An Evaluation of the Asymmetric Impacts of Communication by the Federal Reserve

An Evaluation of the Asymmetric Impacts of Communication by the Federal Reserve

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Table of Contents

ACKNOWLEDGEMENTS ..... **IV**

LIST OF TABLES ..... **VI**

LIST OF FIGURES ..... **VIII**

ABSTRACT **1**

1 INTRODUCTION **2**

2 LITERATURE REVIEW **5**

3 DATA **8**

3.1 FEDERAL RESERVE COMMUNICATIONS 8

3.1.1 Dates and Content of Communication *8*

3.2 MONETARY POLICY MEASUREMENT 15

3.3 MACROECONOMIC DATA 17

3.4 FINANCIAL MARKET DATA 19

4 MODEL **20**

5 EMPIRICAL RESULTS **22**

5.1 IMPACT OF MORE GENERAL SPECIFICATIONS OF TONE 22

5.2 IMPACT OF TYPE SPECIFIC POSITIVE AND NEGATIVE TONE 24

6 CONCLUSION **32**

REFERENCES **35**

APPENDIX A: ADDITIONAL TABLES **38**

APPENDIX B: FIGURES **57**

VITA **59**

List of Tables

TABLE 1: *WORDS ASSOCIATED WITH EXPANSIONS AND CONTRACTIONS* 12

TABLE 2: *REACTION OF FINANCIAL MARKET RETURNS TO TYPE SPECIFIC POSITIVE AND NEGATIVE TONE, PRE-FINANCIAL CRISIS, SHORT TERM* 25

TABLE 3: *REACTION OF FINANCIAL MARKET RETURNS TO TYPE SPECIFIC POSITIVE AND NEGATIVE TONE, PRE-FINANCIAL CRISIS, LONG TERM* 26

TABLE 4: *REACTION OF FINANCIAL MARKET RETURNS TO TYPE SPECIFIC POSITIVE AND NEGATIVE TONE, POST-FINANCIAL CRISIS, SHORT TERM* 28

TABLE 5: *REACTION OF FINANCIAL MARKET RETURNS TO TYPE SPECIFIC POSITIVE AND NEGATIVE TONE, POST-FINANCIAL CRISIS, LONG TERM* 29

TABLE A1: *SUMMARY OF TONE VARIABLES* 38

TABLE A2*: SUMMARY OF POSITIVE AND NEGATIVE TONE VARIABLES, PRE-FINANCIAL CRISIS* 38

TABLE A3: *SUMMARY OF POSITIVE AND NEGATIVE TONE VARIABLES, POST-FINANCIAL CRISIS* 39

TABLE A4: *SUMMARY OF FINANCIAL MARKET SERIES, SHORT TERM* 39

TABLE A5: *SUMMARY OF FINANCIAL MARKET SERIES, LONG TERM* 39

TABLE A6: *REACTION OF FINANCIAL MARKET RETURNS TO AVERAGE TONE, FULL SAMPLE,* 40

SHORT TERM 40

TABLE A7: *REACTION OF FINANCIAL MARKET RETURNS TO AVERAGE TONE, FULL SAMPLE, LONG TERM* 41

TABLE A8: *REACTION OF FINANCIAL RETURNS TO TYPE SPECIFIC TONE, FULL SAMPLE, SHORT TERM* 42

TABLE A9: *REACTION OF FINANCIAL RETURNS TO TYPE SPECIFIC TONE, FULL SAMPLE, LONG TERM* 43

TABLE A10: *REACTION OF FINANCIAL RETURNS TO POSITIVE AND NEGATIVE TONE, FULL SAMPLE, SHORT TERM* 44

TABLE A11: *REACTION OF FINANCIAL RETURNS TO POSITIVE AND NEGATIVE TONE, FULL SAMPLE, LONG TERM* 45

TABLE A12: *REACTION OF FINANCIAL MARKET RETURNS TO AVERAGE TONE, POST FINANCIAL CRISIS, SHORT TERM* 46

TABLE A13: *REACTION OF FINANCIAL MARKET RETURNS TO AVERAGE TONE, POST FINANCIAL CRISIS, LONG TERM* 47

TABLE A14: *REACTION OF FINANCIAL RETURNS TO TYPE SPECIFIC TONE, POST FINANCIAL CRISIS, SHORT TERM* 48

TABLE A15: *REACTION OF FINANCIAL RETURNS TO TYPE SPECIFIC TONE, POST FINANCIAL CRISI, LONG TERM* 50

TABLE A16: *REACTION OF FINANCIAL RETURNS TO POSITIVE AND NEGATIVE TONE, POST FINANCIAL CRISIS, SHORT TERM* 51

TABLE A17: *REACTION OF FINANCIAL RETURNS TO POSITIVE AND NEGATIVE TONE, POST FINANCIAL CRISIS, LONG TERM* 52

TABLE A18: *REACTION OF FINANCIAL MARKET RETURNS TO TYPE SPECIFIC POSITIVE AND NEGATIVE TONE, FULL SAMPLE, SHORT TERM* 53

TABLE A19: *REACTION OF FINANCIAL MARKET RETURNS TO TYPE SPECIFIC POSITIVE AND NEGATIVE TONE, FULL SAMPLE, LONG TERM* 55

List of Figures

FIGURE B1: *FEDERAL RESERVE COMMUNICATION EVENTS, MAY 1999-MARCH 2018* 57

FIGURE B2: *FEDERAL FUNDS RATE SURPRISE, MAY 1999-MARCH 2018* 58

Abstract

This paper explores the impact of communications by the Federal Reserve on financial market returns before and after the financial crisis. It specifically looks at whether markets' responses to communication differ depending on the source and depending on whether the tone is positive or negative. I extract the tone used in communications by using tools from computational linguistics to create a measure based on the number of positive and negative words appearing in a communication. Using this measurement for tone, I find that market returns respond more to the tone of communications after the financial crisis. Second, I find the tone used by the chairperson has a greater impact than the tone of other individuals. Finally, I find that stock market returns react positively to positive and negative statements after the financial crisis, which implies language suggesting a rate increase is ignored by markets once the zero-lower bound was reached.

1 Introduction

Communication by central banks has become an increasingly important aspect of monetary policy. Through communication, central banks are able to provide the public with information on their current and future policy objectives, their economic outlook, and likely path for future monetary policy decisions (Blinder et. al 2008). By communicating this information, a central bank is able to influence market expectations about the future path of both short and long-term interest rates. The influence on long-term rates through communication can then enhance the overall effectiveness of monetary policy because long-term rates have a more important role when it comes to household and business decisions (Lucca and Trebbia 2009).

Although the importance of communication is recognized by all central banks today, this has not always been the case. Prior to the 1990s, central banks believed they should say as little as possible. Alan Greenspan even prided himself on his ability to "mumble with great incoherence" (Blinder et. al 2008). This strategy was founded in the belief that to in order to achieve monetary policy goals, the Federal Reserve needed to surprise financial market with its actions. The Federal Reserve began to change its approach to communication with the public in 1994 when it started releasing statements regarding its decisions on the Federal funds rate target after Federal Open Market Committee (FOMC) policy meetings ended rather than making the market infer its decision from open market operations taken the next day. In May 1999, they began to release a statement after every meeting, regardless of whether there was a change in monetary policy. Ever since then, the statements have also contained information about the future path of monetary policy in some form. The FOMC also began to announce the

votes of the participants immediately after the meeting and expedited the release of the FOMC minutes. Since the financial crisis, the Fed has taken even more steps to improve its communication in order to provide additional policy stimulus and to reduce uncertainty once interest rates reached the zero-lower bound. The Federal Reserve chairperson now gives four press conferences a year. Additionally, the Fed has begun to release the forecasts of the members of the Board of Governors and the presidents of the Federal Reserve Banks for growth, unemployment, inflation, and the Federal funds rate on a quarterly basis. It has also increased its use of forward guidance and begun using more explicit language when discussing the future of the Federal funds rate target by providing the market with specific guidelines for how long and under what economic conditions interest rates would stay at the zero-lower bound. [1]

For the communication advances of the Federal Reserve to have the desired effect, the communication must convey useful information, and the market participants must pay attention to the information and respond appropriately. However, the Federal Reserve does not communicate with the markets through one channel. Instead, it conveys information with formal channels, such as the FOMC statements and minutes, and with less formal channels, such as speeches made by the chairperson, members of the Board of Governors, and presidents of the Federal Reserve banks. Markets may not respond in the same way to each communication type. Moreover, markets may not respond the same

[1] An example of this explicit language occurred at the December 2012 meeting, when the FOMC said, "this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6½ percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the committee's 2 percent longer-run goal and longer-term inflation expectations continue to be well anchored" (Wynne 2013).

way to communication that is more positive about the economy as it would to communication that is more negative.

These potential asymmetric reactions as well as the evolution of Federal Reserve communication since the financial crisis are the main motivations for this study. In this paper I explore how financial market variable reactions to communication tone depend both on the source of communication and on the sign tone. Additionally, I examine whether these reactions are different in the periods before and after the financial crisis. I do this by first extracting the tone of communications using a method from computational linguistics that creates a measure based on the number of positive and negative words appearing in a communication. I then group the tone measurements by their source and create separate variables for positive and negative tone for each source. Finally, I estimate the reactions of financial market returns to these measures of tone both before and after the crisis. From these estimations, I find that communication tone as whole was more important after the financial crisis, that the tone used by the chairperson has larger impact than other individual members of the Federal Reserve, and that positive statements by the FOMC cause an increase in the S&P 500 Index following the financial crisis.

The rest of the paper is organized as follows: In section 2, I summarize the relevant literature and how this paper contributes to it. In section 3, I explain how I collected data on Federal Reserve communication events and how I measure their tone using computational linguistics. I also explain what other variables and news may affect financial market variables and how I measured them. In section 4, I present the model specifications I will use to explore the impact of tone on financial market returns. I

discuss the main findings of the estimation of the model in Section 5, and I summarize the paper and discuss possible extensions in Section 7.

2 Literature Review

There is already an extensive body of literature that examines the impact of Federal Reserve communication on asset prices. However, with the exception of few recent studies, most of the literature up to date has either focused on evaluating whether asset prices respond to any communication without considering potential differences between negative and positive communication, or has used relatively subjective measures of what types of communication are considered positive of negative

Gürkaynak et. al (2005) use an event-study approach to analyze the effects of FOMC statement releases on financial market movements around the time of the releases. Their study discovers there are two factors that affect the reactions of financial markets to information contained in FOMC statements. The first factor that affects markets is the unexpected change in the Federal funds rate, and the second is the information about the future path of monetary policy that is communicated to the market. They also find the informational factor, known as the "path" factor, affects longer term yields more strongly than the unexpected change in the federal funds rate. In a recent study, Swanson (2017) extends the analysis of Gürkaynak et. al to current day and obtains similar results for the effect of the path factor on longer term yields. He also finds the path factor affects bonds of even longer maturities after the financial crisis as more emphasis is placed on forward guidance. Kohn and Sack (2004) examine the impact of speeches, testimony, and FOMC Statements under the Greenspan regime and find that both statements and testimony affect market interest rates. Chirinko and Curran (2013) confirm this result and also find

that these communications significantly affect bond market volatility. Apergis (2014) examines the impact of the FOMC meeting minutes on asset prices and shows that the release of minutes increases the mean return on longer maturities.

Additional papers extend beyond just examining whether or not there is a reaction to Federal Reserve communication and explore how markets react to the content of the communication. Rosa (2011) compares whether the market reacts differently to hawkish and dovish FOMC statements. He determines whether or not a released FOMC statement was hawkish or dovish and compares this score to what markets expected the content of the statement to be. By subtracting the actual content from the expected content, he is able to find the "surprise" component of policy statements Unexpectedly hawkish statements have a significant impact on stock indices, causing a decline in stock prices. Furthermore, the impact of the surprise component of monetary content is greater than the impact of the surprise component of monetary policy action. Farka (2011) also analyzes the content of FOMC statements and classifies them as either informative or uninformative. She finds that informative statements have a larger impact on both the volatility and returns of Treasuries and the stock market. Ehramann and Fratzcher (2007), using newswire reports about FOMC communication, find that speeches and interviews that are related to the economic outlook have a positive impact on bond returns for maturities of up to ten years while speeches and interviews simply related to monetary policy news only affects shorter maturities.

Hayo et. al (2014) classify all speeches made by Federal Reserve Bank presidents, members of the Board of Governors, and the chairperson of the Federal Reserve based on their content regarding monetary policy and economic outlook. Their study has several

main findings: shorter maturities are affected in a meaningful way by the content in speeches, chairperson speeches generate larger market reactions than other positions, and central bank communication is ever more relevant after the financial crisis.

While the previous papers delve more into the content of communication, they do not measure it in a systematic way; communication is coded based on the authors' subjective opinions after reading the relevant communication. More recent papers have improved upon this measure by applying more computational approaches to measuring the content in Federal Reserve Communications in order to get more objective and consistent measurements of the communication content. Bligh and Hess (2010) apply a content analysis software to speeches, testimonies, and FOMC statements made during Greenspan's tenure as chair to compute measurements of their certainty, pessimism, optimism, activity, immediacy, and jargon. Using these measurements of content, they find more pessimistic language is consistent with a decline in the Federal funds futures rates. Smales and Apergis (2017) measure the complexity of FOMC statements by computing a readability score and counting the number of words in a statement. An increase in the complexity of statements results in higher return volatility in stock, bond, and currency markets. Lucca and Trebbi (2009) evaluate the content surprise of an FOMC statement by evaluating news articles discussing the statement before and after its release. For the periods before and after the release, they compute a semantic score based on the amount of words associated with positive and negative target rate movements in the articles. They then measure the content surprise as the difference between the semantic score before and after the release. Using this measurement, they find that longer term treasuries react more strongly to changes in policy communication than to changes

in policy rates. Hansen and McMahon (2015) compute a semantic score similar to Lucca and Trebbi, but instead of evaluating news reports about FOMC statements, they compute an economic situation score from the FOMC statement itself using words associated with an economic expansion and contraction.

This paper will contribute both to the more general study of the impact of Federal Reserve communications on financial markets and to the study of these communications using computational linguistic tools. I contribute to the first strand by examining the reaction of markets to all forms of Federal Reserve communications—minutes, statements, and speeches by bank presidents, members of the Board of Governors, and the chairperson of the Federal Reserve— and comparing the reaction to each type of communication. I also contribute to the growing literature that applies techniques from computational linguistics by measuring the tone of a communication with a dictionary method that creates a ratio based on the amount of positive and negative words used. By using this technique, I create a consistent measure of tone that can easily be applied to all communications by the Federal Reserve.

3 Data

3.1 Federal Reserve communications

3.1.1 Dates and Content of Communication

To perform an analysis on financial market reaction to Federal Reserve communication content, I first create a dataset of the dates and text of all FOMC statements, minutes, and speeches by Federal Reserve Bank presidents, members of the Board of Governors, and the chairperson of the Federal Reserve Bank from May 1999 to March 2018. I choose this range because the statement began to include the Fed's view

on prospective economic development in May 1999. Earlier statements from 1994 to 1999 were only released when there was a change in the federal funds rate and were used to simply notify the market of the change funds rate (Farka 2009). By limiting the sample to the period after 1999, I ensure that the purpose of the FOMC statement release is the same across the sample.

To accurately measure the response of financial markets to Federal Reserve communication content, it is crucial to accurately record the time at which markets would react to the information in the communication. Because FOMC statements are released at a predefined time of 2:00 P.M. on the last day of an FOMC meeting, I record their date as the day of release. As the release is early in the afternoon, markets will still be able to trade until close at 5:00 P.M., so the impact of the content of the statements should be incorporated by the end of the day (Bernanke 2005). Minutes, like statements, are released on a predefined schedule. Prior to 2004, they were released two days after the meeting that followed the meeting the minutes were recorded at. In December 2004, the Committee pushed the publication forward and began releasing them three weeks after the meeting (Jung 2016). Due to this consistent release pattern and their 2:00 P.M. release time, I also record their date as the date of release.

Unlike statements and minutes, speeches are irregularly timed. Thus, it is harder to determine when and if a communication event occurred. A common approach is to examine financial newswire reports and use the day of their reporting about a speech as the date the communication took place. However, this approach has major drawbacks because news organizations are selective in their reporting and may not cover all speeches that the market may consider relevant. Thus, I use the approach of Hayo et. al

(2014) and record the date financial markets should react as the day a speech was given if the speech occurs before the market closes on a weekday. If a speech occurs after trading hours, I record its date as the following day because markets would not have been able to react on the day it was given. If a speech occurs on a weekend, I assign its date as the following Monday. With this approach, I ensure that every piece of news created is captured even if financial news services do not report on it.

In order to examine the content of communications directly rather than through an intermediary like a news service, I obtain the transcript for all statements, minutes, and speeches. I download both statements and minutes transcripts from the Federal Reserve's official website and collect 162 FOMC statements and 154 minutes. Of the statements, all but nine were released after the eight scheduled FOMC policy meetings that occur each year. The nine unscheduled statements were released after unscheduled FOMC meetings where either the policy rate was changed unexpectedly, or additional policy actions aimed to aid markets during the financial crisis were announced.[2] Four of the minutes were associated with these unscheduled meetings but were released with the minutes of the next scheduled meetings.[3]

I obtain the transcripts of speeches made by the presidents of the twelve Federal Reserve Banks from their respective websites and from FRASER, which is the economic history website maintained by the Federal Reserve Bank of St. Louis. I also obtain speeches from the members of the Board of Governors and from the chairperson of the

[2] The dates of these meetings are 1/3/2001, 9/17/2001, 8/10/2007, 8/17/2007, 1/22/2008, 3/11/2008, 10/8/2008, 5/10/2010, 10/30/2013, and 3/19/2014.
[3] The dates of the unscheduled meetings minutes release were 10/9/2007(2 were released), 11/20/2013, and 4/9/2014.

Federal Reserve from FRASER. In total, I collect the transcripts of 3,734 speeches[4]. 486 of these were made by the chairperson, 920 were made by governors of the Federal Reserve, and 2,328 were made by presidents of the Federal Reserve Banks. 1,025 of the speeches made by bank presidents were made by presidents who were voting members of the FOMC while the remaining 1,303 speeches were made by presidents were not voting members of the FOMC. [5] A visualization of the compiled data set can be seen in Figure B1 in the Appendix.

3.1.2 Measuring Content of Communication

To extract the tone from the transcripts, I borrow tools from computational linguistics. First, I clean the raw text of the transcripts. I do this by removing common words, such as "and" and "the", that provide little semantic content.[6] Then, I remove all punctuation and make the entire text lowercase. By making the text lowercase, I ensure case does not matter and that "Increase" and "increase" will be counted as the same word. Finally, I "stem" all words to their root, meaning "increasing" "increased" and "increase" will all be changed to "increas." The application of these steps reduces each transcript to a collection of individual words, or "tokens."

[4] Ninety-one of the speeches could not be found on the Federal Reserve Bank's websites or on FRASER. I collect transcripts for forty-seven of them from Central Banking, which is a news organization focused on covering central banks. For the remaining forty-four speeches, I obtain news articles from LexisNexis that covered the speeches.

[5] The FOMC has twelve voting members with seven of them being the governors, one being the president of the Federal Reserve Bank of New York, and four being presidents of the remaining eleven banks. These four spots are rotated every year with one president from the following groups: Boston, Philadelphia, and Richmond; Cleveland and Chicago; Atlanta, St. Louis, and Dallas; and Minneapolis, Kansas City, and San Francisco. Nonvoting presidents still attend FOMC meetings and contribute to discussions about the economy.

[6] A complete list of the common words removed can be found at http://snowball.tartarus.org/algorithms/english/stop.txt

Next, I apply the "bag-of-words", or dictionary, approach to the cleaned transcripts to capture their tone. In this approach, a dictionary of words associated with an emotion or action is defined, and a score is calculated for each document based on the frequency of words that are in the dictionary. This approach has been applied extensively in the financial literature to measure market sentiment. For example, Loughran and McDonald (2011) construct a list of words associated with negativity in the financial context and use it to calculate the negativity in company 10-K filings.

I use "directional" word lists that measure words associated with expansion and contraction that were defined by Apel and Brix Grimaldi (2012). The full list of words associated with expansion and contraction can be seen in Table 1 below. I choose this dictionary list because it has been applied by both Hansen and McMahon (2015) and Bennani and Neuenkirch (2015) to measure the tone of communication by a central bank. Using this dictionary, I measure the tone of each communication as follows:

$$Tone = \frac{\#\ of\ expansionary\ words - \#\ of\ contractionary\ words}{\#\ of\ expansionary\ words + \#\ of\ contractionary\ words} \quad (1)$$

Based on this specification, the value of tone is bounded between -1 and 1, with 1 representing the most positive tone and -1 representing the most negative tone.

Table 1: *Words Associated with Expansions and Contractions*

Expansion	Contraction
Improv	Moder
Foster	Slow
Increas	Low
Expand	Weak
Rise	Subdu
Higher	Lower
Risen	Fall
Gain	Slower
Strong	Weaker

Acceler	Decreas
Faster	Weaken
Strength	Contract
	Soften
	Decler
	Cool

Since multiple communication events often occur on the same day, I create a tone variable that is the average of the tone of all communication events that occurred on any given day (Avg Tone). To account for the fact that tone is more often positive by this measurement and in order to standardize the data, I subtract the median value of the average tone over the whole sample, so that the tone on each day is capturing the relative positivity or negativity of communication. Since the tone of individual communication events could vary widely on any given day, I also create a measure of the disparity in tone (Tone Disp) for each day be subtracting the minimum value of tone from the maximum value of tone.

However, the two previous measures fail to capture the fact that markets may reaction differently to communication depending on its source. Hayo et. al (2014) find that speeches by the chairman cause larger financial market reactions than speeches by presidents and governors. In another paper, Hayo and Neuenkirch (2013) find that the content of non-voting presidents speeches can be better explained by regional macroeconomic variables than by national macroeconomic variables. This dynamic could cause markets to pay less attention to their tone as it is a response to regional, not national conditions that would have more of an effect on the market. FOMC statements' tone may also have a larger impact on markets due to the "black-out" period the week before an FOMC meeting where FOMC members cannot discuss monetary policy in speeches (Lucca and Moench 2015). This silent period could lead to heightened market

uncertainty, and thus more attention will be paid to the content of the statements than to other types of communication. To account for these potential dynamic, I also create tone measurements that are broken out by the source of the communication—an FOMC statement (Stmt Tone), FOMC minutes (Min Tone), a speech by a nonvoting president (NVP Tone), a speech by a voting president (VP Tone), a speech by a governor (Gov Tone), and a speech by a chairperson (Chair Tone). For each of these measurements, I also subtract the median value as was done with the average tone. I summarize the seven tone types in Tables A1 in the Appendix.

The use of only one variable for the tone may miss important asymmetric dynamics that occur in the stock market in response to positive or negative tone or positive and negative shocks in general. Although conventional economic analysis assumes market participants are rational, this is not always the case. Participants often react based on emotion and intuition. Keynes (1936) refers to this emotional decision making as the "animal spirits" of the market. Due to these "animal spirits", the market may react differently to negative and positive events. This asymmetry in reaction to an event depending on if it is positive and negative has been found in many recent studies. For example, Barnichon et al. (2017) find that negative shocks to the credit supply have large and persistent effects on output while positive credit shocks have no significant effect. In a different paper, Barnichon and Matthes (2018) examine the size of the government spending multiplier and find the multiplier associated with a negative shock to government spending is greater than one while the multiplier associated with a positive shock to government spending is much less than one. Shu et al. (2009) look at the reaction of stock prices to good news and bad news disclosures by public companies and

discover the magnitude of the negative reaction to bad news disclosures is much greater than the magnitude of the positive reaction to good news.

Based on these studies, it is possible the markets would react much more strongly to the presence of negative tone in communication from the Federal Reserve than to the presence of positive tone. To allow for these possible asymmetric reactions to tone, I create positive and negative tone variables for each communication source, with the value of the negative tone variable equaling the absolute value of any tone that is less than zero and the positive tone variable equaling the value of any tone greater than zero. I summarize these variables both before and after the financial crisis in Tables A2 and A3 in the Appendix.[7]

3.2 Monetary Policy Measurement

In order to properly measure the responses of financial market variables to the tone of Federal Reserve communication, I also need to control for any surprise changes in monetary policy that could also affect markets. Only monetary policy surprises need to be accounted for because, under the rational markets hypothesis, markets are forward looking and will have already incorporated any expected changes in monetary policy before the policy is announced. Therefore, on the day of an announcement, expected changes in the federal funds target rate should have little or no effect on the market (Bernanke 2005).

To measure the surprise component of monetary policy, I use the change in the Federal funds futures rate. The Federal funds futures rate contacts are a market-based

[7] I separate the variables pre and post-financial crisis because the average values for the tones are different in the two periods due to the long period of recovery that followed the crisis.

proxy of the expectations of the future of monetary policy. On the day before a monetary policy announcement, the futures rate will reflect what the market expects rates to be. After an announcement is made, the futures rate will reflect the actual rate change. Thus, by finding the difference in the futures rate the day before a monetary policy announcement and the day of an announcement, the surprise component of the policy can be computed.

However, an issue arises because the federal funds futures settlement price is based on the monthly average Federal funds rate. Using the method developed by Kuttner (2001), I account for this problem by scaling up the change in the Federal funds futures rate to reflect the number of days in the month affected by the change. This adjustment makes the surprise change in the Federal funds for a date, *t*, equal to

$$\Delta ff_t^u = \left[\frac{D}{D-t}\right](f_{m,t}^0 - f_{m,t-1}^0) \quad (2)$$

, where D is the number of days in the month, $f_{m,t}^0$ is the futures rate on day t of month m, and $f_{m,t-1}^0$ is the futures rate from the day before t.

With this equation, I calculate the Federal funds rate surprise for the 162 days on which the FOMC announced its decision regarding the Federal funds rate using daily 30-day Federal funds futures contracts purchased from the Stevens Continuous Financial Database.[8] A visualization of the surprise during the sample can be seen in Figure B2 in the Appendix.

[8] This database is available at https://www.quandl.com/data/SCF-Continuous-Futures. I use the CBOT 30-day Federal Funds Futures #2 (FF2) - Unadjusted Prices, Roll on First of Month, Continuous Contract History series.

3.3 Macroeconomic Data

Monetary policy surprises are not the only additional factor that can affect financial market variables. Financial markets can also react to major macroeconomic releases. Due to the high number of days communication events occur on, many macroeconomic data releases also occur on the same day. Therefore, I also need to control for the surprise component of major macroeconomic data releases that are closely watched by market participants. I consider the same thirteen data releases as Kohn and Sack (2003) and Bligh and Hess (2010) that were found to have a significant effect on the three-month ahead Federal funds futures contract: employment cost index (ECI), advance GDP (GDP), capacity utilization rate (CUR), consumer sentiment index (CS), core consumer price index (CPI), durable goods orders (DGO), Institute of Supply Management Index (ISM), non-farm payroll employment (NFP), new home sales (NHS), core producer price index (PPI), retail sales (RS), unemployment rate (UR), and initial claims for unemployment (JC). I construct the surprise for each release by finding the difference between the actual reported number from the first data release and the number from the most recent market survey (Kohn and Sack 2003). Since all data releases occur during the time period in which markets are trading, I record the date of a surprise as the day on which the data was released.

All but two of these releases are from governmental organizations and can be found on various government websites. I obtain data on advance retail sales (month over month percentage change), new home sales (total home sales, annualized) and durable goods orders (month over month percentage change) from the United States Census Bureau. Data on all three measurements is released on a monthly basis, so I have 226

release dates for each. I also obtain data on the employment cost index (month over month percentage change), producer price index (less energy and foods, year over year change), consumer price index (urban consumers less food and energy, month over month change), non-farm payroll employment (total change since last month), and the unemployment rate from the United States Bureau of Labor Statistics. Data on the producer price index, consumer price index, unemployment rate, and non-farm payrolls are released on a monthly basis, so I have 226 release dates for each. Employment cost index data is only released quarterly, so I have 76 release dates in the sample. The data on the capacity utilization rate was obtained from the Federal Reserve Board of Governors website. Since capacity utilization is a monthly announcement as well, I get 226 release dates. I find data on the weekly initial claims for unemployment insurance from the Department of Labor. Since this release is weekly, there are 987 releases during the sample. I also find data on the first release of advance GDP (annual percentage growth rate) from the Federal Reserve Bank of Philadelphia's real-time dataset and end up with 76 release dates as GDP estimates are announced on a quarterly basis. [9]

I obtain data on the Institute of Supply Management Index from the Institute of Supply Management's database that is housed on the website Quandl.[10] For the measurement of consumer sentiment, there are two commonly used indexes: The Consumer Confidence Index published by the Conference Board and the University of Michigan's Consumer Sentiment Index. Due to availability of data, I use the latter measurement and collect the data from University of Michigan's website.[11] Both the

[9] All data is seasonally adjusted.
[10] https://www.quandl.com/data/ISM-Institute-for-Supply-Management
[11] The Index is normalized to have a value of 100 in 1964

Consumer Sentiment Index and the Institute of Supply Management Index are released monthly, so I collect 226 release dates for both measures.

For all data releases except advance GDP, I find the median of survey forecasts on the day before the data release on Bloomberg.[12] For GDP, I use forecasted value for GDP from the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters. Then, I subtract these subtract these forecasted values from the value of the data release to obtain the surprise. To standardize the levels of the surprises, I divide the surprise value by the actual data release value for all series that are not in percentage changes.

3.4 Financial Market Data

Caggiano et al. (2017) find that uncertainty affects markets, particularly after the Great Recession. To control for this effect, I obtain data on the VIX Index from the Chicago Board Options Exchange and use it as proxy for market uncertainty. Ajayi and Mougoue (1996) also find that fluctuations in the United States exchange rate can affect the stock market, so I gather daily data on the broad US foreign exchange rate index from the Federal Reserve Economic Data (FRED) to account for this dynamic.

In order to determine the financial market reaction to Federal Reserve communication, I collect data on daily market yields for 1-month, 3-month and 1-year Treasury bills and 2-year, 3-year, 5-year, 7-year, and 10-year Treasury notes from the

[12] The specific series are as follows: RSTAMOM (retail sales), ECI SA% (employment cost index), CPICHNG (consumer price index), CONNSENT (consumer sentiment), CPUPXCHG (consumer price index), DGNOCHNG (durable goods orders), NAPMMII (Institute of Supply Management Index), NFPTCH (non-farm payrolls), NHSTOT (new home sales), PPIXYOY (producer price index), USURTOT (unemployment rate), INJC (initial claims for unemployment). The series are missing survey data for retail sales from 1999-2001 and producer price index from 1999-2008. For these dates, I forecast the values of retail sales and producer price index with a seasonally adjusted ARMA model and use these forecasted values as the survey value when computing the surprise.

Federal Reserve's Statistical Releases[13]. I then compute the daily return as the change in the yields by subtracting the yield from the day before from the current day's yield. Additionally, I collect daily data on the S&P 500 Index from the Yahoo! Finance database and compute the daily return as

$$100 * \ln(\frac{p_t}{p_{t-1}})$$

, where p_t is the price the day of and p_{t-1} is the price the day before.

4 Model

Following Hayo et. al (2014), I use daily data when estimating the effect of communication content on asset returns. This is because I am interested in economically important effects that persist over time, not just minor responses that happen at the time of the event and then die out within a minute or within an hour. Additionally, the precise time of speech delivery is not known, only the scheduled delivery time. Thus, it would not be possible to measure the response on a minute by minute level.

Descriptive statistics in Tables A4 and A5 in the Appendix show that all financial market series exhibit excess kurtosis, which indicates the presence of autoregressive conditional heteroskedasticity (ARCH) effects (Engle 1982). Therefore, I will use an event-study ARCH model of order one to estimate the effect of communication tone on daily returns financial variables. To examine the effects of average tone, type specific tone, positive and negative tone, I will estimate the following four model specifications:

[13] For the 1-month Treasury bill, I only collect data from July 31st 2001 as that is when it started trading. For all other variables, there is data from May 1999- March 2018.

$$R_t = \alpha + \beta_1 BOND_{t-1} + \beta_2 SP500_{t-1} + \beta_3 FX_{t-1} + \rho \Delta ff_t^u + \sum_{i=1}^{4} \gamma_i DAYOFWEEK_i + \sum_{i=1}^{13} \delta_i MAC_{it}^u + \lambda VIX_t + \theta_1 AVGTONE_t + \theta_2 TONEDISP_t + \mu_t \quad (3)$$

$$R_t = \alpha + \beta_1 BOND_{t-1} + \beta_2 SP500_{t-1} + \beta_3 FX_{t-1} + \rho \Delta ff_t^u + \sum_{i=1}^{4} \gamma_i DAYOFWEEK_i + \sum_{i=1}^{13} \delta_i MAC_{it}^u + \lambda VIX_t + \theta_1 NVPTONE_t + \theta_2 VPTONE_t + \theta_3 GOVTONE_t + \theta_4 CHAIRTONE_t + \theta_5 STMTTONE_t + \theta_6 MINTONE_t + \mu_t \quad (4)$$

$$R_t = \alpha + \beta_1 BOND_{t-1} + \beta_2 SP500_{t-1} + \beta_3 FX_{t-1} + \rho \Delta ff_t^u + \sum_{i=1}^{4} \gamma_i DAYOFWEEK_i + \sum_{i=1}^{13} \delta_i MAC_{it}^u + \lambda VIX_t + \theta_1 POSTONE_t + \theta_2 NEGTONE_t + \theta_3 TONEDISP_t + \mu_t \quad (5)$$

$$R_t = \alpha + \beta_1 BOND_{t-1} + \beta_2 SP500_{t-1} + \beta_3 FX_{t-1} + \rho \Delta ff_t^u + \sum_{i=1}^{4} \gamma_i DAYOFWEEK_i + \sum_{i=1}^{13} \delta_i MAC_{it}^u + \lambda VIX_t + \theta_1 POSNVP_t + \theta_2 NEGNVP_t + \theta_3 POSVP_t + \theta_4 NEGVP_t + \theta_5 POSGOV_t + \theta_6 NEGGOV_t + \theta_7 POSCHAIR_t + \theta_8 NEGCHAIR_t + \theta_9 POSSTMT + \theta_{10} NEGSTMT_t + \theta_{11} POSMIN_t + \theta_{12} NEGMIN_t + \mu_t . \quad (6)$$

The error term is defined as

$$\mu_t = z_t \sigma_t \quad (7)$$

for each model, where z_t is the stochastic part, and σ_t is time-dependent standard deviation. The variance is then defined as

$$\sigma_t^2 = \phi_0 + \phi_1 \mu_{t-1}^2 . \quad (8)$$

In each regression, I allow the financial variables' returns, R_t , to respond to the surprise component of FOMC monetary policy (Δff_t^u), macroeconomic data release surprises (MAC_{it}^u), the volatility index (VIX_t), and the lag of the return of the foreign exchange rate index (FX_{t-1}). Additionally, because asset returns are known to differ depending on the day of the week (Gibbons and Hess 1981), I also include dummies to control for day of the week effects, with Monday being the reference day. To control for potential autoregressive dynamics, I also include one lag of the of the specific bond being

regressed on as well as one lag of stock returns. When regressing on stock returns, I use the lag of the three-month Treasury bill as the bond return, as was done in Hayo et al (2014).

After estimating the previous four ARCH(1) model specifications, I exclude all insignificant variables to obtain the most reduced model, using the general-to-specific approach (Hendry 1995).

5 Empirical Results

I am most interested in the estimation of equation 6 for the period before and after the financial crisis. This specification accounts for the existence of asymmetric reactions to positive and negative tone and to who or what is the source of the tone. Using split sample analysis for the periods before and after the financial crisis, I will also capture any changes in market reactions that occurred due to the crisis and the following increased emphasis on Federal Reserve communications. For robustness, I include the estimations of equations 3 through 5 to show the need for disaggregating tone by type and source and for estimating it pre and post crisis.

5.1 Impact of More General Specifications of Tone

The results of the estimation of Equation 3 for the full sample can be found in Tables A6 and A7 in the Appendix. The coefficient on average tone is insignificant on five of the financial market series, and when it is significant, the impact is small except for the impact on the S&P 500 Index. These results are expected since average tone is constructed by averaging the tone for all communication events that occurred in a day and does not distinguish the tone by type of communication.

There is reason to believe that the reaction to tone may depend on the source of the communication tone (see Section 3.1.2). To account for these potential dynamics, I follow the method of Hayo et al. (2014) and estimate equation 3 where tone is split by communication type for the full sample, and the results can be found in Tables A8 and A9 in the Appendix. By disaggregating the tone by type, I am able to find that statement tone has a significantly positive impact on all bond returns with a matrutiy of less than 5-years and that it also has a significantly negative impact on the returns of the S&P 500 Index. [14] These results show that there is a need to disaggregate by the source of the tone in order to obtain meaningful results.

The source type is not the only characteristic of tone that might affect the impact on financial markets. Whether the tone is positive or negative could also affect the impact, as markets often have asymmetric reactions to positive and negative shocks. Therefore, I estimate equation 5 for the full sample and present the results in Tables A10 and A11 in the Appendix. As with the average tone in Equation 1, the majority of the coefficients on positive and negative tone are insignificant.

Another possible source of differing impacts of tone is the financial crisis. With Federal funds rate constrained by its effective lower bound, the Federal Reserve used communication as a way to provide further policy stimulus by lowering expectations of future interest rates (Bernanke 2012). This new policy tool may have increased the importance of the tone as communication events would contain more information about the future of monetary policy than they did before the crisis. Additionally, since monetary

[14] The coefficient on statements (and all other subsequent tone coefficients) can be interpreted as follows: 0.0197 denotes an increase by 1.97 bps after a perfectly positive statement with a tone score of one is released.

policy had never been conducted at the zero-lower bound before the financial crisis, there was greater uncertainty overall about the future of monetary policy (Plante et. al 2017). Due to this increased uncertainty, markets may react more to communication events after the start of the financial crisis.

Due to these two reasons, I re-estimate equations 3 through 5 for only the dates after the start of the financial crisis.[15] The results can be found in Tables A12-A17 in the Appendix. Based on the results, there is evidence for the theory that tone impact could have changed after the financial crisis. For example, the magnitude of the coefficient on both governor and statement tone doubled when restricting the period to the post crisis period.

5.2 Impact of Type Specific Positive and Negative Tone

Due to the shortcomings of the previously evaluated models, I now estimate equation 6 with tone split by both source and sign for the full sample. The results of this estimation can be seen in Tables A18 and A19 in the Appendix. These results show there was a need to control for variables other than the tone of communications. The Federal funds rate surprises have a positive impact on bond returns up the 5-year Treasury note and have negative impact on stocks returns. This result is consistent with expectations that an increase in interest rates should increase the yields on bonds and lower stock prices. Many of the macroeconomic surprises also have a significant impact on the

[15] I choose August 17, 2007 as the start date of the financial crisis because on this day, the Federal Reserve announced it was the lowering the rate it lends to banks at half a percentage point to 5.75 percent and warned that "tighter credit conditions and increased uncertainty" could affect growth moving forward. This was a sign that the problems in the subprime mortgage market were beginning to spill over into financial markets, causing credit crunches, even though the economy itself was still growing and not yet in a recession.

returns of financial market variables of all maturities. The uncertainty in the market as measured by the VIX Index is also highly negative and significant for all financial market returns. Most importantly, the coefficients on positive and negative tone for sources show that there are differing impacts depending on the sign of the tone. This can be seen in the effect of governor tone on the 1, 3, and 5-year bonds. Positive tone has a strong positive effect on their returns while negative tone does not have a statistically significant impact.

However, estimating equation 6 for the full sample misses possible changes that occurred because of the financial crisis. Therefore, I estimate it separately for the periods before and after the crisis. Tables 2 and 3 show the results for the period preceding the financial crisis, and Tables 4 and 5 show the results for the period after the start of the financial crisis.

Table 2: *Reaction of Financial Market Returns to Type Specific Positive and Negative Tone, Pre-Financial Crisis, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds		0.0349***	0.0384***	0.0500***	0.0404***
		(0.0020)	(0.0039)	(0.0074)	(0.0107)
PPI			0.0206*		
			(0.0116)		
CPI	0.0066*				
	(0.0035)				
NHS	0.0090***				
	(0.0034)				
NFP			0.0075	0.0141*	0.0149*
			(0.0051)	(0.0083)	(0.0089)
RS	0.0093**			0.0073***	0.0066***
	(0.0036)			(0.0023)	(0.0025)
GDP			0.0113**	0.0243***	0.0222***
			(0.0048)	(0.0059)	(0.0068)
UR			-0.0098***	-0.0109**	
			(0.0034)	(0.0046)	
CUR		0.0071***			0.0113

	1-month	3-month	1-year	2-year	3-year
		(0.0026)			(0.0072)
ISM				0.0126*	0.0106
				(0.0070)	(0.0080)
DGO		0.0071***			0.0113
		(0.0026)			(0.0072)
VIX Index	-0.0226**	-0.0477***	-0.0607***	-0.0757***	-0.0755***
	(0.0109)	(0.0084)	(0.0133)	(0.0178)	(0.0192)
Pos NVP	-0.0046	-0.0057	-0.0022	0.0093	0.0050
	(0.0048)	(0.0047)	(0.0062)	(0.0097)	(0.0114)
Neg NVP	-0.0050	-0.0060	-0.0066	-0.0229*	-0.0186
	(0.0084)	(0.0062)	(0.0078)	(0.0136)	(0.0148)
Pos VP	-0.0039	-0.0098*	0.0022	-0.0050	-0.0087
	(0.0047)	(0.0056)	(0.0078)	(0.0112)	(0.0120)
Neg VP	0.0010	-0.0082	0.0023	0.0098	0.0079
	(0.0106)	(0.0073)	(0.0112)	(0.0185)	(0.0180)
Pos Gov	-0.0144*	-0.0048	0.0266***	0.0231	0.0203
	(0.0086)	(0.0059)	(0.0086)	(0.0150)	(0.0152)
Neg Gov	0.0208***	0.0016	-0.0011	-0.0053	-0.0045
	(0.0028)	(0.0068)	(0.0094)	(0.0131)	(0.0133)
Pos Chair	0.0117	0.0071	0.0085	0.0142	0.0142
	(0.0102)	(0.0072)	(0.0104)	(0.0164)	(0.0175)
Neg Chair	-0.0008	-0.0089	-0.0126	-0.0166	-0.0115
	(0.0084)	(0.0081)	(0.0084)	(0.0132)	(0.0147)
Pos Stmt	-0.0036	-0.0166***	0.0179*	0.0388**	0.0407*
	(0.0073)	(0.0049)	(0.0095)	(0.0195)	(0.0220)
Neg Stmt	-0.0338***	-0.0618***	0.0047	-0.0089	-0.0091
	(0.0047)	(0.0028)	(0.0067)	(0.0092)	(0.0101)
Pos Min	-0.0666**	-0.0190	-0.0165	-0.0040	0.0015
	(0.0287)	(0.0211)	(0.0282)	(0.0489)	(0.0508)
Neg Min	0.0816***	0.0449	0.0574**	0.1361***	0.1848***
	(0.0160)	(0.0356)	(0.0277)	(0.0446)	(0.0564)

Table 3: *Reaction of Financial Market Returns to Type Specific Positive and Negative Tone, Pre-Financial Crisis, Long Term*

	5-year	7-year	10-year	S&P 500
Fed Funds	0.0335**	0.0234**		-0.6219***
	(0.0133)	(0.0117)		(0.1512)
PPI				-0.7538**
				(0.3586)
NFP	0.0335**	0.0234**		-0.6219***

	5-year	7-year	10-year	S&P 500
	(0.0133)	(0.0117)		(0.1512)
RS	0.0335**	0.0234**		-0.6219***
	(0.0133)	(0.0117)		(0.1512)
GDP	0.0335**	0.0234**		-0.6219***
	(0.0133)	(0.0117)		(0.1512)
CUR	0.0335**	0.0234**		-0.6219***
	(0.0133)	(0.0117)		(0.1512)
ISM		0.0103		-0.2248**
		(0.0092)		(0.0917)
VIX Index	-0.0681***	-0.0576***	-0.0480**	-2.2776***
	(0.0203)	(0.0205)	(0.0194)	(0.3374)
Pos NVP	0.0335**	0.0234**	-0.0020	-0.6219***
	(0.0133)	(0.0117)	(0.0114)	(0.1512)
Neg NVP	-0.0174	-0.0142	-0.0144	-0.1406
	(0.0161)	(0.0163)	(0.0163)	(0.1976)
Pos VP	-0.0106	-0.0061	-0.0009	-0.0240
	(0.0132)	(0.0132)	(0.0122)	(0.2133)
Neg VP	0.0217	0.0207	0.0262	0.1249
	(0.0196)	(0.0196)	(0.0188)	(0.3479)
Pos Gov	0.0123	0.0113	0.0114	0.2326
	(0.0152)	(0.0143)	(0.0134)	(0.2329)
Neg Gov	-0.0012	0.0014	0.0043	0.1637
	(0.0134)	(0.0138)	(0.0130)	(0.2275)
Pos Chair	0.0141	0.0077	0.0095	0.2056
	(0.0178)	(0.0172)	(0.0167)	(0.2979)
Neg Chair	-0.0115	-0.0044	-0.0006	-0.4586
	(0.0165)	(0.0162)	(0.0151)	(0.3506)
Pos Stmt	0.0306	0.0169	0.0110	0.5414*
	(0.0208)	(0.0221)	(0.0196)	(0.3233)
Neg Stmt	-0.0143	0.0003	0.0003	0.2599
	(0.0120)	(0.0124)	(0.0115)	(0.1757)
Pos Min	-0.0003	0.0118	0.0005	0.2048
	(0.0491)	(0.0468)	(0.0463)	(0.6969)
Neg Min	0.1349**	0.1320**	0.1144**	-1.0605
	(0.0627)	(0.0582)	(0.0516)	(0.7908)

In the pre-crisis period, positive statements positively affect capital market instruments up to 3 years while negative statements have a negative impact on only short-term instruments. FOMC minutes with negative tone are the only communication event with statistically significant effects on longer term financial instruments as well as on

shorter term. This dynamic is explained by the fact that minutes are released on a delayed schedule, and the economy before the financial crisis would bounce back quickly from economic downturns (Bordo and Haubrich 2016). So, while the minutes contain negative content regarding the economy, by the time they are released, policy actions to address the economic situation have been taken, and market participants will expect the economy to start doing better. This means returns will be increasing, causing the negative tone in the minutes to be associated with a positive impact.

Table 4: *Reaction of Financial Market Returns to Type Specific Positive and Negative Tone, Post-Financial Crisis, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0157***	0.0127***	0.0132***	0.0243***	0.0055*
	(0.0007)	(0.0013)	(0.0019)	(0.0044)	(0.0032)
PPI			-0.0038***	-0.0038**	
			(0.0006)	(0.0016)	
CPI		0.0029**			
		(0.0011)			
NHS			-0.0016		
			(0.0012)		
NFP		-0.0169*	-0.0520***		-0.0493***
		(0.0087)	(0.0043)		(0.0158)
JC			0.0021**	0.0028**	0.0038**
			(0.0006)	(0.0013)	(0.0017)
RS			0.0097***	0.0157***	0.0202***
			(0.0006)	(0.0022)	(0.0031)
GDP		0.0131***			
		(0.0010)			
UR	0.0021**	0.0016*	0.0015		
	(0.0009)	(0.0008)	(0.0011)		
CUR	-0.0039***		0.0030***	0.0064**	
	(0.0009)		(0.0012)	(0.0030)	
ISM	0.0024***		-0.0012	0.0091**	0.0101*
	(0.0008)		(0.0010)	(0.0042)	(0.0057)
ECI		0.0126***			
		(0.0017)			
CS	-0.0058***	-0.0050***	0.0052***		
	(0.0010)	(0.0006)	(0.0005)		

	1-month	3-month	1-year	2-year	3-year
DGO		0.0035***			
		(0.0007)			
VIX Index	0.0318***	0.0089***	-0.0234***	-0.0488***	-0.0436***
	(0.0013)	(0.0012)	(0.0025)	(0.0055)	(0.0077)
Pos NVP	0.0090***	-0.0049**	0.0112***	0.0023	0.0073
	(0.0013)	(0.0023)	(0.0016)	(0.0064)	(0.0081)
Neg NVP	0.0018	0.0002	0.0045*	0.0019	0.0053
	(0.0017)	(0.0017)	(0.0026)	(0.0050)	(0.0075)
Pos VP	-0.0101***	-0.0013	-0.0002	0.0088	0.0061
	(0.0026)	(0.0020)	(0.0036)	(0.0057)	(0.0096)
Neg VP	-0.0118***	0.0045**	0.0049*	0.0061	0.0103
	(0.0018)	(0.0021)	(0.0029)	(0.0067)	(0.0092)
Pos Gov	-0.0309***	0.0036	-0.0018	0.0101	0.0056
	(0.0026)	(0.0035)	(0.0043)	(0.0104)	(0.0140)
Neg Gov	0.0098***	0.0004	0.0009	0.0065	0.0106
	(0.0011)	(0.0018)	(0.0025)	(0.0050)	(0.0071)
Pos Chair	0.0034	-0.0056*	0.0060	-0.0190**	-0.0196
	(0.0055)	(0.0031)	(0.0049)	(0.0095)	(0.0147)
Neg Chair	-0.0181***	-0.0044**	-0.0058**	0.0069	-0.0013
	(0.0017)	(0.0021)	(0.0023)	(0.0048)	(0.0077)
Pos Stmt	0.0076	-0.0081**	-0.0190**	0.0111	0.0280*
	(0.0076)	(0.0041)	(0.0086)	(0.0111)	(0.0149)
Neg Stmt	-0.0195***	-0.0042	-0.0115**	-0.0025	0.0100
	(0.0047)	(0.0028)	(0.0055)	(0.0103)	(0.0105)
Pos Min	0.0289	0.0547**	-0.0309	0.0479	0.1004
	(0.0215)	(0.0226)	(0.0287)	(0.0552)	(0.0837)
Neg Min	-0.0188***	-0.0278***	-0.0248*	-0.0078	-0.0199
	(0.0050)	(0.0054)	(0.0137)	(0.0252)	(0.0207)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table 5: *Reaction of Financial Market Returns to Type Specific Positive and Negative Tone, Post-Financial Crisis, Long Term*

	5-year	7-year	10-year	S&P 500
NFP	-0.0525**	-0.0439*	-0.0409	
	(0.0231)	(0.0248)	(0.0277)	
JC	0.0039*			
	(0.0023)			
RS	0.0230***	0.0238***	0.0255***	
	(0.0043)	(0.0050)	(0.0053)	
UR	0.0077**	0.0081*	0.0070*	-0.1902***

	5-year	7-year	10-year	S&P 500
	(0.0037)	(0.0042)	(0.0042)	(0.0582)
CUR				0.1285*
				(0.0740)
ISM	0.0116**	0.0163***	0.0193***	0.4462***
	(0.0053)	(0.0059)	(0.0057)	(0.0780)
VIX Index	-0.0728***	-0.0797***	-0.0657***	-2.7738***
	(0.0103)	(0.0107)	(0.0101)	(0.1291)
Pos NVP	0.0058	0.0057	0.0062	-0.5641***
	(0.0109)	(0.0112)	(0.0109)	(0.1666)
Neg NVP	0.0005	-0.0011	-0.0032	-0.1720
	(0.0106)	(0.0111)	(0.0108)	(0.1509)
Pos VP	0.0115	0.0148	0.0142	0.3631
	(0.0157)	(0.0173)	(0.0161)	(0.2404)
Neg VP	0.0095	0.0117	0.0091	0.1712
	(0.0124)	(0.0131)	(0.0126)	(0.1908)
Pos Gov	-0.0068	-0.0017	-0.0044	0.5691
	(0.0173)	(0.0199)	(0.0201)	(0.3507)
Neg Gov	0.0055	0.0044	0.0008	-0.0215
	(0.0099)	(0.0108)	(0.0105)	(0.1735)
Pos Chair	-0.0163	-0.0171	-0.0190	-0.0868
	(0.0181)	(0.0197)	(0.0196)	(0.3314)
Neg Chair	0.0068	0.0126	0.0150	0.9721***
	(0.0107)	(0.0127)	(0.0122)	(0.0882)
Pos Stmt	0.0377**	0.0372*	0.0257	1.6287***
	(0.0171)	(0.0208)	(0.0220)	(0.5084)
Neg Stmt	-0.0056	0.0098	0.0116	1.7279***
	(0.0114)	(0.0111)	(0.0110)	(0.1760)
Pos Min	0.1560	0.1443	0.1398	0.4314
	(0.1168)	(0.1354)	(0.1604)	(1.8014)
Neg Min	-0.0487	-0.0128	0.0266	-0.7267
	(0.0339)	(0.0455)	(0.0358)	(0.4914)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

After the financial crisis, I find more statistically significant coefficients for specific positive and negative tone types than there were before the crisis, which indicates that communication plays a more pronounced role during and after the financial crisis. Negative minutes are also no longer associated with an increase in returns in the post crisis period. Instead, they have a negative impact on returns on bonds with maturities of one year or less. This shift in reaction is consistent with changes that occurred in the

economy following the financial crisis. The pattern of quick recovery from recessions does not exist in the economy after the crisis. Instead, the recovery of the economy has been sluggish in comparison (Fernald et. al 2017). Thus, by the time the negative minutes are released, the economic situation has not improved as it would have before the crisis, so they are now associated with a decline in returns.

I also find communication by the chairperson to be more important than other members of the Federal Reserve (not including minutes and statements as they are not the communication of one individual) in terms of the number of significant coefficients. This result is consistent with the results of both Hayo et. al (2014) and Rosa (2016) as both studies find increased reactions to the communication by the chairperson after the financial crisis. I also find that the returns of the S&P 500 Index react positively to negative tone and that returns of bonds up to 2-year maturities react negatively to negative tone. The sign of the reactions to negative tone make economic sense as negative tone would signal either a decrease in rates or the continuation of low interest rates, which cause the returns of bonds to fall and the returns of the S&P 500 Index to rise. Additionally, the reaction of the S&P 500 Index to only negative tone is in line with the previous studies where a negative shock had greater impact than a positive shock.

Additionally, negative and positive statements both have very large and significant positive impacts on the returns of the S&P 500 Index when compared to the period before the financial crisis. The strong positive reaction to negative statements is explained by two factors: first, a negative statement would imply that rates were going to stay very low, which is good for businesses and the stock market. Second, negative statements during this period were often accompanied by announcements of

unconventional monetary policy, such as the decision of the Federal Reserve to purchase mortgage-backed securities and other assets in order to stimulate the economy (Blinder 2010). These announcements would cause stock returns to go up even more than the simple assurance of low interest rates. The positive reaction to positive statements can be attributed to the fact the positive statements are a signal that the economy is doing better, which is good news for the stock market. Usually a positive statement would also be a signal for higher interest rates in the near future, which would be bad news for the stock market. However, from December 2008 to December 2015, the Federal funds rate stayed close to zero with no increases. This long period of no increases could have lowered the credibility of the Federal Reserve. Thus, even when a statement contained language that would imply an increase in the future, the market did not believe the increase would actually come and instead only reacted to the signal the economy was doing better.[16]

6 Conclusion

In this paper, I study the reaction of financial market variables to the content of all communication by the Federal Reserve from May 1999 to March 2018. Specifically, I explore how financial market variable reactions to communication tone are dependent on both its source and on whether it is positive or negative. Additionally, I examine whether these reactions are different in the periods before and after the financial crisis.

In order to do this, I first create a dataset of the dates and transcripts of all FOMC statements, minutes, and speeches by the chairperson, members of the Board of

[16] To check this interpretation, I run the regression during the period where rates were kept at 0 and find the response to positive statements is larger in magnitude. In the period after rates were increased for the first time, the response is insignificant.

Governors, and presidents of the Federal Reserve Banks. I then create an objective measure of tone based on the number of words associated with expansions and contractions that appear in each communication. To account for asymmetric reactions to the source of tone and to the sign of the tone, I also create tone measurements that are broken out by the source of the communication and by whether the tone is positive or negative. To control for other surprises that would affect financial markets, I construct measures for monetary policy surprises, macroeconomic surprises, and uncertainty in the market.

Using an ARCH(1) model, I then estimate the effect of tone split by both source and sign on financial market returns both before and after the financial crisis. I find that negative minutes have a large, positive effects on returns in the period before the crisis. After the crisis, this effect is reversed, and negative minutes are either insignificant or have a negative effect on returns. I also find the tone of communication is more important following the crisis, which indicates that communication plays a more pronounced role after the crisis and markets respond more to it. I also find the tone of the chairperson is more important than other individual members of the Fed, which makes sense since the chair has the most control over the course of monetary policy. Finally, I find that both positive and negative statements have large and positive effects on the S&P 500 Index after the crisis. While the negative statement effect makes economic sense, the positive statement impact is more surprising. It implies that even when the Federal Reserve uses language that implies a positive economic outlook and thus an upcoming rate change, the stock market does not believe an increase in rates was coming and only responds to the positive news about the economy.

The work of this paper could be extended by creating separate tone variables with one capturing the tone regarding the economic outlook and another capturing the tone regarding the future monetary policy stance. This could be done by applying multiple dictionaries instead of one as was done in this paper. The response of financial market variables could then be disaggregated into a response to economic outlook tone and a response to monetary policy tone. However even without this split, I am still able to show that the tone used in communication has a significant impact on financial markets and that this impact depends on the source and sign of the communication.

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Appendix A: Additional Tables

Tables

Table A1: *Summary of Tone Variables*

	Maximum	Minimum	Average	Median
Avg Tone	1.0000	-1.000	0.3097	0.3289
NVP Tone	1.0000	-1.0000	0.2446	0.2549
VP Tone	-1.0000	1.0000	0.2852	0.2852
Gov Tone	1.000	-0.7647	0.4230	0.4678
Chair Tone	-1.0000	1.0000	0.4648	0.4737
Stmt Tone	-1.000	1.0000	0.0433	0.1667
Min Ton	-0.4000	0.6071	0.1550	0.1648

Table A2*: Summary of Positive and Negative Tone Variables, Pre-Financial Crisis*

	Maximum	Minimum	Average	Median
Pos Tone	0.6958	0.0002	.28463	0.2636
Neg Tone	1.3042	0.0017	0.2737	0.1931
Pos NVP	0.7828	0.0012	0.3278	0.3049
Neg NVP	1.2116	0.0027	0.2784	0.2162
Pos VP	0.7308	0.0035	0.2971	0.2692
Neg VP	0.8692	0.0025	0.2164	0.1859
Pos Gov	0.5657	0.0005	0.2433	0.2397
Neg Gov	0.8958	0.0001	0.2699	0.2238
Pos Chair	0.5455	0.0049	0.2625	0.2597
Neg Chair	1.4545	0.0101	0.2488	0.1629
Pos Stmt	0.8571	0.0571	0.4262	0.3571
Neg Stmt	1.1429	0.1429	0.5803	0.4762
Pos Min	0.4412	0.0008	0.1851	0.1675
Neg Min	0.5659	0.0010	0.1776	0.1183

Table A3: *Summary of Positive and Negative Tone Variables, Post-Financial Crisis*

	Maximum	Minimum	Average	Median
Pos Tone	0.6958	0.0002	.28463	0.2636
Neg Tone	1.3042	0.0017	0.2737	0.1931
Pos NVP	0.7828	0.0012	0.3278	0.3049
Neg NVP	1.2116	0.0027	0.2784	0.2162
Pos VP	0.7308	0.0035	0.2971	0.2692
Neg VP	0.8692	0.0025	0.2164	0.1859
Pos Gov	0.5657	0.0005	0.2433	0.2397
Neg Gov	0.8958	0.0001	0.2699	0.2238
Pos Chair	0.5455	0.0049	0.2625	0.2597
Neg Chair	1.4545	0.0101	0.2488	0.1629
Pos Stmt	0.8571	0.0571	0.4262	0.3571
Neg Stmt	1.1429	0.1429	0.5803	0.4762
Pos Min	0.4412	0.0008	0.1851	0.1675
Neg Min	0.5659	0.0010	0.1776	0.1183

Table A4: *Summary of Financial Market Series, Short Term*

	1-month	3-month	1-year	2-year	3-year
Observations	3,751	4,281	4,281	4,281	4,281
Mean	-0.001	-0.002	-0.001	-0.001	-0.001
Standard Deviation	0.066	0.048	0.039	0.053	0.057
Skewness	-1.080	-1.536	0.067	-0.019	0.001
Excess kurtosis	67.728	64.761	19.985	9.15	7.392
Minimum	-1.050	-0.810	-0.360	-0.450	-0.440
Maximum	0.860	0.760	0.520	0.380	0.370

Table A5: *Summary of Financial Market Series, Long Term*

	5-year	7-year	10-year	S&P 500
Observations	4,281	4,281	4,281	4,281
Mean	-0.001	-0.001	-0.001	0.01
Standard Deviation	0.061	0.062	0.059	1.215
Skewness	0.012	0.006	-0.035	-0.356
Excess kurtosis	5.809	5.614	5.425	10.359
Minimum	-0.460	-0.530	-0.510	-9.470
Maximum	0.340	0.300	0.250	10.246

Table A6: *Reaction of Financial Market Returns to Average Tone, Full Sample, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0167***	0.0160***	0.0148***	0.0636***	0.0078***
	(0.0006)	(0.0007)	(0.0013)	(0.0054)	(0.0019)
PPI			-0.0024**		
			(0.0010)		
CPI	0.0039**				
	(0.0018)				
NHS	-0.0014**	0.0017***			
	(0.0014)	(0.0005)			
NFP			0.0052**	0.0116**	0.0130***
			(0.0022)	(0.0051)	(0.0042)
JC			0.0024***		
			(0.0008)		
RS	0.0074***	0.0021*	0.0044***	0.0079***	0.0106***
	(0.0014)	(0.0011)	(0.0004)	(0.0023)	(0.0014)
GDP				0.0095**	0.0110**
				(0.0039)	(0.0046)
CUR	0.0074***	0.0021*	0.0044***	0.0079***	0.0106***
	(0.0014)	(0.0011)	(0.0004)	(0.0023)	(0.0014)
ISM	0.0028**		-0.0034***	0.0075**	0.0080*
	(0.0011)		(0.0011)	(0.0029)	(0.0045)
ECI	-0.0027	-0.0106***		0.0068*	
	(0.0035)	(0.0009)		(0.0040)	
CS	-0.0053***		0.0049***		
	(0.0014)		(0.0012)		
DGO		-0.0054***			
		(0.0006)			
VIX Index	-0.0132***	-0.0238***	-0.0321***	-0.0442***	-0.0551***
	(0.0013)	(0.0022)	(0.0030)	(0.0068)	(0.0080)
Avg Tone	-0.0076***	-0.0012	0.0029**	0.0018	0.0048*
	(0.0006)	(0.0008)	(0.0014)	(0.0024)	(0.0029)
Tone Disp	-0.0074***	-0.0017**	0.0016	0.0029	0.0059*
	(0.0009)	(0.0008)	(0.0012)	(0.0023)	(0.0032)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A7: *Reaction of Financial Market Returns to Average Tone, Full Sample, Long Term*

	5-year	7-year	10-year	S&P 500
Fed Funds	0.0053**			-0.2041***
	(0.0026)			(0.0521)
PPI				-0.1292***
				(0.0437)
NFP	0.0128**	0.0117*	0.0107	
	(0.0056)	(0.0064)	(0.0065)	
RS	0.0130***	0.0135***	0.0165***	
	(0.0021)	(0.0023)	(0.0029)	
GDP	0.0106*	0.0095*		
	(0.0054)	(0.0057)		
UR		0.0051*		
		(0.0030)		
CUR	0.0091**	0.0092**	0.0067*	
	(0.0038)	(0.0038)	(0.0035)	
ISM	0.0104**	0.0127***	0.0141***	0.1384***
	(0.0048)	(0.0049)	(0.0047)	(0.0519)
CS				0.1209*
				(0.0648)
VIX Index	-0.0652***	-0.0691***	-0.0566***	-2.0827***
	(0.0088)	(0.0090)	(0.0084)	(0.1100)
Avg Tone	0.0050	0.0028	0.0022	-0.0978*
	(0.0033)	(0.0035)	(0.0034)	(0.0519)
Tone Disp	0.0051	0.0055	0.0043	0.0517
	(0.0040)	(0.0041)	(0.0040)	(0.0587)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A8: *Reaction of Financial Returns to Type Specific Tone, Full Sample, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0125***	0.0164***	0.0138***	0.0335***	0.0070***
	(0.0008)	(0.0009)	(0.0014)	(0.0020)	(0.0020)
PPI			-0.0019*		
			(0.0010)		
CPI	0.0032*				
	(0.0019)				
NHS	0.0032*				
	(0.0019)				
NFP			0.0053**	0.0117**	0.0132***
			(0.0027)	(0.0047)	(0.0044)
JC		-0.0014***	0.0024***	0.0029**	
		(0.0005)	(0.0008)	(0.0013)	
RS	0.0066***		0.0044***	0.0113***	0.0106***
	(0.0014)		(0.0004)	(0.0012)	(0.0014)
GDP		-0.0054***		0.0116***	0.0113**
		(0.0013)		(0.0039)	(0.0045)
CUR	0.0070***	0.0042***	0.0055***	0.0083***	0.0097***
	(0.0012)	(0.0009)	(0.0019)	(0.0031)	(0.0034)
ISM	0.0023*		-0.0033***	0.0072*	0.0078*
	(0.0013)		(0.0011)	(0.0037)	(0.0045)
CS			0.0048***		
			(0.0012)		
DGO		-0.0056***	0.0023	-0.0042**	
		(0.0006)	(0.0018)	(0.0018)	
VIX Index	-0.0393***	-0.0254***	-0.0327***	-0.0537***	-0.0567***
	(0.0013)	(0.0023)	(0.0031)	(0.0068)	(0.0080)
NVP Tone	-0.0022	-0.0004	-0.0052***	0.0029	0.0025
	(0.0016)	(0.0016)	(0.0020)	(0.0037)	(0.0046)
VP Tone	0.0002	-0.0033**	-0.0023	-0.0030	-0.0059
	(0.0015)	(0.0016)	(0.0030)	(0.0048)	(0.0056)
Gov Tone	-0.0160***	-0.0032	0.0054**	0.0065	0.0049
	(0.0008)	(0.0020)	(0.0023)	(0.0045)	(0.0054)
Chair Tone	0.0026	0.0042*	0.0074***	0.0054	0.0031
	(0.0020)	(0.0024)	(0.0027)	(0.0046)	(0.0060)
Stmt Tone	0.0197***	0.0046***	0.0093***	0.0076*	0.0145***
	(0.0021)	(0.0009)	(0.0029)	(0.0043)	(0.0051)
Min Tone	-0.0413***	-0.0115	-0.0160*	-0.0150	-0.0390**
	(0.0054)	(0.0093)	(0.0086)	(0.0142)	(0.0199)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A9: *Reaction of Financial Returns to Type Specific Tone, Full Sample, Long Term*

	5-year	7-year	10-year	S&P 500
Fed Funds				-0.2043***
				(0.0558)
PPI				-0.1367***
				(0.0436)
NFP	0.0129**	0.0118*	0.0107	
	(0.0057)	(0.0064)	(0.0066)	
RS	0.0131***	0.0135***	0.0165***	
	(0.0021)	(0.0024)	(0.0029)	
GDP	0.0111**	0.0096*		
	(0.0053)	(0.0056)		
UR		0.0053*		
		(0.0031)		
CUR	0.0093**	0.0094**	0.0069**	
	(0.0038)	(0.0038)	(0.0035)	
ISM	0.0102**	0.0125**	0.0139***	0.1340**
	(0.0048)	(0.0049)	(0.0047)	(0.0527)
CS				0.1368**
				(0.0624)
VIX Index	-0.0663***	-0.0707***	-0.0584***	-1.9915***
	(0.0089)	(0.0090)	(0.0085)	(0.1105)
NVP Tone	0.0035	0.0032	0.0049	-0.1566*
	(0.0058)	(0.0058)	(0.0056)	(0.0803)
VP Tone	-0.0058	-0.0050	-0.0032	0.0427
	(0.0069)	(0.0071)	(0.0067)	(0.1122)
Gov Tone	0.0018	0.0019	0.0022	0.0638
	(0.0062)	(0.0066)	(0.0063)	(0.1128)
Chair Tone	-0.0001	-0.0045	-0.0061	-0.2856***
	(0.0073)	(0.0078)	(0.0074)	(0.0699)
Stmt Tone	0.0196***	0.0070	0.0027	-0.2078**
	(0.0058)	(0.0067)	(0.0067)	(0.0972)
Min Tone	-0.0041	-0.0116	-0.0194	0.7009**
	(0.0241)	(0.0259)	(0.0237)	(0.3493)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A10: *Reaction of Financial Returns to Positive and Negative Tone, Full Sample, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0141***	0.0161***	0.0150***	0.0637***	0.0083***
	(0.0007)	(0.0008)	(0.0013)	(0.0054)	(0.0020)
PPI			-0.0024**		
			(0.0011)		
CPI	0.0030**				
	(0.0015)				
NHS	-0.0097***	-0.0241***	-0.0320***	-0.0443***	-0.0556***
	(0.0014)	(0.0022)	(0.0030)	(0.0068)	(0.0080)
NFP			-0.0024**		
			(0.0011)		
JC			0.0024***		
			(0.0008)		
RS	0.0071***	0.0021*	0.0044***	0.0079***	0.0107***
	(0.0014)	(0.0011)	(0.0004)	(0.0023)	(0.0014)
GDP				0.0095**	0.0110**
				(0.0039)	(0.0046)
CUR	-0.0133***	0.0042***	0.0054***	0.0048*	0.0096***
	(0.0008)	(0.0009)	(0.0018)	(0.0027)	(0.0034)
ISM	0.0032***		-0.0034***	0.0075**	0.0078*
	(0.0012)		(0.0011)	(0.0029)	(0.0045)
ECI		-0.0106***		0.0068*	
		(0.0009)		(0.0040)	
CS	-0.0050***		0.0048***		
	(0.0010)		(0.0012)		
DGO		-0.0057***			
		(0.0006)			
VIX Index	-0.0097***	-0.0241***	-0.0320***	-0.0443***	-0.0556***
	(0.0014)	(0.0022)	(0.0030)	(0.0068)	(0.0080)
Pos Tone	-0.0148***	-0.0046***	0.0054**	0.0023	0.0084
	(0.0014)	(0.0015)	(0.0024)	(0.0039)	(0.0053)
Neg Tone	-0.0103***	-0.0010	-0.0013	-0.0014	-0.0018
	(0.0008)	(0.0009)	(0.0020)	(0.0036)	(0.0042)
Tone Disp	-0.0046***	-0.0015*	0.0014	0.0028	0.0055*
	(0.0009)	(0.0008)	(0.0012)	(0.0024)	(0.0032)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A11: *Reaction of Financial Returns to Positive and Negative Tone, Full Sample, Long Term*

	5-year	7-year	10-year	S&P 500
Fed Funds	0.0052*			-0.1929***
	(0.0027)			(0.0525)
PPI				-0.1317***
				(0.0435)
NFP	0.0128**	0.0117*	0.0107	
	(0.0056)	(0.0064)	(0.0065)	
RS	0.0130***	0.0135***	0.0165***	
	(0.0021)	(0.0023)	(0.0029)	
GDP	0.0106**	0.0095*		
	(0.0054)	(0.0057)		
UR		0.0051*		
		(0.0030)		
CUR	0.0091**	0.0092**	0.0067*	
	(0.0038)	(0.0038)	(0.0035)	
ISM	0.0105**	0.0127***	0.0140***	0.1329**
	(0.0048)	(0.0049)	(0.0047)	(0.0519)
CS				0.1202*
				(0.0650)
VIX Index	-0.0651***	-0.0691***	-0.0567***	-2.1193***
	(0.0088)	(0.0090)	(0.0084)	(0.1121)
Pos Tone	0.0042	0.0029	0.0032	0.0119
	(0.0060)	(0.0062)	(0.0059)	(0.0931)
Neg Tone	-0.0058	-0.0027	-0.0012	0.2079***
	(0.0048)	(0.0052)	(0.0049)	(0.0631)
Tone Disp	0.0052	0.0055	0.0042	0.0392
	(0.0040)	(0.0041)	(0.0041)	(0.0586)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A12: *Reaction of Financial Market Returns to Average Tone, Post Financial Crisis, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0073***	0.0176***	0.0149***	0.0253***	
	(0.0008)	(0.0025)	(0.0017)	(0.0039)	
PPI		-0.0016***	-0.0024***	-0.0040***	
		(0.0005)	(0.0006)	(0.0015)	
CPI	-0.0055***	0.0028**			
	(0.0021)	(0.0011)			
NFP	0.0189**	-0.0168**	-0.0509***	-0.0578***	-0.0505***
	(0.0086)	(0.0082)	(0.0050)	(0.0132)	(0.0169)
JC			0.0019***	0.0035***	0.0038**
			(0.0005)	(0.0013)	(0.0017)
RS	0.0044***	0.0020	0.0093***	0.0157***	0.0202***
	(0.0011)	(0.0014)	(0.0005)	(0.0019)	(0.0030)
GDP	0.0001	-0.0043***			
	(0.0022)	(0.0012)			
UR		0.0017**	0.0018*		
		(0.0007)	(0.0009)		
CUR	-0.0096***			0.0069**	
	(0.0008)			(0.0029)	
ISM	0.0029***			0.0091**	0.0108*
	(0.0011)			(0.0042)	(0.0058)
CS	-0.0052***	-0.0052***	-0.0026***		
	(0.0008)	(0.0005)	(0.0005)		
DGO	0.0083***	0.0041***	0.0010		
	(0.0014)	(0.0006)	(0.0015)		
VIX Index	0.0277***	0.0079***	-0.0236***	-0.0497***	-0.0460***
	(0.0012)	(0.0013)	(0.0025)	(0.0052)	(0.0072)
Avg Tone	0.0019*	-0.0035***	-0.0008	-0.0014	0.0003
	(0.0010)	(0.0009)	(0.0012)	(0.0027)	(0.0036)
Tone Disp	0.0030***	-0.0002	-0.0001	0.0007	0.0048
	(0.0006)	(0.0007)	(0.0010)	(0.0023)	(0.0035)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A13: *Reaction of Financial Market Returns to Average Tone, Post Financial Crisis, Long Term*

	5-year	7-year	10-year	S&P 500
PPI			-0.0047*	
			(0.0026)	
NFP	-0.0528**	-0.0446*	-0.0396	
	(0.0232)	(0.0249)	(0.0271)	
JC	0.0042*	0.0045*	0.0041*	
	(0.0023)	(0.0025)	(0.0025)	
RS	0.0231***	0.0237***	0.0251***	
	(0.0043)	(0.0049)	(0.0052)	
UR	0.0073**	0.0078*		-0.1316**
	(0.0036)	(0.0041)		(0.0623)
CUR				
ISM	0.0118**	0.0162***	0.0193***	0.4212***
	(0.0054)	(0.0058)	(0.0056)	(0.0824)
VIX Index	-0.0729***	-0.0821***	-0.0649***	-2.2533***
	(0.0100)	(0.0105)	(0.0109)	(0.1357)
Avg Tone	0.0035	0.0038	0.0035	-0.2140***
	(0.0046)	(0.0051)	(0.0049)	(0.0637)
Tone Disp	0.0034	0.0041	0.0030	0.0386
	(0.0051)	(0.0054)	(0.0055)	(0.0798)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A14: *Reaction of Financial Returns to Type Specific Tone, Post Financial Crisis, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0159***	0.0128***	0.0143***	0.0240***	
	(0.0006)	(0.0012)	(0.0018)	(0.0042)	
PPI			-0.0026***	-0.0041***	
			(0.0006)	(0.0015)	
CPI		0.0028**			
		(0.0011)			
NFP		-0.0176**	-0.0491***	-0.0554***	-0.0496***
		(0.0086)	(0.0048)	(0.0133)	(0.0160)
JC			0.0016***	0.0035***	0.0040**
			(0.0006)	(0.0013)	(0.0017)
RS			0.0091***	0.0151***	0.0205***
			(0.0005)	(0.0020)	(0.0031)
GDP		0.0136***			
		(0.0010)			
UR		0.0015*			
		(0.0008)			
CUR	-0.0053***			0.0070**	
	(0.0010)			(0.0028)	
ISM	0.0024***			0.0092**	0.0102*
	(0.0009)			(0.0041)	(0.0057)
ECI		0.0128***			
		(0.0016)			
CS	-0.0054***	-0.0049***	-0.0022***		
	(0.0012)	(0.0006)	(0.0006)		
DGO		0.0037***			
		(0.0007)			
VIX Index	0.0374***	0.0113***	-0.0239***	-0.0484***	-0.0459***
	(0.0012)	(0.0013)	(0.0024)	(0.0055)	(0.0075)
NVP Tone	0.0053***	-0.0022*	-0.0056***	0.0000	0.0011
	(0.0012)	(0.0013)	(0.0012)	(0.0036)	(0.0051)
VP Tone	0.0061***	-0.0036**	-0.0021	0.0007	-0.0031
	(0.0011)	(0.0014)	(0.0023)	(0.0041)	(0.0065)
Gov Tone	-0.0154***	0.0004	-0.0003	-0.0025	-0.0061
	(0.0009)	(0.0015)	(0.0020)	(0.0045)	(0.0061)

	1-month	3-month	1-year	2-year	3-year
Chair Tone	0.0115***	0.0021	0.0063***	-0.0107***	-0.0036
	(0.0015)	(0.0021)	(0.0020)	(0.0039)	(0.0065)
Stmt Tone	0.0177***	0.0013	0.0025	0.0051	0.0071
	(0.0041)	(0.0021)	(0.0042)	(0.0072)	(0.0075)
Min Tone	0.0216***	0.0313***	0.0133	0.0152	0.0378**
	(0.0059)	(0.0050)	(0.0127)	(0.0229)	(0.0181)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A15: *Reaction of Financial Returns to Type Specific Tone, Post Financial Crisi, Long Term*

	5-year	7-year	10-year	S&P 500
NFP	-0.0526**	-0.0441*	-0.0441*	
	(0.0229)	(0.0248)	(0.0248)	
JC	0.0040*			
	(0.0023)			
RS	0.0233***	0.0241***	0.0241***	
	(0.0043)	(0.0050)	(0.0050)	
UR	0.0078**	0.0077*	0.0077*	-0.1364**
	(0.0037)	(0.0042)	(0.0042)	(0.0574)
ISM	0.0115**	0.0165***	0.0165***	0.4401***
	(0.0053)	(0.0058)	(0.0058)	(0.0797)
VIX Index	-0.0738***	-0.0827***	-0.0827***	-2.5597***
	(0.0102)	(0.0107)	(0.0107)	(0.1369)
NVP Tone	0.0028	0.0038	0.0038	-0.1114
	(0.0072)	(0.0074)	(0.0074)	(0.1055)
VP Tone	-0.0012	-0.0012	-0.0012	0.0845
	(0.0093)	(0.0099)	(0.0099)	(0.1463)
Gov Tone	-0.0059	-0.0043	-0.0043	0.1488
	(0.0082)	(0.0090)	(0.0090)	(0.1531)
Chair Tone	-0.0090	-0.0139	-0.0139	-0.7177***
	(0.0089)	(0.0103)	(0.0103)	(0.0750)
Stmt Tone	0.0173*	0.0065	0.0065	-0.9318***
	(0.0092)	(0.0098)	(0.0098)	(0.1507)
Min Tone	0.0905***	0.0722**	0.0722**	0.4502
	(0.0273)	(0.0365)	(0.0365)	(0.4609)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A16: *Reaction of Financial Returns to Positive and Negative Tone, Post Financial Crisis, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0141***	0.0161***	0.0150***	0.0637***	0.0083***
	(0.0007)	(0.0008)	(0.0013)	(0.0054)	(0.0020)
PPI			-0.0024**		
			(0.0011)		
CPI	0.0030**				
	(0.0015)				
NHS	-0.0097***	-0.0241***	-0.0320***	-0.0443***	-0.0556***
	(0.0014)	(0.0022)	(0.0030)	(0.0068)	(0.0080)
NFP			-0.0024**		
			(0.0011)		
JC			0.0024***		
			(0.0008)		
RS	0.0071***	0.0021*	0.0044***	0.0079***	0.0107***
	(0.0014)	(0.0011)	(0.0004)	(0.0023)	(0.0014)
GDP				0.0095**	0.0110**
				(0.0039)	(0.0046)
CUR	-0.0133***	0.0042***	0.0054***	0.0048*	0.0096***
	(0.0008)	(0.0009)	(0.0018)	(0.0027)	(0.0034)
ISM	0.0032***		-0.0034***	0.0075**	0.0078*
	(0.0012)		(0.0011)	(0.0029)	(0.0045)
ECI		-0.0106***		0.0068*	
		(0.0009)		(0.0040)	
CS	-0.0050***		0.0048***		
	(0.0010)		(0.0012)		
DGO		-0.0057***			
		(0.0006)			
VIX Index	-0.0097***	-0.0241***	-0.0320***	-0.0443***	-0.0556***
	(0.0014)	(0.0022)	(0.0030)	(0.0068)	(0.0080)
Pos Tone	-0.0148***	-0.0046***	0.0054**	0.0023	0.0084
	(0.0014)	(0.0015)	(0.0024)	(0.0039)	(0.0053)
Neg Tone	-0.0103***	-0.0010	-0.0013	-0.0014	-0.0018
	(0.0008)	(0.0009)	(0.0020)	(0.0036)	(0.0042)
Tone Disp	-0.0046***	-0.0015*	0.0014	0.0028	0.0055*
	(0.0009)	(0.0008)	(0.0012)	(0.0024)	(0.0032)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A17: *Reaction of Financial Returns to Positive and Negative Tone, Post Financial Crisis, Long Term*

	5-year	7-year	10-year	S&P 500
Fed Funds	0.0052*			-0.1929***
	(0.0027)			(0.0525)
PPI				-0.1317***
				(0.0435)
NFP	0.0128**	0.0117*	0.0107	
	(0.0056)	(0.0064)	(0.0065)	
RS	0.0130***	0.0135***	0.0165***	
	(0.0021)	(0.0023)	(0.0029)	
GDP	0.0106**	0.0095*		
	(0.0054)	(0.0057)		
UR		0.0051*		
		(0.0030)		
CUR	0.0091**	0.0092**	0.0067*	
	(0.0038)	(0.0038)	(0.0035)	
ISM	0.0105**	0.0127***	0.0140***	0.1329**
	(0.0048)	(0.0049)	(0.0047)	(0.0519)
CS				0.1202*
				(0.0650)
VIX Index	-0.0651***	-0.0691***	-0.0567***	-2.1193***
	(0.0088)	(0.0090)	(0.0084)	(0.1121)
Pos Tone	0.0042	0.0029	0.0032	0.0119
	(0.0060)	(0.0062)	(0.0059)	(0.0931)
Neg Tone	-0.0058	-0.0027	-0.0012	0.2079***
	(0.0048)	(0.0052)	(0.0049)	(0.0631)
Tone Disp	0.0052	0.0055	0.0042	0.0392
	(0.0040)	(0.0041)	(0.0041)	(0.0586)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A18: *Reaction of Financial Market Returns to Type Specific Positive and Negative Tone, Full Sample, Short Term*

	1-month	3-month	1-year	2-year	3-year
Fed Funds	0.0063***	0.0114***	0.0136***	0.0338***	0.0084***
	(0.0007)	(0.0007)	(0.0015)	(0.0022)	(0.0020)
PPI			-0.0019*		
			(0.0010)		
CPI	0.0055***				
	(0.0017)				
NHS	-0.0021				
	(0.0016)				
NFP			0.0053*	0.0116**	0.0130***
			(0.0028)	(0.0046)	(0.0043)
JC			0.0024***	0.0028**	
			(0.0008)	(0.0014)	
RS	0.0068***		0.0044***	0.0115***	0.0106***
	(0.0014)		(0.0004)	(0.0013)	(0.0014)
GDP		0.0067***		0.0116***	0.0115**
		(0.0011)		(0.0039)	(0.0045)
CUR	-0.0134***	0.0050***	0.0055***	0.0086***	0.0100***
	(0.0008)	(0.0008)	(0.0018)	(0.0031)	(0.0034)
ISM			-0.0034***	0.0070*	0.0077*
			(0.0011)	(0.0037)	(0.0045)
ECI	-0.0037	0.0073***			
	(0.0024)	(0.0011)			
CS	-0.0048***		0.0048***		
	(0.0013)		(0.0012)		
DGO		-0.0070***		-0.0039**	
		(0.0005)		(0.0019)	
VIX Index	-0.0150***	-0.0207***	-0.0322***	-0.0549***	-0.0562***
	(0.0016)	(0.0023)	(0.0031)	(0.0069)	(0.0079)
Pos NVP	-0.0075***	-0.0024	-0.0046	0.0042	0.0033
	(0.0020)	(0.0024)	(0.0030)	(0.0055)	(0.0070)
Neg NVP	-0.0050*	-0.0011	0.0049	-0.0024	-0.0018
	(0.0027)	(0.0022)	(0.0031)	(0.0058)	(0.0070)
Pos VP	-0.0129***	-0.0086***	-0.0022	0.0012	0.0006
	(0.0017)	(0.0021)	(0.0039)	(0.0063)	(0.0077)
Neg VP	-0.0110***	0.0022	0.0026	0.0078	0.0131
	(0.0024)	(0.0027)	(0.0047)	(0.0082)	(0.0090)
Pos Gov	-0.0184***	-0.0021	0.0155***	0.0228***	0.0201**
	(0.0027)	(0.0024)	(0.0040)	(0.0083)	(0.0098)
Neg Gov	0.0138***	0.0027	-0.0021	0.0017	0.0035
	(0.0009)	(0.0027)	(0.0030)	(0.0057)	(0.0069)

	1-month	3-month	1-year	2-year	3-year
Pos Chair	0.0098***	-0.0024	0.0111**	0.0038	0.0020
	(0.0033)	(0.0030)	(0.0046)	(0.0099)	(0.0112)
Neg Chair	-0.0077***	-0.0066*	-0.0055	-0.0052	-0.0030
	(0.0025)	(0.0036)	(0.0034)	(0.0056)	(0.0075)
Pos Stmt	-0.0091***	-0.0237***	0.0025	0.0428***	0.0435***
	(0.0034)	(0.0031)	(0.0051)	(0.0092)	(0.0116)
Neg Stmt	-0.0746***	-0.0598***	-0.0108***	0.0082	-0.0009
	(0.0017)	(0.0012)	(0.0035)	(0.0053)	(0.0058)
Pos Min	-0.0146	0.0008	-0.0015	0.0088	0.0211
	(0.0196)	(0.0112)	(0.0133)	(0.0242)	(0.0344)
Neg Min	0.0392***	0.0261*	0.0313***	0.0332*	0.0861***
	(0.0061)	(0.0139)	(0.0116)	(0.0183)	(0.0270)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table A19: *Reaction of Financial Market Returns to Type Specific Positive and Negative Tone, Full Sample, Long Term*

	5-year	7-year	10-year	S&P 500
Fed Funds	0.0051*			-0.1671***
	(0.0027)			(0.0528)
PPI		0.0051*		
		(0.0031)		
NFP	0.0128**	0.0117*	0.0106	
	(0.0056)	(0.0064)	(0.0065)	
JC				
RS	0.0129***	0.0132***	0.0160***	
	(0.0021)	(0.0023)	(0.0029)	
GDP	0.0107**	0.0095*		
	(0.0054)	(0.0057)		
UR		0.0051*		
		(0.0031)		
CUR	0.0096**	0.0097**	0.0071**	
	(0.0038)	(0.0038)	(0.0035)	
ISM	0.0101**	0.0123**	0.0137***	0.1329***
	(0.0048)	(0.0049)	(0.0047)	(0.0516)
CS				0.1288**
				(0.0636)
VIX Index	-0.0657***	-0.0710***	-0.0589***	-2.2073***
	(0.0088)	(0.0090)	(0.0085)	(0.1151)
Pos NVP	0.0023	0.0016	0.0030	-0.4423***
	(0.0081)	(0.0081)	(0.0077)	(0.1114)
Neg NVP	-0.0050	-0.0047	-0.0065	-0.1316
	(0.0091)	(0.0092)	(0.0088)	(0.1206)
Pos VP	0.0018	0.0051	0.0070	0.1540
	(0.0099)	(0.0103)	(0.0097)	(0.1547)
Neg VP	0.0142	0.0158	0.0143	0.1246
	(0.0105)	(0.0105)	(0.0101)	(0.1734)
Pos Gov	0.0106	0.0102	0.0090	0.3218
	(0.0112)	(0.0117)	(0.0112)	(0.2002)
Neg Gov	0.0033	0.0029	0.0018	0.0892
	(0.0079)	(0.0084)	(0.0080)	(0.1421)
Pos Chair	0.0004	-0.0022	-0.0028	0.0606
	(0.0127)	(0.0129)	(0.0128)	(0.2340)
Neg Chair	0.0011	0.0067	0.0089	0.5468***
	(0.0093)	(0.0101)	(0.0094)	(0.0711)
Pos Stmt	0.0381***	0.0291**	0.0215	0.9828***
	(0.0127)	(0.0143)	(0.0144)	(0.2579)

	5-year	7-year	10-year	S&P 500
Neg Stmt	-0.0078	0.0037	0.0072	0.7281***
	(0.0070)	(0.0079)	(0.0077)	(0.1102)
Pos Min	0.0512	0.0541	0.0449	0.1926
	(0.0381)	(0.0400)	(0.0402)	(0.6700)
Neg Min	0.0506	0.0653*	0.0707**	-1.0573**
	(0.0326)	(0.0338)	(0.0303)	(0.4141)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Appendix B: Figures

Figure B1: *Federal Reserve Communication Events, May 1999-March 2018*

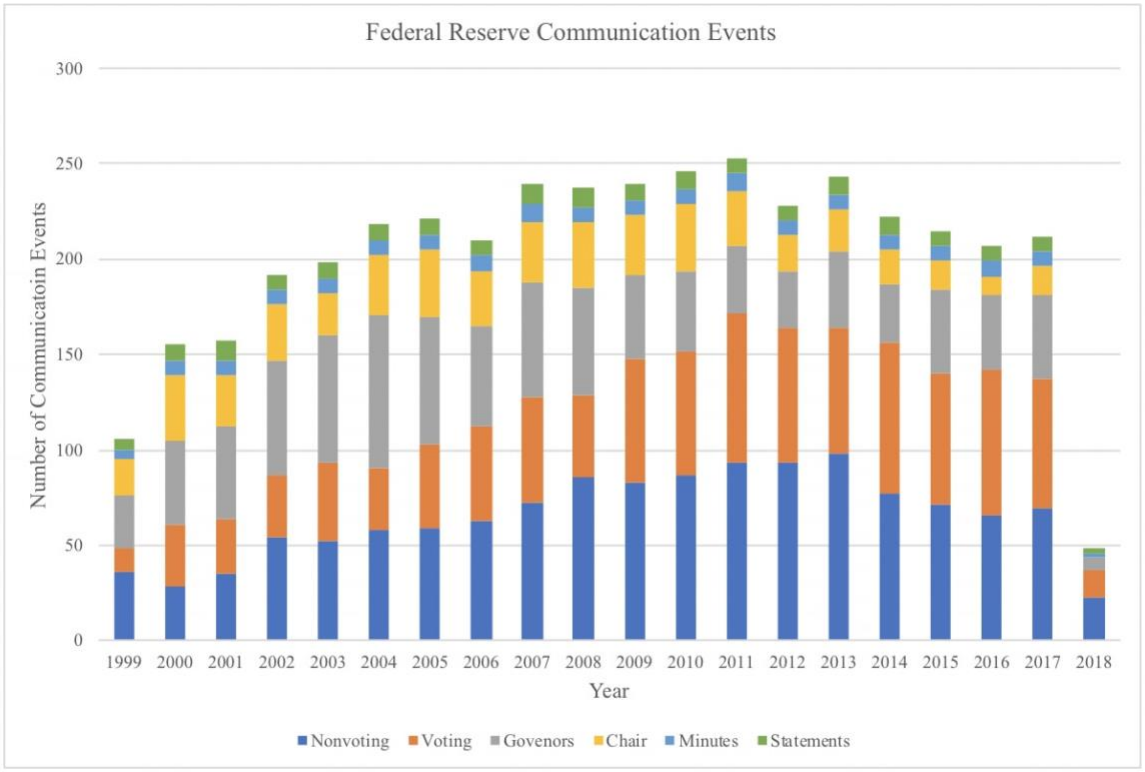
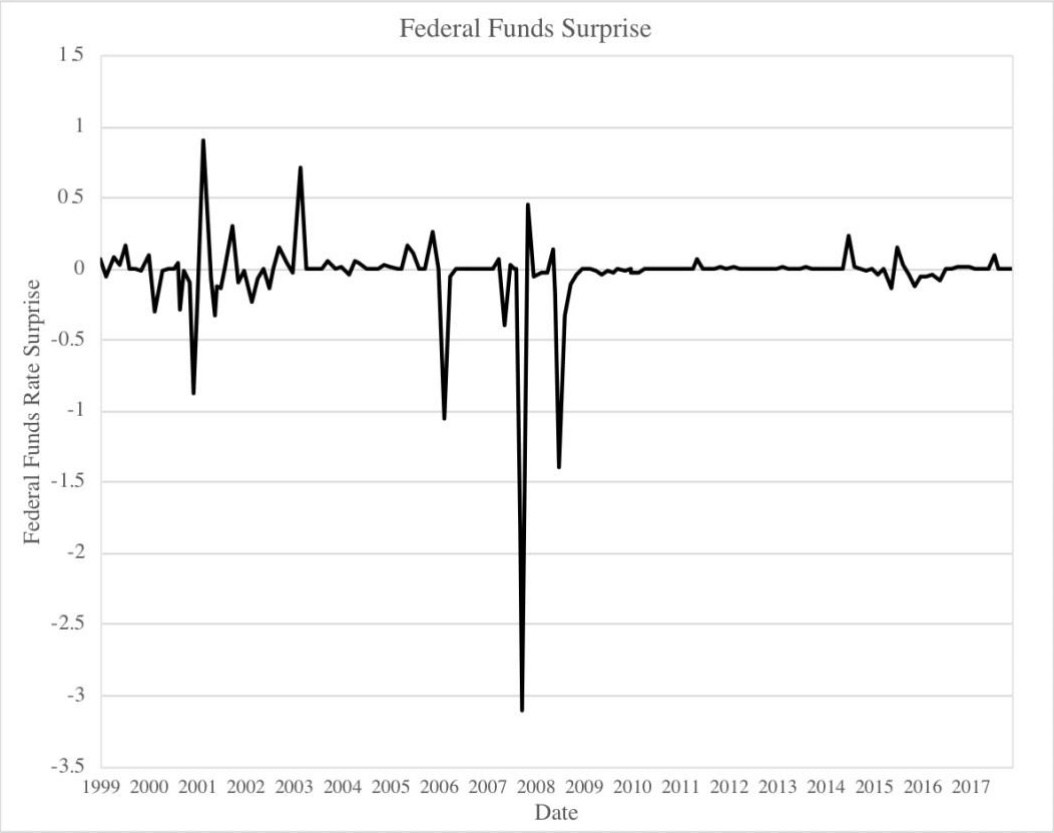


Figure B2: *Federal Funds Rate Surprise, May 1999-March 2018*



Vita

Madison White was born in 1995 in Edmond, Oklahoma. She graduated as class Valedictorian from Edmond Memorial High School in 2013. She then attended Lehigh University and earned a Bachelor of Science from the Integrated Degree in Engineering and Arts and Sciences program with concentrations in computer science engineering and economics in May 2017. She is now completing a Master of Science in Economics through the Presidential Scholarship program and will graduate in May 2018. Starting in Fall 2018, she will work as a Research Assistant at the Federal Reserve Board of Governors.