfully implemented clear and transparent communications to support UMP measures addressing the economic challenges caused by the COVID-19 pandemic. Our descriptive analysis shows that Fed’s communication was used in a timed and targeted way, showcasing Fed’s increasing experience in crisis-specific communication management. The methodologies and technical tools used in this paper, such as R functions and applications to central bank texts, are available in Benchimol et al. (2020b).

In a highly uncertain economic environment such as that of the COVID-19 crisis, the standard for effective central bank communications would normally consist of straightforward and timely updates about current and near-term policy actions. Accordingly, financial stability updates have prevailed in the Fed’s monetary policy and financial market-related communications. To proxy for the degree of financial stability conveyed in a central bank communication, we calculate a financial stability score for each relevant communication based on a word count of the terms that can also be found in the financial stability dictionary (Correa et al., 2021).

We study how monetary policy and financial stability are considered in central bank communications over time, from the dot-com crisis to the COVID-19 pandemic. Specifically, we analyze how the Fed’s communication policy during the COVID-19 pandemic compares to that of the dot-com and GFC crises. The correlation of the sentiment and uncertainty of the Fed’s communications to economic and financial variables, unconventional monetary policies, and the COVID-19 pandemic is also investigated. Finally, we focus on how the Fed’s UMP-related communications have evolved during the past two decades.

We find that the content, timing, and sentiment of the Fed’s communications exhibit noteworthy differences conditional on the crisis. Since the GFC, communications regarding UMP have become the “new normal,” as reflected in all three communication types, namely, FFR announcements, FOMC minutes, and Fed chairman speeches. COVID-19 appears to have caused structural changes in the Fed’s

⁵ See, e.g., Bianchi et al. (2020) and Guerrieri et al. (2020).

communication content. We also find evidence for a link between conventional monetary policy and financial stability sentiment.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 presents the results of the text analysis. Section 4 presents the results of the sentiment analysis. Section 5 presents the results of the topic modeling of the past and current economic situations. Section 6 examines the Fed’s communications on unconventional monetary policy. Section 7 discusses the Fed’s early communications on the pandemic. Section 8 compares the Fed’s conventional monetary policy to its financial stability sentiment over the past two decades. Section 9 derives some policy implications, and Section 10 concludes. Section 12 presents the dictionaries used to analyze UMP and COVID-19 and additional results. The methodologies used in this paper are presented in Benchimol et al. (2020b).

2. Data

2.1 Text Data

Our study focuses on the most significant types of Fed’s communications intended for public consumption. We gathered 776 of these communications for the period 2000–2020. The sample contains formal communications detailing monetary policy discussions (FFR announcements and FOMC minutes) as well as less formal communications (Fed chairman speeches).

Our dataset is summarized in Table 1. In addition to the texts, we use dictionaries for our text analysis purposes: namely, a well-known finance dictionary (Loughran and McDonald, 2011), a financial stability dictionary (Correa et al., 2021), an UMP dictionary (Christensen and Rising, 2017; Henry, 2008), and our own COVID-19 dictionary.⁶

Loughran and McDonald (2011) is a dictionary developed to measure the sentiment of financial texts better than general dictionaries. This dictionary is widely used in text analyses in the finance and economics literatures (Loughran and McDonald, 2016; Benchimol et al., 2020a). Loughran and McDonald (2011) also developed a dictionary to measure the uncertainty conveyed in financial texts.

Table 1. Descriptive Statistics: Federal Reserve Texts

	No. Texts	No. Words (average)	Sample
FFR Announcements	181	400	2000–2020
FOMC Minutes	170	6809	2000–2020
Chairman Speeches	425	2931	2000–2020
Total	776	3213	2000–2020

Notes: “Total” refers to the sum of all three communication types.

Sources: The Federal Reserve Board of Governors and FederalReserve.gov archives.

⁶ Our UMP and COVID-19 dictionaries are presented in the Appendix.

Correa et al. (2021) construct a dictionary explicitly tailored to financial stability contexts. This dictionary classifies words as positive or negative based on the sentiment they convey in financial stability reports.

For the UMP dictionary, we rely on a dictionary that translates central bank communications about future monetary policy into groups of positive and negative words (Christensen and Rising, 2017), and merge this dictionary with a more market-related dictionary (Henry, 2008). These two dictionaries are analyzed and compared in Erasmus and Hollander (2020).

Finally, we construct a COVID-19 dictionary by compiling relevant keywords that relate to the pandemic. We use this dictionary to capture the frequency (or “intensity”) of words associated with the COVID-19 pandemic in the Fed’s communications in order to identify virus-related content in those communications.

We describe how we apply these dictionaries to our sample in Section 3. See the Appendix for more details about the UMP and COVID-19 dictionaries.

2.2 COVID-19 Data

The database for the COVID-19 statistics is the COVID-19 Data Repository⁷ maintained by the Johns Hopkins University Center for Systems Science and Engineering (CSSE), with the support of the ESRI Living Atlas Team and the Johns Hopkins University Applied Physics Lab (APL). In our analysis, we essentially utilize the daily number of new COVID-19 cases.

2.3 Financial Data

The daily financial dataset used in this paper is collected through Bloomberg. It includes the SP500 equity index, the CBOE VIX, the nominal effective exchange rate (broad), and the nominal interest rate (FFR).

3. Methodology

This study aims to capture the change and impact of the Fed’s communications during the COVID-19 pandemic.⁸ To this end, we build text-based measures of uncertainty and sentiment in the Fed’s communications by utilizing an array of custom dictionaries, as described in the previous section.

We use three text-mining techniques: word counting, sentiment scoring, and topic modeling. First, we use simple word-counting procedures. Specifically, we count the terms related to UMP and COVID-19 that appear in the Fed’s communications. Second, we use sentiment scoring. This supervised machine-learning method allows us to measure sentiments conveyed by the Fed’s communications. Specifically, we use the Loughran and McDonald’s (2011) dictionary to proxy for sentiment and uncertainty in the Fed’s communications and build several sentiment scores and polarity indicators based on general (NRC, SentiWords, Hu&Liu, Jockers) and specialized (financial stability, UMP) dictionaries. Third, we use topic modeling. This unsupervised machine-learning method allows us to extract and examine the thematic

⁷ The full dataset can be downloaded from <https://github.com/CSSEGISandData/COVID-19>

⁸ Central bank communications are defined as significant communications such as FFR announcements, FOMC minutes, and Fed chairman speeches.

content of the Fed’s communications. Specifically, we use the latent Dirichlet allocation (LDA) algorithm to compare the content of Fed’s communications to economic and financial developments.

The results presented below are obtained with the statistical software R. The R functions and packages used in this paper are described in Benchimol et al. (2020b).

3.1 Word Counting

To estimate the amount of coverage of the COVID-19 pandemic in each of the Fed’s communications, we construct a COVID-19-specific dictionary, presented in the Appendix. By counting the number of COVID-19-related words in each Fed communication, we can estimate how the Fed perceived the severity of the pandemic at that time.

In addition, we construct another dictionary that captures communications regarding the Fed’s UMP measures by merging two existing dictionaries, those of Erasmus and Hollander (2020) and Henry (2008). We then calculate the overall sentiment related to UMP measures using this merged dictionary.

Finally, we explore whether the onset of the COVID-19 pandemic impacted communication clarity.

3.2 Sentiment Scoring

To measure the sentiment of the Fed’s communications, we implement several methods of capturing text sentiment. The general methodology is based on counting positive and negative words according to a specific dictionary. The sentiment score is calculated by dividing the difference between the number of positive and negative words by the total amount of words.

To this end, we use Correa et al.’s (2021) dictionary, which is specifically tailored to capture financial stability sentiment. Correa et al. (2021) explain movements in financial cycle indicators related to credit, asset prices, systemic risk, and monetary policy rates and classify words (positive/negative) based on the sentiment conveyed in financial stability reports. The second dictionary focuses on forward-guidance and quantitative measures (Christensen and Rising, 2017) that we merge with another dictionary that focuses more on the regulatory context, structural attributes, and dual informational-promotional role of earnings press releases (Henry, 2008).

We use another set of dictionaries to capture different dimensions of the sentiment expressed in the text, such as the Loughran and McDonald (2011) sentiment dictionary, as well as a set of commonly used sentiment dictionaries in the text-mining literature, such as the Jockers, NRC, and Hu&Liu dictionaries. We use these dictionaries in conjunction with the so-called valence shifters (i.e., negators, amplifiers/intensifiers, de-amplifiers/downtoners) to capture nuances in the sentiment of the relevant text.

Last but not least, we construct two types of sentiment indicators based on the Loughran and McDonald (2011) dictionary. One is the standard score measure described above. The other is a polarity measure that includes the possibility of neutral, positive, negative, very positive, or very negative sentiment, according to the sentiment of the words immediately preceding and following the considered word.

Section 4 presents sentiment scores produced from these dictionaries for FFR announcements, FOMC minutes, and Fed chairman speeches. For these three communication types, we note a sharp decrease in sentiments in the first quarter of 2020, as well as a spike in uncertainty-related words during that same period. This finding suggests that the Fed's communications reflect its willingness to address the ongoing developments during the COVID-19 pandemic proactively.

3.3 Topic Modeling

Our goal in this section is to identify underlying themes that drive the Fed's communications and to capture theme prevalence over time. For this purpose, we rely on the so-called topic modeling approach. This algorithm allows us to identify a small number of verbal themes that best explain thematic variation over time, and we use it to capture the Fed's assessments of economic and financial risks in real-time.

Topic modeling is an unsupervised machine-learning technique that does not require any training or dictionary-based analysis. Here, we use LDA, which works in the following way. The LDA algorithm views each document as a mixture of topics that are present in the body of the text. The algorithm scans a set of relevant documents (FFR announcements, FOMC minutes, and Fed chairman speeches), detects words and phrases within them, and automatically clusters word groups (i.e., topics) that best characterize a set of documents. In essence, the algorithm identifies the different topics represented in the document, and calculates the prevalence of each of them (Blei et al., 2003).

In the following Section 4, we present the results of the word-counting and sentiment-scoring analysis and interpret them by providing a descriptive picture of the sentiments the Fed's communications conveyed. Section 5 presents the results of the topic modeling analysis. Overall, we find that at the onset of the COVID-19 pandemic, the topics related to policy intervention gained prominence, at the expense of other topics. We relate UMP to our various indicators and the Fed's communication types in Section 6 and control for the severity of the outbreak by including the number of COVID-19 cases at the time of the communication in Section 7. We also describe and relate our text-mining indicators to financial stability and interest rate decisions over the past two decades in Section 8.

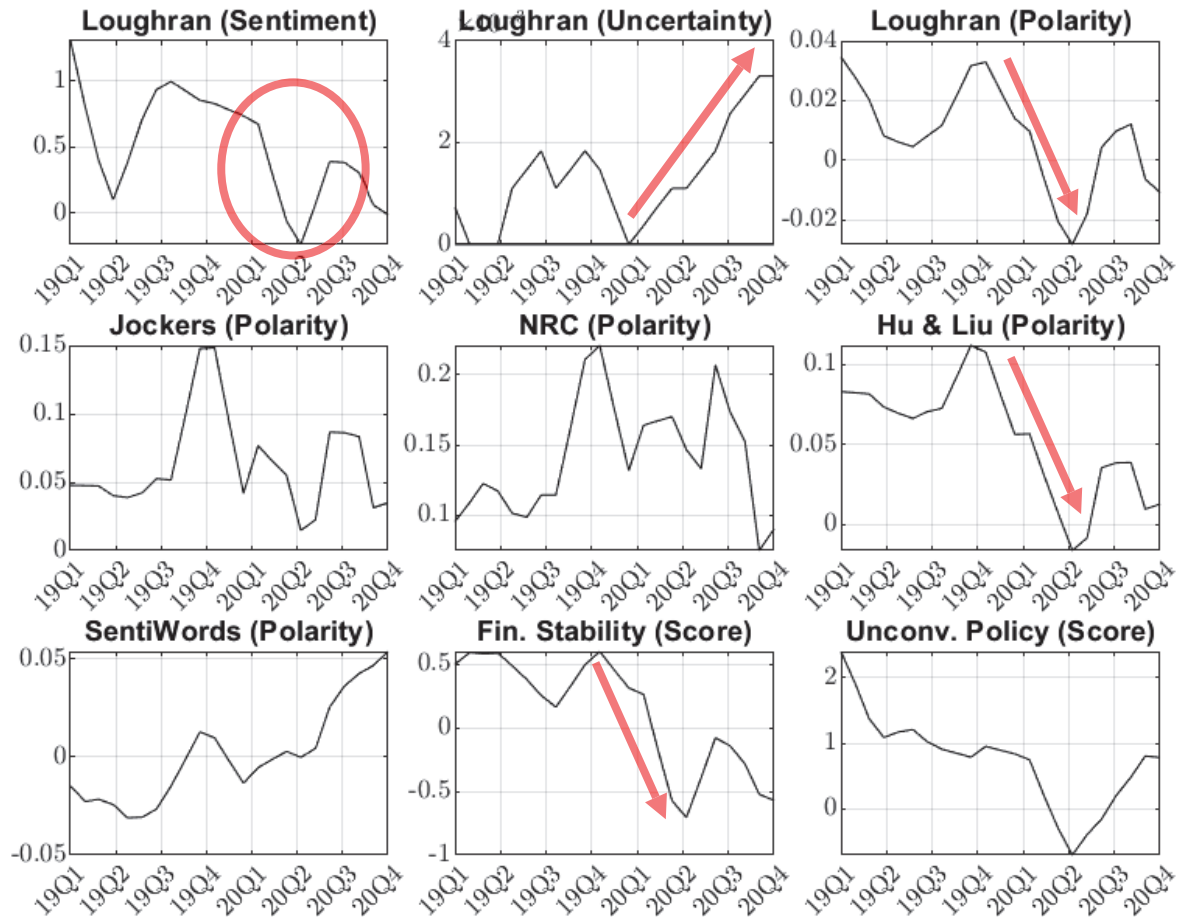
4. Sentiment Analysis

Figure 1 presents several sentiment indicators extracted from the text analysis of FFR announcements. The sentiments sharply degraded following the COVID-19 outbreak in China in January 2020 and the US in March 2020. This date range corresponds to an increase in the contextual uncertainty indicator (the number of words reflecting uncertainty, scaled by text length).

Based on the Loughran and McDonald (2011) dictionary, our new polarity indicator decreases but displays a more optimistic sentiment for 2020Q3. FFR announcements summarize the current state of the economy and monetary policy decisions. Figure 1 shows that the shock that occurred in January 2020 lasts up until April 2020.

The sharp decrease in sentiments in 2020Q1-Q2, and the increase in the contextual uncertainty in 2020Q1-Q3, correspond to the beginning of the COVID-19 crisis.

Figure 1. Sentiment Scores in FFR Announcements



Notes: Solid black lines represent sentiment score values. Red arrows represent trends related to the COVID-19 outbreak.

Figure 1 also shows that the SentiWords, Jockers, and NRC polarity indexes are (apparently) less informative, while the Hu&Liu polarity index displays similar dynamics to our Loughran and McDonald-based polarity index. SentiWords, a high-coverage polarity index, captures an interesting increase in the sentiment of FFR announcements from the beginning of the COVID-19 crisis. A potential explanation for this increase is that the Fed used a different communication strategy in this crisis than in the GFC and dot-com crisis.⁹ The financial stability sentiment has been decreasing into negative territory since 2019Q4, which means that more negative financial stability-related words were present in the FFR announcements than positive ones.

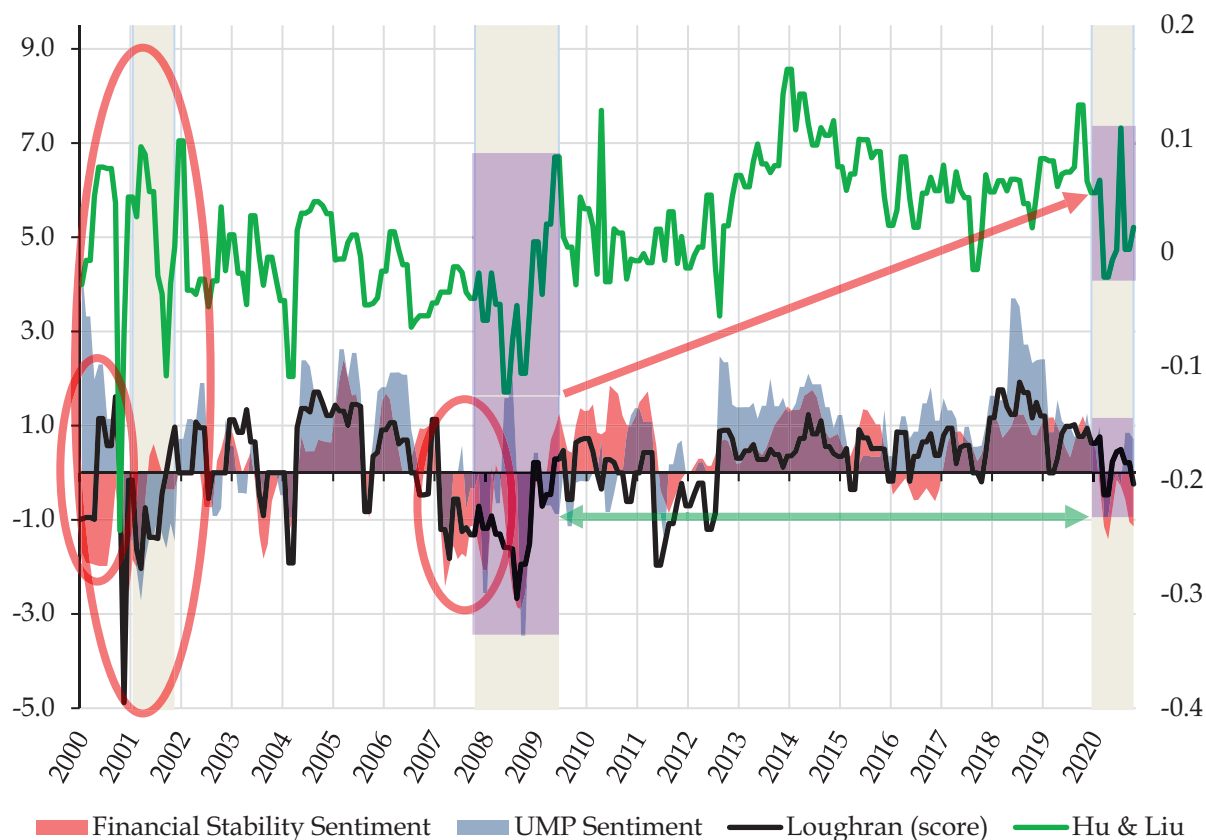
Interestingly, the UMP sentiment decreased mainly because this indicator includes forward-guidance sentiment but also words found in standard dictionaries.

⁹ SentiWords polarity index sharply decreases for the GFC and dot-com crisis. The results of the full sample are available in the Appendix (Figure A1).

Note that these results are based on FFR announcements, which are the most supervised and controlled¹⁰ communication type.

Figure 2 presents selected sentiment indicators over the full sample. As proxied by our sentiment measures, the Fed's communications differ significantly in sentiment during the COVID-19 crisis, compared to the GFC and the dot-com crisis.

Figure 2. A Tale of Three Crises: Sentiment.



Notes: The gray shaded area represents the NBER recessions periods. Solid lines represent sentiment scores computed from FFR announcements.

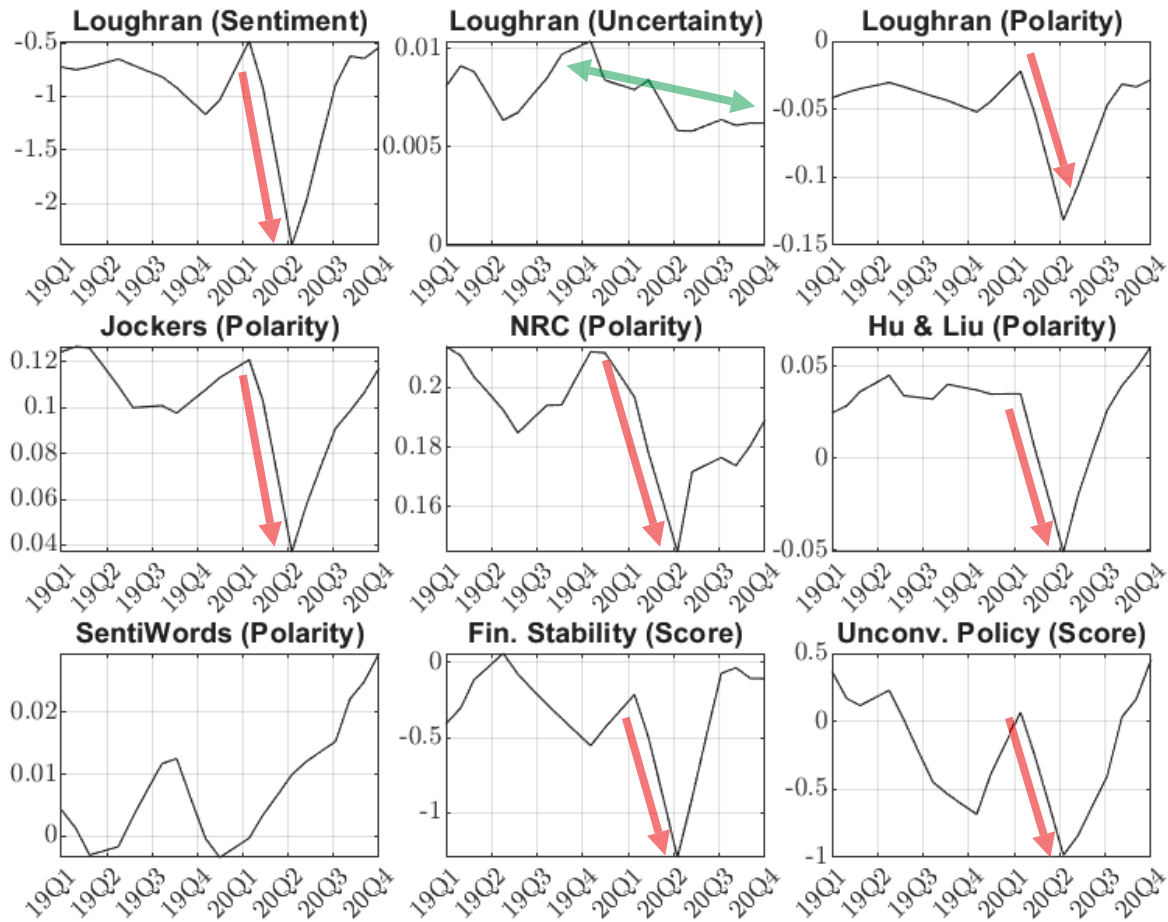
The financial stability sentiment sharply deteriorated before the GFC and dot-com crisis, whereas it is significantly positive before the COVID-19 pandemic. The FFR announcements appear to be a significant predictor of future conventional monetary policy (see Section 8).

The Hu and Liu sentiment polarity index improved from the GFC until the COVID-19 crisis. It decreased less in the COVID-19 crisis than in the other crises. While the Loughran and McDonald sentiment index did not improve between the crises, it decreased less in the COVID-19 crisis than in the other crises. Also, the volatility of these indicators was less pronounced in the COVID-19 crisis than in the GFC and dot-com crisis. Although Figure 2 presents the tale of three crises, it also clearly shows a tale of three communication policies.

¹⁰ By the spokesperson, and other Fed's departments or officials.

Figure 3 presents the same indicators for the FOMC minutes. The dynamics for almost all sentiment indicators display a sharp deterioration in 2020Q2, which is much more pronounced for the FOMC minutes than for the FFR announcements.

Figure 3. Sentiment Scores for the Fed’s FOMC Minutes



Notes: Solid black lines represent sentiment score values. Red arrows represent trends related to the COVID-19 outbreak.

This probably reflects the gap between the description of the current economic situation (FFR announcements) and the discussions and tentative solutions to the COVID-19 crisis (discussed in the minutes). The Loughran and McDonald score and polarity indexes showed a sharp decrease in sentiment related to financial uncertainty from January to April 2020.

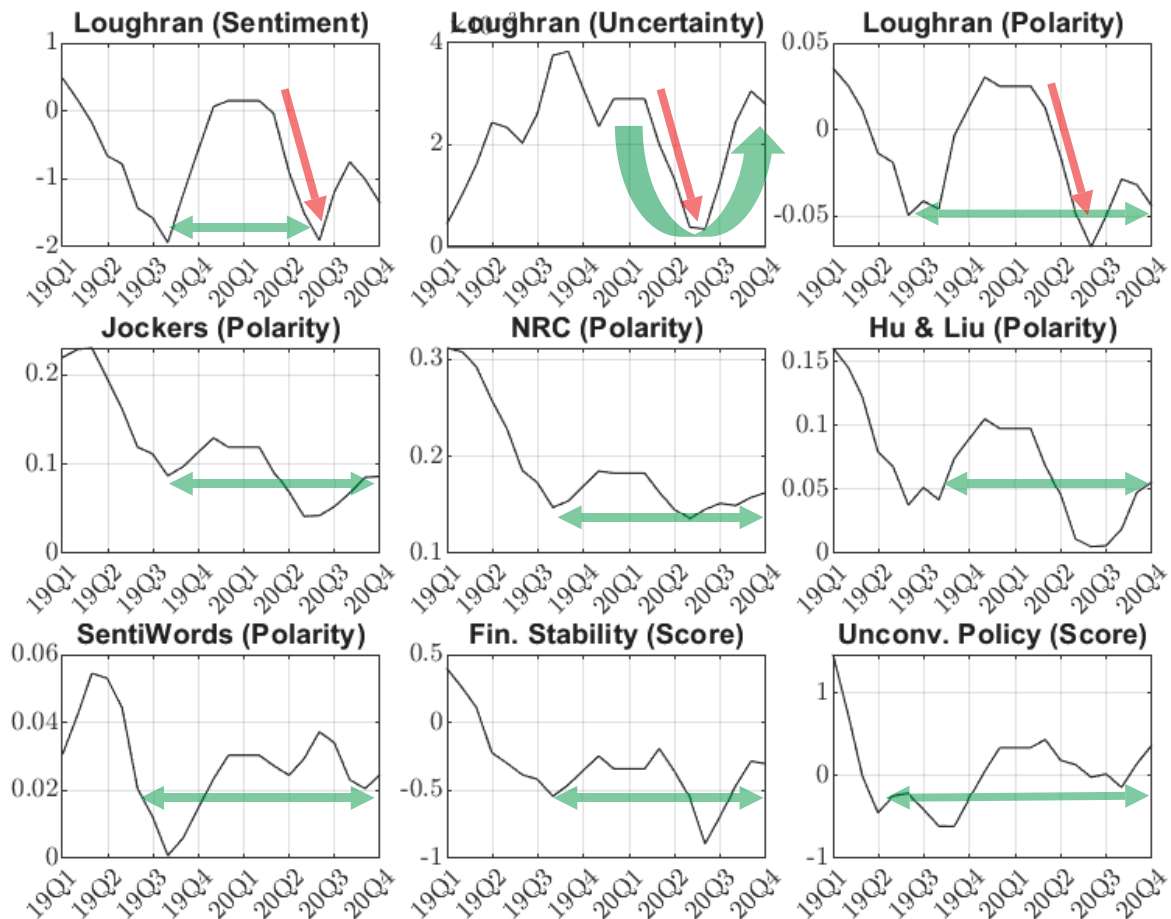
The UMP sentiment score decreases until 2020Q2 and then sharply increases until it becomes positive. This phenomenon corresponds to the more positive language adopted in FOMC minutes regarding UMP steps taken during the COVID-19 crisis. Figure 3 also shows that according to FOMC minutes (i.e., according to policymakers during monetary policy committee discussions), financial stability was perceived to be at risk in 2020Q2. This was effectively the case in reality but less so than during the GFC, as explained in the Appendix (Figure A5).

The high coverage of the SentiWords index captures an interesting pattern of increasing sentiment from the beginning of the COVID-19 crisis. This may result from the Fed’s communication strategy to calm and reassure economic agents with the use

of more positive words. This was not the case during the GFC, where the SentiWords indicator sharply declined to historically low levels.¹¹

Figure 4 presents the sentiment indicators for the official speeches of the chairman of the Federal Reserve.

Figure 4. Sentiment Scores for Fed Chairman Speeches



Notes: Solid black lines represent sentiment score values. Red arrows represent trends related to the COVID-19 outbreak. Green arrows represent trends that remain constant before and after the COVID-19 outbreak.

The sentiment conveyed by Fed chairman speeches decreases less in comparison to the minutes and announcements. A potential explanation is that the speeches might be aimed at managing expectations more than the minutes and announcements are. Although the economic situation worsened and sentiments degraded from February 2020 onward, contextual uncertainty decreased.

The sentiment conveyed by the Fed chairman speeches is generally more volatile than the sentiment conveyed by FFR announcements and minutes (Benchimol et al., 2020a). However, the small sample makes the sentiment indicators for the COVID-19 crisis presented in Figure 4 less volatile than those for the GFC.¹²

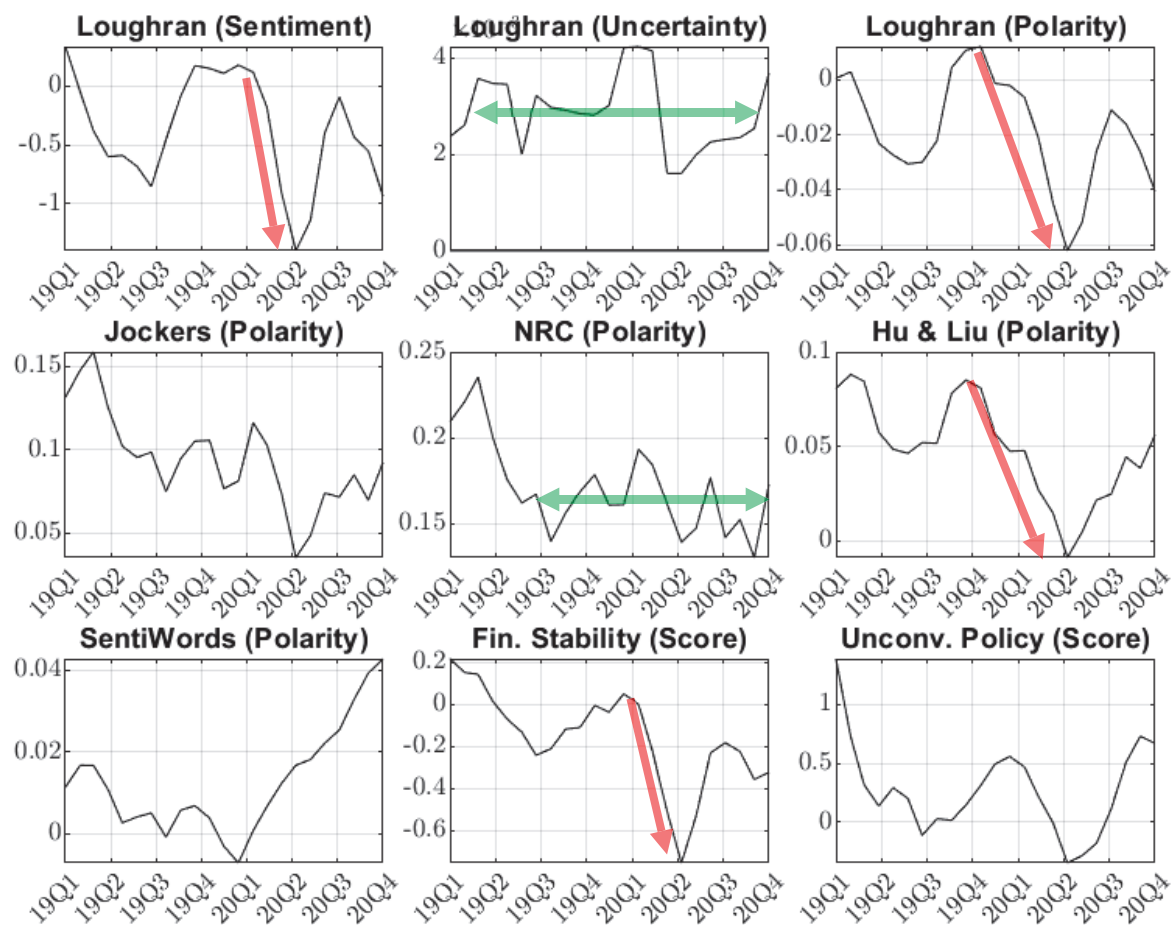
¹¹ The results of the full sample are available in the Appendix (Figure A2).

¹² The results of the full sample are available in the Appendix (Figure A3).

As for the FFR announcements and minutes, the large scope of the SentiWords dictionary captures this specific Fed’s communication policy held during the COVID-19, which seems to have been in force at least up until 2020Q4. The Loughran and McDonald dictionary also shows a decrease in the use of uncertainty-related words in the Fed chairman speeches since the COVID-19 outbreak in China, which may also result from a specific communication policy.

Figure 5 presents aggregated sentiment indicators based on FFR announcements, FOMC minutes, and Fed chairman speeches.

Figure 5. Sentiment Scoring of Main Fed Communications



Notes: Solid black lines represent sentiment score values. Red arrows represent trends related to the COVID-19 outbreak. Green arrows represent trends that remain constant before and after the COVID-19 outbreak.

We provide a global picture of the Fed’s communications by aggregating all communication types in our dataset. Figure 5 shows a sharp decrease in the uncertainty sentiment, which is mainly driven by minutes and speeches. The financial stability sentiment sharply decreases from January to April 2020, which may be correlated with volatility measures such as the CBOE VIX (see Section 7).

The results presented in Figures 1–5 point to the same conclusion. Namely, it is highly likely that the Fed has globally implemented the same communication policy across all communication types (FFR announcements, FOMC minutes, Fed chairman

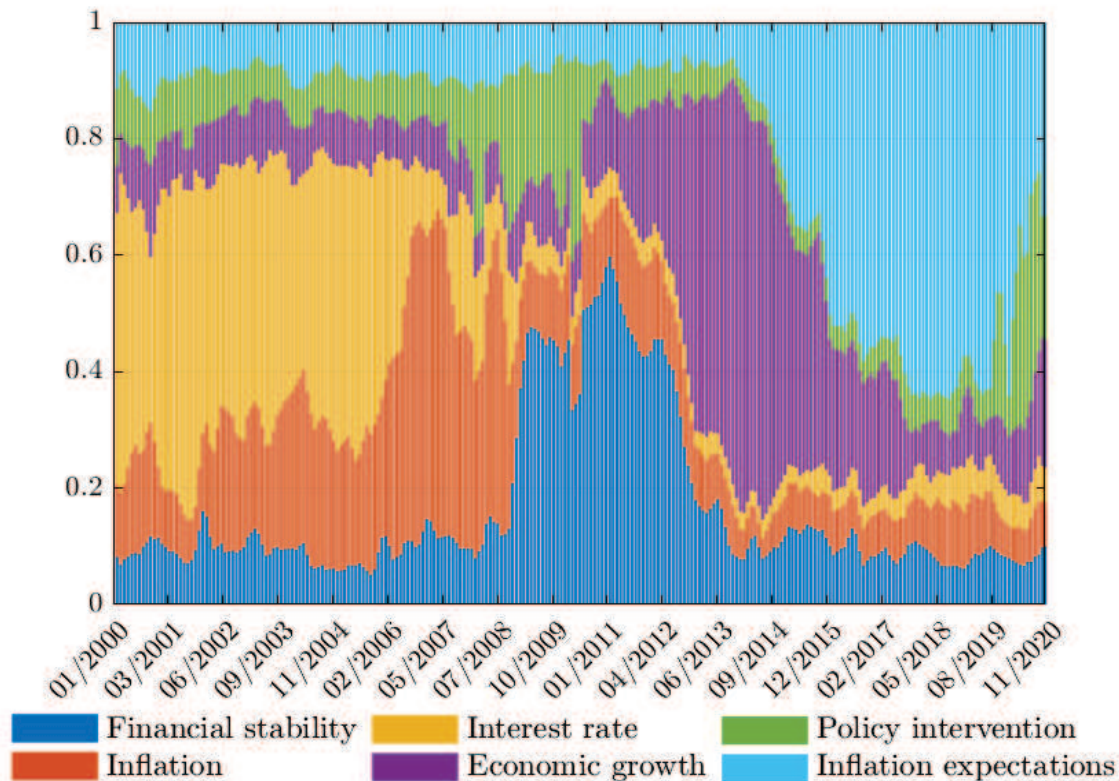
speeches) during the COVID-19 crisis. These results also demonstrate the different sentiments involved in the COVID-19 crisis compared to the GFC.¹³

This section covers the special sentiment deterioration that occurred from January to April of 2020. The recovery of sentiment into positive territory took place following this deterioration, with some sentiment measures rising above pre-crisis levels. Looking at the pronounced differences in sentiment over time, we find evidence that the Fed’s communications were used to shape the narrative and manage expectations.

5. Topic Modeling

In this section, we focus on the topics extracted from our sample of texts. It is important to note that the topic modeling methodology does not use any predetermined dictionaries. In contrast to sentiment analysis, it is a more structural and unsupervised approach to interpreting word-topic linkages in texts.

Figure 6. A Tale of Three Crises: Topics.



Note: Bars represent the topic probability computed from FFR announcements. For clarity and robustness, we restrict attention to the six most frequently discussed topics.

Source: Benchimol et al. (2020a).

Figure 6 presents the six topics extracted from FFR announcements over the past two decades. It shows that discussion of policy interventions was more pronounced during the COVID-19 than during the other crises. Interestingly, Figure 6 shows that

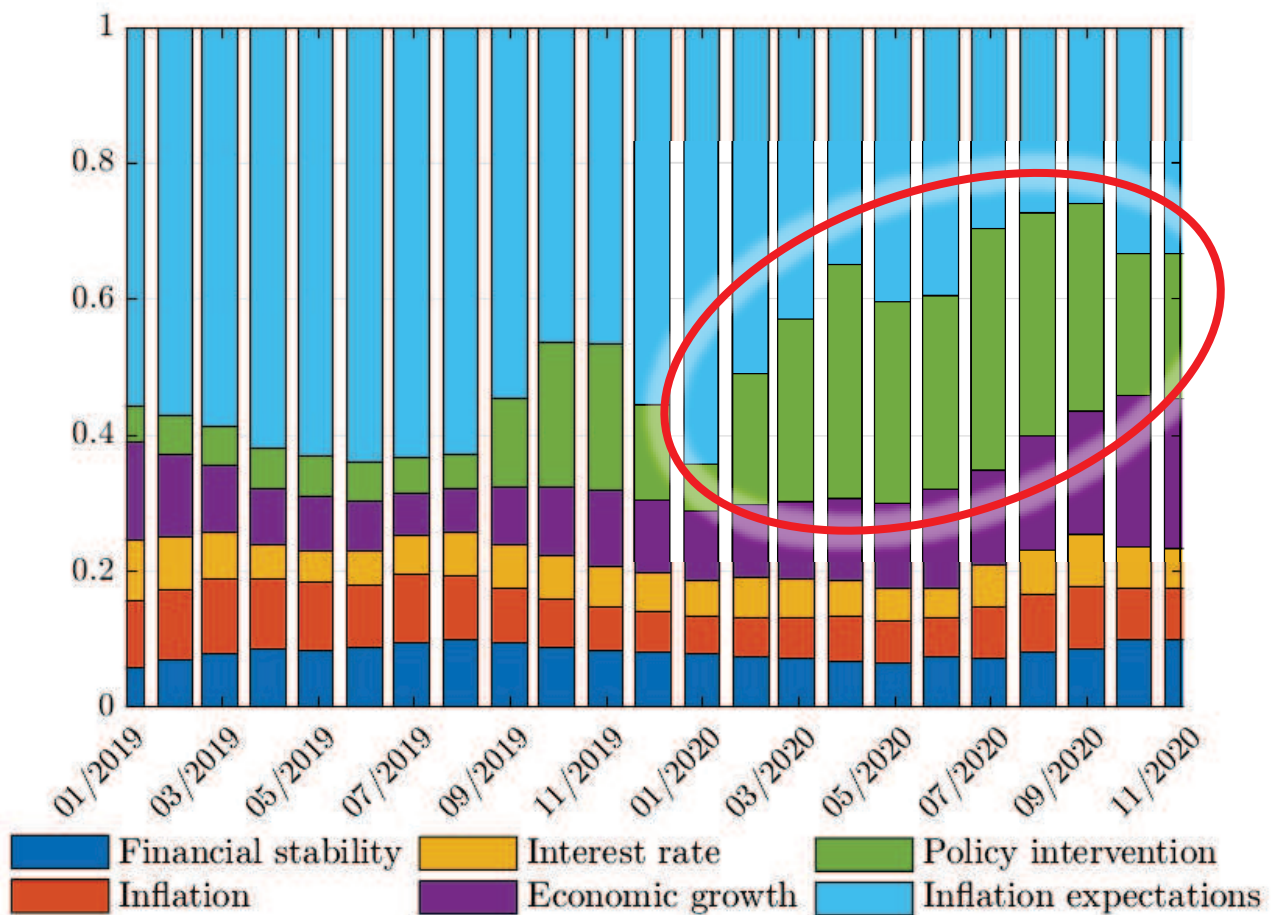
¹³ The results of the full sample are available in the Appendix (Figure A4).

the topic of inflation expectations decreased in importance while the topic of economic growth, which includes economic growth considerations and concerns, increased.

Another interesting observation from Figure 6 is related to each crisis's relative influence on the Fed's communications. While the dot-com crisis had almost no effect on the topics conveyed to the public in the FFR announcements, the GFC and COVID-19 crises strongly shaped the topics conveyed in these announcements.

Figure 7 shows that the probability that policy intervention was discussed in FFR announcements significantly increased after the COVID-19 outbreak in China. However, this topic had begun to increase earlier, which indicates that it may be at least partly related to previous concerns unrelated to COVID-19.

Figure 7. Topic Analysis of FFR Announcements



Notes: For clarity and robustness, we restrict attention to the six most frequently discussed topics.

A sharp decrease in the topic probability of inflation expectations coincides with the COVID-19 outbreak, which is in line with monetary policy considerations at that time, when the focus shifted to policy intervention.

To a lesser extent, inflation is less discussed, and economic growth more discussed, in FFR announcements during the COVID-19 crisis.

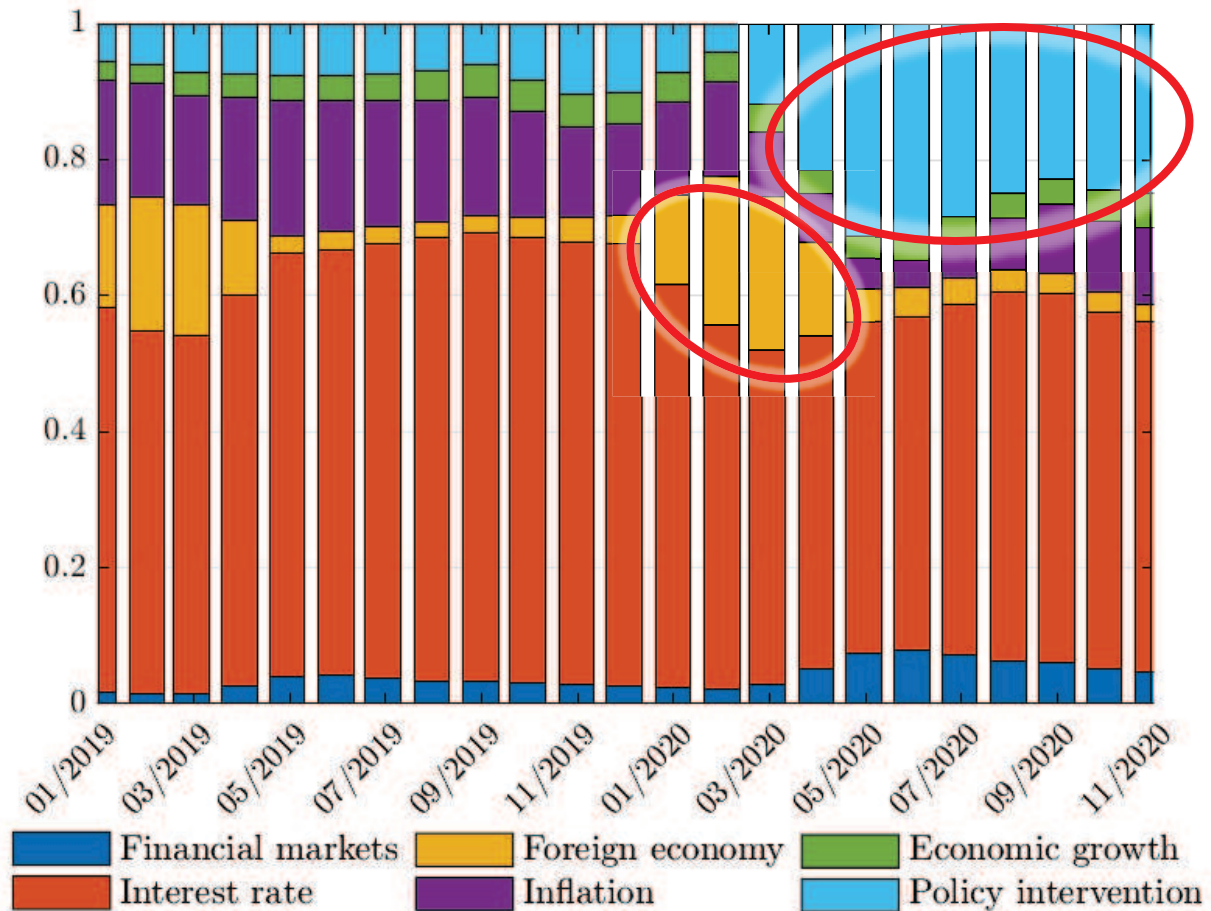
The increase in the topic probability of policy intervention in FFR announcements decreases the topic probability of inflation expectations and, to a lesser extent, inflation. Although the Fed's main objective is to stabilize prices, this

finding demonstrates that its FFR announcements were less related to inflation concerns after the COVID-19 outbreak.

The topic of economic growth slightly increased after the COVID-19 outbreak in China. This finding indicates the Fed's concern that a pandemic would pose a threat to economic growth.

Figure 8 presents the topic analysis of FOMC minutes. It shows that the COVID-19 outbreak significantly shaped the discussions of the Federal Open Market Committee.

Figure 8. Topic Analysis of FOMC Minutes



Notes: For clarity and robustness, we restrict attention to the six most frequently discussed topics.

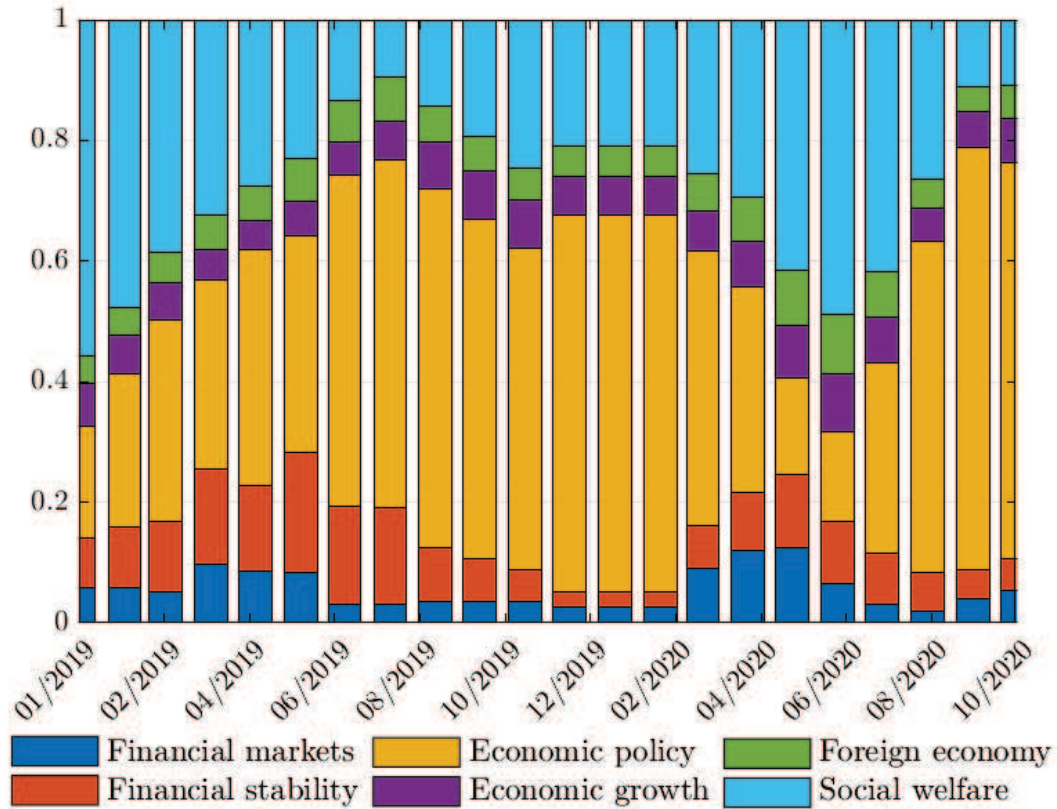
Interestingly, like the FFR announcements, the FOMC minutes are also influenced by the topic of policy intervention, even though the interest rate is the most prominent topic. The probability of discussion of inflation also decreased for the FOMC minutes due to the COVID-19 outbreak, while discussions of policy intervention and financial markets increased.

The topics conveyed by the Fed's FOMC minutes reflect a sharp increase in coverage of policy intervention and foreign economy. However, the coverage of foreign economy had begun to increase even before the COVID-19 outbreak while inflation and interest rate topics had begun to decrease.

Figure 9 presents the topic analysis of Fed chairman speeches. These speeches focused on social welfare concerns after the COVID-19 outbreak, similar to the pre-

crisis concerns about education and inequality in the US. This finding shows that Fed chairman speeches are often devoted to issues unrelated to its primary objective of stabilizing prices, such as education, health, and development economics, including family and labor markets.¹⁴

Figure 9. Topic Analysis of Fed Chairman Speeches



Notes: For clarity and robustness, we restrict attention to the six most frequently discussed topics.

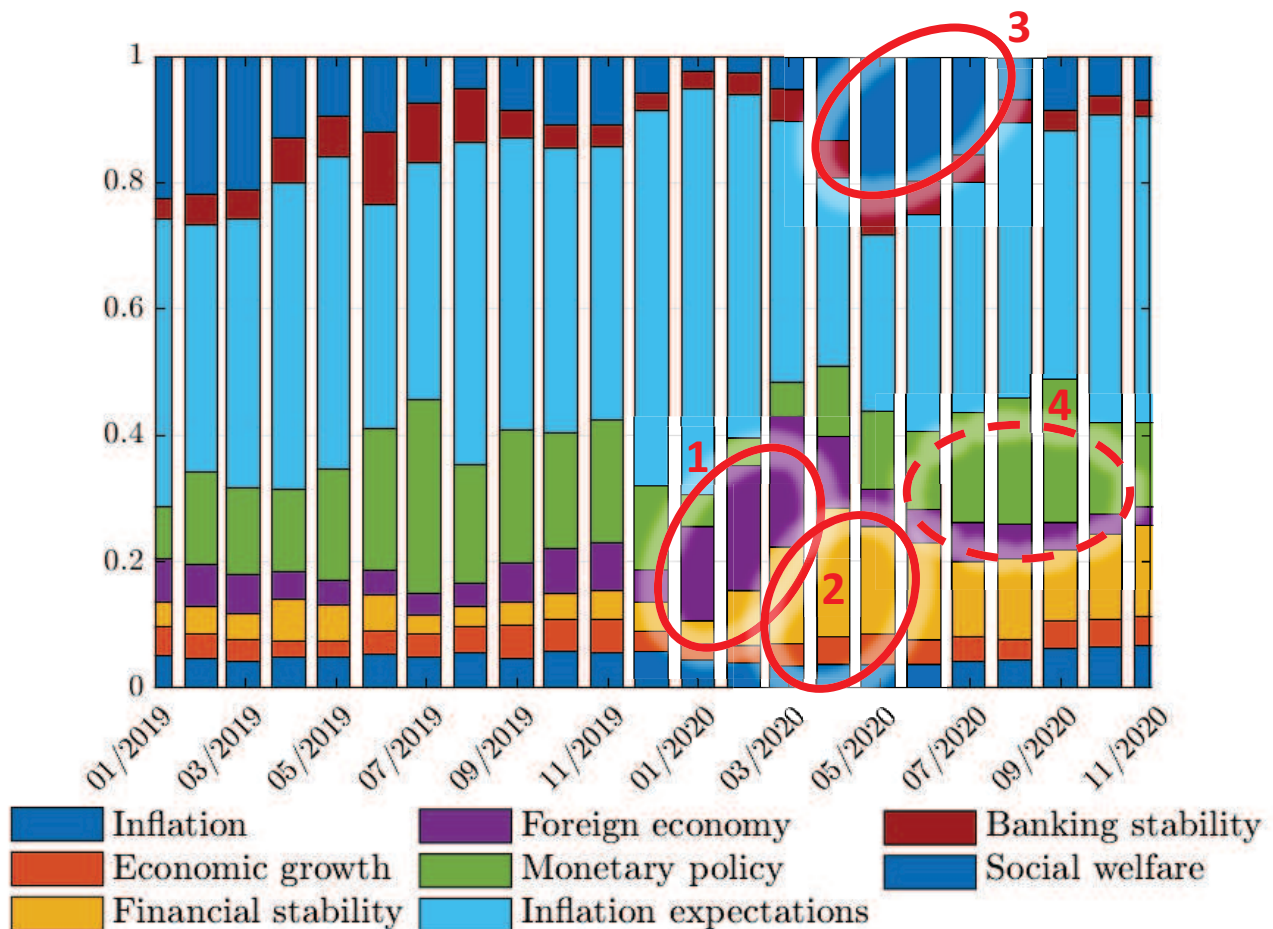
The fact that the speeches are less supervised and held to a broader audience than traditional FFR announcements and FOMC minutes, which are more focused on inflation and output growth, may explain the increase in discussion of social welfare issues. We also observe an increase in discussions of economic policy after June 2020. This may be due to COVID-19 spillovers, but we cannot reject the US election effect. Before the COVID-19 outbreak, economic policy considerations occupied the attention of most Fed chairman speeches.

Figure 10 presents the topics discussed in the Fed's communications in the aggregate. We provide a global picture of the topic modeling of the Fed's communications by aggregating all communication types in our dataset, namely, FFR announcements, FOMC minutes, and Fed chairman speeches. Because of the considerable number of texts analyzed, and their respective, often different, characteristics, we were constrained to include a larger number of topics for the global

¹⁴ The most frequently used words and word fragments (root words) in the context of the topic of social welfare are *communiti*, *economi*, *educ*, *work*, *develop*, *research*, *busi*, *job*, *peopl*, *mani*, *help*, *opportun*, *can*, *import*, *family*.

topic modeling. Taken together, these topics include most of the topics described in Figures 5 to 7.

Figure 10. Topic Analysis of Main Fed Communications



Notes: For clarity and robustness, we restrict attention to the six most frequently discussed topics.

Note that the monetary policy topic contains some references to UMP and unemployment, which may be attributed to the Fed's dual mandate.

The topic of inflation expectations continues to attract most of the Fed's attention overall, which the COVID-19 crisis and long-term interest rate concerns may have reinforced.

Figure 10 shows three prevalent topics that emerged in quick succession. First, the Fed's communications regarding the foreign economy increased as the COVID-19 pandemic spread from China to the rest of the world (1). Second, the Fed's communications regarding financial stability increased as fears about the financial system due to the impact of the COVID-19 crisis increased (2). Third, the Fed's communications regarding social welfare increased as the potential need of Americans for additional relief plans from the government and the Fed increased (3). The Fed's communications regarding conventional monetary policy (especially average inflation targeting) and UMP decreased at the beginning of the COVID-19 pandemic but increased thereafter (4).

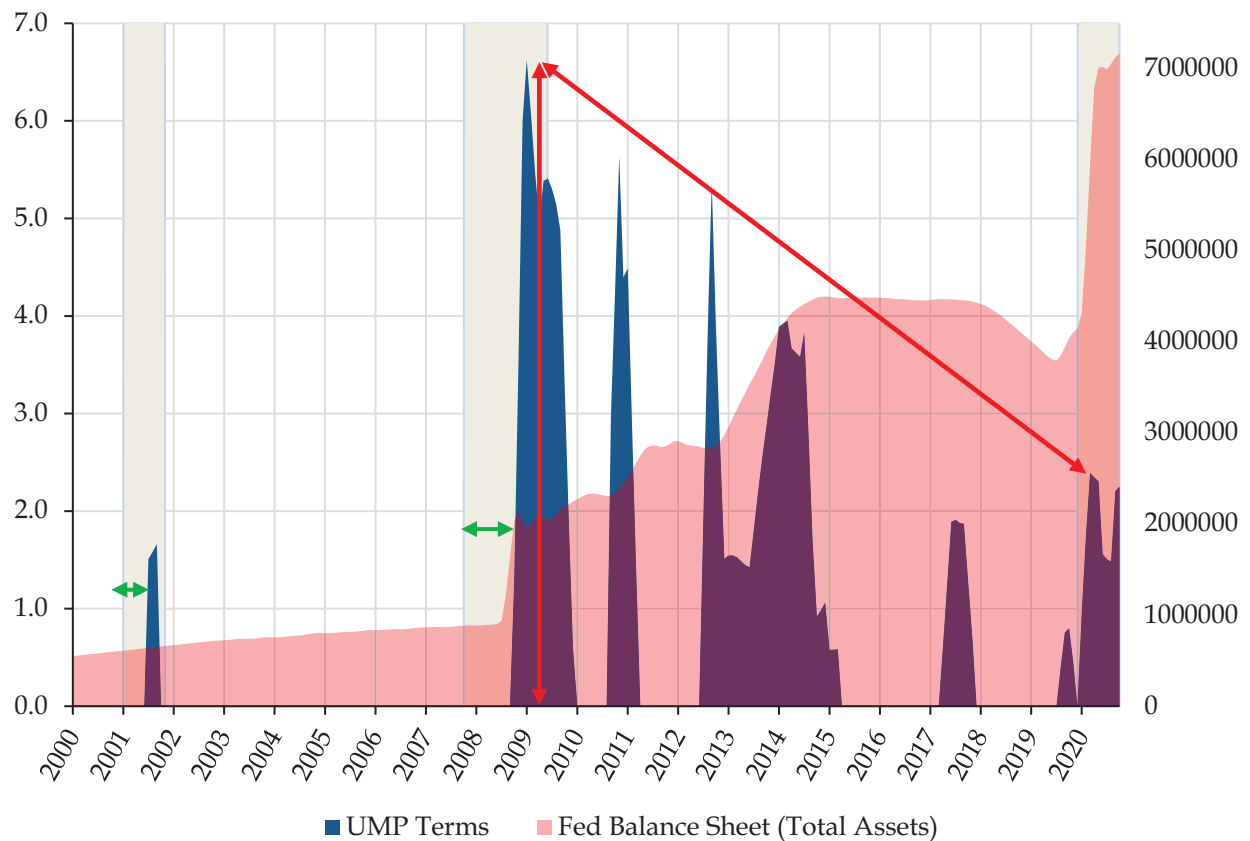
Overall, the content and timing of the Fed’s communications exhibit differences across the three crises discussed above. Unlike the GFC and dot-com crises, the COVID-19 crisis has caused the focus of the Fed’s communications to shift away from discussions of inflation expectations to discussions of policy intervention.

Interestingly, the topic of policy intervention is much more prevalent in the Fed’s communications during the Covid-19 crisis, compared to GFC and dot-com crises. It seems that the policymakers not only implement policy interventions but discuss these interventions differently across the crises, and that the content, sentiment, and timing of these communications are conditioned on the crisis.

6. Unconventional Monetary Policy

This section analyzes the link between the Fed’s communications, its actions, UMP, and COVID-19. Figure 11 compares UMP terms with UMP measures as reflected by the Fed’s balance sheet.

Figure 11. Unconventional Monetary Policy in FFR Announcements



Notes: The gray shaded area represents NBER recession periods. The red shaded area represents total assets (minus eliminations from consolidation) in the Fed’s balance sheet in millions of US dollars. The blue shaded area represents the word-counting indicator based on our UMP dictionary presented in the Appendix. The red arrows indicate UMP terms’ intensity from the onset of the GFC to the outbreak of COVID-19. The green arrows indicate the timing of the Fed’s UMP communications.

Source: Board of Governors of the Federal Reserve System (US).

Figure 11 shows that the Fed communicated more extensively about UMP during the GFC than during the COVID-19 crisis. However, it is important to note the timing. The Fed communicated about and acted against the GFC after a delay of nine months, whereas it hastened to do so during the COVID-19 crisis and the communications and actions were more clearly coordinated.

Figure 11 shows that the Fed's communications regarding UMP during the COVID-19 crisis (according to a word count of the terms listed in our UMP dictionary in the Appendix) correspond to effective UMP measures that led to Fed balance sheet changes with several lags.

It is notable that whereas actions were implemented *before* they were communicated during the GFC, they were implemented *after* they were communicated after the GFC and during the COVID-19 crisis.

Another feature of our dictionary is that it can be used to identify other periods beyond the above-noted crises when substantial UMP measures were taken to support the US economy. Indeed, as can be seen in Figure 11, each communication peak related to a UMP measure influenced the Fed's balance sheet shortly after the communication shock. The communications about UMP in 2013–2014 were devoted to conveying the message that these expansionary policies would cease (and effectively did so according to the Fed's balance sheet), thus proving that our UMP dictionary captures tapering communication policies.

The Fed implemented this gradual reversal of QE easing policies to mitigate economic growth expectations. The “tapering” effectively started in 2013 when Ben Bernanke, the Fed chairman at the time, commented that the Fed would lower the amount of purchased assets each month if economic conditions, such as inflation and unemployment, continued to be favorable.¹⁵

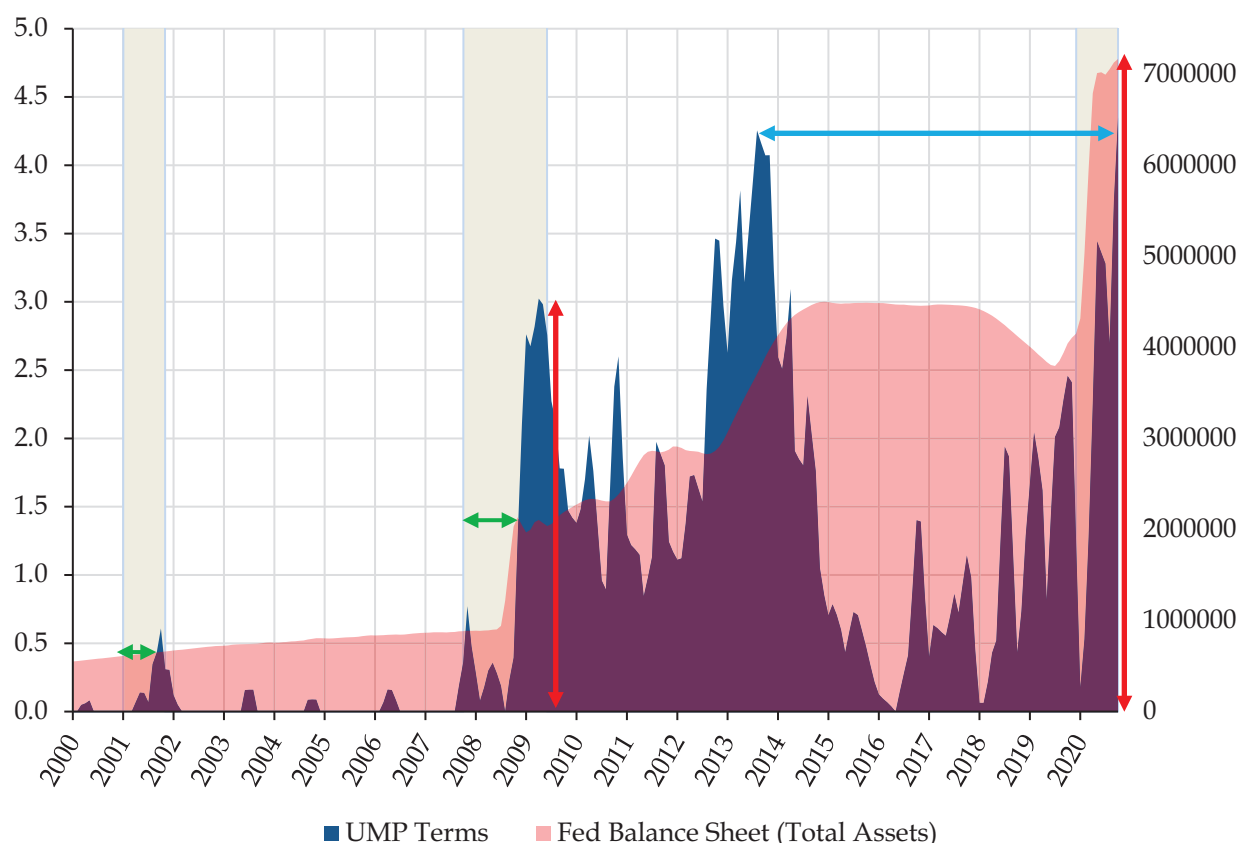
Figure 12 shows that FOMC minutes discuss UMP actions relatively earlier for the COVID-19 crisis than for the GFC. The quantity of these UMP discussions is similar to tapering discussions held by the FOMC in 2013, and the overall level is higher in late 2020 compared to the GFC period.

It is worth noting the difference between the FFR announcements and the FOMC minutes with respect to UMP. Although FOMC minutes are less supervised and longer than FFR announcements, pre-COVID-19 crisis UMP FOMC discussions were more intense than pre-GFC or even during the first half of the GFC, a behavior confirmed by comparing Figures 11 and 12.

In summarizing the discussions held between monetary policy committee members, FOMC minutes typically contain more UMP terms (discussions or controversies about potential solutions or policy implementations) than FFR announcements do. It is interesting to note that such terms have remained in frequent use since the GFC.

¹⁵ “Tapering” refers to gradually reducing the Fed's asset purchases, not altogether eliminating them.

Figure 12. Unconventional Monetary Policy and Minutes



Notes: The gray shaded area represents NBER recession periods. The red shaded area represents total assets (minus eliminations from consolidation) in the Fed's balance sheet in millions of US dollars. The blue shaded area represents the word-counting indicator based on our UMP dictionary presented in the Appendix. The red arrows indicate UMP terms' intensity from the onset of the GFC to the outbreak of COVID-19. The green arrows indicate the timing of the Fed's UMP communications. The blue arrow indicates that UMP discussions in the Fed's minutes during the pre-tapering period were almost as high as during the COVID-19 crisis.

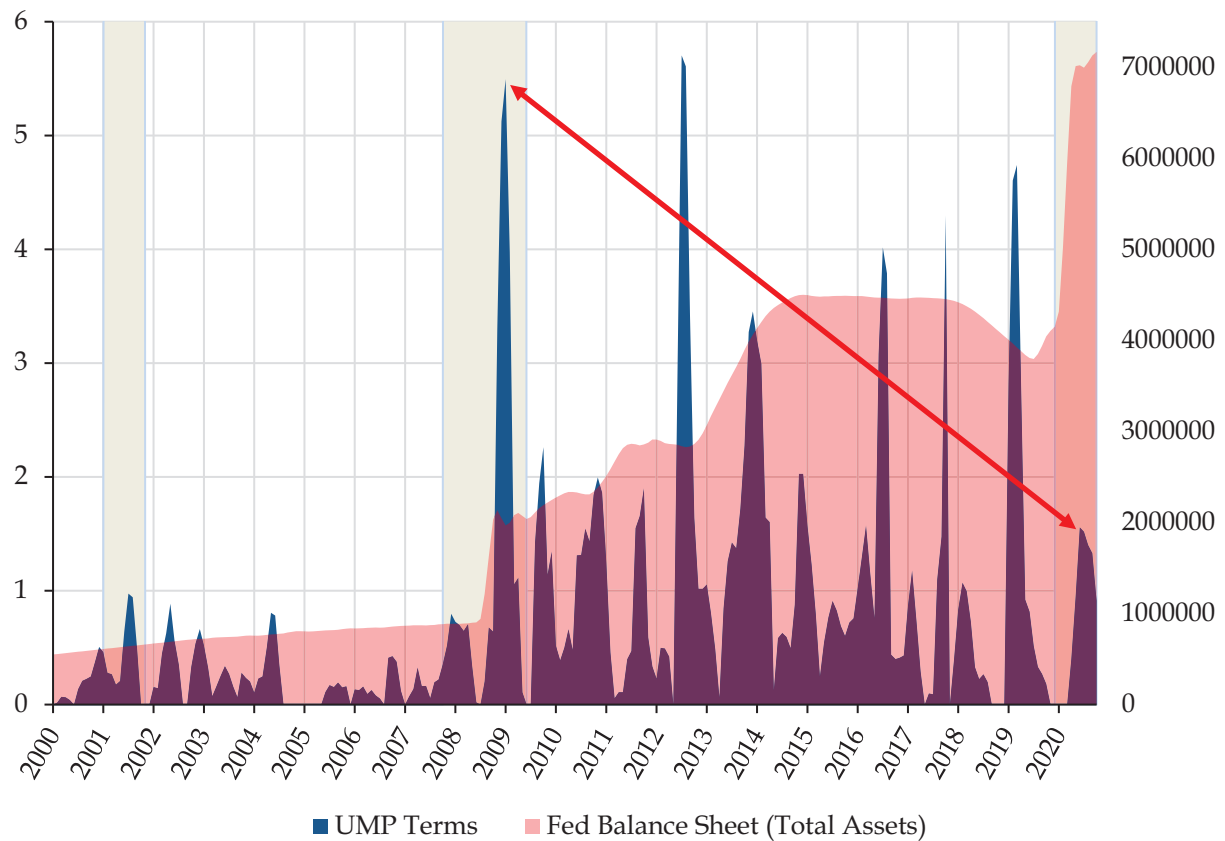
Source: Board of Governors of the Federal Reserve System (US).

Figure 13 presents the word counts related to UMP terms in Fed chairman speeches.

Figure 13 shows that relevant communication shocks, like during the GFC or the third round of monthly purchases of Treasury securities and mortgage-backed securities (MBS) in September 2012 (third QE), are strongly related to the UMP content of the Fed chairman speeches. Indeed, during or after each communication peak, the dynamics of the Fed's balance sheet changed. Most of the peaks that did not influence the Fed's balance sheet were related to forward-guidance communications.

The Fed chairman speeches appear to be the privileged platform for mentioning UMP terms. It is interesting to compare the frequency of UMP terms in the speeches delivered before and after each crisis. As the Figure 13 shows, the frequency of the UMP terms in the speeches increases in the wake of the GFC, dot-com, and COVID-19 crises. However, the frequency is higher, and earlier, in the COVID-19 crisis, compared to the other crises.

Figure 13. Unconventional Monetary Policy and Fed Chairman Speeches



Notes: The gray shaded area represents NBER recession periods. The red shaded area represents total assets (minus eliminations from consolidation) in the Fed’s balance sheet in millions of US dollars. The blue shaded area represents the word-counting indicator based on the dictionary presented in the Appendix.

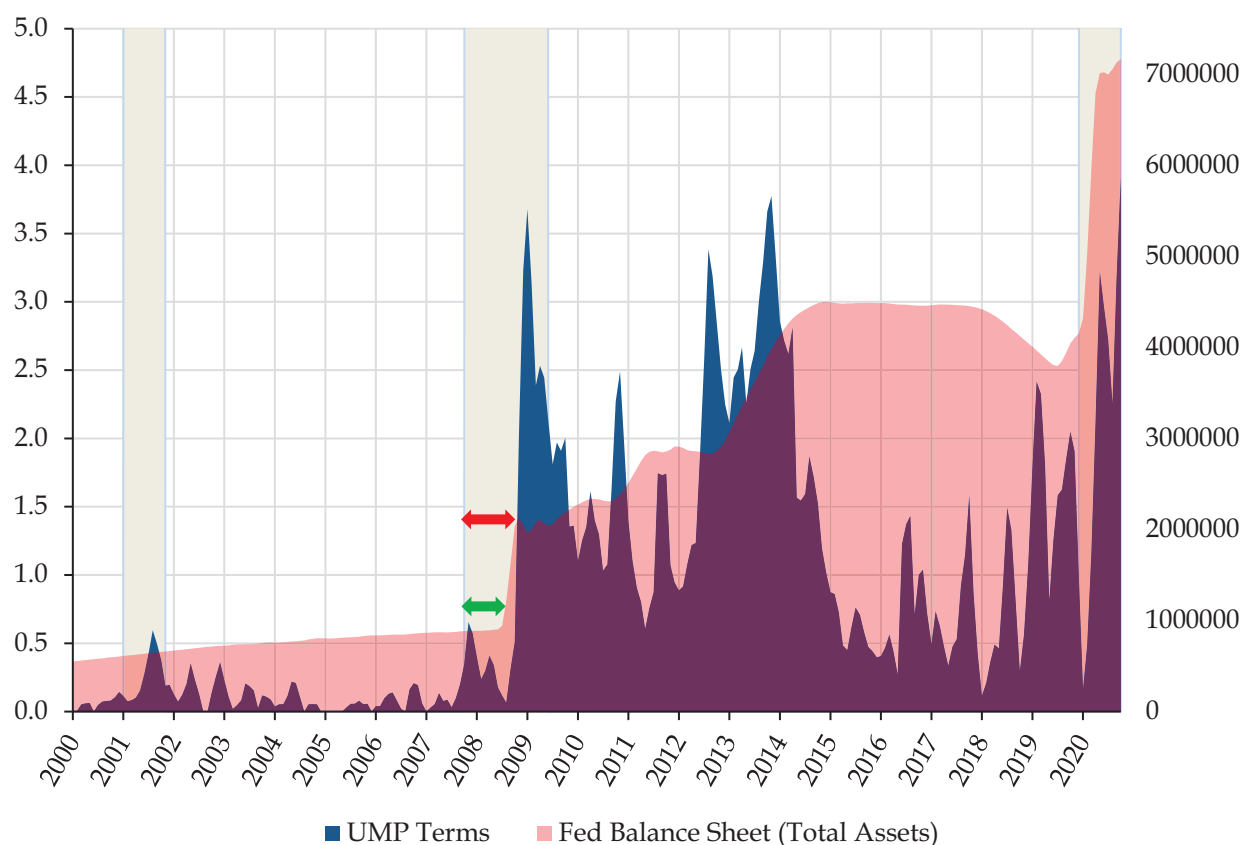
Source: Board of Governors of the Federal Reserve System (US).

Figure 14 presents an aggregated UMP indicator for main Fed communications. The figure shows differences in the timing of UMP communications and actions for the COVID-19 and GFC crises

Notable is the post-GFC “new normal,” where UMP communications and actions are more frequent than in the pre-GFC period. This continuous need for UMP tools may eventually transform their unconventional character into a more conventional or regular one.

Overall, communicating about QE and forward-guidance (UMP) actions became the “new normal” for the Fed since the GFC (Bernanke, 2020), while the frequency of UMP terms remains higher for the COVID-19 crisis than for previous crises.

Figure 14. Unconventional Monetary Policy in Main Fed Communications



Notes: The gray shaded area represents NBER recession periods. The red shaded area represents total assets (minus eliminations from consolidation) in the Fed's balance sheet in millions of US dollars. The blue shaded area represents the word-counting indicator based on the dictionary presented in the Appendix. The arrows indicate the time periods between the beginning of the GFC crisis and the first UMP communications (red) and the first UMP measures (green) influencing the Fed's balance sheet.

Source: Board of Governors of the Federal Reserve System (US).

7. COVID-19

In this section we examine the use of COVID-19 terms with our dictionary presented in the Appendix. We compare these terms with UMP and contextual uncertainty terms, and financial volatility and new COVID-19 cases.

Figure 15 presents the repartition of COVID-19-related terms used in the main Fed's communications in 2020.

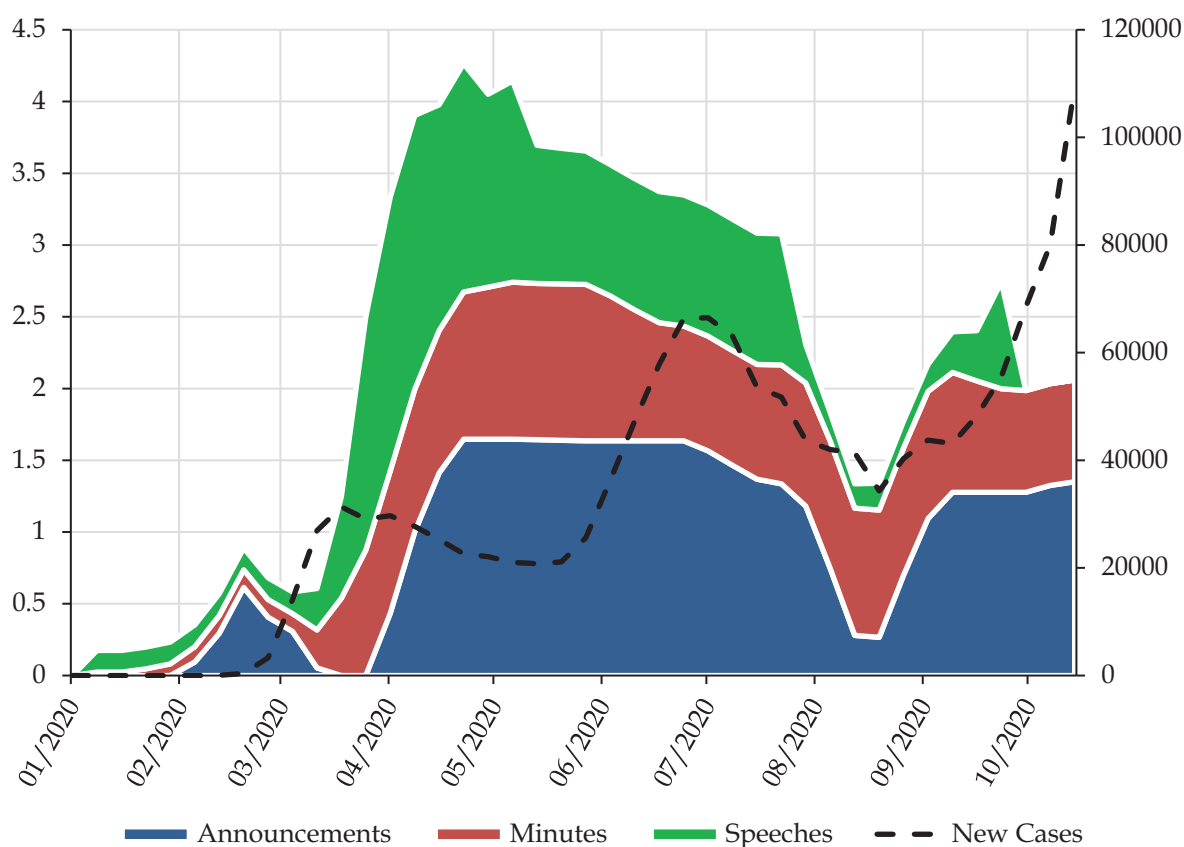
The figure shows that the Fed chairman speeches anticipated the waves of new COVID-19 cases. One has to consider this result cautiously since the first tests started later in the US compared to other countries. Nevertheless, the speeches anticipated the spillovers of the virus from China, focusing on the US economy.

It is worth noting that the Fed chairman speeches provide a more timely and flexible communication vehicle than FOMC minutes and FFR announcements. They are disseminated quickly and informally compared to the other communication types, and allow health, political or foreign considerations that are less discussed in the other communication types.

Interestingly, Figure 15 presents two types of COVID-19 waves: the first type of wave plots new cases of COVID-19 based on medical statistics from the COVID-19 Data Repository, and the second type of wave plots the intensity of COVID-19-related terms in the Fed’s communications based on our COVID-19 dictionary presented in the Appendix. It is visually apparent that the Fed communication waves precede the virus waves.¹⁶

The magnitude and severity of the COVID-19 virus were rapidly understood and communicated to the public by the Fed via its FFR announcements and chairman speeches. The FFR announcements used more COVID-19-related terms than the other communication types and contributed better to the first communication wave than the speeches, but they lagged a few weeks behind the first Fed chairman speeches mentioning COVID-19-related terms.

Figure 15. COVID-19 and Main Fed Communications



Notes: The shaded areas represent the word-counting indicator for each communication type based on our COVID-19 dictionary presented in the Appendix. The dashed line represents the number of new COVID-19 cases in the US (right axis).

Source: Johns Hopkins University Center for Systems Science and Engineering (CSSE).

The decrease in the intensity of COVID-19 terms in the Fed chairman speeches in the second quarter of 2020 is directly correlated to the decrease in positive sentiment reported in Figure 5 for the same period. It is also correlated to the increase in the

¹⁶ Granger causality tests also confirm this finding, but given the few observations available, the results are not reported.

topicality of social welfare in the Fed chairman speeches during this period, as reported in Figure 9. Consequently, both the topics and the sentiments of the Fed chairman speeches were affected by the COVID-19 outbreak.

Interestingly, the increase in the SentiWords sentiment exposed in Section 4 seems to be confirmed by the decrease in the frequency of COVID-19-related terms after 2020Q3 despite the increase in the number of new cases during that quarter. In other words, the Fed's communications conveyed a more positive message than the reality of the pandemic and its economic spillovers would warrant. This seems to be the result of a crisis-specific communication strategy.

Overall, the waves of Fed communications about the COVID-19 crisis anticipated the waves of new COVID-19 cases. The Fed chairman speeches communicated about the first wave of COVID-19 earlier than the other communication types (FFR announcements and FOMC minutes). This result again confirms that speeches are less supervised than announcements and minutes and thus allow the Fed to communicate in a timelier manner. It also indicates that the Fed had an early understanding of the severity and magnitude of the COVID-19 pandemic and its economic spillovers.

Figure 16 compares new COVID-19 cases in the US and word-counting indicators based on the dictionaries of UMP and COVID-19 terms. This figure also includes the Chicago Board Options Exchange (CBOE) Volatility Index (VIX) to compare market volatility and potential financial uncertainty underlying the virus outbreak with UMP and COVID-19 terms.

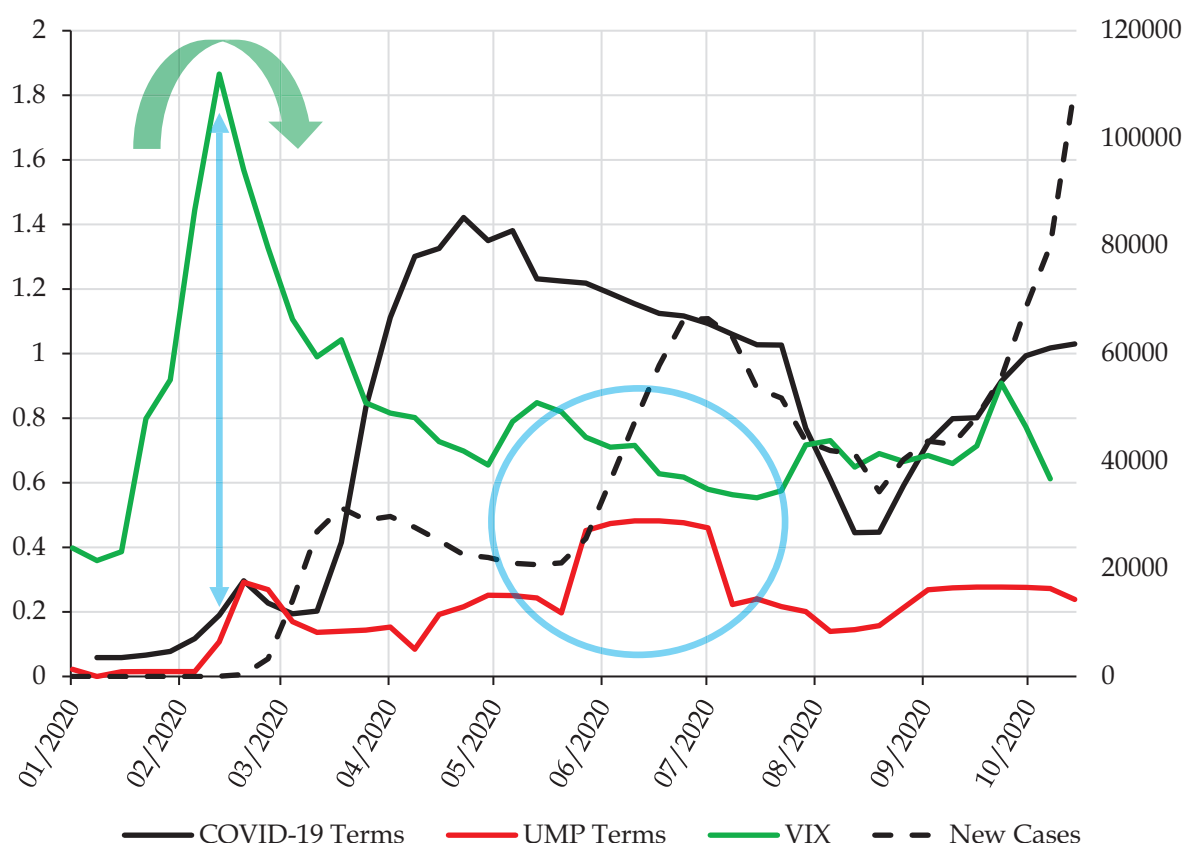
Figure 16 shows that the COVID-19-related terms in the Fed's communications in January 2020 about the virus outbreak in China considerably upset financial markets in the US. However, the UMP-related terms in the Fed's subsequent communications, about the UMP actions taken by the Fed in response to the pandemic, helped to decrease this financial volatility.

The CBOE VIX dramatically increased with the COVID-19 outbreak in China and several other countries, including the US. COVID-19 mentions in the Fed's communications preceded UMP considerations and waves of new cases in the US.

Between May and July of 2020, the Fed extensively communicated about unconventional monetary policies. During this period, although new cases of COVID-19 significantly increased, the Fed's communications and actions slightly decreased financial volatility.

Following this period, the increase in the frequency of UMP-related terms in the Fed's communications as the pandemic continued to worsen may have stabilized the volatility of financial markets.

Figure 16. COVID-19 and UMP Terms in Main Fed Communications



Notes: The dark blue line represents the word-counting indicator based on our dictionary of COVID-19 terms presented in the Appendix. The dashed line represents the number of new COVID-19 cases in the US (right axis). The green arrow indicates the CBOE VIX reversal due to UMP communications (and actions) highlighted with the blue arrow. The blue circle highlights the other relations between increases in UMP communications and decreases in the VIX.

Sources: Bloomberg and Johns Hopkins University Center for Systems Science and Engineering (CSSE).

Figure 17 presents our COVID-19 and UMP word-counting indicators based on Loughran and McDonald's (2011) dictionary of contextual uncertainty terms.

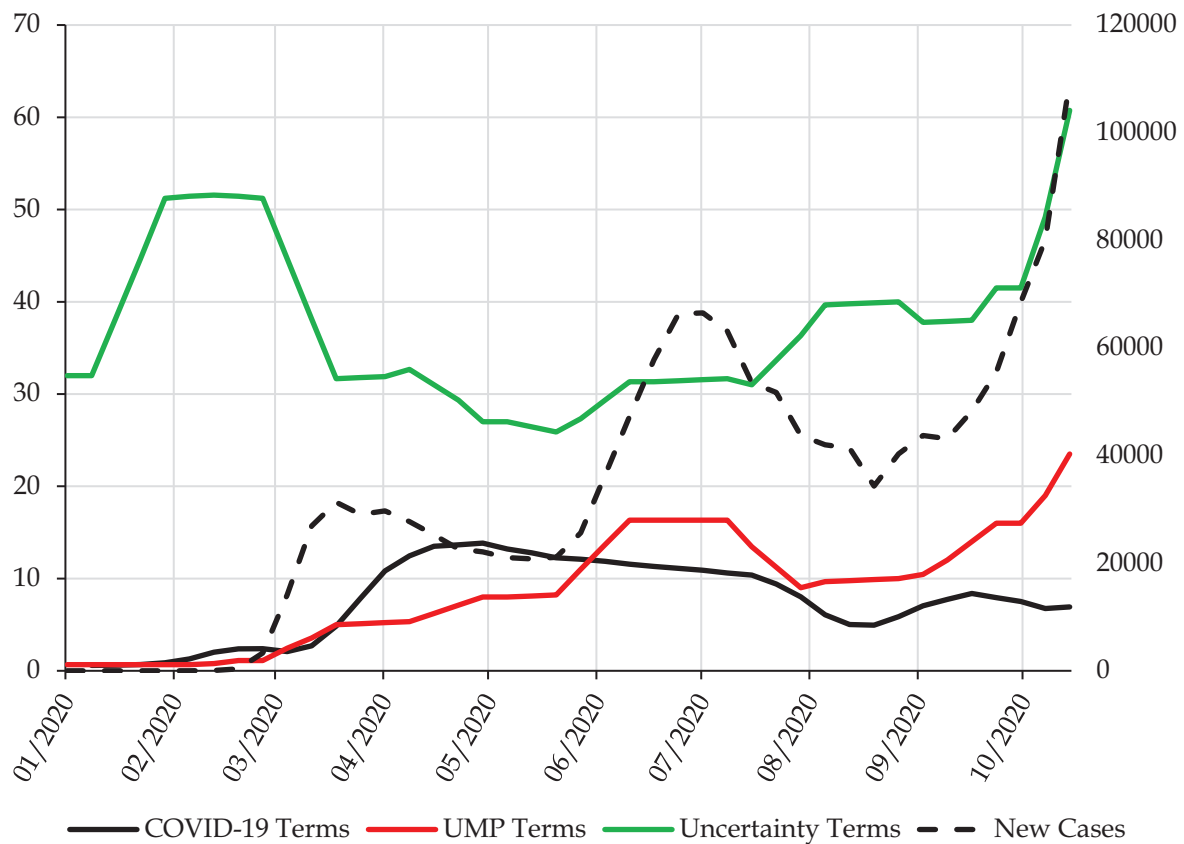
Uncertainty in the Fed's communication is related to the number of UMP terms found in those communications, what we interpret as the "uncertainty effect". COVID-19, UMP, and uncertainty comove in the Fed's communications, especially during the second half of 2020. This is not necessarily the case at the beginning of the COVID-19 sample period, mainly because the suddenness of the outbreak of the virus took everyone by surprise and increased the frequency of the uncertainty-related terms before the others. The "uncertainty effect" appears during crisis periods necessitating UMP to mitigate market and economic uncertainty.

Figure 17 also demonstrates the anticipatory effects of uncertainty- and UMP-related terms in the Fed's communication regarding COVID-19. The increase in the use of uncertainty terms appears to precede increases in new cases of the virus.

The correlation between the contextual uncertainty from Loughran and McDonald's (2011) dictionary and the UMP-related terms from the UMP dictionary

presented in the Appendix is significantly positive at 0.44 for weekly average communications between 2000 and 2020 (i.e., 1090 observations).

Figure 17. COVID-19, UMP, and Uncertainty in Main Fed Communications



Notes: The dashed line represents the number of new COVID-19 cases in the US (right axis). The contextual uncertainty indicator is the number of uncertainty terms according to Loughran and McDonald (2011).

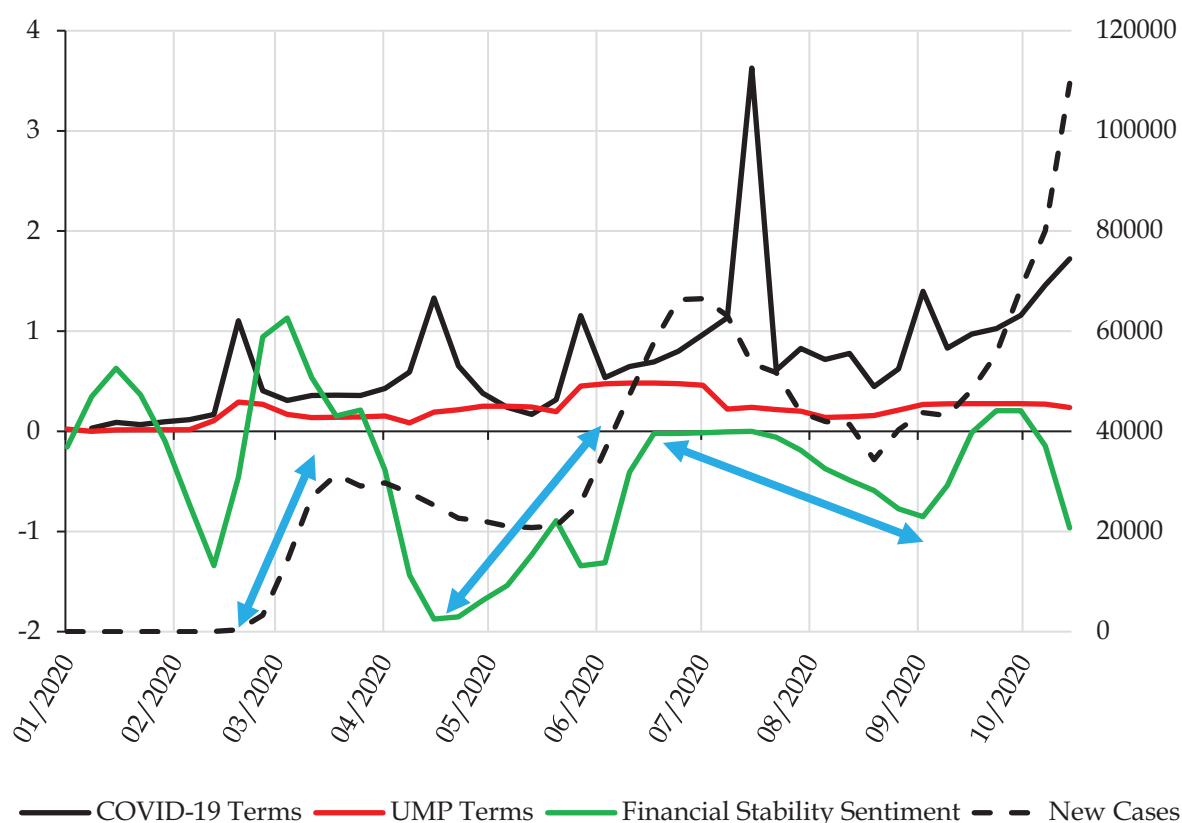
Source: Johns Hopkins University Center for Systems Science and Engineering (CSSE).

Figure 18 presents our COVID-19 and UMP word-counting indicators together with the financial stability sentiment (Correa et al., 2021) and the number of new COVID-19 cases in the US.

Except at the beginning of the COVID-19 crisis, increases in the sentiment associated with financial stability are correlated to increases in the number of new virus cases. The end-of-sample decrease in the financial stability sentiment is partly driven by the lack of chairman's speeches during this period.

Figure 18 shows that the decrease in sentiment associated with financial stability lags a few weeks behind the increases in both COVID-19- and UMP-related terms in the Fed's communications. This result is not surprising given that discussions and decisions related to financial stability generally occur after shocks to financial stability. The several deteriorations in financial stability sentiment that precedes the increase in the number of new COVID-19 cases may confirm the anticipatory effect of the Fed's discussions of their stabilization policies.

Figure 18. COVID-19, UMP, and Financial Stability in Main Fed Communications



Notes: The blue line represents the word-counting indicator based on our COVID-19 dictionary presented in the Appendix. The dashed line represents the number of new COVID-19 cases in the US (right axis). The financial stability index is rescaled to match scale constraints. The blue arrows indicate similar trends between the number of new COVID-19 cases and the financial stability index.

Sources: Johns Hopkins University Center for Systems Science and Engineering (CSSE).

Following the GFC, the Fed’s communications anticipated effective UMP implementations (actions). The timing and magnitude of these implementations were dramatically different between crises. It was shown in Figure 18 that the Fed’s communications about the COVID-19 crisis also anticipated waves of new COVID-19 cases. The UMP implementations were indeed aimed at reducing market volatility together with COVID-19 spillovers.

We have also shown that the contextual uncertainty in the Fed’s communications well anticipated COVID-19 waves. Finally, it appears that the decrease in sentiment associated with the Fed’s communications about financial stability generally anticipated increases in the number of new COVID-19 cases. The anticipatory effects of contextual uncertainty in the Fed’s communications seem to confirm its early understanding of the COVID-19 spreading and its economic spillovers.

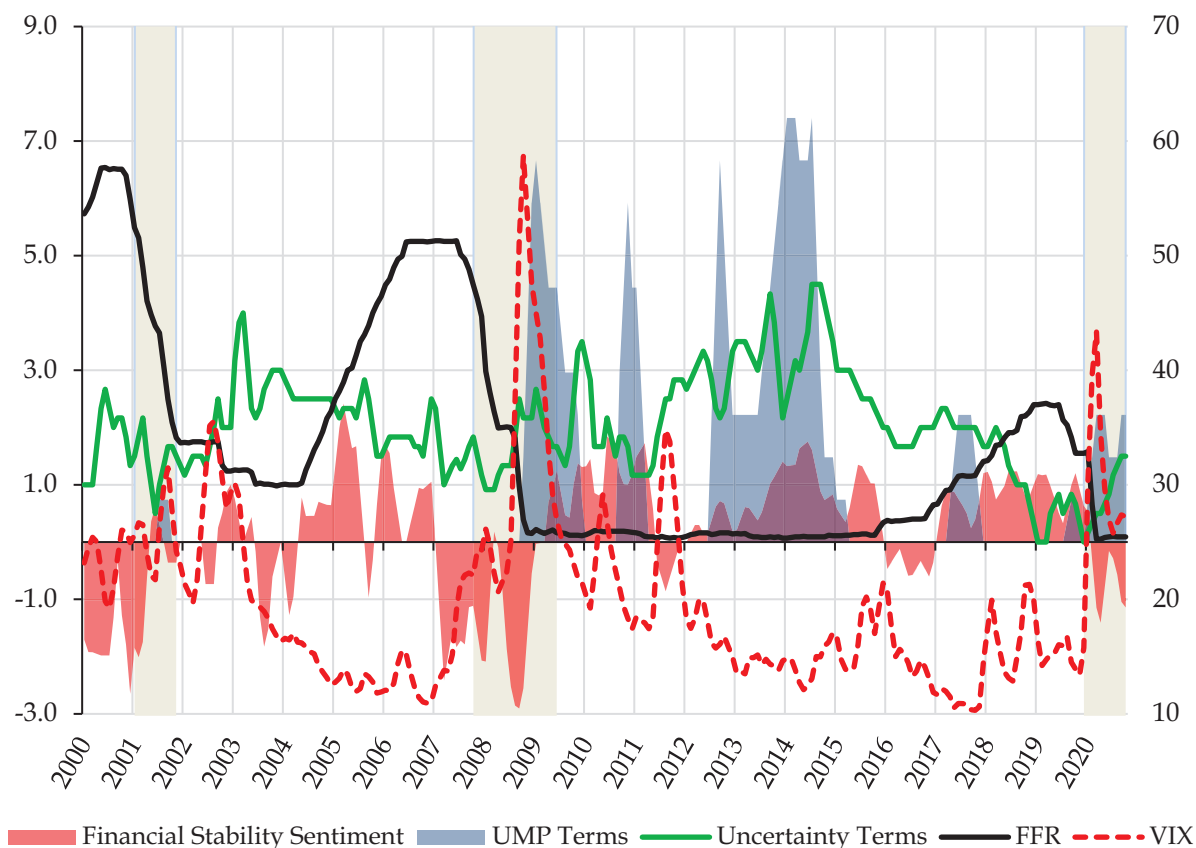
8. Financial Stability

UMP- and uncertainty-related terms are associated with financial stability and volatility. This section focuses on the financial stability sentiment and contextual

uncertainty and their respective dynamics relative to the conventional monetary policy instrument (the FFR) and financial market volatility (CBOE VIX).

Figure 19 compares the financial stability sentiment, UMP- and uncertainty-related terms from FFR announcements and the CBOE VIX.

Figure 19. Financial Stability and Monetary Policy in FFR Announcements



Notes: The gray shaded area represents NBER recession periods. The right axis indicates the VIX level.

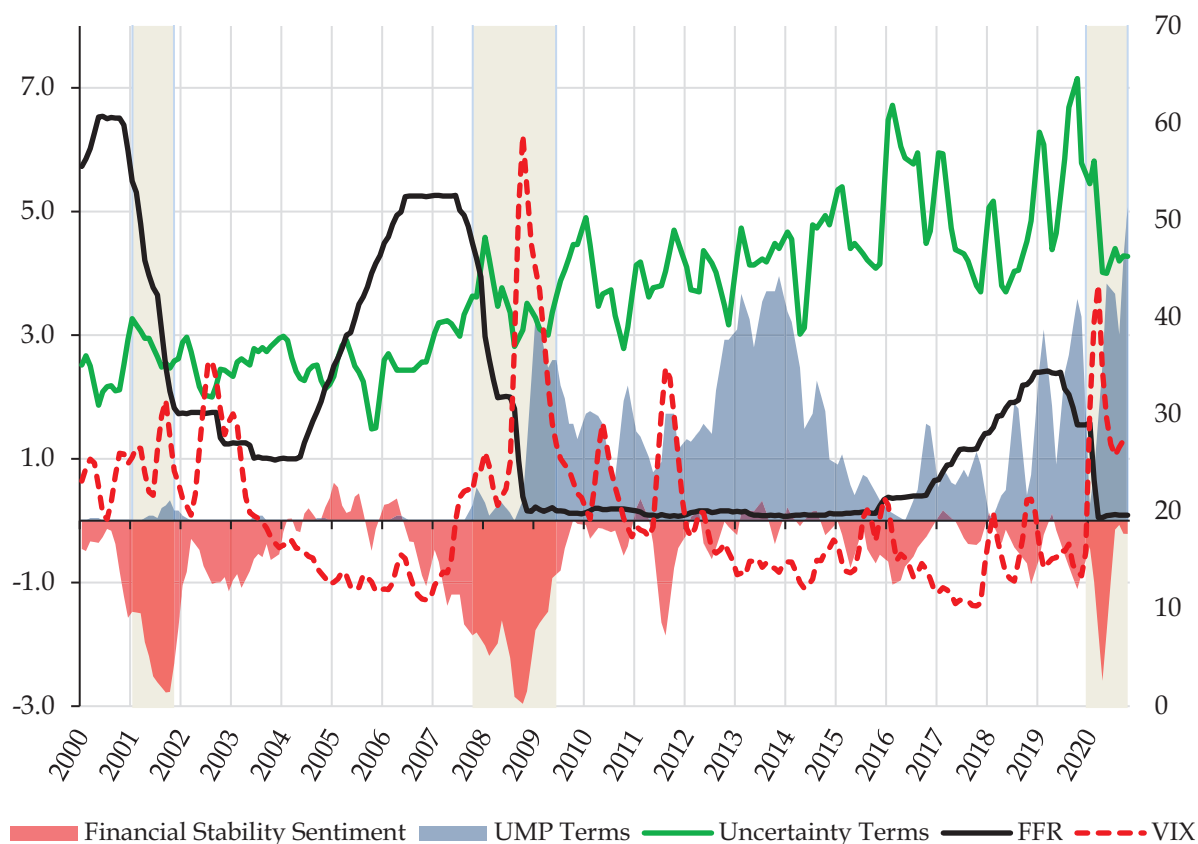
Figure 19 shows the Fed used fewer uncertainty-related words in its FFR announcements, and so voluntarily limited contextual uncertainty, during the COVID-19 crisis than in previous years and previous crises. This suggests a communication strategy that aimed to decrease market uncertainty (volatility) when the number of new virus cases sharply increased. Before the dot-com and GFC crises, a strong decrease in the positive sentiment associated with financial stability sentiment occurred, but this was not the case in the COVID-19 crisis. This is mainly due to the unpredictable characteristics of this crisis as well as its rapid spillovers on market uncertainty rather than the banking system.

The UMP-related terms played a significant role in decreasing market volatility during the dot-com and GFC crises but also during the COVID-19 crisis. In all of these crises, FFR announcements about the implementation of UMP measures reduced the VIX.

The financial stability sentiment is closely related to the FFR level. A decrease in the financial stability sentiment generally corresponds to a decrease in the FFR.

Figure 20 is the same as Figure 19 except that FOMC minutes are considered instead of FFR announcements.

Figure 20. Financial Stability and Monetary Policy in FOMC Minutes



Notes: The gray shaded area represents NBER recession periods. The right axis indicates the VIX level.

Interestingly, although each crisis was preceded by an increase in the use of uncertainty-related terms in FOMC minutes, a clear tendency to reduce uncertainty-related words during crises is observed in Figure 20, similar to Figure 19. The VIX is negatively correlated to financial stability sentiment, and both precede UMP terms, which generally leads to UMP actions being taken to stabilize the markets and financial stability fears and financial volatility (VIX).

As FOMC minutes provide detailed information on the monetary policy committee views about the suitable and near-term policy stance and the US economic outlook, they convey financial stability sentiments and UMP terms earlier than FFR announcements.

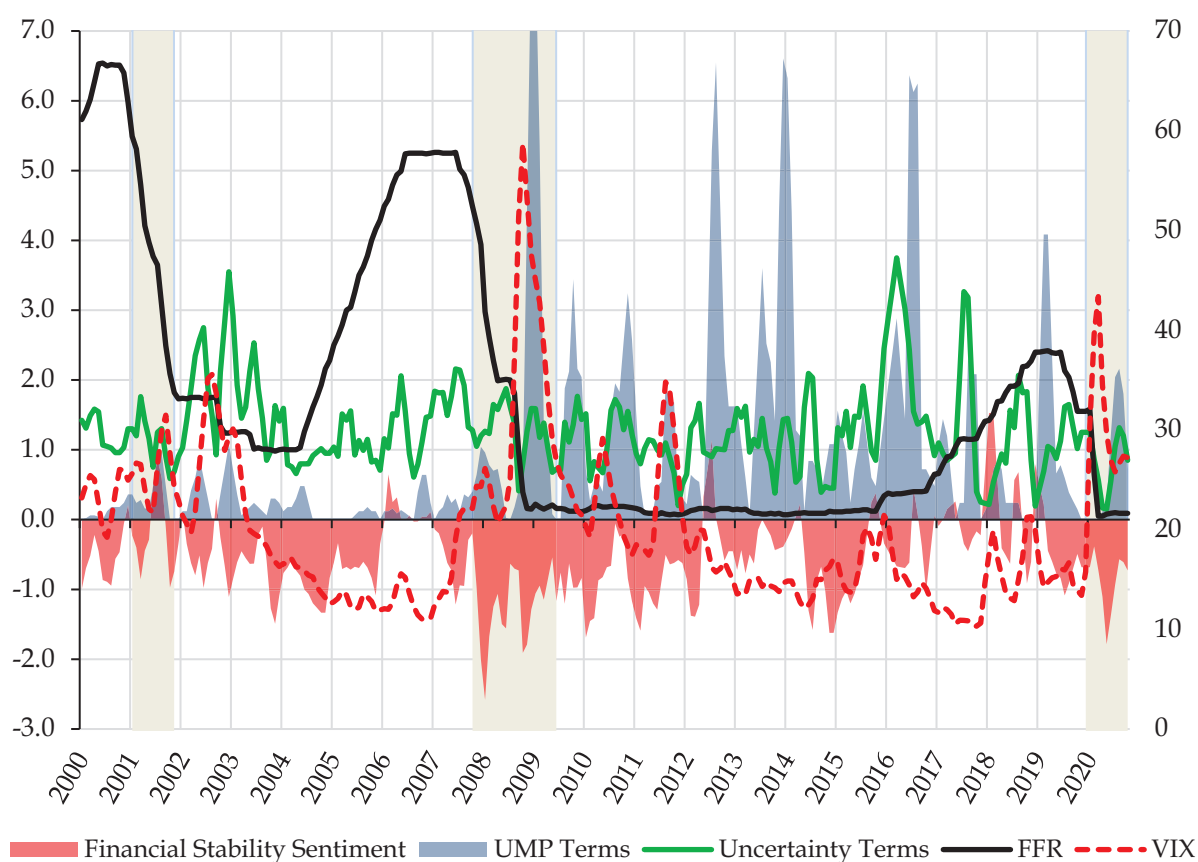
The FFR increases correspond to high financial stability sentiment levels, except during 2012–2015 where the financial stability sentiment was driven up by UMP communications and actions.

Figure 21 presents Fed chairman speeches together with the FFR announcements and financial volatility.

The financial stability sentiment present in the speeches is less indicative of the future FFR compared to the announcements and minutes. Chairman speeches may convey a negative financial stability sentiment even as the FFR increases, which on

average does not happen in FFR announcements and FOMC minutes (see Figures 19 and 20).

Figure 21. Financial Stability and Monetary Policy in Fed Chairman Speeches



Notes: The gray shaded area represents NBER recession periods. The right axis indicates the VIX level.

Comparing the period between the dot-com and GFC crises (P1) with the period between the GFC and the COVID-19 crises (P2) is informative. While few Fed chairman speeches contained UMP-related terms during P1, the “new normal” is on its way to being established during P2. More interestingly, the UMP- and uncertainty-related terms are relatively correlated during P2, whereas this correlation is nonexistent during P1. This comparison is, to a lesser extent, also valid for the VIX- and uncertainty-related terms, which are less correlated during P1 compared to P2.

Figure 21 shows that uncertainty-related terms in Fed chairman speeches were fewer during the COVID-19 crisis than in the previous years and previous crises. However, the contrast is less stark for the announcements and the minutes. The strong instability in the speeches is due to the wide-ranging fields and objectives they cover, coupled with the fact that speeches are generally less supervised than announcements and minutes.

The communication related to UMP occurred after the volatility peaks during the GFC and COVID-19 crises. Figures 20 and 21 highlight the Fed interventionism policy, which most central banks of developed countries employ: after each FFR decreases, UMP communication, usually followed by actions, compensates for the

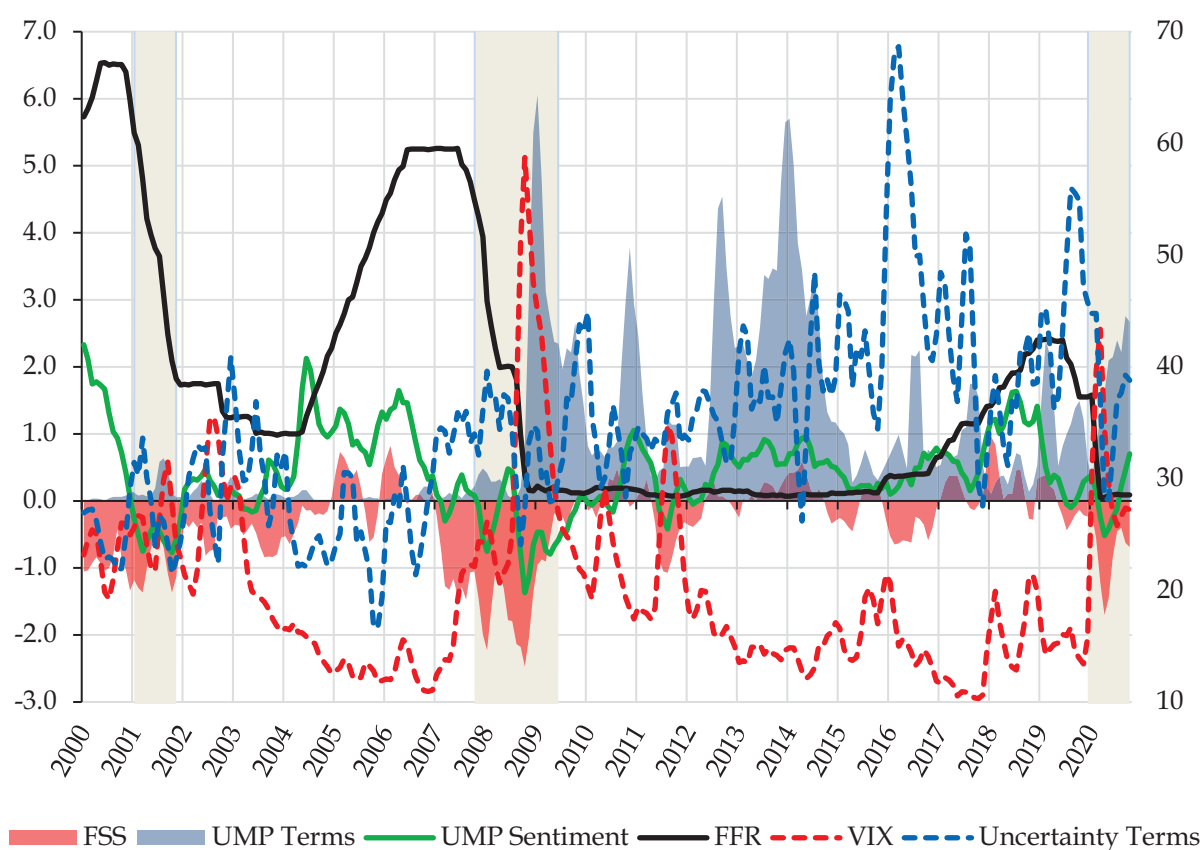
inability of the central bank to use the nominal interest rate, their main policy instrument, stuck at the ZLB.

Figure 22 aggregates the Fed’s three communication types to present a global picture of the Fed’s communications.

Our previous finding that the Fed had a crisis-specific communication strategy is confirmed. Indeed, Figure 22 supports the finding that, during crises, the Fed decreased the sentiment associated with UMP measures around the same time that it decreased the frequency of uncertainty-related terms in its communications.

Decreases in financial stability sentiment generally precede VIX increases, except in the COVID-19 crisis. A potential explanation for this finding is that the COVID-19 crisis was less predictable than the dot-com and GFC crises.

Figure 22. Financial Stability and Monetary Policy in Main Fed Communications

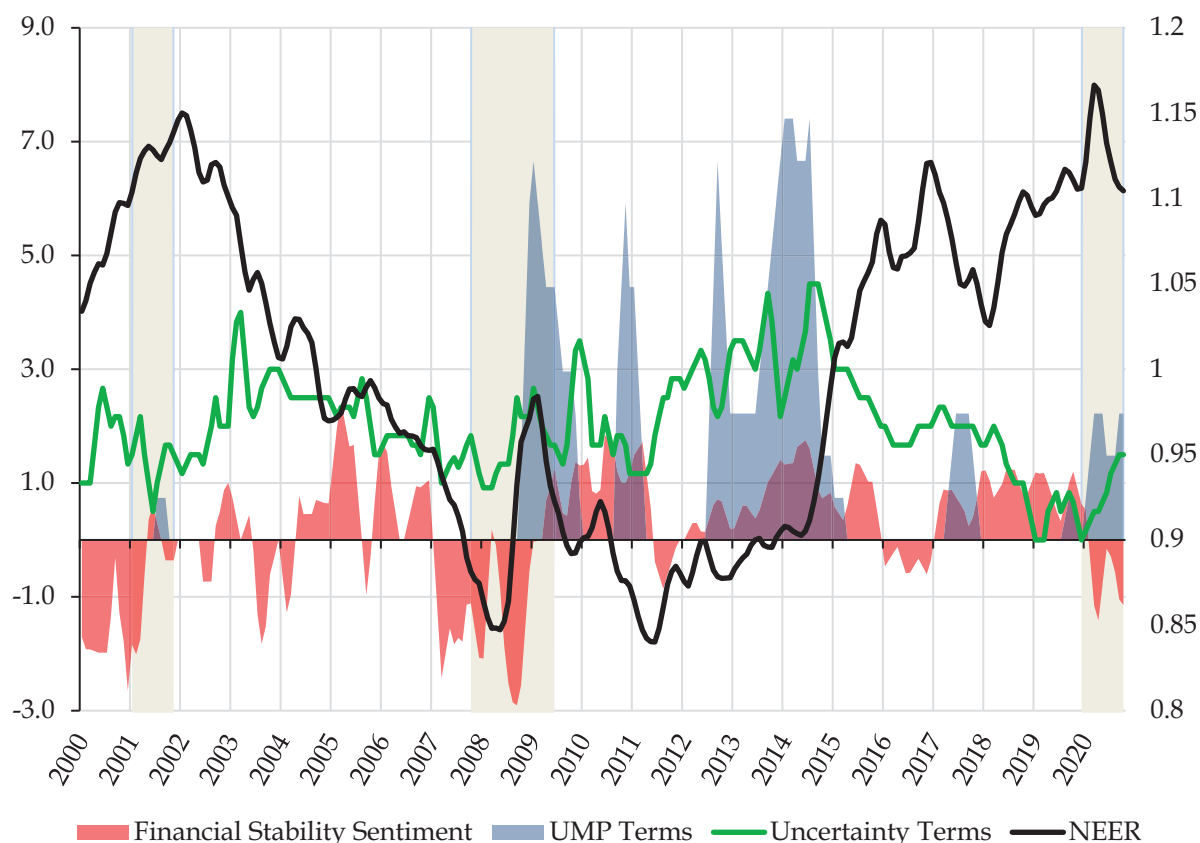


Notes: The gray shaded area represents NBER recession periods. FSS stands for “financial stability sentiment.” The right axis indicates the VIX and uncertainty terms levels.

Following the GFC, a new normal was established in which the Fed’s communications came to be increasingly fed by discussions of UMP tools, including forward-guidance measures. Typically, these UMP discussions were characterized by a high-level contextual uncertainty. This new normal was partly upset by the COVID-19 crisis, where the Fed adopted a communication strategy to use fewer uncertainty-related terms in their UMP communications.

The previous figures were focused on financial stability, but the Fed's communications also addressed economic stability. Figure 23 relates the word-counting indicators discussed above to the nominal effective exchange rate (NEER).

Figure 23. Financial Stability, NEER, and FFR Announcements



Notes: The gray shaded area represents NBER recession periods. The NEER corresponds to the amount of US dollars needed to purchase foreign currency (right axis). The financial stability sentiment, UMP, and uncertainty terms are related to FFR announcements.

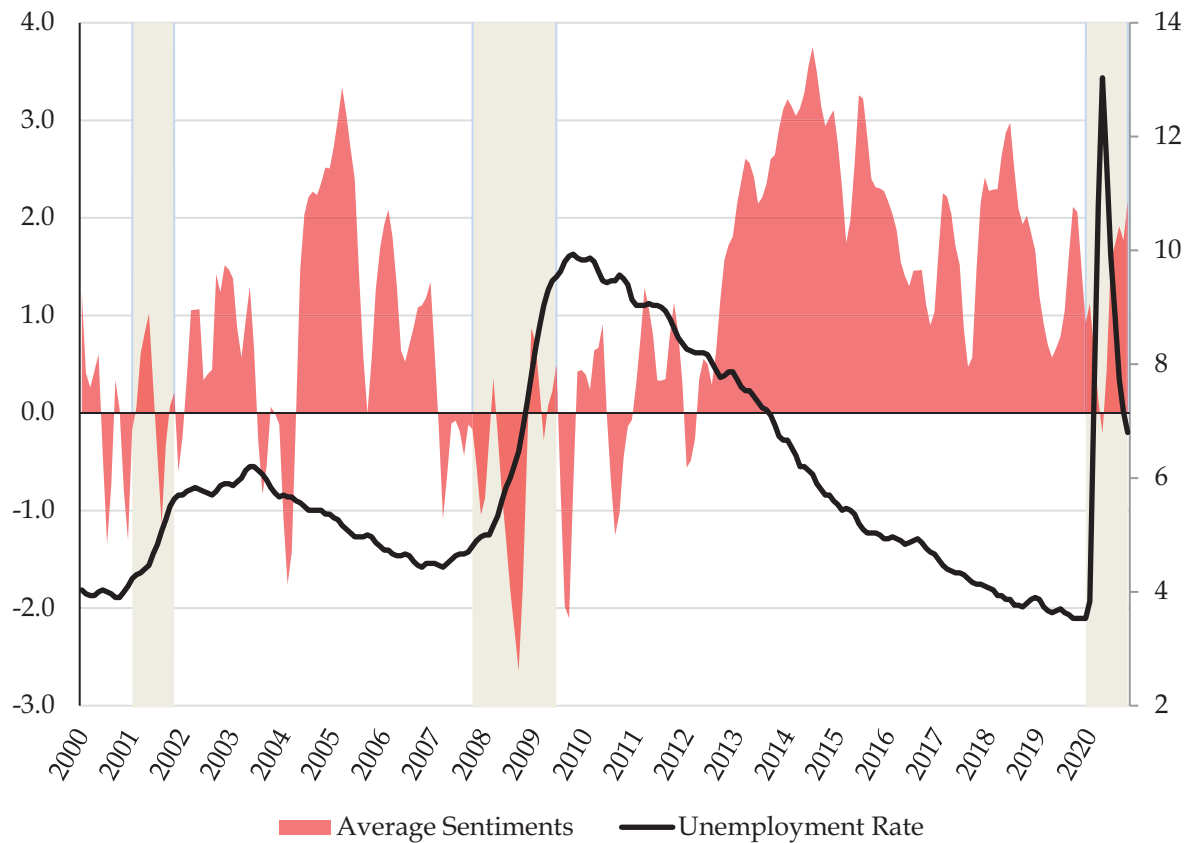
Figure 23 shows that increases in the NEER are correlated to decreases in the frequency of uncertainty-related words in the Fed's FFR announcements. It also shows UMP communications (and actions) generally decrease the NEER except during the tapering period where the NEER increased. High NEER levels also correspond to low levels of uncertainty-related terms in the Fed's communications.

Figure 24 relates the sentiment indicators discussed above to another measure of economic stability: the unemployment rate.

Figure 24 shows that sentiment and the unemployment rate are almost always inversely related. When the aggregated sentiment is positive, the unemployment rate tends to decrease. A switch from a positive to a negative aggregated sentiment usually coincides with an increase in the unemployment rate. The unpredictable nature of the COVID-19 crisis makes this statement debatable but not necessarily wrong. Unlike previous crises, the COVID-19 crisis increased the unemployment rate in the US from 3.5% to 13% in a short period of time, between January and May 2020. The unemployment rate decreased to lower levels after May 2020, around 6%. The sharp

and short-time shock on the aggregate sentiment was even shorter than the one on the unemployment rate, which may indicate a crisis-specific communication strategy toward communication optimism during crises.

Figure 24. Sentiment and Unemployment



Notes: The gray shaded area represents NBER recession periods. The right axis indicates the unemployment rate levels. The average sentiment aggregate contains an equally weighted average of sentiments according to the Loughran and McDonald (score and polarity), Hu&Liu (polarity), Jockers (polarity), NRC (polarity), SentiWords (polarity), UMP (score), and financial stability (score) sentiments. To achieve a balanced aggregated indicator for each communication type, we weight this average sentiment aggregate for FFR announcements more than for FOMC minutes, which in turn are weighted more than for chairman speeches.

Figure 24 confirms this intuition again that the Fed adopted a communication strategy to convey positive sentiments during the COVID-19 crisis.

To summarize, we show that the financial stability sentiment relates to FFR decisions in FFR announcements and FOMC minutes but not significantly enough in speeches. Increases in conventional monetary policy are often preceded by increases in financial stability sentiment, except during the period where UMP terms are used by Fed's communications, which generally involve actions improving financial stability.

We have also shown that the positive aggregated sentiment in the main Fed's communications correlates with decreasing unemployment. Except in times of

significant UMP steps, the NEER correlates with the level of uncertainty in the Fed's communications.

9. Policy Implications

The Fed implemented more unconventional monetary policies during the COVID-19 pandemic than during the dot-com and GFC crises. Moreover, it did so in a concise time window due to the abrupt upward slope of adverse shocks to the economy that the COVID-19 restrictions generated. The Fed's experience in crisis-specific communication and UMP tools acquired during the dot-com and GFC also contributed to understand better and address the COVID-19 crisis. To be successful, the Fed's UMP steps needed to be supported by clear and transparent communications and engagement with both the financial markets and the public.

We show that both the supervised and unsupervised learning methods we employ demonstrated that the Fed's communications during the COVID-19 crisis sharply differ from those of previous crises. Comparing the terms, sentiments, and topics conveyed by the Fed's communications with COVID-19 and financial data confirms that the Fed adopted a specific communication strategy during the COVID-19 crisis that also differs from the one adopted during the GFC and dot-com crises. We conclude that the Fed is getting better at using its communications to manage crises.

Our analysis determines that this communication policy consists of conveying optimism to the public during the worst periods of the pandemic while discussing (and implementing) earlier than in the previous crisis (Figure 14) unconventional monetary policies by justifying their importance in mitigating risks and uncertainties (Figures 16 and 17).

Another critical finding corroborates the Fed's forward-looking ability and its appropriate use of communication to convey a determined sentiment and justify UMP before each wave of the virus or each worsening of the financial conditions due to the virus's spillovers.

While we are still far from recovery, our results show that communications regarding the adopted policies and emergency programs allowed them to be perceived as a useful tool supporting economic recovery.

The Fed may have conducted a specific communication strategy for the COVID-19 crisis. This potential strategy conveyed less uncertainty and more optimism to the public while promoting UMP measures for managing the crisis situation. We interpret this behavior as conveying optimism without affecting transparency. The Fed's timely communications, together with its actions, succeeded in stabilizing financial markets.

10. Conclusion

This paper provides a comprehensive analysis of central bank communication during the past two decades, emphasizing the COVID-19 pandemic.

We show that both the supervised and unsupervised learning methods we employ determined that the Fed's communications during the COVID-19 crisis sharply differ from those of previous crises. Comparing the terms, sentiments, and topics conveyed by the Fed's communications with COVID-19 and financial data

confirms that the Fed adopted a specific communication strategy during the COVID-19 crisis that also differs from the one adopted during the GFC and dot-com crises.

During the COVID-19 pandemic, the Fed's communications emphasized topics of health, social welfare, and UMP interventions, which appear to be related to the conveyed sentiments. The Fed's communications regarding COVID-19 and UMP typically touch on the topics of financial volatility, uncertainty, and stability.

The content, sentiment, and timing of the Fed's communications changed in the COVID-19 crisis compared to previous crises. In particular, the sentiments of the Fed's communications significantly changed during the COVID-19 crisis compared to the GFC. Following the GFC, communicating about UMP became a "new normal" in the Fed's minutes and chairman speeches. Interestingly, we have shown that a negative financial stability sentiment usually precedes conventional monetary policy accommodation, except under the ZLB.

COVID-19 caused structural changes in the Fed's communication content. The Fed may have implemented a specific communication policy for the COVID-19 crisis that contrasted with its communication policy during the dot-com and GFC crises.

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12. Appendix

12.1 Unconventional Monetary Policy Dictionary

Our targeted lexicon (presented in Table 2) was constructed by collecting words related to unconventional monetary policies from Fed communications using topic modeling and Bag-of-Words (BoW); see Benchimol et al. (2020b).

Table 2. Unconventional Monetary Policy Lexicon

asset purchases	depreciation pressure	market disrupt	risk premium
helicopter	direct lending	market functioning	securities purchases
QE	ELB	monetary base	stagflation
securities purchases	foreign exchange reserve	monetary stimulus	support
balance sheet	forward guidance	money supply	support liquidity
business support	funding	negative policy	supporting corporat
credit facilit	insolvency	negative rate	swap line
credit impair	intervention	NIRP	unconventional
deferral	lending facilit	quantitative easing	ZLB
deflation	lower bound	relaxing regulatory	

Source: Words and root words were extracted mainly from Fed communications.

12.2 COVID-19 Dictionary

Table 3 was constructed essentially from terms related to COVID-19 that appeared in both media (e.g., Google Trends search queries) and recent Fed communications (BoW) using the same methodology as in Table 2.

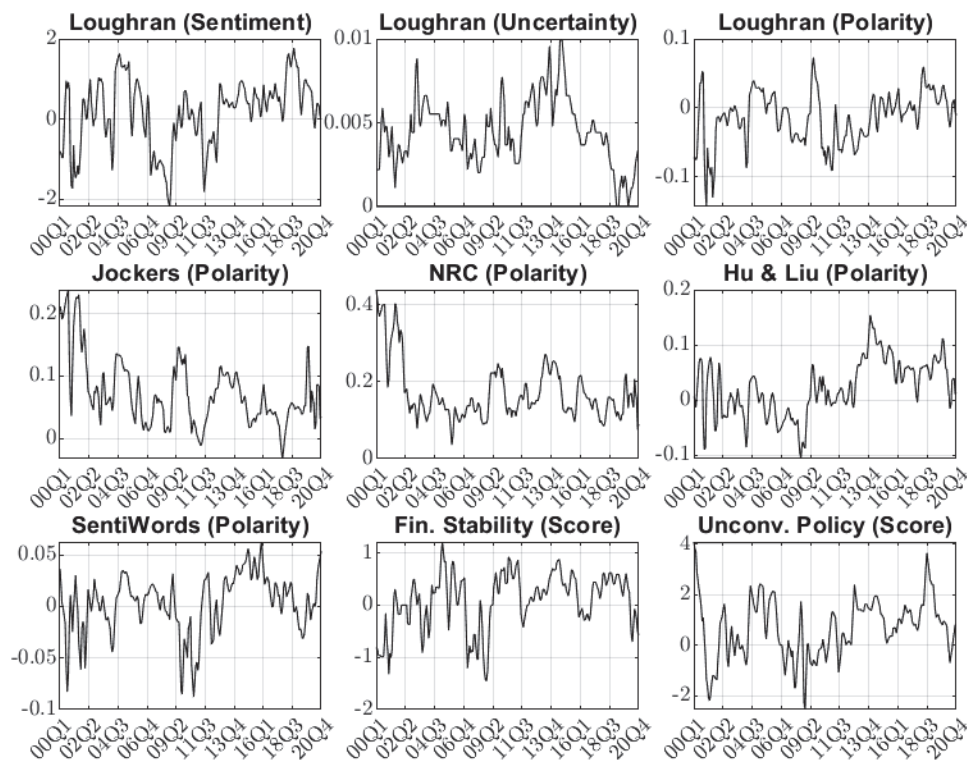
Table 3. COVID-19 Lexicon

acute	elderly	infect	pandemic	severe acute
cases	emergency	infection	pneumonia	sickness
confin	epidem	infection rate	quarantine	spreading
contagio	epidemic	lockdown	relief	syndrom
corona	hcov	mask	reproduction rate	testing
coronavirus	health	medical	respirator	vaccin
covid	hospital	morbid	respiratory	virus
death	hubei	morbidity rate	sars	wave
disabilit	human	mortal	sars cov	wuhan
disease	illness	ncov	sarscov	
disorder	inception rate	outbreak	sars-cov	

Source: Words and root words were extracted mainly from media and Fed communications.

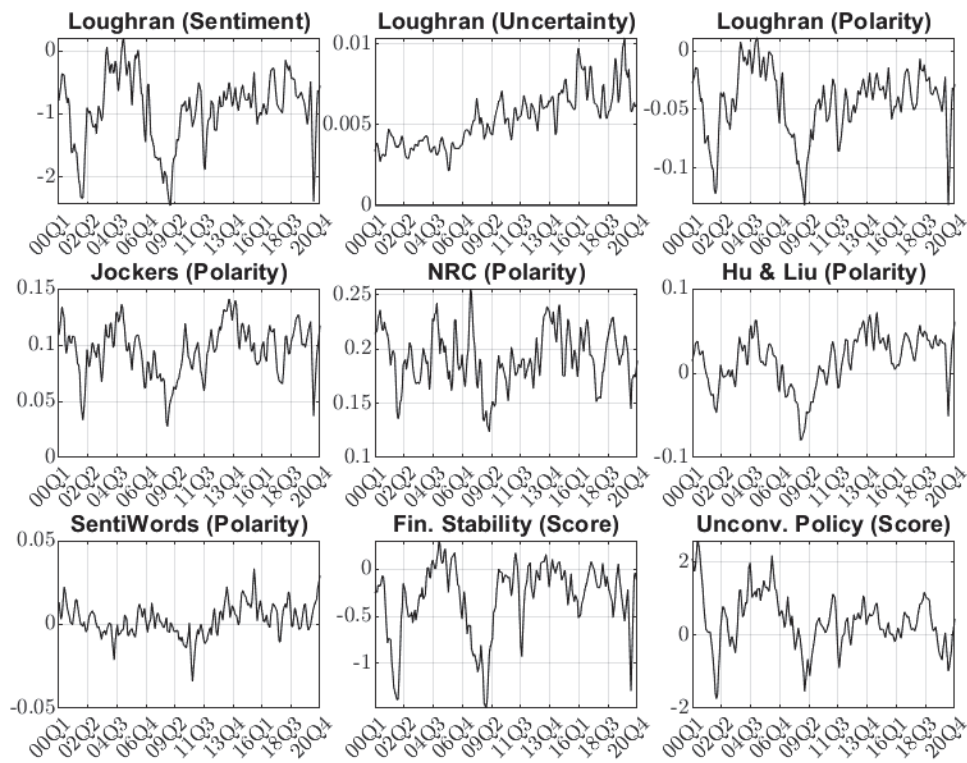
12.3 Full Sample Figures

Figure A1. Sentiment Scores in FFR Announcements – Full Sample



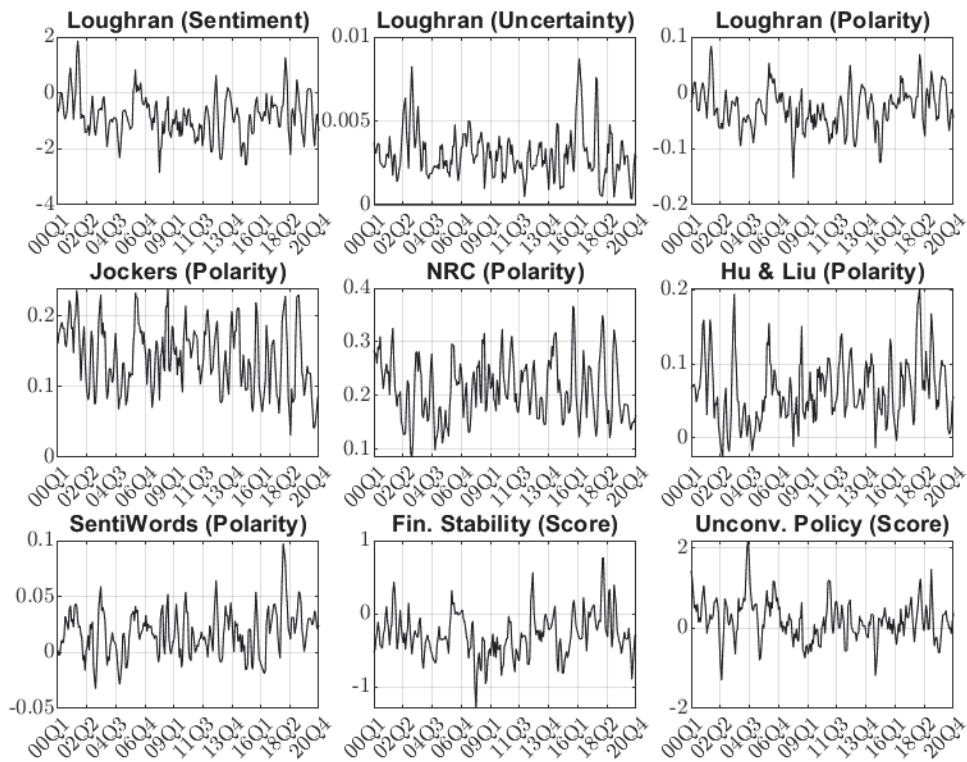
Notes: Solid black lines represent sentiment score values. *Source:* Benchimol et al. (2020a).

Figure A2. Sentiment Scores for the Fed's FOMC Minutes - Full Sample



Notes: Solid black lines represent sentiment score values. Source: Benchimol et al. (2020a).

Figure A3. Sentiment Scores for Fed Chairman Speeches – Full Sample



Notes: Solid black lines represent sentiment score values. Source: Benchimol et al. (2020a).

Figure A4. Sentiment Scoring of Main Fed Communications – Full Sample

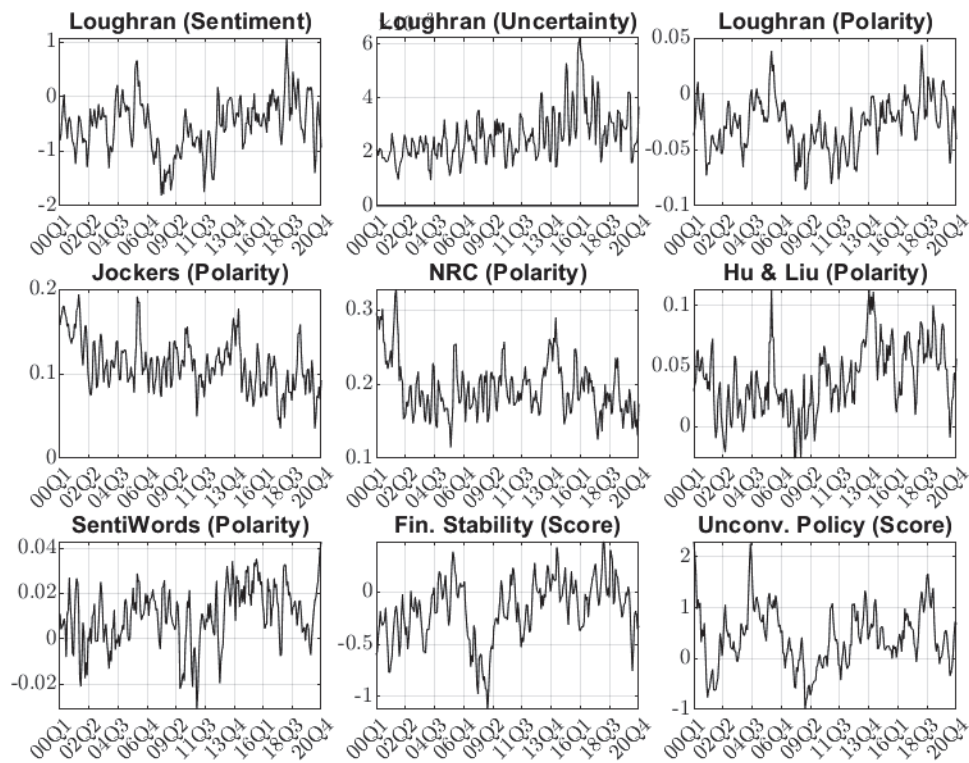


Figure A5. Topic Analysis of Main Fed Communications

