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JEL Classification: E03, E50, E61

Keywords: Federal Reserve, Financial stability, communications, monetary policy

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September 2022

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1 Introduction

This paper studies the informational content of speeches of Federal Reserve officials with respect to financial stability concerns and how the latter affect its monetary policy decisions. This issue is important as, although the Federal Reserve does not have an explicit financial stability objective that extends beyond its supervisory responsibilities, a narrow interpretation of the dual mandate, i.e. ignoring any financial stability risks beyond their direct effect on inflation and employment "does not seem credible" (Kashyap and Siegert, 2020). In 2018, the Federal Reserve Board launched a biannual Financial Stability Report (FSR), which explicitly monitors the resilience of the US financial system. While rich in analysis, the FSR does not provide a discussion of the policy implications of financial stability for the Fed or other authorities (Kashyap and Siegert, 2020). The lack of a formal communication strategy on these implications is also recognized within the Federal Open Market Committee (FOMC):

> *Some participants remarked that, because financial stability risks are a consideration for achieving the Committee's dual mandate, a clear communications strategy would be needed to convey the Committee's assessments of financial vulnerabilities and their potential implications for the monetary policy outlook.*
>
> — FOMC minutes, January 2020

However, even in the absence of an institutional communication strategy, FOMC members[1] might still express their view on financial stability risks and policy consequences through public remarks. Therefore, the goal of this paper is to assess what Fed officials' speeches (1997-2018) reveal about their financial stability concerns and whether these concerns systematically correlate with monetary policy. In other words, our analysis aims to analyze past Fed decisions, linking policy actions to the importance Fed officials give to financial stability issues in their speeches. The advantage of analyzing speeches is that they give the speaker discretion over the content, and, to some extent, reflect debates and opinions that have also been expressed in FOMC meetings and have, therefore, guided policy (Bernanke, 2015).

We find that when Fed officials communicate more about financial stability, the Federal Reserve provides accommodation beyond what the state of the economy suggests. We further assess whether the institutional role of the speaker matters and find that speeches of Federal Reserve Bank (FRB) presidents contain a stronger signal for this relationship than speeches of Fed Chairs and those of other members of the Board of Governors (Governors).

[1] Note that throughout the paper, "FOMC" refers to all Board members and all Federal Reserve Bank presidents (not only those with voting rights).

To investigate the role of financial stability concerns for monetary policy, we consider the big picture of how financial stability considerations are communicated and dealt with by looking at three typical dimensions of a central bank policy strategy: the objective, the analysis of developments and the policy response.[2] The "objective" dimension, which we refer to as Financial Stability (FS), relates to communication about excessive risk-taking behavior or vulnerabilities in financial markets. Note that, unlike price stability, financial stability is not quantifiable with a single variable (or a simple or weighted average of many variables). The "analysis" dimension, which we refer to as Financial Conditions (FC), pertains to communication about financial and banking developments that are also part of the monetary policy strategy to monitor the economy and assess risks to the fulfillment of the dual mandate. The assessment of these conditions is also part of a typical FSR. In the analysis dimension, we also include the monitoring of the housing market, which could be part of financial conditions but, given its prominence in the US economy, we treat it as a separate topic. Finally, the "policy dimension", which we refer to as Supervision and Regulation (S&R), relates to the supervisory and regulatory measures taken by the Fed, alone or in cooperation with other agencies, to mitigate the risks and consequences of financial instabilities. We refer to these four topics together as the "financial-related" topics.

To quantify Fed communication we compute two speech-based indicators using a combination of machine learning and dictionary methods. First, we classify each speech into different economic and financial-related topics and calculate *topic proportions*: the share of a speech dedicated to a specific topic. For the period 1997-2018, we identify 12 topics: Economy, Monetary Policy, Financial Stability, Supervision and Regulation, Financial Conditions, Housing, International, Fiscal, Financial Risk Management, Community, Research and Payments. Second, we calculate a *tone indicator* for finance-related topics based on a dictionary of positive and negative words tailored to a financial stability context, taken from Correa et al. (2021).

Overall, we observe that FRB presidents gave more speeches than Governors around and after the global financial crisis. Moreover, FRB presidents exhibit more variation in the topic proportions of their speeches and devote a larger share of them to the economic outlook and monetary policy compared with Governors. Only during the financial crisis do we observe that the speeches of FRB presidents become more balanced in terms of topic shares, with the financial-related topics gaining in importance. In the aftermath of the financial crisis, FRB presidents move back to more intensive communication on monetary policy, reflecting their concerns about

[2] A parallel can be drawn in this respect with the objective of price stability, and the related economic analysis and monetary policy decision.

unconventional tools, exit strategies, and a desire for normalization. These differences likely reflect the institutional design and different responsibilities of FRB presidents versus Governors.

To assess the relevance of financial stability communication for monetary policy decisions, we include our speech-based indicators in a forward-looking Taylor rule alongside Greenbook inflation and output gap forecasts, estimated at the frequency of FOMC meetings. Our results for the period before the global financial crisis, 1997-2007, show that these indicators are relevant explanatory variables for policy changes, providing additional information to what is captured by the Fed's internal forecasts of output gap and inflation. We find that, a longer speaking time (higher topic proportion) or a more negative tone on Financial Conditions, Financial Stability and Supervision and Regulation correlate with a more accommodating monetary policy stance, while communication on Housing correlates with a tighter policy stance. The effects are economically sizeable: a one percentage point increase in the Financial Stability topic proportion is associated, on average, with a decrease in the Federal Funds Rate of around five basis points on impact and 40 basis points in the long run. Importantly, the results are robust to the inclusion of standard financial indicators based on market data, such as the VIX, implying that our speech-based measures provide additional information.

In the Taylor rule on the full available sample, 1997 to 2016 (limited by the public availability of the Greenbook forecasts), we do not find that the financial stability speech-based indicators convey information about the monetary policy stance. We subsequently show that this result is driven by the post-2007 sample.

By incorporating information that reflects the importance Fed officials give to financial stability issues, we show that financial stability concerns help to explain the Fed's monetary policy stance before the global financial crisis. Our results suggest that the Fed acted to "clean up" or "mitigate" the damage rather than to "lean" against financial imbalances. Interestingly, we uncover a "leaning against the wind" stance when we look at housing market concerns.

Finally, we find that a stronger signal on the likely direction of monetary policy is conveyed by the speeches of FRB presidents than those of the Governors and Fed Chair. Further, it matters *how many* and *how much* FRB presidents speak on the Financial Stability topic. That is, when more FRB presidents speak more than usual about financial stability, monetary policy is more accommodative. When we analyze subgroups of FRB presidents, for instance FRB presidents with or without FOMC voting rights, we do not find results that differ markedly from the full set of FRB presidents.

Our study relates to several strands of the literature. First, it contributes to understanding the role and informational content of central bank communication (see Blinder et al. (2008) for a review) and more closely to the literature studying central bank communication outside of regular meeting days, i.e. in the form of speeches or Congress/Parliament hearings (see Kohn and Sack (2004), Kliesen et al. (2019), Neuhierl and Weber (2019), Ehrmann et al. (2022) for the Fed, Ehrmann and Fratzscher (2007) and Born et al. (2014) for several central banks, Ehrmann et al. (2014), Gertler and Horvath (2018), Tillmann and Walter (2019), Leombroni et al. (2021) and Istrefi et al. (2022) for the ECB, among others). We contribute to this literature by showing that speeches given by FOMC members, and FRB presidents in particular, carry information that is systematically related to the Fed's policy decisions. Our findings highlight differences in communication patterns between Governors and FRB presidents and the Fed's institutional framework. By showing that the speaker matters, we also contribute to the literature of decision-making in committees (Blinder, 2007; Riboni and Ruge-Murcia, 2010; Ehrmann and Fratzscher, 2007; Swank et al., 2008; Bordo and Istrefi, 2018; Malmendier et al., 2021).

Moreover, our paper contributes to the literature that studies the role of financial (in)stability concerns for monetary policy (see Adrian and Liang (2018) for an extensive survey). A strand of this literature employs augmented Taylor rules with prices of particular assets or financial indicators (Bernanke and Gertler, 2000, 2001; Cecchetti et al., 2000; Fuhrer and Tootell, 2008; Schmeling and Wagner, 2019; Filardo et al., 2022). A recent strand uses text-based measures to investigate the relationship between financial stability and monetary policy (Friedrich et al., 2019; Wischnewsky et al., 2021; Peek et al., 2016; Dybowski and Kempa, 2020).[3] Unlike existing studies, we highlight multidimensional aspects of communication about financial stability by building several speech indicators (topic proportion and tone for different speaking groups within the FOMC) on Financial Conditions, Housing, Financial Stability, and Supervision and Regulation. We show that our speech-based measures convey information about the Fed's monetary policy beyond market-based financial indicators, like the VIX or the Goldman Sachs US Financial Conditions Index (GSFCI).

More generally, our paper also relates to the literature that investigates text in economics (Tetlock, 2007; Tetlock et al., 2008; Loughran and McDonald, 2011; Baker et al., 2016; Caldara and

[3]Whereas we analyze speeches, these papers have looked at other forms of communication. For instance, Friedrich et al. (2019) look at the mandates, regulations, and monetary policy statements of several central banks to construct a financial stability orientation index. Peek et al. (2016) look at FOMC meeting transcripts to capture the intensity of financial instability concerns and Wischnewsky et al. (2021) build a tone measure of financial stability from the semiannual Congressional hearings of Fed Chairs. Dybowski and Kempa (2020) build a financial stability topic indicator from the ECB's monetary policy statements and find no evidence for financial stability considerations influencing ECB interest rate decisions either before or after the financial crisis.

Iacoviello, 2022). Work related to central bank communication, among others, includes Lucca and Trebbi (2011); Schonhardt-Bailey (2013); Hansen and McMahon (2016); Hansen et al. (2018); Acosta and Meade (2015); Hubert and Labondance (2021); Ehrmann et al. (2022); Correa et al. (2021); Gorodnichenko et al. (2021).[4] An overview of methods for analyzing text and a survey of applications in economics is provided in Gentzkow et al. (2019).

The paper is organized as follows. Section 2 describes our dataset and the methodology used to construct our topic proportion and tone measures and provides insights into their variation over time and compares them with standard financial indicators. In Section 3, we show the main results based on forward-looking Taylor rule regressions, discuss some of the potential channels behind our findings and describe robustness exercises. Section 4 concludes.

2 Speech communication measures and their dynamics over time

2.1 Fed Speeches

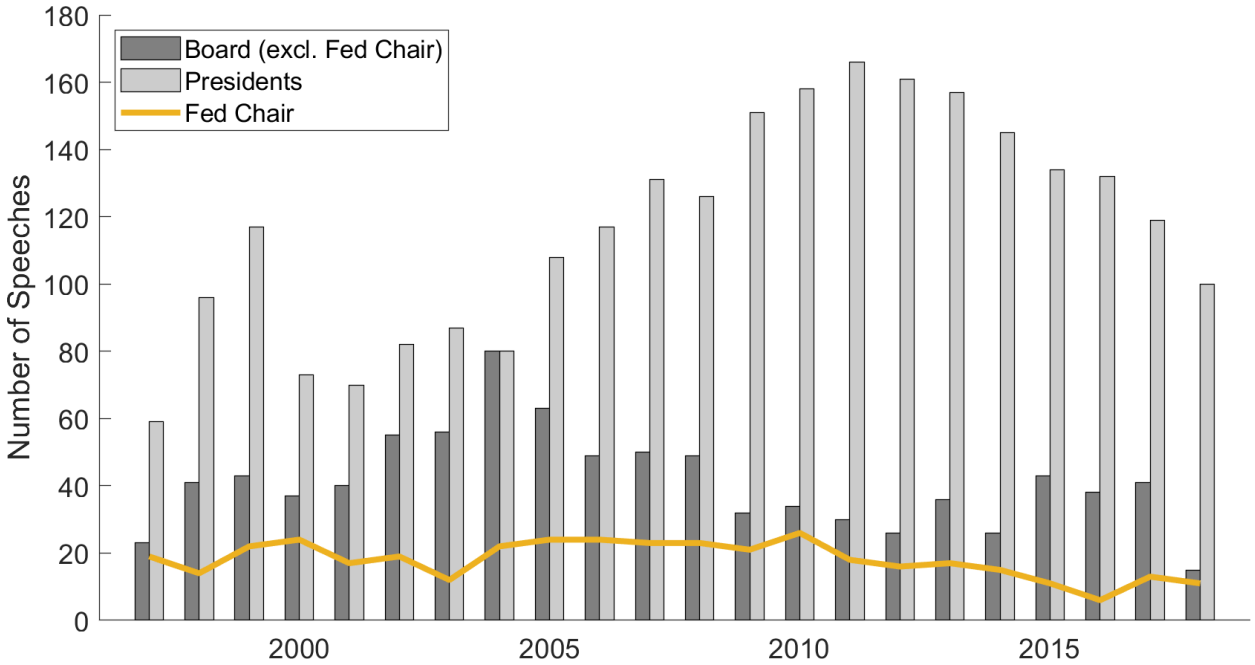
There are several reasons why speeches given by members of the FOMC may contain useful information. First, compared with other forms of Fed communication, speeches provide real-time publicly accessible information on a variety of topics. In contrast to FOMC policy statements and biannual testimonies of the Federal Reserve Chair to the Congress, Fed speeches allow for more discretion on the side of the speaker and cover a broader range of topics with time-varying intensity. Second, due to the degrees of freedom in their format and the greater variety of speakers, speeches reflect to a greater extent the diversity of opinions expressed within the Fed, both in the cross-section of Fed officials and over time. In Bernanke's (2015) words, each FOMC participant gets only a few minutes to express their policy views during the meeting and one can think of speeches as a continuation of the FOMC debate in other venues. This is in line with the attention that Fed watchers pay to speeches. Moreover, speeches are often used to initiate debates, to strategically communicate the speaker's opinion, or to influence both markets and their colleagues' expectations before FOMC meetings (Ehrmann et al., 2022). Speeches may therefore reveal information about considerations not reported in other standard forms of Fed communication that may nonetheless have influenced policy.

Our dataset consists of publicly accessible speeches given by the Chair of the Federal Reserve (Fed Chair), the other members of the Board of Governors (Governors) and the presidents of the

[4] Ehrmann et al. (2022), Malmendier et al. (2021) and van Dieijen and Lumsdaine (2019) have looked at Fed speeches in other contexts, not considering financial stability implications for monetary policy.

12 Federal Reserve Banks (FRB presidents). These speeches are available from the website of the Federal Reserve Board and the respective websites of the Federal Reserve Banks. For each speech, we observe and record the text of the speech, its title, the speaker, and the date the speech was given. Our data sample ranges from January 1997 to December 2018 and consists of a total of 3881 speeches. For the rest of the paper, we will refer to the set of all speeches as the corpus.

Figure 1: Fed speeches by type of speaker, 1997-2018



Note: The figure shows the total of number of speeches per year. Speeches of Dallas Fed presidents only start in January 2004.

Figure 1 shows the number of speeches over time, grouped into the speeches of the four Fed Chairs (Alan Greenspan, Ben S. Bernanke, Janet L. Yellen, and Jerome H. Powell), 24 Governors and 35 different FRB presidents who served from 1997 to 2018. We observe that Fed Chairs have given a fairly constant number of speeches over time. The same holds for Governors, although the number of speeches per year varies more than for the Fed Chair and declined during the Zero Lower Bound (ZLB) period. Part of this decline could be due to many unfilled Board seats since 2010 — out of a seven-member Board, the number of Board members has been as low as three (counting the Fed Chair). Another reason could be a more cautious communication policy as the contemporaneous decline in Fed Chair speeches suggests.

FRB presidents, on the other hand, were increasingly vocal during the financial crisis and the ZLB period. Roughly with the onset of policy normalization, the number of speeches by FRB presidents started to fall and reached pre-crisis levels in 2018. Part of the variation in the number of speeches over time could also relate to speaker fixed effects, i.e. to the personality of

certain FOMC members. For instance, some FRB presidents communicated more than their peers through speeches, having an impact on the total number of speeches.

2.2 Topic Modeling

To convert the raw text from Fed speeches into meaningful quantities that we can analyze, we combine elements from unsupervised machine learning with dictionary approaches.[5] Our aim is to classify each speech into different topics and study the variation in these topics over time.

We start by pre-processing the corpus of speeches: we make all words lower case, remove punctuation and numbers, remove stop words, such as "the", "and" and "a" and create word collocations (of up to three words); for instance, the term "annual stress test" is represented as "annual", "stress", "test" and "annual.stress.test". Next, we prune, i.e. we only retain words that occur in at least ten speeches and word collocations that occur in at least five speeches.

In a second step, we estimate a topic model based on a Latent Dirichlet Allocation (LDA, Blei et al. (2003)), which is an unsupervised learning algorithm that clusters terms according to their co-occurrence across speeches. The input required by the LDA algorithm is a corpus and a pre-specified number of clusters C. The output is a list of words for each cluster and a series of proportions that express the share of speech d that is captured by terms in topic k, denoted by $\{\theta_k\}_{d=1}^{D} \in [0,1]$, for $c = 1, ..., C$, where D denotes the total number of speeches and c is the cluster index. In the literature, the choice of the number of clusters varies considerably. As a general guideline, the number should be an increasing function of the number of documents, their size and the breadth of topics covered (see the discussion in Dybowski and Kempa (2020)). We set $C = 40$ due to the large and heterogenous corpus of speeches. Since LDA models have become popular in economic research, we do not discuss the methodology in further detail here. Prior specifications for the document-topic and topic-word distributions are taken from Hansen and McMahon (2016).

In a third step, using the top 20 terms of each cluster, we allocate the 40 clusters to 12 "economics-themed" topics: Economy, Monetary Policy, Financial Stability, Supervision and Regulation, Financial Conditions, Housing, International, Fiscal, Financial Risk Management, Community, Research, Payments. We discard six of the 40 clusters that have topic-word distributions that do not relate to economic themes in a systematic way. We decided to estimate the LDA with 40 clusters, and not, for example, directly 12, because our aim is to construct topics that are associated with a specific economic theme rather than being based on simple co-occurrence.For

[5] Davis et al. (2020) argue that a hybrid approach can lead to more precise results.

instance, the economic outlook and monetary policy decisions might often be discussed together but we want to treat them as distinct topics. Table 1 shows an example of five of the clusters (with the ten most relevant words) estimated by LDA.[6]

Table 1: Raw LDA results - examples

Economy	Monetary Policy	Financial Stability	Supervision & Regulation	Housing
productivity	monetary_policy	financial	regulators	mortgage
growth	central_bank	system	market_discipline	borrowers
productivity_growth	policy	financial_stability	standards	lenders
investment	reserves	capital	capital_requirements	credit
labor	balance_sheet	leverage	regulation	loans
expansion	actions	crisis	supervision	housing
rate	federal_reserve	financial_institutions	supervisory	loan
output	Fed	stress	rules	mortgages
tech	independence	risks	regulatory	cra
technology	policies	institutions	disclosures	foreclosures

Note: The table shows the first ten words of five examples of the 40 clusters estimated via LDA. The column label was assigned by the authors.

In the fourth and final step, we augment the 12 topic dictionaries with terms that were left "unmatched" in the third step, i.e. words that are in the corpus but are not assigned to the first 20 words of the selected clusters.[7] A word can be unmatched mainly because it cannot be associated with any of the economic topics, the LDA misclassified it or it appears infrequently. Consequently, most of the unmatched terms are either adjectives, words not specific to economics or very specialized terms. To avoid a loss of information due to the latter reason, we selected terms from this list and assigned them to the 12 defined topics. This step is akin to using a dictionary approach, widely used in the literature - see for instance Tetlock (2007); Loughran and McDonald (2011); Baker et al. (2016).[8]

To select the additional terms, two of the authors independently assigned unmatched words to the 12 topics and we kept those words that were selected by both readers. For instance, among the unmatched terms, we assigned the term "accommodative_monetary_policy" to the Monetary Policy topic and the term "macroprudential_supervision" to the Supervision and Regulation topic. Many of these terms are collocations that are combinations of classified words with a lower number of words. The total number of unmatched terms is 16,468. This step allowed us to reassign 1959 terms to one of the 12 topics.

[6]The LDA can assign similar words to different topics, as similar words can be used in different contexts. We therefore did not opt for a mutually exclusive allocation of LDA terms.

[7]The relevance of a term is determined by a weighted average of the topic-word probability and the relative frequency of the word in the corpus. We use a weight of 0.6 for the former, as suggested by Sievert and Shirley (2014). We show that the results are robust to using the top 50 or 100 words in each topic in the Online Appendix.

[8]In the dictionary approach, the researcher relies on "expert-curated" (Davis et al., 2020) terms to characterize and quantify the information content in relevant text documents.

Figure 2 displays several *word clouds* with the 50 terms that occur most frequently in Fed speeches for our six main topics of interest (Economy, Monetary Policy and the four financial-related topics). The font size of a term is proportional to its frequency relative to all other terms in the respective topic. For instance, Panel (a) shows the words for the topic Economy and its most frequent words "economy" and "growth". For the Monetary Policy topic in Panel (b), "inflation" and "monetary_policy" are among the top words used, i.e. words that relate to the goals and tools of monetary policy, and terms that relate to the Fed's dual mandate such as "price stability", "goals", and "long run".

Figure 2: Word clouds of selected topics

(a) Economy (b) Monetary Policy (c) Housing

(d) Financial Conditions (e) Financial Stability (f) Supervision and Regulation

Note: The figures show the 50 most frequent words for the main six topics of interest. The font size is proportional to the frequency of the word relative to the frequency of other words in the same topic.

Panels (c) to (f) of Figure 2 display the word clouds for the financial-related topics: Housing, Financial Conditions, Financial Stability, and Supervision and Regulation. The Financial Conditions topic broadly covers the communication about lending and borrowing conditions in the economy (i.e. words about households and firms) or about banking conditions. The analysis of these conditions, together with the Economy topic, is part of the monetary policy strategy to monitor economic developments and assess risks to the fulfillment of the dual mandate. The FOMC policy

statement often points out that the Committee seeks monetary and financial conditions that will foster price stability and promote sustainable growth in output. The analysis of financial and banking conditions also constitutes also the main part of a typical Financial Stability Report (FSR). We therefore regard it as an important element to assess financial stability communication. We also consider the Housing topic to be part of financial conditions but treat it separately in order to assess the importance of this topic for the Federal Reserve. The Housing topic is comprised of words that define lending and borrowing conditions in the housing market.

The Financial Stability (FS) topic words relate to communication about excessive behavior in financial markets, and includes terms such as "losses", "volatility", "systemic" and "leverage", i.e. words that describe vulnerabilities in the financial system that are likely to have large effects on the economy. This discussion is also typically found in a FSR. Finally, the policy layer, Supervision and Regulation relates to the supervisory and regulatory measures taken by the Fed, alone or in cooperation with other agencies, to mitigate financial risks and prevent financial instability (i.e., "basel_ii", "regulation", "stress_tests".).

Figure 2 shows that the three topics in panels (d) to (f) share common words like financial, bank, risk, and capital, among others. However, these topics also feature specialist terms that reflect their differences as described above. Financial Conditions shares 20 words with the FS topic (around 7% of its total words), while Supervision and Regulation shares 24 words with FS (around 6%), and the rest of the topics not more than four words.

As for the other topics, Risk Management and Payments cover risk management and accounting practices, and the technical side of the US digital payment infrastructure, respectively. Community is associated with FRB presidents addressing the community developments of their respective jurisdictions. Research mainly includes references to academic research. Together with International and Fiscal, these six topics have a combined average share in speeches of about 30%, whereas the former six make up an average 70% of the terms in speeches.

2.3 Topic Proportion

In the following we construct topic proportion indicators and investigate their variation over time. For a given speech d and a topic $k = 1, ..., 12$, the proportion of each topic is computed as follows :

$$\text{Topic Proportion}_{k,d} = \text{TP}_{k,d} = \frac{\sum_{j=1}^{R_k} r_{k,d,j}}{\sum_{i=1}^{12} \sum_{j=1}^{R_i} r_{i,d,j}}, \tag{1}$$

where R_k denotes the total number of terms in topic k, $r_{k,d,j}$ denotes the number of occurrences of topic k's term j in speech d. The numerator counts the number of occurrences of topic k terms, and the denominator divides by the number of occurrences of terms of all topics, i.e. the measure adjusts for double-counting of terms that appear in more than one topic, and sums to one.

To get a topic proportion index at FOMC meeting frequency, we aggregate the topic proportion of all speeches given between meetings by taking the average:

$$\text{TP}_{k,t} = \frac{1}{M_t} \sum_{d \in m_t} \text{TP}_{k,d}, \tag{2}$$

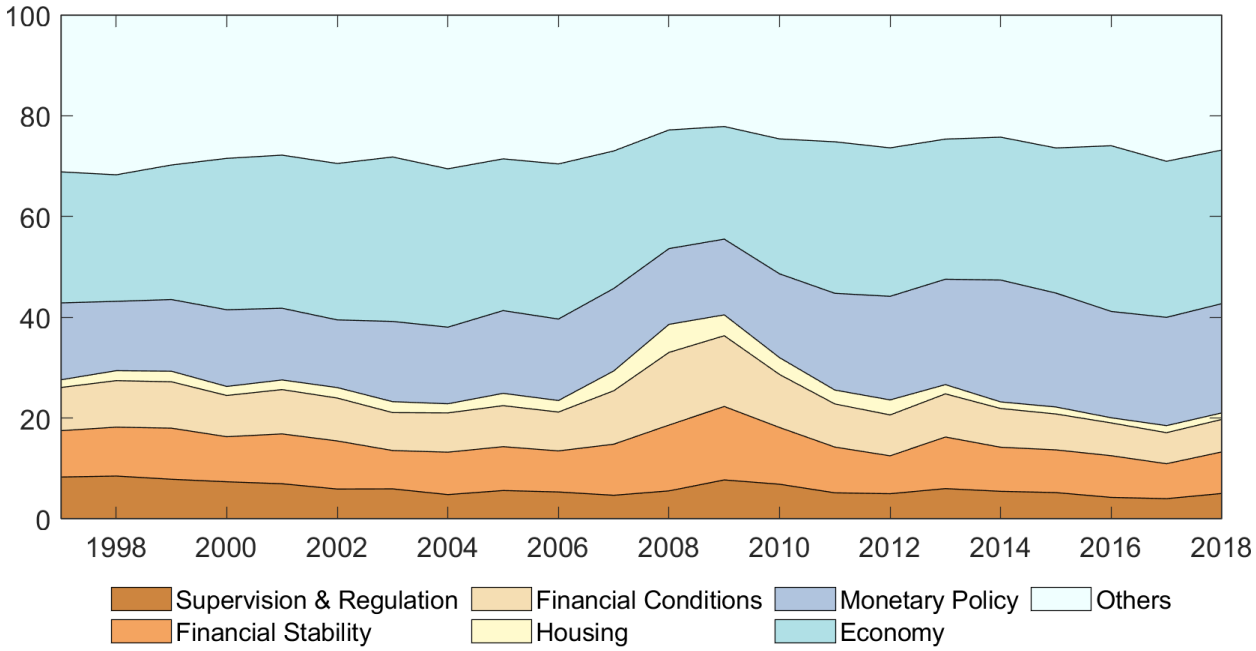
where t is at meeting frequency, m_t denotes the set of speeches given between meeting $t-1$ and t, and M_t denotes the total number of speeches given between meeting $t-1$ and t.

Figure 3 shows the variations in the topic proportions for the main six topics, for the period 1997-2018.[9] As expected, the topic Economy represents the largest share as many of the speeches provide an overview of the economic outlook in a particular period. When combined, Economy and Monetary Policy account for roughly 40% to 50%, except during the financial crisis. Financial Stability and Supervision and Regulation combined make up for about 20%, and up to 35% combined with the Financial Conditions topic. The share of the Housing topic increases during the run-up to the financial crisis and falls below the pre-crisis level thereafter.

The smoothed topic proportions appear relatively stable up until the financial crisis of 2007-2008, with the Financial Stability and Financial Conditions topics gaining in importance between 2007 and 2010 and during the European sovereign debt crisis. Thereafter, the Monetary Policy occupies a larger share of speeches compared with before the crisis. This relates not only to the expansion of monetary policy tools but also to public discussions about the challenges for monetary policy, exit strategies and normalization, especially in the FRB presidents' speeches.

[9]Note that throughout the revision processes of the paper, we retrieved 30 additional speeches, mostly given in 2018. We added them to the corpus without re-doing step one to four in Section 2.2. Our topic proportion and tone indicators are based on the updated sample of 3881 speeches.

Figure 3: Topic proportions, 1997-2018



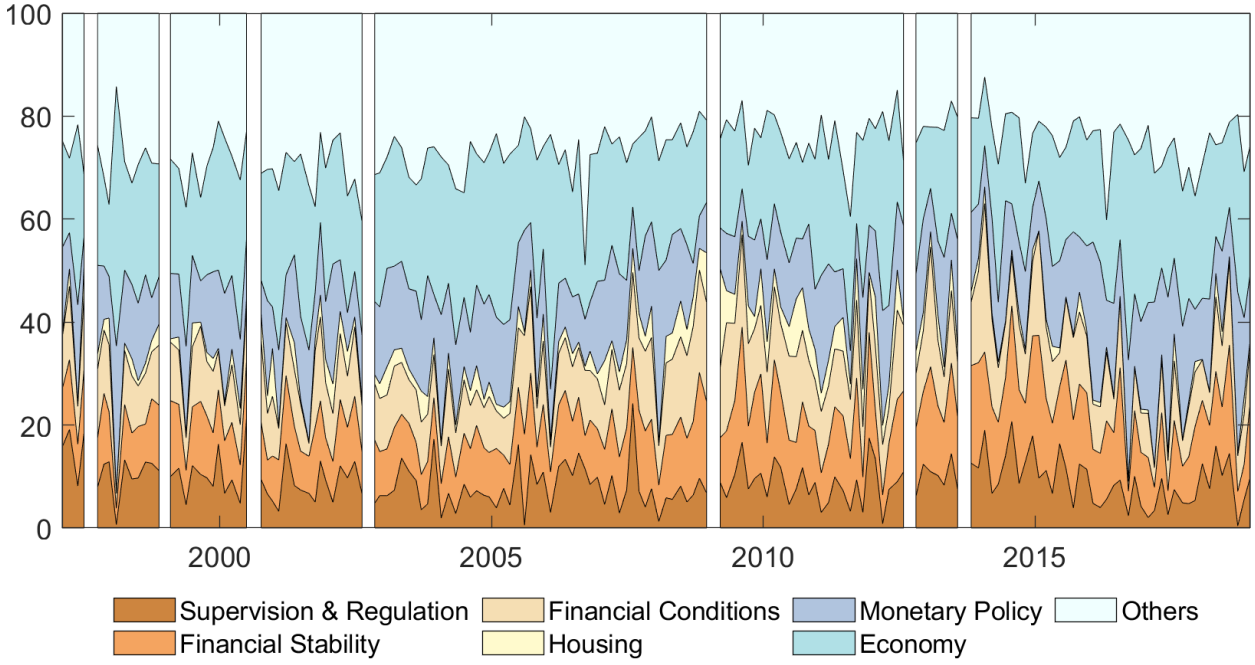
Note: The figure shows the proportion of the six main topics extracted from the Fed speeches for the period 1997-2018. The topic proportions displayed in the figure are the moving average of the seven previous and current FOMC meetings, i.e. roughly annual averages.

In the Online Appendix, we show examples of speeches that rank the highest on the topic proportion in selected topic categories and observe that the topics Monetary Policy and Economy may individually take up to more than 60% of a speech, while Financial Stability and Supervision and Regulation rarely exceed 40%. Speeches with the highest topic proportions on Monetary Policy, Economy and Financial Stability are mainly given by FRB presidents. In contrast, speeches with the highest proportion on Supervision and Regulation are all given by Governors.

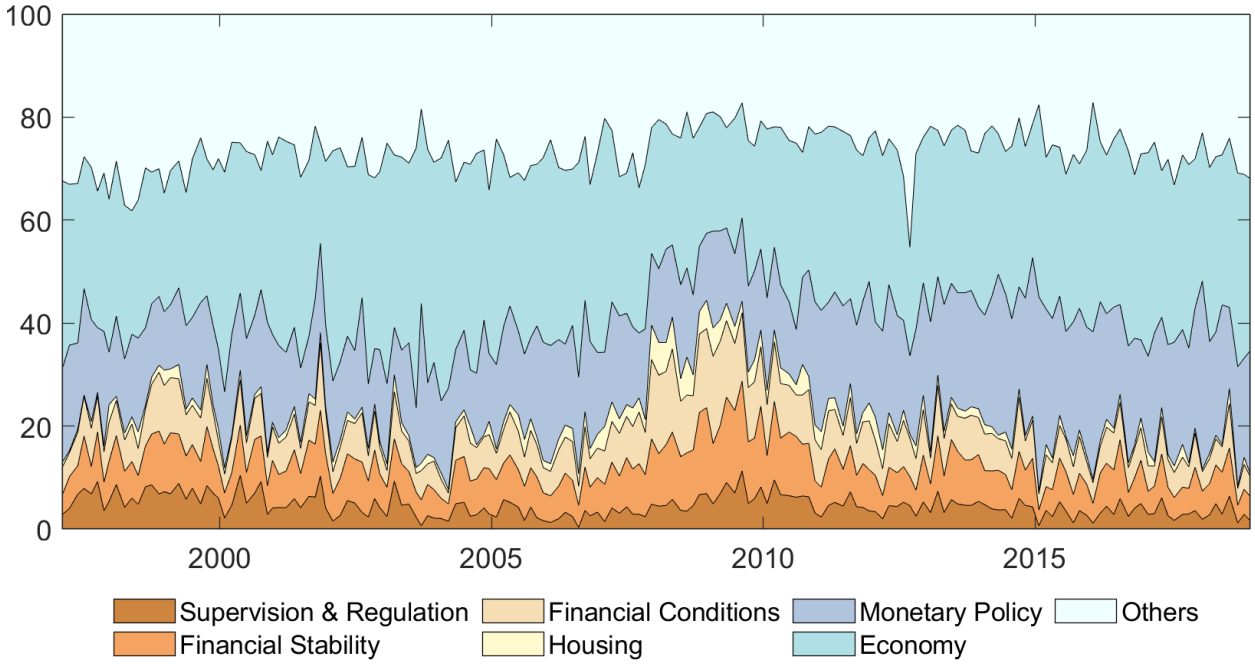
Figure 4 shows the variation in topics by type of speaker - Governors versus FRB presidents - at meeting frequency. We observe three main differences between these groups: i) FRB presidents have a higher topic proportion dispersion than Governors, ii) topic proportions exhibit smoother variation over time for FRB presidents than for Governors, and iii) on average, Governors have a higher proportion on financial-related topics than FRB presidents.

The Economy topic accounts for the highest share over time of FRB presidents' speeches (Panel b in Figure 4). Their speeches became more balanced in terms of topic shares only during the global financial crisis, with the financial-related topics gaining in importance. In the aftermath of the crisis, FRB presidents became increasingly vocal about monetary policy. More intensive communication on monetary policy during this period corresponds to the introduction of new policy tools, like forward guidance and balance sheet expansions. In contrast, the topic

Figure 4: Main topic proportions based on Fed speeches, 1997-2018



(a) Governors



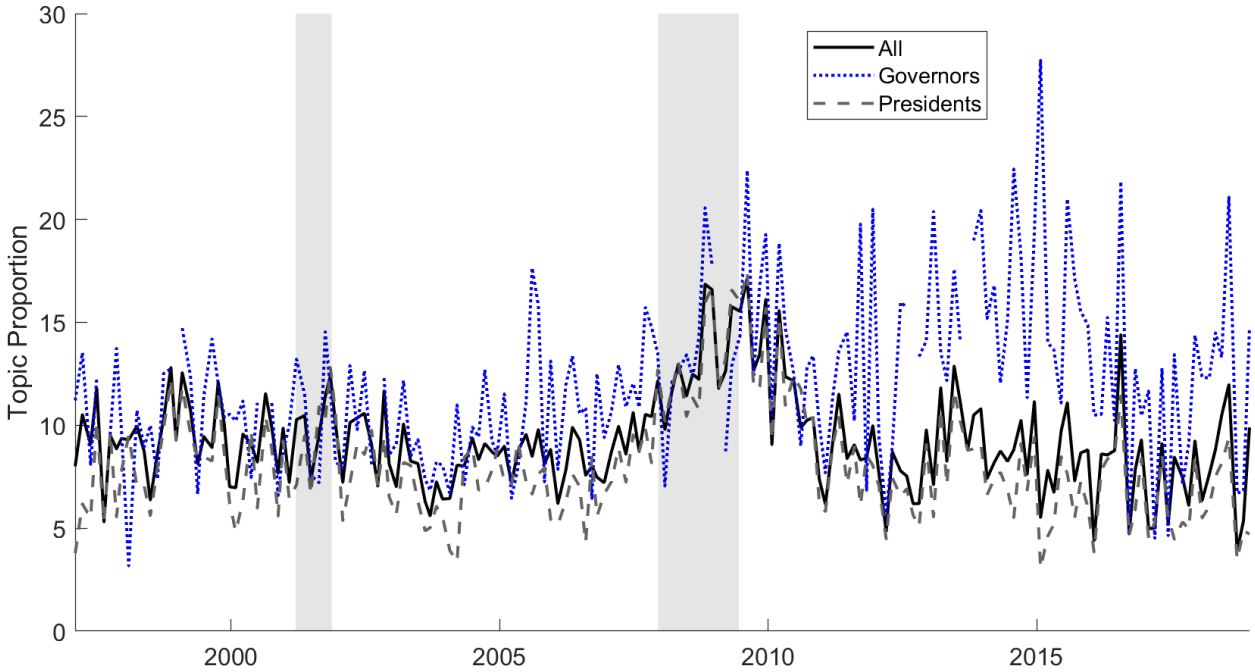
(b) Presidents

Note: The figures show the topic proportions of Supervision and Regulation, Financial Stability, Financial Conditions, Housing, Monetary Policy and Economy at FOMC meeting frequency. Panel (a) shows the results for speeches given by Governors (excluding Fed Chairs), and Panel (b) shows the results for speeches given by all FRB presidents. The blank areas in Panel (a) correspond to intermeeting periods without speeches by Governors.

proportions of speeches by Governors (Panel a) exhibit no strong time trends.

The differences in topics between FRB presidents and Governors may relate to the Fed's institutional design and to the different responsibilities between the two groups. For instance, all FRB presidents and Governors take part in the discussions about US monetary policy as FOMC members and participants.[10] Unsurprisingly, a large proportion of their speeches is devoted to the economy and monetary policy. In addition, the Board of Governors drafts regulations and creates supervisory policy for the Federal Reserve System.[11] As part of their duties, Governors are also assigned to several Board Committees, including the Committee on Economic and Monetary Affairs, the Committee on Financial Stability, and the Committee on Supervision and Regulation. This job "specialization" of Governors may be reflected in speech "specialization" and therefore a higher average proportion of them on financial-related topics. The smoother topic variation for FRB presidents may be partly driven by averaging over more speakers (12 FRB presidents) relative to the six Governors (excl. the Fed Chair).

Figure 5: Financial Stability topic proportion by type of speaker, 1997-2018



Note: The figure shows the Financial Stability topic proportion by type of speaker at FOMC meeting frequency. The gray shaded areas indicate NBER recessions.

Figure 5 shows the variations in the Financial Stability topic proportion at meeting frequency according to the type of the speaker. As discussed above, we observe that in general, Governors

[10] All 12 FRB presidents take part in FOMC discussions, though only five are voting members at any point in time.

[11] Since 2010, the FOMC has also had a vice chair for supervision, created by the 2010 Dodd-Frank Act. The vice-chair for supervision leads the regulation and enforcement of banks and other financial institutions that the Board supervises. However, many of the Fed's banking supervision/regulation activities are delegated to the Federal Reserve Banks.

have a higher speaking proportion on this topic than FRB presidents. The correlation between the topic indicators of these two groups is around 29%. The difference is especially striking after the financial crisis. It should be noted that during 2012-2016 a new set of US banking and supervisory regulations was put in place.

2.4 Topic Tone

We compute a measure of tone (or sentiment) regarding the financial-related topics based on a dictionary approach using a dictionary tailored to the financial stability context as developed by Correa et al. (2021).[12] This dictionary lists 391 positive and negative words typically used when discussing financial stability issues in the Financial Stability reports of 64 central banks and multilateral institutions.

We focus on a measure of *negative tone* for two reasons.[13] First, the vocabulary of Correa et al. (2021) is asymmetric, i.e. it includes 295 negative words and only 96 positive words. Second, Loughran and McDonald (2011) observe that, at least in the context of corporate communication, negated positive words are common but negated negatives are not. This means that the chance of incorrectly counting negated positives as positives is higher than the probability of counting negated negative words as negative.

The methodology we use to construct our tone indicator is similar to that of Hansen and McMahon (2016), where the individual sentences in the speeches are used as a unit of observation. Performing the tone analysis at the sentence level allows us to better match the tone with the financial-related topics. Each sentence for which at least a share of $\alpha = 10\%$ of the sentence's total words is about topic k, taking only the four financial-related topics, is classified as being a sentence belonging to topic k, which we label *k-sentence*. We then count the negative words within each *k-sentence*, and rescale them by the total number of words in the sentence:

$$\text{Negative Tone}_{k,d} = \text{NT}_{k,d} = \sum_{j=1}^{J_d} r_{k,d,j}^{(-)}, \tag{3}$$

where J_d denotes the number of *k-sentences* in speech d and $r_{k,d,j}^{(-)}$ denotes the number of negative tone words as a share of the total words in sentence j.

Unlike other papers that have looked at the tone of homogeneous texts, such as Hansen and McMahon (2016), who analyzed monetary policy statements, and Correa et al. (2021), who

[12] In the Online Appendix, we show that a tone indicator based on the dictionary of Loughran and McDonald (2011) is very similar to the tone indicator based on Correa et al. (2021).

[13] This is similar to Ehrmann et al. (2022), among others.

considered financial stability reports, our corpus is highly heterogeneous. Each of the speeches we look at can (i) cover a variety of topics and (ii) do so with a changing intensity of financial stability or other financial-related issues. Further, our final measure is computed at meeting frequency, which implies that more than one speech (document) is available for each meeting. Therefore, and unlike the papers mentioned above, to deal with the heterogeneity in speeches, we weigh the tone measure of a speech by its respective topic intensity. In detail, to get a NT index at meeting frequency, we aggregate the tone of all speeches given between meetings by weighting them with the topic intensity of the respective speech:

$$\text{Negative Tone}_{k,t} = \frac{1}{M_t} \sum_{d \in m_t} \text{NT}_{k,d} * \text{TI}_{k,d}, \tag{4}$$

where t is at meeting frequency, m_t denotes the set of speeches given between meeting $t-1$ and t, M_t denotes the total number of speeches given between meeting $t-1$ and t, and $\text{TI}_{k,d}$ denotes the topic intensity which is computed as the share of topic k terms in speech d.[14] We weight by the topic intensity of the speech to mitigate the impact of speeches that are not mainly on topic k issues, i.e. the tone of speeches that are actually devoted to the topic receives relatively more attention in our measure. We additionally divide by the number of speeches to avoid a situation where more (fewer) speeches necessarily yield a more (less) negative tone indicator. Note that given eq. (4), the tone indicator can also be interpreted as a tone-refined version of the topic proportion measure presented in Section 2.3, i.e. a topic proportion indicator re-weighted by its own tone at the speech level.

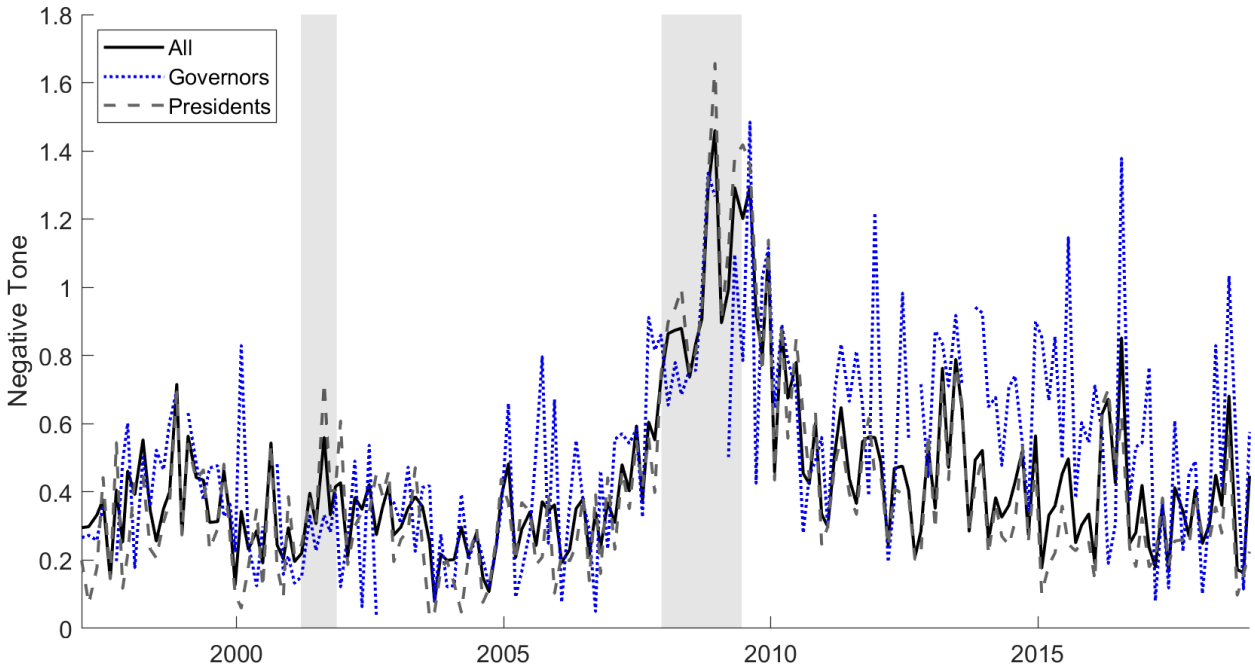
Figure 6 shows the tone indicator related to the Financial Stability topic, at meeting frequency, according to the type of the speaker. We observe that the tone on this topic was markedly negative during the global financial crisis of 2007-2009. The increase in the negative tone in speeches after the global financial crisis likely reflects two different factors: (i) in this period there was an increase in speeches on lessons for financial stability "a decade after the crisis", which does not reflect real-time negative sentiment, and (ii), in the period before and during the normalization of monetary policy, some speeches were discussing the challenges that a low interest rate environment poses for financial stability, which may have contributed to the negative tone.

The correlation between the negative tone on Financial Stability and the topic proportion is high; 75% for Governors and 88% for FRB presidents. This high correlation is partly due to the

[14] Weighting by $\text{TP}_{k,d}$, the topic proportion based on eq. (1) leads to qualitatively similar results, but produces an index with a few outliers.

construction of the tone measure but also because many of the terms in the Financial Stability topic already convey a negative sentiment. Thus, an increase in talk of Financial Stability takes place in periods of stress, and with a negative tone. However, since the Correa et al. (2021) dictionary is mainly based on adjectives rather than nouns (unlike our topic words dictionary), the tone measure might nonetheless provide complementary information to our measure of Financial Stability topic proportion. We will investigate this possibility in Section 3.

Figure 6: Financial Stability negative tone by type of speaker, 1997-2018



Note: The figure shows the Negative Tone indicator for the Financial Stability topic computed by type of speaker, as described in (4), at FOMC meeting frequency. The gray shaded areas indicate NBER recessions.

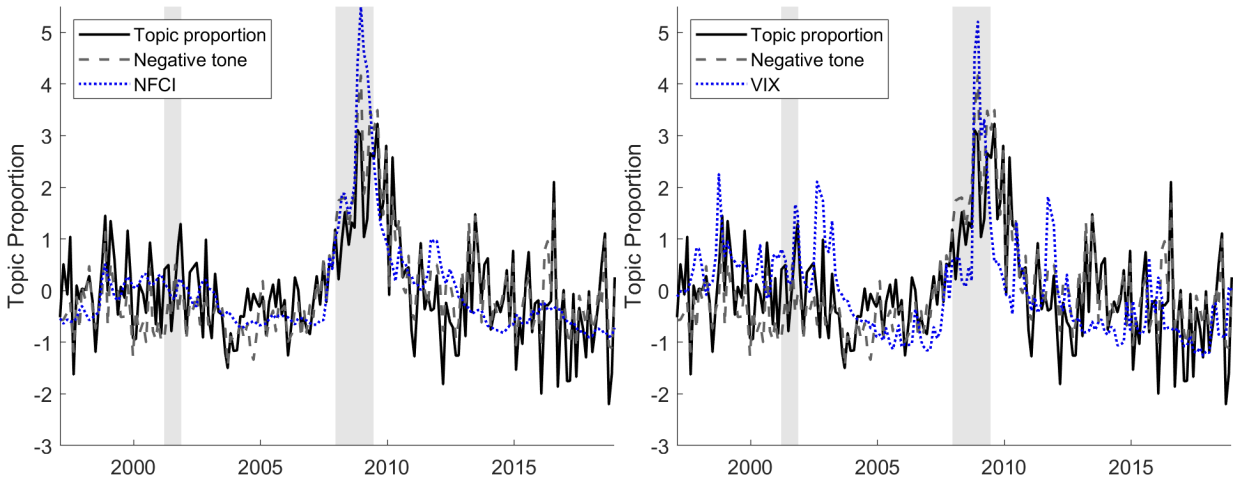
2.5 Comparison with market-based indicators

As a first step to assessing the informational content of our speech-based topic and tone indicators, we compare them to market-based measures of financial conditions and financial stress. Although there is a variety of indices of financial stress and financial conditions that are based on market data, we focus here on two well-known indicators: the National Financial Conditions Index (NFCI) of the Chicago Fed and the Chicago Board Options Exchange Volatility Index (VIX). The NFCI is computed using a factor model and a large number of financial series, and published by the Chicago Fed. The VIX is a widely used and purely market-based measure of volatility in stocks listed in the S&P 500. Both indices typically spike during times of financial turmoil.

Figure 7 plots the FS topic and tone indicators against the NFCI and VIX. The topic proportion (solid line) and the tone measure are more volatile than the NFCI or the VIX, but variations in

them are relatively similar around important economic and financial events, such as the Dotcom bubble or the Global Financial Crisis. Overall, a visual inspection confirms that the Financial Stability speech-based indicators reflect, in part, financial market developments but there is also individual variation. The correlations between the FS topic proportion and the NFCI and VIX are 59% and 45%, respectively. The correlations between the FS tone measure and the NFCI and VIX are 75% and 47%.

Figure 7: FS speech-based vs market-based financial indicators



(a) NFCI vs speech-based measures

(b) VIX vs speech-based measures

Note: Panel (a) plots the NFCI (dotted line) against the Financial Stability topic proportion indicator (solid line) and the Financial Stability sentiment indicator (dashed line). Panel (b) plots the VIX (dotted line) against the Financial Stability topic proportion indicator (solid line) and the Financial Stability sentiment indicator (dashed line). To improve the legibility of the plot, we standardized the NFCI, the VIX, the topic and tone indicator by demeaning the series and dividing them by their respective standard deviation.

3 Monetary policy implications of financial stability communication

The FOMC has stressed, in particular since the Great Recession, that financial vulnerabilities and financial stability risks play a role in achieving the Fed's dual mandate. In the absence of an institutional communication channel that addresses the monetary policy implications of financial vulnerabilities, this section investigates empirically whether financial-related communication in Fed speeches provides valuable information in this direction. To this end, we estimate an interest rate reaction function that links the endogenous response of monetary policy to macroeconomic conditions, in the spirit of Taylor (1993), and to our financial-related communication measures. As a benchmark interest rate reaction function, we take a standard version of the Taylor rule that uses real-time measures of the Federal Reserve Board staff's forecasts of macroeconomic conditions, the so-called Greenbook forecasts, as in Orphanides (2003). The baseline Greenbook

forecast-based Taylor rule takes the following form:

$$i_t = c + \phi_i i_{t-1} + \phi_\pi E_{t^-} \pi_{t+4} + \phi_x E_{t^-} x_{t+4} + u_t, \tag{5}$$

where t is the time index at meeting frequency, i_t is the target Federal Funds Rate (FFR) set at each FOMC meeting, c is the intercept, $E_{t^-} \pi_{t+4}$ is the Greenbook forecast of annualized quarter-on-quarter CPI inflation four quarters ahead (denoted by $\text{CPI}_{t,h=4}$ in the tables), $E_{t^-} x_{t+4}$ is the Greenbook forecast for the output gap four quarters ahead (denoted by $\text{OG}_{t,h=4}$ in the tables), and E_{t^-} denotes the expectations formed right before the FOMC meeting. This version of the Taylor rule also includes a smoothing term for the FFR.[15] All the variables are expressed in percent.

Greenbook forecasts are made available to the public with a lag of five years, which constrains our data sample to the period from 1997, the start of our speech data set, to the end of 2016, the latest available Greenbook forecasts. We want to highlight two important challenges that come with this data sample. First, the global financial crisis and the subsequent Great Recession had a profound impact on the perception of financial stability. Second, the FFR was kept constant from December 2008 to December 2015 at the zero lower bound (ZLB). For these reasons, the literature that studies the Fed's decisions with Taylor rules typically restricts the estimation sample to 2007 or 2008 (Bordo and Istrefi, 2018; Malmendier et al., 2021; Shapiro and Wilson, 2022). Therefore, we estimate our Taylor rules on two samples: (i) on the pre-Great Recession period, from January 1997 to November 2007, following the NBER business cycle classification, and (ii) on the full available sample, from 1997 to 2016. For the latter sample, we use the shadow rate of Wu and Xia (2016) whenever the FFR is at the ZLB.

Results of the baseline specification (5) for the pre-crisis period are shown in Table 2, column (1). The coefficients for CPI inflation and the output gap forecasts have the expected sign and are found to be relevant predictors, i.e. the Federal Reserve responds significantly to changes in its forecasts. The estimated reaction of the Fed to the forecasted inflation is significantly greater than one (the long-run estimate $\phi_\pi = 0.219/(1 - 0.876) = 1.766$). This implies that the Taylor principle, with the nominal interest rate responding more than one-for-one to inflation, is satisfied. An additional one percentage point in the annualized four-quarter ahead CPI inflation forecast leads to an increase in the FFR of about 22 basis points on impact. Similarly, an additional one percentage point in the output gap forecast leads to an increase in the FFR of about 14 basis

[15] Since all the right-hand variables are available prior to the interest rate decision, we estimate this Taylor rule by least squares as in Coibion and Gorodnichenko (2012). In line with the latter, we use heteroskedasticity and autocorrelation robust standard errors (HAC) based on the Bartlett kernel of Newey and West (1987). For lag length choice we follow Stock and Watson (2014) and set the lag length to $0.75\text{T}^{1/3}$, where T denotes the sample size.

points on impact.

3.1 A Taylor rule augmented with communication indicators

To assess whether the content of speeches given by FOMC members contains useful information for the reaction function of the Fed, we augment the baseline Taylor rule with financial-related communication measures. In the following, when presenting the results, we will focus on the Financial Stability (FS) topic first and then comment on the other financial-related topics: Financial Conditions, Supervision and Regulation, and Housing.

Our speech-augmented Taylor rule takes the following form:

$$\begin{aligned} i_t =& c + \phi_i i_{t-1} + \phi_\pi E_{t^-} \pi_{t+4} + \phi_x E_{t^-} x_{t+4} + \phi_{\text{TP}} \text{TP}_t + \phi_{\text{NT}} \text{NT}_t \\ &+ c_{p07} p07 + \text{p07} \cdot (\phi_{\text{TP,p07}} \text{TP}_t + \phi_{\text{NT,p07}} \text{NT}_t) + u_t, \end{aligned} \tag{6}$$

where TP_t represents the topic proportion computed as in equation (2), and NT_t the negative tone as constructed in equation (4). p07 denotes an indicator variable equal to one for the period post 2007. Note that since by definition p07 is zero in the pre-crisis sample, in regressions based on pre-crisis data the predictors associated with p07 are not present. The timing of the two indicators is such that they are computed using all speeches given before the meeting at time t but after the previous meeting at time $t-1$.

Financial stability topic: Results of the augmented Taylor rule for the FS topic for the pre-Great Recession period are shown in columns (2) to (4) of Table 2 and for the full sample in columns (5) to (8). We find that both FS topic proportion and tone are statistically and economically relevant predictors of interest rate changes for the pre-crisis period. An increase in the topic proportion indicator of one percentage point is, on average, associated with a reduction in the FFR of 5.2 basis points on impact. Due to the interest rate smoothing, a one percentage point increase implies a long-run effect in the FFR of 41 basis points, above the Fed's typical rate step-size of 25 basis points. The roughly four percentage point increase in the topic proportion in 2007 that occurred during the run-up to the financial crisis was, on average, associated with a reduction in the FFR of 20 basis points in the short-run, or about a quarter of the 75 basis points FFR cut that occurred between January 2007 and November 2007.

Extrapolating these results for the entire financial crisis – when the topic proportion indicator increased by about six and half percentage points – would imply a reduction in the FFR of around

250 basis points in the long run; this corresponds to half of the roughly 500 basis point reduction that occurred until December 2008. That the topic proportion contribution makes up to 50% of the FFR reduction in this period likely reflects the fact that some of the major downward forecast revisions of the Greenbook occurred relatively late, starting at the end of 2008, while stress in the financial system materialized much earlier. Hence, a monetary policy reaction function that factors in financial stability considerations, in a timely manner, helps to explain important monetary policy decisions during this period.

Table 2: Taylor rule results — baseline specification

	FFR	FFR	FFR	FFR	SR	SR	SR	SR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
r_{t-1}	0.876***	0.877***	0.882***	0.878***	0.961***	0.926***	0.929***	0.931***
	(0.031)	(0.030)	(0.034)	(0.031)	(0.016)	(0.026)	(0.026)	(0.024)
$CPI_{t,h=4}$	0.219*	0.278**	0.241**	0.277**	0.118*	0.227**	0.208**	0.227**
	(0.112)	(0.110)	(0.115)	(0.111)	(0.069)	(0.097)	(0.098)	(0.094)
$OG_{t,h=4}$	0.143***	0.139***	0.138***	0.139***	0.026	0.022	0.021	0.018
	(0.046)	(0.039)	(0.045)	(0.040)	(0.020)	(0.019)	(0.022)	(0.021)
FS Proportion		−0.052***		−0.047**	0.003	−0.046**		−0.039
		(0.017)		(0.023)	(0.029)	(0.020)		(0.028)
Neg. Tone			−0.506***	−0.098	−0.259		−0.499***	−0.162
			(0.177)	(0.223)	(0.357)		(0.191)	(0.279)
p07 x FS Proportion						0.050**		0.065
						(0.025)		(0.047)
p07 x Neg. Tone							0.484**	−0.110
							(0.215)	(0.456)
AIC	-7.9	-18.11	-12.38	-16.26	28.47	18.89	21.64	21.64
SIC	4.37	-3.38	2.35	0.92	49.96	43.44	46.19	52.33
Observations	86	86	86	86	159	159	159	159
Adjusted R^2	0.985	0.987	0.986	0.987	0.992	0.992	0.992	0.992

Note: The table shows Taylor rule results for the period ranging from January 1997 to November 2007, and January 1997 to December 2016, as indicated by the column names FFR and SR respectively. FFR denotes the target Federal Funds Rate, whereas SR denotes the shadow rate of Wu and Xia (2016). The FS topic proportion and the negative tone indicator are computed based on speeches of all FOMC members. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

With regard to the FS tone, in the pre-crisis period, a one point increase in the negative tone indicator is associated with a reduction in the FFR of about 50 basis points. Once we include both measures in the regression, the coefficient for the tone measure becomes insignificant. This suggests that the two indicators convey similar information in the case of the Financial Stability topic, as communication generally increases in times of stress and negative financial developments.

As discussed earlier, in our setup, the FS topic mainly reflects financial stability concerns, e.g. communication about excessive behavior in financial markets or vulnerabilities in the financial system. Thus, specification in column (2) will be our preferred one for the remainder of the paper.

Columns (5) to (8) of Table 2 report the results for the full sample going from 1997 to 2016, using the shadow rate of Wu and Xia (2016) during the ZLB period. Column (5) shows the results when we estimate the coefficient without allowing for a potential break around the Great Recession. The smoothing coefficient increases relative to column (4), whereas the coefficients for the CPI and output gap forecast decrease. Coefficient estimates for the FS proportion are not statistically different from zero. The coefficient for the negative tone is smaller in absolute value than in the pre-crisis period and less precisely estimated. Columns (6) to (8) show the specifications that allow for a change in the FS proportion and FS tone coefficient in the post-crisis sample. The coefficient associated with the interaction of post-2007 (abbreviated as p07) and the speech-based indicators is positive and statistically significant. The sum of the FS Proportion (Neg. Tone) coefficient and the p07 x FS Proportion (Neg. Tone) is close to zero, suggesting that the FS topic proportion and tone of FOMC speeches do not provide a signal about FFR changes in the post-2007 sample. Note that we only report the coefficients associated with the interaction of the post-2007 indicator variable but that post-2007 is also included as a regressor. In the Online Appendix we further explore Taylor rule results for the post-crisis sample, including a specification in which all coefficients are allowed to change around the Great Recession. These results largely confirm our findings with regard to speech indicators reported in column (6) to (8).

As mentioned above, the largest changes in the speech-based indicators occur during the run-up to the global financial crisis. This period is associated with concerns about the health of the financial system and a subsequent easing of the policy stance. However, although speeches are given before policy meetings, i.e. pre-determined relative to the actual policy decision, the coefficients associated with the speech-based indicators cannot be unequivocally interpreted as causal. For instance, we cannot exclude that policy makers are more concerned about financial stability during cycles of easing: lower interest rates could increase risk-taking and, therefore, financial stability risks. Similarly, policymakers might be less concerned about financial stability when in a tightening cycle; if higher rates lower financial risks, there might be less reason to talk about financial stability.

Other financial-related topics: Results for the Taylor rule equation (6) augmented with topic

proportion and tone-specific measures for the three other financial-related topics - Regulation and Supervision (S&R), Financial Conditions (FC) and Housing - are presented in Tables A.1 and A.3 in Section A. The results for S&R and FC are qualitatively similar to those for the FS topic. Both topic proportions' coefficients are significant and have a negative sign. The results are also comparable for both the pre-crisis and the whole sample period using the shadow rate. One difference is that the tone-specific measures are higher in magnitude and more relevant for those two topics, compared with the FS case. This might be due to the fact that the topic words of S&R and FC do not have the same negative connotation as the words in the FS topic.

Interestingly, an increase in the speaking share on Supervision and Regulation also correlates with a more accommodative monetary policy. This suggests that the FOMC could have talked about supervision and regulatory policies but also used monetary policy to counteract the adverse consequences of financial risks for the economy. This idea is reflected in a recent FOMC discussion:

> *Recognizing these limitations [of countercyclical macroprudential tools], many participants remarked that the Committee should not rule out the possibility of adjusting the stance of monetary policy to mitigate financial stability risks, particularly when those risks have important implications for the economic outlook and when macroprudential tools had been or were likely to be ineffective at mitigating those risks.*
>
> — FOMC minutes, January 2020

We also report results for the Housing topic (see Table A.5 in Section A). While the evidence is somewhat weaker, the topic proportion enters the Taylor rule significantly in the pre-crisis sample, but with a positive sign: an increase in the proportion of the Housing topic in Fed speeches is associated with an increase in the FFR.

Overall, our results are in line with the recent literature that looks at other forms of Fed communication (FOMC meeting transcripts in Peek et al. (2016) and semiannual Congressional hearings in Wischnewsky et al. (2021)), different sample periods and different text-based measures. We confirm that financial stability concerns coincide with a more accommodative monetary policy. The Fed has adjusted its policy stance by responding to existing financial stability risks, rather than acting pre-emptively to prevent the build-up of such risks. In other words, our results suggest a *cleaning up* rather than a *leaning against the wind* approach by the Fed.[16] This approach is observed in a time period in which effective macroprudential tools in the US were lacking,

[16]The empirical findings in White (2009) and Friedrich et al. (2019) are similar for a comparable sample period.

especially before the GFC (Dudley, 2015). Interestingly, our disaggregated topic analysis reveals *leaning against the wind* of the Fed against housing market developments in the period before the GFC, since longer speaking time on Housing is associated with positive changes in the FFR.

3.2 Taylor rule regressions with market-based financial controls

As mentioned earlier, a variety of market-based financial stress and financial conditions indicators exist that may be part of the information set available to FOMC members when deciding on monetary policy. We now formally test whether text-based and marked-based indicators contain the same information for monetary policy decisions. We consider several financial indicators that are widely used in the literature and by practitioners. The list includes the VIX, the NFCI of the Chicago Fed, the adjusted NFCI (ANFCI), the Kansas City Financial Stress Index (KCFSI), the Goldman Sachs US Financial Conditions Index (GSFCI) and the Excessive Bond Premium (EBP) based on Gilchrist and Zakrajšek (2012).[17]

It is worth noting that all of the indicators, apart from the VIX and the GSFCI, became publicly available after or during the global financial crisis.[18] As such, these synthetic indicators may not have been part of the FOMC's real-time (pre-financial crisis) information set, although most of the underlying financial variables were. These indicators are available at different frequencies: for those available on a weekly basis (or at a higher frequency), we computed the four week average prior to the respective FOMC meetings.[19,20]

To evaluate whether the FS topic proportion has predictive power beyond the information embedded in the financial indicators described above, we run our preferred Taylor rule specification including both text-based and market-based indicators. The results, displayed in Table 3, show that the coefficient of the FS topic proportion remains significant in each regression and similar in size to that of the baseline regression in Section 3.1. Interestingly, the coefficients of market-based financial indicators also have negative point estimates and are significantly different from zero (except for the ANFCI and GSFCI).

These results confirm that our FS speech-based measure provides information about FFR

[17] We provide definitions and sources for these indicators in the Online Appendix.

[18] The VIX in its current format started to be computed in 2003, and earlier versions based only on the S&P 100 started as early as 1993. The GSFCI is based on Dudley and Hatzius (2000) and is available from around 2000.

[19] Note that financial indicators are potentially at an informational advantage of about ten days due to the blackout period on Fed communication during which Fed staff generally do not speak publicly. The blackout periods "begin the second Saturday before the beginning of the Federal Open Market Committee (FOMC) meeting and end the Thursday following a meeting unless otherwise noted." (Federal Reserve Bank of St. Louis, 2022).

[20] The Online Appendix shows that the results are unchanged when we compute the financial indicators over the entire intermeeting six-week average.

Table 3: Pre-crisis period results with different financial indicators: FOMC

	Dependent Variable: Federal Funds Target Rate					
	NFCI	ANFCI	KCFSI	VIX	GSFCI	EBP
	(1)	(2)	(3)	(4)	(5)	(6)
FFR_{t-1}	0.903***	0.892***	0.903***	0.885***	0.860***	0.892***
	(0.025)	(0.031)	(0.023)	(0.025)	(0.034)	(0.024)
$CPI_{t,h=4}$	0.192*	0.252**	0.194*	0.220**	0.327***	0.262**
	(0.110)	(0.112)	(0.108)	(0.103)	(0.116)	(0.109)
$OG_{t,h=4}$	0.137***	0.142***	0.133***	0.144***	0.104*	0.122***
	(0.038)	(0.042)	(0.036)	(0.032)	(0.053)	(0.040)
Financial Index	−0.492***	−0.089	−0.116**	−0.017***	−0.080	−0.085*
	(0.148)	(0.077)	(0.045)	(0.004)	(0.063)	(0.051)
FS Proportion	−0.031**	−0.047***	−0.037***	−0.026*	−0.050***	−0.046***
	(0.014)	(0.016)	(0.014)	(0.014)	(0.018)	(0.017)
AIC	-29.31	-16.87	-26.66	-43.52	-18.49	-21.3
SIC	-12.13	0.31	-9.48	-26.34	-1.31	-4.12
Observations	86	86	86	86	86	86
Adjusted R^2	0.989	0.987	0.988	0.991	0.987	0.988

Note: The table shows pre-crisis Taylor rule results, ranging from January 1997 to November 2007, when additionally controlling for a financial indicator based on market data. The column name implies which indicator is used for the variable Financial Index in the regression. The dependent variable is the target FFR. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

changes, beyond the effect of market-based financial indicators. One possible explanation is that our approach takes account of the fact that Fed officials likely form their beliefs about financial stability by paying attention to an evolving set of financial and banking variables. These beliefs are then reflected in communication with the public and in policy decisions.

3.3 Does it matter who is speaking?

So far, our analysis suggests that communication on financial-related topics preceding FOMC meetings provides information on monetary policy decisions beyond the effects that such concerns might have on the forecasts for inflation and the output gap. A question that naturally arises is: does it matter whose speeches we look at - those by the Fed Chair, Governors, or the FRB presidents? To answer this question, we estimate the augmented Taylor rule (6) with the topic proportions computed using the speeches of each group separately.

Results for the FS topic and the pre-crisis sample are reported in Table 4. Column (1) restates the baseline results of column (2) in Table 2 for comparison. Columns (2) to (4) show the coefficients for regressions with group-specific topic proportions as indicated by the column name. The coefficient of the FS proportion for FRB presidents is the highest and closer to the estimate for the FOMC as a whole. A one percentage point increase in the FS proportion of FRB presidents is associated, on average, with a reduction in the FFR of about 4 basis points on impact, or about 30 basis points in the long run.

The number of observations for the regression reported in columns (2) and (3) are different from the baseline regression reported in column (1) because there are periods in which no speeches were given by Governors or the Fed Chair and we drop these periods from the sample. Note further that the "Board" column refers to members of the Board of Governors excluding the Fed Chair.

The results for the topics of Supervision and Regulation and Financial Conditions are presented in Section A, where we focused on the tone instead of topic proportions since it is the preferred specification in baseline regressions. The relevance of the tone indicator is again mainly driven by the speeches of FRB presidents, as shown in Table A.2 and Table A.4. In addition, a specification that controls for both the FS and the Housing topic proportions, shown in Table A.6 in Section A, confirms that: i) the Housing coefficient is positive while that of FS remains significant and negatively correlated with FFR movements and, ii) the strongest signal comes from FRB presidents' speeches. Overall, the results with respect to all the financial-related topics provide strong

Table 4: Taylor rule results — pre-crisis period — by FOMC members

	Dependent variable: Federal Funds Target Rate			
	FOMC	Board	Fed Chair	Presidents
	(1)	(2)	(3)	(4)
r_{t-1}	0.877***	0.873***	0.889***	0.876***
	(0.030)	(0.030)	(0.029)	(0.032)
$CPI_{t,h=4}$	0.278**	0.263**	0.267***	0.273**
	(0.110)	(0.113)	(0.098)	(0.121)
$OG_{t,h=4}$	0.139***	0.144***	0.142***	0.136***
	(0.039)	(0.044)	(0.047)	(0.038)
FS Proportion	−0.052***	−0.016*	−0.020***	−0.041***
	(0.017)	(0.009)	(0.005)	(0.015)
AIC	-18.11	-5.46	-10.48	-17.42
SIC	-3.38	8.98	3.34	-2.69
Observations	86	82	74	86
Adjusted R^2	0.987	0.985	0.987	0.987

Note: The table shows pre-crisis Taylor rule results, ranging from January 1997 to November 2007, where the financial stability topic proportion indicator is computed based on speeches of different subgroups of the FOMC, as indicated in the column name. The dependent variable is the target FFR. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

evidence that there is information in the speeches of FRB presidents.

In what follows, we discuss three potential explanations for why the communication of FRB presidents has a stronger signaling power for FFR changes than that of other FOMC members. The first relates to the institutional design of the Federal Reserve System, which is comprised of the Board of Governors and the FRBs. The second explanation relates to a potential strategic motive driving FRB presidents' communication. And the third considers potentially different information sets of FRB presidents in relation to their supervisory responsibilities.

Institutional Design: A stronger signal from the speeches of FRB presidents might simply be due to the larger number of FRB presidents speaking between FOMC meetings (and about the same topic), compared with the seven Board members (in a situation where all seats are filled and including the Fed Chair). Indeed, Figure 1 showed that FRB presidents on average make a greater number of speeches per year than Governors. More speeches could produce a clearer signal and, therefore, more explanatory power in our Taylor rule estimations, especially when several FRB presidents speak on the FS topic at the same time. As discussed previously, a higher topic share on FS and S&R could relate to the specific responsibilities of the Board of Governors. For instance,

Governors' responsibilities with respect to supervision and regulation likely lead to a higher specialization of their speeches. This specialization seems to result in more focus on certain topics and less variation in the topic proportion over time, thus not generating "news".

Related to the institutional design, it could also be that the information in the speeches of FRB presidents comes from those of the New York (NY) Fed president. The NY Fed has several unique responsibilities related to its function of being in charge of the implementation of monetary policy, which include conducting open market operations, intervening in foreign exchange markets, among others. The NY Fed also supervises the largest banks in the US Financial markets and financial stability concerns are therefore at the heart of its mission. Moreover, the NY Fed president is the only FRB president with a permanent voter status in the FOMC. Therefore, to test whether our results are driven by the institutional role of the New York Fed president when it comes to finance-related matters, we constructed a topic proportion indicator based on the speeches of FRB presidents but excluding the NY Fed president.

Strategic communication of FRB presidents: FRB presidents vote in the FOMC on a rotating basis with only five out of the 12 FRB presidents voting at a time. The president of the NY Fed has a permanent voting status, whereas the four others alternate on a one-year voting right basis. Communicating on a certain topic at a certain time could, therefore, be a strategic move by FRB presidents to reinforce their bargaining power in FOMC deliberations. This could be especially relevant when FRB presidents have FOMC voting rights. At the same time, FOMC members without voting rights may have an incentive to steer the public debate before the FOMC meeting to wield influence over the FOMC decision despite their lack of a voting rights. We therefore test whether it is the communication of voters vs non-voters that provides extra information, by computing Financial Stability topic measures for these two groups (additionally excluding the NY Fed president from the group of voters for reasons discussed above). As voting rights alternate yearly, so does the group of speakers used to construct the indicators.[21]

Different Information Sets: We also investigate whether the results in Table 4 are driven by the supervisory responsibilities of FRB presidents. While the Board of Governors has authority over and is responsible for the supervision of financial institutions, it delegates the authority for day-to-day supervisory activities to the FRBs. Within the Federal Reserve System, each

[21]This hypothesis is in the spirit of Ehrmann et al. (2022) who examine whether there is a difference in speech intensity and tone on monetary policy for voters and non-voters.

FRB supervises the financial institutions that are located within its district and, therefore, the total assets under supervision are markedly different across FRBs. Consequently, we investigate whether the predictive content of speeches by FRB presidents is different depending on the size of the banking assets under supervision. To do so, we classify FRBs as "High Assets" versus "Low Assets". In particular, we compute the average total assets of commercial banks supervised in a given district over the years 1997-2007, and thus obtain a ranking of FRBs by asset supervision (based on data from the St. Louis Fed database FRED). Excluding the NY Fed, the five FRBs with the most assets under supervision are, in descending order, the Richmond Fed, the Chicago Fed, the San Francisco Fed, the Cleveland Fed, and the Atlanta Fed, which consequently constitute the "High Assets" group of banks. The "Low Assets" group consists of the Boston Fed, the St. Louis Fed, the Kansas City Fed, the Philadelphia Fed, the Minneapolis Fed, and the Dallas Fed.

To conduct a formal test of the importance of the NY Fed President's speeches and the *strategic interaction* and *information set* channels discussed above, we run individual regressions as in equation (6), where the topic proportions are computed for the respective subgroups of FRB Presidents: Presidents without NY Fed, Voters, Non-Voters, High Asset FRBs and Low Asset FRBs.

We further investigate whether there is a signal when *more* FRB presidents talk about the same topic *more* than usually. To this end, we augment equation (6) with an interaction term between the FS topic proportion and "the number of unique speakers giving speeches with an FS topic proportion above the average" (labeled as NUS). On average, for the pre-GFC period, the FS topic proportion is around 8% and the NUS is about three speakers out of the 12 FRB presidents.

The results of these alternative Taylor rule estimations are provided in Table 5, columns (2) to (7), while column (1) presents the baseline results as in column (4) of Table 4, for comparison.

Column (2) shows that there is a stronger signal coming from the combination of *how many* FRB presidents are speaking on a specific topic, and *how much*. The interaction term shows that when the FS topic proportion is at or above the average, an increasing number of unique speakers suggests an increasingly dovish attitude of the FOMC, as the effect in the FFR is negative.

In addition, we find that the importance of FRB presidents' communication about financial stability is not driven by the speeches of NY Fed presidents. Indeed, the coefficient, shown in column (3), becomes larger and relatively more precisely estimated when compared with the results for all the presidents shown in column (1). However, the results are overall similar across

the different groups; neither the strategic communication of voters nor the different information sets based on supervisory responsibility appears to clearly drive the results in Table 4.

Table 5: Taylor rule results — pre-crisis period — additional results

	Dependent variable: Federal Funds Target Rate						
	Presidents	NumS	w/o NY	Voters	Non-Voters	High Assets	Low Assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
r_{t-1}	0.876***	0.873***	0.881***	0.878***	0.878***	0.884***	0.873***
	(0.032)	(0.031)	(0.030)	(0.032)	(0.031)	(0.030)	(0.031)
$CPI_{t,h=4}$	0.273**	0.258**	0.256**	0.235**	0.234**	0.227**	0.235*
	(0.121)	(0.113)	(0.116)	(0.114)	(0.119)	(0.107)	(0.120)
$OG_{t,h=4}$	0.136***	0.144***	0.134***	0.139***	0.143***	0.144***	0.140***
	(0.038)	(0.038)	(0.034)	(0.040)	(0.038)	(0.041)	(0.040)
FSP	−0.041***	−0.011	−0.051***	−0.032***	−0.028**	−0.033**	−0.017***
	(0.015)	(0.020)	(0.015)	(0.012)	(0.012)	(0.014)	(0.006)
NUS		0.123***					
		(0.039)					
FSP x NUS		−0.014***					
		(0.005)					
AIC	-17.42	-18.24	-23.64	-19.03	-11.76	-15.38	-8.13
SIC	-2.69	1.4	-8.92	-4.52	2.82	-0.65	6.31
Observations	86	86	86	83	84	86	82
Adjusted R^2	0.987	0.987	0.988	0.987	0.986	0.987	0.985

*Note:*The table shows pre-crisis Taylor rule results, ranging from January 1997 to November 2007. The row FSP shows the coefficient for the Financial Stability topic proportion. The row NUS shows the coefficient for the number of unique speakers with a FS topic proportion above the average, and the row FSP x NUS shows the respective interaction coefficient. For columns (3) to (7) the financial stability topic proportion indicator was computed based on speeches of different subgroups of Fed presidents, as indicated in the column name. The dependent variable is the target FFR. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

Interestingly, FRB presidents are at times accused of cacophony by the financial press and market participants. For instance, the Hutchins Center's survey on Fed communication found that 64%of respondents thought that FRB presidents should talk less and let the Fed Chair speak - see Olson and Wessel (2016). However, we show that FRB presidents' communication provides useful information for policy decisions, i.e. there is a policy signal in their public remarks.

Our findings with regard to FRB presidents are in line with Kliesen et al. (2019), who show that markets react significantly on days when there are multiple FRB presidents speaking. Furthermore, from 2009 to 2013, the Macroeconomic Advisers LLC have consistently ranked FRB presidents as the most impactful speakers (with the exception of the Fed Chair) when analyzing market

reaction to speeches and giving the "Who moved the markets" award.[22] In contrast, Governors' speeches consistently ranked in the neutrality zone, not generating "news" and thus not moving markets.

3.4 Robustness checks

We conducted several robusteness exercises, which investigate: i) alternative computations of the speech-based topic and tone indicators and ii) alternative specifications of the Taylor rules. Table 6 provides an overview of the robustness checks. More detailed descriptions and the respective tables with the results are provided in the Online Appendix.

Table 6: Robustness checks

	Type	Rationale
	Alternative computations of the speech-based indicators	
1	Topic indicator based on LDA only	Topic proportions are entirely based on the LDA results, leaving out step three and four described in Section 2.2.
2	Top words in the LDA	Alternative speech indicators using the top 50 and 100 words in step three described in Section 2.2 respectively.
3	Number of LDA clusters	Alternative speech indicators based on estimating 12 instead of 40 clusters for the LDA.
4	LDA with stemming of the corpus	Alternative speech indicators based on using stemming of text in the preprocessing stage to reduce the dimensionality of data.
5	Tone dictionary	Alternative tone indicator based on the Loughran and McDonald (2011) dictionary.
	Post-2007 sample period in Taylor rule regressions	
6	Post-2007 sample with interaction term	Accounting for potential parameter changes in the Taylor rule around the global financial crisis.
7	Post-2007 sample only	Taylor rule estimation on a sample starting in 2008.
	Alternative Taylor rule specifications	
8	Greenbook nowcasts	We include nowcasts instead of four-quarter-ahead Greenbook predictions. This controls for the possibility that text-based indicator could have an informational advantage over Greenbook forecasts by supplying information about both the current and future state.
9	Include further speech-based topics	To rule out the possibility that the FS topic indicator is not merely a substitute for important information about economic conditions that is revealed in speeches but not reflected in the Greenbook projections.
10	Six week average for financial indicators	We compute financial indicators over the entire intermeeting six-week average, instead of a four-week average.

[22] Each year Macroeconomic Advisers rank FOMC members according to the effects of their communication (speeches, television and radio interviews, and Op-Ed articles) on the two-year (ten-year after 2012) US Treasury yield.

4 Concluding remarks

The Federal Reserve does not have an institutional communication strategy regarding the monetary policy implications of financial stability concerns. In this paper, therefore, we investigate the communication of FOMC members on financial stability-related topics by analyzing their speeches. This type of communication has the advantage of being a flexible medium to express concerns and therefore to reflect the diversity of opinions held within the Fed.

We assessed the speeches' informational content in a monetary policy reaction function and found that communication through speeches on financial-related issues is indeed informative about upcoming monetary policy decisions by the Fed in the pre-Great Recession period. A higher topic proportion of or a more negative tone on Financial Conditions, Financial Stability, and Supervision and Regulation correlates with a more accommodative monetary policy stance, while communication on Housing correlates with a tighter policy stance.

Moreover, by looking at the speeches of different subgroups of FOMC members, we uncover several differences in the communication patterns and explanatory power for policy decisions between Governors and FRB presidents. Speeches by FRB presidents seem to convey timely and clear information on financial-related concerns and the likely direction of monetary policy, especially when several of them speak at the same time, and more than usual on the same topic.

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Appendix A Results for other financial-related topics

Table A.1: Taylor rule results — Supervision and Regulation

	FFR	FFR	FFR	FFR	SR	SR	SR	SR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
r_{t-1}	0.876***	0.878***	0.882***	0.882***	0.960***	0.926***	0.924***	0.928***
	(0.031)	(0.028)	(0.031)	(0.030)	(0.017)	(0.026)	(0.028)	(0.027)
$CPI_{t,h=4}$	0.219*	0.239**	0.209**	0.216**	0.076	0.186*	0.185*	0.182*
	(0.112)	(0.096)	(0.105)	(0.099)	(0.060)	(0.102)	(0.105)	(0.103)
$OG_{t,h=4}$	0.143***	0.160***	0.174***	0.173***	0.039**	0.032	0.032	0.031
	(0.046)	(0.043)	(0.043)	(0.043)	(0.017)	(0.021)	(0.023)	(0.023)
SR Proportion		−0.031***		−0.008	0.014	−0.009		−0.005
		(0.010)		(0.011)	(0.020)	(0.011)		(0.015)
Neg. Tone			−0.809***	−0.679**	−0.294		−0.182	−0.119
			(0.260)	(0.316)	(0.367)		(0.268)	(0.381)
p07 x SR Proportion						0.032		0.032
						(0.023)		(0.029)
p07 x Neg. Tone							0.383	0.039
							(0.375)	(0.476)
AIC	-7.9	-13.17	-16.86	-15.16	32.23	24.35	25.28	28.21
SIC	4.37	1.56	-2.14	2.02	53.71	48.9	49.83	58.9
Observations	86	86	86	86	159	159	159	159
Adjusted R^2	0.985	0.986	0.987	0.987	0.991	0.992	0.992	0.992

Note: The table shows Taylor rule results for the period ranging from January 1997 to November 2007, and January 1997 to December 2016, as indicated by the column names FFR and SR respectively. FFR denotes the target Federal Funds Rate, whereas SR in the column headline denotes the shadow rate of Wu and Xia (2016). The explanatory variables S&R topic proportion and Neg. Tone are computed based on speeches of all FOMC members for the topic Supervision and Regulation. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

Table A.2: Pre-crisis period — Tone Results for Supervision and Regulation

	Dependent Variable: Federal Funds Rate			
	FOMC	Board	Fed Chair	Presidents
	(1)	(2)	(3)	(4)
FFR_{t-1}	0.882^{***}	0.875^{***}	0.906^{***}	0.873^{***}
	(0.031)	(0.032)	(0.030)	(0.032)
$CPI_{t,h=4}$	0.209^{**}	0.233^{**}	0.187^{*}	0.230^{**}
	(0.105)	(0.113)	(0.100)	(0.112)
$OG_{t,h=4}$	0.174^{***}	0.155^{***}	0.135^{***}	0.169^{***}
	(0.043)	(0.047)	(0.050)	(0.040)
Neg. Tone	-0.809^{***}	-0.212^{*}	-0.168^{*}	-0.675^{***}
	(0.260)	(0.119)	(0.091)	(0.189)
AIC	-16.86	-4.2	-4.17	-19.37
SIC	-2.14	10.24	9.65	-4.64
Observations	86	82	74	86
Adjusted R^2	0.987	0.985	0.986	0.987

*Note:*The table shows pre-crisis Taylor rule results, ranging from January 1997 to November 2007, where the negative tone indicator with respect to the Supervision and Regulation topic is computed based on speeches of different subgroups of the FOMC, as indicated in the column name. The dependent variable is the target FFR. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

Table A.3: Taylor rule results — Financial Conditions

	FFR	FFR	FFR	FFR	SR	SR	SR	SR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
r_{t-1}	0.876***	0.877***	0.885***	0.882***	0.966***	0.935***	0.946***	0.942***
	(0.031)	(0.031)	(0.035)	(0.033)	(0.017)	(0.026)	(0.025)	(0.026)
$CPI_{t,h=4}$	0.219*	0.241**	0.217*	0.231**	0.124**	0.193**	0.178**	0.191**
	(0.112)	(0.102)	(0.112)	(0.105)	(0.062)	(0.092)	(0.087)	(0.085)
$OG_{t,h=4}$	0.143***	0.143***	0.138***	0.140***	0.018	0.018	0.015	0.021
	(0.046)	(0.043)	(0.046)	(0.045)	(0.019)	(0.023)	(0.022)	(0.022)
FC Proportion		−0.038***		−0.022	0.012	−0.034**		−0.010
		(0.013)		(0.015)	(0.019)	(0.014)		(0.016)
Neg. Tone			−0.600***	−0.353	−0.531*		−0.668***	−0.555***
			(0.204)	(0.228)	(0.297)		(0.200)	(0.195)
p07 x FC Proportion						0.023		0.055
						(0.019)		(0.041)
p07 x Neg. Tone							0.426*	−0.123
							(0.231)	(0.508)
AIC	-7.9	-13.07	-13.09	-12.41	18.97	21.68	17.43	19.06
SIC	4.37	1.65	1.64	4.77	40.45	46.23	41.98	49.75
Observations	86	86	86	86	159	159	159	159
Adjusted R^2	0.985	0.986	0.986	0.986	0.992	0.992	0.992	0.992

Note: The table shows Taylor rule results for the period ranging from January 1997 to November 2007, and January 1997 to December 2016, as indicated by the column names FFR and SR respectively. FFR denotes the target Federal Funds Rate, whereas SR in the column headline denotes the shadow rate of Wu and Xia (2016). The explanatory variables FC topic proportion and Neg. Tone are computed based on speeches of all FOMC members for the topic Financal Conditions. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

Table A.4: Pre-crisis period — Tone Results for Financial Conditions

	Dependent Variable: Federal Funds Rate			
	FOMC	Board	Fed Chair	Presidents
	(1)	(2)	(3)	(4)
FFR_{t-1}	0.885***	0.875***	0.918***	0.882***
	(0.035)	(0.033)	(0.029)	(0.033)
$CPI_{t,h=4}$	0.217*	0.228**	0.153	0.257**
	(0.112)	(0.116)	(0.094)	(0.119)
$OG_{t,h=4}$	0.138***	0.149***	0.105***	0.130***
	(0.046)	(0.046)	(0.038)	(0.046)
Neg. Tone	−0.600***	−0.123	−0.246**	−0.501***
	(0.204)	(0.131)	(0.122)	(0.162)
AIC	-13.09	-3.28	-18.39	-12.59
SIC	1.64	11.16	-4.65	2.14
Observations	86	82	73	86
Adjusted R^2	0.986	0.985	0.988	0.986

*Note:*The table shows pre-crisis Taylor rule results, ranging from January 1997 to November 2007, where the negative tone indicator with respect to the Financial Conditions topic is computed based on speeches of different subgroups of the FOMC, as indicated in the column name. The dependent variable is the target FFR. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

Table A.5: Taylor Rule Results — Housing

	FFR	FFR	FFR	FFR	SR	SR	SR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
r_{t-1}	0.876***	0.874***	0.873***	0.874***	0.911***	0.921***	0.911***
	(0.031)	(0.029)	(0.031)	(0.030)	(0.026)	(0.025)	(0.026)
$CPI_{t,h=4}$	0.219*	0.216**	0.221**	0.216**	0.214**	0.195*	0.226**
	(0.112)	(0.107)	(0.110)	(0.106)	(0.105)	(0.103)	(0.101)
$OG_{t,h=4}$	0.143***	0.150***	0.147***	0.150***	0.033	0.026	0.037
	(0.046)	(0.045)	(0.047)	(0.046)	(0.025)	(0.023)	(0.024)
Housing Proportion		0.040**		0.041	0.013		0.021
		(0.020)		(0.034)	(0.024)		(0.040)
Neg. Tone			0.392	−0.030		0.021	−0.150
			(0.418)	(0.629)		(0.459)	(0.694)
post2007 x Housing Proportion					0.021		0.106*
					(0.031)		(0.063)
post2007 x Neg. Tone						0.133	−1.255
						(0.504)	(0.994)
AIC	-7.9	-7.92	-6.75	-5.93	24.27	26.17	24.71
SIC	4.37	6.8	7.97	11.25	48.82	50.72	55.4
Observations	86	86	86	86	159	159	159
Adjusted R^2	0.985	0.985	0.985	0.985	0.992	0.992	0.992

Note: The table shows Taylor rule results for the period ranging from January 1997 to November 2007, and January 1997 to December 2016, as indicated by the column names FFR and SR respectively. FFR denotes the target Federal Funds Rate, whereas SR in the column headline denotes the shadow rate of Wu and Xia (2016). The explanatory variables Housing proportion and Neg. Tone are computed based on speeches of all FOMC members for the topic Housing. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01

Table A.6: Pre-Crisis Period — By FOMC Members — Financial Stability and Housing

	Dependent Variable: Federal Funds Target Rate			
	FOMC	Board	Fed Chair	Presidents
	(1)	(2)	(3)	(4)
r_{t-1}	0.873***	0.871***	0.891***	0.871***
	(0.027)	(0.030)	(0.029)	(0.029)
$CPI_{t,h=4}$	0.281***	0.268**	0.261***	0.255**
	(0.104)	(0.117)	(0.100)	(0.104)
$OG_{t,h=4}$	0.149***	0.147***	0.138***	0.147***
	(0.037)	(0.044)	(0.045)	(0.036)
FS Proportion	−0.057***	−0.017*	−0.019***	−0.042***
	(0.017)	(0.009)	(0.005)	(0.014)
Housing Proportion	0.058***	0.012	−0.006	0.054**
	(0.022)	(0.013)	(0.011)	(0.023)
AIC	-20.96	-4.22	-8.86	-20.13
SIC	-3.78	12.63	7.27	-2.95
Observations	86	82	74	86
Adjusted R^2	0.988	0.985	0.987	0.988

Note: The table shows pre-crisis Taylor rule results, ranging from January 1997 to November 2007, where the topic proportions are computed based on speeches of different subgroups of the FOMC, as indicated in the column name. The dependent variable is the target FFR. Standard errors are computed using a HAC based on Newey and West (1987). *p<0.1; **p<0.05; ***p<0.01