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How Central Bank Mandates Influence Content and Tone of Communication Over Time

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Abstract

In this paper, we analyze the relevance of central bank mandates on the content and tone of communication via speeches. Comparing this communication channel for mandate-related objectives between the Federal Reserve and the European Central Bank reveals similarities before the Great Financial Crisis, while notable differences emerge afterward. Furthermore, we propose a study design to examine how hawkish the tone of speeches becomes in light of current versus expected macroeconomic developments. We find that, since the GFC, expectations of unemployment drive the tone of FED speeches while inflation expectations influence the tone of ECB speeches.

JEL Classification: E50, E52, E58

Keywords: ECB, Expectations, FED, Inflation, Central Bank Mandates, Speeches, Structural Topic Model, Unemployment

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1 Introduction

Inflation, unemployment, and real economic conditions are among the key macroeconomic variables that influence decisions made by central banks. This is especially true for systemically important central banks, such as the Federal Reserve (FED), which has a dual-mandate to ensure stable prices and maximize sustainable employment, and the European Central Bank (ECB) whose primary responsibility is to ensure price stability.

The last three decades in monetary policy can, for convenience, be divided into two parts. The 1990s and the early 2000s have been called the era of the Great Moderation (Bernanke, 2004). Then, near the end of the 2000s, the FED and the ECB faced financial crises. In the U.S., it was the legacy of newly created financial instruments in a deregulated financial system while in Europe a sovereign debt crisis would be the culprit. Economic conditions would deteriorate, and both central banks would be confronted with the zero lower bound (ZLB) together with persistently low inflation rates. Indeed, the specter of secular stagnation (Summers, 2014) permeated the debate about how to conduct monetary policy in a low inflation and low economic growth environment. In response, the monetary policy toolkit of leading central banks expanded. Instead of relying primarily on policy rates, central banks implemented large-scale asset purchase programs and provided more verbal guidance about the future course of interest rates. Central banks came to the realization that communicating the stance of monetary policy is critical and set out, gradually, to improve what and how much was said in public.

One goal of central banks was to ensure that expectations would be anchored to explicit inflation objectives (Woodford, 2003). Another goal was to improve the public's understanding of the objectives and limitations of monetary policy. Nevertheless, even as the Great Financial Crisis (GFC) was underway, central banks had still much to learn about effective communication (Blinder et al., 2008). By the time the pandemic of 2020 arrived, both central banks underwent strategy reviews during a period that also brought new challenges to monetary policy (Orphanides, 2021).

The completed strategy reviews of the Federal Reserve System (2020) and the European Central Bank (2021) provide another occasion to revisit the role of communication during the last two decades. Research on central bank communication suggests that speeches are a critical vehicle to convey monetary policy aims and objectives to the public. For example, Ferrara (2020) uses speeches to analyze the changing understanding of the ECB Executive Board during the sovereign debt crisis. The study indicates that, during the crisis, members of the Executive Board identified its origin in systemic risks instead of public debt. Indeed, identification of intellectual development in the area of monetary policy is possible based on speeches such as, for example, when the former president of the ECB, Mario Draghi, intervened with his famous speech in London on July 26, 2012 (Ferrara, 2020).

Generally, analyses of central bank communication via speeches tend to focus on the general thrust of the messages that are conveyed to the general public. The variables that lie at the core of the leading central banks' mandates, inflation and unemployment, in contrast, are generally not separately examined from the stand point of whether and how they drive the content and tone of speeches, leaving some unanswered interesting questions for researchers to explore. Indeed, economic models used to analyze central bank communication concentrate on observed inflation and unemployment (e.g., Hansen and McMahon (2016), Shapiro and Wilson (2021)), while the theoretical literature also emphasizes the important role of expectations.

In this paper we ask: how economic objectives spelled out in central bank mandates affect the content and tone of speeches? Do differences exist between a dual-mandate and a single-mandate central bank? Furthermore, how do central bank expectations about inflation and unemployment affect the tone of speeches in relation to ongoing macroeconomic developments? This study aims to address these questions by analyzing and comparing the FED and the ECB.

To address the foregoing research questions, we first construct a new data set consisting of speeches from the FED Board of Governor members from mid-1996 until March 2021 and all speeches from the ECB Executive Board members from the introduction of the Euro in

1999 until the end of 2020. Using text mining and Structural Topic Models (STM; Roberts et al. (2016)), we classify every speech according to the underlying topic and display their development over time. While ECB Executive Board members focus more on inflation and unconventional monetary policy than employment issues in the years after the GFC, the FED Board of Governors tend to focus on employment and labor market conditions. The FED Governors talk less about long-term supply-side behavior and devote more attention to aggregate demand conditions.

Next, we zero in on the speeches that address central bank mandates and quantify the tone of each speech using the new dictionary of Apel et al. (2019). Using tone as a dependent variable, we show that expectations about the economic variables that are at the center of each central bank mandate significantly drive the tone of speeches. The relationship is visible in both FED and ECB speeches since the GFC, and our results are insensitive to several robustness checks. Furthermore, our comparison of the FED and the ECB reveals significant qualitative differences between the dual and single-mandate regarding the tone of speeches, at least since the GFC. While inflation expectations influence the tone of speeches of ECB Executive Board members, consistent with their mandate, unemployment expectations shape the speech tone of FED Governors, with inflation having a lesser role.

This study contributes to the existing literature by systematically analyzing the role of economic variables that define the respective mandates of the FED and the ECB and how they are reflected in speeches delivered by members of the respective policy-making committee. We use topic modeling to disentangle the different messages conveyed by central bankers. Equally important, this study suggests that focusing on specific topics may be more effective in helping us understand the conduct of monetary policy than considering the whole corpus of speeches when analyzing how economic developments influence some of the most important elements of central bank communication.

The remainder of this study is structured as follows. After providing a brief literature review in section 2, section 3 presents our data and how we use the STM methodology to classify all speeches according to the underlying topic covered. Section 4 provides a broad investigation

of how central bankers address the objectives of their mandate from a long-term perspective. In section 5, we present our regression model to analyze how mandates influence the tone of speeches. In section 6 and 7, we provide the results and robustness checks. The final section concludes.

2 Related Literature

The increase in emphasis on central bank communication since the new millennium significantly shifted research on monetary policy (Blinder et al. (2008), Bholat et al. (2015)). An often-mentioned motivation for improvements in communication stems from the introduction of inflation targeting. Indeed, this development is also reflected in the rise in central bank transparency over the past two decades (e.g., see Dincer et al. (2019)), which emphasizes that clear and coherent communication are necessary to manage inflation expectations effectively. In what follows, we provide only a selective overview of the relevant research, which has expanded considerably in recent years.

One branch of the literature evaluates the immediate economic effects of central bank communication on real economic developments and via movements in asset prices. Gürkaynak et al. (2005) use factor analysis with high-frequency federal funds rate futures data to identify two factors that explain policy changes in real-time. Gürkaynak et al. (2005) define the first factor as the "current federal funds rate target" to identify current changes in the Federal Funds Rate and the second as "future path of policy" that relates to expected future changes. The authors analyze how monetary policy announcements drive the second factor during press conferences. Hansen and McMahon (2016) focus on announcements and forward guidance during FED press conferences and conclude that there are no economically significant effects on the real side of the economy. Altavilla et al. (2019) use high-frequency financial data during ECB press conferences and identify the increased relevance of communication to influence mid-term interest rates.

A separate branch of the literature studies communication channels to understand central

bankers' developing intentions and their learning process. Shapiro and Wilson (2021) use the transcripts of FOMC meetings to quantify the "true" loss function and inflation target of the FOMC. They measure the sentiment of contributions of the individual FOMC members using the dictionary of Loughran and McDonald (2011) and regress the sentiment on macroeconomic variables. From 2000 until 2011, Shapiro and Wilson (2021) identify a "true" inflation goal of 1.5%, which is lower than the announced 2% inflation target. Analogously, Paloviita et al. (2020) assess the preferences of the ECB council by analyzing ECB press conference statements and estimate a "true" inflation target of 1.7%. Hansen et al. (2018) use the quasi-natural experiment that the FOMC transcripts before 1993 were not released and provide evidence that career concerns influence deliberations and how policymakers react under transparency. Dybowski and Kempa (2020) demonstrate the changing relevance of the monetary analysis by using the press conference statements of the ECB president. While the significance of monetary factors fell until the GFC, the importance increased in the years there after. However, monetary aggregates and financial factors are now related to financial stability concerns and less to inflation. The European Central Bank (2021) confirms this analysis by renaming the *monetary analysis* as *monetary and financial analysis* while institutionalizing knowledge gained over the years.

Speeches are a particular means of communication for central banks, as central bankers can communicate more freely while retaining the ability to choose the speech topic. Bohl and Siklos (2007) were among the early contributors in analyzing the focus of speeches by Bundesbank officials based on a classification of topics developed by the Bundesbank. Benanni and Neuenkirch (2017) develop a dictionary to measure the hawkish- or dovishness of speeches by the ECB Governing Council members and conclude that the tone varies depending on whether a governing council member is speaking domestically or abroad, motivating Benanni and Neuenkirch (2017) to call it the "home bias." The degree of central bank independence before the Euro introduction also influences the tone of speeches by national central bank presidents of the Eurosystem. Moschella and Pinto (2019) demonstrate how concerns about the reputation of the FED affect the topic selection of speeches by Board of Governor mem-

bers. Analogously, Moschella et al. (2020) provide evidence that the satisfaction of the Euro area citizens with the ECB affects the topic selection of speeches by the Executive Board members. Declining satisfaction goes hand in hand with a higher topic diversity in speeches beyond the core mandate.

3 Identifying Underlying Topics

3.1 Data

We construct a data set consisting of all speeches of the FED Board of Governors and the ECB Executive Board. The European Central Bank (2019) provides all speeches from the Executive Board members on their website.[1] Speeches of the FED Board of Governors from 2006 onward are available on the Board of Governors website (Federal Reserve System, 2021),[2] while speeches before 2006 are available in the archives of the Federal Reserve System (2016).[3] We exclude all speeches without any text and collect speeches given by FED Board of Governors or ECB Executive Board members. Furthermore, we exclude all speeches by ECB Executive Board members not given in English.[4] Tables (1) and (2) provide lists of all members of the FED Board of Governors and the ECB Executive Board and the number of speeches each central banker held, respectively.

- Table (1) around here -

- Table (2) around here -

Table (1) reports all FED Board of Governors members from mid-June 1996 until March 2021 and the number of speeches each member held. Similarly, table (2) provides an overview of all ECB Executive Board members from January 1999 until the end of 2020 and the

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[1]https://www.ecb.europa.eu/press/key/html/downloads.en.html (Last Access: July 12, 2021)

[2]https://www.federalreserve.gov/newsevents/speeches.htm (Last Access: July 12, 2021)

[3]https://www.federalreserve.gov/newsevents/speech/2005speech.htm (Last Access: July 12, 2021)

[4]Using translated non-English speeches creates the risk of mistranslating essential words. Furthermore, excluding non-English speeches reduces the "home bias" of European central bankers adjusting to the preferences of a national public (Benanni and Neuenkirch, 2017).

respective number of speeches. One difference between the FED Board of Governors and the ECB Executive Board relates to the distribution of speeches between the head of the policy-making committee and the members. The ratio of speeches between the chair and committee members is higher for the Board of Governors than for the Executive Board. Furthermore, the number of speeches during the 2000s and the 2010s given by Board of Governor members declined from 878 to 596. In contrast, Executive Board members' speeches even increased from 879 to 1113.

3.2   Classification Method

To identify the underlying topics of central bank speeches, we use the STM methodology, an unsupervised machine learning model developed by Roberts et al. (2016). The STM defines topics from a mixture of words from the corpus of documents based on the probability that the words appear in a text. Each document consists of several topics, where our model assigns the document to the topic with the highest probability. In contrast to other topic modeling approaches, such as Latent Dirichlet Allocation (Blei et al., 2003), STM uses a correlated topical model structure and includes document metadata as covariates. We use a dummy variable that equals one if the speaker is the Chairman of the FED or the President of the ECB to separately identify these speakers from the rest of the respective policy-making committees. Furthermore, we include a dummy variable for each committee speaker to account for the fact that the policy-making committees assign specific tasks to each member, which may spillover into the content of their speeches. Figure (1) from Roberts et al. (2016) illustrates the data generating process for the STM.

- Figure (1) around here -

In this figure, white nodes denote latent random variables, while shaded nodes denote the observable variables. Only the 'observed words' and the covariates which comprise the meta-data are observable. The model algorithm infers the topic word distribution, the document-topic proportions, and the per-word topic assignment that incorporates the latent structure (Dybowski and Kempa (2020), Roberts et al. (2016)).

To estimate the STM on our two corpora of speeches, we first need to follow certain prepro-cessing steps: remove the bibliography and references, convert all letters to lower case letters, exclude punctuation and stop words, and reduce the words to their word stem. Furthermore, building on the advice of Ferrara et al. (2021), we exclude every word in each speech with a term frequency lower than two. This last step increases the classification precision of the STM by removing words without content that do not necessarily belong to the typical list of stop words. Our corpus consists of 1824 speeches from the FED Board of Governors consisting of 585054 words and 2165 speeches from the ECB Executive Board containing 450683 words.

In the next step, the user has to choose the number of topics, K, identified by the STM algorithm. In this context, a higher K leads to more concrete topics. However, there is no known optimal choice for the value of K. Therefore, we follow the approach of Roberts et al. (2019) and focus on topic exclusivity (Bischof and Airoldi, 2012) and semantic coherence (Mimno et al., 2011). Topic exclusivity and semantic coherence lead to a trade-off since the first increases with a higher K while the latter decreases. We first estimate STM with $K \in \{4, ..., 60\}$ and calculate topic exclusivity and semantic coherence for each STM.[5]

4   How Mandates Affect the Content of Speeches

In this section, we use our STM methodology to focus on the topics related to the mandates of the FED and ECB to analyze the differences in communication between a single-mandate and a dual-mandate central bank. The main takeaway is that differences between the dual-mandate and single-mandate manifest themselves in the content of speeches about monetary policy, especially after the GFC. FED Governors increasingly discuss unemployment, while ECB Executive Board members barely mention labor market issues and focus on price sta-bility.

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[5]Figure (A1) and (A2) in the appendix illustrate the average values for semantic coherence and topic exclusivity for the Pareto efficient set of topics for each policy-making committee. We choose the topic models in the quadrant at the upper right corner (Ferrara et al., 2021).

4.1 Dual Mandate: FED Board of Governors

Having identified a Pareto efficient set of STM, we have to choose a specific K. We base our decision on the interpretability of the underlying topics. For our descriptive analysis of Board of Governors communication, we choose $K = 10$.[6] In the next step, we generate and use bar diagrams of the most important words (Figure (2)) and the most representative speeches of each topic to identify and name every topic. The relevance of each word is measured by its beta value, while the gamma value is the probability that a speech generates from its affiliated topic (Roberts et al., 2019).[7]

- Figure (2) around here -

Figure (2) shows each topic's ten most relevant words measured by the beta value. We focus on keywords relating to inflation and unemployment that link to topics at the core of most central bank mandates. Using the information that figure (2) provides, we identify that topics four and eight relate to inflation and monetary policy due to words like *"inflat,"* *"price,"* *"monetari,"* and *"polici"*. Furthermore, topics two and ten focus on issues regarding the real economy and the labor market. Therefore, we concentrate on these four topics with relatable words. They are: topic two *"Globalization, Growth, and Technology,"* topic four *"Stabilization Policy,"* topic eight *"Monetary Policy Implementation,"* and topic ten *"Community Development"*.[8] Figure (3) provides an overview of the development of all topics over time.

- Figure (3) around here -

During the last ten years of Greenspan's chairmanship (1996 - 2006), Governors mention inflation, especially in speeches about *"Monetary Policy Implementation,"* in which they discuss monetary policy strategies to ensure price stability (for example, Ferguson Jr. (1999),

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[6]The selection of K does not affect our results, see section 7.

[7]In the appendix, we provide example speeches with their gamma values for the topics we focus on for FED and ECB.

[8]Using the information in Figure (2) and reading the most representative speeches, we choose a name for each topic that fits with the underlying content.

Gramlich (2003), Bernanke (2003))[9], the increasing relevance of central bank communication (for example, Bernanke (2004b)), and different challenges for monetary policy (for example, Bernanke (2004a)). Interestingly, figure (2) suggest that employment-related words do not have strong relevance. Instead, our STM identifies the topic *"Stabilization Policy"*. Consistent with the dual mandate, the FED Governors provide speeches that explain and discuss the relevance of monetary policies for short-run business cycle stabilization (for example, Kohn (2003), Bernanke (2005)).

Governors also discuss employment issues from a longer term, structural point of view, focusing on the effects of globalization and the development of productivity growth in the United States (for example, Ferguson Jr. (2004), Bernanke (2004c), Kroszner (2006)). In particular, Greenspan and Bernanke, once he became FOMC chairman in 2006, discuss employment issues from a non-monetary perspective.[10] The speeches of the members of the Board of Governors during the chairmanship of Greenspan, and the first two years of Bernanke's chairmanship, provide evidence for the observation that, until the onset of the GFC of 2008/2009, the FED interprets and communicates that price stability automatically creates the optimal environment for full employment. Without stable prices, markets could not work efficiently, leading to inefficient labor market allocation (Orphanides, 2019).

Not surprisingly, the GFC represents a break in the content composition of the corpus. As visible in figure (3), the topic *"Globalization, Growth, and Technology"* practically disappears. While the relevance of the topic *"Monetary Policy Implementation"* stays similar, the topic *"Stabilization Policy"* gains in importance. Governors address, in these speeches, the implementation of unconventional monetary policies for macroeconomic stabilization and to reduce unemployment.

With the onset of the COVID-19 pandemic, Governors primarily focus on speeches about monetary policy and community development, next to financial stability concerns.[11] Regard-

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[9]At the end of the appendix, we provide a list of all *illustrative speeches* that we refer to.

[10]For example, see Greenspan (1997, 2000, 2002, 2004) and Bernanke (2006, 2007).

[11]Figure (A3) provides the ratio for each topic to the overall number of speeches during the time between March 2020 and March 2021.

ing speeches associated with "*Monetary Policy Implementation*" and "*Stabilization Policy,*" Governors address the results of the monetary policy strategy review[12] and provide explanations and discussions on the economic outlook and how to react during the pandemic recession,[13] respectively. Regarding "*Community Development*", Governors' discuss in speeches the adverse economic effects of the pandemic on the labor market and the distributional consequences on minorities. How the community reinvestment act (CRA) could support communities and small- and medium-sized enterprises is also discussed.[14]

Does evidence exist in the corpus that is indicative of the changes in the monetary policy strategy between the years 2012 and 2020? Examining the fourth topic indicates that a learning process took place at the Board of Governors between strategic reviews. One noticeable change concerns the assessment of whether the Federal Fund Rate's decline alone can ensure achieving the dual mandate as the FED's policy rate approaches the ZLB.[15] This observation is addressed several times after interest rates begin to rise at the end of 2015 (for example, Brainard (2015), Powell (2018)). The Governors' explanations rest on developments in the real side of the economy and demographic factors. For example, Fischer (2016, 2017) notes that, demographic developments, the increased desire to accumulate savings, and the decline in the labor force potential reduce long-term interest rates. As a theoretical underpinning, Governors call attention to the *natural real interest rate* to emphasize the importance of considering real economic factors when explaining the reasoning behind the low historical level of interest rates (for example, Fischer (2017), Clarida (2019)).

The Governors also mention growing acceptance of short-term inflation overshooting to stabilize inflation expectations (Brainard, 2018) even before it became incorporated into the new monetary policy strategy as *Average Inflation Targeting* (AIT) in 2020. AIT is intended to ensure that the FED has room to maneuver in future recessions and to minimize

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[12]for example, Powell (2020a), Clarida (2020), and Clarida (2021)

[13]for example, Brainard (2020d), Powell (2020b), and Powell (2021)

[14]for example, Brainard (2020a), Brainard (2020b), Brainard (2020c), and Brainard (2020e))

[15]Unlike the ECB, the FED has rejected negative interest rates until now. In an interview with Adam S. Posen at PIIE, Powell reaffirms this position, see https://www.piie.com/events/economic-update-fed-chair-jerome-h-powell (Last Access: 26 October 2021).

shortfalls[16] from the level of full employment.

4.2   Single Mandate: ECB Executive Board

Analogously to section 4.1, we choose K for the corpus of speeches of the ECB Executive Board from the set of Pareto efficient STMs. Aiming for interpretability, we choose $K = 13$ as the suitable number of topics.[17]   In the next step, we use bar diagrams for the most important words (figure (4)) and the most representative speeches to define and name each topic.

- Figure (4) around here -

As before, we first provide each topic's ten most relevant words in figure (4). Using the keywords *"inflat," "monetari," "polici,"* and *"price"* we identify topics two, five, and eight as associated with monetary policy and inflation. Considering the additional keywords and analyzing speeches that the STM associates with each topic, we name topic two *"Conventional Monetary Policy,"* topic five *"Unconventional Monetary Policy,"* and topic eight *"Monetary Policy in a Changing Environment."*

- Figure (5) around here -

Figure (5) provides an overview of the development of the topics of the speech corpus over time.[18]   Looking at the relative proportions, we spot the first characteristic of the corpus. The STM assigns most of the speeches between 1999 and 2011 with the keywords *"monetari," "polici," "stabil," "price,"* and *"euro"* to the topic *"Conventional Monetary Policy."* Furthermore, most of the speeches after 2011 with keywords like *"monetari," "inflat," "purchase," "measure,"* and *"bank"* are associated with the topic *"Unconventional Monetary Policy."* The noticeable decline in the relative importance of topic two goes hand in hand

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[16]The FOMC removed the word *deviations* to highlight "that a low unemployment rate by itself, in the absence of evidence that price inflation is running or is likely to run persistently above mandate-consistent levels or pressing financial stability concerns, will not, under our new framework, be a sufficient trigger for policy action." (Clarida, 2020))

[17]The selection of K does not affect our results, see section 7.

[18]Feldkircher et al. (2021) identified similar topics using a data set consisting of speeches by the ECB Executive Board and national central bank presidents of the Eurosystem.

with a discernible increase in the absolute number and proportion of speeches assigned to topic five. Specifically, this occurs in 2010/2011, roughly coinciding with the change in presidency from Jean-Claude Trichet (2003 - 2011) to Mario Draghi (2011 - 2019).

In the speeches under topic two, central bankers emphasize the importance of central bank independence and sustainable public finances in the Euro area member states for the institutions of the Eurosystem, and to sustain price stability (for example, Issing (2001), Duisenberg (2003), Papademos (2005)). In contrast, the speeches of topic five focus on the rationale for implementing unconventional monetary policies at the ZLB and persistently low inflation rates. Furthermore, Executive Board members explain the functioning and effects of policies such as Quantitative Easing or forward guidance.

Another characteristic of the corpus is the low relevance of labor market - related words in all speeches on the topics of monetary policy. Instead, as visible in figure (4), the STM identifies labor market - related keywords for topic ten, which we call *"Labor Market"*. In speeches on this topic, European central bankers do not emphasize monetary policy as an instrument to reduce unemployment. Instead, the central bankers address unemployment and labor productivity from a longer term perspective. Accordingly, these speeches contain references to *"structural reforms"* or supply-side reforms to increase productivity (for example, Trichet (2005a, 2005b, 2006, 2007)). Following the GFC, on the one hand, we can see a decline in the proportion of topic *"Labor Market"* in the corpus. On the other hand, central bankers continue to communicate unemployment issues as a structural problem (for example, Draghi (2017)). Fortes and Guenedal (2020), analyzing different means of communication of the ECB, reach a similar conclusion about labor productivity communication in the Euro area.

Analyzing the content of speeches also exposes the intellectual path taken from the strategy review in 2003 to the strategy review in 2021. In line with the communication about monetary policy visible in the speeches of Executive Board members, the European Central Bank (2021) finally incorporates the instruments considered "unconventional" into its standard repertoire. This is also consistent with scholars' views who point out that the financial crises in recent years marks the transformation of an ordoliberal European Central Bank

modeled on the Deutsche Bundesbank into an American-type central bank that does not hesitate to intervene in the market by conducting large-scale asset purchases (Brunnermeier et al. (2016), Ferrara (2020)). Nevertheless, consistent with the ECB's primary mandate, unemployment is not discussed, confirming findings from the speeches: unemployment is not a macroeconomic objective that is actively pursued by monetary policy.[19]

5 How Mandates Affect the Tone of Speeches

Until now, we focused on the overall development of how FED Board of Governors members and ECB Executive Board members address their objectives within their speeches. While the analysis in the previous section captures how mandates influence the content, in this section, we focus on how mandates affect the tone of speeches.

5.1 Regression Specification

Speeches offer central bankers an opportunity to communicate their understanding of their mandate, in light of current economic developments, reflecting an ongoing learning process. Central bankers also use speeches to share their assessment of the current macroeconomic situation and outlook. This information can be of high value for market participants since these assessments may contain relevant implications for the future course of monetary policy. From this perspective, one can view central bank speeches as complements to more formal monetary policy tools.

That raises the question of how the central bank's mandate affects the tone of the speeches. We would expect a significant positive effect of an increase in the forward or backward-looking inflation data on our dependent variable for both the FED and the ECB. That is, central bankers operating under a price stability mandate may use more words signaling

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[19]This is also observable during the COVID-19 pandemic. Figure (A4) provides the ratio of each topic to the overall number of speeches between March and December 2020. Speeches associated with the fifth topic, *"Unconventional Monetary Policy"*, gain significant importance. Executive Board members discuss and explain unconventional and novel monetary policy instruments to combat the pandemic's adverse effects and guarantee price stability while barely mentioning unemployment. Example speeches are Schnabel (2020), Lane (2020a), Lane (2020b), Mersch (2020), and Lagarde (2020).

a restrictive course for monetary policy than a central bank that has a broader mandate. Analogously, we would expect a significant negative impact of an increase in the forward or backward-looking unemployment data on the tone of speeches by FED Governors. In other words, do similar considerations that, for example, Taylor rules imply for the setting of short-term interest rates (Taylor (1993), Coibion and Gorodnichenko (2012)) also affect the tone of speeches? To test this hypothesis, we estimate the following regression model:

$$
\begin{aligned}
tone_t = \beta_0 + \beta_1 * E_t x_{t+12}{}^{Infl} + \beta_2 * E_t x_{t+12}{}^{Unemp} + \beta_3 * \bar{\pi}_t \\
+ \beta_4 * \bar{u}_t + \beta_5 * \bar{i}_t + \beta_6 * tone_{t-1} + \sum_{i=7} \beta_i * X_{it} + \epsilon_t
\end{aligned}
\tag{1}
$$

The dependent variable is the average tone of central bank speeches ($tone_t$). Determinants of the core variables of the central bank mandate consists of central bank expectations about inflation ($E_t x_{t+12}{}^{Infl}$) and unemployment ($E_t x_{t+12}{}^{Unemp}$) during the next 12 months. As the backward-looking factor, we use the averages of inflation ($\bar{\pi}_t$) and unemployment ($\bar{u}_t$) from previous months covering the period prior to the release of a forecast at time t. The selection of the time horizon for averaging must take into account data availability in real-time. Therefore, we choose six-month averages to capture the current macroeconomic environment that is usually part of speeches by central bankers. Nonetheless, to ensure that this decision does not affect our results, we also consider specifications with nine-month and twelve-month averages. Furthermore, to control for the stance of monetary policy ($\bar{i}_t$) we utilize the shadow interest rate of Wu and Xia (2016) to have a comparable indicator for both central banks that also incorporates the effect of unconventional monetary policies on financing conditions.[20] We model $\bar{i}_t$ analogous to the backward-looking variables to ensure that the tone of speeches does not only reflect the degree of accommodative monetary policy. Finally, we include the first lag of our dependent variable ($tone_{t-1}$) to accommodate persistence in this variable.

We build our analysis partly on Coibion and Gorodnichenko (2011, 2012), who document

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[20]Since Wu and Xia (2016) provide their shadow interest rate for the Eurosystem from 2005, we fill the missing years with the interest rate for the main refinancing operations of the ECB.

that it is appropriate to approximate central bank expectations with forecasts when resorting to Taylor rules.[21] For the FED and the ECB, we use the quarterly published forecasts of the Survey of Professional Forecasts (SPF) for each central bank. Using the SPF forecasts offers several advantages: SPF provides forecasts for different time horizons, including short-term and long-term forecasts, and the publication dates between every new publication of the SPF forms a consistent time series regarding the length of each observation. Furthermore, the SPF is available for the general public such that the public and audiences are aware of the forecasts when central bankers hold their speeches.[22] Finally, using forecasts based on similar methodology is beneficial for our comparative analysis of central bank mandates.

To construct consistent one-year ahead central bank expectations for the FED Board of Governors, we use an average weighting approach similar to Benanni and Neuenkirch (2017) on the current and following calendar year forecasts of the SPF. However, instead of constructing daily central bank expectations, we weight the current and following year forecasts by the number of days left from the forecast's release until the end of the current year. The following equation defines our proxy for the expectations of the Board of Governors:

$$E_t x_{t+12}{}^{J,FED} = \frac{d}{365} E_{t,d} x_{cy}^{J,FED} + \frac{365-d}{365} E_{t,d} x_{ny}^{J,FED} \ \ for \ J \in \{Inflat, \ Unemp\} \quad (2)$$

where x_{cy}^{J} represents the current calendar year forecasts while x_{ny}^{J} is the forecast for the next calendar year. d is the number of remaining days from t until the end of the year. We use the same approach for the SPF published by the ECB to proxy the short-term inflation and unemployment expectations of the Executive Board:

$$E_t x_{t+12}{}^{J,ECB} = \frac{d}{365} E_{t,d} x_{cy}^{J,ECB} + \frac{365-d}{365} E_{t,d} x_{ny}^{J,ECB} \ \ for \ J \in \{Inflat, \ Unemp\} \quad (3)$$

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[21]As long as the forecast is independent of the monetary policy decision, such estimated models are not considered to be misspecified.

[22]Unlike the Greenbook forecasts, which are released with a five-year publication lag so that data availability becomes another advantage of SPF.

Regarding current macroeconomic developments, for the U.S., we use the inflation rate in the Personal Consumption Expenditure Price Index and the average change of the seasonally adjusted monthly unemployment rate from the U.S. Bureau of Labor Statistics.[23] For the Euro area, we use the inflation rate of the Harmonized Consumer Price Index and the average change of the seasonally adjusted monthly unemployment rate from the Labor Force Survey.[24] Depending on the specification, these averages consist of six, nine, and twelve months before the central banks release new forecasts at time t.

As additional control variables, we use the first lag of the forward-looking independent variables[25] and a dummy variable that equals one if the economy is in a recession. We use the recession chronologies of the NBER[26] and CEPR[27] for the FED and ECB, respectively. To account for the European sovereign debt crisis, we include an additional dummy variable for the time May 2010 until June 2013 for the ECB specification.[28]

5.2 Tone of Speeches

To quantify the tone of text data, we use sentiment analysis. That is, we choose an appropriate lexicon and apply a search-and-count algorithm to our two corpora independently. Loughran and McDonald (2011) is a well-known study and lexicon about sentiment analysis in which the authors also document that one needs a different lexicon for economics texts than for the analysis of everyday language. Shapiro and Wilson (2021) and Paloviita et al. (2020) use the lexicon of Loughran and McDonald (2011) to analyze the sentiment of FED transcripts and ECB press conference statements, respectively. Scholars like Picault and

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[23]We downloaded the data from FRED Economic Data of the St. Louis FED: *PCEPI* (BEA Account Code: DPCERG) and *UNRATE* (Source Code: LNS14000000) (Last Access: 29 October 2021).

[24]We downloaded the data from the ECB Statistical Data Warehouse: *HICP* and *Unemployment rate* (Last Access: 29 October 2021).

[25]We do not include lags of the backward-looking variables to avoid overlapping, since we consider at least six months' averages while new forecasts are published quarterly.

[26]https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions (last access: 9 November 2021

[27]https://eabcn.org/dc/chronology-euro-area-business-cycles (last access: 9 November 2021)

[28]We take these dates from Hartmann and Smets (2018)

Renault (2017) argue that central bank communication needs a more field-specific lexicon due to differences in communication styles between central banks and corporations. Benanni and Neuenkirch (2017) provide a field-specific lexicon based on speeches of Executive Board members of the ECB and the national central bank presidents of the Eurosystem. Analogously, Neuhierl and Weber (2019) provide a field-specific lexicon based on speeches by Board of Governors members of the FED during the 2000s. For our analysis, these dictionaries are unsuitable since, for comparability, the same lexicon should encompass language used by both central banks in our study and not tailored to one or the other central bank.

Instead, we use the Apel et al. (2019) lexicon which is an updated version of the dictionary originally developed by Apel and Blix-Grimaldi (2012) and is designed based on the transcripts and minutes of the Federal Open Market Committee (FOMC). The simple bigram approach focusing on the mandate-related topics *"Inflation," "Economic Activity,"* and *"Employment"* make this dictionary attractive for comparative analyses based on English-written documents of central banks due to the wide usage of the selected words. Furthermore, the lexicon by Apel et al. (2019) permits a distinction between hawkish and dovish word combinations. As Apel et al. (2019) suggests, we use the lexicon and our search-and-count algorithm on stemmed speeches. We consider all direct word combinations of the terms and their respective modifiers without considering stop words.[29] To evaluate the net tone of each speech i, we define the following indicator:

$$NetSentiment_{t_i} = 100 * \frac{Hawk_{t_i} - Dove_{t_i}}{\frac{1}{2} * N_{t_i}} \qquad (4)$$

Since the terms our search-and-count algorithm detects are bigrams, we divide the net tone of each speech by the absolute number of words divided by $\frac{1}{2}$.[30] Doing this, we adjust for the

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[29]Apel et al. (2019) provide their dictionary in the appendix of their paper.

[30]The three unigram terms in Apel et al. (2019) can be interpreted as bigrams together with their modifiers. This interpretation does not affect the estimation, though it simplifies interpretation of the results.

lengths of speeches[31] and consider using bigrams.[32] The last step simplifies the interpretation without affecting the estimation.

In the next step, we follow Moschella and Pinto (2019) and cluster the topics into three categories: primary mission, secondary mission, and ancillary mission of the respective central banks. Using the classification scheme of Moschella and Pinto (2019) leads to an exclusive focus on topics dealing only with monetary policy. Otherwise, we risk biasing the quantification of the tone of speeches since dictionaries relating to monetary policy may not fit with speeches dealing with education or financial stability (Correa et al., 2021). Therefore, we combine topics four and eight of the FED Board of Governors corpus into an aggregate primary mandate topic. Analogously, we combine topics two, five, and eight of the ECB Executive Board corpus. Now we run our search-and-count algorithm with Apel et al. (2019) dictionary on the primary mandate topics of the respective central banks. We calculate the average tone for each period t:

$$tone_t = \frac{1}{N} \sum_{i=1}^{N} NetSentiment_{t_i} \tag{5}$$

We plot the development of $tone_t$ for the primary mandate speeches of the FED Board of Governors and ECB Executive Board and add recessions as shaded areas based on the recession dates of the NBER and CEPR.

- Figure (6) around here -

Looking at the average quarterly tone in figure (6), we identify interesting differences between the two central banks. The tone of speeches by the Board of Governor members becomes steadily more dovish from mid-1996 until 2006. Furthermore, at the beginning of the 2000s, the number of dovish surpasses the number of hawkish terms. Interestingly,

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[31]N_t does not consider stop words that we take from the established dictionaries *Onix, SMART,* and *Snowball.*

[32]Another indicator to derive the sentiment of text is $\frac{Hawk_{t_i} - Dove_{t_i}}{Hawk_{t_i} + Dove_{t_i}}$ (Apel and Blix-Grimaldi, 2012). However, this indicator does not consider the length of speeches which varies considerably in contrast to, for example, introductory statements during press conferences.

although the tone has become gradually more hawkish since the GFC, it took about seven years before the average number of hawkish terms surpassed the dovish terms. In contrast, the tone of speeches by Executive Board members is relatively more volatile than the tone emanating from the FED. This may reflect differences in the distribution of speech giving across members of the Board of Governors versus the Executive Board (see tables (1) and (2)). Furthermore, the tone of Executive Board members seems more responsive around recessions. Looking at the individual data points, we can detect that the tone of the Executive Board becomes abruptly more dovish during every recession in our sample.

6 Results

We estimate equation (1) using OLS and split our sample at the decadal change from the 2000s to the 2010s. This split is motivated by the thematic shifts in the corpora of the two central banks identified in the fourth section.[33] Table (3) shows the regression results for the FED Board of Governors and table (4) the results for the ECB Executive Board using specifications with different averages for the backward-looking data

- Table (3) around here -

For the sake of brevity, we limit the presentation to the central results of our analysis. In the first part of our sample, visible in specifications (1) - (3) of the table (3), we estimate a statistically significant effect of the change in unemployment on the tone of speeches. Consistent with our expectation given the mandate of the FED, an increase in the unemployment rate leads to a more dovish tone in the Governors' speeches. In contrast, we do not find a significant effect of backward or forward-looking inflation that one would consider statistically significant given the price stability mandate. Instead, we estimate a significant effect of the policy rate on tone. The parameter sign is consistent with the intuition that a more hawkish tone accompanies interest rate hikes while are more dovish tone accompanies interest rate reductions. One explanation could be that speeches are used to explain changes

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[33]We provide the full sample estimations in the appendix.

in the stance of monetary policy.

In specifications (4) - (6), covering the sample since 2010, we identify a significant negative effect of unemployment expectations on the tone of speeches. Higher unemployment expectations lead to a more dovish tone, that is, the number of hawkish terms to dovish terms decreases significantly after controlling for the length of speeches. Looking at the coefficients, we estimate that an increase in unemployment expectations by one percentage point leads, on average, to a net decline in hawkish terms given the length of speech by 0.1 to 0.14 percentage points. This result is robust across the specifications and provides evidence for the increased importance of expectations for the Board of Governors after hitting the ZLB.

- Table (4) around here -

Table (4) presents the results for the ECB Executive Board. During the first period of our sample, visible in specifications (1) - (2), we cannot estimate any significant effect of the forward or backward-looking inflation data on the tone of speeches. The significant impact of expectations on the tone of speeches in the third specification vanishes when considering shorter averages of $\bar{\pi}_t$ and $\bar{u}_t$, implying that central bankers may consider more recent developments. An interesting difference vis-á-vis the results for the Board of Governors is the significant, though negative, effect of lagged interest rates. When the ECB reduces interest rates, Executive Board members use more hawkish language. One can interpret this communication as an attempt to eliminate any impression of a deviation from the Bundesbank tradition and to anchor inflation expectations. Furthermore, one should recall that during the first decade of the ECB, the central bank was undoubtedly preoccupied with a need to explain its role, build its credibility, and inform the public about the implications of a single monetary policy. Moreover, inflation developments rarely threatened the ECB's price stability definition (that is, inflation below 2%) before the crisis-prone era that began after 2009. Finally, it may be that the tone of pre-GFC speeches sought to reassure the public that, despite the Maastricht Treaty's emphasis on price stability, Executive Board members wanted to convey the impression that they are not inflation 'nutters' and comment every change in short-term inflation expectations.

Following the GFC, in specifications (4) - (6), we estimate an economically and statistically significant effect of inflation expectations, on the tone of speeches. The positive parameter sign is consistent with our hypothesis that higher inflation risks lead to a more hawkish tone in the speeches. Moreover, the result is consistent with the theoretical perspective that private-sector inflation expectations determine the actual inflation rate rather than past developments.[34] If the private sector expects lower inflation, it may lead to lower increases in prices and wages, resulting in downward risks for the inflation target. As a response, the ECB Executive Board changes the tone of its speeches to stabilize inflation expectations. Despite using a different specification with a lexicon not tailored to the Eurosystem, our results are consistent with Benanni and Neuenkirch (2017) concerning the increased importance of inflation expectations to the ECB since the GFC.

In the next step, we analyze how *long-term* inflation expectations affects the tone of the speeches. Central bankers may focus on long-term inflation forecasts since price stability is a macroeconomic aim that central banks want to achieve in the medium to the long-run. Therefore, we extend our regression model to include long-term inflation expectations proxied by the 10Y forecasts for inflation from the SPF of the Federal Reserve Bank of Philadelphia for the FED Board of Governors and the 5Y forecasts for inflation from the SPF of the ECB for the Executive Board.[35]

- Table (5) around here -

Table (5) shows the results for the Board of Governors. For the first period, as shown in specifications (1) - (3), we estimate a statistically and economically significant positive effect of long-term inflation expectations on the tone of speeches on the 10%-level. When including long-term inflation expectations, we estimate a significant effect of the dual mandate of the FED on the tone of speeches, driven by long-term inflation expectations and the actual

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[34]Nevertheless, it is worth noting the difference between central bank forecasts and measurable household expectations (Coibion et al., 2020).

[35]We use 10Y inflation forecasts since the Federal Reserve Bank of Philadelphia published 5Y forecasts for inflation only since Q3 2005. Nonetheless, in the robustness check, we show that using 5Y inflation forecasts for the second estimation period does not have significant qualitative effects on the results.

development of unemployment. For the second period, as seen in specifications (4) - (6), the results remain qualitatively similar.

- Table (6) around here -

Table (6) provides the results for the ECB Executive Board. Regarding the first period, we have to reject the hypothesis of a statistically significant effect of short- or long-term inflation expectations on tone. Furthermore, the significant effect of the past interest-rate setting vanishes when including long-term inflation expectations. Regarding the second period, the inclusion of long-term inflation expectations leads short-term inflation expectations to become insignificant. Instead, we estimate an economically and statistically significant effect of the long-term inflation expectations with an increase leading to an increase in hawkish over dovish terms by over two percentage points, after controlling for the length of speeches. Our estimation provides evidence that European central bankers react strongly to inflation target deviations. This relationship becomes apparent after the GFC, when the ZLB binds money market rates and the Executive Board introduces unconventional monetary policy instruments.

- Table (7) around here -

- Table (8) around here -

Finally, we estimate our specifications while excluding the GFC (1 September 2008 - 31 December 2009)[36] and the COVID-19 pandemic (1 March 2021 onwards)[37] to analyze the relevance of mandates when a crisis is of a non-monetary nature. Our aim is to assess the extent to which crises of all types drive some of our results.

In the case of the Board of Governors (table (7)) the main difference with the estimation results in table (5) is the vanishing significant negative effect of the actual change in the unemployment rate on tone. This result seems to be driven by the abrupt increase in the

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[36]We define the period for the GFC from September 2008, the bankruptcy of Lehman Brothers, until the end of 2009. We exclude 2009 since both central banks implemented unconventional monetary policies throughout.

[37]The World Health Organization (2020) declared COVID-19 on 11 March 2020 as a pandemic.

unemployment rate during the GFC that one could not associate with *structural* problems like globalization or education. Regarding the specifications (4) - (6), the results remain similar though we estimate an economically and statistically significant effect of unemployment expectations on tone on the 1% level across all specifications. Turning to the ECB Executive Board (table (8)), the results remain qualitatively similar to ones discussed previously.

Excluding crises periods does have some impact on speech sentiment at both central banks. Pre-GFC, we have to reject our hypothesis of a significant effect of forward or backward-looking inflation data on the tone of ECB speeches. Although the content analysis demonstrates that European central bankers talk about inflation, tone does not seem to be driven by current developments. Nonetheless, with the onset of the ZLB, (long-term) inflation expectations affect the tone of speeches, demonstrating the continued relevance of the price stability mandate. The insignificant effect of backward- or forward-looking unemployment rates is consistent with the single mandate of the Eurosystem and consistent with the earlier content analysis: the Executive Board communicates unemployment mainly as a structural problem. This communication contrasts to the FED Governors, who increasingly communicate about labor market conditions since the GFC with unemployment expectation shaping their tone.

7 Robustness Checks and Further Results

We perform several robustness checks. We use the specification with six-month averages for the macroeconomic data for brevity. Nonetheless, our results remain robust when using specifications with nine or twelve-month averages. We provide tables and figures in the appendix.

To use the STM, choosing a specific number of topics K is necessary before estimating the model. We also tried different values for K that we derive in section 3.2. Our specifications remain unchanged. The results remain robust when using different values for K.

Next, we replace the short-term shadow rate of Wu and Xia (2016) with the shadow rate

estimates of Krippner (2013) and run our regression estimation for every K from the prior robustness check. The results remain robust when we rely on a different estimate of the shadow rate.

In the case of the FED, we proxy long-term inflation expectations with the 5Y forecasts from the SPF instead of the 10Y forecasts. Due to data availability, we can only consistently estimate the post-GFC with the 5Y forecasts. Nonetheless, the results remain robust when using a shorter forecast horizon for the inflation expectations regardless of which shadow rate we use and which number of K for the STM methodology we choose.

Finally, to ensure that potential structural breaks do not bias our results, we implement the computational and graphical multiple breakpoint identification approach of Zeileis et al. (2003). For the FED Board of Governors, we identify structural breakpoints at the year-end of 1999 and 2016. Furthermore, we identify a structural break at the year-end of 2004 after reducing our sample and repeat the identification approach on the smaller sample. We estimate our model specifications for January 2005 until December 2016, considering and without considering the GFC. The estimation results remain robust and analogous to our estimation results for the second period in the previous section. In the case of the ECB Executive Board, we cannot identify any structural break.

8 Conclusions

This study examines the influence of central banks' mandates on the content and tone of speeches made by senior officials at the FED and the ECB. We contribute to the existing literature by creating a study design that allows for a proper comparison between the dual-mandated FED and the single-mandated ECB. Although speeches about monetary policy objectives reveal similarities during the Great Moderation at both central banks, stark differences appear following the GFC. On the one hand, both central banks discuss the usage and novelty of unconventional monetary policy instruments. On the other hand, the FED Board of Governors explain how monetary policy can influence unemployment and assists

in restoring full employment. In contrast, the ECB Executive Board members focus solely on price stability and, if mentioned at all, consider unemployment primarily as a structural problem. Regarding the tone of the speeches, we find significant qualitative differences between the FED and the ECB on the tone of each corpus of speeches. Before the GFC, we could not detect a significant difference between both central banks.

While long-term inflation expectations might influence the tone of speeches by FED Governors, we cannot estimate any significant effect of the ECB's mandate on the tone of Executive Board members speeches. Following the GFC, we estimate significant effects of inflation and unemployment expectations on the tone of speeches, though with substantial qualitative differences between the FED and the ECB. Unemployment expectations influence the tone of speeches by FED Governors, while (long-term) inflation expectations affect the tone of ECB Executive Board member speeches. ECB Executive Board members' speeches are delivered with a tone consistent with their mandate despite the increase in unemployment in the Euro area during the last decade. In contrast, a similar development regarding unemployment in the U.S. significantly shifted the content and tone of speeches by Board of Governor members.

Our analysis demonstrates the importance of mandates in driving the content and tone of speeches by central bankers. Moreover, speeches also clearly reflect the times when they are delivered. Nevertheless, once the pandemic has passed, an update of our analysis, left for future research, ought to capture a pivot in the tone of central bank speeches much as the GFC did. It will be interesting to see, assuming central bank mandates do not change, whether the tone and content of speeches will follow more closely wider societal concerns that have been the focus of many COVID-19 related policies, including better coordination with fiscal policies, climate change, and concerns about income inequality.

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Figures

Figure 1: **Illustration of the Structural Topic Model** (Roberts et al., 2016)

$$\beta \propto \exp(m_v + \kappa_{k,v}^{(t)} + \kappa_{y_d,v}^{(c)} + \kappa_{y_d,k,v}^{(i)})$$
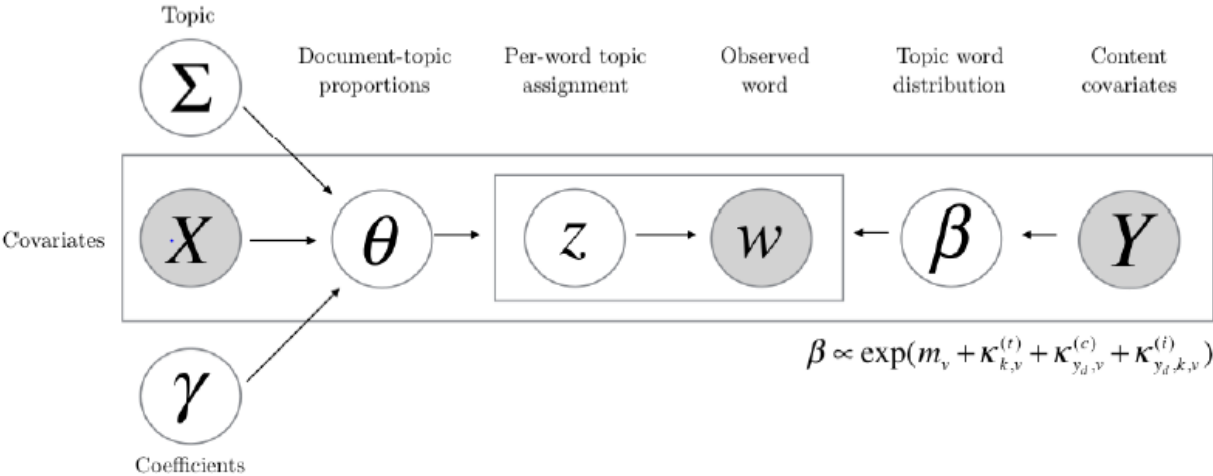
Note: This figure illustrates the data generating process of the STM methodology from Roberts et al. (2016). White nodes denote latent random variables, while shaded nodes denote the observable variables. Only the 'observed words' and the covariates which comprise the metadata are observable.

Figure 2: **Most Influential Words in the Topics of the Board of Governors Corpus**
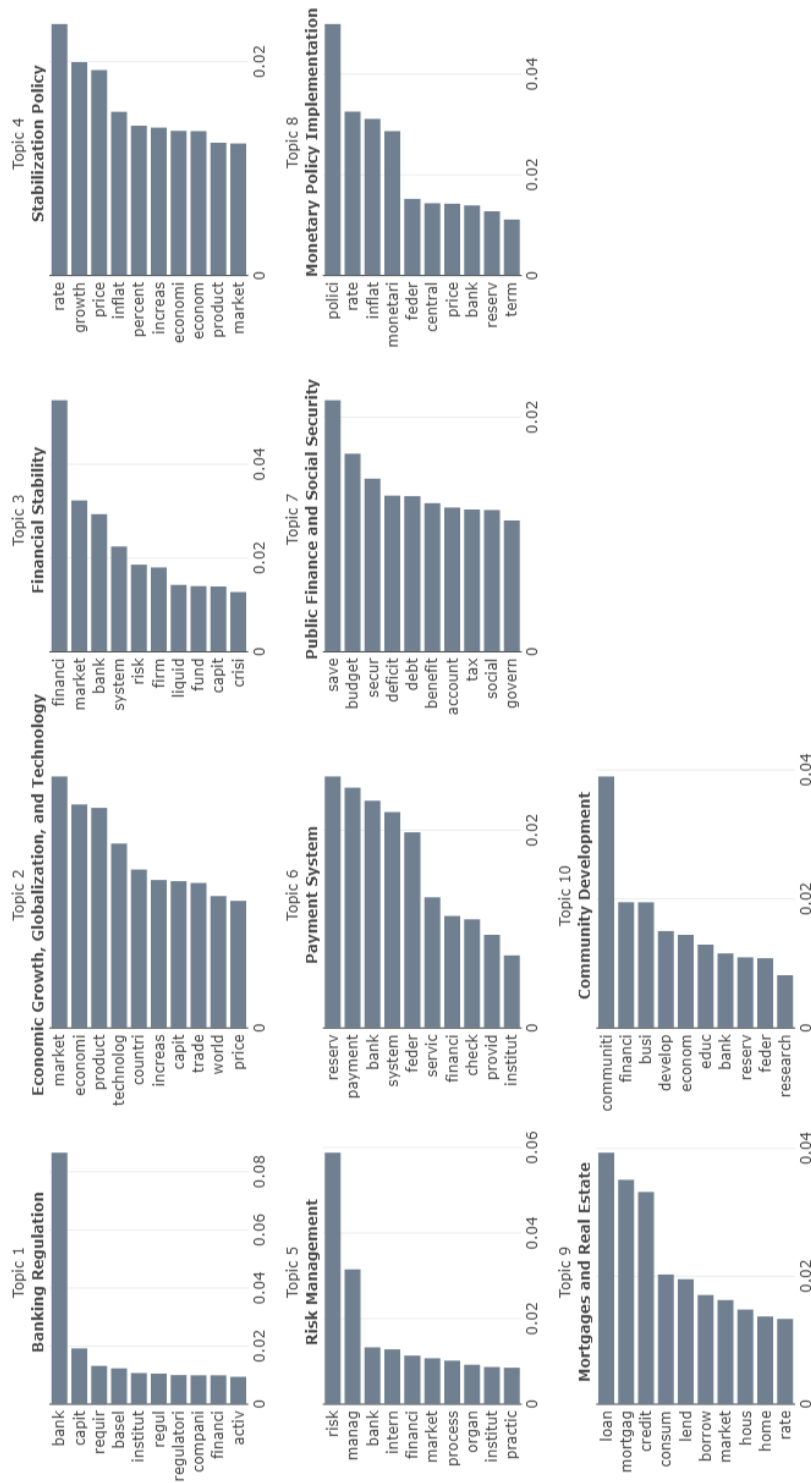
Note: We generate these bar charts for the FED Board of Governors corpus using the STM with a topic number of $K = 10$. We use ten topics to provide the highest interpretability and clarity. For each topic, we show the most influential words based on their respective beta values. We derive the names after reading the most representative speeches of each topic.

Figure 3: **Development of Board of Governors Topic**
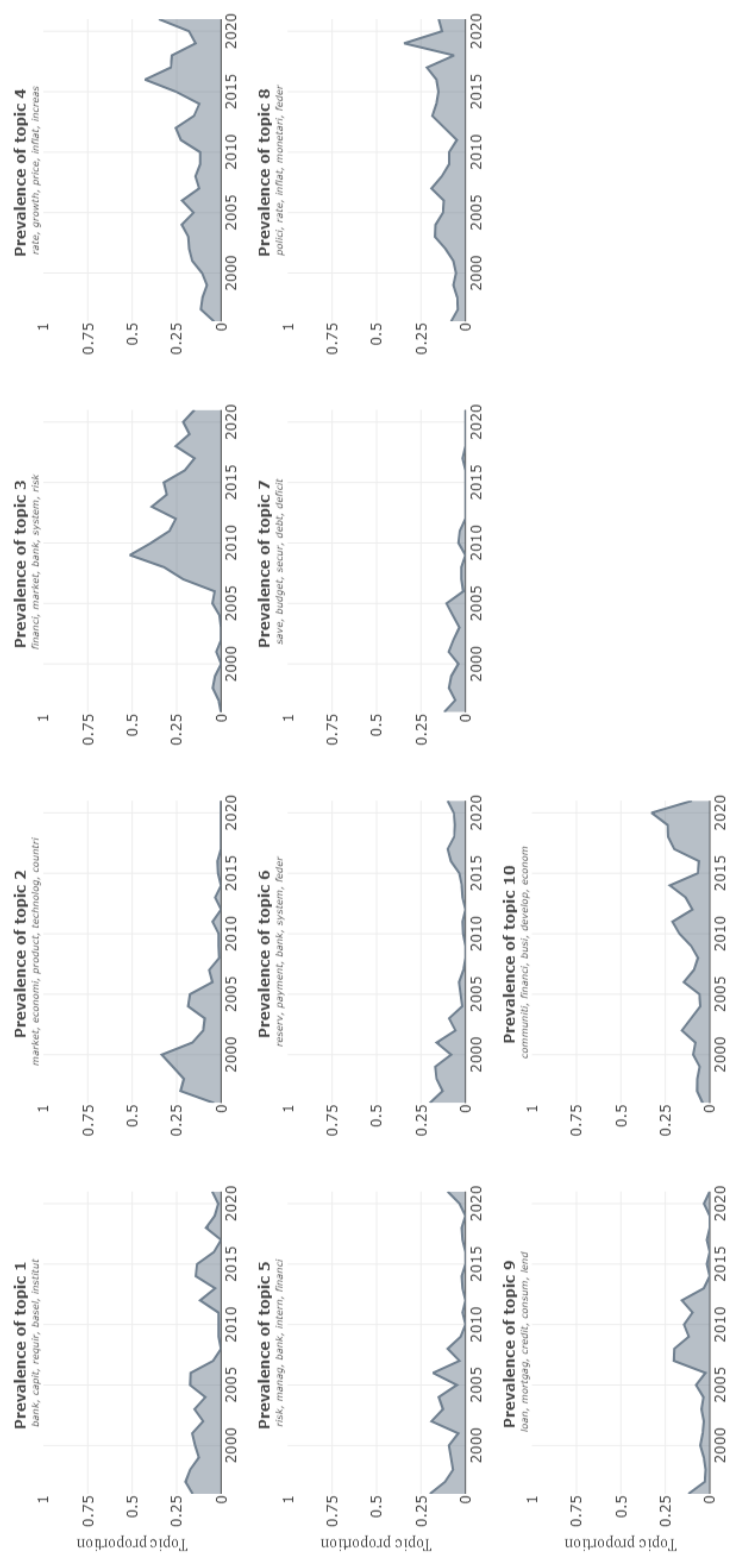
Note: This diagram illustrates the prevalence of every topic identified with the STM, using $K = 10$, for the FED Board of Governors between 1996 and 2020 annually. We use 10 topics to provide the highest interpretability and clarity.

Figure 4: **Most Influential Words in the Topics of the Executive Board Corpus**

Note: We generate these bar charts for the ECB Executive Board corpus using the STM with a topic number of $K = 13$. We use 13 topics to provide the highest interpretability and clarity. For each topic, we show the most influential words based on their respective beta values. We derive the names after reading the most representative speeches of each topic.

Figure 5: **Development of the Executive Board Topics**

Figure 6: **Average Tone of Primary Mandate Speeches**

Board of Governors: Average Quarterly Tone of Primary Mandate Speeches

Executive Board: Average Quarterly Tone of Primary Mandate Speeches
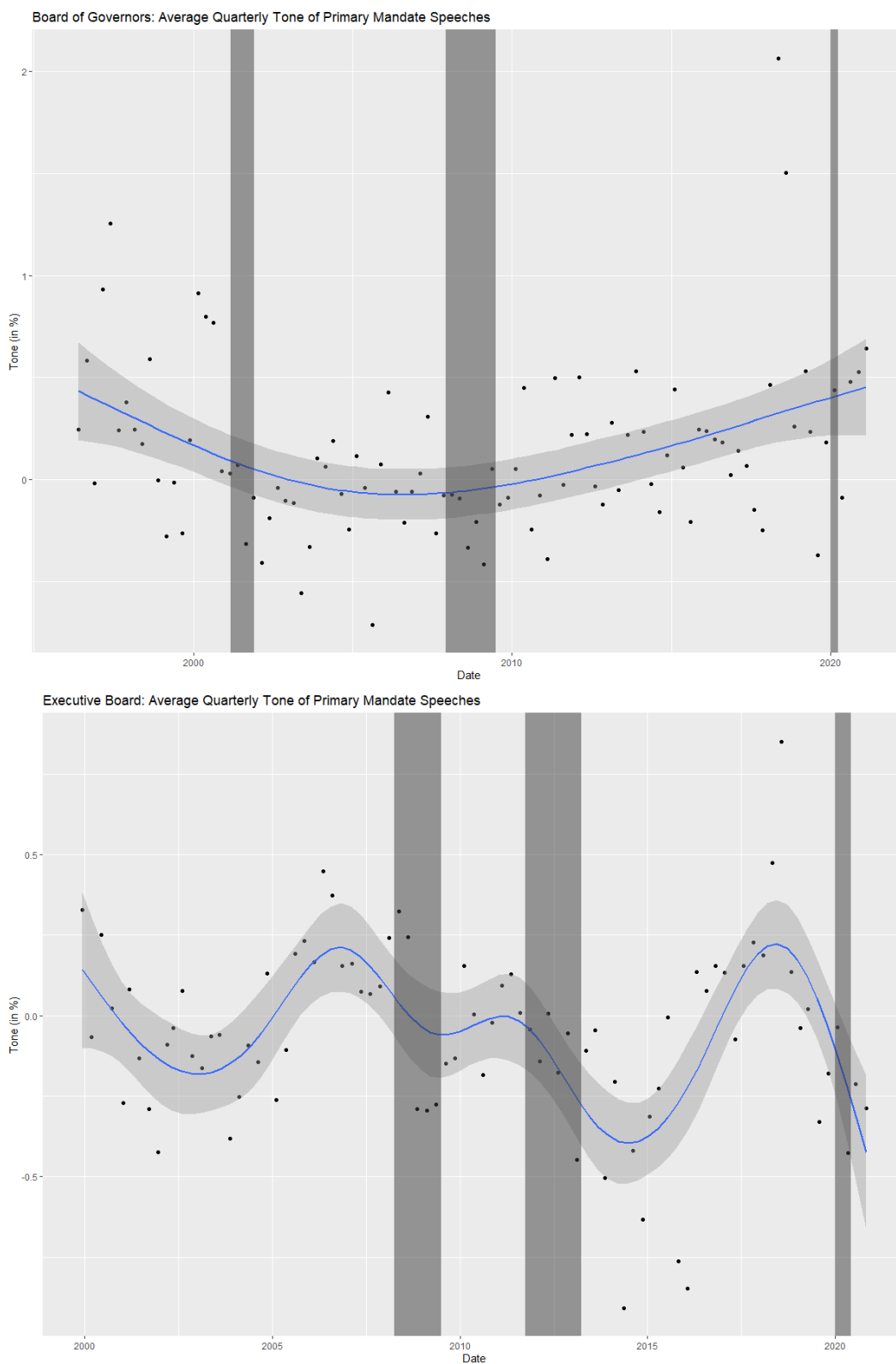
Note: The figures show the average quarterly development of our dependent variable $tone_t$ between 1997 - 2020 (FED) and 2000 - 2020 (ECB) using regression splines. We describe the calculation of $tone_t$ in section 5. We constrain the corpus to speeches that directly relate to the primary mandate of each central bank. We denote recessions with shaded areas using the dates of the recessions of the NBER and CEPR.

Tables

Table 1: **FED Board of Governors Speakers**

Speaker	In Office	Chairman	Number of Speeches
Bernanke, Ben S.	5 Aug 2002 - 21 Jun 2005	No	47
	1 Feb 2006 - 31 Jan 2014	**Yes**	229
Bies, Susan S.	7 Dec 20001 - 30 Mar 2007	No	83
Bowman, Michelle W.	Since 26 Nov 2018	No	23
Brainard, Lael	Since 16 Jun 2014	No	90
Clarida, Richard H.	Since 17 Sep 2018	No	32
Duke, Elizabeth A.	5 Aug 2008 - 31 Aug 2013	No	51
Ferguson, Roger W.	5 Nov 1997 - 28 Apr 2006	No	152
Fischer, Stanley	28 May 2014 - 16 Oct 2017	No	45
Gramlich, Edward M.	5 Nov 1997 - 31 Aug 2005	No	68
Greenspan, Alan	11 Aug 1987 - 31 Jan 2006	**Yes**	278
Kohn, Donald L.	5 Aug 2002 - 1 Sep 2010	No	88
Kroszner, Randall S.	1 Mar 2006 - 21 Jan 2009	No	50
Lindsey, Lawrence B.	26 Nov 1991 - 5 Feb 1997	No	4
Meyer, Laurence H.	24 Jun 1996 - 31 Jan 2002	No	93
Mishkin, Frederic S.	5 Sep 2006 - 31 Aug 2008	No	30
Olson, Mark W.	7 Dec 2001 - 30 Jun 2006	No	54
Phillips, Susan M.	2 Dec 1991 - 30 Jun 1998	No	18
Powell, Jerome H.	25 May 2012 - 4 Feb 2018	No	55
	Since 5 Feb 2018	Yes	49
Quarles, Randal K.	Since 13 Oct 2017	No	53
Raskin, Sarah B.	4 Oct 2010 - 13 Mar 2014	No	18
Rivlin, Alice M.	25 Jun 1996 - 16 Jul 1999	No	20
Stein, Jeremy C.	30 May 2012 - 28 May 2014	No	15
Tarullo, Daniel K.	28 Jan 2009 - 5 Apr 2017	No	78
Warsh, Kevin	24 Feb 2006 - 2 Apr 2011	No	19
Yellen, Janet L.	12 Aug 1994 - 17 Feb 1997	No	1
	4 Oct 2010 - 2 Feb 2014	No	23
	3 Feb 2014 - 4 Feb 2018	**Yes**	58

Note: This table provides the speakers and the respective number of speeches in our corpus for the FED Board of Governors from 13 June 1996 until 23 March 2021.

Table 2: **ECB Executive Board Speakers**

Speaker	In Office	President	Number of Speeches
Asmussen, Jörg	1 Jan 2012 - 8 Jan 2014	No	36
Bini Smaghi, Lorenzo	1 Jun 2005 - 31 Dec 2011	No	107
Cœuré, Benoît	1 Jan 2012 - 31 Dec 2019	No	180
Constâncio, Vítor	1 Jun 2010 - 31 May 2018	No	121
De Guindos, Luis	Since 1 Jun 2018	No	51
Draghi, Mario	1 Nov 2011 - 31 Oct 2019	**Yes**	183
Duisenberg, Willem F.	1 Jun 1998 - 31 Oct 2003	**Yes**	111
González-Páramo, José Manuel	1 Jun 2004 - 31 May 2012	No	95
Hämäläinen, Sirkka	1 Jun 1998 - 31 May 2003	No	41
Issing, Otmar	1 Jun 1998 - 31 May 2006	No	78
Lagarde, Christine	Since 1 Nov 2019	**Yes**	24
Lane, Philip R.	Since 1 Jun 2019	No	18
Lautenschläger, Sabine	27 Jan 2014 - 31 Oct 2019	No	78
Mersch, Yves	15 Dec 2012 - 14 Dec 2020	No	151
Noyer, Christian	1 Jun 1998 - 31 May 2002	No	44
Padoa-Schioppa, Tommaso	1 Jun 1998 - 31 May 2005	No	42
Panetta, Fabio	Since 1 Jan 2020	No	14
Papademos, Lucas	1 Jun 2002 - 31 May 2010	No	87
Praet, Peter	1 Jun 2011 - 31 May 2019	No	117
Solans, Eugenio Domingo	1 Jun 1998 - 31 May 2004	No	58
Schnabel, Isabel	Since 1 Jan 2020	No	18
Stark, Jürgen	1 Jun 2006 - 31 Dec 2011	No	65
Trichet, Jean-Claude	1 Nov 2003 - 31 Oct 2011	**Yes**	310
Tumpel-Gugerell, Gertrude	1 Jun 2003 - 31 May 2011	No	136

Note: This table provides the speakers and the respective number of speeches in our corpus for the ECB Executive Board from 14 January 1999 until 16 December 2020.

Table 3: **FED Board of Governors - Tone**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$	(4) $tone_t$	(5) $tone_t$	(6) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.17	0.12	0.16	0.35	0.33	0.31
	(0.12)	(0.12)	(0.12)	(0.30)	(0.30)	(0.30)
$E_t x_{t+12}{}^{Unemp}$	0.21	0.15	0.16	-0.14**	-0.10*	-0.10*
	(0.24)	(0.22)	(0.24)	(0.05)	(0.05)	(0.05)
$\bar{\pi}_t^{6m}$	-0.01			0.13		
	(0.07)			(0.17)		
$\bar{u}_t^{6m}$	-0.08**			0.01**		
	(0.04)			(0.01)		
$\bar{i}_t^{6m}$	0.10***			-0.00		
	(0.03)			(0.05)		
$\bar{\pi}_t^{9m}$		-0.03			0.03	
		(0.07)			(0.11)	
$\bar{u}_t^{9m}$		-0.11**			0.01	
		(0.05)			(0.01)	
$\bar{i}_t^{9m}$		0.09***			0.01	
		(0.03)			(0.05)	
$\bar{\pi}_t^{12m}$			-0.02			0.02
			(0.07)			(0.09)
$\bar{u}_t^{12m}$			-0.10*			0.02*
			(0.05)			(0.01)
$\bar{i}_t^{12m}$			0.09**			0.00
			(0.03)			(0.05)
$Constant$	-0.96	-1.08	-0.98	0.07	-0.18	-0.18
	(0.88)	(0.92)	(0.93)	(0.53)	(0.44)	(0.38)
Obs	54	54	54	45	45	45
R^2	0.39	0.39	0.36	0.32	0.29	0.3
$Controls$	YES	YES	YES	YES	YES	YES
$Post\text{-}GFC$	NO	NO	NO	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on NBER. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: **ECB Executive Board - Tone**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$	(4) $tone_t$	(5) $tone_t$	(6) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.13	0.16*	0.15*	0.65**	0.59**	0.57**
	(0.14)	(0.09)	(0.08)	(0.29)	(0.27)	(0.28)
$E_t x_{t+12}{}^{Unemp}$	-0.19	-0.22*	-0.24*	0.04	0.03	0.03
	(0.13)	(0.13)	(0.13)	(0.16)	(0.16)	(0.16)
$\bar{\pi}_t^{6m}$	-0.03			-0.18		
	(0.12)			(0.13)		
$\bar{u}_t^{6m}$	-0.13			-0.02		
	(0.10)			(0.05)		
$\bar{i}_t^{6m}$	-0.10**			-0.01		
	(0.04)			(0.03)		
$\bar{\pi}_t^{9m}$		-0.05			-0.04	
		(0.13)			(0.11)	
$\bar{u}_t^{9m}$		-0.06			0.00	
		(0.09)			(0.08)	
$\bar{i}_t^{9m}$		-0.10**			0.01	
		(0.04)			(0.03)	
$\bar{\pi}_t^{12m}$			-0.03			-0.01
			(0.11)			(0.12)
$\bar{u}_t^{12m}$			-0.04			0.01
			(0.08)			(0.07)
$\bar{i}_t^{12m}$			-0.10**			0.01
			(0.04)			(0.03)
Constant	1.12*	1.13**	1.22**	0.20	0.51	0.61
	(0.63)	(0.55)	(0.51)	(0.54)	(0.61)	(0.67)
Obs	40	40	40	44	44	44
R^2	0.56	0.55	0.54	0.43	0.42	0.42
Controls	YES	YES	YES	YES	YES	YES
Post-GFC	NO	NO	NO	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Before 2005, we use the interest rate for the main refinancing operations. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, a dummy variable that equals one if the economy is in a recession based on CEPR, and a dummy that considers the Euro area sovereign debt crisis (May 2010 - June 2013). Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ 40

Table 5: **FED Board of Governors - Considering Long Term Inflation Forecasts**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$	(4) $tone_t$	(5) $tone_t$	(6) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.14	0.10	0.14	0.31	0.28	0.20
	(0.11)	(0.11)	(0.12)	(0.27)	(0.28)	(0.29)
$E_t x_{10Y}{}^{Infl}$	0.77*	0.74*	0.79*	0.32	0.48	0.82
	(0.39)	(0.38)	(0.39)	(1.17)	(1.32)	(1.36)
$E_t x_{t+12}{}^{Unemp}$	0.31	0.23	0.24	-0.15**	-0.12*	-0.13*
	(0.22)	(0.21)	(0.23)	(0.06)	(0.07)	(0.07)
$\bar{\pi}_t^{6m}$	0.00			0.13		
	(0.07)			(0.16)		
$\bar{u}_t^{6m}$	-0.07**			0.01*		
	(0.03)			(0.01)		
$\bar{i}_t^{6m}$	0.08***			-0.00		
	(0.03)			(0.05)		
$\bar{\pi}_t^{9m}$		-0.02			0.02	
		(0.06)			(0.11)	
$\bar{u}_t^{9m}$		-0.09**			0.02	
		(0.04)			(0.01)	
$\bar{i}_t^{9m}$		0.08***			0.01	
		(0.02)			(0.05)	
$\bar{\pi}_t^{12m}$			-0.02			0.03
			(0.07)			(0.10)
$\bar{u}_t^{12m}$			-0.07			0.02*
			(0.05)			(0.01)
$\bar{i}_t^{12m}$			0.07**			-0.00
			(0.03)			(0.05)
Constant	-2.04*	-2.06*	-2.01	-0.48	-0.98	-1.55
	(1.19)	(1.20)	(1.20)	(1.90)	(2.19)	(2.23)
Obs	54	54	54	45	45	45
R^2	0.45	0.44	0.42	0.32	0.29	0.3
Controls	YES	YES	YES	YES	YES	YES
Post-GFC	NO	NO	NO	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Furthermore, we include the ten year inflation forecast $E_t x_{10Y}{}^{Infl}$ of the SPF from the Federal Reserve Bank of Philadelphia. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on NBER. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: **ECB Executive Board - Considering Long Term Inflation Forecasts**

	(1)	(2)	(3)	(4)	(5)	(6)
	$tone_t$	$tone_t$	$tone_t$	$tone_t$	$tone_t$	$tone_t$
$E_t x_{t+12}{}^{Infl}$	0.18	0.18	0.16	0.46	0.38	0.37
	(0.17)	(0.12)	(0.11)	(0.28)	(0.27)	(0.27)
$E_t x_{5Y}{}^{Infl}$	0.10	0.04	0.24	2.52**	2.57**	2.44**
	(0.90)	(1.05)	(0.98)	(0.95)	(0.99)	(1.01)
$E_t x_{t+12}{}^{Unemp}$	-0.14	-0.21	-0.21	0.00	-0.04	-0.03
	(0.20)	(0.21)	(0.18)	(0.13)	(0.12)	(0.12)
$\bar{\pi}_t^{6m}$	-0.05			-0.24		
	(0.13)			(0.15)		
$\bar{u}_t^{6m}$	-0.10			0.02		
	(0.12)			(0.07)		
$\bar{i}_t^{6m}$	-0.10			-0.05*		
	(0.06)			(0.02)		
$\bar{\pi}_t^{9m}$		-0.03			-0.12	
		(0.14)			(0.12)	
$\bar{u}_t^{9m}$		-0.03			0.07	
		(0.12)			(0.08)	
$\bar{i}_t^{9m}$		-0.09			-0.04	
		(0.06)			(0.03)	
$\bar{\pi}_t^{12m}$			0.01			-0.06
			(0.11)			(0.12)
$\bar{u}_t^{12m}$			-0.03			0.07
			(0.10)			(0.07)
$\bar{i}_t^{12m}$			-0.09			-0.03
			(0.06)			(0.03)
$Constant$	0.81	1.08	0.60	-3.79**	-3.56**	-3.28*
	(2.27)	(2.82)	(2.63)	(1.49)	(1.69)	(1.76)
$Observations$	37	37	37	44	44	44
R^2	0.58	0.56	0.55	0.55	0.54	0.53
$Controls$	YES	YES	YES	YES	YES	YES
$Post\text{-}GFC$	NO	NO	NO	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Before 2005, we use the interest rate for the main refinancing operations. Furthermore, we include the five year inflation forecast $E_t x_{5Y}{}^{Infl}$ of the SPF from the ECB. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on CEPR, and a dummy that considers the Euro area sovereign debt crisis (May 2010 - June 2013). Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: **FED Board of Governors: Excluding GFC and COVID-19**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$	(4) $tone_t$	(5) $tone_t$	(6) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.15	0.14	0.13	0.07	0.19	0.21
	(0.18)	(0.17)	(0.18)	(0.23)	(0.22)	(0.26)
$E_t x_{10Y}{}^{Infl}$	0.97*	0.98*	1.16*	0.27	0.68	0.59
	(0.57)	(0.56)	(0.60)	(1.36)	(1.46)	(1.64)
$E_t x_{t+12}{}^{Unemp}$	0.05	-0.05	-0.12	-1.05***	-0.88***	-0.82***
	(0.37)	(0.36)	(0.39)	(0.26)	(0.23)	(0.27)
$\bar{\pi}_t^{6m}$	-0.01			0.22		
	(0.08)			(0.20)		
$\bar{u}_t^{6m}$	-0.06			0.30**		
	(0.04)			(0.13)		
$\bar{i}_t^{6m}$	0.04			-0.04		
	(0.08)			(0.07)		
$\bar{\pi}_t^{9m}$		-0.04			0.11	
		(0.08)			(0.15)	
$\bar{u}_t^{9m}$		-0.07			0.24*	
		(0.05)			(0.13)	
$\bar{i}_t^{9m}$		0.02			-0.04	
		(0.07)			(0.07)	
$\bar{\pi}_t^{12m}$			-0.02			0.03
			(0.09)			(0.12)
$\bar{u}_t^{12m}$			-0.03			0.10
			(0.06)			(0.16)
$\bar{i}_t^{12m}$			0.01			-0.01
			(0.07)			(0.08)
$Constant$	-1.73	-1.66	-1.56	0.17	-0.98	-1.20
	(1.40)	(1.37)	(1.34)	(2.30)	(2.45)	(3.02)
Obs	49	49	49	41	41	41
R^2	0.43	0.42	0.43	0.43	0.37	0.33
$Controls$	YES	YES	YES	YES	YES	YES
$Post\text{-}GFC$	NO	NO	NO	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Furthermore, we include the ten year inflation forecast $E_t x_{10Y}{}^{Infl}$ of the SPF from the Federal Reserve Bank of Philadelphia. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on NBER. We exclude the GFC (1 September 2008 - 31 December 2009) and the COVID-19 Pandemic (1 March 2020 onwards) from our sample. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: **ECB Executive Board: Excluding GFC and COVID-19**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$	(4) $tone_t$	(5) $tone_t$	(6) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.36 (0.40)	0.48 (0.33)	0.46 (0.29)	0.38 (0.26)	0.30 (0.25)	0.33 (0.26)
$E_t x_{5Y}{}^{Infl}$	0.72 (1.03)	0.79 (1.20)	0.66 (1.23)	3.09*** (0.90)	2.81** (1.03)	2.55** (1.06)
$E_t x_{t+12}{}^{Unemp}$	-0.21 (0.18)	-0.19 (0.19)	-0.26 (0.16)	-0.09 (0.40)	0.02 (0.37)	0.15 (0.34)
$\bar{\pi}_t^{6m}$	0.05 (0.22)			-0.32* (0.17)		
$\bar{u}_t^{6m}$	-0.12 (0.11)			0.19 (0.24)		
$\bar{i}_t^{6m}$	-0.08* (0.05)			-0.07** (0.03)		
$\bar{\pi}_t^{9m}$		-0.09 (0.27)			-0.16 (0.16)	
$\bar{u}_t^{9m}$		-0.07 (0.12)			0.16 (0.18)	
$\bar{i}_t^{9m}$		-0.07 (0.06)			-0.05** (0.02)	
$\bar{\pi}_t^{12m}$			-0.06 (0.19)			-0.10 (0.15)
$\bar{u}_t^{12m}$			-0.01 (0.13)			0.09 (0.11)
$\bar{i}_t^{12m}$			-0.08 (0.05)			-0.04 (0.03)
Constant	-2.01 (2.41)	-2.49 (2.85)	-1.98 (2.92)	-4.58*** (1.46)	-3.80* (1.86)	-3.38* (1.89)
Obs	32	32	32	41	41	41
R^2	0.67	0.65	0.65	0.59	0.56	0.54
Controls	YES	YES	YES	YES	YES	YES
Post-GFC	NO	NO	NO	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Before 2005, we use the interest rate for the main refinancing operations. Furthermore, we include the five year inflation forecast ($E_t x_{5Y}{}^{Infl}$) of the SPF from the ECB. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on CEPR, and a dummy that considers the Euro area sovereign debt crisis (May 2010 - June 2013). We exclude the GFC (1 September 2008 - 31 December 2009) and the COVID-19 Pandemic (1 March 2020 onwards) from our sample. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix to "FED and ECB Speeches:
How Mandates Influence Content and Tone Over Time"

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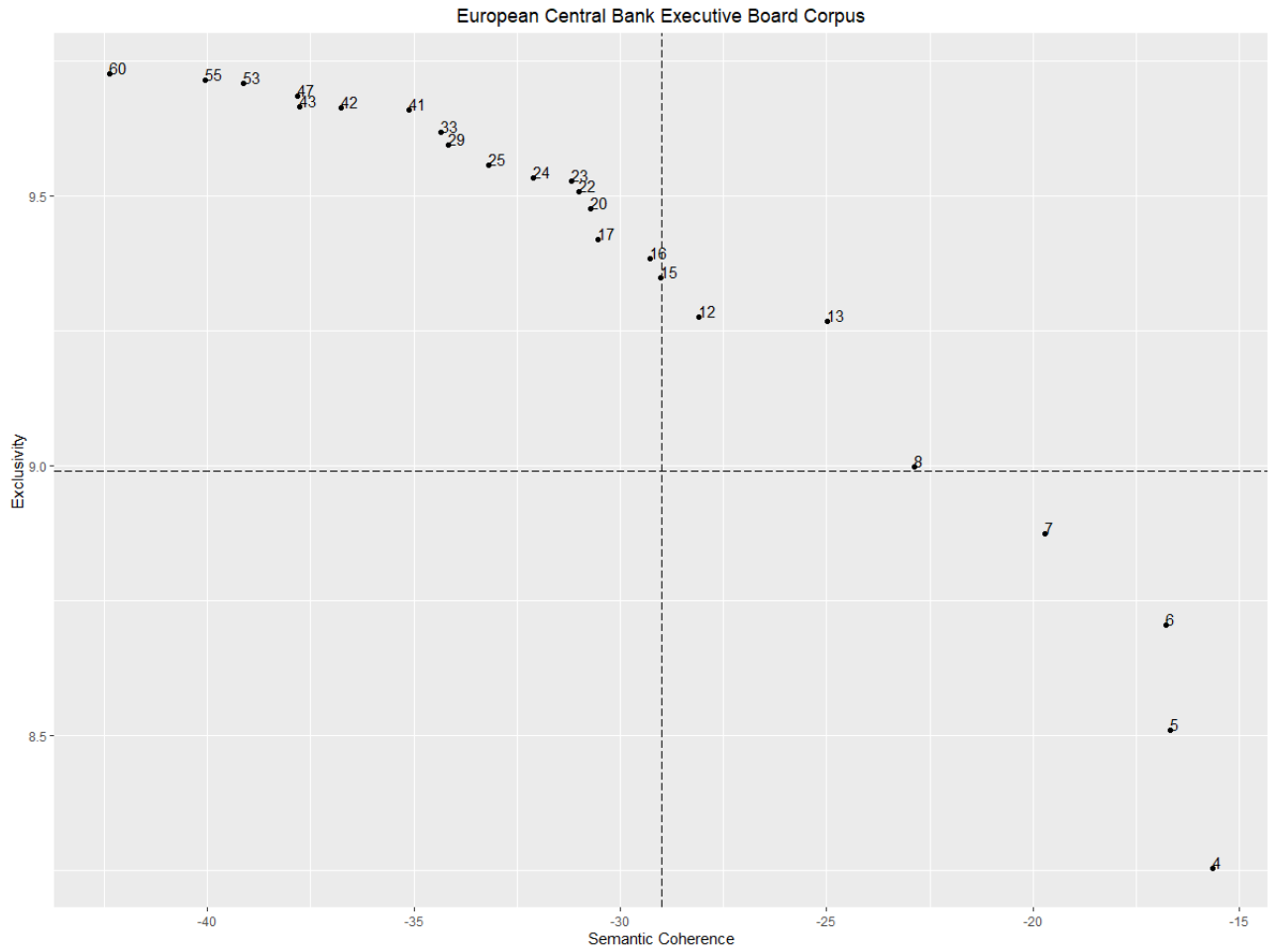
A Additional Figures

Figure A1: **Semantic Coherence and Exclusivity for the Board of Governors Corpus**
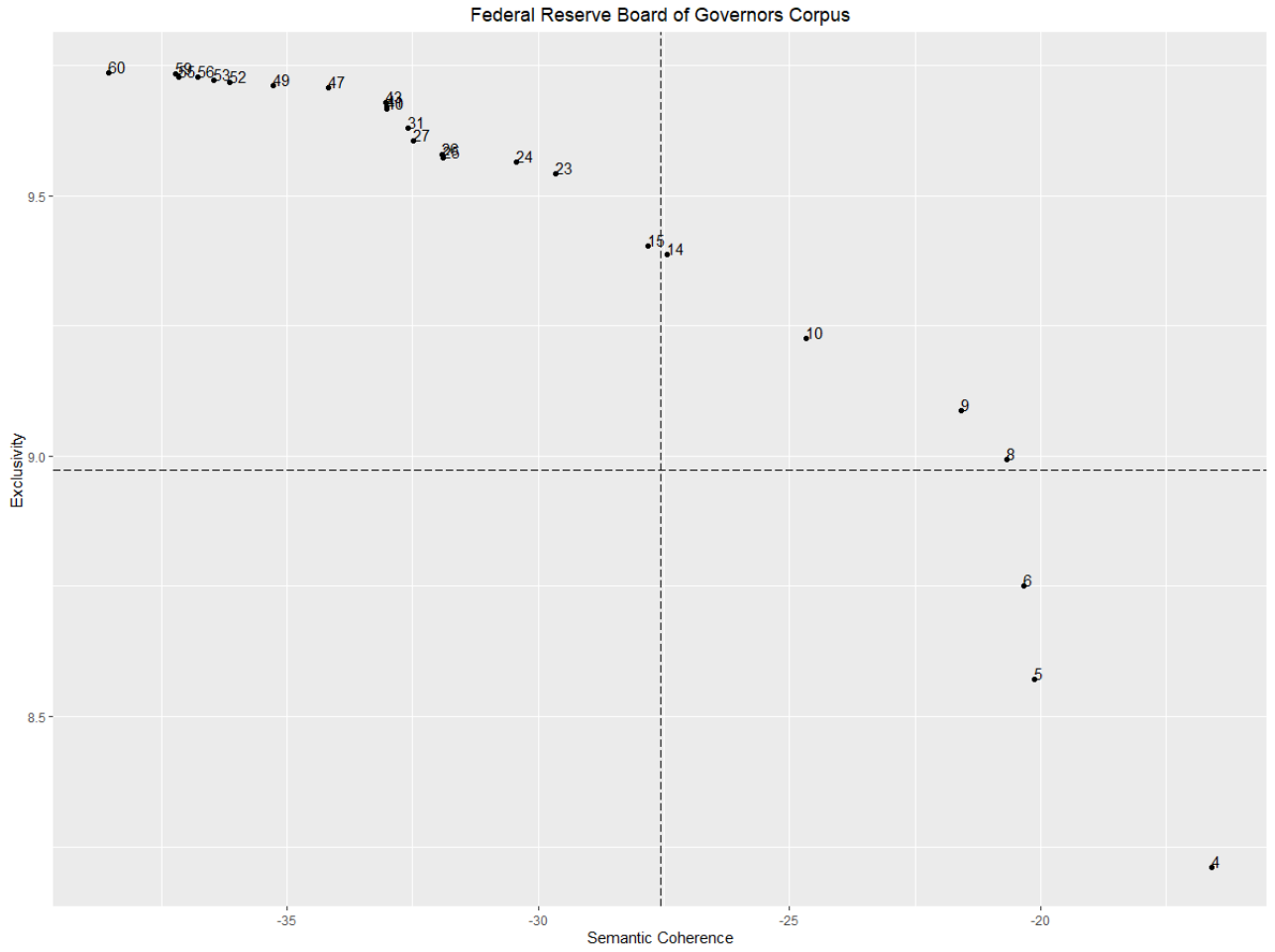

Note: This figure illustrates the trade-off between exclusivity and semantic coherence for the FED Board of Governors corpus. We estimate STM for $K \in \{4, ..., 60\}$ and remove all models strictly dominated in metrics. We focus on the topic numbers in the upper right corner and choose $K \in \{8, 9, 10\}$ as possible classifiers based on interpretability.

Figure A2: **Semantic Coherence and Exclusivity for the Executive Board Corpus**

European Central Bank Executive Board Corpus

Note: This figure illustrates the trade-off between exclusivity and semantic coherence for the ECB Executive Board corpus. We estimate STM for $K \in \{4, ..., 60\}$ and remove all models strictly dominated in metrics. We focus on the topic numbers in the upper right corner and choose $K \in \{12, 13\}$ as possible classifiers based on interpretability.

Figure A3: **Topic Ratios of FED Board of Governors during COVID-19 Pandemic**
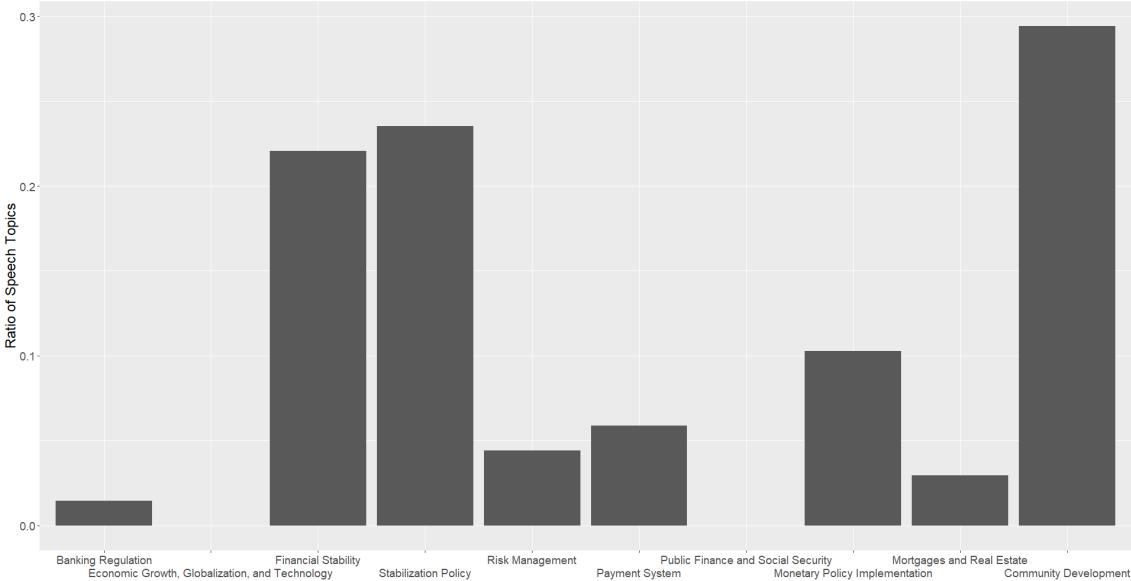

Note: This figure shows the ratio of speeches of each topic to the absolute number of speeches for the FED Board of Governors between 1 March 2020 and 31 March 2021. We define the beginning of the COVID-19 pandemic based on the announcement of the World Health Organization (2020). The overall number of speeches during this period is 68.

Figure A4: **Topic Ratios of ECB Executive Board during COVID-19 Pandemic**
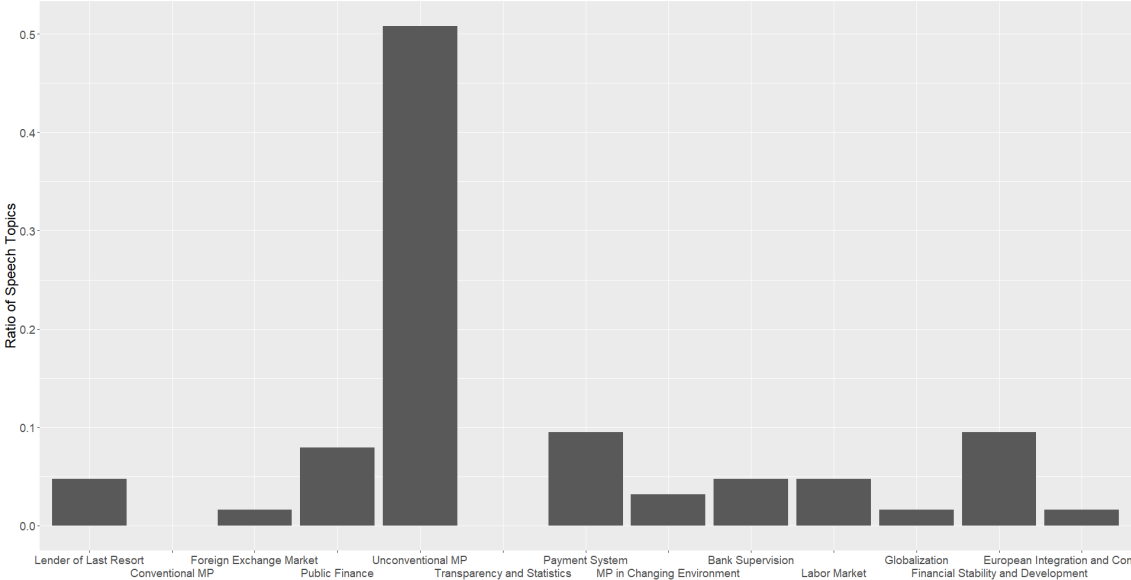
Note: This figure shows the ratio of speeches of each topic to the absolute number of speeches for the ECB Executive Board between 1 March 2020 and 31 December 2020. We define the beginning of the COVID-19 pandemic based on the announcement of the World Health Organization (2020). The overall number of speeches during this period is 63. "MP" stands for *Monetary Policy*.

Figure A5: **Robustness Check - Board of Governors (Exclude Crises)**
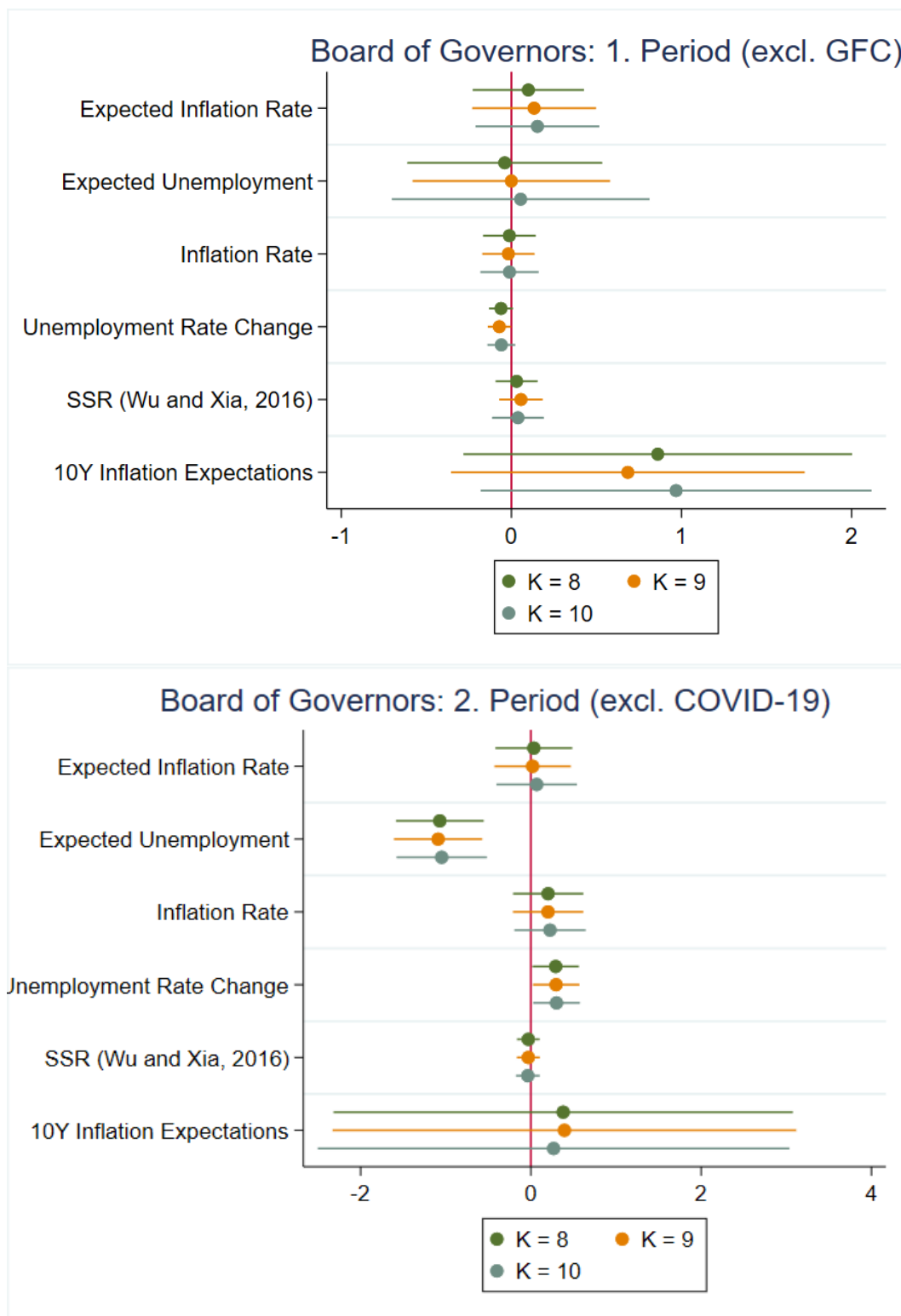
Note: The figures plot the regression coefficients for expected and current inflation and unemployment, the Short Shadow Rate (SSR) of Wu and Xia (2016), and the 10Y inflation expectations for $K \in \{8, 9, 10\}$. Each specification is the same as in table (7) for the FED. We use the 10Y forecasts for inflation from the SPF of the Federal Reserve Bank of Philadelphia.

Figure A6: **Robustness Check - Executive Board (Exclude Crises)**
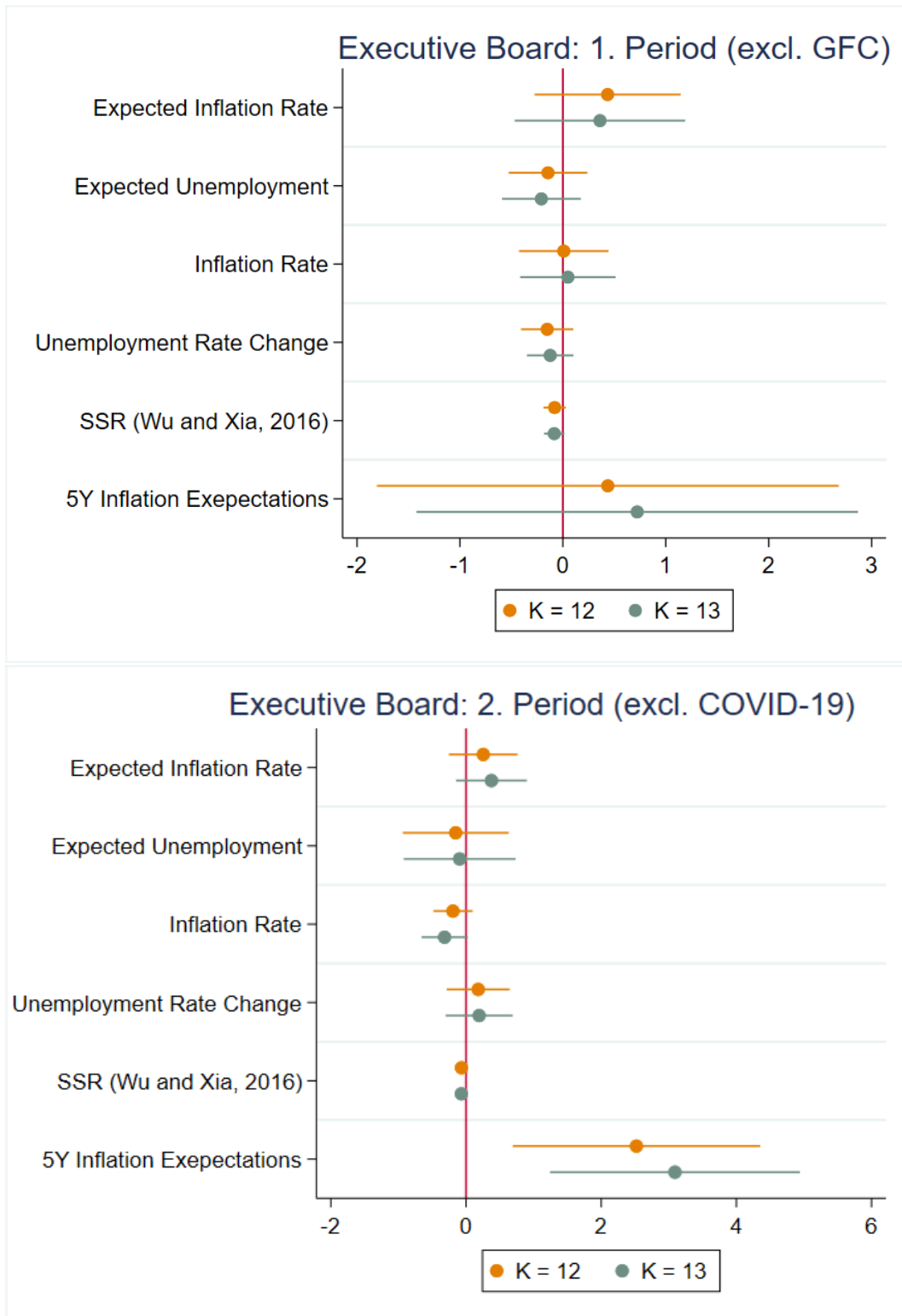
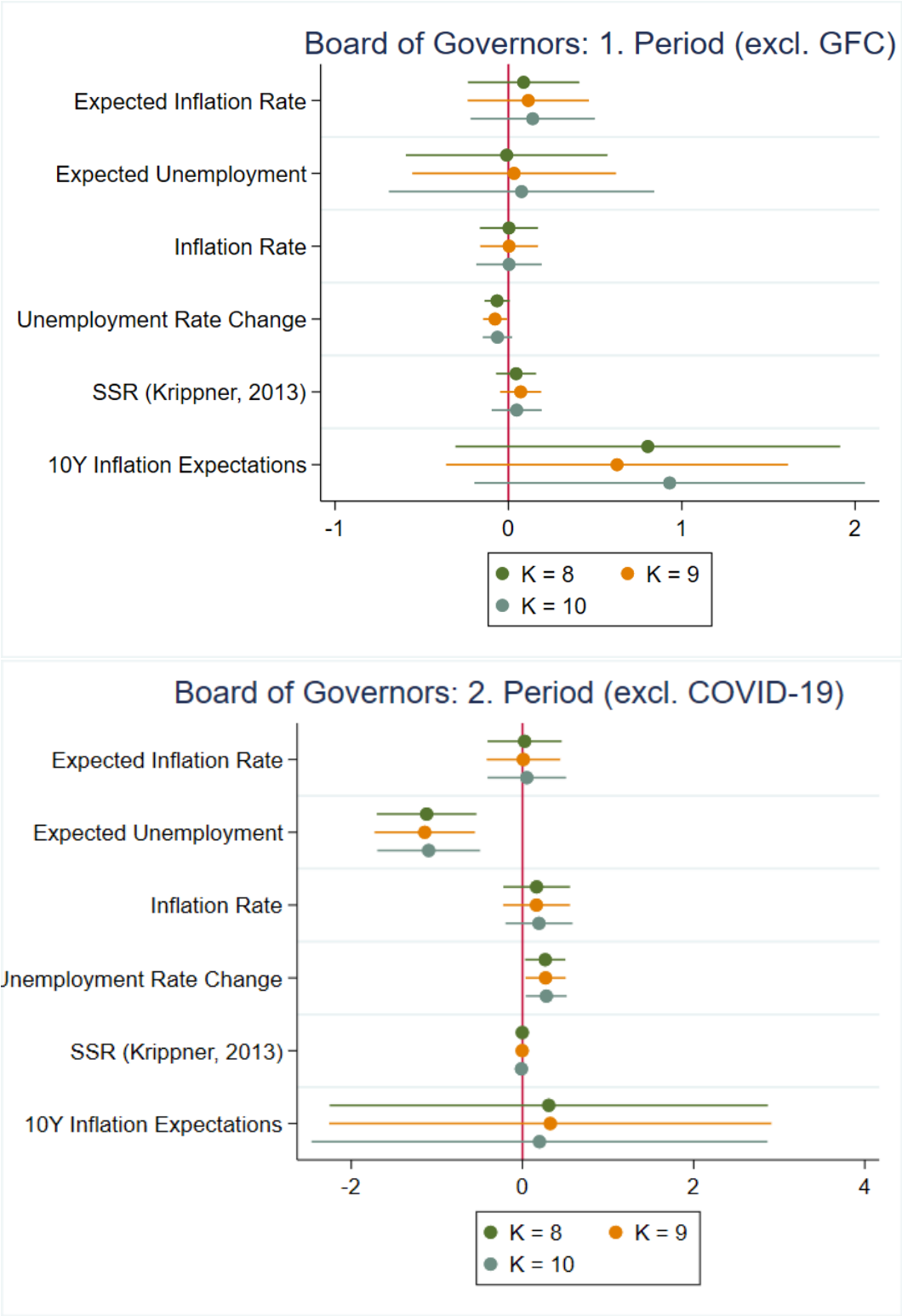**Note**: The figures plot the regression coefficients for expected and current inflation and unemployment, the Short Shadow Rate (SSR) of Wu and Xia (2016), and the 5Y inflation expectations for $K \in \{12, 13\}$. Each specification is the same as in table (8) for the ECB. We use the 5Y forecasts for inflation from the SPF of the ECB.

Figure A7: **Robustness Check - Board of Governors using Krippner (2013) (Exclude Crises)**

Note: The figures plot the regression coefficients for expected and current inflation and unemployment, the Short Shadow Rate (SSR) of Krippner (2013), and the 10Y inflation expectations for $K \in \{8, 9, 10\}$. Each specification is the same as in table (7) for the FED. We use the 10Y forecasts for inflation from the SPF of the Federal Reserve Bank of Philadelphia.

Figure A8: **Robustness Check - Executive Board using Krippner (2013) (Exclude Crises)**

Note: The figures plot the regression coefficients for expected and current inflation and unemployment, the Short Shadow Rate (SSR) of Krippner (2013), and the 5Y inflation expectations for $K \in \{12, 13\}$. Each specification is the same as in table (8) for the FED. We use the 5Y forecasts for inflation from the SPF of the ECB.

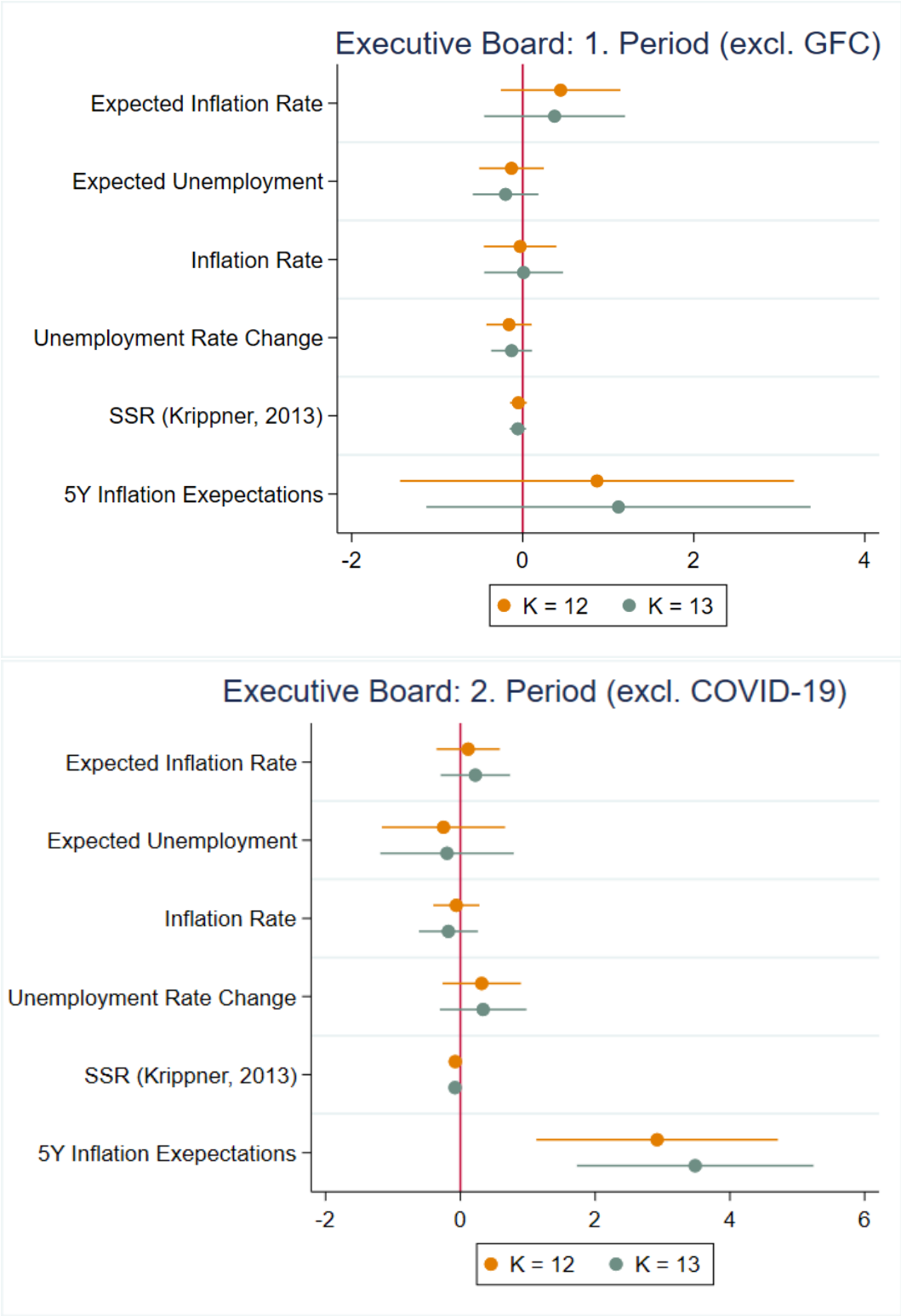Figure A9: **Robustness Check - Board of Governors with 5Y Inflation Forecasts (Exclude Crises)**

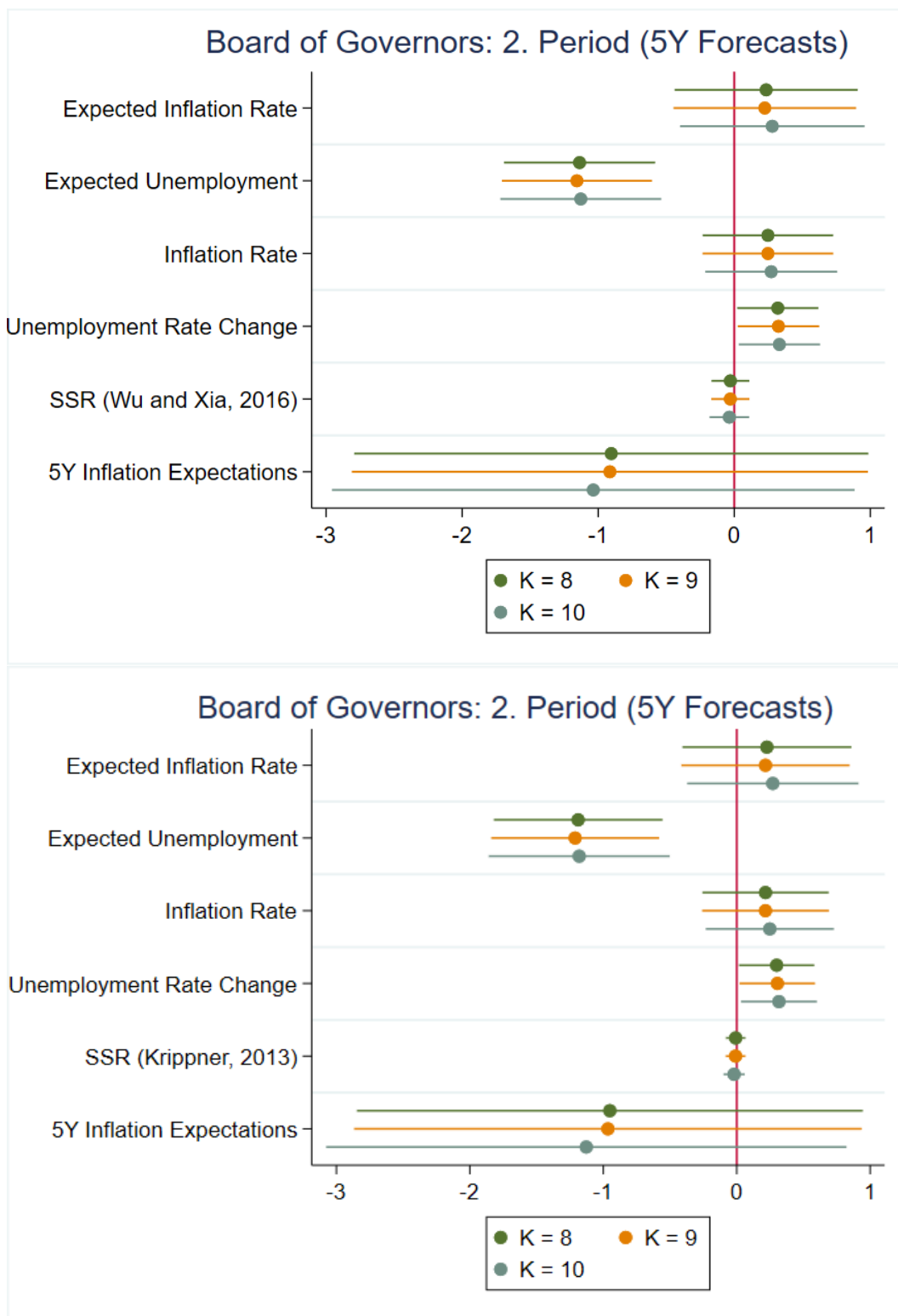**Note**: This figure plots the regression coefficients for expected and current inflation and unemployment, the Short Shadow Rate (SSR) of Wu and Xia (2016) or Krippner (2013), and the 5Y inflation expectations for $K \in \{8, 9, 10\}$. Each specification is the same as in table (A6) for the FED. We use the 5Y forecasts for inflation from the SPF of the Federal Reserve Bank of Philadelphia.

B   Additional Tables

Table A1: **Descriptive Statistics of Speeches**

CB	Number of Speeches	Words	Remove Stop Words	Stemming	Remove $TF = 1$
FED BoG	1824	1560801	1160597	922869	585054
ECB EB	2165	1770179	1305350	1069046	450683

Note: This table provides the number of speeches and the sum of all individual words per speech within the corpora, and how this number of words develops during the individual preprocessing steps. *TF* denotes Term Frequency.

Table A2: **Gamma Values of selected FED Speeches**

Date	Speaker	Gamma Value	Topic
1997-12-03	Alan Greenspan	0.60	2
2000-04-11	Alan Greenspan	0.57	2
2000-04-11	Alan Greenspan	0.57	2
2002-10-29	Alan Greenspan	0.63	2
2004-03-12	Alan Greenspan	0.48	2
2004-01-04	Roger W. Ferguson, Jr.	0.59	2
2004-03-30	Ben S. Bernanke	0.52	2
2006-08-31	Ben S. Bernanke	0.54	2
2003-09-24	Donald L. Kohn	0.89	4
2005-03-08	Ben S. Bernanke	0.95	4
2006-09-27	Randall S. Kroszner	0.47	4
2015-12-01	Lael Brainard	0.62	4
2016-10-17	Stanley Fischer	0.59	4
2016-07-31	Stanley Fischer	0.58	4
2018-05-31	Lael Brainard	0.78	4
2020-07-14	Lael Brainard	0.81	4
2020-10-06	Jerome Powell	0.78	4
2021-02-10	Jerome Powell	0.74	4
1999-01-15	Roger W. Ferguson, Jr.	0.45	8
2003-01-04	Edward M. Gramlich	0.82	8
2003-03-25	Ben S. Bernanke	0.91	8
2004-01-03	Ben S. Bernanke	0.97	8
2004-01-14	Ben S. Bernanke	0.83	8
2018-08-24	Jerome Powell	0.58	8
2019-11-12	Richard H. Clarida	0.76	8
2020-08-27	Jerome Powell	0.67	8
2020-08-31	Richard H. Clarida	0.89	8
2021-01-13	Richard H. Clarida	0.83	8
2007-09-24	Ben S. Bernanke	0.80	10
2020-10-15	Lael Brainard	0.72	10
2020-11-10	Lael Brainard	0.74	10
2020-12-01	Lael Brainard	0.80	10
2020-12-18	Lael Brainard	0.38	10

Note: We provide the date, speaker, gamma value, and the topic affiliation of speeches that we list as examples for the respective topic in section 4.1. The gamma value is the probability that a document generates from a topic. For information about each topic, see the text.

Table A3: **Gamma Values of selected ECB Speeches**

Date	Speaker	Gamma Value	Topic
2001-02-21	Otmar Issing	0.69	2
2001-06-04	Willem F. Duisenberg	0.71	2
2001-12-17	Willem F. Duisenberg	0.75	2
2003-02-17	Willem F. Duisenberg	0.68	2
2005-06-03	Lucas Papademos	0.68	2
2005-04-26	Lucas Papademos	0.74	2
2015-06-30	Peter Praet	0.76	5
2015-12-11	Peter Praet	0.86	5
2018-01-29	Peter Praet	0.90	5
2018-10-10	Yves Mersch	0.97	5
2020-06-10	Isabel Schnabel	0.71	5
2020-08-27	Philip R. Lane	0.85	5
2020-10-06	Philip R. Lane	0.91	5
2020-11-11	Christine Lagarde	0.72	5
2002-03-26	Otmar Issing	0.72	8
2002-08-30	Otmar Issing	0.9	8
2005-06-03	Jean-Claude Trichet	0.78	8
2006-11-10	Lucas Papademos	0.93	8
2007-09-21	Lucas Papademos	0.84	8
2007-11-26	Jürgen Stark	0.91	8
2008-06-11	Jürgen Stark	0.87	8
2005-10-10	Jean-Claude Trichet	0.91	10
2005-11-10	Jean-Claude Trichet	0.98	10
2006-05-22	Jean-Claude Trichet	0.96	10
2007-06-04	Jean-Claude Trichet	0.90	10
2008-02-15	Jean-Claude Trichet	0.92	10
2014-09-26	Yves Mersch	0.88	10
2016-11-30	Mario Draghi	0.85	10
2017-09-22	Mario Draghi	0.81	10

Note: We provide the date, speaker, gamma value, and the topic affiliation of exemplary speeches for the respective topics in section 4.2. The gamma value is the probability that a document generates from a topic. For information about each topic, see the text.

Table A4: **FED Board of Governors: Full Sample Estimation**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$
$E_t x_{t+12}^{Infl}$	0.12	0.14	0.13
	(0.11)	(0.11)	(0.11)
$E_t x_{10Y}^{Infl}$	0.16	0.14	0.20
	(0.34)	(0.35)	(0.35)
$E_t x_{t+12}^{Unemp}$	-0.14***	-0.11***	-0.11***
	(0.04)	(0.04)	(0.04)
$\bar{\pi}_t^{6m}$	0.02		
	(0.06)		
$\bar{u}_t^{6m}$	0.01**		
	(0.00)		
$\bar{i}_t^{6m}$	-0.00		
	(0.02)		
$\bar{\pi}_t^{9m}$		-0.01	
		(0.05)	
$\bar{u}_t^{9m}$		0.01	
		(0.01)	
$\bar{i}_t^{9m}$		-0.01	
		(0.02)	
$\bar{\pi}_t^{12m}$			-0.02
			(0.05)
$\bar{u}_t^{12m}$			0.02**
			(0.01)
$\bar{i}_t^{12m}$			-0.01
			(0.02)
Constant	-0.04	-0.07	-0.18
	(0.72)	(0.73)	(0.74)
Obs	99	99	99
R^2	0.28	0.28	0.28
Controls	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Furthermore, we include the ten year inflation forecast $E_t x_{10Y}^{Infl}$ of the SPF from the Federal Reserve Bank of Philadelphia. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}^{Infl}$, $E_t x_{t+12}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on NBER. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: **ECB Executive Board: Full Sample Estimation**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.30** (0.14)	0.24** (0.12)	0.23** (0.11)
$E_t x_{5Y}{}^{Infl}$	1.28*** (0.47)	1.34*** (0.49)	1.36*** (0.50)
$E_t x_{t+12}{}^{Unemp}$	-0.14* (0.08)	-0.16** (0.08)	-0.16** (0.08)
$\bar{\pi}_t^{6m}$	-0.14* (0.09)		
$\bar{u}_t^{6m}$	-0.01 (0.04)		
$\bar{i}_t^{6m}$	-0.02** (0.01)		
$\bar{\pi}_t^{9m}$		-0.08 (0.08)	
$\bar{u}_t^{9m}$		0.01 (0.04)	
$\bar{i}_t^{9m}$		-0.02** (0.01)	
$\bar{\pi}_t^{12m}$			-0.04 (0.08)
$\bar{u}_t^{12m}$			0.01 (0.04)
$\bar{i}_t^{12m}$			-0.02** (0.01)
Constant	-1.81** (0.71)	-1.83** (0.75)	-1.84** (0.78)
Obs	81	81	81
R^2	0.50	0.49	0.49
Controls	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. Before 2005, we use the interest rate for the main refinancing operations. Furthermore, we include the five year inflation forecast ($E_t x_{5Y}{}^{Infl}$) of the SPF from the ECB. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on CEPR, and a dummy that considers the Euro area sovereign debt crisis (May 2010 - June 2013). Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: **FED Board of Governors: Using 5Y Inflation Forecasts**

	(1) $tone_t$	(2) $tone_t$	(3) $tone_t$	(4) $tone_t$	(5) $tone_t$	(6) $tone_t$
$E_t x_{t+12}{}^{Infl}$	0.28	0.40	0.40	0.27	0.38	0.38
	(0.33)	(0.38)	(0.39)	(0.31)	(0.37)	(0.38)
$E_t x_{5Y}{}^{Infl}$	-1.04	-0.70	-0.66	-1.13	-0.86	-0.64
	(0.94)	(0.88)	(0.94)	(0.95)	(0.88)	(0.91)
$E_t x_{t+12}{}^{Unemp}$	-1.13***	-0.93***	-0.89***	-1.18***	-1.05***	-0.92***
	(0.30)	(0.26)	(0.31)	(0.33)	(0.29)	(0.32)
$\bar{\pi}_t^{6m}$	0.27			0.25		
	(0.24)			(0.23)		
$\bar{u}_t^{6m}$	0.33**			0.32**		
	(0.15)			(0.14)		
$\bar{\pi}_t^{9m}$		0.13			0.09	
		(0.15)			(0.14)	
$\bar{u}_t^{9m}$		0.27*			0.24**	
		(0.15)			(0.11)	
$\bar{\pi}_t^{12m}$			0.07			0.03
			(0.15)			(0.14)
$\bar{u}_t^{12m}$			0.16			0.10
			(0.18)			(0.14)
$\bar{i}_t^{6m,WX}$	-0.04					
	(0.07)					
$\bar{i}_t^{9m,WX}$		-0.04				
		(0.07)				
$\bar{i}_t^{12m,WX}$			-0.02			
			(0.08)			
$\bar{i}_t^{6m,K}$				-0.02		
				(0.04)		
$\bar{i}_t^{9m,K}$					-0.01	
					(0.04)	
$\bar{i}_t^{12m,K}$						0.01
						(0.04)
$Constant$	2.24	1.24	0.85	2.36	1.34	0.63
	(1.94)	(1.58)	(1.70)	(2.04)	(1.57)	(1.71)
Obs	41	41	41	39	39	39
R^2	0.45	0.37	0.33	0.44	0.37	0.33
$Controls$	YES	YES	YES	YES	YES	YES
$Post\text{-}GFC$	YES	YES	YES	YES	YES	YES

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) (Krippner (2013)) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. WX (K) refers to the SSR of Wu and Xia (2016) (Krippner (2013)). Furthermore, we include the five year inflation forecast $E_t x_{5Y}{}^{Infl}$ of the SPF from the Federal Reserve Bank of Philadelphia instead of the ten year forecasts. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on NBER. We exclude the COVID-19 Pandemic (1 March 2020 onwards) from our sample. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: **FED Board of Governors: Reduced Sample Estimation (2005-2016)**

| | (1) | (2) | (3) | (4) | (5) | (6) |
	$tone_t$	$tone_t$	$tone_t$	$tone_t$	$tone_t$	$tone_t$
$E_t x_{t+12}{}^{Infl}$	-0.07	-0.07	-0.07	-0.12	-0.08	-0.06
	(0.13)	(0.14)	(0.13)	(0.18)	(0.18)	(0.19)
$E_t x_{10Y}{}^{Infl}$	-0.12	0.14	0.11	-0.11	0.14	0.06
	(0.71)	(0.71)	(0.70)	(0.79)	(0.74)	(0.76)
$E_t x_{t+12}{}^{Unemp}$	-0.48**	-0.42**	-0.46**	-0.63***	-0.60***	-0.61**
	(0.19)	(0.17)	(0.20)	(0.22)	(0.21)	(0.22)
$\bar{\pi}_t^{6m}$	0.05			0.06		
	(0.08)			(0.10)		
$\bar{u}_t^{6m}$	0.07			0.08		
	(0.06)			(0.06)		
$\bar{i}_t^{6m}$	-0.02			-0.02		
	(0.03)			(0.03)		
$\bar{\pi}_t^{9m}$		-0.02			-0.03	
		(0.07)			(0.08)	
$\bar{u}_t^{9m}$		0.02			0.06	
		(0.07)			(0.10)	
$\bar{i}_t^{9m}$		-0.02			-0.02	
		(0.03)			(0.04)	
$\bar{\pi}_t^{12m}$			-0.01			-0.03
			(0.07)			(0.07)
$\bar{u}_t^{12m}$			0.05			0.06
			(0.07)			(0.08)
$\bar{i}_t^{12m}$			-0.03			-0.02
			(0.04)			(0.04)
Constant	0.54	-0.15	-0.06	0.52	-0.17	-0.05
	(1.45)	(1.37)	(1.36)	(1.61)	(1.44)	(1.44)
Obs	48	48	48	43	43	43
R^2	0.26	0.25	0.26	0.23	0.24	0.24
Controls	YES	YES	YES	YES	YES	YES
GFC	YES	YES	YES	NO	NO	NO

Note: We regress our variables on our sentiment indicator $tone_t$ from equation (5). Our sample is constrained to the period January 2005 until December 2016 to remove structural breaks which we identify using the approach of Zeileis et al. (2003). $\bar{\pi}_t^{Xm}$, $\bar{u}_t^{Xm}$, and $\bar{i}_t^{Xm}$ denote the average of inflation, unemployment, and the Wu and Xia (2016) (Krippner (2013)) shadow interest rate in the X months prior to the release of the forecast in time t, respectively. WX (K) refers to the SSR of Wu and Xia (2016) (Krippner (2013)). Furthermore, we include the five year inflation forecast $E_t x_{5Y}{}^{Infl}$ of the SPF from the Federal Reserve Bank of Philadelphia instead of the ten year forecasts. All specifications include a lag of the dependent variable. Additional control variables are the lags of $E_t x_{t+12}{}^{Infl}$, $E_t x_{t+12}{}^{Unemp}$, and a dummy variable that equals one if the economy is in a recession based on NBER. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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