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FOMC Communication and Interest Rate Sensitivity to News

Jenny Tang

Abstract:
In this paper, I examine whether communications by the Federal Open Market Committee (FOMC) play a role in determining the types of macroeconomic news that financial markets pay attention to. To do so, I construct novel measures of the intensity with which FOMC statements and meeting minutes discussed labor relative to other topics. I find that these labor topic intensity measures are related to the amount by which interest rates' response to labor-related news exceeds their response to all other news. This relationship is especially strong for interest rates of longer maturities and is also present for short-term interest rate expectations over various horizons.

Keywords: Federal Reserve, FOMC, central bank communication, interest rates
JEL Classifications: E43, E52, E58, G12

Jenny Tang is an economist in the research department of the Federal Reserve Bank of Boston. Her email address is jenny.tang@bos.frb.org.

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1 Introduction

Over the past few decades, it has become widely accepted that central bank communication can be a valuable monetary policy tool. The aspect of central bank communications that has received the most attention is the use of forward guidance, since many studies have shown that it can stimulate demand when nominal interest rates are close to zero, a situation that many advanced economies have recently experienced.[1] Likewise, much of the empirical work on central bank communication has focused on the effect of communications on the level of interest rate expectations.

However, less attention has been paid to other dimensions of central bank communication, such as its ability to convey information regarding the policy reaction function. In this paper, I take a step in this direction by exploring the relationship between the language used in communications by the Federal Reserve Open Market Committee (FOMC) and financial market responses to different types of macroeconomic news. More specifically, I construct two novel measures capturing the extent of discussion related to a particular topic in FOMC communications, specifically the meeting minutes and post-meeting statements. I then look for the existence of an interaction effect where emphasis on certain economic topics in FOMC communications might lead to stronger responses of interest rates to news related to those topics. As central banks are taking increasingly greater steps to improve the public's understanding of their objectives and operations, it is important to gain a better understanding of the potential for financial markets to glean information about policy reaction functions from central banks' communications.

In the current analysis, I focus on the topic of labor because of some relevant recent developments in FOMC communications. As will be shown below, the extent of discussion regarding labor market conditions in FOMC minutes and statements has grown rapidly since the start

[1] Some notable examples are Krugman (1998) and Eggertsson and Woodford (2003), while Woodford (2012) summarizes many of the key issues covered in this literature.

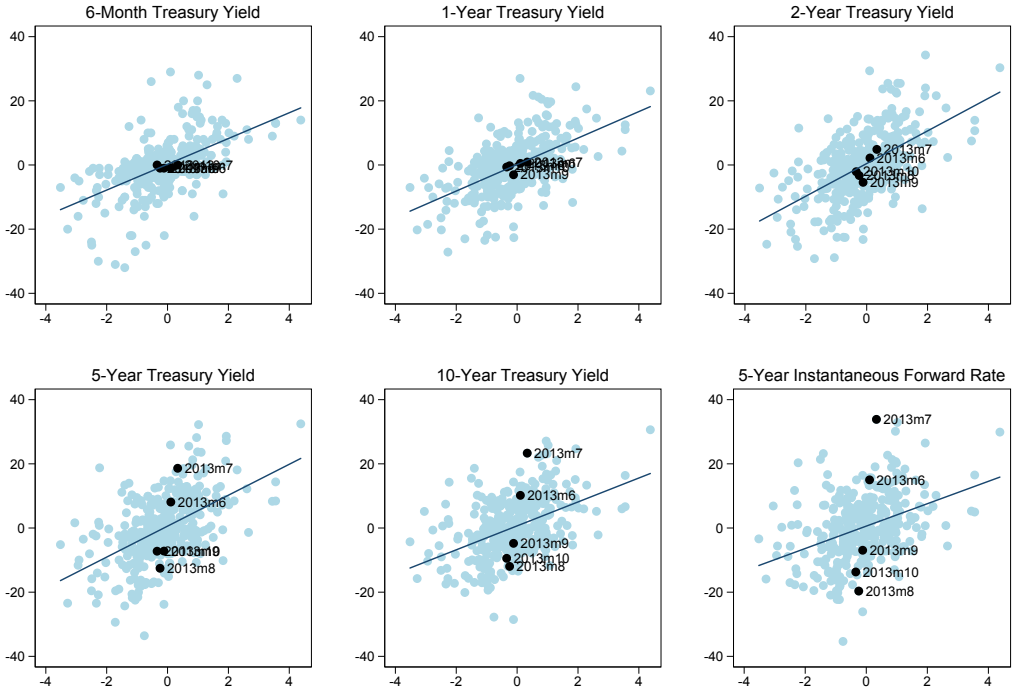
of the recent recession. One especially salient event occurred in December 2012, when the FOMC began including an explicit unemployment threshold in its statements.

There is also evidence that financial markets sometimes exhibit more responsiveness to labor-related news in particular. One instance of this occurred in the months following Federal Reserve Chairman Ben Bernanke's May 22, 2013, address to Congress's Joint Economic Committee. During the address, he first mentioned that the Fed could "step down" the pace of its asset purchases over the next few meetings and emphasized that this decision would be based on the health of the labor market. Following the testimony, asset markets went through a period of turbulence that's been dubbed the "taper tantrum." Figures 1, 2, and 3 show one-day changes in various interest rates surrounding macroeconomic news releases against surprises measured as the actual data less forecasts published by Informa Global Markets (previously known as Money Market Services). The news releases shown are those for nonfarm payroll employment, core CPI inflation, and the ISM Manufacturing Purchasing Managers' Index. The graphs highlight the points corresponding to the five months following Chairman Bernanke's testimony where it's clear that markets were abnormally sensitive to surprises in nonfarm payroll employment data while responsiveness to the other three series remained consistent with historical patterns.

In this paper, I examine the connection between FOMC communications and interest rate responsiveness to macroeconomic news in a systematic manner by using the large amount of information available in FOMC texts to construct measures capturing the extent of labor-related discussion. More specifically, I construct two distinct measures. One is based on the proportion of terms in a document that fall into a set of labor-related terms chosen from the set of all words appearing in FOMC minutes and statements. The second measure is based on a multinomial Naive Bayes text classification model that is trained using text from FOMC Greenbooks. Reassuringly, the two measures are very highly correlated.

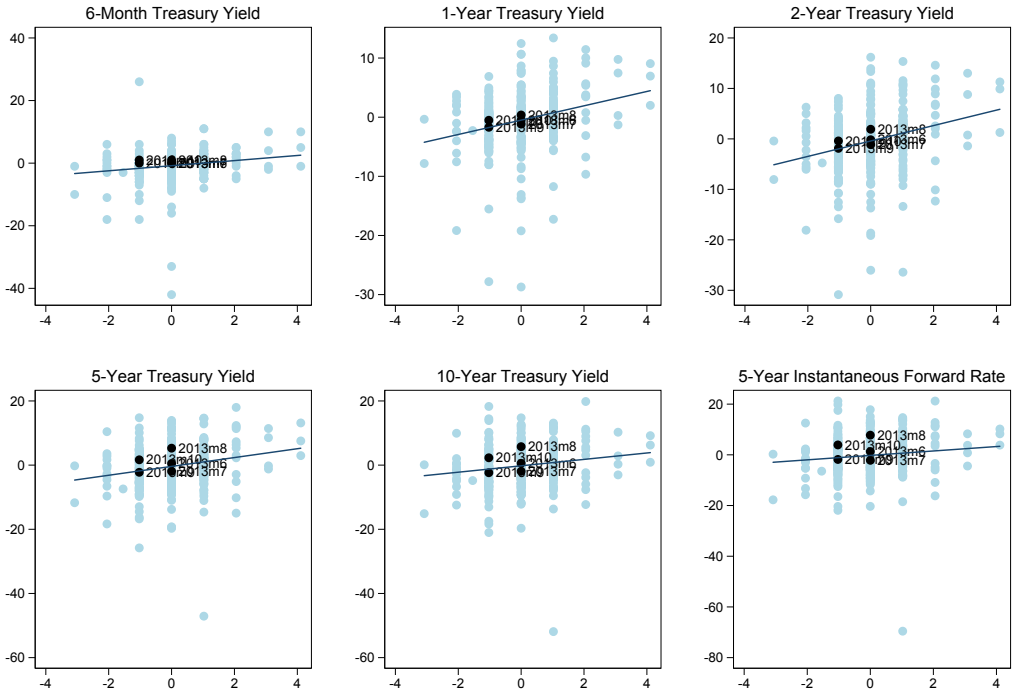
I then relate these measures to financial market responses to different types of macroeconomic

Figure 1: One-day Interest Rate Changes and Surprises in Nonfarm Payroll Employment



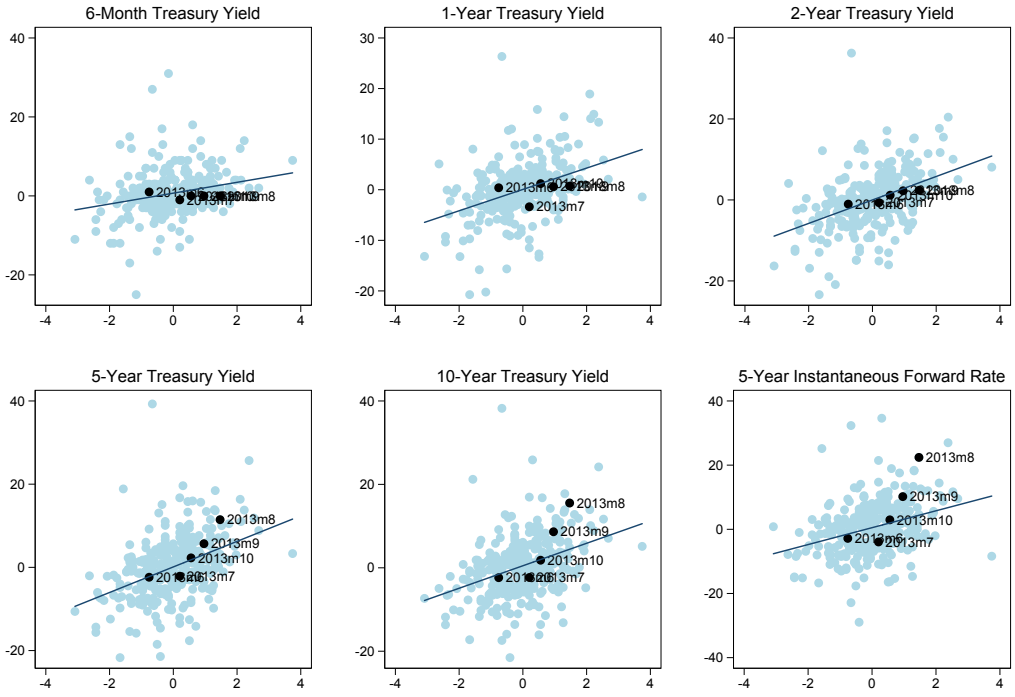
Source: Author's calculations.

Figure 2: One-day Interest Rate Changes and Surprises in Core CPI Inflation



Source: Author's calculations.

Figure 3: One-day Interest Rate Changes and Surprises in ISM Manufacturing PMI



Source: Author's calculations.

news using two different approaches (both inspired by the analysis in Swanson and Williams 2014). The first approach involves an initial step estimating unrestricted time variation in the sensitivity of interest rates to labor-related news as well as all other news. I then relate the estimated differential sensitivity to labor-related news versus all other news to my measures of labor topic intensity in FOMC communications. The second approach is a more parametric procedure. I estimate an equation expressing changes in interest rates as a function of news, where the differential response to labor-related news is restricted to be a function of labor topic intensity in FOMC texts. Both methods show a positive relationship, and furthermore, this relationship is stronger for interest rates of longer maturities. I also find a similar relationship when focusing only on the component of Treasury yields that corresponds to short-term interest rate expectations. This indicates that my results are not solely driven by the behavior of term premia, and that FOMC communications are indeed associated with variation in the response of interest rate expectations to different types of

macroeconomic news.

The next subsection reviews the related literature. Section 2 gives background on FOMC texts and describes the labor topic intensity measures. Section 3 describes the estimation of time-varying sensitivity to news. The relationship between these estimates and word-use measures are explored in Section 4. Section 5 presents the more parametric estimation approach, and Section 6 concludes.

1.1 Related literature

Several existing papers measure the sensitivity of interest rates to macroeconomic news. Two recent examples are Gürkaynak, Sack, and Swanson (2005b) and Faust et al. (2007). Swanson and Williams (2014) estimate time-varying sensitivity to general macroeconomic news, showing its decline during the current zero lower bound (ZLB) episode. In this paper, I largely follow their estimation procedures, but I divide news into two categories: labor related and other.

Few papers have attempted to relate changes in interest rate sensitivity to news to central bank communications. One exception is the Bernanke, Reinhart, and Sack (2004) event study of the August 2003 introduction of the phrase "considerable period" into the FOMC statement. This phrase is interpreted as indicating concern for the "jobless" nature of the recovery. The authors find that sensitivity of 10-year Treasury yields to news regarding nonfarm payroll employment is greater after the phrase was introduced.

The empirical work examining FOMC communications more generally has followed a natural progression.[2] Some of the first papers in this area examined central bank communications' effect on financial market volatility to assess whether they move markets per se. Two notable papers in this category are Kohn and Sack (2004) and Gürkaynak, Sack, and Swanson (2005a), which both provide evidence that the statements accompanying FOMC meetings

[2]Much of this literature is reviewed in Blinder et al. (2008).

have an effect on financial market variables beyond the target change.

Once it was established that financial markets do indeed respond to communications, attention was turned toward the question of whether these responses are in the expected directions. The earlier studies categorized communications as "hawkish" versus "dovish" through authors' readings of FOMC communications (see Bernanke, Reinhart, and Sack 2004). Recent papers have turned to more objective methods used in computer science to perform this quantification (see Lucca and Trebbi 2011).

More recently, some authors have tried to quantify FOMC communications along more dimensions than just monetary policy stance. Boukus and Rosenberg (2006) use Latent Semantic Analysis to extract themes from FOMC meeting minutes and show that the prevalence of these themes—not just the release of minutes—has an effect on Treasury yields. Hansen, McMahon, and Prat (Forthcoming) use Latent Dirichlet Allocation to estimate topics in FOMC transcripts and relate the extent to which the concentration of topics discussed during FOMC meetings is affected by the publication of FOMC transcripts. In contrast to these unsupervised learning algorithms, this paper illustrates two supervised methods that measure the extent of discussion about specific researcher-defined topics in FOMC communications. One measure is based on counts of occurrences of a manually chosen set of terms defined to be specific to the topic of labor. This method has also been applied to FOMC documents by Gorodnichenko and Shapiro (2007), Cieslak and Vissing-Jorgensen (2017), and Husted, Rogers, and Sun (2017) to the topics of price-level versus inflation targeting, the stock market, and uncertainty, respectively. The second measure is based on a supervised learning algorithm that relies on training texts, which is similar to the techniques used by Antweiler and Frank (2004) and Gentzkow and Shapiro (2010) to measure investor sentiment from stock market message boards and media slant of newspapers, respectively.

2 FOMC text data

2.1 Background on FOMC communications

The primary texts analyzed in this paper are the FOMC meeting minutes and policy statements. The most timely communications issued by the FOMC regarding monetary policy is the post-meeting policy statement. This document first appeared following the February 1994 meeting. In January 2000, the Committee announced that a statement would be issued following each regularly scheduled meeting.

Meeting minutes give a more extensive summary of the issues discussed at each FOMC meeting. The publication of minutes in their present form began with those of the February 1993 meeting. The current minutes combine material previously covered by two separate documents: the Record of Policy Actions and the Minutes of Actions. Prior to December 2004, minutes from one meeting were published approximately three days after the following meeting. Since then, publication has been accelerated to three weeks following the meeting.

In addition to these documents, the FOMC releases the Tealbook (formerly the Greenbook) which are documents summarizing the staff's analysis of the economy. The FOMC also releases meeting transcripts, which are the most detailed record of meeting proceedings available. Due to their five-year publication lag, Greenbooks/Tealbooks and transcripts are not considered to be forms of FOMC communication regarding current policy.

Lastly, some papers have also looked at central bankers' speeches, interviews, congressional testimonies, papers, and books as additional forms of central bank communication. Kohn and Sack (2004) show that congressional testimony by Chairman Alan Greenspan had a significant effect on the unexplained variance of changes in various Treasury yields and interest rate futures while his speeches did not. Ehrmann and Fratzscher (2005) find that asset markets reacted more strongly to speeches, interviews, and testimony by Chairman

Greenspan than those by other FOMC members.

2.2 Processing text

For the analysis, I use minutes and statements from meetings starting with those from February 1993 and February 1994, respectively, and ending with the June 2016 publications.[3] The analysis includes most statements from unscheduled meetings, but I disregard five statements in which no word with an "econ" root appears.[4]

For statements, I remove the title of the press release and procedural statements from the text. The procedural statements include the sentences stating the discount rate action and associated requests made by various Reserve Banks. They also include sentences indicating members who voted in favor of the policy action as well as sentences about member absences. Sentences describing dissenting votes are retained, because these sometimes contain information regarding the reason for dissent, which may have economic content. For minutes, I follow Boukus and Rosenberg (2006) in removing administrative items and keeping only sections of text containing economic content. This text comprises mainly the part of the minutes starting with a phrase such as "The Committee then turned to a discussion of the economic outlook" or "The information reviewed at this meeting...." The text also includes discussion regarding special studies conducted by the Federal Reserve staff or statements regarding unconventional policy during the recent period.

After this pre-processing, I transform the remaining text into numeric data using techniques common to many natural-language processing procedures. First, I remove formatting, punctuation, capitalization, and numbers. I then remove stop words, which are commonly used words such as "the," "and," "a," "that," etc.[5] Next, the remaining words are stemmed using

[3]The original texts were obtained from the Federal Reserve's website.

[4]Most of these statements were announcements of unconventional policy actions to improve financial market liquidity during the recent financial crisis and did not include discussion of any underlying economic fundamentals.

[5]I use the list of stop words provided by Jason Chen and Siamak Faridani as part of their Natural Language Processing toolbox for Matlab. The full list is available at https://github.com/faridani/MatlabNLP/blob/

the Porter Stemmer to reduce them to their roots.[6] Figure 4 shows an example of an original FOMC statement and the list of words that remains after this procedure.

Figure 4: Example of text processing

FRB: Press Release–FOMC statement–January 22, 2008

The Federal Open Market Committee has decided to lower its target for the federal funds rate 75 basis points to 3-1/2 percent.

The Committee took this action in view of a weakening of the economic outlook and increasing downside risks to growth. While strains in short-term funding markets have eased somewhat, broader financial market conditions have continued to deteriorate and credit has tightened further for some businesses and households. Moreover, incoming information indicates a deepening of the housing contraction as well as some softening in labor markets.

The Committee expects inflation to moderate in coming quarters, but it will be necessary to continue to monitor inflation developments carefully.

Appreciable downside risks to growth remain. The Committee will continue to assess the effects of financial and other developments on economic prospects and will act in a timely manner as needed to address those risks.

Voting for the FOMC monetary policy action were: Ben S. Bernanke, Chairman; Timothy F. Geithner, Vice Chairman; Charles L. Evans; Thomas M. Hoenig; Donald L. Kohn; Randall S. Kroszner; Eric S. Rosengren; and Kevin M. Warsh. Voting against was William Poole, who did not believe that current conditions justified policy action before the regularly scheduled meeting next week. Absent and not voting was Frederic S. Mishkin.

In a related action, the Board of Governors approved a 75-basis-point decrease in the discount rate to 4 percent. In taking this action, the Board approved the requests submitted by the Boards of Directors of the Federal Reserve Banks of Chicago and Minneapolis.

↓

feder open market committe decid lower target feder fund rate basi point percent committe action view weaken econom outlook increas downsid risk growth strain short term fund market eas broader financi market condit continu deterior credit tighten busi household incom inform deepen hous contract soften labor market committe expect inflat moder quarter continu monitor inflat develop carefulli appreci downsid risk growth remain committe continu assess effect financi develop econom prospect act time manner address risk vote william pool current condit justifi polici action regularli schedul meet week

Table 1 shows some descriptive statistics of the processed texts. As these word counts

master/nlp%20lib/corpora/English%20Stop%20Words/english.stop

[6]Implementations of this algorithm in various programming languages are available at http://tartarus.org/martin/PorterStemmer/index.html.

indicate, FOMC minutes are lengthier than statements and contain a greater variety of language.

Table 1: Properties of FOMC minutes and statements

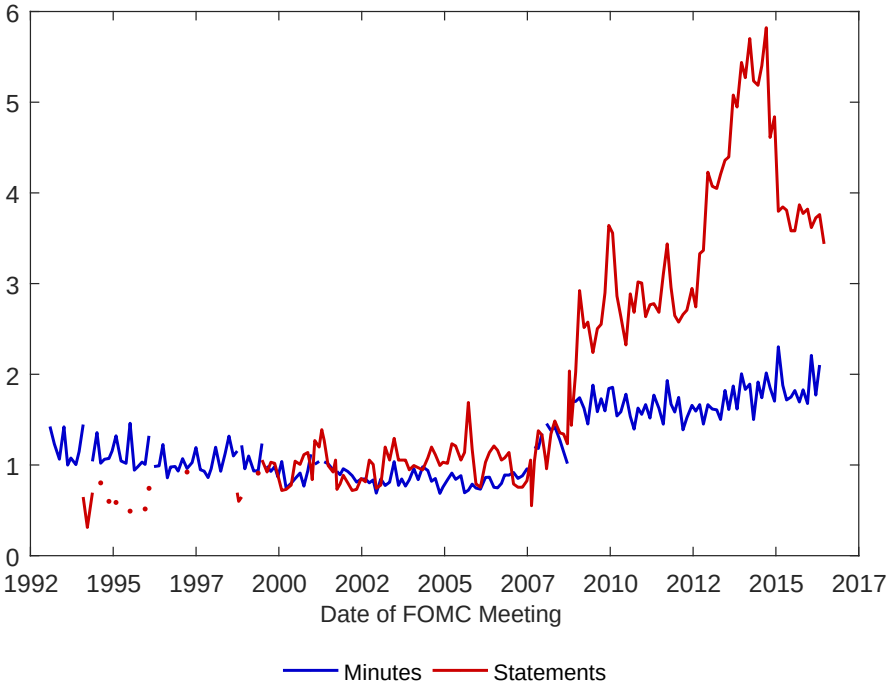
	Meeting minutes	Statements
Total # of documents	186	157
Words per document		
Mean	2716	166
Median	2363	100
Min	1521	26
Max	5100	486
Number of unique words	3730	923

Source: Author's calculations.

Furthermore, statements have evolved more than minutes. Since the start of the recent recession, the FOMC has been trying to convey more information in the post-meeting statements. This change in the nature of FOMC statements is apparent in Figure 5. This graph plots the word counts of both texts as ratios of their pre-2008 averages. The figure shows that the word counts of statements were relatively stable until the recent period but are now more than five times as high as the pre-2008 average. Word counts of meeting minutes have also grown since the start of the recent recession, but not nearly as dramatically.

Because of the greater detail included in FOMC meeting minutes, it may be reasonable to believe that financial market participants extract more information regarding the Committee's decision-making process from these documents than from the post-meeting statements. For both this reason and the apparent evolution of the nature of FOMC statements, I will focus on measures using minutes, though results are qualitatively similar for statements.

Figure 5: Word counts as a ratio of pre-2008 averages



Source: Author's calculations.

2.3 Labor topic intensity

I employ two methods to measure the extent to which FOMC texts emphasize the topic of labor. Both methods are based on bag-of-words models in which each document is represented by the set of terms it contains without regard for the positions of the terms. The first method measures the prevalence of a set of labor-related terms that are culled from the set of unique (stemmed) words across both minutes and statements. The second method is based on a multinomial Naive Bayes model, which is trained using texts of Greenbooks/Tealbooks. Both measures are dated according to the release date of each document.[7] I detail the construction of each measure below.

For the first measure, I first identify a subset of labor-related terms within the set of words in

[7]The release dates for documents were scraped from the historical calendar of monetary policy press releases available at https://www.federalreserve.gov/newsevents/pressreleases.htm. One correction was made for the December 19, 2000, meeting minutes, which were published on February 1, 2001, rather than January 4, 2001.

FOMC minutes and statements. This subset of terms is displayed in Table 2. The first set of words at the top of this table are root words based on the Porter stemming algorithm. The second set of phrases or words in double quotes is treated literally rather than stemmed.[8] For example, the word "unions" is considered a labor-related word, while the singular form "union" is not, since the latter appears only in the context of the European Union. Similarly, inspection of the underlying texts reveals that while the word "tightness" is most often used to refer to labor markets, other variations on the root word "tight" are more commonly used to describe policy actions or credit market conditions.

Table 2: Labor-related terms

emploi	employ	employe	fulltim	hire	hour	job
jobless	jobseek	labor	layoff	mismatch	nonparticip	overtim
payrol	quit	recruit	retir	retire	slack	underemploy
unemploi	unemploy	vacanc	work	worker	workforc	workweek
"continuing claim"		"full time"		"initial claim"		"natural rate"
"part time"		"participation"		"tightness"		"unions"

Using this set of words, I construct a labor-term-proportion measure as the proportion of each document's terms that are within this labor-related set,

$$LaborInt_t^{TP,d} = \frac{\sum_{w \in L^w} T_{d,t,w}}{\sum_{w \in W_{d,t}} T_{d,t,w}},$$

where d indexes the document type (minutes or statement), t indexes the release date, and $T_{d,t,w}$ is a count of the number of times that word w appears in the type d document at time t. The set $W_{d,t}$ is the set of all words/terms that appear in this document, and the set L^w is the set of terms given in Table 2. This use of a researcher-defined set of terms to measure properties of texts is akin to the methods used to construct uncertainty indices in papers such as Baker, Bloom, and Davis (2016); Hassan et al. (2016); and Husted, Rogers, and Sun

[8]For the construction of this measure, these particular phrases or words are exempted from stemming in the text processing procedure described in the previous section.

(2017). This method is well suited to this environment, after the stop-word removal and stemming procedure, because the complete set of words that remains in FOMC minutes and texts is small enough for it to be feasible to consider each term individually.

The second measure of labor topic intensity in FOMC documents is constructed by applying a multinomial Naive Bayes model to classify sentences in each document as being about the topic of labor or not.[9] Using this classification, I then construct a measure of the proportion of a document's words that are in sentences about labor.

More specifically, let $S_{d,t}$ denote the set of all sentences in a document of type d released at time t; let $L^s_{d,t} \subset S_{d,t}$ denote the subset of these sentences that are classified as being about the topic of labor; and let n_s denote the number of words/terms in a particular sentence $s \in S_{d,t}$. Then, the measure of labor topic intensity based on a multinomial Naive Bayes model is given by

$$LaborInt_t^{NB,d} = \frac{\sum_{s \in L_{d,t}} n_s}{\sum_{s \in S_{d,t}} n_s}, \tag{1}$$

where the denominator is the total term count in the document.

The multinomial Naive Bayes model classifies sentences using an estimated posterior probability of a particular topic conditional on the sentence. This posterior probability is the product of the prior probability of the topic and the likelihood of observing a sentence conditional on the topic. Since the main topic of interest in this study is labor, I consider only two classifications: labor and "other." I use a flat prior, so the posterior is simply proportional to the likelihood itself. More specifically, the probability of the labor topic conditional on a particular sentence s is

$$P(labor|s) = P(labor)P(s|labor) \propto P(s|labor),$$

and likewise for the "other" topic.

[9]For more details on this model, see Chapter 13 of Manning, Raghavan, and Schütze (2008), which is available at https://nlp.stanford.edu/IR-book/.

In this model, each sentence is characterized only by the set of terms that it contains, and the likelihood of a sentence appearing conditional on it being about a particular topic is modeled as the product of independent likelihoods of observing each underlying term conditional on that topic. That is,

$$P(s|labor) = \prod_{w \in W_s} P(w|labor),$$

where W_s denotes the set of words/terms in a particular sentence. An analogous expression holds for the "other" topic.

The likelihood of a term appearing conditional on the labor topic is estimated using a training text (which I describe below) that is a priori determined to represent the labor topic as follows:

$$P(w|labor) = \frac{T_{labor,w} + 1}{\sum_{\tilde{w} \in V} (T_{labor,\tilde{w}} + 1)}, \tag{2}$$

where $T_{labor,w}$ is a count of the number of times that word w appears in the labor-training text, and V is the complete set of words that appear in any of the texts considered. An analogous definition is used for the "other" topic. The addition of 1 to each count $T_{labor,w}$ can be interpreted as a uniform prior that each term in the vocabulary appears once in each of the training texts. Without this adjustment, a sentence can have a labor likelihood of zero when the sentence contains a word that does not appear in the labor-training text regardless of the other words in the sentence. Additionally, I include only words in the vocabulary V that appear in at least one of the training texts. According to the definition in equation (2), a word that does not appear in either of the training texts is assigned a conditional probability based solely on the total word count of that topic's training text. Including these words in the vocabulary would bias the classification of a sentence toward the topic with a shorter training text.

Finally, a sentence is considered to be about labor if the posterior probability of the labor topic conditional on that sentence is higher than that of the other topic. Thus, the set of

labor sentences used to construct the Naive Bayes labor-intensity index defined in equation (1) is:

$$L_{d,t} = \{s \in S_{d,t} : P(labor|s) \geq P(other|s)\}.$$

I use this method of categorizing sentences instead of directly using the estimated probabilities for words or sentences ($P(w|labor)$ or $P(s|labor)$), because the Naive Bayes method yields accurate discrete classification results despite the probability estimates sometimes being of low quality (see Manning, Raghavan, and Schütze 2008). Instead of applying the discrete characterization at the document level, I do so at the sentence level and then aggregate up using equation (1) to obtain a more continuous labor intensity measure over time.

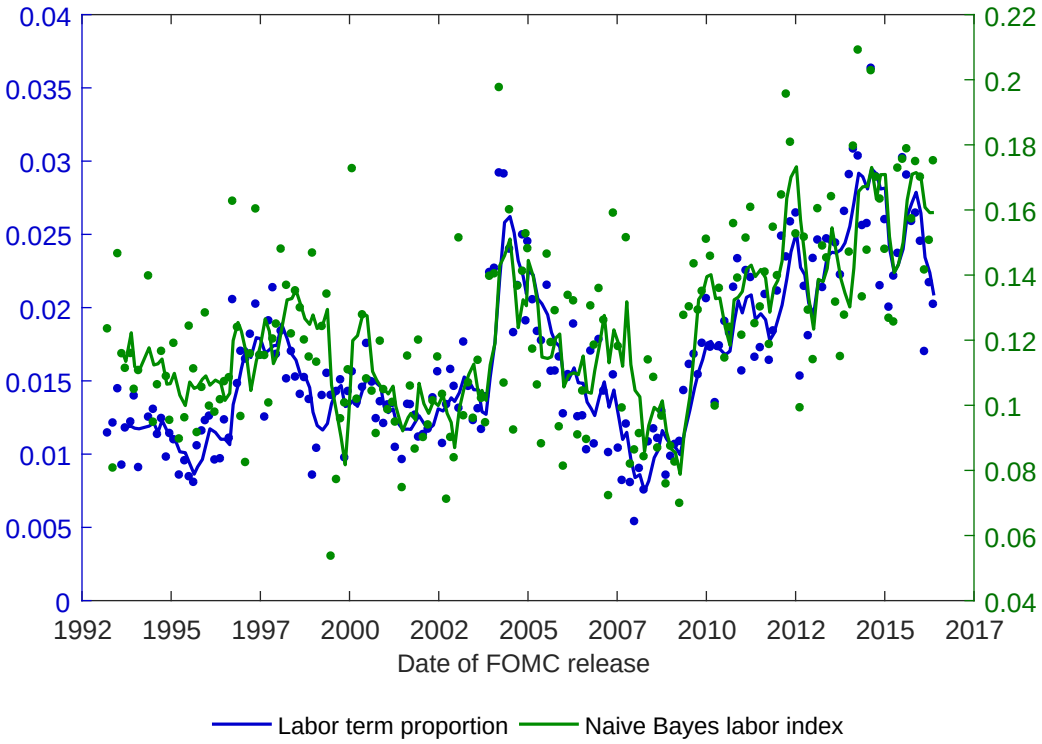
The set of texts that I use to train this model are taken from FOMC Greenbooks from February 1990 to April 2010. In particular, I use the section of Part II of the Greenbook that reviews recent developments in the domestic nonfinancial category. One advantage of using the Greenbook to construct training texts is that the language used in this document should be very similar in style to the language used in the FOMC's other public communications. Another advantage of using this section of the Greenbook is that it is consistently split into subsections covering well-defined topics. There is always a section devoted to the labor market (usually with a title of "Labor Market Developments" or "Employment and Unemployment"), while the other sections cover topics such as industrial production, personal income and consumption, investment, government spending, prices, etc.[10] Thus, I use the labor market subsections of all the Greenbooks in my sample as the labor topic training text and use the other subsections for the "other" category.[11]

Figure 6 plots the labor-term proportion measure (based on terms in Table 2) as well as the Naive Bayes labor index for FOMC minutes. The dots represent individual documents, while the line is a moving average (MA) of the current plus three most recent releases.

[10] In mid-2010, the Greenbook was replaced by the Tealbook which has a different format.

[11] These training texts are put through the same stop-word-removal and stemming processes described above.

Figure 6: Measures of labor intensity in FOMC minutes



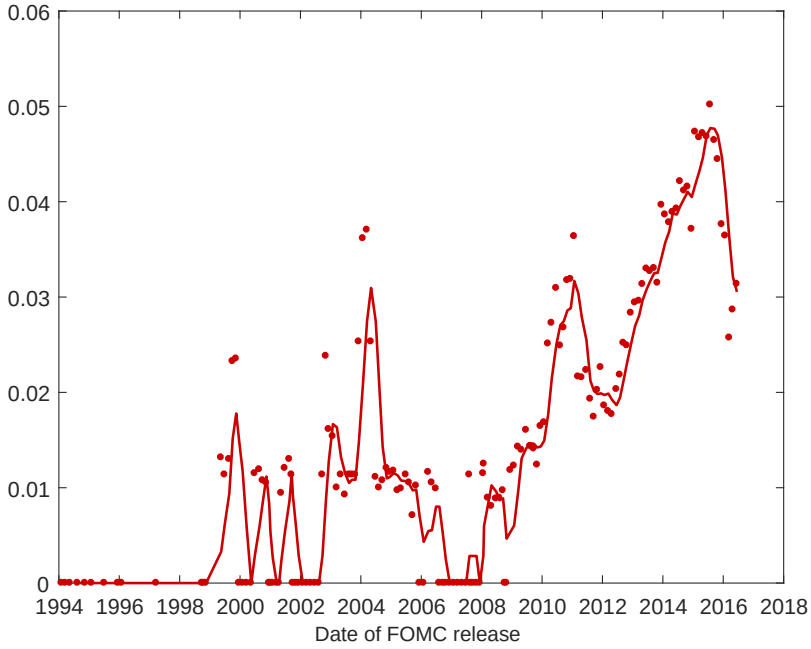
Source: Author's calculations.

Though constructed using very different methods, the two measures of labor topic intensity in FOMC minutes follow a remarkably similar pattern over time. The correlation of the raw indices is 74 percent, while the correlation of the two four-release moving averages is 87 percent.

Figure 7 plots the labor-term proportion for FOMC statements. The Naive Bayes method is not applied to statements because of the inherently short nature of statements. On average, statements have only 11.1 sentences, and some statements have as few as two sentences. By contrast, FOMC minutes have 180 sentences on average, and the minimum number is 106. Due to the small number of sentences in FOMC statements, applying the definition in equation (1) would result in a measure that is both volatile and potentially dominated by estimation error.

The labor-term proportion measure for FOMC statements is more volatile than that for

Figure 7: Labor-term proportion in FOMC statements



Source: Author's calculations.

minutes. Forty-six statements out of a total of 157 contain none of the terms in the above set of labor-related terms, and two-thirds of these instances occurred prior to 2003. All measures of labor-word intensity in Figures 6 and 7 reflect the same broad pattern of a hump shape in labor-related discussion over the 2003–2008 period followed by a steady increase and then a drop-off toward the end of the sample.

3 Estimating interest rate sensitivity to news

I follow the methods of Swanson and Williams (2014) to estimate interest rate sensitivity to news. The main departure is that I categorize news as being related to labor or not and separately estimate sensitivity to labor-specific news versus other news. For the first exercise, I estimate these time-varying sensitivities and then relate the FOMC labor topic intensity measures from the previous section to the estimated differential sensitivity to labor-specific news relative to other news. In Section 5, I take a more parametric approach and estimate

a single equation that models sensitivity to labor-specific news as a function of FOMC labor topic intensity while controlling for more general time variation in sensitivity to all news.

3.1 Interest rates and macroeconomic news data

The interest rates I examine include the secondary market rate on the six-month Treasury bill from the Federal Reserve Bank of St. Louis's FRED database as well as one-, two-, five-, and 10-year zero-coupon Treasury yields from Gürkaynak, Sack, and Wright (2007).[12] I also include a five-year ahead instantaneous forward rate from this latter source.

To gauge whether the time variation in sensitivity of these interest rates to news is coming from variation in the sensitivity of short-term interest rate expectations or term premia, I perform the same analysis using estimates of the short-term interest rate expectations component of one-, two-, five-, and 10-year yields based on the term premia estimated in Kim and Wright (2005).[13]

In terms of macroeconomic data releases, I consider the same 12 indicators as Swanson and Williams (2014), and these are: nonfarm payroll employment, the unemployment rate, initial jobless claims, consumer confidence, capacity utilization, new home sales, leading indicators index, ISM manufacturing index, core CPI inflation, core PPI inflation, real GDP growth (advance release), and retail sales. The first three items in this list are categorized as labor specific. To measure the news (or surprise) content within these data releases, I take the difference between the actual release and the median survey forecasts from Informa Global Markets (previously known as Money Market Services).[14] Each news series is divided by its standard deviation to facilitate comparison of coefficients across different news series.

[12]Daily zero-coupon yield estimates are updated regularly and available from http://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html.

[13]Daily term premia and fitted yield data are updated regularly and available from https://www.federalreserve.gov/pubs/feds/2005/200533/200533abs.html.

[14]This data is obtained through Haver Analytics. The surveys are conducted each Friday for the data releases taking place the following week, so the information set of forecasters is at most seven days old relative to the data release date.

Regressions at the daily frequency include only days on which there was an announcement of one of these 12 indicators. Each news series is set to zero on days when there is no data release.

3.2 Time-varying sensitivity to labor news

In this section, I follow the two-step estimation process used in Swanson and Williams (2014) to arrive at daily estimates of the sensitivity of various interest rates to labor and all other news. The first step involves estimating the following equation using nonlinear least squares.

$$\Delta i_t = \alpha_s + \delta_s \beta News_t^{labor} + \zeta_s \gamma News_t^{other} + \varepsilon_t, \tag{3}$$

where Δi_t is the one-day change in the relevant interest rate, $News_t^{labor}$ is a vector of the three labor-related news realizations on date t, and $News_t^{other}$ is a vector of the nine other news realizations on date t. The coefficients α, δ, and ζ vary over calendar years s, with δ and ζ normalized to average 1 over the 1990–2006 period. With this normalization, β and γ can be interpreted as coefficients representing the average contribution of individual news releases to interest rate changes during the baseline 1990–2006 period.

In the second stage of this estimation, the estimated $\hat{\beta}$ and $\hat{\gamma}$ vectors from the first step are used to construct one-dimensional series of labor and other news:

$$\widehat{News_t^{labor}} \equiv \hat{\beta} News_t^{labor} \quad \text{and} \quad \widehat{News_t^{other}} \equiv \hat{\gamma} News_t^{other}.$$

Then, rolling regressions with two-year windows whose midpoint is date τ are estimated at a daily frequency to obtain daily estimates of sensitivity to labor and other news:[15]

$$\Delta i_t = \gamma_\tau + \delta_\tau \widehat{News_t^{labor}} + \zeta_\tau \widehat{News_t^{other}} + \varepsilon_t. \tag{4}$$

As shown in Swanson and Williams (2014), there is time variation in sensitivity of interest

[15] Strictly speaking, since we retain only days on which there is at least one macroeconomic announcement, the frequency is not truly daily. Therefore, the estimation windows are defined as 250 days, which is the median length of two calendar years in the data set.

rates to macroeconomic news in general, even prior to the recent ZLB episode. This method allows me to focus on the differential sensitivity to labor news in particular while controlling for time variation in interest rate sensitivity to all news in general.

All the regressions in this section are run over the sample from July 30, 1991, to June 30, 2016 (excluding the week following September 11, 2001).

Table 3 shows the nonlinear least squares estimates for β and γ in equation (3). These estimates are broadly in line with those presented in Swanson and Williams (2014), which come from estimating equation (3) over a slightly shorter sample with the restrictions $\delta_s = \zeta_s \ \forall s$. Some patterns are evident from these estimates, such as the relatively greater sensitivity of higher maturity yields to core PPI inflation and the relatively greater sensitivity of lower maturity yields to the leading indicators index and real GDP growth. One thing to note here is that the data strongly reject the restriction that the sensitivities to labor and other news are equal at the annual frequency (that is, that $\delta_s = \zeta_s \ \forall s$).

Table 4 shows the same set of estimates for the short-rate expectations component of yields. Again, the data strongly reject the restriction that $\delta_s = \zeta_s \ \forall s$.

Table 3: Sensitivity of interest rates to individual news items

	6–Month	1–Year	2–Year	5–Year	10–Year	5Y Inst Fwd
Nonfarm Payrolls	2.95***	3.54***	4.38***	4.07***	3.06***	2.92***
	[0.36]	[0.41]	[0.51]	[0.53]	[0.48]	[0.55]
Unemployment Rate	−0.89***	−1.04***	−1.01**	−0.70*	−0.48	−0.34
	[0.33]	[0.39]	[0.45]	[0.40]	[0.32]	[0.32]
Initial Claims	−0.53***	−0.88***	−1.00***	−0.94***	−0.71***	−0.53***
	[0.14]	[0.17]	[0.19]	[0.18]	[0.15]	[0.15]
Consumer Confidence	0.59***	1.43***	1.62***	1.49***	1.42***	1.41***
	[0.20]	[0.35]	[0.42]	[0.44]	[0.39]	[0.41]
Capacity Utilization	−0.16	1.70**	2.41***	2.43***	1.39***	1.12***
	[0.63]	[0.74]	[0.67]	[0.55]	[0.43]	[0.42]
New Home Sales	0.70**	0.93**	1.13***	1.22***	1.09***	1.15***
	[0.30]	[0.36]	[0.41]	[0.39]	[0.35]	[0.38]
Leading Indicators	1.73***	0.41	0.15	−0.06	0.37	0.70
	[0.59]	[0.53]	[0.49]	[0.46]	[0.40]	[0.44]
ISM Manufacturing	0.77**	2.29***	3.22***	3.27***	2.79***	2.74***
	[0.32]	[0.39]	[0.44]	[0.41]	[0.37]	[0.41]
Core CPI Inflation	0.63**	1.48***	1.79***	1.74***	1.34***	1.02**
	[0.26]	[0.38]	[0.43]	[0.43]	[0.41]	[0.44]
Core PPI Inflation	0.01	0.11	0.22	0.22	0.64*	0.47
	[0.19]	[0.43]	[0.45]	[0.40]	[0.36]	[0.37]
Real GDP Growth (advance)	0.49*	0.91*	1.02	0.81	0.52	0.56
	[0.29]	[0.52]	[0.73]	[0.82]	[0.68]	[0.72]
Retail Sales	0.66**	1.86***	2.21***	2.39***	2.61***	2.90***
	[0.31]	[0.51]	[0.56]	[0.55]	[0.50]	[0.57]
Adjusted R^2	0.125	0.147	0.144	0.112	0.085	0.066
$H_0 : \delta_s = \zeta_s \ \forall s$, p-value	0.04	0.00	0.00	0.00	0.01	0.01
N	3112	3112	3112	3112	3112	3112

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Source: Author's calculations.

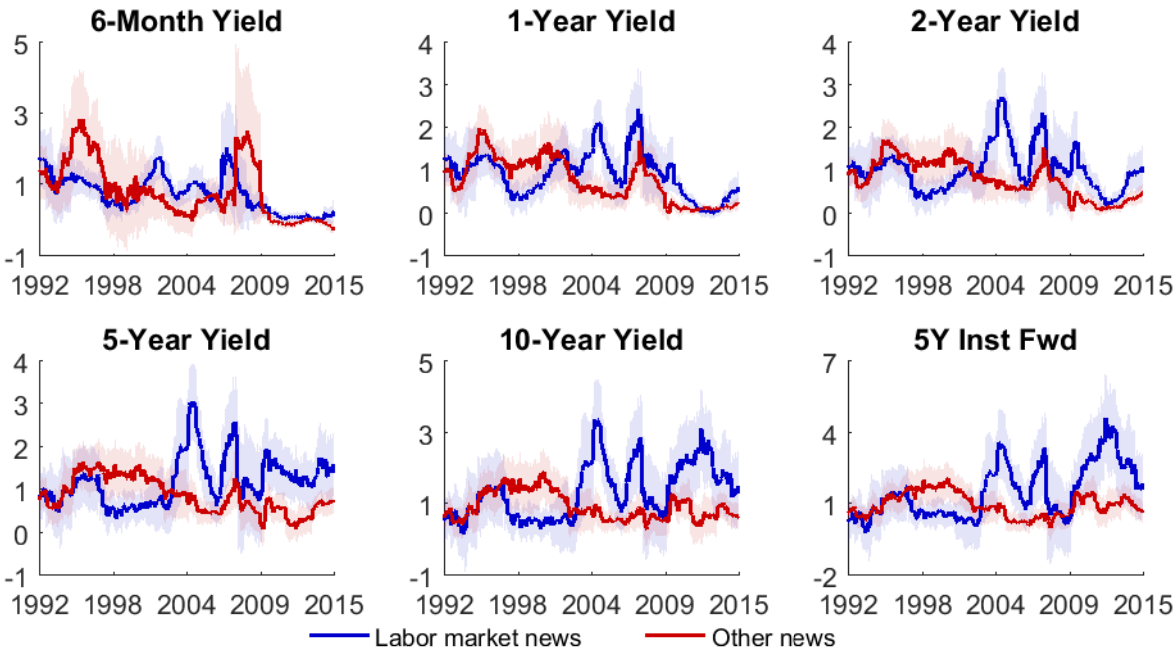
Table 4: Sensitivity of short-rate expectations components to individual news items

	1–Year	2–Year	5–Year	10–Year
Nonfarm Payrolls	2.51^{***}	2.60^{***}	1.81^{***}	1.27^{***}
	[0.29]	[0.29]	[0.21]	[0.17]
Unemployment Rate	-0.68^{***}	-0.68^{**}	-0.44^{**}	-0.24^{*}
	[0.26]	[0.27]	[0.18]	[0.13]
Initial Claims	-0.43^{***}	-0.51^{***}	-0.42^{***}	-0.30^{***}
	[0.11]	[0.11]	[0.08]	[0.06]
Consumer Confidence	0.82^{***}	0.90^{***}	0.71^{***}	0.53^{***}
	[0.21]	[0.22]	[0.16]	[0.13]
Capacity Utilization	0.63	1.07^{*}	0.85^{**}	0.55^{**}
	[0.71]	[0.56]	[0.38]	[0.27]
New Home Sales	0.55^{**}	0.62^{***}	0.58^{***}	0.49^{***}
	[0.23]	[0.24]	[0.17]	[0.13]
Leading Indicators	0.79	0.50	0.34	0.33^{*}
	[0.53]	[0.43]	[0.27]	[0.18]
ISM Manufacturing	1.45^{***}	1.68^{***}	1.31^{***}	0.98^{***}
	[0.26]	[0.27]	[0.19]	[0.14]
Core CPI Inflation	0.81^{***}	0.97^{***}	0.75^{***}	0.52^{***}
	[0.23]	[0.25]	[0.19]	[0.16]
Core PPI Inflation	0.05	0.10	0.18	0.20
	[0.23]	[0.26]	[0.18]	[0.13]
Real GDP Growth (advance)	0.87^{***}	0.81^{**}	0.50	0.34
	[0.32]	[0.37]	[0.32]	[0.27]
Retail Sales	0.81^{**}	1.05^{***}	0.99^{***}	0.88^{***}
	[0.32]	[0.33]	[0.23]	[0.19]
Adjusted R^2	0.147	0.153	0.138	0.104
$H_0 : \delta_s = \zeta_s \ \forall s$, p-value	0.00	0.00	0.00	0.00
N	3112	3112	3112	3112

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Source: Author's calculations.

Figure 8 plots the estimates of sensitivity to labor news and other news obtained from rolling regressions of equation (4). Note that none of the estimates is significantly negative.[16] Due to the normalization of δ_s and ζ_s in the estimation of equation (3), the magnitudes of these estimates can be interpreted as sensitivity relative to the 1990–2006 baseline average. These estimates show appreciable differences in interest rates' sensitivity to labor news relative to other news. This is especially apparent for longer maturity yields, where the sensitivity to labor news is often close to three times its baseline average level in the post-2003 period, while sensitivity to other news is never more than double its baseline average.

Figure 8: Time-varying sensitivity of interest rates to labor news and other news



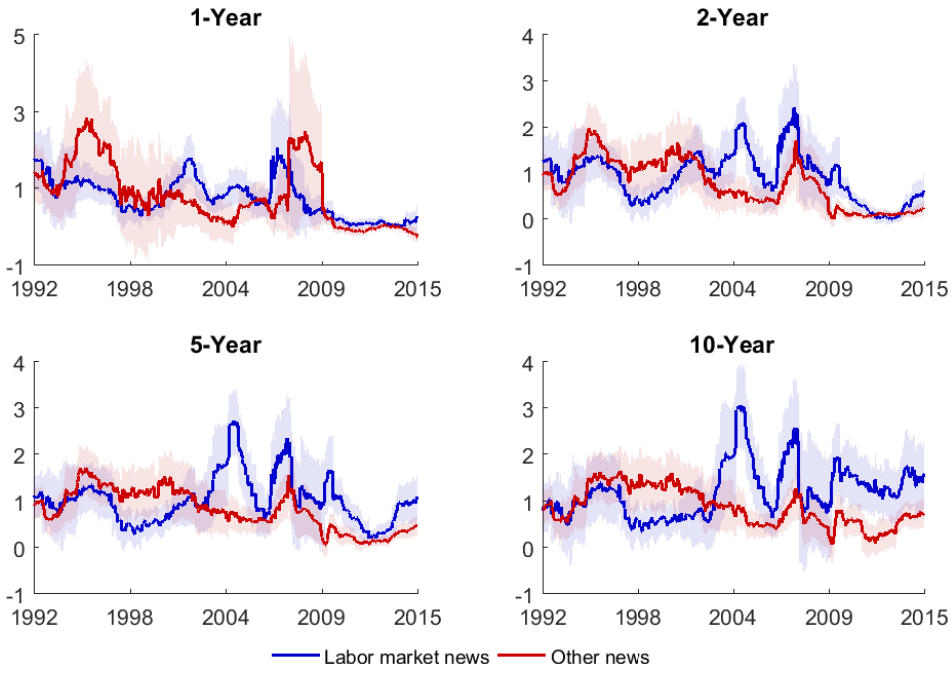
Note: Shaded areas are 90 percent confidence intervals based on heteroskedasticity-consistent standard errors, which have been adjusted for the use of generated regressors. Source: Author's calculations.

Figure 9 plots the same rolling estimates for the short-rate expectations components of yields. These estimates display the same patterns over time as the estimates for yields and are of

[16]The standard errors of these estimates are heteroskedasticity-consistent and are adjusted for the use of generated regressors $\{\widehat{News}_t^{labor}, \widehat{News}_t^{other}\}$, using the method outlined in Ch. 6A of Wooldridge (2002).

a similar magnitude. This indicates that time variation in the interest rate sensitivities also appears in the short-rate expectations component of yields and is not completely driven by the behavior of term premia.

Figure 9: Time-varying sensitivity of short-rate expectations components to labor news and other news

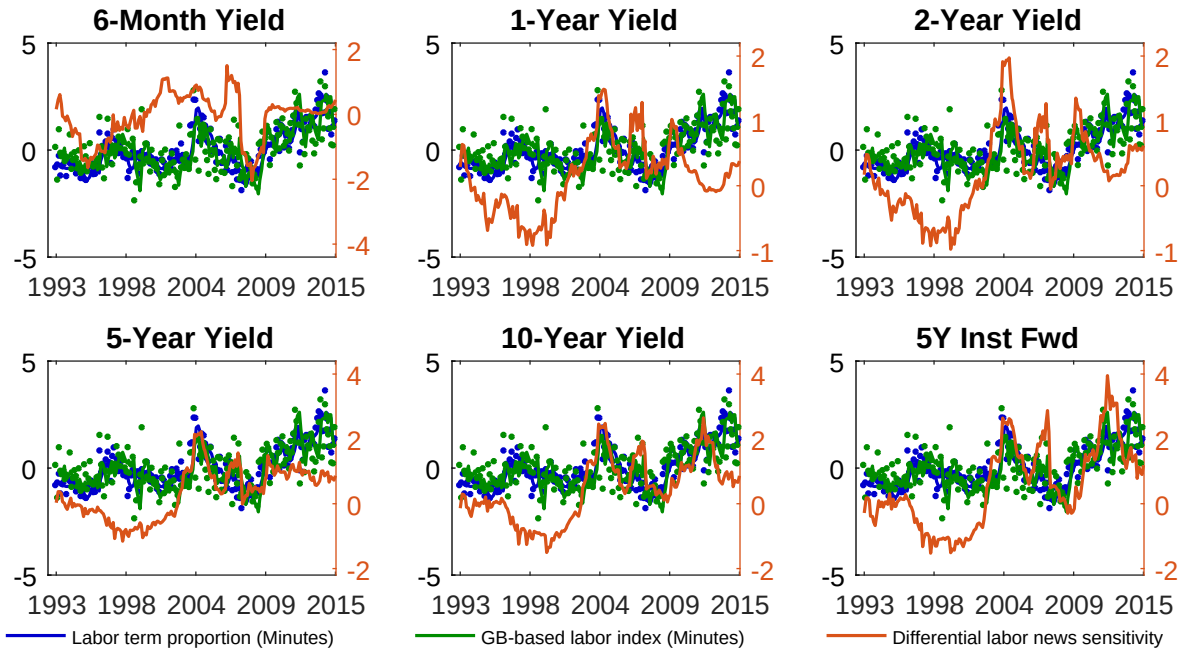


Note: Shaded areas are 90 percent confidence intervals based on heteroskedasticity-consistent standard errors, which have been adjusted for the use of generated regressors. Source: Author's calculations.

4 Relating sensitivity to FOMC labor word use

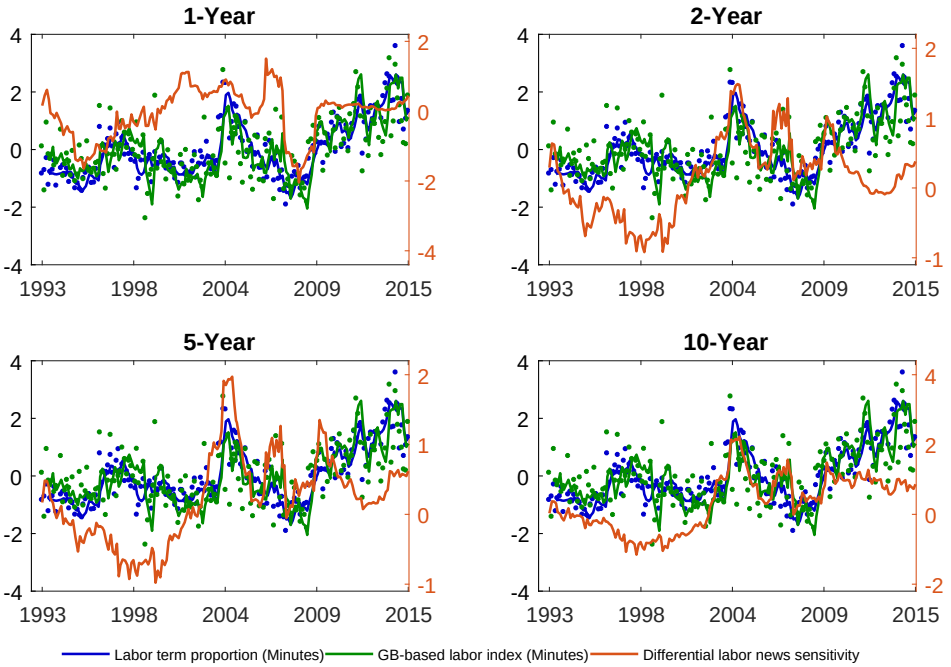
In this section, I explore the relationship between labor topic intensity in FOMC communications and the estimated differential sensitivity of interest rates and short-rate expectations to labor news over other news, $\hat{\delta}_s - \hat{\zeta}_s$. Figures 10 and 11 plot these series against both measures of labor topic intensity in FOMC minutes for interest rates and short-rate expectations, respectively. In the plots, the relationships appear tighter for longer maturities, and this feature is confirmed below.

Figure 10: FOMC minutes labor word use and differential sensitivity of interest rates to labor news



Source: Author's calculations.

Figure 11: FOMC minutes labor word use and differential sensitivity of short-rate expectations to labor news



Source: Author's calculations.

For the remainder of this section, the frequency of observation is the release dates of either FOMC minutes or statements. The sensitivity measures used are the rolling estimates from the two-year window whose midpoint is closest to the date of the relevant FOMC release. Unless otherwise indicated, the analyses are run over the full sample, which starts in August 1993 for FOMC minutes and February 1994 for FOMC statements and ends in May 2015 for both.[17]

To quantify the relationships between differential labor news sensitivity and FOMC labor topic intensity, I perform the following regression:

$$\hat{\delta}_t - \hat{\zeta}_t = constant + \theta LaborInt_t^m + \Phi X_t + error_t \tag{5}$$

for different measures of labor topic intensity (indexed by m) and different sets of control variables X_t. I consider the three measures of labor topic intensity and their four-release moving averages seen in Figures 6 and 7. In the regression, the labor topic intensity measures are standardized to facilitate comparison of coefficient estimates across different measures.

I consider two possible control variables. First, because my sample extends into the period of quantitative easing, one might be concerned about sensitivity of interest rates to news fluctuating due to changes in the amount of government debt held by private investors as opposed to the Federal Reserve or government agencies. To control for this, I use the percentage of government debt privately held, which was obtained from the Federal Reserve Bank of Dallas.[18] I also control for the level of the short rate (defined here as the six-month zero-coupon yield) to account for the presence of the ZLB in my sample and for overall business cycle conditions.

[17]The results are not sensitive to starting the analysis for FOMC statements in 2000, when the Committee announced that statements would be issued following every meeting.

[18]Data for market and par values of government debt are available at https://www.dallasfed.org/research/econdata/govdebt. I calculate this percentage based on par values in my analysis, but the results are nearly identical if market values are used instead, because the two measures have a correlation of 99.9 percent in my sample.

Table 5 shows the estimates of θ from equation (5) for the labor-term proportion in FOMC minutes with interest rates of different maturities in columns. There are three sets of specifications containing different sets of controls using either the current release or a four-release moving average (MA). All of the regression coefficients in the table are positive, and almost all are significant at the 5 percent level or lower. The size of the effect tends to grow with the maturity of the interest rate, with the largest effect being on the five-year-ahead instantaneous forward rate. The effects also tend to be larger and more statistically significant for the four-release MA than they are when you look at the current release alone. This perhaps isn't too surprising, given that the estimates of differential sensitivity come from a two-year window around the date of the FOMC release.

Compared to the case of no controls, the effects maintain the same magnitudes and significance when the regression additionally controls for the percentage of debt that's privately held. Note that even though the inclusion of this control has little impact on the estimated coefficients on $LaborInt_t^m$, the increases in the adjusted R-squareds indicate that this control variable contributes a substantial amount of explanatory power to the regression.

When the level of the short-term interest rate is added as another control variable, the magnitude and significance of the effect of labor topic intensity are reduced but still remain positive and statistically significant for most maturities, particularly the longer ones.

Table 5: Regressions of differential sensitivity of interest rates to labor news on labor-term proportion in FOMC minutes

	6–Month	1–Year	2–Year	5–Year	10–Year	5Y Inst Fwd	N
			No controls				
Current release	0.24***	0.13***	0.25***	0.40***	0.48***	0.70***	178
	[0.05]	[0.04]	[0.04]	[0.05]	[0.07]	[0.08]	
Adjusted R^2	0.093	0.041	0.131	0.226	0.208	0.255	
4-release MA	0.31***	0.15***	0.29***	0.48***	0.56***	0.83***	175
	[0.06]	[0.04]	[0.05]	[0.05]	[0.07]	[0.09]	
Adjusted R^2	0.134	0.051	0.150	0.260	0.236	0.298	
			Controlling for percent of debt privately held				
Current release	0.25***	0.13***	0.25***	0.41***	0.48***	0.70***	178
	[0.04]	[0.03]	[0.04]	[0.04]	[0.06]	[0.08]	
Adjusted R^2	0.377	0.302	0.282	0.310	0.264	0.289	
4-release MA	0.33***	0.16***	0.30***	0.48***	0.57***	0.84***	175
	[0.05]	[0.03]	[0.04]	[0.04]	[0.07]	[0.09]	
Adjusted R^2	0.462	0.353	0.318	0.349	0.292	0.331	
			Controlling for percent of debt privately held and short-rate level				
Current release	0.26***	0.01	0.09*	0.19***	0.24***	0.45***	178
	[0.07]	[0.04]	[0.05]	[0.05]	[0.07]	[0.09]	
Adjusted R^2	0.373	0.406	0.423	0.468	0.396	0.370	
4-release MA	0.36***	0.03	0.13**	0.26***	0.32***	0.58***	175
	[0.07]	[0.04]	[0.05]	[0.06]	[0.07]	[0.09]	
Adjusted R^2	0.462	0.445	0.445	0.487	0.410	0.398	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Constant and coefficients on controls are omitted for brevity. The labor topic intensity measure is standardized so coefficients can be interpreted as the effect of a one-standard-deviation increase in labor topic intensity. Source: Author's calculations.

Table 6 shows the same estimates for differential labor news sensitivity of short-term rate expectations components. Here, we see the same qualitative patterns.

Tables 7 and 8 show results from estimating equation (5) using the Naive Bayes labor intensity measure for FOMC minutes. These estimates follow the same qualitative patterns seen

Table 6: Regressions of differential sensitivity of short-rate expectations to labor news on labor-term proportion in FOMC minutes

	1–Year	2–Year	5–Year	10–Year	N
		No controls			
Current release	0.18***	0.18***	0.24***	0.34***	178
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.098	0.087	0.140	0.185	
4-release MA	0.22***	0.21***	0.29***	0.40***	175
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.118	0.103	0.161	0.215	
		Controlling for percent of debt privately held			
Current release	0.19***	0.18***	0.25***	0.34***	178
	[0.03]	[0.03]	[0.03]	[0.04]	
Adjusted R^2	0.323	0.299	0.332	0.316	
4-release MA	0.23***	0.22***	0.30***	0.41***	175
	[0.03]	[0.03]	[0.03]	[0.04]	
Adjusted R^2	0.383	0.348	0.374	0.356	
		Controlling for percent of debt privately held and short-rate level			
Current release	0.09**	0.06	0.10**	0.16***	178
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.388	0.402	0.470	0.449	
4-release MA	0.13***	0.09**	0.14***	0.22***	175
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.436	0.439	0.497	0.472	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Constant and coefficients on controls are omitted for brevity. The labor topic intensity measure is standardized so coefficients can be interpreted as the effect of a one-standard-deviation increase in labor topic intensity. Source: Author's calculations.

in Tables 5 and 6, though the effect of the four-release moving average of the Naive Bayes measure tends to be larger than that of the term proportion measure.

Table 7: Regressions of differential sensitivity of interest rates to labor news on Naive Bayes labor intensity in FOMC minutes

	6–Month	1–Year	2–Year	5–Year	10–Year	5Y Inst Fwd	N
			No controls				
Current release	0.17***	0.07*	0.17***	0.30***	0.37***	0.54***	178
	[0.05]	[0.04]	[0.05]	[0.05]	[0.07]	[0.09]	
Adjusted R^2	0.042	0.010	0.058	0.122	0.120	0.148	
4-release MA	0.30***	0.11**	0.29***	0.54***	0.68***	1.02***	175
	[0.07]	[0.05]	[0.05]	[0.06]	[0.08]	[0.11]	
Adjusted R^2	0.072	0.014	0.088	0.206	0.214	0.277	
			Controlling for percent of debt privately held				
Current release	0.23***	0.12***	0.21***	0.34***	0.41***	0.59***	178
	[0.05]	[0.04]	[0.04]	[0.05]	[0.07]	[0.08]	
Adjusted R^2	0.361	0.292	0.236	0.235	0.200	0.204	
4-release MA	0.44***	0.21***	0.38***	0.64***	0.78***	1.13***	175
	[0.06]	[0.04]	[0.05]	[0.06]	[0.08]	[0.11]	
Adjusted R^2	0.475	0.357	0.312	0.359	0.324	0.360	
			Controlling for percent of debt privately held and short-rate level				
Current release	0.21***	0.04	0.09**	0.18***	0.23***	0.37***	178
	[0.06]	[0.04]	[0.05]	[0.05]	[0.07]	[0.09]	
Adjusted R^2	0.360	0.409	0.426	0.467	0.397	0.354	
4-release MA	0.46***	0.07	0.18***	0.38***	0.50***	0.84***	175
	[0.08]	[0.05]	[0.06]	[0.07]	[0.09]	[0.12]	
Adjusted R^2	0.473	0.449	0.452	0.510	0.444	0.435	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Constant and coefficients on controls are omitted for brevity. The labor topic intensity measure is standardized so coefficients can be interpreted as the effect of a one-standard-deviation increase in labor topic intensity. Source: Author's calculations.

Lastly, Tables 9 and 10 present corresponding results for labor-term proportion in FOMC statements. Again, it's clear the relationship is stronger for interest rates and short-rate ex-

Table 8: Regressions of differential sensitivity of short-rate expectations to labor news on Naive Bayes labor intensity in FOMC minutes

	1–Year	2–Year	5–Year	10–Year	N
		No controls			
Current release	0.10**	0.10**	0.17***	0.25***	178
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.026	0.026	0.063	0.101	
4-release MA	0.15**	0.16***	0.28***	0.45***	175
	[0.06]	[0.06]	[0.05]	[0.06]	
Adjusted R^2	0.029	0.032	0.096	0.170	
		Controlling for percent of debt privately held			
Current release	0.14***	0.15***	0.21***	0.30***	178
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.276	0.262	0.288	0.265	
4-release MA	0.24***	0.25***	0.38***	0.55***	175
	[0.05]	[0.05]	[0.04]	[0.05]	
Adjusted R^2	0.338	0.322	0.377	0.383	
		Controlling for percent of debt privately held and short-rate level			
Current release	0.07	0.06	0.10**	0.16***	178
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.381	0.402	0.474	0.455	
4-release MA	0.11**	0.10*	0.20***	0.35***	175
	[0.05]	[0.05]	[0.05]	[0.06]	
Adjusted R^2	0.419	0.434	0.509	0.503	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Constant and coefficients on controls are omitted for brevity. The labor topic intensity measure is standardized so coefficients can be interpreted as the effect of a one-standard-deviation increase in labor topic intensity. Source: Author's calculations.

pectations components of greater maturities as well as for the four-release moving average of the labor-term proportion measure. Overall, the results in this section indicate a moderately strong relationship between how intensely FOMC minutes discuss the topic of labor and the sensitivity of yields and short-rate expectations to labor-related news relative to other news.

Table 9: Regressions of differential sensitivity of interest rates to labor news on Naive Bayes labor intensity in FOMC statements

	6–Month	1–Year	2–Year	5–Year	10–Year	5Y Inst Fwd	N
			No controls				
Current release	0.06	0.04	0.19***	0.34***	0.40***	0.59***	148
	[0.05]	[0.04]	[0.04]	[0.05]	[0.07]	[0.09]	
Adjusted R^2	−0.000	−0.001	0.072	0.162	0.133	0.163	
4-release MA	0.09	0.07	0.24***	0.42***	0.49***	0.71***	145
	[0.06]	[0.04]	[0.05]	[0.06]	[0.08]	[0.10]	
Adjusted R^2	0.004	0.005	0.098	0.207	0.165	0.198	
			Controlling for percent of debt privately held				
Current release	0.19***	0.14***	0.27***	0.40***	0.47***	0.65***	148
	[0.04]	[0.03]	[0.04]	[0.05]	[0.07]	[0.08]	
Adjusted R^2	0.214	0.246	0.194	0.202	0.157	0.171	
4-release MA	0.28***	0.22***	0.37***	0.52***	0.59***	0.81***	145
	[0.05]	[0.04]	[0.05]	[0.06]	[0.08]	[0.10]	
Adjusted R^2	0.261	0.288	0.254	0.263	0.196	0.210	
			Controlling for percent of debt privately held and short-rate level				
Current release	0.29***	−0.02	0.06	0.14*	0.12	0.32**	148
	[0.09]	[0.05]	[0.06]	[0.07]	[0.10]	[0.13]	
Adjusted R^2	0.228	0.333	0.297	0.301	0.263	0.223	
4-release MA	0.44***	0.06	0.17**	0.29***	0.25**	0.51***	145
	[0.09]	[0.05]	[0.07]	[0.08]	[0.11]	[0.14]	
Adjusted R^2	0.290	0.349	0.322	0.326	0.271	0.239	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Constant and coefficients on controls are omitted for brevity. The labor topic intensity measure is standardized so coefficients can be interpreted as the effect of a one-standard-deviation increase in labor topic intensity. Source: Author's calculations.

Table 10: Regressions of differential sensitivity of short-rate expectations to labor news on Naive Bayes labor intensity in FOMC statements

	1–Year	2–Year	5–Year	10–Year	N
		No controls			
Current release	0.11***	0.11***	0.17***	0.25***	148
	[0.04]	[0.04]	[0.04]	[0.05]	
Adjusted R^2	0.032	0.032	0.063	0.100	
4-release MA	0.14***	0.14***	0.21***	0.31***	145
	[0.04]	[0.04]	[0.05]	[0.06]	
Adjusted R^2	0.042	0.046	0.086	0.128	
		Controlling for percent of debt privately held			
Current release	0.20***	0.20***	0.25***	0.33***	148
	[0.03]	[0.03]	[0.04]	[0.05]	
Adjusted R^2	0.264	0.236	0.216	0.181	
4-release MA	0.29***	0.29***	0.34***	0.43***	145
	[0.03]	[0.04]	[0.05]	[0.05]	
Adjusted R^2	0.329	0.302	0.270	0.225	
		Controlling for percent of debt privately held and short-rate level			
Current release	0.09*	0.05	0.04	0.09	148
	[0.05]	[0.05]	[0.05]	[0.06]	
Adjusted R^2	0.303	0.308	0.327	0.282	
4-release MA	0.18***	0.15***	0.15**	0.20***	145
	[0.05]	[0.05]	[0.06]	[0.07]	
Adjusted R^2	0.352	0.349	0.346	0.294	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Constant and coefficients on controls are omitted for brevity. The labor topic intensity measure is standardized so coefficients can be interpreted as the effect of a one-standard-deviation increase in labor topic intensity. Source: Author's calculations.

The results in this and the previous section are also robust to using a kernel estimation instead of rolling windows in the second stage. They are also robust to directly estimating equation (3) with sensitivity parameters δ_s and ζ_s varying at higher frequencies using state-space methods.

5 A more parametric approach

In this section, I consider a more parametric estimation, where the differential sensitivity to labor news is constrained to be a linear function of FOMC labor topic intensity and potentially other control variables. I also allow for time variation in sensitivity to all news at the same frequency as the relevant FOMC text. That is, I use nonlinear least squares to estimate the following relationship:

$$\Delta i_t = \alpha + f\left(LaborInt^m_{r(t)}, X_r(t)\right)\beta News^{labor}_t + \zeta^{all}_{r(t)}\left(\beta News^{labor}_t + \gamma News^{other}_t\right) + \varepsilon_t, \quad (6)$$

$$\text{where } f\left(LaborInt^m_{r(t)}, X_r(t)\right) = constant + \theta LaborInt^m_{r(t)} + \Phi X_r(t).$$

The subscript t indicates variation at the frequency of macroeconomic announcements. The date of the most recent FOMC release for a given date t is denoted $r(t)$. This subscript indicates variation at the lower frequency of the relevant FOMC release.[19] Constraints are imposed such that the values of $f\left(LaborInt^m_r, X_r\right)$ and ζ^{all}_r average to 0 and 1, respectively, from the start of the sample to the end of 2006. This normalization allows for the scales of β and γ to be identified and interpretable as the average sensitivity to labor and other news, respectively, over the period through 2006. Again, the labor topic intensity measures are standardized to ease interpretation of coefficients.

Table 11 shows the estimates of θ in equation (6) for various interest rates using the labor-term proportion in FOMC minutes and the same sets of controls used in the previous section. These results reflect the same patterns evident in Section 4, which are that an increase in labor topic intensity in FOMC communications is associated with larger responses of interest rates to labor-related news after controlling for general time variation in the size of responses

[19]The controls X_r are sampled at different frequencies. The percentage of debt that's privately held is available monthly. To transform this measure to the frequency of the FOMC releases, I interpolate the debt measure to the frequency of macroeconomic announcements and then take the average between FOMC release dates. That is, the measure corresponding to $r(t)$ is the average of the interpolated measure between dates $r(t)$ and $r(t+1)-1$. The same averaging procedure is applied to the short rate, which is available on all macroeconomic announcement days. This averaging procedure takes into account that these controls apply to the labor news sensitivity for all macroeconomic releases that take place from date $r(t)$ to $r(t+1)-1$.

to all news. These results change little with the inclusion of the percentage of debt privately held in the function f. Including the short rate as another control adds more noise to the estimates, but they remain statistically significant for longer maturities. In addition, the magnitudes of the coefficients at longer maturities change little or become even larger with this additional control variable.

Table 11: Parametric nonlinear regressions with differential sensitivity of interest rates to labor news being a linear function of labor-term proportion in FOMC minutes

	6–Month	1–Year	2–Year	5–Year	10–Year	5Y Inst Fwd	N
			No controls				
Current release	0.05	0.20*	0.34***	0.40***	0.38*	0.45	2909
	[0.21]	[0.11]	[0.11]	[0.14]	[0.22]	[0.31]	
Adjusted R^2	0.126	0.162	0.158	0.131	0.105	0.095	
4-release MA	0.16	0.27**	0.39***	0.47***	0.49**	0.63*	2858
	[0.23]	[0.11]	[0.13]	[0.17]	[0.24]	[0.35]	
Adjusted R^2	0.127	0.161	0.158	0.132	0.105	0.095	
			Controlling for percent of debt privately held				
Current release	0.01	0.18*	0.32***	0.38***	0.39*	0.48	2909
	[0.20]	[0.10]	[0.11]	[0.14]	[0.22]	[0.32]	
Adjusted R^2	0.126	0.164	0.160	0.131	0.104	0.095	
4-release MA	0.11	0.25**	0.38***	0.47***	0.49**	0.62*	2858
	[0.22]	[0.11]	[0.12]	[0.16]	[0.25]	[0.37]	
Adjusted R^2	0.127	0.162	0.159	0.132	0.105	0.095	
			Controlling for percent of debt privately held and short-rate level				
Current release	−0.19	0.08	0.24*	0.35*	0.48	0.64	2909
	[0.25]	[0.13]	[0.14]	[0.18]	[0.31]	[0.45]	
Adjusted R^2	0.127	0.164	0.160	0.131	0.104	0.095	
4-release MA	−0.11	0.14	0.27*	0.43**	0.61*	0.83	2858
	[0.28]	[0.15]	[0.16]	[0.22]	[0.35]	[0.52]	
Adjusted R^2	0.127	0.163	0.159	0.132	0.105	0.095	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Source: Author's calculations.

Table 12 shows that the same qualitative results hold for the sensitivity of the short-rate expectations components of yields. Finally, Tables 13 and 14 show that the same qualitative results hold when we use the Naive Bayes measure of labor intensity in FOMC minutes.

Table 12: Parametric nonlinear regressions with differential sensitivity of short-rate expectations to labor news being a linear function of labor-term proportion in FOMC minutes

	1–Year	2–Year	5–Year	10–Year	N
		No controls			
Current release	0.23*	0.29**	0.38***	0.46***	2909
	[0.13]	[0.12]	[0.12]	[0.17]	
Adjusted R^2	0.152	0.163	0.149	0.116	
4-release MA	0.30**	0.36***	0.43***	0.52***	2858
	[0.15]	[0.13]	[0.14]	[0.18]	
Adjusted R^2	0.150	0.161	0.148	0.116	
		Controlling for percent of debt privately held			
Current release	0.19	0.27**	0.35***	0.43***	2909
	[0.12]	[0.11]	[0.12]	[0.16]	
Adjusted R^2	0.154	0.165	0.150	0.116	
4-release MA	0.27*	0.34***	0.41***	0.51***	2858
	[0.14]	[0.13]	[0.13]	[0.18]	
Adjusted R^2	0.151	0.162	0.149	0.116	
		Controlling for percent of debt privately held and short-rate level			
Current release	0.14	0.19	0.27*	0.41*	2909
	[0.15]	[0.14]	[0.15]	[0.22]	
Adjusted R^2	0.154	0.165	0.151	0.116	
4-release MA	0.22	0.24	0.31*	0.48*	2858
	[0.18]	[0.16]	[0.17]	[0.25]	
Adjusted R^2	0.151	0.163	0.150	0.116	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Source: Author's calculations.

Table 13: Parametric nonlinear regressions with differential sensitivity of interest rates to labor news being a linear function of Naive Bayes labor intensity in FOMC minutes

	6–Month	1–Year	2–Year	5–Year	10–Year	5Y Inst Fwd	N
			No controls				
Current release	−0.17	0.15	0.24**	0.28**	0.33	0.35	2909
	[0.16]	[0.10]	[0.11]	[0.14]	[0.22]	[0.32]	
Adjusted R^2	0.126	0.162	0.157	0.130	0.105	0.095	
4-release MA	0.03	0.21	0.35**	0.49**	0.62*	0.82*	2858
	[0.22]	[0.13]	[0.15]	[0.21]	[0.33]	[0.50]	
Adjusted R^2	0.127	0.160	0.156	0.131	0.105	0.096	
			Controlling for percent of debt privately held				
Current release	−0.16	0.18*	0.28***	0.33**	0.32	0.31	2909
	[0.16]	[0.10]	[0.11]	[0.14]	[0.22]	[0.32]	
Adjusted R^2	0.127	0.164	0.159	0.131	0.104	0.095	
4-release MA	0.06	0.30**	0.45***	0.58***	0.62*	0.76	2858
	[0.23]	[0.14]	[0.15]	[0.21]	[0.33]	[0.50]	
Adjusted R^2	0.127	0.162	0.159	0.132	0.105	0.095	
			Controlling for percent of debt privately held and short-rate level				
Current release	−0.31	0.10	0.21	0.28*	0.38	0.41	2909
	[0.20]	[0.12]	[0.13]	[0.17]	[0.28]	[0.41]	
Adjusted R^2	0.127	0.164	0.160	0.131	0.104	0.094	
4-release MA	−0.14	0.18	0.33*	0.52*	0.70	0.92	2858
	[0.29]	[0.17]	[0.19]	[0.26]	[0.43]	[0.65]	
Adjusted R^2	0.127	0.163	0.159	0.132	0.105	0.095	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Source: Author's calculations.

Table 14: Parametric nonlinear regressions with differential sensitivity of short-rate expectations to labor news being a linear function of Naive Bayes labor intensity in FOMC minutes

	1–Year	2–Year	5–Year	10–Year	N
		No controls			
Current release	0.11	0.18*	0.25**	0.25	2909
	[0.11]	[0.11]	[0.12]	[0.17]	
Adjusted R^2	0.152	0.162	0.148	0.114	
4-release MA	0.16	0.27*	0.39**	0.52**	2858
	[0.16]	[0.14]	[0.16]	[0.24]	
Adjusted R^2	0.149	0.160	0.147	0.115	
		Controlling for percent of debt privately held			
Current release	0.13	0.21**	0.28**	0.28*	2909
	[0.11]	[0.11]	[0.12]	[0.16]	
Adjusted R^2	0.153	0.164	0.150	0.114	
4-release MA	0.23	0.35**	0.48***	0.58**	2858
	[0.17]	[0.15]	[0.17]	[0.23]	
Adjusted R^2	0.151	0.162	0.149	0.116	
		Controlling for percent of debt privately held and short-rate level			
Current release	0.07	0.14	0.20	0.22	2909
	[0.13]	[0.12]	[0.14]	[0.20]	
Adjusted R^2	0.153	0.165	0.150	0.114	
4-release MA	0.14	0.23	0.36*	0.50	2858
	[0.20]	[0.18]	[0.21]	[0.31]	
Adjusted R^2	0.151	0.162	0.150	0.115	

Notes: *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively. Heteroskedasticity-consistent t-statistics are in brackets. Source: Author's calculations.

6 Conclusion

In this paper, I presented novel measures of the extent to which FOMC communications were skewed toward labor-related language. The development of these indices contributes to an emerging academic literature that seeks to quantify FOMC communications along the dimensions of particular topics. One of the methods presented here, the Naive Bayes model with FOMC Greenbooks as training texts, can be readily applied to a variety of other topics in FOMC communications.

I then showed an interaction effect where an increase in labor topic intensity in FOMC texts is positively associated with the extent to which interest rates' response to labor-related news exceeds their response to all other news. The relationship seems to be especially strong for interest rates of longer maturities and is also present when focusing only on the short-rate expectations components of yields.

In terms of policy implications, it's not clear whether it's desirable for FOMC communications to affect financial market variables in this way. One immediate implication is that increased central bank discussion of specific economic variables could raise financial market volatility in response to data releases. Since there is inherently noise in these measures, this increased sensitivity of financial market variables may not be efficient. Enriching our understanding of the effects of FOMC communications will help guide the design of an optimal central bank communication strategy.

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