FedSpeak Matters: FOMC Statments and Monetary Policy Expectations

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Abstract

The Federal Open Market Committee (FOMC) claims that their post-meeting statements shift market expectations of future monetary policy. In this paper, I provide evidence supporting this claim. I apply a methodology from computational text analysis to produce a pairwise-statement similarity measure that compares wording between two FOMC statements. This similarity measure documents that FOMC statements have become more similar over time. With an event-study approach, I find that a decrease in the similarity of sequential FOMC statements is correlated with an increase the variation of federal funds rate expectations, calculated from high-frequency fed funds futures prices. This relationship persists even after controlling for changes in the target federal funds rate and Federal Reserve Chair. Standard monetary regressions omit any measure of policy statement texts and are thus biased. Adding the sequential statement similarity measure to a regression of federal funds rate expectations on the target rate accounts for 1.5 times the variation in market expectations. This paper suggests that more detailed text analysis on FOMC statements will improve modeling of monetary policy expectations.

Keywords: Monetary Policy, FOMC statements, text analysis, high-frequency
JEL Codes: E52, E58, C49, G14

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1 Introduction

The Federal Reserve (Fed) controls US monetary policy with the stated objectives of maximizing employment, stabilizing inflation, managing interest rates, and encouraging stability of the financial system. The policymaking branch of the Federal Reserve, the Federal Open Market Committee (FOMC), releases a statement after each policy meeting.[1] Following the 2008 Financial Crisis, the Fed has also emphasized policy objectives of consumer protection and financial stability. To achieve these objectives, the FOMC can use open market operations to shift the federal funds rate and money supply. Once at the zero lower bound in 2009, the Federal Reserve sought unconventional monetary policy tools to interact with the economy. In particular, they strongly emphasized using post-meeting policy statements to adjust market expectations of future monetary policy and future states of the economy.

This paper presents evidence that changes in FOMC statement wording does shift market expectations. I produce a measure of similarity between sequential FOMC statements' wording to quantitatively represent how FOMC statements are changing from one meeting to the next. This measure allows me to numerically compare changes in FOMC statement text, changes in the target federal funds rate, and changes market expectations of future federal funds rates.

The main results of this paper center on the quantitative analysis of this relationship. A common regression in monetary economics is to regress changes in expectations on changes in the target federal funds rate. Adding a measure of sequential FOMC statement similarity to that specification accounts for approximately 1.5 times the variation in market expectations compared to when the similarity measure is omitted.

Specifications that include both changes in the target rate and FOMC statement wording exhibit an amplification effect: when the FOMC is changing the target federal funds rate by

[1]The FOMC votes on monetary policy that the Federal Reserve will pursue 8 times per year. I will refer to both the FOMC and Federal Reserve Bank as the monetary policy makers. FOMC members include the Board of Governors, the president of the Federal Reserve Bank of New York, and four of the other eleven regional Federal Reserve Bank presidents

a larger increment, then changes in the statement wording shift market expectations more, and vice versa. Leveraging this interaction effect, my empirical work indicates that while at the zero lower bound, the FOMC was still able to shift market expectations by changing the wording of their post-meeting statements.

This paper also has a descriptive contribution. I find quantitative evidence that the FOMC statements' vocabulary has become more less varied over time, using statements from May 1999 through October 2019. I extend the work from Meade and Acosta (2015), who calculate document similarity through 2015. There is a noticeable up-tick in the persistence of statement wording around the time when the FOMC hit the zero lower bound and increased their reliance on post-meeting statements as a method for shifting expectations. However, even after the federal funds rate increased from the zero lower bound, FOMC statements have still remained sequentially very similar. This is evidence that the federal funds rate and wording of FOMC statements are not perfectly correlated, and therefore may have different effects on market expectations of future monetary policy.

As is common in the literature, I transform Fed Fund Futures (FFF) to represent monetary policy expectations (Gürkaynak, Sack and Swanson, 2005; Campbell, Evans, Fisher and Justiniano, 2012; Nakamura and Steinsson, 2018). FFF prices are 100 less the expected average federal funds rate for the month in which the contract ends. There are FFF contracts with 1 month to 24 month horizons representing expectations of future monetary policy for 1 month to two years into the future. Due to low trading volume, I restrict my analysis to FFF contracts with 1 to 6 month horizons. I use tick-level, time-of-sales data from the CME Group, the owner of the Chicago Mercantile Exchange.

I use an event-study approach to analyze the relationship between expectations and FOMC statement text. High-frequency FFF data allows me to construct a 30-minute event window, as in Nakamura and Steinsson (2018). The underlying assumption of event-study analysis is that the only changes in the dependent variable come from data variation within the event window. This paper assumes the contents of the FOMC announcement cause

the changes in market expectations from 10 minutes before an FOMC announcement to 20 minutes after FOMC announcements. The small event window makes it unlikely that variation in expectations is caused by other factors. Any information changes, such as macroeconomic data releases or other major announcements, that occur before the FOMC announcement window would already be incorporated into the asset prices measured 10 minutes before the FOMC announcement. Because the word choice can vary by the author, I also include an indicator variable for each Fed Chair. Accounting for Fed Chair does not change the bottom line that the more dissimilar sequential FOMC statements, the more market expectations move.

Monetary economists have debated, on both the theoretical and quantitative level, whether FOMC statements matter for shifting relevant economic variables. A collection of papers argue that the Fed has private information that FOMC statements introduce into the market and that this added information is what causes markets to move (Crawford and Sobel, 1982; Cukierman and Meltzer, 1986; Morris and Shin, 2002) . Within this literature there are many papers that interpret FOMC statements as cheap talk where the ability of the statements to shift expectations is proportional to the reputation of the central bank and to the specificity of the statement (Farrell and Rabin, 1996; Stein, 1989; Moscarini, 2007; Bassetto, 2019).

Other economists argue that the Fed is able to aggregate the information of the economy and translate it to predictions of future economic dynamics; that is, that the added information of FOMC statements comes from the forward guidance components of the FOMC statements. In the field of behavioral New Keynesian models, like Angeletos and Lian (2018), cite this logic to assume that if the Fed can control expectations then they can shift consumer behavior and other aggregate variables. This paper does not take a stand on how the Fed changes expectations. Rather it leverages the variation in FOMC statement wording-changes to study if FOMC statements shift public monetary policy expectations.

This paper fits in the literature that quantitatively tests whether the Fed statements

matter. Gürkaynak et al. (2005), Nakamura and Steinsson (2018), Campbell et al. (2012), and Ai and Bansal (2018) use high frequency data to estimate the fluctuations of asset prices around FOMC statement releases and find that FOMC statements do matter when measuring monetary surprises. The Nakamura and Steinsson (2018) policy news shock and the Gürkaynak et al. (2005) target and path factors rely on the same identification assumption of this paper: changes in asset prices in a small window around FOMC announcements are caused by the information revealed in the FOMC announcement. One contribution of this paper is that I identify how changes in FOMC statement text versus changes in the target federal funds rate contribute to expectation shifts.

This paper also relates to the growing number of studies that measure FOMC text directly using text analysis. Romer and Romer (2004) read FOMC documents to calculate the FOMC's intended federal funds rate, independent of forecasts of economic performance. Using this shock series, they find monetary policy greatly impacts the real economy. While Romer and Romer (2004) extract one aspect of FOMC texts for their study, Hansen and McMahon (2016) use a combination of computational text analysis and a narrative approach to identify descriptive versus guidance dimensions of FOMC statements. They find that FOMC statements have a weak impact on real economic variables. Hansen, McMahon and Prat (2018) use word frequency and latent Dirichlet allocation (LDA) topic modeling to quantify the transparency of FOMC communication regarding policy and economic expectations, jointly and broken down by FOMC member. Similar to Hansen and McMahon (2016) and Hansen et al. (2018), I use word frequencies to build a numerical representation of FOMC text. I use overall wording variation from one statement to the next to create an absolute value measure of sequential statement similarity. Although this is an unsupervised approach, I am unable to have directional sentiment analysis like Hansen and McMahon (2016). My contribution to this literature is in using a simple measure of FOMC statement text variation to show their wording does change market expectations. My paper contributes to both the quantitative and text analysis monetary literatures. The general question un-

derlying these works is "do FOMC statements matter?" In this paper, I show that they do.

The paper proceeds as follows. Section 2 discusses the text analysis techniques used to produce the pairwise FOMC statement similarity measure. Section 3 discusses the other data sources I use to study the the relationship between the wording of FOMC statements and expectations of monetary policy. Section 4 presents my empirical results and different regression specifications. In section 5, I summarize the contributions of this paper and conclude.

2 FOMC Statement Text Analysis

Following their scheduled policy meetings, the FOMC releases a brief statement summarizing the committee's evaluation of the economy, how they intend to work towards their mandates, and the approved monetary policy. The FOMC has released a statement immediately after their monetary policy meeting since May 1999. Table A1 has a list of every FOMC statement release date and time for the sample period: May 1999 through October 2019.[2] The FOMC claims to write their announcements with the intention of shifting public expectations about the future evolution of the economy and future monetary policy (Board of Governors of the Federal Reserve System U.S., 2016). Accordingly, they appear to choose their words carefully. The pre-meeting materials[3] include multiple drafts of FOMC post-meeting statements with word-by-word edits from the previous meeting's statement. This indicates that the FOMC are changing words when they are want to change their signal. To quantitatively measure the wording changes across statements requires text analysis.

[2]Press conferences occur at least 30 minutes after the statement is released, if at all. Meetings with press conferences are also indicated in table A1.

[3]There are different reports that the FOMC reference throughout the meetings to help make their policy decisions. One of these reports - the Beige Book - is released to the public two weeks prior to before FOMC meetings and summarizes economic conditions for each of the Fed's districts. The reports that provided more detail on the US and global economy, in addition to monetary policy recommendations - the Teal or the Blue and Green books depending on the year - are only available to FOMC members before FOMC meetings and are released to the public with a 5 year lag.

Economists are increasingly incorporating computational text analysis into their research in order to quantify and extract information from myriad bodies of text. These methods rely on both supervised and unsupervised machine learning algorithms. In this paper, I use an unsupervised learning method known as a bag-of-words model. With this method, text is represented as an unordered, weighted-frequency of words. Documents that have common word occurrences are assumed to be discussing similar topics. After transforming documents into vectors of word frequencies, vector analysis allows me to create a measure of the similarity between two document vectors. This paper does this for the collection of FOMC statements that were released from May 1999 through August 2019 and uses their similarity for additional economic analysis.

The May 1999 through December 2014 FOMC statements are from the Federal Reserve's Historical Materials webpage and the January 2015 through October 2019 FOMC statements are from the Federal Reserve's Meeting calendars, statements, and minutes webpage. Both of which can be accessed on the Federal Reserve Board's website at https://www.federalreserve.gov/monetarypolicy/fomc.htm. I limit my sample to only post-meeting statements that were released after scheduled meetings. If I had included unscheduled meetings, I could not separate whether the effect on expectations came from a change in the wording of the statement or from the fact that the meeting itself was unexpected. I cleaned (converted all words to lower cases, separated words and spaces) the collection of FOMC statements to prepare them for analysis.

The rest of this section will proceed as follows: first, a discussion on how word frequencies are used to represent documents; second, an explanation of measuring statement similarities; and third, setting up how the FOMC statement similarity measure can be used for economic analysis.

The weighted frequency of words commonly used in text analysis is called Term-Frequency-Inverse-Document-Frequency (TFIDF). I followed the documentation from Python's library on text analysis (sklearn) for calculating the TFIDF matrix. Each word is multiplied by the

frequency it occurs in a particular document over the number of documents where the word occurs. Words like "a," "the," "and," etc. are words that appear often within all statements, but do not signal anything about the content of the statement. Accordingly, their frequency is down weighted by a very high occurrence across documents, a high document-frequency. Because every FOMC statement in the collection is talking about monetary policy, words like "federal funds rate," "inflation," or "unemployment" will also be down weighted by the inverse document-frequency. Words that do not occur in every FOMC statement, like "shortfalls" or "persists", are indicative of the economic environment when that FOMC meeting took place compared to a different meeting. Differences in these *informative* words will help us measure differences between FOMC statements.

The actual calculations for the TFIDF values are as follows. Call the collection of documents - that is, the collection of FOMC statements - D and then the set of terms that appear across the whole collection is called T. All terms are made lowercase. A statement in the collection is indexed by $d \in D$ and a word in the collection is indexed as $t \in T$. Let $tf_{d,t}$ be the term frequency of a particular term t in a particular document d,

$$tf_{d,t} = \log\left(\frac{tc_{d,t}}{nt_d}\right) + 1, \ \forall d \in D, t \in T$$

where $tc_{d,t}$ is the number of times the word t appears in the document d and nt_d is the total number of words in the document d. Taking the logarithm and adding 1 are to smooth the weighting term. Then the inverse document frequency $idf_{d,t}$ is also a document, word specific value calculated as

$$idf_{d,t} = \log\left(\frac{nd_d}{df_{d,t} + 1}\right) + 1, \ \forall d \in D, t \in T$$

where nd_d is the number of documents in the collection of texts and $df_{d,t}$ is the number of documents where the term t appears. Finally, we join the two terms to get the weighted

Table 1: FOMC Statements Words with Top 30 TFIDF Scores

erosion	fundamentals	footing	facilitating
fostering	sensitive	shortfalls	improvements
governance	serve	flat	induced
good	fostered	fed	restrictive
gdp	sectors	falling	result
gap	forth	fallen	indication
segments	sharp	government	
seizing	forceful	gulf	

frequency of each word t in each document d

$$TFIDF_{d,t} = tf_{d,t} * idf_{d,t}, \ \forall d \in D, t \in T$$

The produces a matrix with D rows and T columns. Each element represents the $TFIDF_{d,t}$, the term frequency, the number of times a word appears in a particular document divided by the number of words in that document, divided by the document frequency, the number of documents where that word appears divided by the total number of documents. The intuition for the TFIDF values is a weighted frequency of words in the collection of documents: the higher this measure, the more informative that word is about the content of the statement and what makes this statement different from the other statements.

The TFIDF matrix for the sample of FOMC statements has information about which words are more useful in distinguishing one document from the next. There are 165 FOMC statements in sample. Across these statements, there are 1368 different terms. Accordingly, the TFIDF matrix for FOMC statements from May 1999 to October 2019 is a 165 by 1368 matrix. Words with the higher TFIDF represent words that are useful in distinguishing one statement from the others. Table 1 shows a list of the top 30 TFIDF scores for the collection of FOMC statements.

To produce a matrix whose values represent similarity measures between pairs of docu-

ments, multiply TFIDF matrix by its transpose:

$$\text{Document Similarity Matrix} = TFIDF \cdot TFIDF^T$$

For each document, there is a row vector from the TFIDF matrix of TFIDF values for each word $t \in T$ as it appears in document d. In that vector d, the TFIDF values are only positive for words that occurred in document d. The vectors for every document have the same magnitude because everything is normalized by the number of documents and words. Thus, taking the dot product of the TFIDF matrices, we are effectively comparing the cosine of the angles between of every pair of document row vectors in the collection of FOMC statements.

The more similar two FOMC statements are, the more similar the TFIDF vectors will be, and as the angle between the vectors goes to zero, the cosine of that angle goes to one[4]. Because every vector should have the same magnitude, the output from $TFIDF \cdot TFIDF^T$ will be a matrix where each row and column represents a particular document $d \in D$ and each cell contains the cosine of the angle between the row document and column document TFIDF vectors. These values are often called the cosine similarity of two documents or the document similarity. I refer to this matrix as the Document Similarity Matrix and I call the values in the matrix the pairwise-document similarity measure. Note that values equal to 1 mean that the two documents are more identical and if the cosine similarity is 0 then the two documents have no common words. Therefore, two FOMC statements are more similar the closer their cosine similarity value is to 1.

Consider two examples of statement pairs and their corresponding similarity measure in figure 1 and figure 2. For each of the comparisons, the words where the documents differ have been highlighted in yellow. Figure 1 shows the statements from January 2004 and March 2004, which have a similarity measure of .92. This is an above average similarity for subsequently released statements according to the descriptive statistics in table 2. Figure 2

[4]For two vectors, a and b that are θ degrees apart, then $a \cdot b = |a|cos(\theta)|b|$

shows the statements from March 2004 and May 2004, which have a similarity of .71. The January-March 2004 comparison has fewer highlighted differences than the March-May 2004 comparison. This illustration is meant to give an intuition for the similarity measure: more words in common means a higher similarity measure. Each cell in the Document Similarity Matrix (figure 3) represents these comparisons for all FOMC statements in my sample.

The Document Similarity Matrix for FOMC Statements from May 1999 through October 2019 is represented as a heat map in figure 3. For an FOMC statement of a particular row d and an FOMC statement in the column d', then the cell at (d, d') tells us how similar statement d and d'. The statements are ordered by release date. The May 1999 statement is in the top-left corner and statements are chronologically ordered as one shifts down rows or shifts right over columns. Due to the size of the matrix, 165 by 165, I use a heat map to convey the values of pairwise-document similarity. The darker cells represent higher similarity values and the lighter cells represent lower similarity values.

The diagonal of the matrix is a diagonal of ones (darkest color), because these cells are where a document d is compared against itself. As we move away from the main diagonal, we can compare FOMC statements with other FOMC statements and analyze patterns over time. The document similarity value for FOMC statement d and $d-1$ would a one cell deviation from the main diagonal and would represent how similar sequential statements are. For the rest of the paper, I will refer to this as the sequential FOMC similarity, the FOMC statement similarity with 1 statement lag, or S^1. To extend this notation, S^n is the similarity between documents d and $d-n$.

One pattern in the heat map shows the cells around the main diagonal become darker in color as time increases - moving from top-left to bottom-right. This means that FOMC statements are varying less over time. This extends the finding of Meade and Acosta (2015) to a larger sample period and represents comparisons between a FOMC statements with larger lags.

The FOMC statement wording is more persistent for more recent FOMC statements

Figure 1: January 2004 - March 2004 : Statement Similarity 0.92
Dissimilar text is highlighted and italicized.

January 2004 The Federal Open Market Committee decided today to keep its target for the federal funds rate at 1 percent. The Committee continues to believe that an accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. The evidence accumulated over the intermeeting period *confirms* that output is *expanding briskly.* Although *new hiring remains subdued, other indicators suggest an improvement in the labor market.* Increases in core consumer prices are muted and expected to remain low. The Committee perceives that the upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. The probability of an unwelcome fall in inflation has diminished in recent months and now appears almost equal to that of a rise in inflation. With inflation quite low and resource use slack, the Committee believes that it can be patient in removing its policy accommodation.

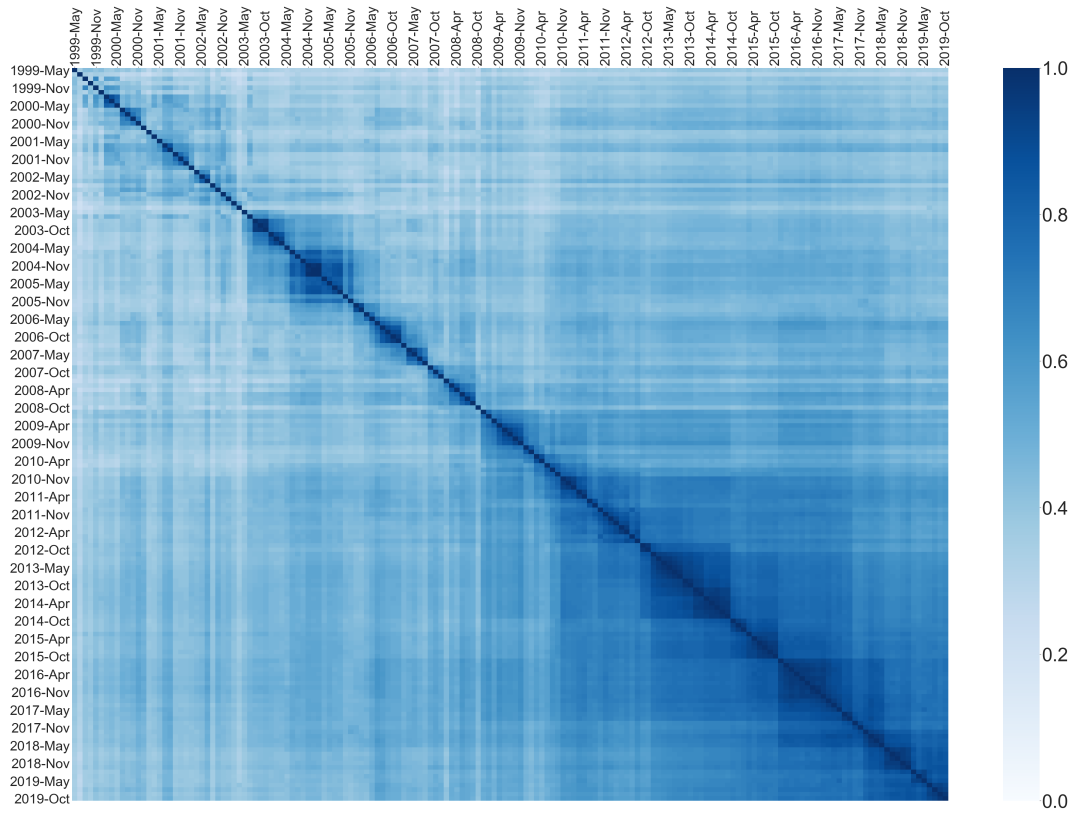
March 2004 The Federal Open Market Committee decided today to keep its target for the federal funds rate at 1 percent. The Committee continues to believe that an accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. The evidence accumulated over the intermeeting period *indicates* that output is *continuing to expand at a solid pace.* Although *job losses have slowed, new hiring has lagged.* Increases in core consumer prices are muted and expected to remain low. The Committee perceives the upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. The probability of an unwelcome fall in inflation has diminished in recent months and now appears almost equal to that of a rise in inflation. With inflation quite low and resource use slack, the Committee believes that it can be patient in removing its policy accommodation.

Figure 2: March 2004 - May 2004 : Statement Similarity 0.71
Dissimilar text is highlighted and italicized.

March 2004 The Federal Open Market Committee decided today to keep its target for the federal funds rate at 1 percent. The Committee continues to believe that an accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. The evidence accumulated over the intermeeting period indicates that output is continuing to expand at a solid *pace.* Although *job losses have slowed, new hiring has lagged.* Increases in core consumer prices are muted and expected to remain low. The Committee perceives the upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. *The probability of an unwelcome fall in inflation has diminished in recent months and now appears almost equal to that of a rise in inflation.* With inflation quite low and resource use slack, the Committee believes that *it can be patient in removing its policy accommodation.*

May 2004 The Federal Open Market Committee decided today to keep its target for the federal funds rate at 1 percent. The Committee continues to believe that an accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. The evidence accumulated over the intermeeting period indicates that output is continuing to expand at a solid *rate and hiring appears to have picked up.* Although *incoming inflation data have moved somewhat higher, long-term inflation expectations appear to have remained well contained.* The Committee perceives the upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. *Similarly, the risks to the goal of price stability have moved into balance. At this juncture,* with inflation low and resource use slack, the Committee believes that *policy accommodation can be removed at a pace that is likely to be measured.*

Figure 3: Document Similarity Matrix for FOMC Statements May 1999 - October 2019



Notes: Each cell contains the cosine similarity for the FOMC statement of that row and column. This value represents how similar the words of those two statements are. The darker blue color represents documents that have higher similarity measures (measures closer to 1), and the whiter cells represent statements that do not have wording in common (measures closer to 0). The main diagonal is all ones. These similarity measures are produced by comparing a statement with itself (identical statements), thus producing an similarity measure of 1.

because the region in the bottom-right corner is a darker color. This jump in document similarity begins is somewhere between late-2009 and mid-2010 which coincides with the FOMC lowering the federal funds rate to the zero lower bound. In addition to lower variation in the federal funds rate, during this period the FOMC wanted to calm markets and claimed it was using post-meeting statements to help achieve this goal. The attention to statement wording with the intent to avoid surprises could also contribute to lower variation in vocabulary across FOMC statements. The region representing documents from 2015 to 2019 still have very high similarity measures, represented by dark colored cells, despite the FOMC regularly changing the target federal funds rate during that time.

Figure 4: S^1 Statement Similarity with 1 statement lag

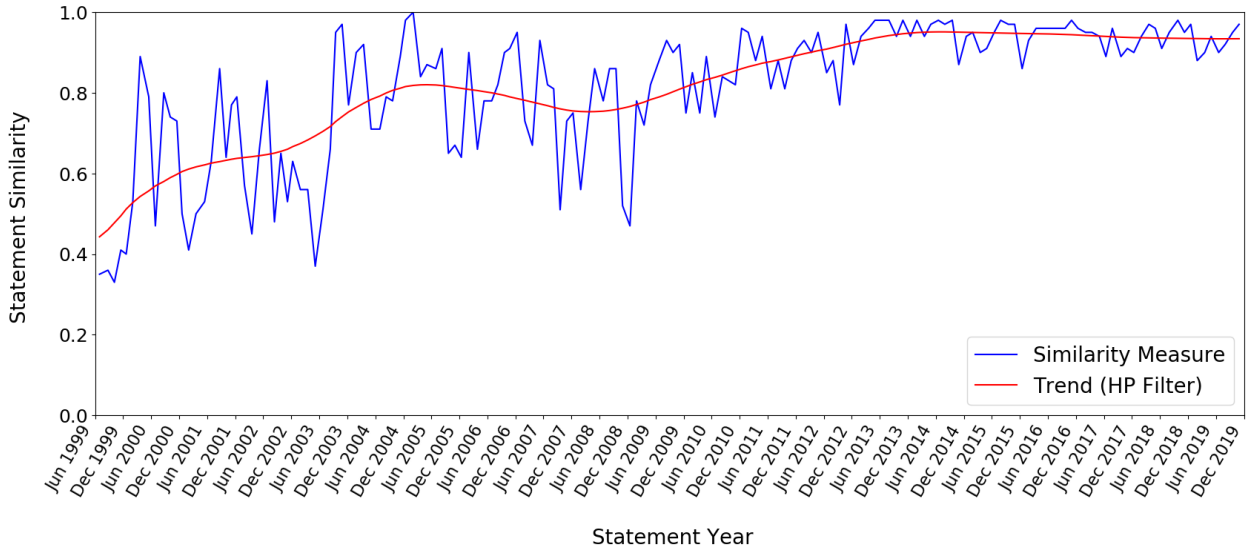


Figure 4, figure 5, and figure 6 graph the FOMC statement similarity with the previous statement S^1, the statement from 4 meetings prior S^4 (approximately 6 months prior), and the statement from 8 meetings prior S^8(approximately 1 year prior), respectively. The color trend in the heat map is also in these plots: as time has continued, FOMC statement similarity with previous FOMC statements has increased.

For regression analysis, I transform the document similarity measure into one of document dissimilarity. For any two documents, the dissimilarity measure is 1 minus the similarity measure. The dissimilarity of sequential FOMC statements is

$$D_i^1 = 1 - S_i^1$$

for every i, representing each sequential comparison of statements. The descriptive statistics for similarity and dissimilarity measures of sequential FOMC statements (S^1 and D^1) are in table 2.

It is important to note that the document similarity, or dissimilarity, measure deals with absolute changes. It does not speak to what direction the FOMC statement has changed

Figure 5: S^4 Statement Similarity with 4 statement lag (approximately 6 months lag)

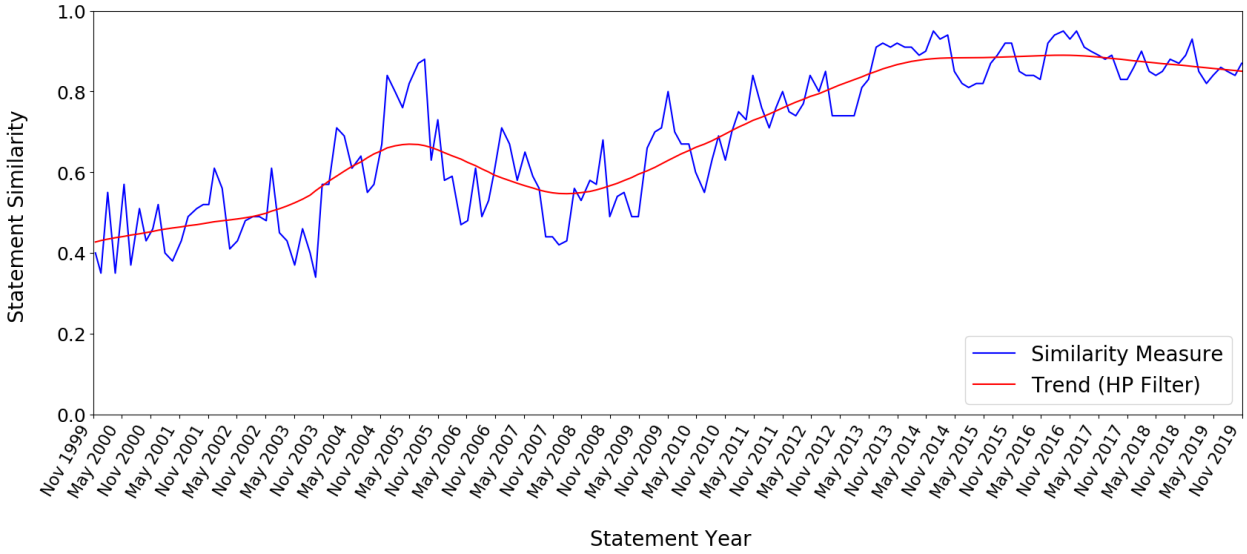
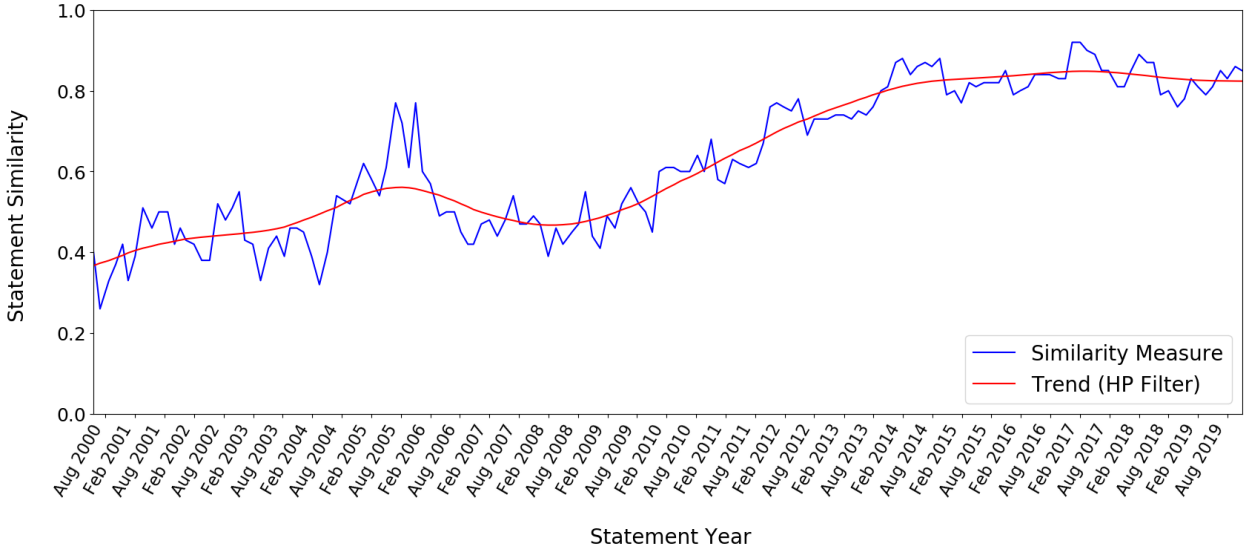


Figure 6: S^8 Statement Similarity with 8 statement lag (approximately 1 year lag)



(e.g. is the statement indicative of more expansionary or contractionary policy?) it only shows that it has changed. Therefore, when considering other variables in regressions I will also transform the other variables to represent absolute changes from before to after the FOMC meeting values.

3 Data

Besides sequential FOMC statement dissimilarity, I use data on tick-by-tick fed funds futures (FFF), the target federal funds rate, Federal Reserve Chair indicators, and dates for relevant macroeconomic data announcements. In this section, I will first discuss the FFF data, how to convert FFF data into expectations over federal funds rates, and then talk about other control variables.

I use tick-level, time-of-sales data for fed funds futures contracts with 1 to 6 month horizons purchased from CME Group. The main experiment looks at how changes in wording of FOMC statements relates to changes in expectations around FOMC announcements. I use a small event window, as in Nakamura and Steinsson (2018), to calculate changes in expectations. The difference between FFF prices 10 minutes before FOMC announcements and 20 minutes after FOMC announcements construct the series of expectation changes.

The FFF contract pays out the average federal funds rate over the month the contract ends. FFF prices are calculated by subtracting the expected average federal funds rate at the end of the contract horizon from 100. Accordingly, when people expect the federal funds rate to increase, the FFF price will decrease. FF1 is the code for the FFF contract with a 1 month horizon. I will use the notation FF_i^n to represent the price of the FFF contract with an n month horizon at time i.

To transform changes in FFF prices into changes over expectations over federal funds rates, I extend the work in Nakamura and Steinsson (2018). In the following equations, the $i-$ time notation represents variables evaluated 10 minutes before a FOMC statement is

released on date i. The $i+$ time notation represents variables evaluated 20 minutes after a FOMC statement is released on date i. FF^1_{i-} (FF^1_{i+}) is the price of a FFF contract with a 1 month horizon evaluated 10 minutes before (20 minutes after) the FOMC announcement at date i. $\bar{r}_0$ represents the average federal funds rate for month where FOMC meeting 0 occurs. This average depend on what day of the month the FOMC meeting occurs. Accordingly, d_0, the day of the month the FOMC meeting occurs, and m_0, the total days in the month, are used as weights for the average.

$$FF^1_{i-} = 100 - \mathbb{E}_{i-}\left[\bar{r}_0\right] = 100 - \left(\frac{d_0}{m_0} r_{-1} + \frac{m_0 - d_0}{m_0}\mathbb{E}_{i-}\left[r_0\right]\right)$$
$$FF^1_{i+} = 100 - \mathbb{E}_{i+}\left[\bar{r}_0\right] = 100 - \left(\frac{d_0}{m_0} r_{-1} + \frac{m_0 - d_0}{m_0}\mathbb{E}_{i+}\left[r_0\right]\right)$$

The change, and absolute change, in expectations of the federal funds rate for the current FOMC meeting (meeting 0) are thus:

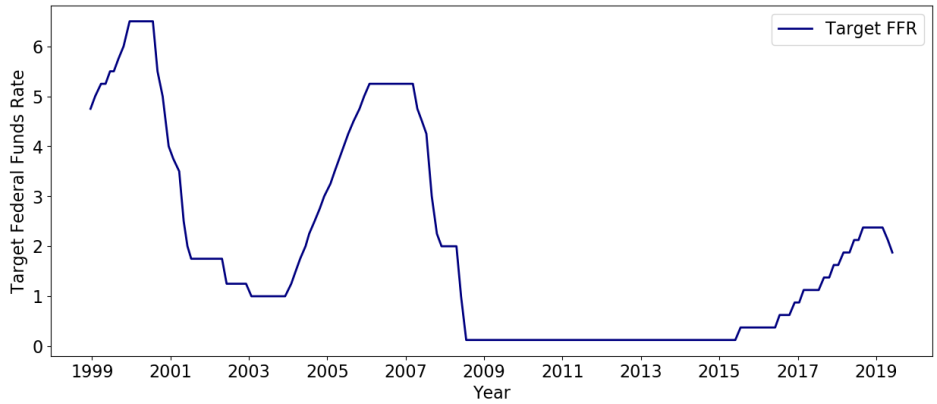
$$\mathbb{E}_{i+}\left[r_0\right] - \mathbb{E}_{i-}\left[r_0\right] = -\frac{m_0}{m_0 - d_0}\left(FF^1_{i+} - FF^1_{i-}\right)$$
$$\left|\mathbb{E}_{i+}\left[r_0\right] - \mathbb{E}_{i-}\left[r_0\right]\right| = \frac{m_0}{m_0 - d_0}\left|FF^1_{i+} - FF^1_{i-}\right|$$

To avoid multiplying FFF prices by large numbers, if the FOMC meeting occurred in the last 7 days of a month, I use the next months FFF (Nakamura and Steinsson, 2018). For example, if meeting 0 occurred so that $m_0 - d_0 \leq 7$, then the absolute change in expectations would be the following:

$$\left|\mathbb{E}_{i+}\left[r_0\right] - \mathbb{E}_{i-}\left[r_0\right]\right| = \left|FF^2_{i+} - FF^2_{i-}\right|$$

A change in expectation of the federal funds rate for the current FOMC meeting is often called a "monetary policy surprise." If the expectations 10 minutes before and 20 minutes after the FOMC meeting were equal, $\mathbb{E}_{i+}\left[r_0\right] = \mathbb{E}_{i-}\left[r_0\right]$, then markets were able to accurately

Figure 7: Target Federal Funds Rate, May 1999 - October 2019



Note: Since Dec 16,2008, rate is graphed as mean of Federal Fund Rate target range for the given date.

predict r_0 before the meeting. These expectations differ when the market learns unexpected information about the target federal funds rate and about the state of the economy. The goal of this paper is to find how changes in FOMC statement text and in the target rate affect market expectations.

Nakamura and Steinsson (2018) calculate date i changes in expectations for the next two FOMC meetings (meeting 0 and 1) for use in their policy news shock. I continue this calculation for meetings 2 and 3. There are 4 expectation change calculations for each FOMC meeting from May 1999 through October 2019. The meeting index represents the next j meeting from date i. For each FOMC meeting date i, for meeting $j \in \{1, 2, 3\}$ the change in expectations is:

$$|\Delta \mathbb{E}_i [r_j]| = |\mathbb{E}_{i+} [r_j] - \mathbb{E}_{i-} [r_j]|$$

$$|\Delta \mathbb{E}_i [r_j]| = \begin{cases} \left| FF_{i+}^{n+1} - FF_{i-}^{n+1} \right| \ , \ if \ m_j - d_j \leq 7 \\ \left| \frac{m_j}{m_j - d_j} \left[\left(FF_{i-}^{n} - FF_{i+}^{n} \right) - \frac{d_j}{m_j} \left(\mathbb{E}_{i+} [r_{j-1}] - \mathbb{E}_{i-} [r_{j-1}] \right) \right] \right| \ , \ o.w. \end{cases}$$

Where n represents the FFF contract that expires the month of meeting j. These indexes are different because FOMC meetings do not occur every month. The descriptive statistics for $\{|\Delta \mathbb{E}_i [r_j]|\}_{j=0}^{3}$ are in table 2.

The target federal funds rate data are from May 1999 through October 2019 from the FRED, Federal Reserve Bank of St. Louis website. Figure 7 graphs the federal funds rate target over the sample period. Since December 2008 the FOMC has issued a target range for the federal funds rate . This range has a constant size and only varies by level. Thus, I use the average of the target range for the federal funds rate as data on the target federal funds rate. The target federal funds rate also changes in the event window since it is announced simultaneously with the FOMC statement. Accordingly, it is an necessary control for the event-study analysis.

Often the target rate is used as a sufficient statistic for the informational quantity of the FOMC statement. The federal funds rate is announced in the FOMC announcement, however, the FOMC announcement includes other information about the state of the economy or forward guidance. In comparing figure 7 and figure 4, the variation in FOMC sequential similarity and changes in the target federal funds rate are not perfectly colinear. Accordingly, the FOMC statement text and the target federal funds rate may influence expectations in different ways.

In table 2 are descriptive statistics for the FOMC statement sequential similarity S^1, dissimilarity D^1, target federal funds rate change Δr, absolute change $|\Delta r|$, and absolute changes in expectations of future federal funds rates for the current and subsequent 3 meetings.

Because word choice is something that varies from person to person, I also control for the Chair of the Federal Reserve for each meeting. Table 3 shows descriptive statistics of statement similarity grouped by Fed Chair. My sample includes periods of Alan Greenspan (1987-2006), Ben Bernanke (2006-2014), Janet Yellen (2014-2018), and Jerome Powell (2018-present) tenure. The mean similarity value for each chair follows the trend in figure 4. Under Greenspan, there were more wording changes from one statement to the next compared to the periods of his successors' tenures. For regression results in the next section, I drop the indicator for Jerome Powell as chair because he has the fewest observations.

Table 2: Descriptive Statistics

	S^1	D^1	Δr	$\lvert\Delta r\rvert$	$\Delta\mathbb{E}[r_0]$	$\lvert\Delta\mathbb{E}[r_0]\rvert$
Count	164	164	164	164	165	165
Mean	0.814	0.186	-0.018	0.118	-0.003	0.017
Stdv	0.168	0.168	0.255	0.226	0.039	0.035
Min	0.330	0	-1.250	0	-0.206	0
Median	0.880	0.120	0	0	0	0.005
Max	1	0.670	0.500	1.250	0.130	0.206

	$\Delta\mathbb{E}[r_1]$	$\lvert\Delta\mathbb{E}[r_1]\rvert$	$\Delta\mathbb{E}[r_2]$	$\lvert\Delta\mathbb{E}[r_2]\rvert$	$\Delta\mathbb{E}[r_3]$	$\lvert\Delta\mathbb{E}[r_3]\rvert$
Count	165	165	165	165	155	155
Mean	-0.003	0.018	-0.002	0.021	-0.005	0.026
Stdv	0.035	0.031	0.039	0.032	0.048	0.041
Min	-0.180	0	-0.204	0	-0.210	0
Median	0	0.009	0	0.010	-0.001	0.012
Max	0.120	0.180	0.110	0.204	0.252	0.252

Macroeconomic data releases from U.S. Bureau of Labor Statistics (2020), including CPI or employment announcements, almost never occur on the same day as FOMC announcements and never occur in the 30-minute event window around FOMC announcements. If the public became aware of new information that would sway the FOMC's policy, then this would create movement in FFF prices. There are 13 days in my sample where Consumer Price Index (CPI) data releases occurred on FOMC announcement days. Those dates are listed in table A2. However, any information changes, such as macroeconomic data releases or other major announcements, that occur before the FOMC announcement window would already be incorporated into the asset prices measured 10 minutes before the FOMC announcement. Therefore, the change in expectations over the following 30 minutes is should not be altered by variation out of the event window.

Table 3: S^1 Sequential Statement Similarity by Fed Chair

S^1	Greenspan	Bernanke	Yellen	Powell
Count	54	64	32	14
Mean	0.678	0.838	0.942	0.939
Stdv	0.188	0.118	0.033	0.032
Min	0.330	0.470	0.860	0.880
Median	0.665	0.860	0.950	0.950
Max	1.000	0.980	0.980	0.980

4 Results

In this section, I discuss the specifications and results of regressions that test if the FOMC statement dissimilarity measure accounts for any of the variation of the market's monetary-policy expectations. I run an OLS regression for each of the 4 federal funds rate expectations under 3 different specifications. Changes in expectations of the federal funds rate at the current FOMC meeting and the 3 subsequent FOMC meetings are measured over the 30-minute window around FOMC announcements. This small event-window around the FOMC announcement makes it unlikely that any shocks, besides the announcement itself, are affecting the regression. Thus supporting the identifying assumption common to event-study analysis. Regressions use HAC standard errors that are consistent with heteroskedasticity and autocorrelation (White, 1980; Piazzesi and Swanson, 2008).

The first specification only includes FOMC statement sequential dissimilarity D_i^1 for expectations looking $j \in \{0, 1, 2, 3\}$ meetings into the future:

$$|\Delta \mathbb{E}_i [r_j]| = \beta_0 + \beta_1 D_i^1 + \epsilon_i \tag{1}$$

The second regression equation interacts FOMC statement sequential dissimilarity D_i^1 and

Table 4: Regression Results - Specification (1) and (2)

	(1)				(2)			
	$\lvert\Delta\mathbb{E}[r_0]\rvert$	$\lvert\Delta\mathbb{E}[r_1]\rvert$	$\lvert\Delta\mathbb{E}[r_2]\rvert$	$\lvert\Delta\mathbb{E}[r_3]\rvert$	$\lvert\Delta\mathbb{E}[r_0]\rvert$	$\lvert\Delta\mathbb{E}[r_1]\rvert$	$\lvert\Delta\mathbb{E}[r_2]\rvert$	$\lvert\Delta\mathbb{E}[r_3]\rvert$
D^1	0.113***	0.086***	0.097***	0.123***	0.074***	0.043***	0.067***	0.061***
	(0.020)	(0.019)	(0.018)	(0.026)	(0.014)	(0.012)	(0.014)	(0.019)
$\lvert\Delta r\rvert$					0.047	0.038	0.049	0.023
					(0.031)	(0.029)	(0.033)	(0.037)
$D^1 \times \lvert\Delta r\rvert$					0.042	0.070	0.007	0.193
					(0.094)	(0.098)	(0.102)	(0.136)
Intercept	-0.004	0.002	0.003	0.004	-0.004*	0.003	0.002	0.006***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
N	164	164	164	154	164	164	164	154
R^2	0.29	0.22	0.25	0.25	0.43	0.42	0.37	0.44
Adj. R^2	0.29	0.22	0.25	0.25	0.42	0.40	0.35	0.42

Notes: HAC standard errors in parentheses. * is significance at the 10% level, ** is significance at the 5% level, and *** is significance at the 1% level.

absolute changes in the target federal funds rate $|\Delta r_i|$:

$$|\Delta\mathbb{E}_i[r_j]| = \beta_0 + \beta_1 D_i^1 + \beta_2 |\Delta r_i| + \beta_3 \left(D_i^1 \times |\Delta r_i|\right) + \epsilon_i \tag{2}$$

Table 4 shows the regression results for the first two specifications. Under the first column of the first specification, a one standard deviation increase in the FOMC statement dissimilarity increases the absolute change of federal funds rate expectations for the current meeting by 0.54 standard deviations. Using the literature's terminology, it increases the magnitude of monetary surprises by 0.54 standard deviations[5].

The example statement comparison of January 2004-March 2004 (figure 1) and March 2004-May 2004 (figure 2) from earlier in the paper will help provide intuition for the coefficient interpretation. To increase the FOMC statement dissimilarity by 1 standard deviation would be like switching from issuing the January 2004 statement to issuing the May 2004

[5]One standard deviation increase in D^1, increases $|\Delta\mathbb{E}[r_0]|$ by $\left(\beta_0 \frac{stdv(D^1)}{stdv(|\Delta\mathbb{E}[r_0]|)}\right) \approx 0.54$ standard deviations

statement after the March 2004 statement. The more the words change from one statement to the next, the more expectations of the federal funds rate change.

The second specification shows that even after controlling for changes in the target federal funds rate, that the changes in the wording of FOMC statements account for variation in market expectations of future monetary policy. The positive coefficient on the interaction term, $\beta_3 > 0$, indicates that changes in wording and movements in the target federal funds rate amplify each other's effect on market expectations. For larger target federal fund rate is changes, changing the wording in the current statement compared to the past FOMC statement has a larger effect on market expectations. This makes sense because the more information changes that are revealed in the FOMC announcement the more information market expectations can respond to. Including both D^1 and $|\Delta r|$ in the regression accounts for approximately double the variation in market expectations compared to the regression that only uses sequential FOMC statement dissimilarity. In the appendix, table A3 shows the effect of Δr on expectations of future federal funds rates. The specification (2) regression in table 4 accounts for approximately 1.5 times the variation in market expectations compared to the specification in table A3.

Table 5 shows the results for the specification (3). This setup interacts FOMC statement sequential dissimilarity D_i^1 and absolute changes in the target federal funds rate $|\Delta r_i|$, again. Added in are the indicator variables for the Chair of the Federal Reserve $\{Greenspan_i, Bernanke_i, Yellen_i\}$. If Greenspan was the Fed chair at date i then $Greenspan_i = 1$, otherwise it is 0.

$$\begin{aligned} |\Delta \mathbb{E}_i [r_j]| =& \beta_0 + \beta_1 D_i^1 + \beta_2 |\Delta r_i| + \beta_3 \left(D_i^1 \times |\Delta r_i| \right) \\ &+ \beta_4 Greenspan_i + \beta_5 Bernanke_i + \beta_6 Yellen_i + \epsilon_i \end{aligned} \tag{3}$$

With this specification, we can analyze what the estimated effect of changing FOMC statement wording had on market expectations during the period when the federal funds

Table 5: Regression Results - Specification (3)

	(3)			
	$\lvert\Delta\mathbb{E}[r_0]\rvert$	$\lvert\Delta\mathbb{E}[r_1]\rvert$	$\lvert\Delta\mathbb{E}[r_2]\rvert$	$\lvert\Delta\mathbb{E}[r_3]\rvert$
D^1	0.083***	0.053***	0.076***	0.036*
	(0.020)	(0.017)	(0.020)	(0.020)
$\lvert\Delta r\rvert$	0.059*	0.049	0.062*	0.003
	(0.034)	(0.032)	(0.034)	(0.034)
$D^1 \times \lvert\Delta r\rvert$	0.012	0.041	-0.024	0.245**
	(0.099)	(0.103)	(0.102)	(0.122)
$Greenspan$	-0.000	-0.000	-0.000	0.010
	(0.006)	(0.005)	(0.006)	(0.008)
$Bernanke$	0.006*	0.006	0.007*	-0.000
	(0.004)	(0.004)	(0.004)	(0.004)
$Yellen$	0.004	0.005	0.003	-0.003
	(0.003)	(0.004)	(0.004)	(0.003)
Intercept	-0.009**	-0.003	-0.003	0.009**
	(0.004)	(0.004)	(0.005)	(0.004)
N	164	164	164	154
R^2	0.44	0.42	0.37	0.45
Adj. R^2	0.42	0.40	0.35	0.42

Notes: HAC standard errors in parentheses. * is significance at the 10% level, ** is significance at the 5% level, and *** is significance at the 1% level.

rate was at the zero lower bound. The federal funds rate was at the zero lower bound for many years, meaning $|\Delta r| = 0$. Increasing the dissimilarity of sequential FOMC statements by 1 standard deviation increases the magnitude of changes in expectation of the federal funds rate at the current FOMC meeting, $|\Delta\mathbb{E}[r_0]|$, by 0.40 standard deviations. A 1 standard deviation increase of FOMC statement dissimilarity increases $|\Delta\mathbb{E}[r_1]|$, $|\Delta\mathbb{E}[r_2]|$, and $|\Delta\mathbb{E}[r_3]|$ by 0.29, 0.40, and 0.15 standard deviations, respectively. All of these interpretations are statistically significant. The economic interpretation is consistent with the results from previous regression specifications: the more that changes about FOMC announcements, including words and policy rates, the more market expectations change.

5 Conclusion

This paper has two contributions: a descriptive one and an empirical one. Firstly, I have documented interesting time trends of FOMC statement texts and how they have varied from May 1999 through October 2019. My results from May 1999 through December 2015 are consistent with work from Meade and Acosta (2015). Data since 2015, indicates that even after the federal funds rate left the zero lower bound, the Fed has kept the variation in wording of their FOMC statements very small.

Secondly, incorporating a measure of sequential FOMC statement dissimilarity to common regressions used to study monetary policy expectations increases the amount of explained variation in expectations by 150 percent. The amplification relationship between changes in the target rate and statement wording makes sense because the target rate is announced in the statement, so changing the target literally changes the FOMC statement. Also, because changes in the wording of FOMC statements reflect changing economic conditions that would drive the FOMC to change the target rate. This interaction is important for understanding market responses.

Many economists either use the target federal funds rate as a sufficient statistic for monetary policy. However, we should be careful when generalizing about monetary policy expectations, what changes them, and how we measure them. This paper suggests that further research into analyzing FOMC statement text could provide a more detailed analysis of what phrases in FOMC statements change expectations.

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Appendix: Tables

Table A1: FOMC Statement Release and Press Conference Times, 1999-2019

Statement Date	Statement Time	Press Conference
05/18/1999	02:15 PM	
06/30/1999	02:15 PM	
08/24/1999	02:15 PM	
10/05/1999	02:15 PM	
11/16/1999	02:15 PM	
12/21/1999	02:15 PM	
02/02/2000	02:15 PM	
03/21/2000	02:15 PM	
05/16/2000	02:15 PM	
06/28/2000	02:15 PM	
08/22/2000	02:15 PM	
10/03/2000	02:15 PM	
11/15/2000	02:15 PM	
12/19/2000	02:15 PM	
01/31/2001	02:15 PM	
03/20/2001	02:15 PM	
05/15/2001	02:15 PM	
06/27/2001	02:15 PM	
08/21/2001	02:15 PM	
10/02/2001	02:15 PM	
11/06/2001	02:15 PM	
12/11/2001	02:15 PM	
01/30/2002	02:15 PM	
03/19/2002	02:15 PM	
05/07/2002	02:15 PM	
06/26/2002	02:15 PM	
08/13/2002	02:15 PM	
09/24/2002	02:15 PM	
11/06/2002	02:15 PM	
12/10/2002	02:15 PM	
01/29/2003	02:15 PM	
03/18/2003	02:15 PM	
05/06/2003	02:15 PM	
06/25/2003	02:15 PM	
08/12/2003	02:15 PM	
09/16/2003	02:15 PM	
10/28/2003	02:15 PM	
12/09/2003	02:15 PM	
01/28/2004	02:15 PM	
03/16/2004	02:15 PM	
05/04/2004	02:15 PM	
06/30/2004	02:15 PM	
08/10/2004	02:15 PM	
09/21/2004	02:15 PM	
11/10/2004	02:15 PM	
12/14/2004	02:15 PM	
02/02/2005	02:15 PM	
03/22/2005	02:15 PM	
05/03/2005	02:15 PM	
06/30/2005	02:15 PM	
08/09/2005	02:15 PM	
09/20/2005	02:15 PM	
11/01/2005	02:15 PM	
12/13/2005	02:15 PM	
01/31/2006	02:15 PM	
03/28/2006	02:15 PM	
05/10/2006	02:15 PM	
06/29/2006	02:15 PM	
08/08/2006	02:15 PM	
09/20/2006	02:15 PM	
10/25/2006	02:15 PM	
12/12/2006	02:15 PM	
01/31/2007	02:15 PM	
03/21/2007	02:15 PM	

Statement Date	Statement Time	Press Conference
05/09/2007	02:15 PM	
06/28/2007	02:15 PM	
08/07/2007	02:15 PM	
09/18/2007	02:15 PM	
10/31/2007	02:15 PM	
12/11/2007	02:15 PM	
01/30/2008	02:15 PM	
03/18/2008	02:15 PM	
04/30/2008	02:15 PM	
06/25/2008	02:15 PM	
08/05/2008	02:15 PM	
09/16/2008	02:15 PM	
10/29/2008	02:15 PM	
12/16/2008	02:15 PM	
01/28/2009	02:15 PM	
03/18/2009	02:15 PM	
04/29/2009	02:15 PM	
06/24/2009	02:15 PM	
08/12/2009	02:15 PM	
09/23/2009	02:15 PM	
11/04/2009	02:15 PM	
12/16/2009	02:15 PM	
01/27/2010	02:15 PM	
03/16/2010	02:15 PM	
04/28/2010	02:15 PM	
06/23/2010	02:15 PM	
08/10/2010	02:15 PM	
09/21/2010	02:15 PM	
11/03/2010	02:15 PM	
12/14/2010	02:15 PM	
01/26/2011	02:15 PM	
03/15/2011	02:15 PM	
04/27/2011	12:30 PM	02:15 PM
06/22/2011	12:30 PM	02:15 PM
08/09/2011	02:15 PM	
09/21/2011	02:15 PM	
11/02/2011	12:30 PM	02:15 PM
12/13/2011	02:15 PM	
01/25/2012	12:30 PM	02:15 PM
03/13/2012	02:15 PM	
04/25/2012	12:30 PM	02:15 PM
06/20/2012	12:30 PM	02:15 PM
08/01/2012	02:15 PM	
09/13/2012	12:30 PM	02:15 PM
10/24/2012	02:15 PM	
12/12/2012	12:30 PM	02:15 PM
01/30/2013	02:15 PM	
03/20/2013	02:00 PM	02:30 PM
05/01/2013	02:00 PM	
06/19/2013	02:00 PM	02:30 PM
07/31/2013	02:00 PM	
09/18/2013	02:00 PM	02:30 PM
10/30/2013	02:00 PM	
12/18/2013	02:00 PM	02:30 PM
01/29/2014	02:00 PM	
03/19/2014	02:00 PM	02:30 PM
04/30/2014	02:00 PM	
06/18/2014	02:00 PM	02:30 PM
07/30/2014	02:00 PM	
09/17/2014	02:00 PM	02:30 PM
10/29/2014	02:00 PM	
12/17/2014	02:00 PM	02:30 PM
01/28/2015	02:00 PM	
03/18/2015	02:00 PM	02:30 PM
04/29/2015	02:00 PM	
06/17/2015	02:00 PM	02:30 PM

Statement Date	Statement Time	Press Conference
07/29/2015	02:00 PM	
09/17/2015	02:00 PM	02:30 PM
10/28/2015	02:00 PM	
12/16/2015	02:00 PM	02:30 PM
01/27/2016	02:00 PM	
03/16/2016	02:00 PM	02:30 PM
04/27/2016	02:00 PM	
06/15/2016	02:00 PM	02:30 PM
07/27/2016	02:00 PM	
09/21/2016	02:00 PM	02:30 PM
11/02/2016	02:00 PM	
12/14/2016	02:00 PM	02:30 PM
02/01/2017	02:00 PM	
03/15/2017	02:00 PM	02:30 PM
05/03/2017	02:00 PM	
06/14/2017	02:00 PM	02:30 PM
07/26/2017	02:00 PM	
09/20/2017	02:00 PM	02:30 PM
11/01/2017	02:00 PM	
12/13/2017	02:00 PM	02:30 PM
01/31/2018	02:00 PM	
03/21/2018	02:00 PM	02:30 PM
05/02/2018	02:00 PM	
06/13/2018	02:00 PM	02:30 PM
08/01/2018	02:00 PM	
09/26/2018	02:00 PM	02:30 PM
11/08/2018	02:00 PM	
12/19/2018	02:00 PM	02:30 PM
01/30/2019	02:00 PM	
03/20/2019	02:00 PM	02:30 PM
05/01/2019	02:00 PM	
06/19/2019	02:00 PM	02:30 PM
07/31/2019	02:00 PM	
09/18/2019	02:00 PM	02:30 PM
10/30/2019	02:00 PM	

Dates are sourced from the "FOMC Calendar" and "Transcripts and other historical materials" pages on the Federal Reserve Board Website: https://www.federalreserve.gov/monetarypolicy.htm. Times of meetings and press conferences are based on scheduled releases detailed in announcements https://www.federalreserve.gov/newsevents/pressreleases/monetary20130313a.htm and https://www.federalreserve.gov/newsevents/pressreleases/monetary20110324a.htm

Table A2: Dates of FOMC Meeting Statement Releases and CPI Releases

May 16,2000	December 16,2009	March 15,2017
September 16,2003	October 30,2013	June 14,2017
September 16,2008	September 17,2014	December 13,2017
December 16,2008	December 17,2014	
March 18,2009	March 16,2016	

Note: FOMC Statements are released on the final day of FOMC meetings. Dates were collected from the Federal Reserve's Meeting Calendar and Historical Materials webpages. CPI data release dates were collected on the Bureau of Labor Statistics press release webpage. CPI data releases are at 8:30am while FOMC announcements are usually at 2pm. Therefore, with the high-frequency data, the event-window is small enough that the common announcement days doesn't interfere with identification.

Table A3: Regression Results without D^1

	$\lvert\Delta\mathbb{E}[r_0]\rvert$	$\lvert\Delta\mathbb{E}[r_1]\rvert$	$\lvert\Delta\mathbb{E}[r_2]\rvert$	$\lvert\Delta\mathbb{E}[r_3]\rvert$
$\lvert\Delta r\rvert$	0.087***	0.079***	0.073***	0.115***
	(0.017)	(0.015)	(0.016)	(0.024)
Intercept	0.007***	0.008***	0.012***	0.014***
	(0.002)	(0.002)	(0.002)	(0.002)
N	164	164	164	154
R^2	0.31	0.34	0.26	0.32
Adj. R^2	0.31	0.34	0.26	0.31

Notes: HAC standard errors in parentheses. * is significance at the 10% level, ** is significance at the 5% level, and *** is significance at the 1% level.