Federal Reserve Communication and the COVID-19 Pandemic*

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Abstract

We examine how the Federal Reserve (Fed) communicated during the COVID-19 pandemic and compares it with other periods of stress. This comparison uses novel dictionaries related to COVID-19, unconventional monetary policy (UMP), financial stability, and usual sentiment analysis and topic modeling. We show that Fed communication during the COVID-19 pandemic focused on financial stability, market volatility, social welfare, and UMP, and presented significant contextual uncertainty. We also compare Fed communication during the COVID-19 pandemic with the dot-com and global financial crises regarding content, sentiment, and timing. We find that Fed communication and actions were more reactive to the COVID-19 crisis than to other crises. We also show that declining financial stability sentiment in interest rate announcements and minutes precedes accommodative monetary policy decisions.

Keywords: Central bank communication, Unconventional monetary policy, Financial stability, Text mining, COVID-19.
JEL Classification: C55, E44, E58, E63.

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1. Introduction

At the start of the COVID-19 pandemic, central banks around the world declared that they would take "all necessary steps" to mitigate the impact on their economies, lowering their interest rates to the zero lower bound (e.g., Carney, 2020). In response to the onset of the recession in March 2020, the Federal Reserve (Fed) and many other central banks implemented vigorous unconventional monetary policy (UMP) measures to overcome the limitations of conventional monetary policy. Communication was one of the main tools through which these policies were delivered.

Central banks communicate on a range of topics through different channels and with well-defined objectives (Hansen et al., 2019; Benchimol et al., 2020). Communication by central banks aims to inform (e.g., current and future policy objectives and decisions), explain (e.g., past, current, and future economic outlooks and decisions), and influence (e.g., current and future uncertainty and financial decisions) economic agents. These communication instances are usually published and presented in textual form (Haldane and McMahon, 2018).

The COVID-19 pandemic affected all sectors of the global economy (Chetty et al., 2020). In particular, its effect on financial markets and social welfare led to changes in monetary policy and threatened financial stability (Daly, 2020; Craig et al., 2021). Central banks played an important role in addressing the crisis by adapting and harnessing their communication policies. Central banks used UMP tools (e.g., forward guidance, quantitative easing, funding and lending facilities, adjustments to market operations, negative or dual interest rates, etc.) to manage the crisis, reduce uncertainty, and promote financial stability.

This paper studies how the Fed communicated during the COVID-19 pandemic. Like most central banks whose primary policy instrument—the nominal interest rate—reached the zero lower bound, the Fed implemented policies aimed at shaping expectations through other channels, including communication, quantitative easing (QE), balance sheet policies, lending facilities, fiscal and money drops, forward guidance, and other market operations.[4] The COVID-19 pandemic led to unprecedented central bank monetary policy decisions and communication.

We analyze the main communication instances published during the past two decades, focusing on three economic crises—the Global Financial Crisis (GFC), the dot-com crisis, and the COVID-19 crisis. Specifically, we study the Federal Funds Rate (FFR) decision announcements, the Federal Open Market Committee (FOMC) minutes, and Fed Chairman speeches. Text analysis shows that communication throughout 2020 was uncertain and heterogeneous, both over time and across communications types. We show that announcements on unconventional monetary policies by the Fed might have reduced volatility for US equities, in contrast with the GFC and dot-com episodes. Additionally, we examine whether the Fed successfully implemented clear and transparent communications to support UMP measures addressing the economic challenges caused by the COVID-19 pandemic.

[4] See, e.g., Bianchi et al. (2020) and Guerrieri et al. (2022).

Finally, we show that Fed communication and actions were more reactive to the COVID-19 crisis than to the GFC and dot-com crises. Our findings show that the Fed's communication policy was significantly different during the COVID-19 pandemic than during the GFC and dot-com crises. Although the dot-com, GFC, and COVID-19 crises were inherently different in their causes and effects, they all involved central bank interventions and communication, as well as supply and demand effects detrimental to global economic activity, which allows comparison within the context of central bank communication. When the pandemic hit the economy, it would have been surprising if we had concluded the Fed's emphasis, sentiments, and topics did not shift. Our paper describes the degree to which these differences exist, as well as their intensity (level) between and during crises.

Our analysis shows that Fed communication was used in a timely and targeted way during the COVID-19 crisis, demonstrating the Fed's increasing experience in crisis-specific communication management.[5] In a highly uncertain economic environment, the standard for effective central bank communications would typically consist of straightforward and timely updates about current and near-term policy actions. Accordingly, the prevalent financial stability updates in monetary policy and financial market-related communications were positive after the GFC, and were less negative during the COVID-19 crisis than during the GFC.[6]

The content, timing, and sentiment of the Fed's communications exhibit noteworthy differences depending on the crisis, which might drive financial system developments (Nyman et al., 2021). Since the GFC, communications regarding UMP have become the "new normal," as reflected in the main communication type (FFR announcements, FOMC minutes, and Fed Chairman speeches). We also find evidence for a link between conventional monetary policy and financial stability sentiment (FSS).

We know the pandemic led to unprecedented economic uncertainty (Baker et al., 2020; Coibion et al., 2020). How should central bank communication respond to such conditions? Our paper attempts to answer this question and provide policy implications for the future.

In this paper, we do not intend to evaluate the direct causal impact of the Fed's communication on the financial and economic developments that occurred during the COVID-19 crisis. Instead, we analyze the extent to which sentiments and topics conveyed by the Fed communications were associated with changes in financial and economic conditions. Through our analysis, we seek to shed light on the role of the Fed's communication in shaping sentiment and topics according to the type of communication.

The remainder of the paper is organized as follows. Section 2 describes our data and methodology. Section 3 presents sentiment analysis and topic modeling results. Section 4 examines the Fed's communications on unconventional monetary policy. Section 5 discusses the Fed's early communications regarding the pandemic. Section

[5] The methodology and code used in this paper are available in Benchimol et al. (2022).

[6] 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).

6 compares the Fed's conventional monetary policy to the FSS over the past two decades. Section 7 discusses policy implications, and Section 8 concludes.

2. Data and Methodology

2.1 Data

Our study focuses on the main Fed communications to the public. The sample contains communication instances detailing monetary policy discussions (FFR announcements and FOMC minutes) and Fed Chairman speeches from 2000 to 2020. Our dataset is summarized in Table 1.

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

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

Additionally, we use data related to the pandemic—the daily number of new COVID-19 cases—from the COVID-19 Data Repository maintained by the Johns Hopkins University Center for Systems Science and Engineering (CSSE).[7] We also use daily market-based measures, such as the SP500 equity index, the Chicago Board Options Exchange Volatility Index (VIX), the nominal effective exchange rate (broad), and the nominal interest rate (FFR), collected from Bloomberg.

2.2 Methodology

To quantify Fed communication instances, we build text-based measures of uncertainty and sentiment using an array of custom dictionaries described below. Specifically, we calculate sentiment measures and apply topic modeling techniques to our collection of texts.

First, we utilize simple word-counting procedures. For this purpose, a set of dictionaries is used: a finance-specific sentiment dictionary (Loughran and McDonald, 2011), a financial stability dictionary (Correa et al., 2021), a UMP dictionary (Henry, 2008; Erasmus and Hollander, 2020), and our COVID-19 dictionary.[8] We count the terms related to UMP and COVID-19 that appear in the Fed's communications.

[7] The full dataset can be accessed at github.com/CSSEGISandData/COVID-19
[8] The UMP and COVID-19 dictionaries are presented in the Appendix.

Second, we use sentiment scoring. We use the Loughran and McDonald (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 content of the Fed's communications. Specifically, we use the latent Dirichlet allocation (LDA) algorithm to compare the content of Fed communication to economic and financial developments.

A COVID-19 dictionary is built by compiling relevant keywords related to the pandemic.[9] We use this dictionary to identify virus-related content in texts and capture the frequency (or "intensity") of words associated with the COVID-19 pandemic in the Fed's communications. We estimate the coverage of the COVID-19 pandemic in each Fed communication with this new COVID-19-specific dictionary. By counting the number of COVID-19-related words, we can estimate the amount of attention paid to the pandemic at each point in time.

In addition, we construct a dictionary that captures communications regarding the Fed's UMP measures by merging two dictionaries: Erasmus and Hollander (2020), which translates central bank communications about future monetary policy into groups of positive and negative words, and Henry (2018), which considers more market-related terms. We calculate the overall sentiment related to UMP measures using this merged dictionary. We report the results in Section 4.

We also use a dictionary tailored to capture terms related to financial stability. Correa et al. (2021) explain movements in financial cycle indicators related to credit, asset prices, systemic risk, and monetary policy rates and classify text based on the sentiment conveyed in financial stability reports. The second dictionary (Erasmus and Hollander, 2020) focuses on forward guidance and quantitative measures, and we merge that with another dictionary that focuses more on the regulatory context, structural attributes, and dual informational-promotional role of earnings press releases (Henry, 2008).

For the sentiment expressed in the text, we use the Loughran and McDonald (2011) dictionary, developed to assess the sentiment and uncertainty of financial text, and 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. We use the following formula to calculate the net sentiment score:

$$Score_t = 100\left(\frac{Positive_t}{Positive_t + Negative_t}\right) \quad (1)$$

where $Positive_t$ ($Negative_t$) is the total number of words classified as positive (negative) in the corresponding dictionary for text t.

Lastly, we construct two types of sentiment indicators based on the Loughran and McDonald (2011) dictionary. One is the standard score measure described by Eq. (1).

[9] Presented in the Appendix.

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. The corresponding methodology is described in detail by Benchimol et al. (2020).

Section 3.1 presents sentiment scores produced from this analysis. Overall, we note a sharp decline in sentiment scores in the first quarter of 2020 and a spike in uncertainty-related words during that period. This finding suggests that the Fed's communication reflects its willingness to proactively address the ongoing developments during the COVID-19 pandemic.

Section 3.2 identifies underlying themes that drive Fed communication using topic modeling to capture their prevalence over time. The topic modeling approach identifies several themes that best explain thematic variation over time and is used to capture the Fed's real-time assessments of economic and financial risks.

Topic modeling is an unsupervised machine-learning technique that requires no training or dictionary-based analysis. We use the LDA algorithm, which considers each document as a mixture of topics occurring in the body of the text. The algorithm scans a set of relevant documents, detects words and phrases within them, and clusters word groups (i.e., topics) that best characterize a set of documents. It identifies the different topics in the document and calculates their prevalence (Blei et al., 2003).

Overall, Section 3.2 shows that at the onset of the COVID-19 pandemic, the topics related to policy intervention gained prominence mainly at the expense of the inflation expectation and financial stability topics. This policy intervention topic was more emphasized in the communication of the Fed during the COVID-19 pandemic compared to the GFC.

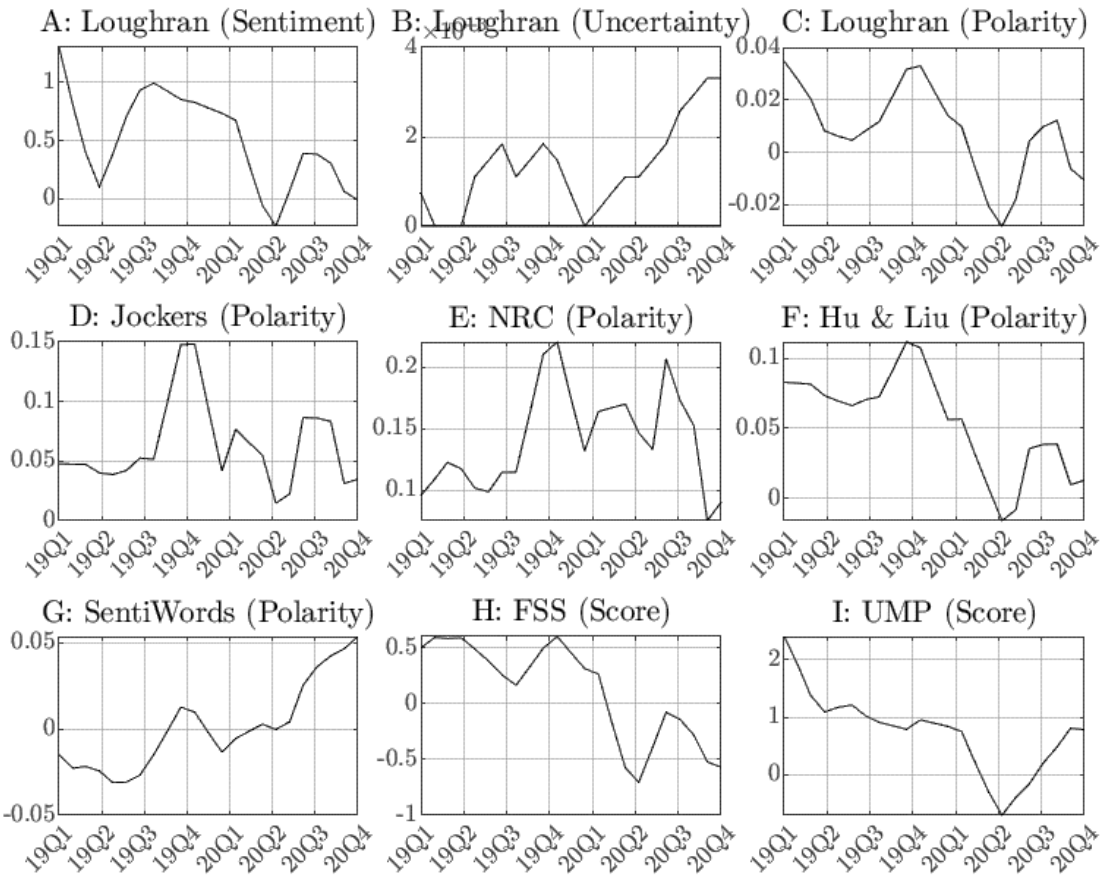
3. Results

3.1 Sentiment Analysis

Figure 1 presents a set of sentiment indicators based on text analysis of FFR announcements. Sentiment declined sharply in January 2020, following the COVID-19 outbreak in China, and again in March 2020, following the outbreak in the US (Panels A, C, F, and H). This date range corresponds to an increase in contextual uncertainty (Panel B), as captured by the uncertainty indicator (the number of words reflecting uncertainty, scaled by text length).

Based on the Loughran and McDonald (2011) dictionary, our new polarity indicator (Panel C) declines but displays a more optimistic sentiment for 2020:Q3. FFR announcements summarize the current state of the economy and monetary policy decisions. Figure 1 shows that the shock that occurred in January 2020 lasted until April 2020. The sharp decline of sentiment in 2020:Q1-Q2 and the rise of contextual uncertainty in 2020:Q1-Q3 coincide with the beginning of the COVID-19 crisis.

Figure 1. Sentiment Scores in FFR Announcements



Notes: Solid black lines represent sentiment score values.

Figure 1 also shows that the Jockers, NRC, and SentiWords polarity indices are 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 crises.[10]

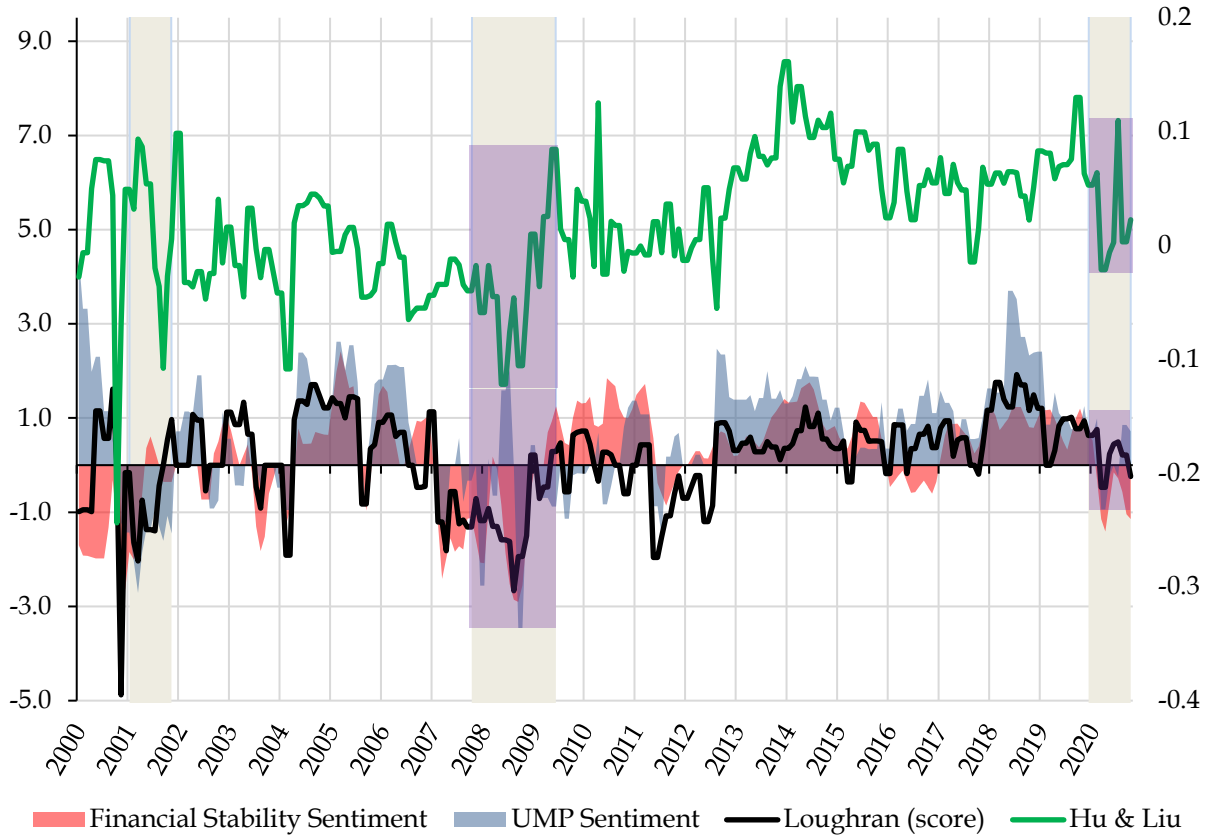
The FSS has been declining into negative territory since 2019:Q4, meaning there were more negative financial stability-related words than positive ones in the FFR announcements.

The UMP sentiment before the COVID-19 crisis was significantly positive due to the Fed's plan to gradually reduce the size of its balance sheet by letting maturing securities *run off* the balance sheet without replacing them. However, as the outbreak of the COVID-19 crisis approached the US, emergency policies were accompanied by negative communications that led to skyrocketing financial uncertainty (Fig. 16).

[10] The SentiWords polarity index declines sharply for the GFC and dot-com crises. The results of the full sample are available in the Appendix (Figure A1).

Figure 2 compares sentiment indicators over the full sample. As proxied by our sentiment measures, the sentiment in Fed communication differs significantly between the GFC and dot-com crises and the COVID-19 crisis.

Figure 2. A Tale of Three Crises: Sentiment.

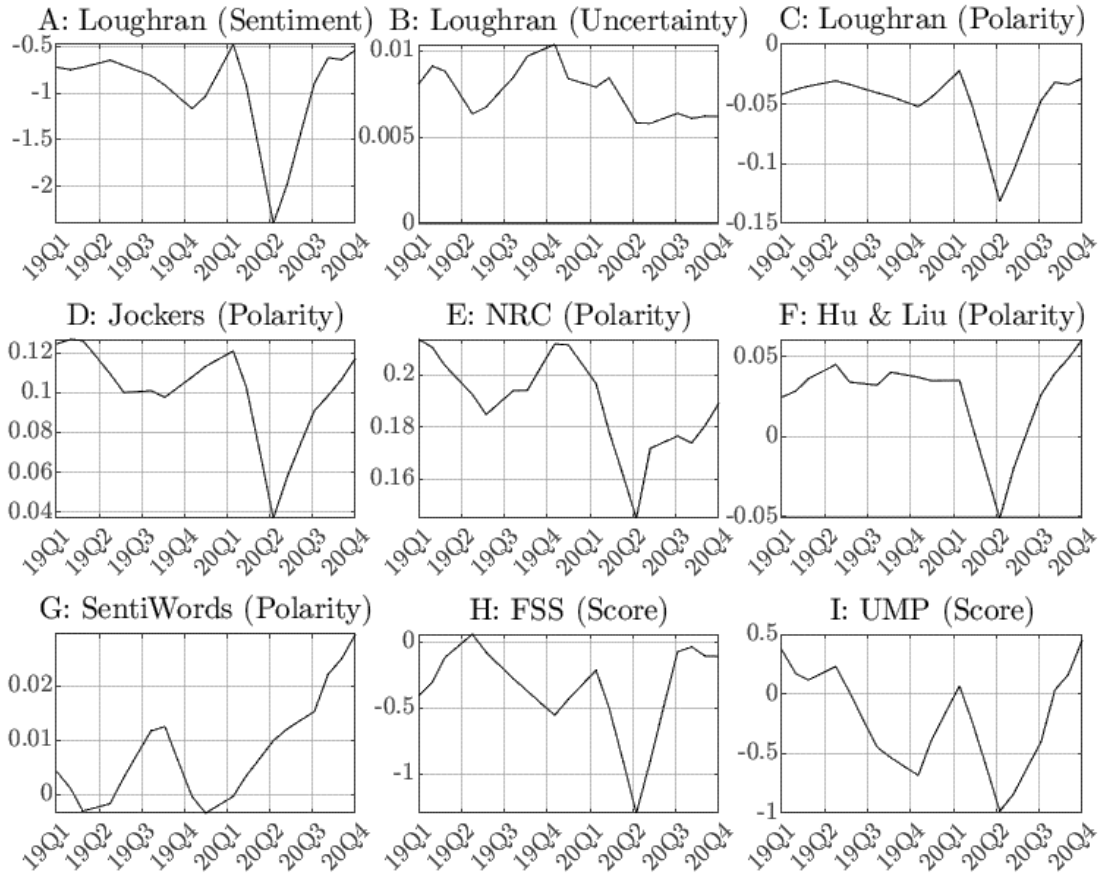


Notes: The vertical shaded areas represent the NBER recession periods. Solid lines represent sentiment scores computed from FFR announcements.

The FSS deteriorated sharply before the GFC and dot-com crises, whereas it was significantly positive before the COVID-19 pandemic. The Hu&Liu sentiment polarity index improved from the GFC until the COVID-19 crisis and declined less during the COVID-19 crisis than in the other crises. While the Loughran and McDonald's sentiment index did not improve between the crises, it declined less during COVID-19 than in other crises. Also, the volatility of these indicators was less pronounced during the COVID-19 crisis than in the GFC and dot-com crises. Although Figure 2 presents the tale of three crises, it also clearly shows a tale of three communication policies.

Figure 3 presents the same indicators for the FOMC minutes. The dynamics for almost all sentiment indicators display a sharp deterioration in 2020:Q2, 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.

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 indices showed a sharp decline in sentiment related to financial uncertainty from January to April 2020.

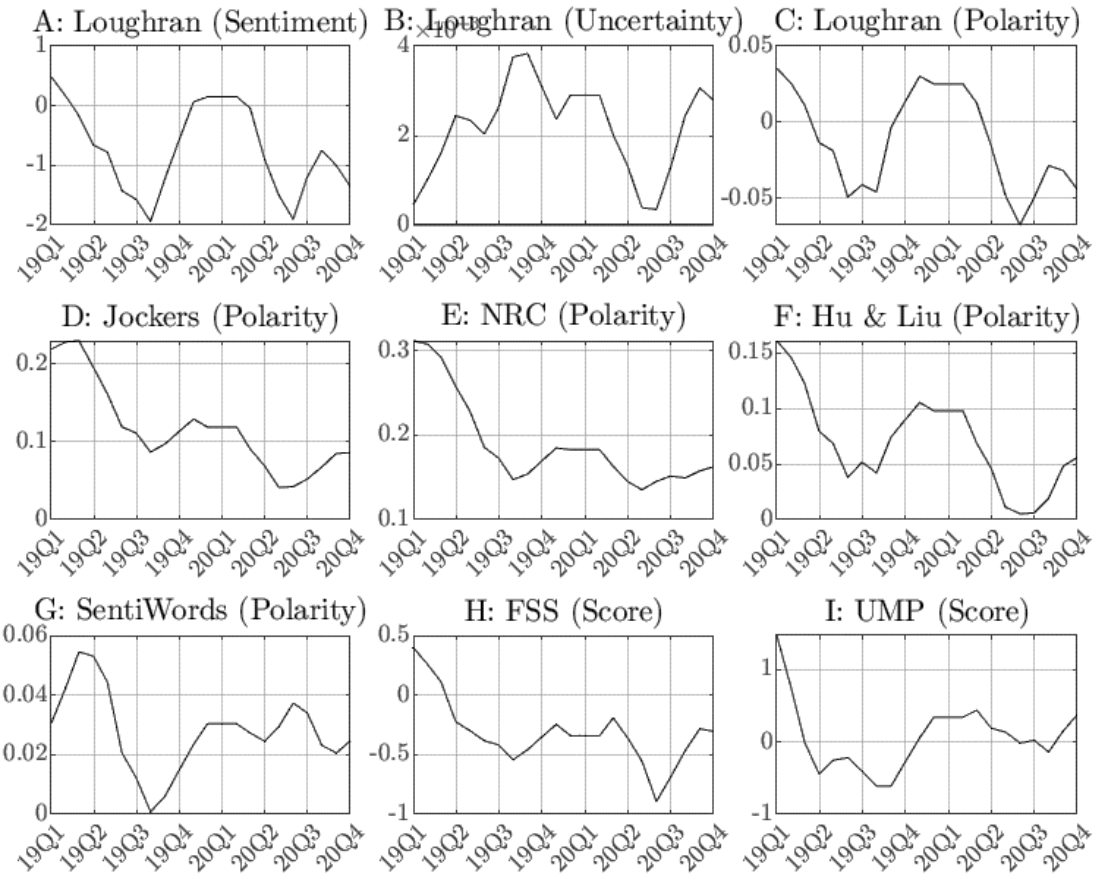
The UMP sentiment score declines until 2020:Q2 and then sharply increases until it becomes positive. This phenomenon corresponds to the more positive language adopted in FOMC minutes regarding UMP steps taken during the COVID-19 crisis. Figure 3 also shows that according to FOMC minutes (i.e., according to policymakers during monetary policy committee discussions), financial stability was perceived to be at risk in 2020:Q2. This was effectively the case 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, possibly due to the Fed's communication strategy to calm and reassure economic agents by using more positive words. This was not the case during the GFC, where the SentiWords indicator sharply declined to historically low levels.[11]

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

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.

The sentiment conveyed by Fed chairman speeches declines less than that of 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 sentiment degraded from February 2020 onward, contextual uncertainty declined.

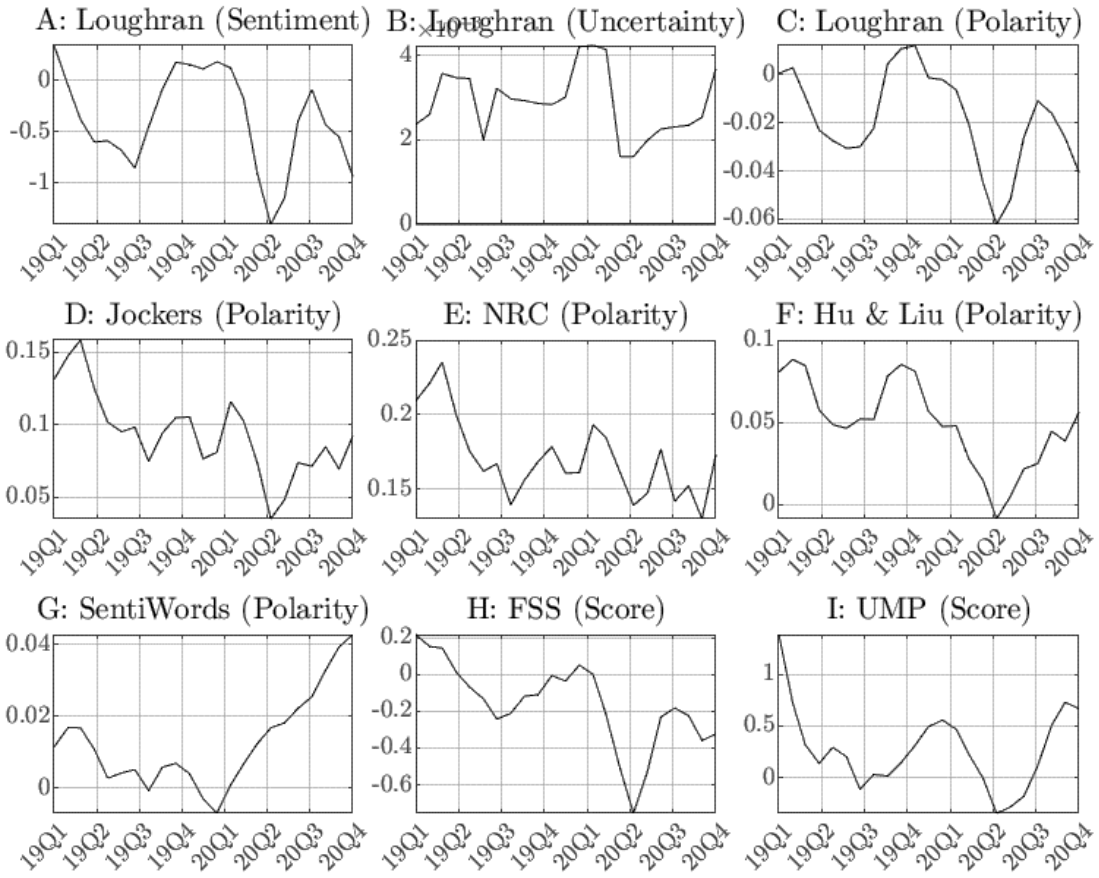
The sentiment in Fed chairman's speeches is generally more volatile than that conveyed by FFR announcements and FOMC minutes (Benchimol et al., 2020). However, the small sample makes the sentiment indicators for the COVID-19 crisis presented in Figure 4 less volatile than those for the GFC.[12]

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

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

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.

We provide a global picture of the Fed's communications by aggregating all communication types in our dataset. Figure 5 shows a sharp decline in the uncertainty sentiment, mainly driven by minutes and speeches. The FSS sharply declined from January to April 2020, which may be correlated with volatility measures such as the VIX (see Section 6).

The results presented in Figures 1–5 point to the same conclusion: the Fed likely 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 during the COVID-19 crisis compared to the GFC.[13]

This section covers the exceptional sentiment deterioration that occurred from January to April 2020. The sentiment recovered into positive territory following this deterioration, with some sentiment measures rising above pre-crisis levels. Looking at

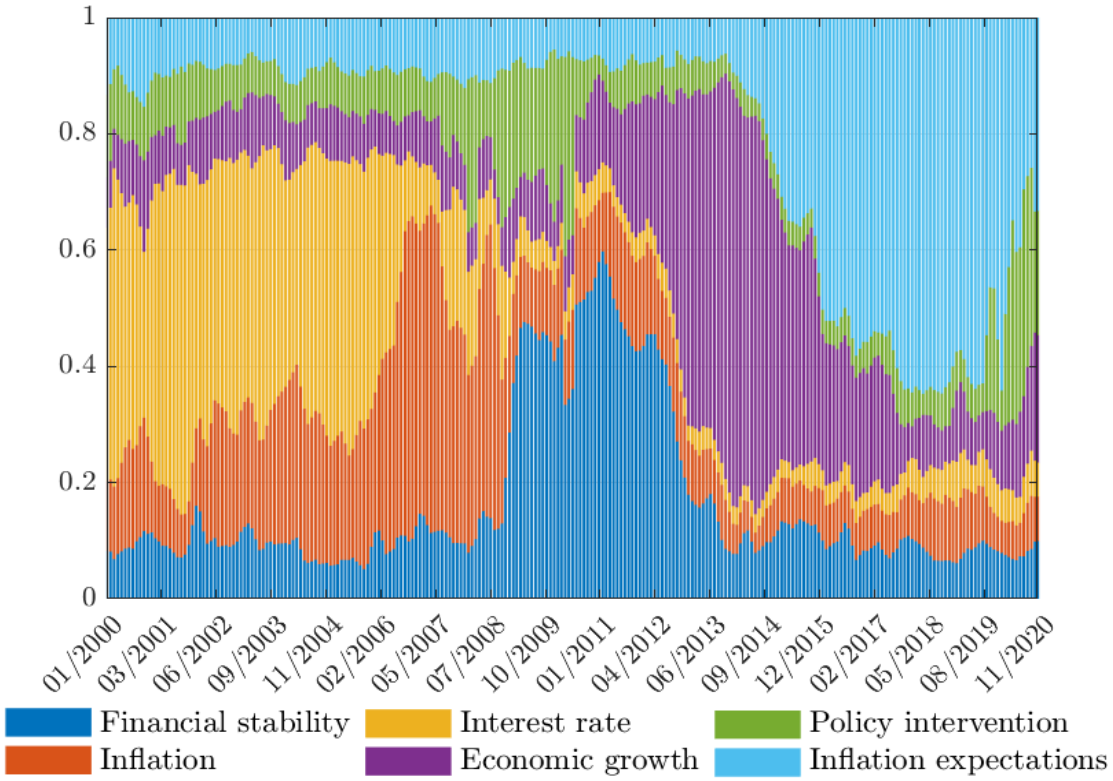
[13] The results of the full sample are available in the Appendix (Figure A4).

the pronounced differences in sentiment over time, we find evidence that Fed communication was used to shape the narrative and manage expectations.

3.2 Topic Modeling

This section focuses on the topics extracted from our sample of texts. It is important to note that the topic modeling methodology uses no 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



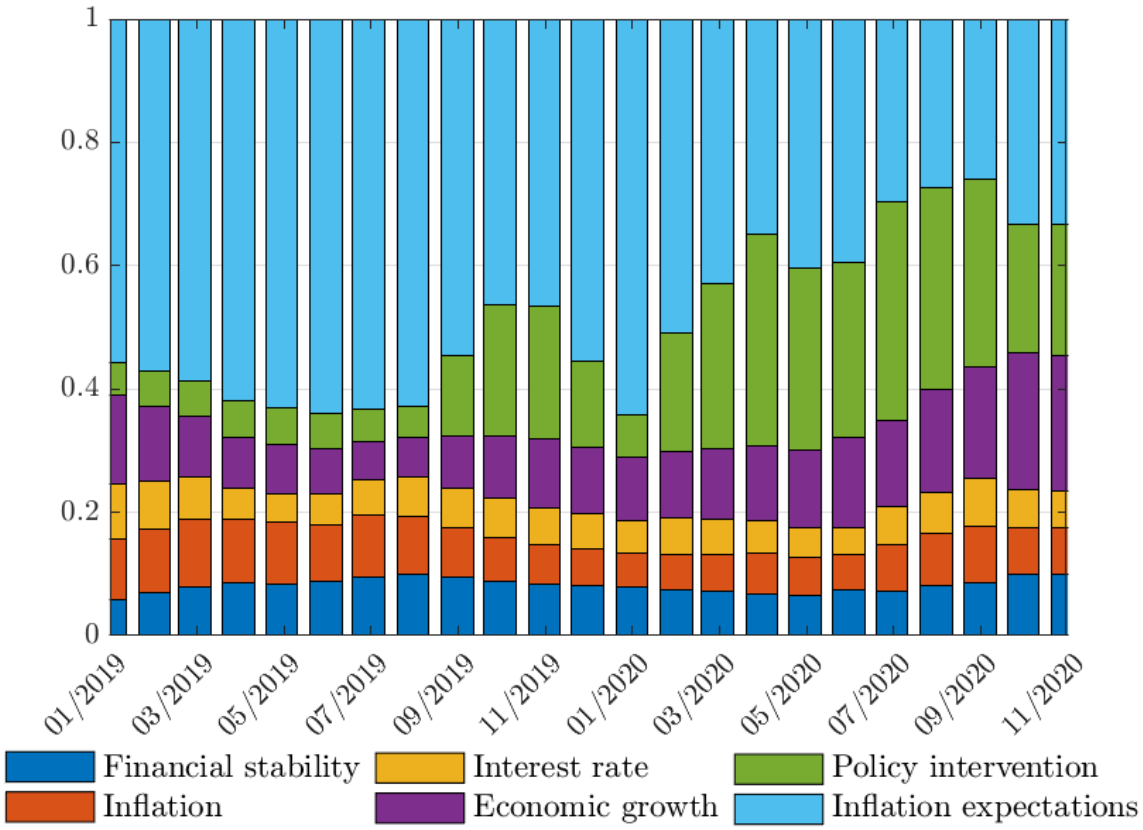
Note: Bars represent the topic probability computed from FFR announcements. For clarity and robustness, we restrict attention to the six most frequently discussed topics.
Source: Benchimol et al. (2020).

Figure 6 presents six topics extracted from FFR announcements over the past two decades. It shows that discussion of policy interventions was more pronounced during COVID-19 than other crises. Interestingly, Figure 6 shows that 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, indicating that it may be partly related to previous concerns unrelated to COVID-19.

Figure 7. Topic Analysis of FFR Announcements



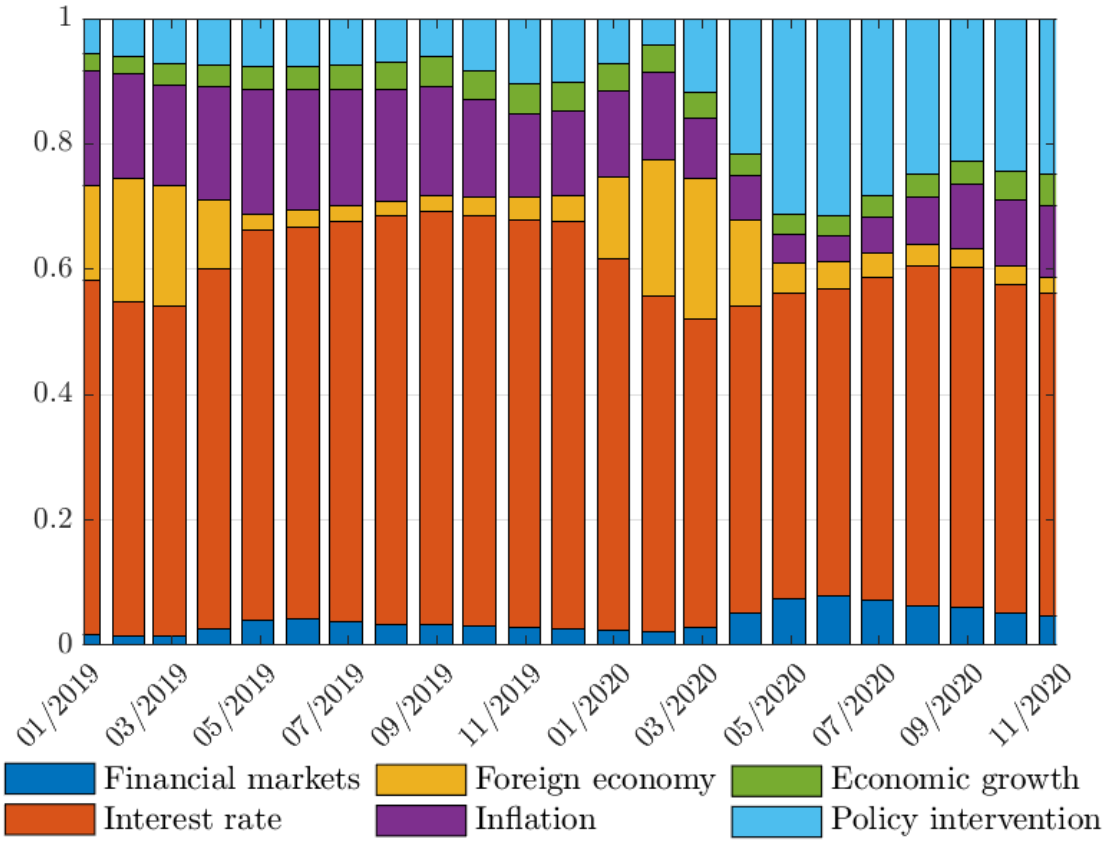
Notes: For clarity and robustness, we restrict attention to the six most frequently discussed topics.

The COVID-19 outbreak coincided with a sharp decline in the topic probability of inflation expectations, which is in line with monetary policy considerations at that time when the focus shifted to policy intervention. To a lesser extent, discussions regarding inflation declined, and discussions of economic growth increased in FFR announcements during the COVID-19 crisis.

The increase in the topic probability of policy intervention in FFR announcements lowers 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, which indicates the Fed's concern that a pandemic would threaten 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.

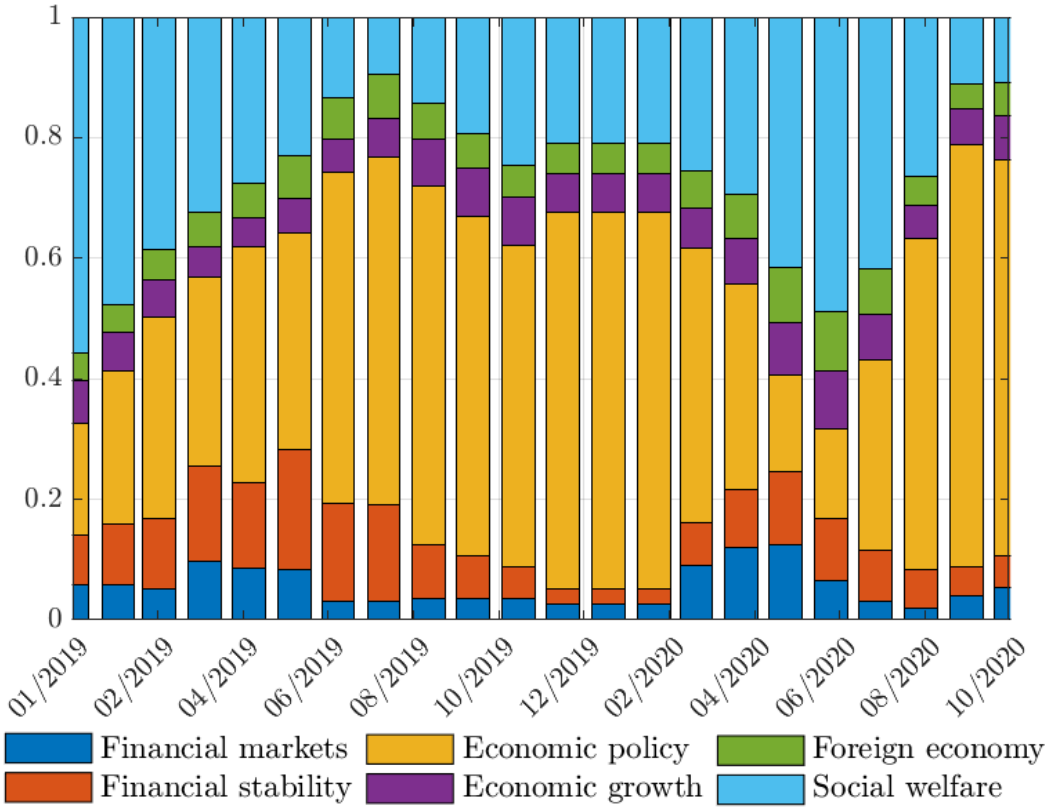
Interestingly, like the FFR announcements, the FOMC minutes are also influenced by the topic of policy intervention, even though the interest rate is the most prominent topic. The probability of discussion of inflation also declined in the FOMC minutes due to the COVID-19 outbreak, while discussions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

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

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 the Fed's primary objective of stabilizing prices, such as education, healthcare, and development economics, including family and labor markets.[14]

[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, help, opportun, import,* and *family*.

Figure 9. Topic Analysis of Fed Chairman Speeches



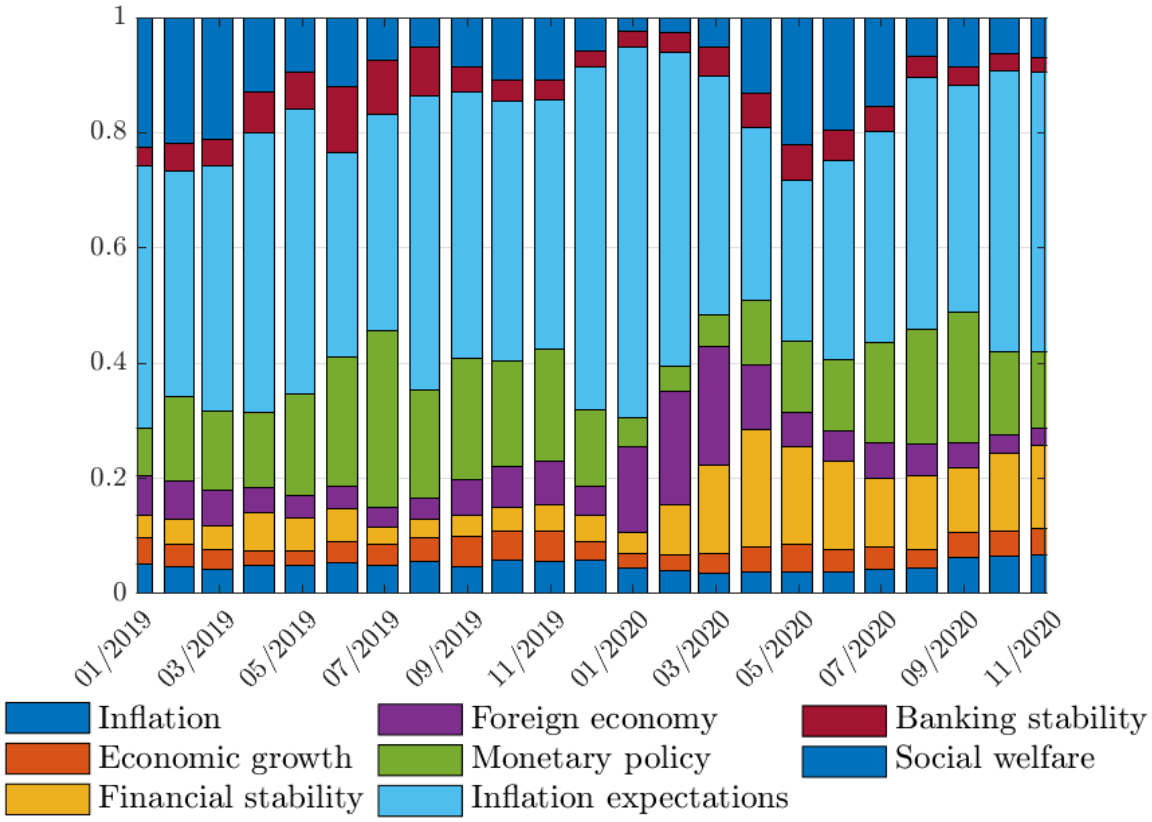
Notes: For clarity and robustness, we restrict attention to the six most frequently discussed topics.

The fact that the speeches are less supervised and meant for broader audiences than traditional FFR announcements and FOMC minutes, which are more focused on inflation and output growth, may explain the increase in the 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 aggregated Fed communications. We provide a global picture of the topic modeling of the Fed's communications by aggregating all communication types in our dataset: FFR announcements, FOMC minutes, and Fed chairman speeches. Because of the considerable number of texts analyzed and their respective characteristics,[15] we consider a larger number of topics for the topic modeling of this aggregate. Taken together, these include most of the topics described in Figures 5 to 7.

[15] The Fed does not communicate similarly and similar topics across its various channels, which include FFR announcements, FOMC minutes, and speeches by the Fed chairman. Different topics are emphasized and communicated in varying ways across these channels. This lack of consistency in communication approaches has implications when considering aggregating these texts regarding the number of topics to assume.

Figure 10. Topic Analysis of Main Fed Communications



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

It is worth noting 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, 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, Fed communication regarding the foreign economy increased as the COVID-19 pandemic spread from China to the rest of the world (01-03/2020). Second, Fed communication regarding financial stability increased as fears about the COVID-19 crisis's impact on the financial system increased (03-05/2020). Third, Fed communication on social welfare increased as the potential need for additional relief plans from the government and the Fed increased (04-07/2020). Fed communication regarding conventional monetary policy (especially average inflation targeting) and UMP declined at the beginning of the COVID-19 pandemic but increased thereafter (06-10/2020).

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

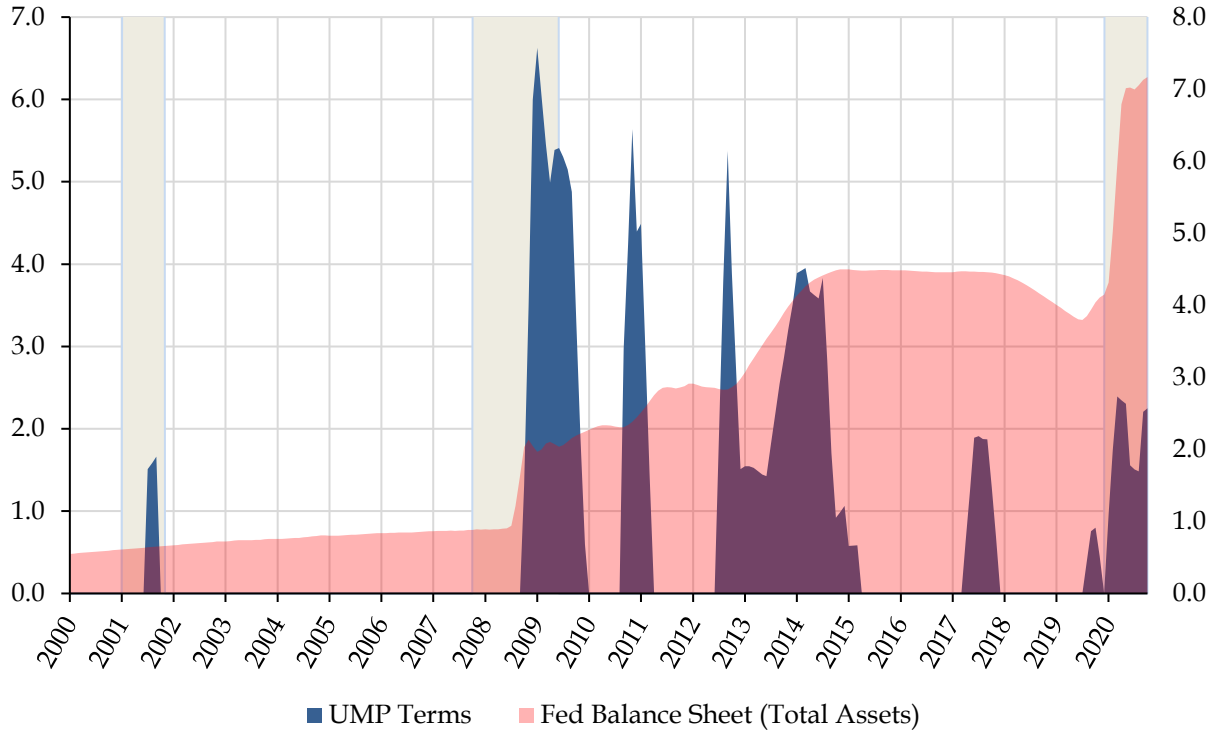
The topic of policy intervention was much more prevalent in communication during the COVID-19 crisis than in the GFC and dot-com crises. It seems that the policymakers not only implemented policy interventions but also discussed these

interventions differently across the crises. The content, sentiment, and timing of these communications are conditioned on the crisis.

4. Unconventional Monetary Policy

This section analyzes the link between the Fed's communication, 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 areas represent NBER recession periods. The blue shaded areas represent the word-counting indicator based on the dictionary presented in the Appendix (left axis). The red shaded area represents total assets (minus eliminations from consolidation) in trillions of US dollars in the Fed's balance sheet (right axis).
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, the timing is essential. After a nine-month delay, the Fed communicated about and acted to combat the GFC. In contrast, it hastened to do so during the COVID-19 crisis when 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 the Fed balance sheet changes with several lags. Whereas actions were implemented *before* they were

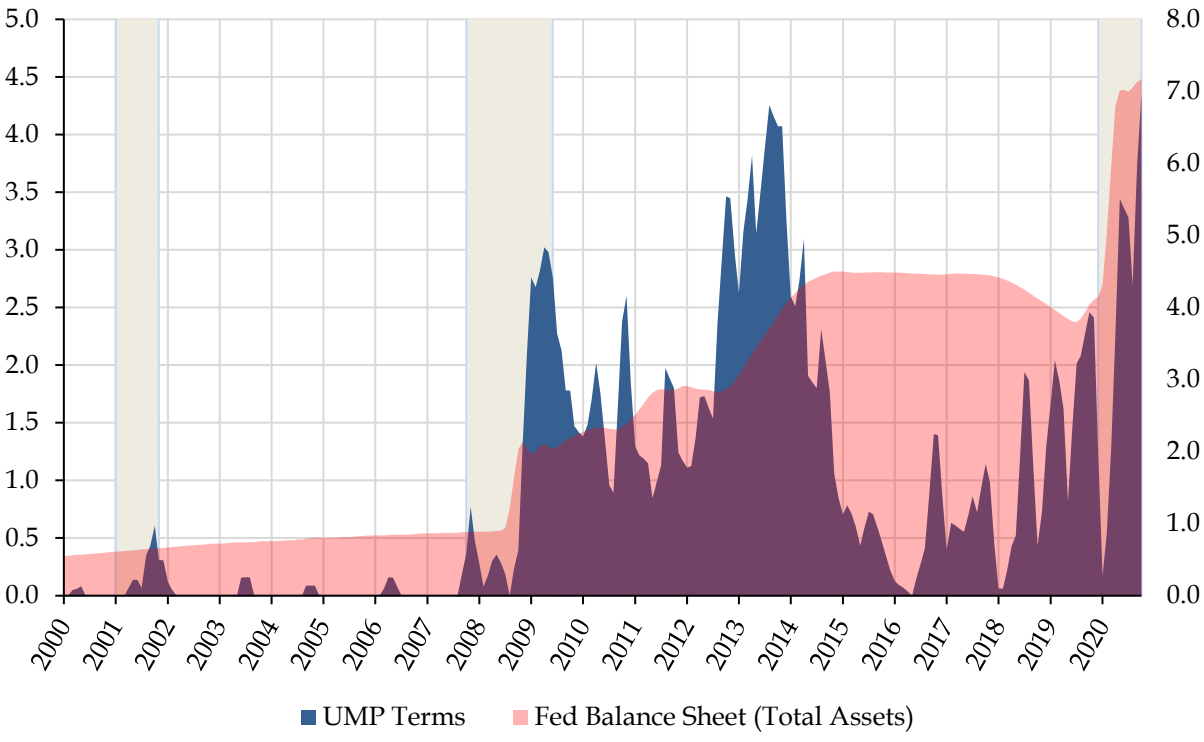
communicated during the GFC, they were implemented *after* they were communicated following the GFC and during the COVID-19 crisis.

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. 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 accommodative 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 quantitative easing (QE) policies to mitigate economic growth expectations. The "tapering," or gradual decrease, 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.

Figure 12 shows that FOMC minutes discuss UMP actions somewhat earlier for the COVID-19 crisis than for the GFC.

Figure 12. Unconventional Monetary Policy and Minutes



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

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

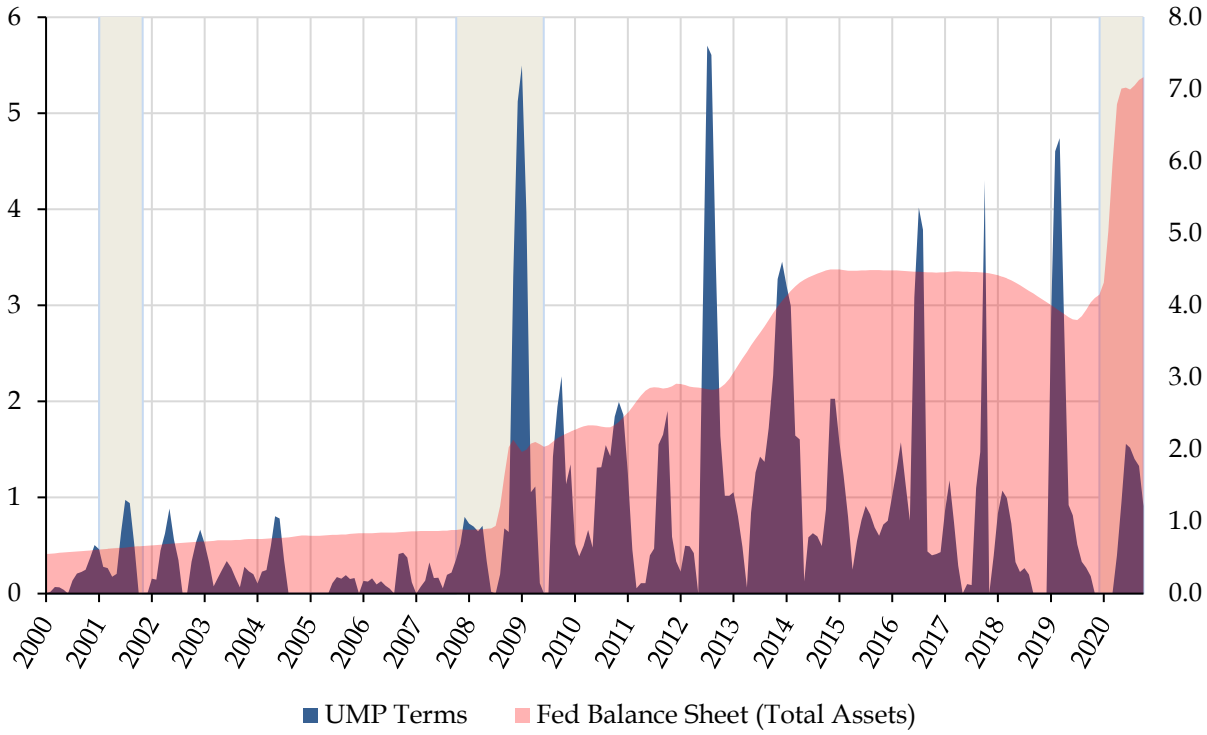
The quantity of these UMP discussions is similar to tapering discussions held by the FOMC in 2013, and the overall level is higher in late 2020 than during the GFC period.

The difference between the FFR announcements and the FOMC minutes concerning UMP is worth noting. Although FOMC minutes are less scripted and are 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. It is interesting to note that such terms have frequently been used since the GFC.

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

Figure 13. Unconventional Monetary Policy and Fed Chairman Speeches



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

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

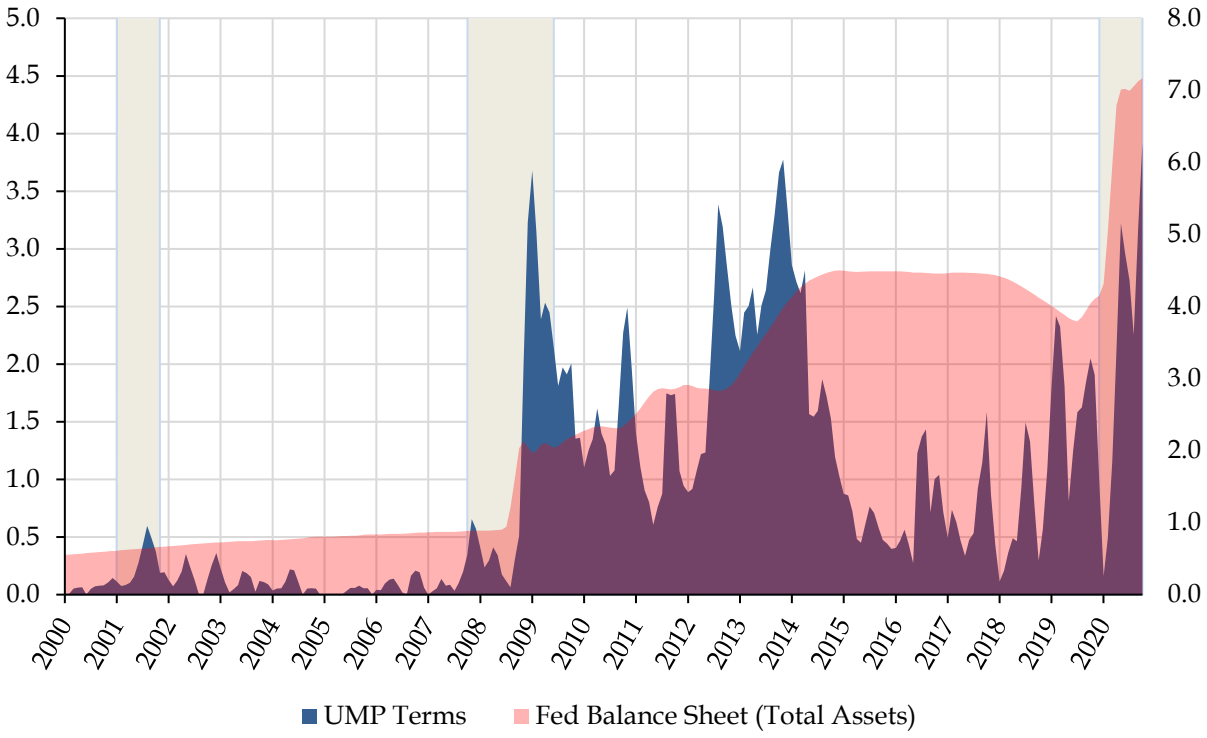
This figure shows that relevant communication shocks, like during the GFC or the third round of monthly purchases of Treasury securities and mortgage-backed securities (MBS) in September 2012 (third QE), are strongly related to the UMP content of the Fed chairman speeches. Indeed, the Fed's balance sheet dynamics changed

during or after each communication peak. Most of the peaks that did not influence the Fed's balance sheet were related to forward-guidance communications.

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

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 were 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.

Figure 14. Unconventional Monetary Policy in Main Fed Communications



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

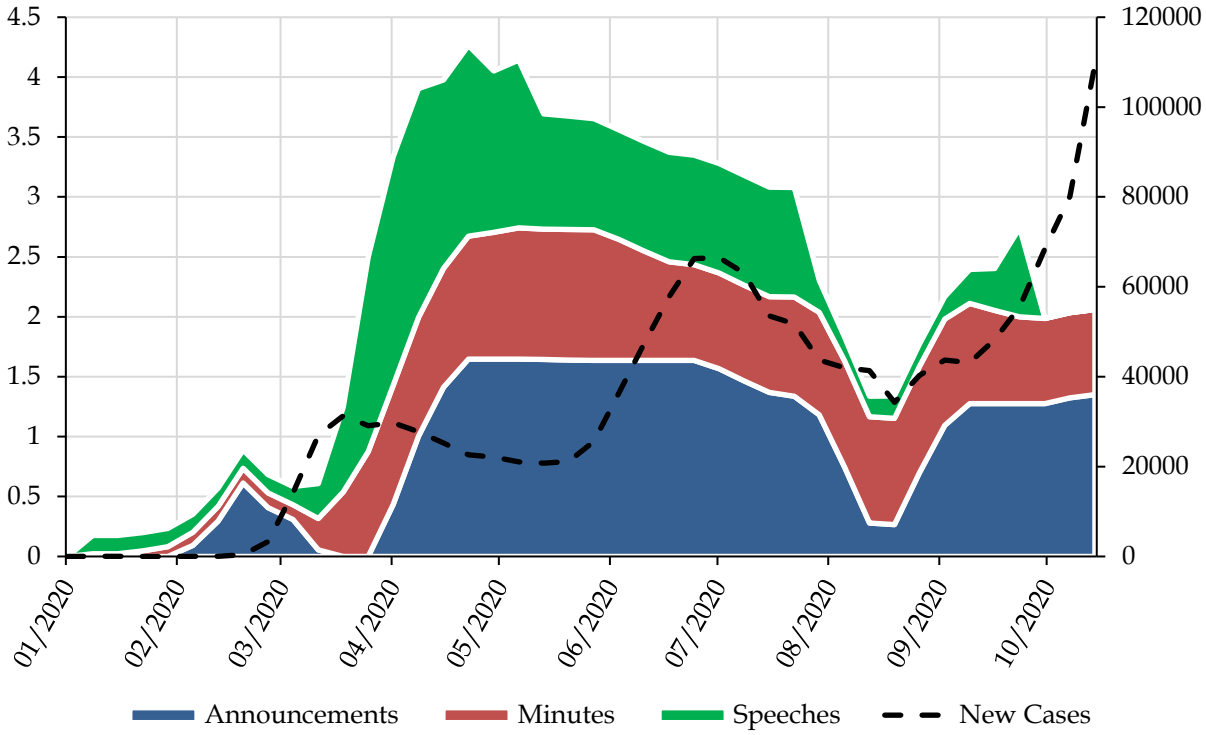
Overall, communicating about QE and forward guidance (UMP) actions has become the "new normal" for the Fed since the GFC (Bernanke, 2020), while the frequency of UMP terms remains higher for the COVID-19 crisis than for previous crises.

5. COVID-19

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

Figure 15 presents the repartition of COVID-19-related terms used in the main Fed communications in 2020. The figure shows that the Fed chairman's speeches preceded the waves of new COVID-19 cases. One has to consider this result cautiously since the first tests started later in the US than in other countries. Nevertheless, the speeches anticipated the spillovers of the virus from China, focusing on the US economy.

Figure 15. COVID-19 and Fed Communication



Notes: The shaded areas represent the word-counting indicator for each communication type based on our COVID-19 dictionary presented in the Appendix (left axis). 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).

It is worth noting that the Fed chairman's speeches provide a more timely and flexible communication vehicle than FOMC minutes or FFR announcements. They are disseminated quickly and informally compared to the other communication types and allow for public 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 COVID-19 cases 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, mainly through 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.

The decline in the intensity of COVID-19 terms in the Fed chairman speeches in the second quarter of 2020 is directly correlated to the decline in positive sentiment reported in Figure 5 for the same period. This decline corresponds to the increase in the 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's speeches were affected by the COVID-19 outbreak.

Interestingly, the decline in the frequency of COVID-19-related terms after 2020:Q3 explained the SentiWords sentiment increase exposed in Section 4, 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.

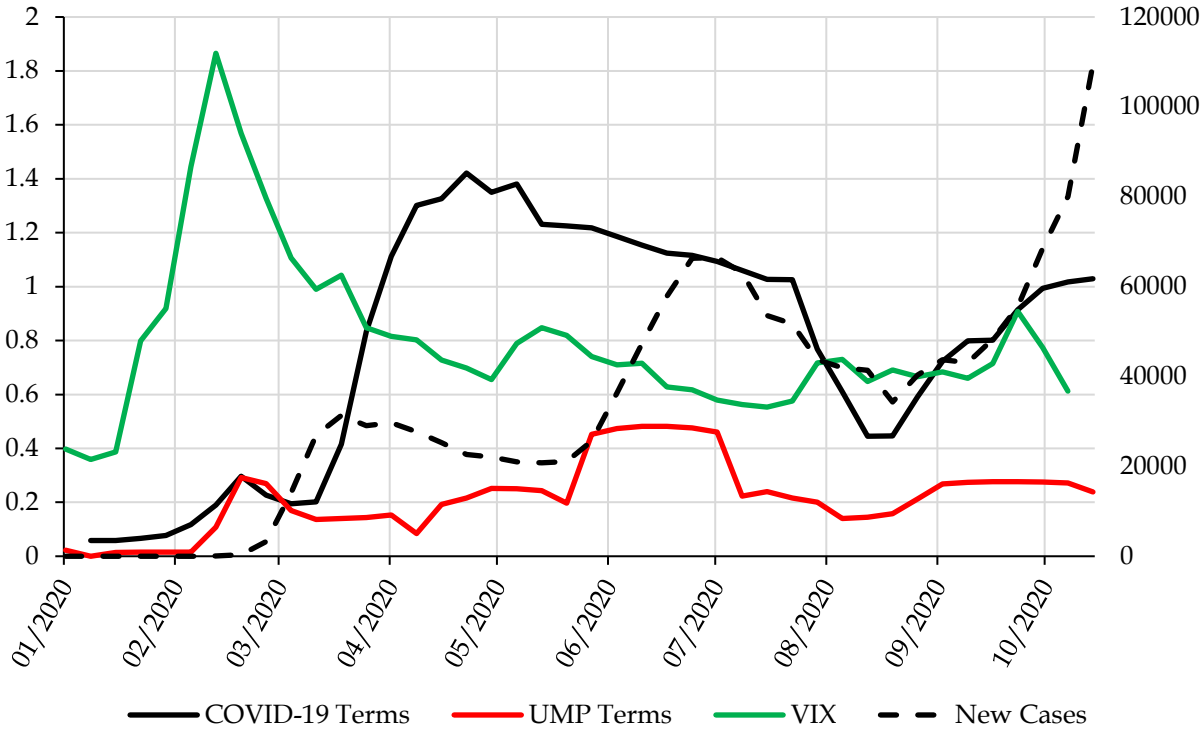
Overall, the waves of Fed communications about the COVID-19 crisis anticipated the waves of new COVID-19 cases. The Fed chairman's speeches communicated about the first wave of COVID-19 earlier than the other communication types (FFR announcements and FOMC minutes). This result again confirms that speeches are less scripted than announcements and minutes and thus allow the Fed to communicate more quickly. It also indicates that the Fed had an early understanding of the severity and magnitude of the COVID-19 pandemic and related 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 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 communication 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 reduce this financial volatility.

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

Figure 16. COVID-19 and UMP Terms



Notes: The black 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).

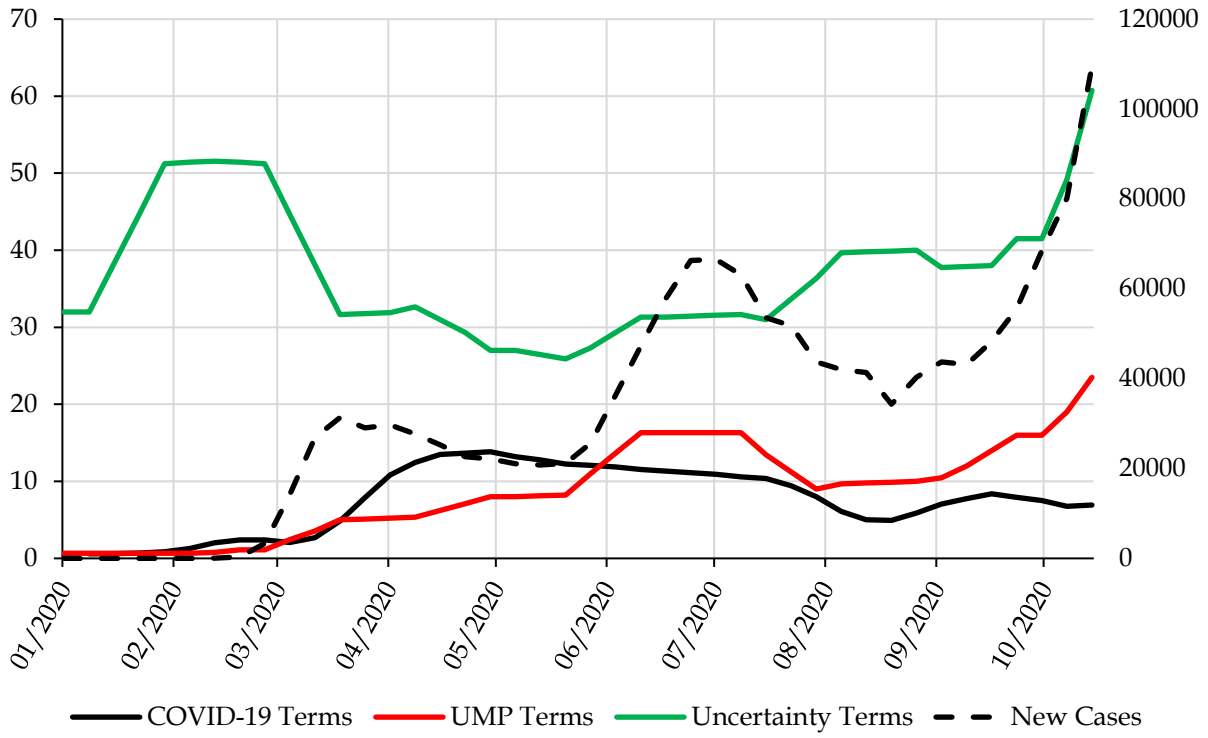
Sources: Bloomberg and Johns Hopkins University Center for Systems Science and Engineering (CSSE).

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

Figure 17 presents our COVID-19 and UMP word-counting indicators based on the Loughran and McDonald (2011) dictionary of contextual uncertainty terms. Uncertainty in Fed communication is related to the number of UMP terms found in those communications, what we interpret as the "uncertainty effect." COVID-19 new cases, UMP, and uncertainty, are correlated in the Fed's communications, especially during the second half of 2020. This was not necessarily the case at the beginning of the COVID-19 sample period, mainly because the sudden virus outbreak 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 virus cases. The correlation between the contextual uncertainty from the Loughran and McDonald (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

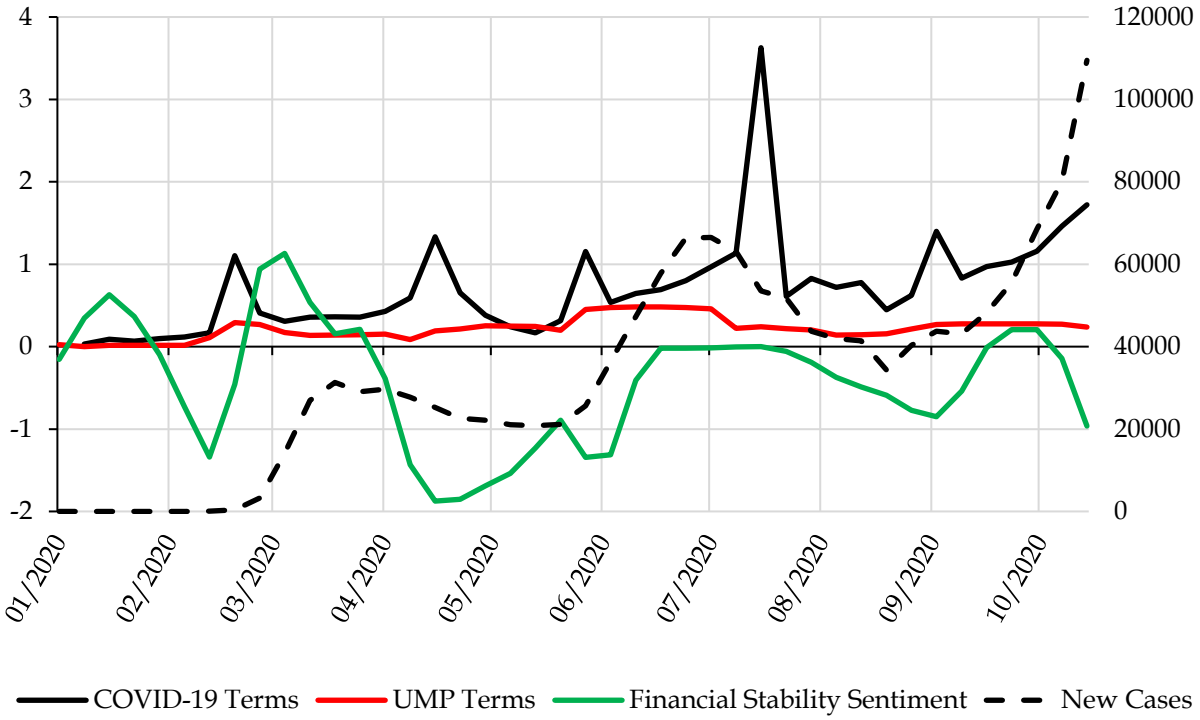


Notes: The dashed line represents the number of new COVID-19 cases in the US (right axis). The contextual uncertainty indicator is the number of uncertainty terms, according to Loughran and McDonald (2011).
Source: Johns Hopkins University Center for Systems Science and Engineering (CSSE).

Figure 18 presents our COVID-19 and UMP word-counting indicators with the FSS (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 correlate with increases in new virus cases. The lack of chairman's speeches partly drives the end-of-sample decline in the FSS.

Figure 18 shows that the decline in financial stability sentiment 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 about financial stability generally occur after financial stability shocks. The several deteriorations in FSS that precede the increases 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



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

Following the GFC, Fed communication anticipated effective UMP implementations. The timing and magnitude of these implementations differed dramatically between crises. It was shown in Figure 18 that Fed communication on the COVID-19 crisis also anticipated waves of new COVID-19 cases. The UMP implementations aimed to reduce market volatility and COVID-19 spillovers.

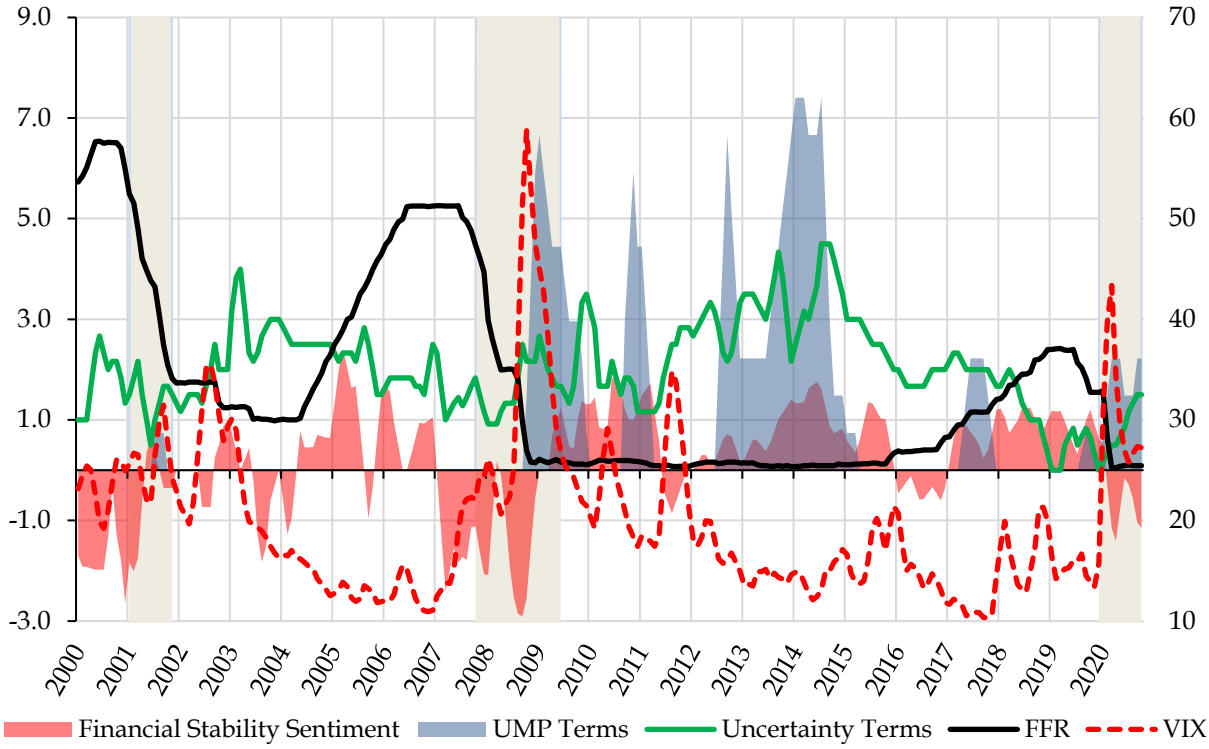
We have also shown that the contextual uncertainty in the Fed's communications well anticipated COVID-19 waves. Finally, the decline in sentiment associated with the Fed's communications about financial stability generally anticipated increases in the number of new COVID-19 cases. The anticipatory effects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

6. Financial Stability

UMP- and uncertainty-related terms are associated with financial stability and volatility. This section focuses on FSS and contextual uncertainty and their respective dynamics relative to the conventional monetary policy instrument (the FFR) and financial market volatility (VIX).

Figure 19 compares the FSS, UMP- and uncertainty-related terms from FFR announcements and the VIX.

Figure 19. Financial Stability and Monetary Policy in FFR Announcements



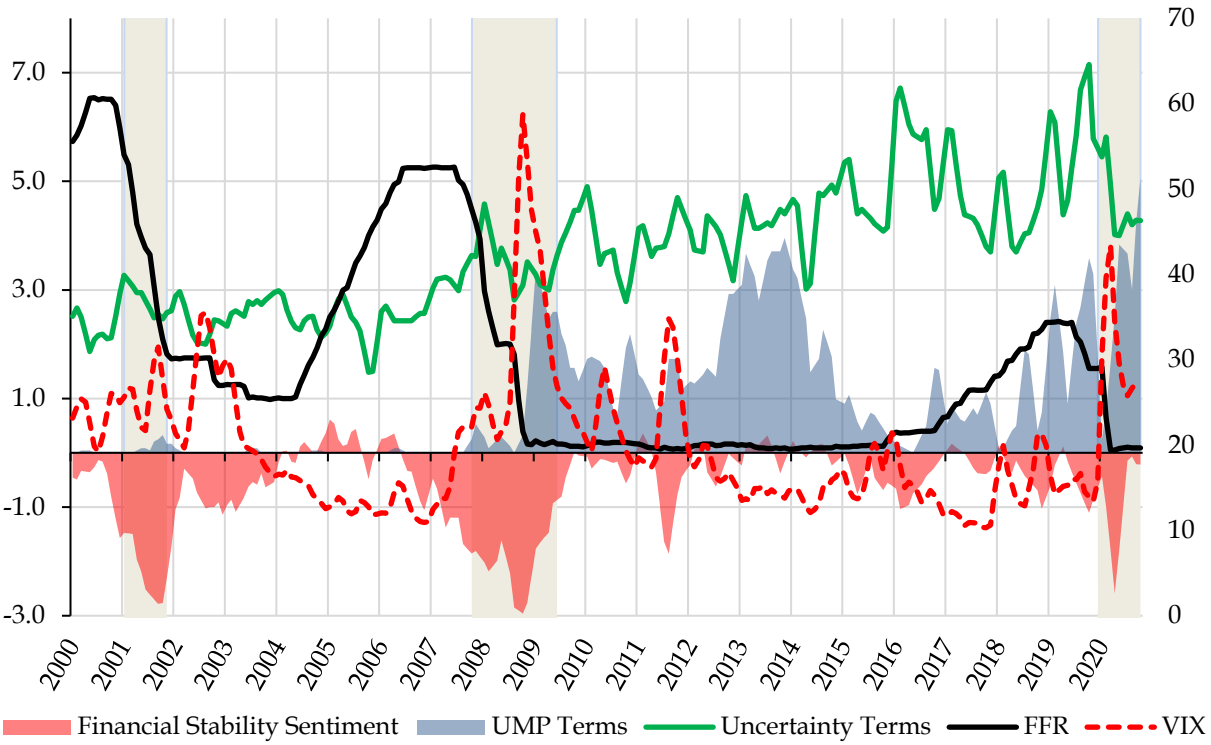
Notes: The gray shaded areas represent NBER recession periods. The right axis indicates the VIX level.

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

The UMP-related terms played a significant role in reducing market volatility during the dot-com and GFC crises and also during the COVID-19 crisis. During these crises, FFR announcements about implementing UMP measures reduced the VIX. FSS is closely related to the FFR level. A decline in FSS 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 areas represent NBER recession periods. The right axis indicates the VIX level.

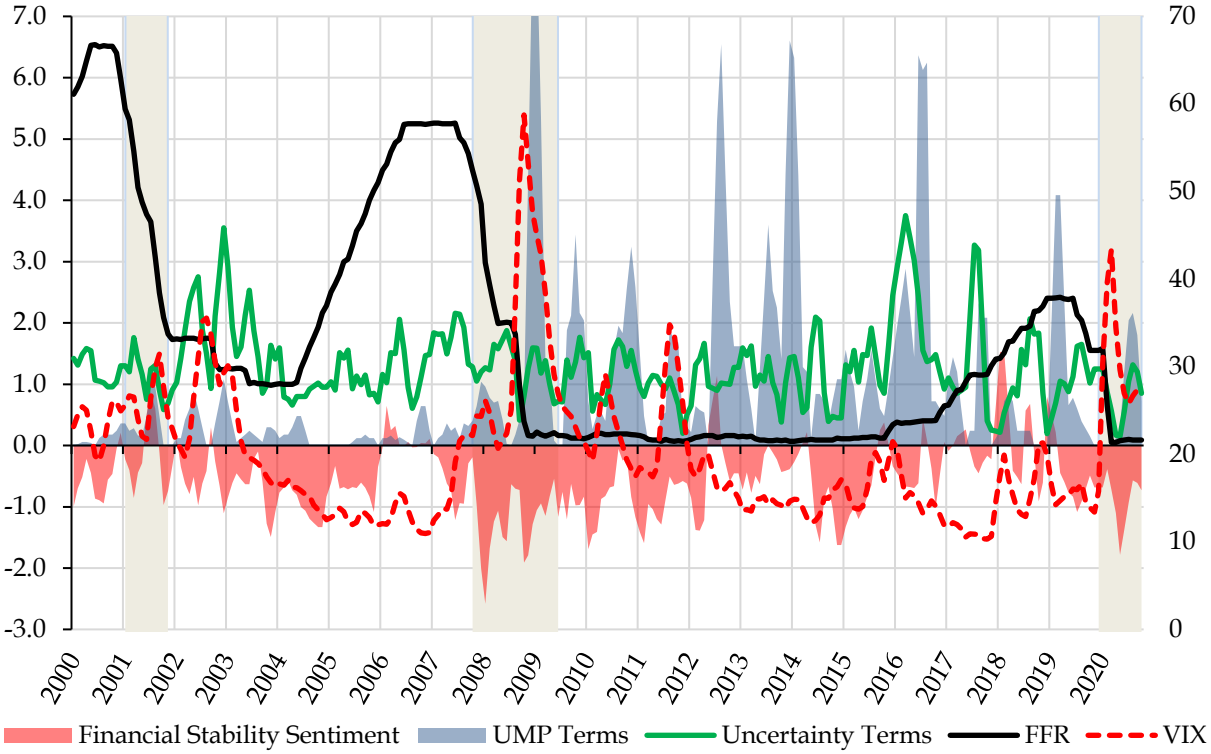
Interestingly, although each crisis was preceded by increased use of uncertainty-related terms in FOMC minutes, a clear tendency to reduce uncertainty-related words during crises is observed in Figure 20, similar to Figure 19. The VIX is negatively correlated with FSS, and both precede UMP terms, which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

As FOMC minutes provide detailed information on the monetary policy committee's views about the suitable 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 FSS levels, except during 2012–2015 when UMP communications and actions drove up the FSS.

Figure 21 presents Fed chairman speeches, FFR announcements, and financial volatility. The FSS present in the speeches is less indicative of the future FFR than announcements and minutes. Chairman's speeches may convey a negative FSS even as the FFR increases, which does not generally happen in FFR announcements or FOMC minutes (see Figures 19 and 20).

Figure 21. Financial Stability and Monetary Policy in Fed Chairman's 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. Interestingly, the UMP- and uncertainty-related terms are relatively correlated during P2, whereas this correlation is nonexistent during P1. To a lesser extent, this comparison is also valid for the VIX- and uncertainty-related terms, which are less correlated during P1 than P2.

Figure 21 shows fewer uncertainty-related terms in Fed chairman speeches during the COVID-19 crisis than in previous years and crises. However, the contrast is less stark concerning 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 controlled than announcements and minutes.

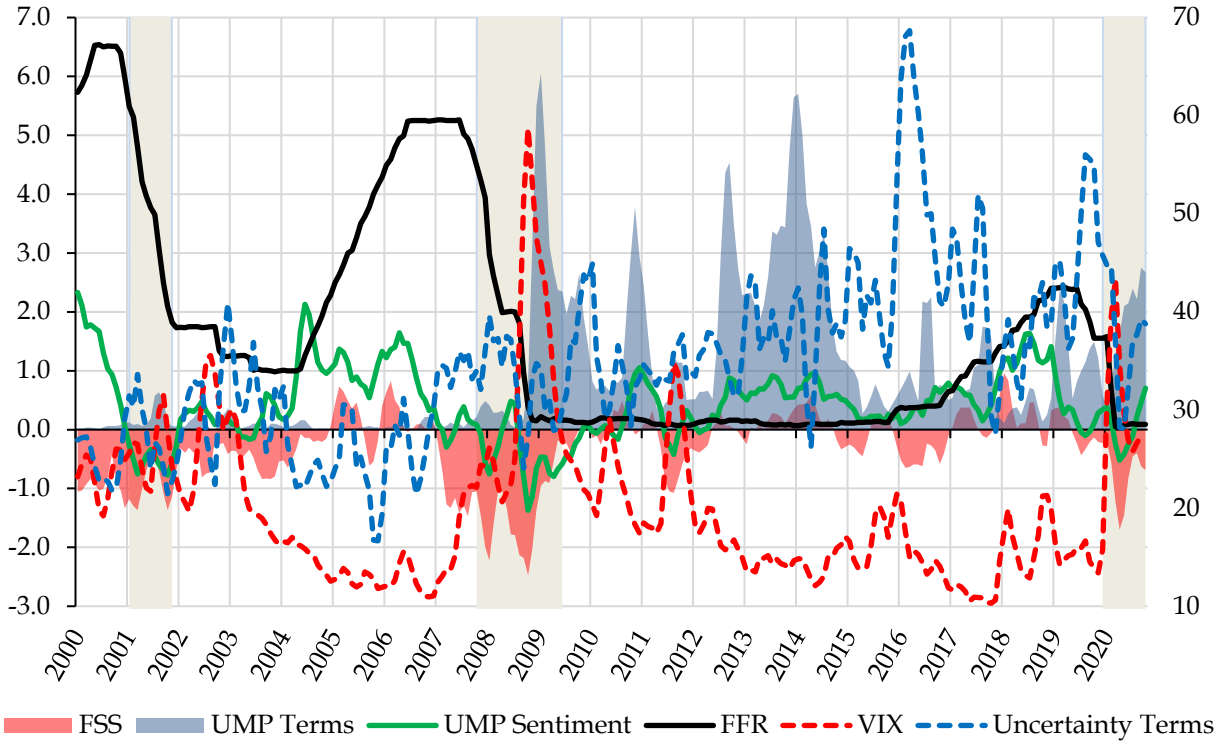
The communication related to UMP occurred after the volatility peaks during the GFC and COVID-19 crises. Figures 20 and 21 highlight the Fed's interventionism policy, which most central banks of developed countries employ: After each FFR decrease, UMP communication, usually followed by actions, compensates for the central bank's inability to use the nominal interest rate, their main policy instrument, stuck at the zero lower bound (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 when it reduced the frequency of uncertainty-related terms in its communications.

Declines in FSS 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



Notes: The gray shaded areas represent NBER recession periods. The right axis indicates the VIX and uncertainty terms levels.

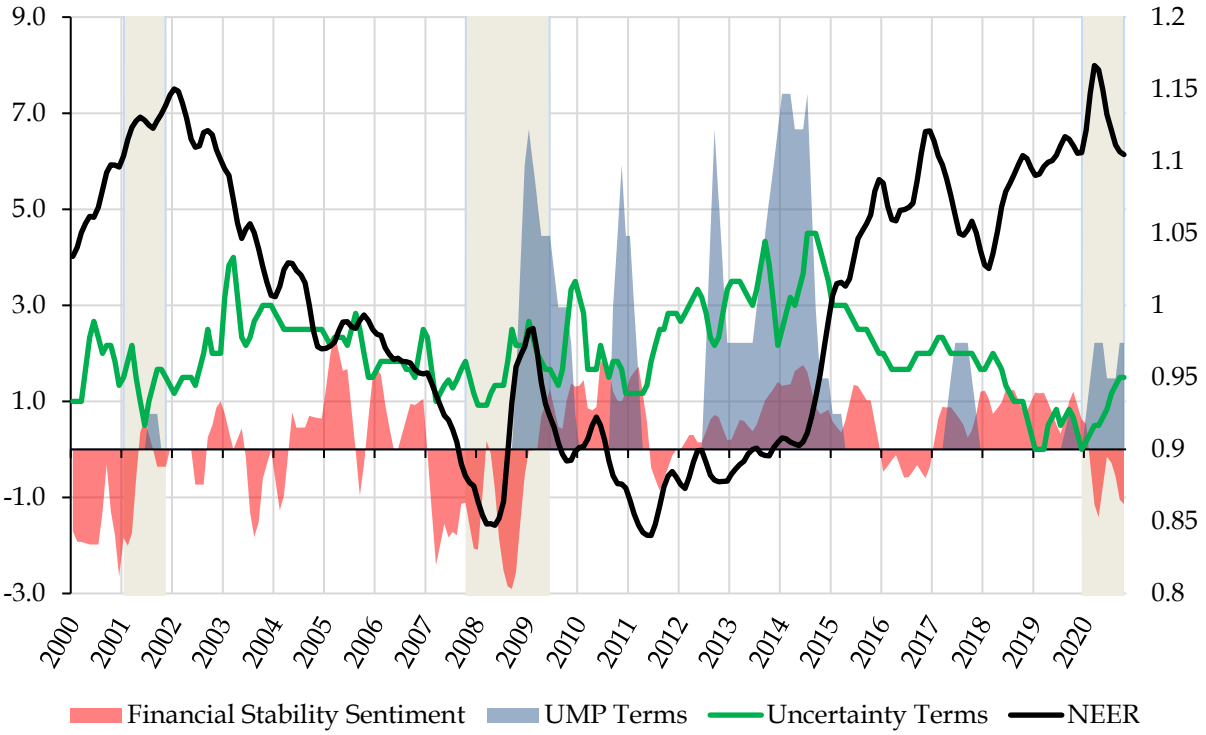
Following the GFC, a new normal was established in which the Fed's communications came to be increasingly fed by discussions of UMP tools, including forward-guidance measures. Typically, these UMP discussions were characterized by high contextual uncertainty. This new normal was partly upset by the COVID-19 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 shows the word-counting indicators discussed above concerning the nominal effective exchange rate (NEER).

Figure 23 shows that increases in the NEER are correlated to declines in the frequency of uncertainty-related words in the Fed's FFR announcements. It also shows UMP communications (and actions) generally reduce 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.[17]

Figure 23. Financial Stability, NEER, and FFR Announcements



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

Figure 24 relates the sentiment indicators discussed above to another measure of economic stability: the unemployment rate. It shows that sentiment and the unemployment rate are almost always inversely related. When the aggregated sentiment is positive, the unemployment rate tends to decline. 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.

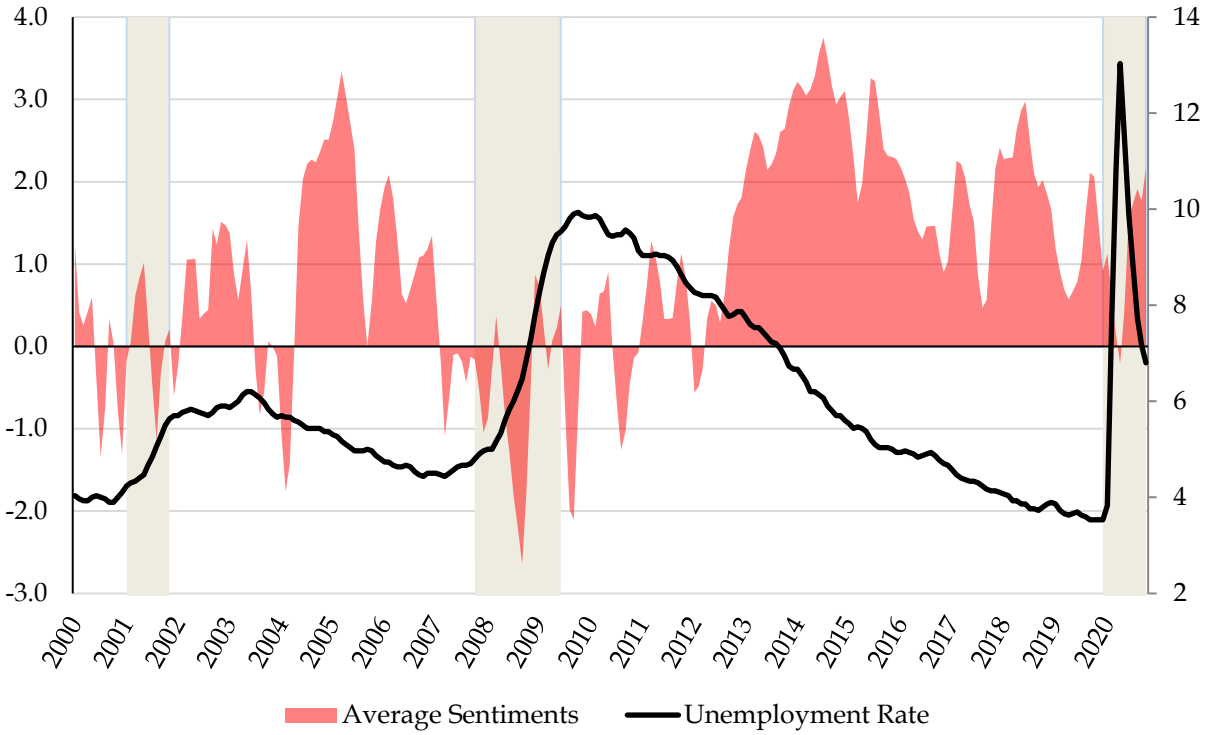
Unlike previous crises, the COVID-19 crisis featured an increase in the US unemployment rate from 3.5% to 13% in a short period (January to May 2020). The unemployment rate declined to lower levels after May 2020, around 6%. The sharp and short-term shock on the aggregate sentiment was even shorter than the one on the unemployment rate, which may indicate a crisis-specific communication strategy toward communication optimism during crises.

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

[17] For more information about the influence of QE on the exchange rate, see Belke et al. (2017).

show that FSS is conveyed in FFR announcements and FOMC minutes but not significantly enough in speeches. Increases in conventional monetary policy (FFR) are often preceded by increases in FSS, except when UMP terms are used in the Fed's communications, which generally involve actions to improve financial stability.

Figure 24. Sentiment and Unemployment



Notes: The gray shaded areas represent 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 weigh this average sentiment aggregate for FFR announcements more than for FOMC minutes, which in turn are weighted more than for chairman speeches.

We have also shown that the positive aggregated sentiment in the main Fed communications correlates with declining unemployment. Except in times of significant UMP steps, the NEER correlates with the level of uncertainty in the Fed's communications.

7. 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 economic shocks that the COVID-19 restrictions generated. The Fed's experience in crisis-specific communication and UMP tools gained during the dot-com and GFC crises may have contributed to better understanding and addressing the communication challenges of the COVID-19 crisis. To succeed, the Fed's UMP steps needed to be supported by clear and transparent communications and engagement with 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 differed from those of previous crises in terms of sentiments conveyed and topics emphasized. 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 differs from those adopted during the GFC and dot-com crises. We conclude that Fed communications may have improved 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) unconventional monetary policies earlier than in the previous crises (Figure 14) by justifying their importance in mitigating risks and uncertainties (Figures 16 and 17). Another critical finding confirms the Fed's forward-looking narrative 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 pandemic's spillovers.

Overall, our results show that communications regarding the adopted policies and emergency programs allowed them to be perceived as useful tools supporting economic recovery. The Fed conducted a specific communication strategy for the COVID-19 crisis. This strategy conveyed less uncertainty and negative sentiment 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 together with UMP and fiscal policy.

8. Conclusion

This paper comprehensively analyzes central bank communication during the past two decades, emphasizing the COVID-19 pandemic. We show that Fed communications during the COVID-19 crisis differ from previous crises. Relating key communication terms, sentiments, and topics conveyed by the Fed's communications to COVID-19 cases and financial data confirms that the Fed adopted a specific communication strategy during the COVID-19 crisis, which differed from the one adopted during the GFC and dot-com crises.

During the COVID-19 pandemic, speeches emphasized topics related to social welfare, unlike FFR announcements and minutes that emphasized topics related to policy interventions. Regarding COVID-19 and UMP, Fed communication typically touched on market volatility, uncertainty, and financial stability topics. The sentiment of Fed communication 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. We also show that a negative FSS usually precedes conventional monetary policy accommodation, except during the ZLB period.

The COVID-19 crisis 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.

Further research may analyze the effect of these indicators on changes in interest rates, market-based expectations, exchange rates, and various asset prices over a short time interval (e.g., 30 minutes) around policy announcements following Gürkaynak et al. (2020).

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Appendix

8.1 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. (2022).

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.

8.2 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.

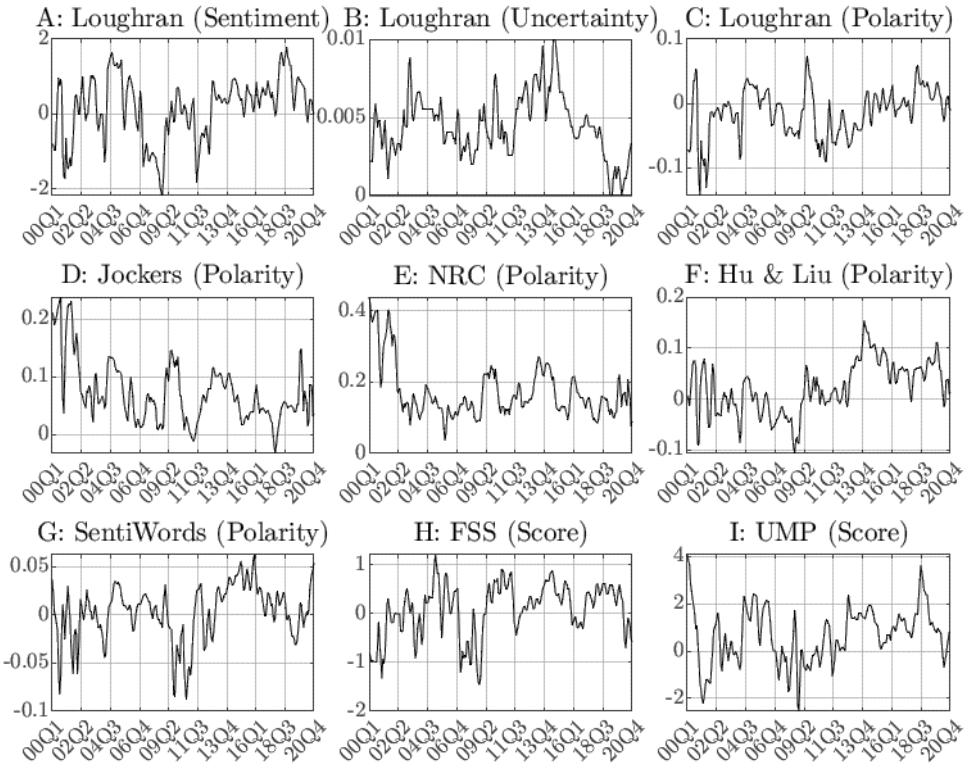
Table 3. COVID-19 Lexicon

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.

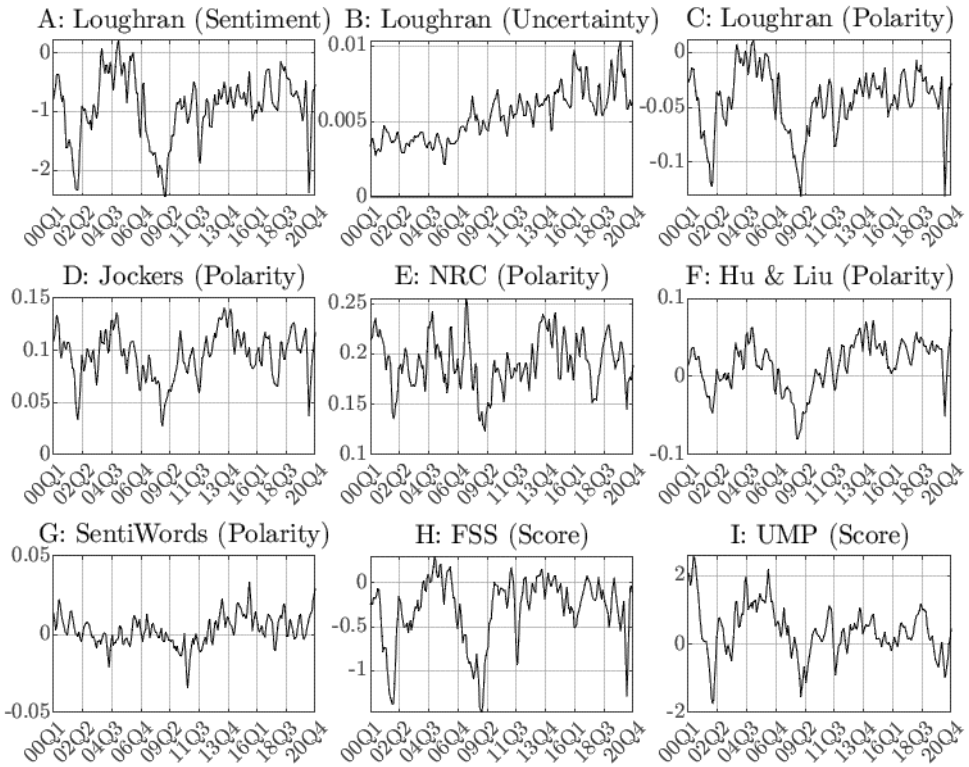
8.3 Full Sample Figures

Figure A1. Sentiment Scores in FFR Announcements – Full Sample



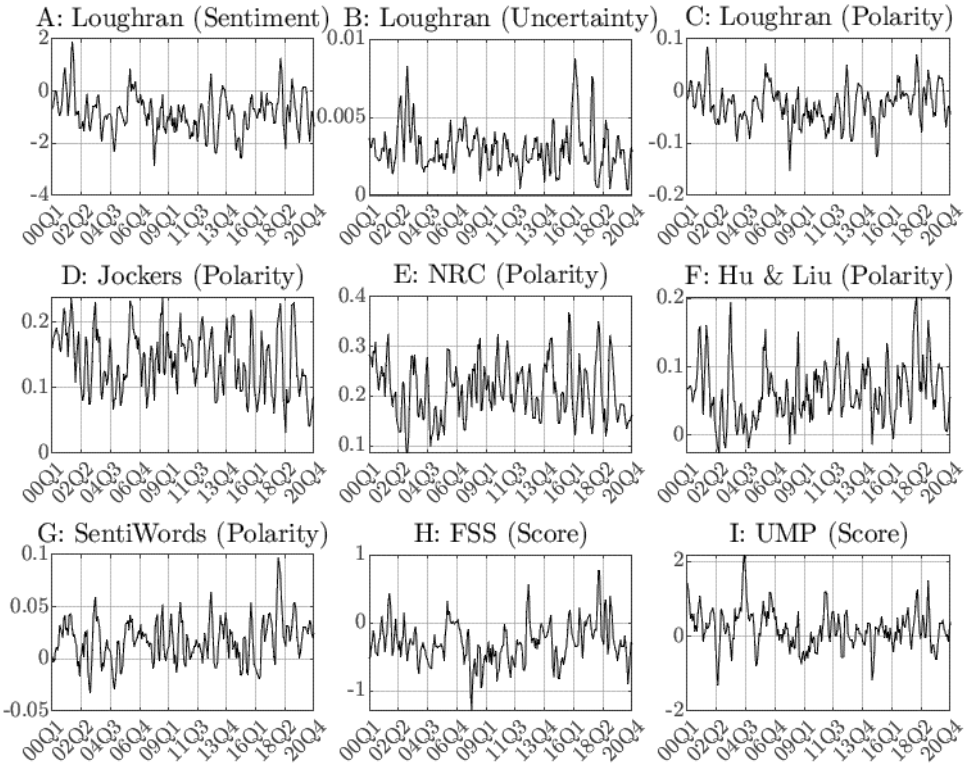
Notes: Solid black lines represent sentiment score values. *Source*: Benchimol et al. (2020).

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



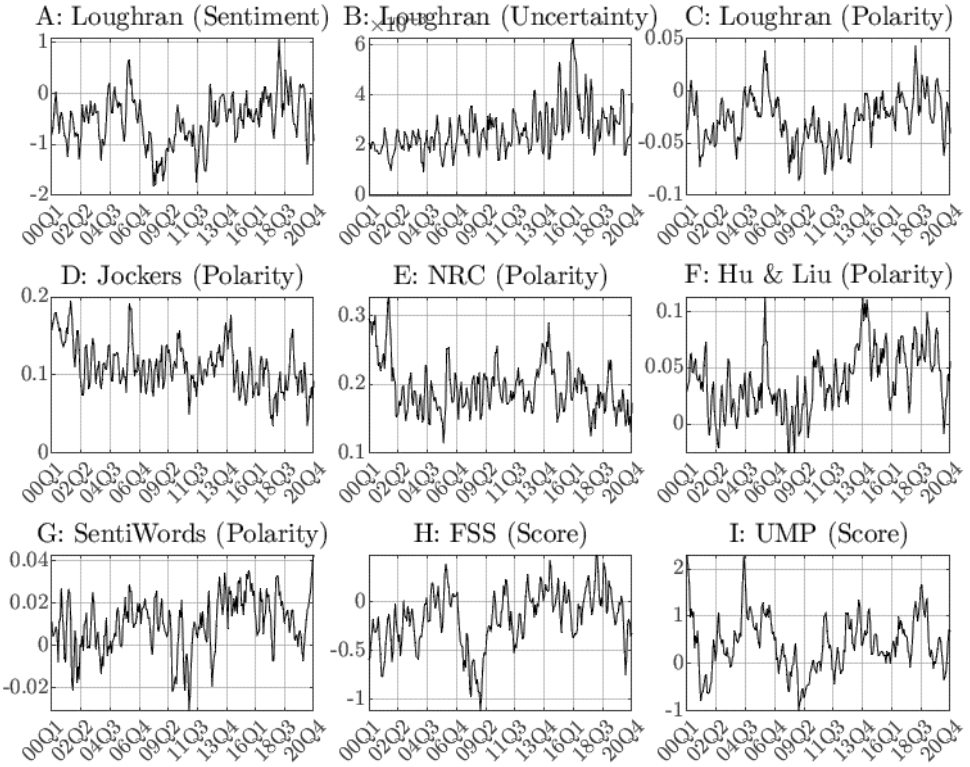
Notes: Solid black lines represent sentiment score values. *Source*: Benchimol et al. (2020).

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



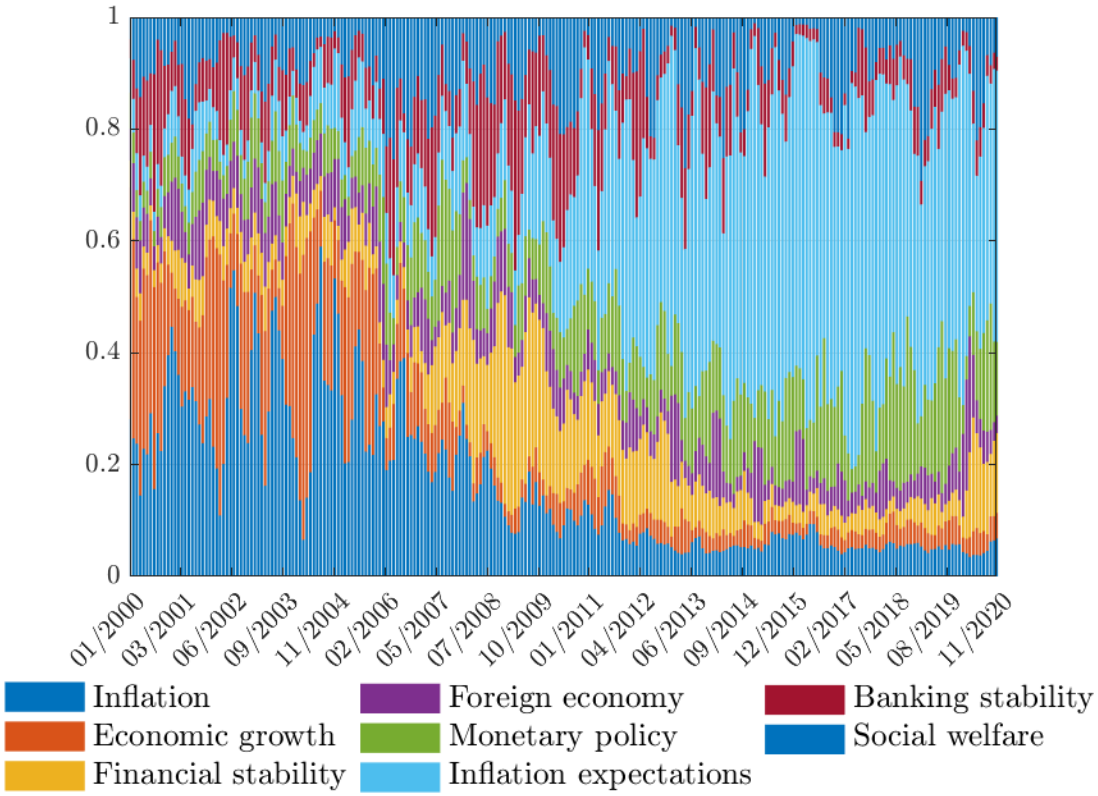
Notes: Solid black lines represent sentiment score values. *Source*: Benchimol et al. (2020).

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



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

Figure A5. Topic Analysis of Main Fed Communications



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