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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Financial Stability and the Fed: Evidence from Congressional Hearings*

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Abstract

This paper retraces how financial stability considerations interacted with U.S. monetary policy before and during the Great Recession. Using text-mining techniques, we construct indicators for financial stability sentiment expressed during testimonies of four Federal Reserve Chairs at Congressional hearings. Including these text-based measures adds explanatory power to Taylor-rule models. In particular, negative financial stability sentiment coincided with a more accommodative monetary policy stance than implied by standard Taylor-rule factors, even in the decades before the Great Recession. These findings are consistent with a preference for monetary policy reacting to financial instability rather than acting pre-emptively to a perceived build-up of risks.

JEL classifications: E52, E58, N12

Keywords: monetary policy, financial stability, Taylor rule, text mining

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1 Introduction

This paper retraces how financial stability considerations interacted with U.S. monetary policy before and during the Great Recession. One could argue that financial stability would not have figured prominently in monetary policy deliberations at the Federal Reserve in the years before the 2007/08 financial crisis. Since the late 1970s, when its monetary policy objectives were last amended by U.S. Congress, the Fed has operated under a dual mandate of maximum employment and stable prices.[1] In addition, the Federal Reserve Act does not explicitly mention financial stability, although some of its elements do have a clear financial stability connotation.[2] Moreover, prior to the crisis, several Federal Reserve officials expressed doubts on whether the Fed should actively engage with potential asset price booms (Greenspan, 2002; Bernanke, 2002). Financial stability in itself was, therefore, most likely not an explicit — and perhaps an even somewhat overlooked — element of the Fed's monetary policy remit in the decades leading up to the Great Recession. In fact, then-Chair Ben Bernanke concluded as much in a paper marking the Fed's centenary (Bernanke 2013, p. 9).

Treating monetary stability as separate from financial stability was, of course, common practice before the Great Recession. During the 1990s and 2000s, inflation targeting (IT) became a commonly used monetary policy strategy. First introduced by the Reserve Bank of New Zealand in 1989, around 30 countries had adopted IT by the time the financial crisis started (Hammond, 2012). The key element of IT is a strong emphasis on delivering low and stable inflation (Bernanke, 2003). In addition, an IT strategy involves extensive communication regarding economic forecasts (Svensson, 1997; Bernanke, 2003; Blinder et al., 2008). In practice, central banks usually use a flexible form of IT, meaning that they try to stabilize both inflation and economic growth (Svensson, 2009). However, as discussed by Mishkin (2011), monetary policy instruments would only focus on minimizing inflation and

[1] Section 2A of the Federal Reserve Act also lists moderate long-term interest rates, but that third objective usually receives less attention in policy and academic discussions. See Zhu (2013) for details on the 1977 Federal Reserve Reform Act.

[2] See, for instance, Section 10 of the Act on emergency advances to member banks.

output gaps, while prudential regulation and supervision would be relied upon to prevent excessive risk-taking that might impair financial stability.

Even so, there had been an active debate on whether such a dichotomy between monetary and financial stability was indeed optimal. In particular, some academics and policymakers pointed to the detrimental effects of asset price boom/bust cycles on the macroeconomy. These effects led them to conclude that asset-price misalignments should play a role in setting monetary policy. By leaning against the wind — i.e., pre-emptively tightening monetary policy when asset prices were out of line with fundamentals — the central bank could reduce the likelihood of asset-price busts, or at least limit the fallout. Overall, this approach would lead to improved macroeconomic performance (Cechetti et al., 2000; Crockett, 2001; Cechetti et al., 2002; Borio and Lowe, 2002; Borio and White, 2004).

In the end, however, the arguments for a leaning-against-the-wind approach to monetary policy had not carried the day. Under the so-called Jackson Hole consensus, monetary policymakers generally did not target asset prices, did not deflate bubbles by raising rates, and reacted — if at all — only after an asset-price bubble had burst (Issing, 2010). An often-used argument was that it was difficult to identify the existence of bubbles (Greenspan, 2002). Another argument was that monetary policy could only have small effects on the probability of financial crises, which would make intervention prohibitively costly (Bernanke and Gertler, 1999).

In focusing on the interactions of U.S. monetary policy with financial stability, our paper is related to recent work by Peek et al. (2016) and Oet and Lyytinen (2017). These papers both argue that U.S. monetary policy before 2008 already acted in a manner consistent with having financial stability as an additional mandate. Both papers construct measures for financial stability concerns from textual data and show that these measures are relevant variables in Taylor-rule estimations for Fed policy.[3] Given the prior that financial stability would not have figured

[3] In a seminal analysis of FOMC transcripts, Cecchetti (2003) found that as equity prices boomed, FOMC members spoke more intensively about the stock market. He also finds evidence that the monetary policy stance was adjusted accordingly. In the paper, Cecchetti estimated various Taylor-rule models, but he did not include word counts for financial stability concerns as separate explanatory variables.

prominently in monetary policy deliberations, these two papers' findings are both interesting and surprising, which is why we further study these issues in this paper.

There are three distinctive aspects of our analysis. First, our paper uses evidence from Congressional hearings, thus switching the focus to a source of information that differs from FOMC deliberations. Congressional hearings are particularly interesting, as these are the occasions where Fed policymakers directly interact with the politicians who decide on the monetary policy mandate. Second, using these hearings enables us to use a communication instrument with a history stretching back to the late 1970s. In contrast, Peek et al. (2016) analyze a sample starting in 1982, while the sample in Oet and Lyytinen (2017) starts in February 1990. A long time series is especially useful in this context, since financial cycles are generally longer than business cycles (Claessens et al., 2012). Third, we apply a wider range of text-mining techniques. Peek et al. (2016) use a fairly small set of keywords to measure sentiment in FOMC transcripts, while Oet and Lyytinen (2017) mainly rely on content analysis, i.e. a hand-coding of the FOMC minutes. In contrast, our paper relies on a broader range of methods for sentiment analysis and topic modeling. In particular, we will rely on a recent sentiment dictionary by Correa et al. (2017) that is especially suited for analyses in the context of financial stability.

Our paper also contributes to a recent literature that applies linguistic methods to the study of monetary policy. Closely related is the paper by Schonhardt-Bailey (2013), who uses textual-analysis software to establish the themes of Congressional hearings. One of her conclusions is that members of Congress were most active in challenging the Fed on the themes of governance, accountability, and transparency, while also focusing on fiscal-policy issues. Based on her classification of themes, there seems to have been little direct attention for financial stability. One additional contribution of our paper is to reassess this by explicitly trying to establish the role — if any — of financial stability in these hearings. Another related paper using linguistic methods is Friedrich, Hess, and Cunningham (2019). They measure the prominence of financial stability references in monetary policy statements and subsequently show that this measure is significant in Taylor-rule models for ten central banks in major advanced countries. Their sample, however, only tracks back to 2000, and for the Fed the relatively short monetary policy press releases are studied. Our paper is also related to work by Correa et al. (2017), who use text-mining techniques to analyze the relation between the financial cycle and sentiment expressed in financial stability reports published by a sample of 35 banks. For the U.S., however, their work has to rely on non-public reports, since the Federal Reserve only started publishing a Financial Stability Report in November 2018.[4] A final related paper is by Cieslak and Vissing-Jorgensen (2019), who use textual analysis of FOMC minutes and transcripts to present evidence for the Fed put, i.e. the idea that monetary policy becomes more accommodative following poor stock returns. Our paper differs in having a broader approach to financial stability than only stock market conditions.

This paper uses text-mining techniques to construct indicators for the Fed's financial stability concerns. We apply these text-mining techniques to 68 testimonies of four Federal Reserve Chairs at Congressional hearings on monetary policy. The sample period starts in February 1979, when Chair William Miller testified during the first so-called Humphrey-Hawkins testimony. We also include testimonies by Paul Volcker, Alan Greenspan, and Ben Bernanke. The sample ends in July 2012, which allows us to analyze the Fed's policy response to the financial crisis and the Great Recession.[5]

We estimate a number of different Taylor-rule models rather than relying on one single specification. For instance, we estimate models relying on projections given in the semiannual Monetary Policy Reports, Greenbook forecasts, as well as output gap projections by the Congressional Budget Office (CBO). In addition, in line with the recent literature (Coibion and Gorodnichenko, 2012), we allow for both interest rate smoothing and persistent monetary-policy shocks in the estimations.

We find that indicators for sentiment on financial stability add explanatory power to conventional Taylor-rule models. This finding implies that, at times, the Federal Reserve Chair has pointed to financial stability considerations in discussing

[4]Correa et al. (2017) rely on confidential reports by the Financial Stability Oversight Council. For details on the Federal Reserve Financial Stability Report, see `https://www.federalreserve.gov/publications/financial-stability-report.htm`. URL last accessed on 29 November 2018.

[5]One practical point concerning the end-point of the sample is that some of our key explanatory variables are from the Fed's Greenbook, which is only available after a five-year delay.

the monetary policy stance with members of Congress. There are two key dimensions to our findings. First, our conclusions do not depend on including the Great Recession or the aftermath of the 1987 stock market crash in the sample. This indicates that financial stability was, to some extent, also considered to be a relevant factor during mostly tranquil times. Second, we find that negative sentiment matters, while positive sentiment does not. In particular, negative financial stability sentiment coincided with a more accommodative monetary policy stance than implied by standard Taylor-rule factors. Taken together, this would confirm a preference for reacting to episodes of financial instability rather than acting preemptively to a perceived build-up of risks. Such a preference would be in line with comments by several Fed officials, such as Greenspan (2002) or Bernanke (2002).

This paper's findings are related to current discussions on the interactions between monetary and financial stability. Central bankers now widely agree that macroprudential policy is an important addition to the macroeconomic toolkit (Blinder et al. 2017). However, there is still an ongoing debate among academics and policymakers on the precise implications of the crisis for the interactions between monetary and financial stability (Smets, 2014; Adrian and Liang, 2017; Svensson, 2017). In Norway and New Zealand, the mandate for monetary policy has recently been broadened. In the U.S., meanwhile, the Fed's post-crisis role in financial stability remains limited, and responsibility for this policy domain is shared with a number other institutions (Haltom and Weinberg, 2017). As in the decade before the financial crisis, the debate centers around the question of whether macroprudential policy and financial regulation are sufficiently equipped to deal with financial instability or whether monetary policy should also, at times, be used for leaning against the wind. Our findings suggest that under a dual mandate such as that of the Fed, financial stability can, at least to some extent, already be factored into monetary policy deliberations.

2 Background on Humphrey-Hawkins hearings

The high levels of inflation and unemployment of the early 1970s motivated U.S. lawmakers to be more closely involved in the formulation of monetary policy. In

1975, Congress adopted House Concurrent Resolution 133. This resolution suggested that the Fed should encourage lower long-term interest rates and focus on promoting maximum employment and stable prices. The resolution also asked that the Board of Governors would regularly consult with Congress. On the one hand, the resolution was non-binding, and the Fed was formally not required to follow up on these suggestions (Binder and Spindel, 2017). However, starting in May 1975, Fed Chair Arthur Burns regularly appeared before Congressional committees as part of the so-called quarterly dialogue on monetary policy.

Following the Concurrent Resolution, Congress did further formalize oversight over monetary policy in two subsequent acts. The first was the Federal Reserve Reform Act of 1977. Using language very similar to the 1975 concurrent resolution, this Reform Act gave the Fed its dual mandate, while also instructing the Board to consult with Congress at semiannual hearings (Zhu, 2013). The second act was the 1978 Full Employment and Balanced Growth Act. This act had, in fact, a focus that was much broader than monetary policy alone. However, Section 108 of this act — often colloquially referred to as the Humphrey-Hawkins Act after its two main sponsors — gave quite detailed instructions on the information that the Fed was to provide to Congress in the context of the semiannual hearings. For instance, the Fed had to provide written information concerning its objectives and plans with respect to growth in money and credit. Also, it had to discuss the relationship between these objectives and the short-term goals detailed in the Economic Report of the President as well as any goals approved by Congress (Steelman, 2013).[6]

This paper uses textual evidence from Congressional hearings between 1979 and 2012. The first hearing included is that of February 1979, when Fed Chair William Miller presented the Fed's first Monetary Policy Report to Congress. The other three Fed Chairs for which this paper includes Humphrey-Hawkins (HH) hearings are Paul Volcker (1979–1987), Alan Greenspan (1987–2005), and Ben Bernanke (2006–2012). In principle, one could also consider earlier testimonies by Fed Chair Arthur Burns since the mid-1970s. However, we have no accompanying economic forecasts available for the earlier testimonies, making it difficult to

[6]Appendix A lists the documents that were consulted for this background section.

include the textual evidence in Taylor rule estimations. The sample ends in July 2012, which allows us to study the Fed's reaction to the financial crisis.

Each of the Congressional hearings has two distinct parts. The starting point is a prepared statement by the Fed Chair, which is largely based on the semiannual Monetary Policy Report. Following the statement, there is a discussion in which members of the Congressional committees debate various topics related to monetary policy with the Fed Chair. This paper focuses on the introductory statements, given that these would presumably contain the most important information that the Fed wanted to present to Congress on monetary policy.

3 Methodology

3.1 Measuring financial stability sentiment

We downloaded all transcripts of the hearings in PDF format from the St. Louis Fed's Fraser web site. We then converted the introductory statements to individual plain-text files. In our analysis, we always use the version that was presented at the House hearings. Using the versions prepared for Senate hearings would lead to similar conclusions, as the text versions of the prepared statements are always nearly identical. Our sample includes 68 Humphrey-Hawkins hearings between 1979 and 2012. Using the R package *Quanteda* (Benoit et al. 2018), we create and analyze a corpus of the 68 introductory statements. In creating the corpus, we take a number of standard text-mining steps, such as removing stopwords and performing word-stemming. Regarding stopwords, we always start from the lists drawn up by Loughran and McDonald (2011).[7] We also remove punctuation and separators, and we also transform all characters to lower case.

To build indicators for financial stability sentiment, we use the dictionary proposed by Correa et al. (2017). Their dictionary consists of 391 words, of which 96 are deemed to have a positive and 295 a negative connotation with respect to financial stability. They constructed this dictionary by having two teams of two

[7] In some of our analyses, we tailor the stopword lists to the specific text-mining technique. For instance, when using *sentometrics* in section 5, we need to ensure that words capturing shifts in the intensity of sentiment remain in the texts.

independent coders classify individual words from a sample of financial stability reports published by central banks in 35 countries. Positive or negative tones were then attributed to individual words by determining how each of these contributed to the sentiment of the sentence as a whole.

We use the Correa et al. (2017) dictionary as it is specifically tailored to the context of financial stability. Using alternatives such as Harvard-IV might be problematic, as words in that lists could have very different connotations in the context of financial stability. A similar caveat still applies to using the word lists by Loughran and McDonald (2011), even though their lists are already more tailored to a financial-economics context. We considered using the word list by Peek et al. (2016). However, that list is much shorter than that from Correa et al. (2017), and applying it to the Humphrey-Hawkins testimonies generated too little variation to be included in the Taylor rule models. It is important to note that we go beyond a plain 'bag of words' approach and moderate the influence of contextual language by accounting for simple negation patterns of positive terms, as in Loughran and McDonald (2011) and Correa et al. (2017).[8]

Over the years, the relative occurrence of words conveying financial stability sentiment has remained fairly stable. To illustrate this, Figure 1 plots the number of total words in each statement (dashed line, right scale) alongside the number of financial-stability related terms (solid line, left scale). There is no obvious trend in either the total number of words nor the number of financial-stability related terms. However, there is quite substantial comovement between both series ($\rho = 0.93$). This indicates that financial-stability considerations do not come at the expense of other topics in the Fed Chair's introductory statements.

insert Figure 1 around here

Table 1 provides a more in-depth look into the frequencies of financial-stability related word counts with stemming (upper panel) and without stemming (lower

[8]We ran a keyword-in-context search for 18 forms of negation and then corrected for false positives if a negation term appeared within a three-word range before a positive word. This step identified 141 false positives in the sample.

panel).[9] In the following discussion, we focus on the broader indicator with stemming. It is worth noting, however, that the correlation of both types of indicators is substantial (see also the note to Table 1). In contrast to Correa et al. (2017), our baseline analysis uses only the stemmed versions of individual words. However, as we will discuss in Section 5, stemming does not materially affect the conclusions.

insert Table 1 around here

As already indicated by Figure 1, financial-stability related terms make up to 10.7% of the total words in each introductory statement with a mean of 7.8% in our sample. On average, there are more negative terms (4.5%) than positive ones (3.3%). Consequently, the difference between negative and positive terms in the bottom line of the upper panel is, on average, larger than zero (1.2%).

3.2 Specifying Taylor rules

To analyze the role of financial stability sentiment in setting monetary policy, we start by estimating benchmark Taylor rules. These benchmark models include standard macroeconomic factors, but they exclude the text-based indicators. In line with the recent empirical literature (Coibion and Gorodnichenko, 2012), we allow for both interest rate smoothing and a first-order autoregressive error-term specification:[10]

$$i_t = \rho_i i_{t-1} + \alpha + \beta_1 E_t \pi_{t+k} + \beta_2 E_t y_t + u_t \quad (1)$$

$$u_t = \rho_u u_{t-1} + e_t \quad (2)$$

where t indexes the semiannual frequency, i_t is the federal funds rate, $E_t \pi_{t+k}$ is the k quarters ahead expected inflation rate, and $E_t y_t$ is the nowcast of the real macroeconomic indicator (see below).

[9] Stemming is a common data preparation step in text-mining, where words are reduced to their roots. For example, 'walking', 'walks', and 'walked' would all be measured as 'walk'.

[10] See, inter alia, Gerlach-Kristen (2004), Rudebusch (2006), or Consolo and Favero (2009) for a discussion of whether to include a partial adjustment mechanism and/or an autoregressive error term into the reaction function.

This paper studies whether the Fed considered financial stability issues in its monetary policy beyond the reaction to inflation and real activity dynamics. Hence, the benchmark Taylor rules without the financial stability indicators should ideally capture as much of the Fed's interest-rate-setting process as possible. Of course, one can always debate the precise specification and choice of variables in the Taylor rule. Therefore, our approach is estimating a battery of benchmark Taylor rules based on Eqs. (1) and (2), in the process employing four different sets of forecasts.

First, we follow Orphanides and Wieland (2008) and Jansen (2011) in relying on the projections reported in the semiannual Monetary Policy Reports. The benefit of this set is that it is timed simultaneously to the HH hearings. We use the output forecast for the current year as real activity indicator and employ two different nominal indicators: (i) the 12-month ahead expected inflation rate and (ii) the current year inflation forecast. The projections are communicated as a range, rather than a point estimate, so we use the mid-point of the central tendency. The second set is based on the Greenbook forecasts prepared by the Fed's staff before each FOMC meeting. Here, following Coibion and Gorodnichenko (2012), we employ the output growth nowcast as real indicator. As the nominal indicator, we again utilize two different variables: (i) the two-quarter ahead expected inflation rate and (ii) the inflation nowcast. In the third set, we replace output growth with the corresponding nowcast for the unemployment rate, since the Fed's dual mandate focuses on employment rather than growth. All three specifications rely on the nowcast of GDP growth or the unemployment rate rather than an output gap measure, thereby also reflecting the difficulties of measuring the latter in real time (Orphanides and van Norden, 2002).[11] To account for time-variation in potential growth, we employ a fourth specification where we utilize the output gap measure by the CBO as real macroeconomic indicator alongside the inflation forecasts and nowcasts of the Greenbook.[12] In addition to the variation in the type of forecasts

[11] To facilitate the interpretation of the constant term as the equilibrium interest rate, we follow the recent literature (e.g. Neuenkirch and Tillmann, 2014; Bauer and Neuenkirch, 2017) and subtract 2% from expected inflation and from the GDP growth nowcast. Hence, we create proxies for the expected inflation gap and a nowcast of the output gap with a time-invariant target or trend.

[12] Fed staff estimates of the (expected) output gap are available since August 1987.

employed, we also estimate Taylor rules with and without the autoregressive error term in Eq. (2).

We select, for each type of forecast, the Taylor rule with the best fit. That is, we check whether the expected inflation rate or the nowcast of inflation better describes the Fed's interest rate setting and whether or not to include an autoregressive error term. Reflecting the findings of Orphanides (2001), we analyze monetary-policy decisions in real-time, which implies that the federal funds rate at the time of the testimony is regressed on the respective latest available forecast. Since all right-hand side variables are observables, we estimate the Taylor-rule models using maximum likelihood.

In the last step of the analysis, we add indicators for financial stability sentiment to the Taylor-rule models. We then use the information on financial stability in three ways. First, we consider the relevance of any term conveying financial stability sentiment. This amounts to using the relative frequency of financial stability terms in each introductory statement, that is, the sum of the number of negative and positive words divided by the total number of words. Second, we distinguish between the connotations of the individual terms and include the relative frequency of negative and positive sentiment terms separately in the regression models. Third, we follow Correa et al. (2017) in computing a financial stability sentiment (FSS) index as follows:

$$FSS_t = \frac{\#Negative\ words_t - \#Positive\ words_t}{\#Total\ words_t} \tag{3}$$

This FSS index expresses the net sentiment of the Fed Chair's introduction at each hearing as a fraction of the total number of words in his statement. A negative (positive) value for the FSS index would indicate that the introductory statement, on balance, signaled positive (negative) sentiment on financial stability.

4 Main results

4.1 Benchmark Taylor rules

As the benchmark model, we will use Taylor rules with inflation forecasts and persistent monetary policy shocks. This choice follows from a comparison of the log-likelihood and AIC of various models that do not yet include measures for financial stability sentiment. Tables B1–B4 in Appendix B provide the estimates for the various Taylor rule models. In all four tables, columns (1) and (3) utilize inflation gap forecasts, whereas columns (2) and (4) use the corresponding nowcasts. In addition, columns (1) and (2) account for interest rate smoothing behavior, whereas columns (3) and (4) additionally incorporate persistent monetary policy shocks. In all four sets of estimations, the models in columns (3) — i.e. those with inflation forecasts and persistent monetary policy shocks — provide the best fit, as indicated by the highest log-likelihood and the lowest AIC.

In general, the results for standard Taylor-rule factors are intuitive. The coefficients indicate that the Fed tightens policy when expected inflation increases or when the output gap widens. In addition, the estimates indicate that policy is loosened when unemployment increases. Finally, we find evidence for interest rate smoothing, while monetary policy shocks are found to be persistent.

According to the results in column (3) of Table B1, the interest rate smoothing parameter (0.59) is smaller than in previous research (e.g. Coibion and Gorodnichenko, 2012). However, this smaller smoothing parameter can be explained by the lower frequency of our analysis: we consider semiannual hearings, while other papers focus on the eight or so FOMC meetings in a calendar year. We find that 38.6% of the previous period's error carries over into the current period as indicated by the coefficient on the MA(1) term. When calculating the steady state reaction — i.e., when dividing the short-run coefficients in Table B1 by 1 minus the interest rate smoothing parameter — the Fed's response to expected inflation (2.16) meets the Taylor principle. In addition, the adjustment to changes in the output gap nowcast (0.92) and the equilibrium interest rate (2.08) are economically reasonable as well.

Next, we take a closer look at the residuals of the benchmark Taylor rules. Figure 2 shows the demeaned FSS index (solid black line) and the residuals of the benchmark Taylor rules over time. Only 1% of the variation in the federal funds rate is not accounted for by the macroeconomic factors. However, in all four cases there is a distinct negative correlation between the residuals and the FSS index, which ranges between −0.19 and −0.30. This correlation is a first indication that the Fed's policy stance deviated from that implied by benchmark Taylor rules in connection with financial stability considerations.

insert Figure 2 around here

4.2 Taylor Rules with financial stability sentiment

We now augment the benchmark Taylor-rule models with measures for the Fed's financial stability sentiment. Tables 2–5 display various estimation results, where the difference is related to the data source for the macroeconomic forecasts: Table 2 uses the semiannual Monetary Policy Reports; Tables 3 and 4 use the Greenbook; and Table 5 uses CBO data. The first column of each of these four tables always replicates the benchmark result reported in the respective Tables B1–B4. Columns (2) then include an indicator for the relative frequency of financial-stability-sentiment terms (negative plus positive terms over total words). Columns (3) look at the separate impact of negative and positive terms. Columns (4) use the FSS index as a covariate.

insert Tables 2–5 around here

Overall, we find that the tone on financial stability rather than the total amount of attention for this topic is relevant in the Taylor rules. Our first measure, which looks at the combined occurrence of positive and negative terms, does not enter significantly into the Taylor models (columns 2 of Tables 2–5). However, when considering negative and positive sentiment words separately (columns 3), we find that a one percentage point (pp) increase in the share of negative words is associated with a 0.20–0.28 pp lower federal funds rate. This implies that, at times, the Fed Chair has pointed to adverse developments in financial stability to motivate deviations of the monetary policy stance from a Taylor rule benchmark. When using the standard deviation of the negative-sentiment indicator (0.86) as a yardstick, it follows that the effect of financial stability sentiment is of economic relevance, as this amounts to slightly below a 25 basis points interest-rate step. The share of positive words, in contrast, is insignificant in all models. Such an asymmetry in the role of positive and negative sentiment is in line with findings reported by Peek et al. (2016). Finally, when using the FSS index (columns 4), we generally observe a significantly negative coefficient for financial stability sentiment. In these four cases, a 1 pp increase in the FSS indicator is associated with a 0.16–0.27 pp lower federal funds rate. Similar to the results in columns (3), this effect is of economic relevance when considering the standard deviation of the FSS indicator (1.15). Finally, it is worth noting that the significance of the persistency of monetary policy shocks is reduced when including the financial stability measures, which points towards an omitted-variable bias in the baseline Taylor Rules in Tables B1–B4.

5 Robustness

We consider the robustness of our findings on the role of financial stability sentiment along seven dimensions. To conserve space, we will report only the estimates for financial stability sentiment indicators. A complete overview of estimation results is available on request.

First, we consider what happens when we exclude the period after which the federal funds rate reached the zero-lower bound (ZLB), i.e. our estimations end with the February 2009 hearing. There are at least two reasons for this sample restriction: (i) the period after February 2009 is an obvious instance where the Fed would point to financial stability considerations and (ii) unconventional monetary policy measures other than interest rate changes were put into action causing the federal funds rate to be an incomplete indicator of the monetary policy stance. As shown in Table 6, the FSS indicator remains significant in all four specifications when the sample restriction is in place. In fact, the point estimates for the pre-ZLB period are slightly larger than those for the 1979-2012 sample.

insert Table 6 around here

Second, we account for the aftermath of the 1987 stock market crash and the onset of the Global Financial Crisis, as these are other obvious times at which the Fed would have pointed to financial instability. We implement the sensitivity check by re-estimating the Taylor rules for the period 1979–2007, but without including the two hearings immediately following the crash, i.e. those in 1988. As indicated by Table 7, we still find evidence that financial stability sentiment was relevant.

insert Table 7 around here

Third, we present results using the Wu and Xia (2016) shadow rate instead of the federal funds rate during the zero lower bound period. As Table 8 shows, using this alternative measure for the monetary policy stance — that also account for unconventional monetary policy measures — leaves the point estimates for the sentiment indicators virtually unchanged, although the significance is slightly less pronounced.

insert Table 8 around here

The fourth point is more technical, as it relates to the details of the text-mining approach. Here, we consider possible effects of word-stemming, by also estimating augmented Taylor rules where the 'raw' words have been counted in the creation of the financial-stability indexes. The results are in Table 9. Skipping stemming in the data processing would have no material impact on the conclusions, as the key results are replicated in that case. In particular, negative sentiment on financial stability is still reflected in the Fed's interest rate setting. When weighting the coefficients in Table 9 with the respective standard deviations (0.66 for negative terms and 0.84 for the FSS index), we find that the effects of financial-stability concerns on the federal funds rate are even more pronounced compared to the results with stemming. Finally, it is also worth noting that the relative frequency of total financial-stability related words is significantly negative in this robustness test when using Greenbook output growth or unemployment nowcasts (columns 2 and 3).

insert Table 9 around here

Fifth, we consider one potential drawback of the wordlist by Correa et al. (2017). As the number of negative words is about three times as large as the number of positive words, this may introduce a bias towards negative sentiment in the overall sentiment index. To overcome this asymmetry, we weight the absolute frequency of negative and positive words found in each of the introductory statements with the total number of negative and positive words in the dictionary, respectively. Most importantly, the results in Table 10 still consistently indicate that negative financial stability sentiment was associated with a more accommodative policy stance. However, there are now some indications that positive sentiment was associated with a more hawkish policy stance (Table 10, columns 3 and 4). However, we only find this when using either the Greenbook series for unemployment or the CBO data. In these cases, the coefficients are, in an absolute sense, smaller than those for negative sentiment, while the levels of significance are also less pronounced.

insert Table 10 around here

Sixth, based on topic models, we find additional evidence that financial stability was discussed throughout the whole sample period, although attention did strongly increase during the Great Recession. As in Hansen et al. (2018), we estimate a Latent Dirichlet Allocation (LDA) model. To do so, we use the R package *topicmodels* by Grün and Hornik (2011). We present results when setting the number of topics equal to six. Figure 3 shows the relative importance of these six topics during the sample period. The increased importance of financial stability during the financial crisis is indicated by the larger black bars that denote the frequency of the topic 'Financial Markets and Stability' after 2007. However, we also find evidence that this topic received attention prior to the Great Recession. Concerning other topics, we find that international factors (e.g., such as international trade and exchange rates) were more relevant during the 1980s. In the 1990s, the importance of demand factors (e.g., household spending and business capital) and supply factors (e.g., labor market and production) increased. The relevance of inflation and prices remained roughly the same over time (with shares between 25% and 40%) until financial stability concerns picked up in importance in July 2007. Ever since then, topics related to financial markets and financial stability made up to 50% of the introductory statements. Finally, the topic related to money and credit received less attention since the 1990s, which presumably reflects the move away from the Volcker-era monetary targeting.

insert Figure 3 around here

Lastly, we use an alternative approach to sentiment analysis and topic modeling based on the R package *sentometrics* (Ardia et al., 2017). One benefit of the *sentometrics* approach is that, in addition to negation, it takes two additional linguistic patterns into account. These additional patterns track whether sentiment is strengthened (*amplified*) or weakened (*deamplified*). We use the so-called valence-shifting clusters approach, where the text sentiment scores are calculated taking the three linguistic elements (negation, amplification, deamplification) into account, always within a window of four words before and two words after a keyword from the Correa et al. (2017) dictionary. Per document, *sentometrics* then calculates an index (henceforth the Sentoindex) by computing the difference between the number of positive and negative words and subsequently normalizing by the total number of polarized words from the sentiment dictionary. It should be noted that this means the sign of the Sentoindex will be opposite to that of the FSS index. In addition, we also use *sentometrics* to estimate a structural topic model. Such a model is methodologically similar to the LDA framework, with the main difference in the model initialization stage, i.e., the starting values of the parameters.[13]

Figure 4 shows the results. As the figure makes clear, we can now also make an integral assessment of sentiment per topic. Comparing the LDA and the *sentometrics* approach, we would broadly identify similar topics, although this to some extent is dependent on our interpretation based on those words that have the strongest association with each topic. For the *sentometrics* approach, we find a strong positive correlation in sentiment for the six topics, pointing to a general tendency of positive or negative sentiment in a given statement. Sentiment on financial stability topics is clearly the most volatile of the six series, indicating that these concerns vary considerably over time. In particular, the negative sentiment associated with financial stability since July 2007 and during the early-1990s coincides with the stronger prevalence of this topic around these times, as demonstrated in Figure 3. Combining these two findings indicates that when financial stability considerations become more prominent in monetary policy discussions, these considerations typically are of a negative sentiment. This finding is, once again, in line with the idea of a preference for a monetary policy that cleans *ex post* rather than leans *ex ante*.

insert Figure 4 around here

As a final step in this particular robustness check, we use the overall Sentoindex in the Taylor-rule estimations. Before discussing the results, we note that there is an almost perfect negative correlation between the FSS index and the Sentoindex ($\rho = -0.93$). This negative correlation indicates that our baseline approach suited to the context of financial stability and a more general approach for measuring the sentiment of non-predefined topics gives similar indications of financial stability sentiment. When including the Sentoindex as a covariate in the Taylor rule models,

[13]The Gibbs Sampling algorithm is used in case of the LDA modeling. For structural topic modeling, we use the so-called Spectral algorithm (Roberts et al., 2019). As in the previous robustness check, we show results when settings the number of topics equal to six. The calculation of the sentiment scores is based on the following assumptions. Each element of the Correa et al. (2017) lexicon has a polarity score (positive: 1 and negative: -1). The amplifiers' strengthening value is fixed to 0.8. Negators inverse the polarity. An even number of negators cancel each other out. Amplifiers are taken as deampflifiers and not double-counted in the case of an odd number of negators (e.g., 'not very').

the coefficients are significant in case we use Greenbook forecasts for unemployment or the CBO estimate for the output gap (Table 11, columns 3 and 4). In both models, the size of the coefficients amounts to roughly 0.25 pp.

insert Table 11 around here

6 Conclusions

We analyze introductory statements by four Federal Reserve Chairs at Congressional hearings and find that, even in tranquil times, they have pointed to financial stability considerations when discussing the stance of U.S. monetary policy. In particular, we find that negative financial stability sentiment expressed during Congressional hearings coincided with a more accommodative monetary policy stance than implied by standard Taylor-rule factors. This role of negative sentiment suggests a preference for reacting to episodes of financial instability rather than acting pre-emptively to a perceived build-up of risks, which would be in line with comments by several Fed officials (Greenspan, 2002; Bernanke, 2002).

This paper's findings have broader relevance for ongoing discussions on the interactions between monetary and financial stability. Currently, there is a lively debate on the implications of the financial crisis for the conduct of monetary policy (Smets, 2014; Adrian and Liang, 2017; Svensson, 2017). A survey by Blinder et al. (2017) finds that academics and central bankers widely agree that macroprudential policy is an important addition to the macroeconomic-policy toolkit. In addition, a majority of central bank governors indicates having considered changing the monetary policy mandate, often by adding a financial stability objective. The evidence in our paper does not address the question of whether adding such an objective would be welfare improving. We also do not address the issue of whether the Fed accounted sufficiently for financial stability in the run-up to the financial crisis. What our paper does suggest, however, is that under a dual mandate such as that of the Fed, financial stability can, at least to some extent, be factored into monetary policy deliberations.

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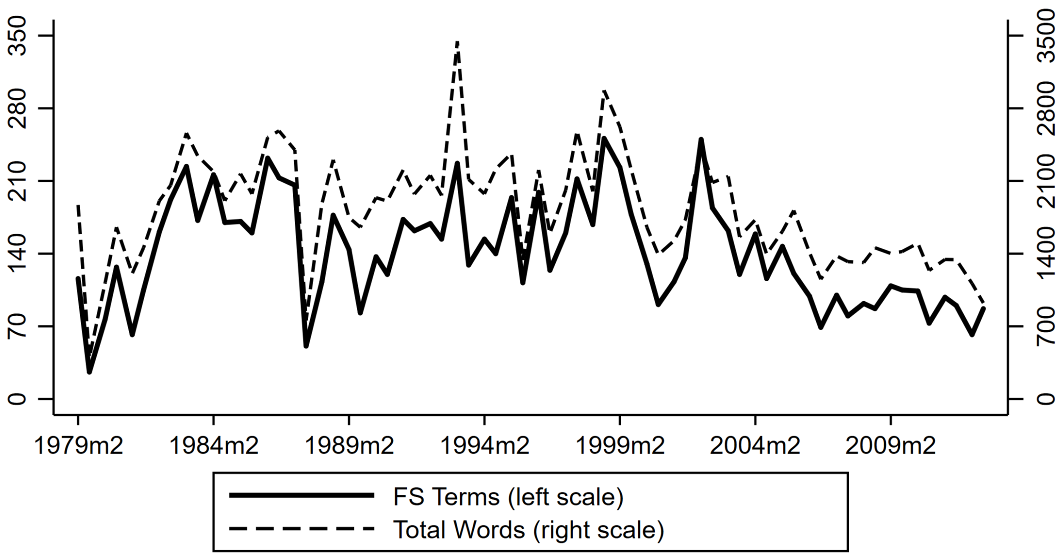
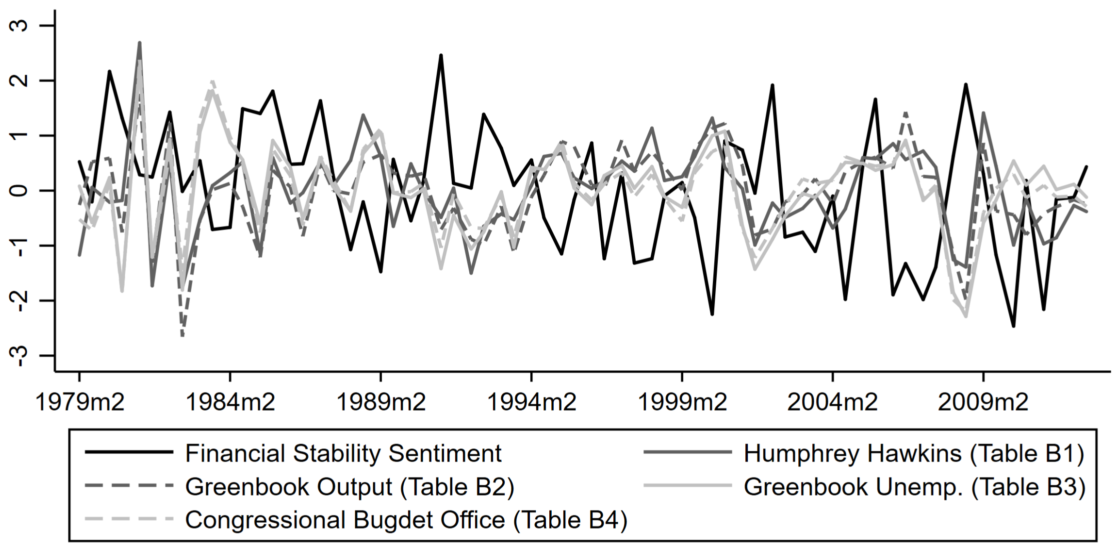
Figure 1: Length of Opening Statements and Financial Stability Terms



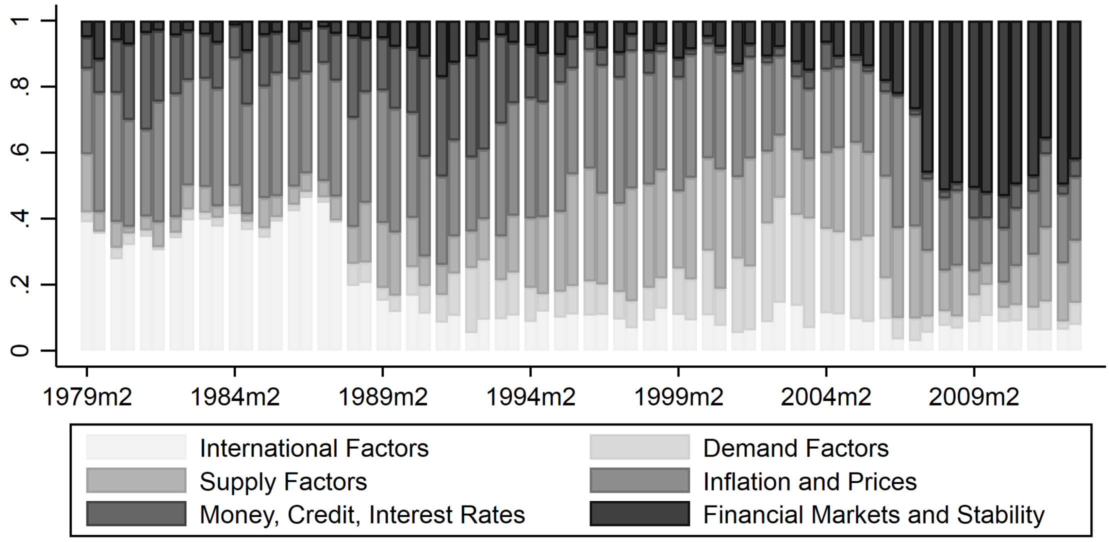
Notes: This figure shows the length of the opening statements by four Federal Reserve Chairs at Congressional hearings on monetary policy (dashed line, right scale) and the number of financial-stability related terms in these statements (solid line, left scale). Financial stability terms are counted using the dictionary by Correa et al. (2017). The sample period is February 1979–July 2012.

Figure 2: Financial Stability Sentiment and Benchmark Taylor-Rule Residuals



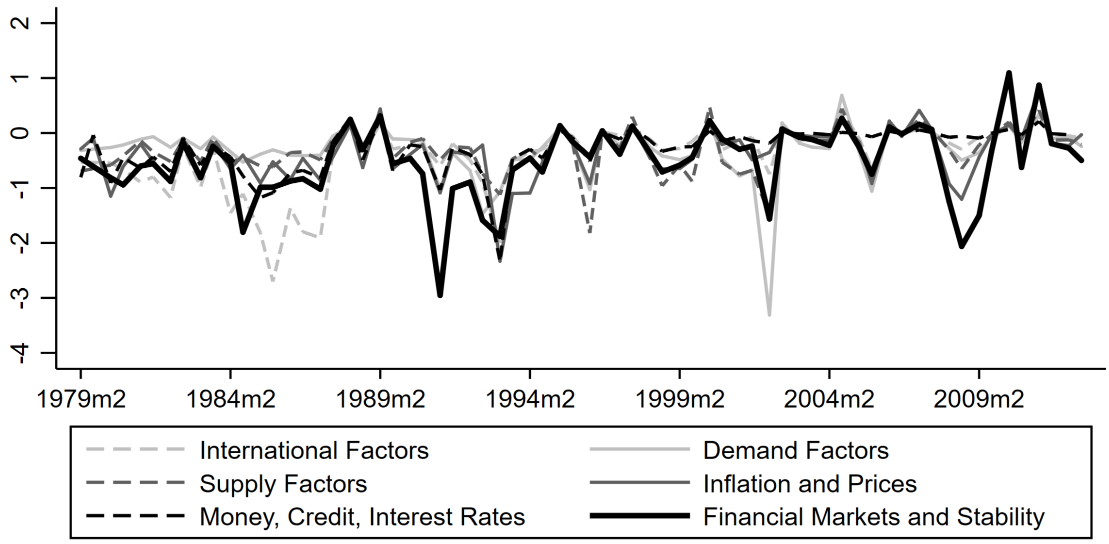
Notes: This figure compares sentiment on financial stability to residuals from the Taylor-rule models in columns (3) of Tables B1–B4. The sentiment index is the number of negative words minus the number of positive words, scaled by the total number of words. The word connotations are determined according to the financial-stability dictionary by Correa et al. (2017). For illustrative purposes, the index has been demeaned. The correlations of the FSS indicator with the Taylor-rule residuals are as follows: Humphrey Hawkins: $\rho = -0.19$, Greenbook Output: $\rho = -0.23$, Greenbook Unemployment: $\rho = -0.30$, Congressional Bugdet Office: $\rho = -0.30$.

Figure 3: Topics in Congressional Hearings According to LDA Model



Notes: This figure shows the frequency of topics in the opening statements by four Federal Reserve Chairs at Congressional hearings on monetary policy, estimated using a Latent Dirichlet Allocation model.

Figure 4: Sentometrics Topic Modeling



Notes: This figure shows the sentiment associated with the topics in the opening statements by four Federal Reserve Chairs at Congressional hearings on monetary policy, estimated using the *sentometrics* approach developed by Ardia et al. (2017).

Table 1: Financial Stability Terms in Congressional Hearings

	Mean	Std. Dev.	Minimum	Maximum
With Stemming				
Negative + Positive FS Terms	7.84	1.18	5.17	10.66
Negative FS Terms	4.54	0.86	2.93	6.91
Positive FS Terms	3.30	0.78	1.48	4.84
Negative – Positive FS Terms	1.24	1.15	−1.23	3.70
Without Stemming				
Negative + Positive FS Terms	3.96	0.74	2.34	5.86
Negative FS Terms	2.48	0.66	1.04	4.35
Positive FS Terms	1.48	0.43	0.43	2.68
Negative – Positive FS Terms	1.00	0.84	−1.19	2.83

Notes: This table reports the relative frequency of occurrences of keywords with a financial stability connotation in opening statements (over all words) by Federal Reserve Chairs at Congressional hearings on monetary policy. The word list is taken from Correa et al. (2017). The sample period is February 1979–July 2012. The correlations of the indicators with stemming and without stemming are as follows: Negative + Positive: $\rho = 0.74$, Negative: $\rho = 0.84$, Positive: $\rho = 0.75$, Negative – Positive: $\rho = 0.86$.

Table 2: Role of Financial Stability Sentiment (Forecasts from MP report)

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.586***	0.597***	0.632***	0.622***
	(0.092)	(0.084)	(0.078)	(0.087)
Constant	0.862***	1.189*	1.236*	0.918***
	(0.298)	(0.705)	(0.697)	(0.280)
Inflation 4Q Forecast Gap	0.895***	0.869***	0.835***	0.856***
	(0.222)	(0.199)	(0.167)	(0.191)
GDP CY Forecast Gap	0.382***	0.378***	0.355***	0.357***
	(0.111)	(0.105)	(0.098)	(0.102)
Persistent MP Shocks	0.386**	0.377***	0.268*	0.273*
	(0.150)	(0.144)	(0.144)	(0.151)
Negative + Positive FS Terms		−0.046		
		(0.078)		
Negative FS Terms			−0.203*	
			(0.117)	
Positive FS Terms			0.115	
			(0.146)	
Negative − Positive FS Terms				−0.161
				(0.108)
σ	0.788***	0.787***	0.773***	0.774***
	(0.083)	(0.081)	(0.081)	(0.083)
AIC	172.73	174.48	173.96	172.20
Log Likelihood	−80.366	−80.241	−78.981	−79.101
Improvement over (1)		0.16%	1.72%	1.57%

Notes: This table shows estimates of Taylor rules following Eqs. (1) and (2) in the main text. Robust standard errors are in parentheses. Columns 2 - 4 use measures of financial stability sentiment based on introductory statements by Federal Reserve Chairs at Humphrey-Hawkins testimonies. In this table, forecasts for macroeconomic variables are obtained from the semiannual Monetary Policy Reports. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level. σ: Standard error of regression. AIC: Akaike information criterion. Improvement over (1): Relative improvement in log likelihood over the benchmark Taylor rule in column (1).

Table 3: Role of Financial Stability Sentiment (Greenbook Output)

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.686***	0.700***	0.717***	0.706***
	(0.071)	(0.065)	(0.064)	(0.070)
Constant	0.719***	1.364*	1.367*	0.834***
	(0.261)	(0.770)	(0.743)	(0.234)
Inflation 2Q Forecast Gap	0.653***	0.624***	0.626***	0.649***
	(0.124)	(0.111)	(0.104)	(0.114)
GDP Nowcast Gap	0.235***	0.233***	0.220***	0.221***
	(0.046)	(0.045)	(0.041)	(0.042)
Persistent MP Shocks	0.199**	0.194**	0.117	0.116
	(0.088)	(0.091)	(0.098)	(0.100)
Negative + Positive FS Terms		−0.087		
		(0.082)		
Negative FS Terms			−0.244**	
			(0.101)	
Positive FS Terms			0.099	
			(0.165)	
Negative − Positive FS Terms				−0.180*
				(0.106)
σ	0.774***	0.768***	0.751***	0.755***
	(0.084)	(0.081)	(0.081)	(0.084)
AIC	170.17	171.18	170.02	168.75
Log Likelihood	−79.085	−78.589	−77.012	−77.377
Improvement over (1)		0.63%	2.62%	2.16%

Notes: See also notes to Table 2. In this table, forecasts for macroeconomic variables are obtained from the Greenbook. The measure for real activity is GDP growth.

Table 4: Role of Financial Stability Sentiment (Greenbook Unemployment)

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.648***	0.657***	0.688***	0.685***
	(0.070)	(0.067)	(0.066)	(0.069)
Constant	0.896***	1.350*	1.181	1.029***
	(0.245)	(0.734)	(0.731)	(0.207)
Inflation 2Q Forecast Gap	0.672***	0.652***	0.653***	0.660***
	(0.147)	(0.137)	(0.125)	(0.128)
Unemployment Nowcast Gap	−0.274***	−0.267***	−0.253***	−0.255***
	(0.087)	(0.084)	(0.075)	(0.078)
Persistent MP Shocks	0.231**	0.237**	0.100	0.094
	(0.098)	(0.097)	(0.115)	(0.111)
Negative + Positive FS Terms		−0.061		
		(0.083)		
Negative FS Terms			−0.281**	
			(0.117)	
Positive FS Terms			0.239	
			(0.185)	
Negative − Positive FS Terms				−0.264**
				(0.121)
σ	0.835***	0.833***	0.798***	0.798***
	(0.083)	(0.082)	(0.073)	(0.073)
AIC	180.53	182.13	178.29	176.34
Log Likelihood	−84.265	−84.064	−81.145	−81.169
Improvement over (1)		0.24%	3.70%	3.67%

Notes: See also notes to Table 2. In this table, forecasts for macroeconomic variables are obtained from the Greenbook. The measure for real activity is the unemployment rate.

Table 5: Role of Financial Stability Sentiment (Greenbook Infl. & CBO Output Gap)

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.644***	0.648***	0.683***	0.685***
	(0.065)	(0.063)	(0.063)	(0.065)
Constant	1.339***	1.543**	1.266*	1.430***
	(0.307)	(0.740)	(0.749)	(0.260)
Inflation 2Q Forecast Gap	0.634***	0.626***	0.625***	0.618***
	(0.141)	(0.134)	(0.120)	(0.121)
GDP Gap (CBO)	0.248***	0.245***	0.232***	0.229***
	(0.071)	(0.070)	(0.062)	(0.064)
Persistent MP Shocks	0.218*	0.223*	0.056	0.064
	(0.117)	(0.116)	(0.138)	(0.128)
Negative + Positive FS Terms		−0.028		
		(0.083)		
Negative FS Terms			−0.252**	
			(0.115)	
Positive FS Terms			0.298	
			(0.184)	
Negative − Positive FS Terms				−0.269**
				(0.116)
σ	0.807***	0.806***	0.767***	0.767***
	(0.088)	(0.087)	(0.075)	(0.075)
AIC	175.78	177.70	172.86	170.92
Log Likelihood	−81.892	−81.848	−78.430	−78.461
Improvement over (1)		0.05%	4.23%	4.19%

Notes: See also notes to Table 2. In this table, forecasts for inflation are obtained from the Fed's Greenbook, while the measure for real activity is the CBO's estimate of the output gap.

Table 6: Robustness Test Excluding the Zero-Lower Bound Episode

	(1) HH	(2) Gbk Output	(3) Gbk Unemp	(4) CBO
Negative + Positive FS Terms	−0.054	−0.123	−0.040	−0.028
	(0.098)	(0.097)	(0.110)	(0.107)
Negative FS Terms	−0.280**	−0.336***	−0.279*	−0.278*
	(0.126)	(0.113)	(0.149)	(0.144)
Positive FS Terms	0.160	0.125	0.287	0.335
	(0.149)	(0.190)	(0.226)	(0.221)
Negative − Positive FS Terms	−0.220**	−0.243**	−0.282*	−0.300**
	(0.105)	(0.122)	(0.147)	(0.140)

Notes: Table shows selected estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 61. ***/**/* indicate significance at the 1%/5%/10% level.

Table 7: Robustness Test for Period 1979–2007, Excluding 1988

	(1) HH	(2) Gbk Output	(3) Gbk Unemp	(4) CBO
Negative + Positive FS Terms	−0.094	−0.203**	−0.119	−0.104
	(0.101)	(0.091)	(0.109)	(0.106)
Negative FS Terms	−0.264**	−0.339***	−0.296*	−0.293**
	(0.125)	(0.113)	(0.154)	(0.146)
Positive FS Terms	0.062	−0.049	0.107	0.155
	(0.139)	(0.158)	(0.184)	(0.175)
Negative − Positive FS Terms	−0.159	−0.163	−0.217	−0.239*
	(0.099)	(0.119)	(0.139)	(0.131)

Notes: Table shows selected estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 56. ***/**/* indicate significance at the 1%/5%/10% level.

Table 8: Robustness Test Using the Wu and Xia (2016) Shadow Rate

	(1) HH	(2) Gbk Output	(3) Gbk Unemp	(4) CBO
Negative + Positive FS Terms	−0.031	−0.063	−0.018	0.010
	(0.084)	(0.086)	(0.085)	(0.086)
Negative FS Terms	−0.166	−0.198*	−0.226*	−0.199*
	(0.125)	(0.109)	(0.117)	(0.117)
Positive FS Terms	0.110	0.097	0.272	0.321*
	(0.153)	(0.171)	(0.187)	(0.186)
Negative − Positive FS Terms	−0.139	−0.153	−0.244**	−0.244**
	(0.112)	(0.110)	(0.117)	(0.115)

Notes: Table shows selected estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level.

Table 9: Robustness Test Without Stemming

	(1) HH	(2) Gbk Output	(3) Gbk Unemp	(4) CBO
Negative + Positive FS Terms	−0.199	−0.380**	−0.283*	−0.229
	(0.184)	(0.183)	(0.163)	(0.167)
Negative FS Terms	−0.386*	−0.548***	−0.502**	−0.443**
	(0.220)	(0.194)	(0.217)	(0.216)
Positive FS Terms	−0.000	−0.098	0.101	0.145
	(0.240)	(0.272)	(0.239)	(0.230)
Negative − Positive FS Terms	−0.204	−0.290*	−0.353**	−0.331**
	(0.168)	(0.158)	(0.170)	(0.164)

Notes: Table shows selected estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level.

Table 10: Robustness Test with Weighted FS Terms

	(1) HH	(2) Gbk Output	(3) Gbk Unemp	(4) CBO
Weighted Negative Words	−1.598*	−2.020**	−2.270**	−2.225**
	(0.919)	(0.830)	(1.037)	(0.992)
Weighted Postive Words	0.616	0.582	1.097*	1.224**
	(0.495)	(0.485)	(0.575)	(0.551)

Notes: Table shows selected estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level.

Table 11: Robustness Test with Sentoindex

	(1) HH	(2) Gbk Output	(3) Gbk Unemp	(4) CBO
Sentoindex	0.075	0.138	0.246**	0.242**
	(0.110)	(0.105)	(0.114)	(0.116)

Notes: Table shows selected estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level.

Appendix A: Sources Consulted

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Appendix B: Baseline Taylor Rules

Table B1: Baseline Taylor Rule with Humphrey-Hawkins Forecasts

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.651***	0.674***	0.586***	0.641***
	(0.061)	(0.067)	(0.092)	(0.078)
Constant	0.665***	0.617**	0.862***	0.733**
	(0.222)	(0.250)	(0.298)	(0.294)
Inflation 4Q Forecast Gap	0.781***		0.895***	
	(0.136)		(0.222)	
Inflation Gap Forecast CY		0.704***		0.749***
		(0.137)		(0.171)
GDP CY Forecast Gap	0.347***	0.317***	0.382***	0.331***
	(0.072)	(0.069)	(0.111)	(0.088)
Persistent MP Shocks			0.386**	0.279**
			(0.150)	(0.112)
σ	0.845***	0.891***	0.788***	0.852***
	(0.083)	(0.100)	(0.083)	(0.107)
AIC	180.00	187.22	172.73	183.27
Log Likelihood	−85.002	−88.611	−80.366	−85.633

Notes: Table shows estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level. σ: Standard error of regression. AIC: Akaike information criterion.

Table B2: Baseline Taylor Rule with Greenbook Forecasts (Output)

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.705***	0.831***	0.686***	0.828***
	(0.064)	(0.052)	(0.071)	(0.059)
Constant	0.647***	0.288	0.719***	0.342
	(0.230)	(0.224)	(0.261)	(0.249)
Inflation 2Q Forecast Gap	0.628***		0.653***	
	(0.112)		(0.124)	
Inflation Nowcast Gap		0.293***		0.273***
		(0.075)		(0.085)
GDP Nowcast Gap	0.246***	0.146***	0.235***	0.123*
	(0.037)	(0.055)	(0.046)	(0.064)
Persistent MP Shocks			0.199**	0.208*
			(0.088)	(0.113)
σ	0.796***	0.905***	0.774***	0.887***
	(0.079)	(0.086)	(0.084)	(0.089)
AIC	171.96	189.43	170.17	188.78
Log Likelihood	−80.979	−89.715	−79.085	−88.390

Notes: Table shows estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level. σ: Standard error of regression. AIC: Akaike information criterion.

Table B3: Baseline Taylor Rule with Greenbook Forecasts (Unemployment)

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.682***	0.813***	0.648***	0.801***
	(0.062)	(0.047)	(0.070)	(0.053)
Constant	0.778***	0.387**	0.896***	0.470**
	(0.224)	(0.192)	(0.245)	(0.218)
Inflation 2Q Forecast Gap	0.621***		0.672***	
	(0.125)		(0.147)	
Inflation Nowcast Gap		0.293***		0.286***
		(0.072)		(0.082)
Unemployment Nowcast Gap	−0.256***	−0.090	−0.274***	−0.082
	(0.072)	(0.067)	(0.087)	(0.080)
Persistent MP Shocks			0.231**	0.276**
			(0.098)	(0.114)
σ	0.866***	0.950***	0.835***	0.914***
	(0.086)	(0.084)	(0.083)	(0.080)
AIC	183.42	196.04	180.53	192.77
Log Likelihood	−86.708	−93.018	−84.265	−90.383

Notes: Table shows estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level. σ: Standard error of regression. AIC: Akaike information criterion.

Table B4: Baseline Taylor Rule with Greenbook Infl. Forecast and CBO Output Gap

	(1)	(2)	(3)	(4)
Interest Rate Smoothing	0.678***	0.811***	0.644***	0.798***
	(0.059)	(0.045)	(0.065)	(0.051)
Constant	1.199***	0.603**	1.339***	0.692**
	(0.274)	(0.245)	(0.307)	(0.282)
Inflation 2Q Forecast Gap	0.584***		0.634***	
	(0.121)		(0.141)	
Inflation Nowcast Gap		0.279***		0.274***
		(0.074)		(0.084)
GDP Gap (CBO)	0.235***	0.123**	0.248***	0.126*
	(0.059)	(0.058)	(0.071)	(0.072)
Persistent MP Shocks			0.218*	0.268**
			(0.117)	(0.128)
σ	0.831***	0.929***	0.807***	0.896***
	(0.090)	(0.086)	(0.088)	(0.081)
AIC	177.75	192.99	175.78	190.19
Log Likelihood	−83.874	−91.495	−81.892	−89.094

Notes: Table shows estimates of Eqs. (1) and (2) with robust standard errors in parentheses. Number of observations: 68. ***/**/* indicate significance at the 1%/5%/10% level. σ: Standard error of regression. AIC: Akaike information criterion.

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