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How Much Information Do Monetary Policy Committees Disclose? Evidence from the FOMC's Minutes and Transcripts*

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Abstract

The purpose of central bank minutes is to give an account of monetary policy meeting discussions to outside observers, thereby enabling them to draw informed conclusions about future policy. However, minutes are by necessity a shortened and edited representation of a broader discussion. Consequently, they may omit information that is predictive of future policy decisions. To investigate this, we compare the information content of the FOMC's minutes and transcripts, focusing on three dimensions which are likely to be excluded from the minutes: 1) the committee's degree of hawkishness; 2) the chairperson's degree of hawkishness; and 3) the level of agreement between committee members. We measure committee and chairperson hawkishness with a novel dictionary that is constructed using the FOMC's minutes and transcripts. We measure agreement by performing deep transfer learning, a technique that involves training a deep learning model on one set of documents – U.S. congressional debates – and then making predictions on another: FOMC transcripts. Our findings suggest that transcripts are more informative than minutes and heightened committee agreement typically precedes policy rate increases.

Keywords: Central Bank Communication, Monetary Policy, Machine Learning.
JEL Classification: D71, D83, E52, E58.

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1 Introduction

A key decision in central bank communication and transparency is how much information to disclose about the deliberations at the monetary policy meetings. One reason for publishing such information is accountability: as central banks are often largely independent from political influence, they need to be transparent towards the legislature and the public. Another reason is that information about the bank's internal discussions may be a useful input for economic agents when trying to predict future policy and economic developments. If the central bank does disclose this kind of information, it is through the publication of minutes, or accounts, of the policy discussions and possibly of voting records. Some central banks also release meeting transcripts with a delay.[1]

A large and growing body of research analyzes the disclosure of information about central banks' internal discussions. One strand of this literature investigates how increased transparency affects policymakers' deliberations. Two commonly-emphasized issues within this literature are the conformity and discipline effects (Hansen et al., 2018). The former suggests that transparency may lead policymakers to alter their decisions by engaging in herding and conformism. The latter refers to the circumstance under which policymakers may exert more effort, prepare more thoroughly, and engage in more open and transparent communication.[2]

Empirical work on the effects of increased transparency on policymakers' behavior is almost exclusively based on a natural experiment at the Federal Reserve. In 1993 it was decided that the transcripts of previous meetings of the Federal Open Market Committee (FOMC) should be released with a five-year lag.[3] Thus, prior to November 1993, transcripts reflect a discussion where the FOMC members assumed that their individual statements would never be public. After November 1993, the discussion

[1] The Federal Reserve releases transcripts after five years and the Bank of Japan releases them after ten.

[2] See, for instance, Prat (2005) and Swank and Visser (2007) for theoretical work on the conformity effect and Gersbach and Hahn (2012) for theoretical work on the discipline effect. The theory literature also suggests other effects of increased transparency. Instead of causing conformity, transparency may under certain circumstances make policymakers more inclined to dissent (see, for instance, Levy (2004, 2007)). It may also cause the real debate to take place informally, prior to the policy meeting Swank and Visser (2013).

[3] For a detailed discussion, see Lindsey (2003).

was held under the premise that everything each member said during the meeting would be public after five years.

Meade and Stasavage (2008) were the first to exploit this natural experiment empirically. They provide evidence that publishing verbatim transcripts of the FOMC meetings made members more reluctant to offer dissenting opinions, supporting the prediction in the theory literature of increased conformity. More recent work examines the effect of the 1993 natural experiment by using computational linguistics to analyze the FOMC's transcripts, some of which also find support for the conformity effect (Schonhardt-Bailey (2013), Acosta (2015), Egesdal et al. (2015), and Woolley and Gardner (2017)). Hansen et al. (2018) find evidence for both effects, but conclude that the discipline effect dominates.

Another strand of the literature examines how useful a central bank's internal discussion is for predicting its future policy decisions. Gerlach-Kristen (2004, 2009) finds that information on disagreement within the Bank of England's monetary policy committee – as expressed by the voting records – improves predictions of future policy decisions. Minority positions, which are not reflected in adjustments to the policy rate, affect the probability of a rate change at the following meeting. Gerlach-Kristen (2004) also demonstrates that financial markets appear to react to the publication of the voting record, suggesting that it improves central bank transparency. The approach in Gerlach-Kristen (2004) has been applied to a number of other countries, including the United States, Poland, the Czech Republic, Hungary, and Sweden.[4]

Related work examines the predictability of future policy from central bank minutes, rather than voting records. Apel and Blix Grimaldi (2014) use text analysis to measure the sentiment and tone of the Swedish Central Bank's minutes. They then convert it into an index that measures the degree of "hawkishness" and find that this index can be used to improve predictions of future policy decisions. More recent work by Shapiro and Wilson (2019) makes use of transcripts to estimate the FOMC's objective function, including its inflation target.

[4]The voting record approach has been examined in the United Kingdom (Riboni and Ruge-Murcia, 2014; Neuenkirch, 2013; El-Shagi and Jung, 2015b), United States (Horváth and Jonášová, 2015; Gerlach-Kristen and Meade, 2010; Horváth et al., 2012; Jung, 2016), Poland (Sirchenko, 2011; Horváth and Jonášová, 2015), the Czech Republic (Horváth and Jonášová, 2015), Hungary (Horváth and Jonášová, 2015), and Sweden (Horváth and Jonášová, 2015; Riboni and Ruge-Murcia, 2014).

Our work has implications for the aforementioned literatures and is most closely related to research that attempts to predict central bank decision-making. Like most of the empirical work on the effects of increased transparency, we make use of the FOMC transcripts, but focus on a novel dimension: that minutes represent a deliberate and strategic choice of how much information to disclose about the deliberations of monetary policy meetings – that is, in effect, a choice of how much the transcripts should be edited before being published as minutes.

In practice, central bank minutes come in many different shapes and forms, from brief summaries to very detailed accounts of policy discussions. Only a few central banks publish both minutes and exact transcriptions of the discussion during the monetary policy meeting. The fact that the Federal Reserve does provides a unique possibility to exploit and gain insights from the differences between minutes and the transcripts.

The informational consequences of releasing only an edited version of the policy discussion remains understudied. In fact, the only other work we are aware of that compares FOMC minutes and transcripts from an informational point of view is Acosta (2015), which attempts to quantify the procedural transparency of the FOMC over time. By comparing minutes to transcripts using latent semantic analysis, he investigates how the Fed responded to demands for increased transparency. He finds that transparency at the FOMC had generally been increasing since 1976, but the 1993 decision to publish the transcripts improved transparency significantly. He also confirms earlier work that suggests that conformity increased once the meetings were made more public.[5]

Our analysis in this paper is related to the transparency literature, but we ask a different research question: Are minutes as informative as transcripts or is information that is useful for predicting monetary policy filtered away in the editing process? That is, do minutes actually portray all the pertinent information from the monetary policy discussion? We focus specifically on three dimensions where transcripts are likely to contain more information than minutes: the committee's degree of hawkishness, the chairperson's degree of hawkishness, and the level of agreement among committee members.

[5]See, for example, Meade and Stasavage (2008) and Woolley and Gardner (2017).

For the measure of hawkishness, we develop a new dictionary that is constructed using the FOMC's minutes and transcripts for the purpose of analyzing central bank texts. It is a substantially extended version of the dictionary introduced in Apel and Blix Grimaldi (2012), which is commonly used in work on central bank communication. The purpose of the modifications is to construct a measure that is well-suited to the analysis of central bank minutes and transcripts.[6]

The measure of committee agreement is constructed using deep transfer learning, which is a technique we import from the machine learning literature. The advantage of using transfer learning is that it can be applied without pre-labelling instances of agreement in our dataset. Furthermore, it will also work in cases when the dataset is insufficiently large to train a deep learning model. In our case, the transcripts from FOMC discussions were not annotated to indicate instances of agreement and disagreement. Annotating them to include such labels would be prohibitively costly and might still yield an insufficiently large dataset. For this reason, we instead train a deep learning model to predict agreement using a U.S. congressional debate corpus that contains labels and is sufficiently large. This corpus is an ideal choice because it associates speech text with a vote that indicates whether a speaker is agreeing or disagreeing with a bill.

After training the deep learning model to achieve high out-of-sample prediction accuracy, we then use it to classify text from FOMC transcripts, giving us a novel measure of committee agreement. Beyond this specific application, the technique we import from the machine learning literature can be used for a large variety of text analysis tasks in economics where the data available is unlabelled or insufficient for model training.

Our analysis yields three main results. First, we show that the net hawkishness of both minutes and the chairperson's contribution to transcripts is a statistically significant predictor of future easing and tightening, even after controlling for the inclusion of minutes, lagged policy, macroeconomic and financial variables, and expectations about future inflation. Increased net hawkishness in both the minutes and chairperson's text is associated with future tightening and decreased net hawkish-

[6]We complement the dictionary introduced by Correa et al. (2017), which can be used to analyze central bank communication, but is focused on the discussion of financial stability topics.

ness is associated with easing. This suggests that our dictionary is able to extract meaningful information about the committee's policy inclination.

Second, we demonstrate that the net hawkishness of the transcripts provides additional information about the committee's policy inclination that is not contained in the minutes or the chairperson's text. In particular, including the transcripts in our specification renders both the minutes and chairperson's contribution to the transcripts statistically insignificant. This finding is robust to 1) alternative specifications for the controls; 2) the inclusion of quantitative easing (QE) in the dependent variable; 3) the removal of the zero lower bound (ZLB) period from the sample; 4) the use of hawkishness as a measure of policy inclination, rather than net hawkishness; and 5) the treatment of the dependent variable as categorical, rather than ordinal.

Third, we find that agreement – which can only be identified via transcripts – tends to rise prior to monetary tightening. We speculate that this could be a consequence of asymmetrically negative media coverage of contractionary monetary policy. To further examine this hypothesis, we perform a robustness test in which we use a model where the dependent variable is treated as categorical, rather than ordinal. We find a substantial increase in both the magnitude and significance of agreement as a predictor for future tightening and a corresponding decrease in significance for agreement as a predictor of easing.

In addition to the statistical significance of our results, we also evaluate their economic significance. We find that a one standard deviation increase in the net hawkishness of transcripts is associated with a 0.14 increase in the probability of tightening. Similarly, a one standard deviation increase in agreement is associated with a 0.11 increase in the probability of tightening. During the period between 2003 and 2005, for example, the strong rise in both agreement and net hawkishness implied a 0.56 increase in the probability of a tightening. Over the same period, the target federal funds rate rose by 400 basis points.

The rest of the paper is organized as follows. Section 2 describes how we measure committee hawkishness, chairperson hawkishness, and committee agreement. Section 3 discusses the estimation problem, introduces our regression specification, and provides descriptive statistics. Section 4 presents the main results, along with a set of robustness checks, and Section 5 concludes.

2 Measurement

In this section, we will discuss the three text-based measures of policy inclination we construct and use in this paper. The first two capture net hawkishness using a novel dictionary-based method, which is based on an extended version of Apel and Blix Grimaldi (2012) and is designed to extract the latent policy inclination contained in FOMC minutes and transcripts. The first measure applies the dictionary to the entire minute and transcript texts. The second one restricts the application to the chairperson's text within the transcripts. Finally, the third measure captures committee agreement, which is constructed by performing transfer learning on U.S. congressional debate texts.

2.1 Committee Hawkishness

We propose an updated and substantially extended version of the Apel and Blix Grimaldi (2012) dictionary, which is commonly used for analyzing central bank communication. One aim of the dictionary was to provide a tool for measuring the extent to which a central bank text or speech was predominantly hawkish or dovish – that is, whether the implicit or explicit message, the policy inclination, leans toward tightening or loosening policy. This differs from standard dictionaries, which are not tailored to central bank texts and, as such, do not capture policy inclination.

Apel and Blix Grimaldi (2012) has been employed in a variety of work in recent years. Hansen and McMahon (2016) couple it with topic modeling and use it to measure the tone of a number of topics in the FOMC statements related to economic activity. They then investigate the effect of a shock to measures of tone on different economic variables. Bennani and Neunkirch (2017) use an extended version of the dictionary to measure the tone of speeches by members of Governing Council of the ECB. They then analyze the determinants of this tone to examine whether national or euro area concerns are more important. Hubert and Labondance (2017) use the dictionary to quantify the tone conveyed in FOMC policymakers' statements and estimate the impact of FOMC sentiment on the term structure of private interest rate expectations. Malmendier et al. (2017) use it to measure the tone of the speeches of all FOMC members since 1951. They investigate if personal experiences of infla-

tion influence members' hawkish or dovish leanings. They find, among other things, that members' lifetime experiences of inflation explain their voting decisions and the hawkishness of the tone of their speeches.[7]

Our updated and revised version of Apel and Blix Grimaldi (2012) partitions the dictionary into three topic sections, each of which has direct relevance for part of the Fed's dual mandate: 1) inflation; 2) economic activity; and 3) employment. We then compute the set of most frequently used unigrams and bigrams terms in the minute and transcript texts, and associate those that are policy relevant with a dictionary topic. We next select the modifiers that are most frequently used in the same sentence as each term to determine whether it was used in a hawkish or dovish context. For example, for "inflation," we pick modifiers such as "rising" and "accelerating." Some terms are substrings of others, such as "inflation" is a part of "core inflation." We count these cases as a single instance. The full dictionary is presented in the Appendix.

For every transcript and set of minutes, we compute the number of occurrences of all term-modifier combinations in the dictionary. We count not only the instances where the term and modifier are adjacent – for example "lower inflation" – but also allow them to be separated by up to seven words within the same sentence. For example, "...expect inflation to be lower..." will also be counted. We also evaluated shorter windows, but found that a 7-word window best captured the relationship between modifiers and terms without adding substantial noise to the series.

We then compute a net hawkishness index for each transcript and set of minutes following the methodology for latent semantic indices, as is described for news stories in Birz and Lott (2011). Our specification is shown in equation (1), where $hawk_t$ and $dove_t$ are the total number of hawkish and dovish combinations in a given document. The raw series for the minutes, transcripts, and chairperson – which we discuss in the following subsection – are shown in Figure 1. Figure 2 shows the rolling percentage

[7]Another direction of research tests the Apel and Blix Grimaldi (2012) dictionary against other dictionaries and approaches. Hubert and Labondance (2017) find that it compares favorably to others. Picault and Renault (2017), on the other hand, find that the Bennani and Neunkirch (2017) extension of the dictionary does a worse job of predicting the ECB's policy decisions after mid-2011. They instead propose an approach where the single dove-hawk index is replaced by two indexes – one for monetary policy and one for the economic outlook.

difference between the measure for transcripts and minutes.[8] FOMC meetings typically occurred every 5 to 8 weeks over our sample period. We plot the percentage differences using a rolling window to highlight the divergence in trends between the two measures.

$$net\_hawishness_t = 1 + \frac{hawk_t - dove_t}{hawk_t + dove_t} \tag{1}$$

The transcript and minute indexes follow each other quite closely in most periods, suggesting that the latent policy inclination captured by the two types of documents is qualitatively similar. The most substantial differences appear to emerge in the form of increased transcript hawkishness during the recovery that followed the 2001 recession and prior to the 2007-2009 financial crisis, as well as increased dovishness prior to the 2001 recession.

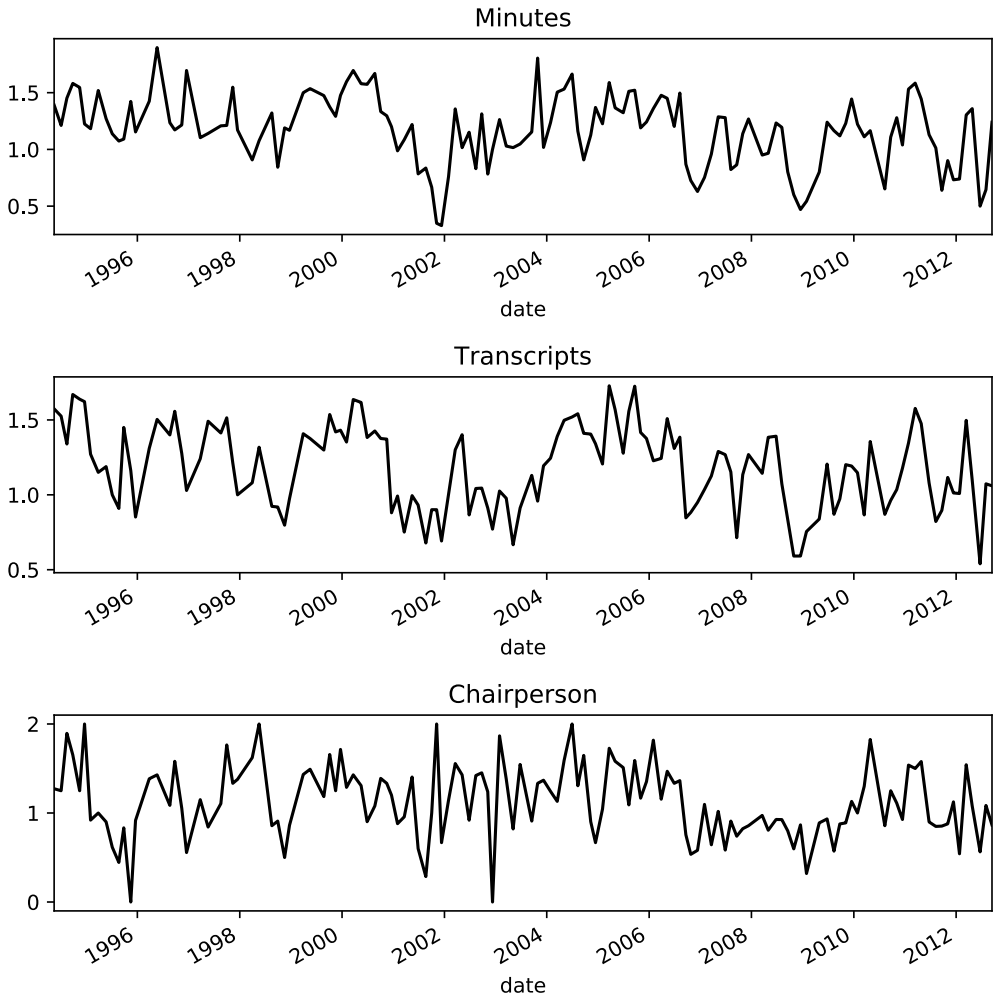
2.2 Chairperson Hawkishness

One branch of research we previously discussed involves the role of the chairperson in monetary policy committee deliberations. In our case, it is possible that the predictive power of the chairperson's hawkishness might be diluted by averaging it together with the entire committee. Gerlach-Kristen (2008), for instance, finds that the chairperson may help reduce the uncertainty about the optimal level of interest rates and thus bring about larger majorities. Interest rate setting is generally worse in an autocratically collegial committee than in an individualistic committee, but the difference in quality is quantitatively small.

Claussen et al. (2012) offer a theory of why the chairperson is rarely found on the losing side of a vote. In their model, it is optimal to give the chairperson more agenda-setting power when there is overconfidence in the committee. This implies that she will almost never lose a vote. Beyond this, a number of empirical studies have investigated the impact of the chairperson of the Federal Reserve, such as Chappell et al. (2004, 2007a,b), Gerlach-Kristen and Meade (2010), and El-Shagi and Jung (2015a).

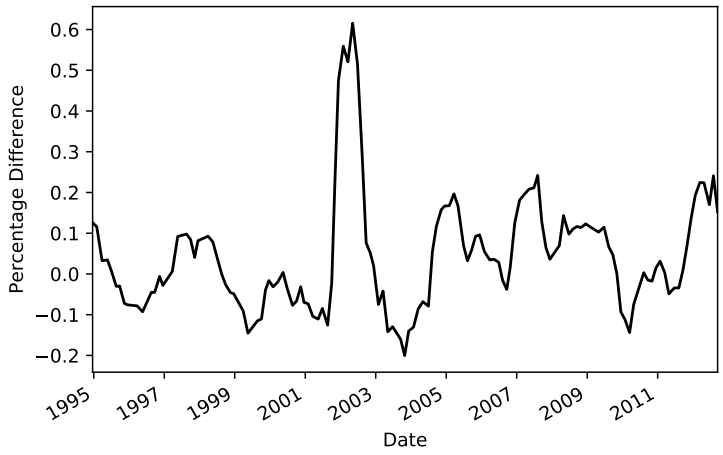
[8] Following Henry and Leone (2010), we have adopted an equally-weighted specification to compute our two basic measures, so that each entry has the same weight of any other entry.

Figure 1: Hawkishness of Minutes, Transcripts, and Chairperson



Notes: The plot above shows the hawkishness series for the text extracted from the minutes and transcripts, as well as the subset of the transcripts that contains the chairperson's speech.

Figure 2: Rolling Percentage Difference Between Transcript and Minute Index Levels



Notes: The plot above shows the rolling average of the percentage difference between transcripts and minute index levels. The underlying series contain one observation per FOMC meeting. There are typically eight FOMC meetings per year with an interval of 5 to 8 weeks between each.

Overall, the evidence suggests that the chairperson does have a disproportionately large influence on the decisions of the FOMC; however, most studies have focused on chairpersons up until Alan Greenspan. When Ben Bernanke took over after Greenspan in 2006, he introduced a less autocratic style of leadership. For example, during the policy meetings, he reportedly waited to speak and voted last.[9]

Evidence of the impact of the chairperson in other countries is scarcer. Empirical work in Chappell et al. (2014) using British and Swedish voting records suggest that the governor has little influence over other members at the Bank of England, while he is highly influential at the Riksbank. The later result is at odds with the evidence in Apel et al. (2015), who asked serving and former board members of the Riksbank about their perspective on different issues in the literature, including – among other things – the role of the chairperson. They did not give much support to statement that the governor has more influence over forecasts and other materials, or that the governor can influence the policy decision by steering the discussion. This is in line with the Riksbank's board members being individually accountable and the

[9]See Blinder (2009)

perception that the committee is individualistic.

Some chairpersons are more likely to have had a significant impact on the committee's decisions, but it is probably difficult to draw any general conclusions. The influence of the chairperson is likely to vary, not only between countries, but also from chairperson to chairperson, depending on personal characteristics and preferences. We test for the influence of the chairperson by identifying all instances in which she speaks during FOMC meetings. We then apply the novel dictionary that we introduce in this paper to recover his latent policy position or "hawkishness."[10]

2.3 Committee Agreement

The existing literature has shown that disagreement and dissent in voting records may help predict future monetary policy. However, the full extent of disagreement is unlikely to be captured in voting records, since dissents are relatively rare, especially among members of the Board of Governors (Thornton and Wheelock, 2014). To the contrary, text-based measures of disagreement or agreement based on FOMC transcripts offer a more complete picture and may contain subtler clues about differences in opinion between members of the committee.[11]

As Gentzkow et al. (2019) discuss in their survey of text analysis, dictionary-based methods dominate work in economics; however, dictionary-based methods are unlikely to be the correct tool for measuring agreement, since they only perform well relative to other methods when the researcher has a strong prior about the data and the data itself is mostly uninformative. Gentzkow et al. (2019) cite work on economic policy uncertainty as an ideal example of when to apply dictionary-based methods. In this case, Baker et al. (2016) knew in advance what they wanted to measure in newspaper data; however, it was unlikely that performing topic modeling on such texts would yield economic policy uncertainty as a topic. Consequently, they constructed a dictionary that was ideally suited to measuring it. This is also true for text-based measures of central bank hawkishness, such as the dictionary we introduce

[10]Most of the observations in our sample period cover the period of Chairman Alan Greenspan. Therefore, the chair will mainly reflect his autocratic leadership.

[11]Meade (2002), for instance, finds anecdotal evidence of disagreement in transcripts that does not immediately manifest itself in the form of voting outcomes.

in this paper, where common terms are used to describe macroeconomic phenomena and policy positions.

Gentzkow et al. (2019) argue that alternative methods, such as text regression, might be better suited to tasks such as the one we consider. In our case, however, we do not have labelled text data: the transcripts and minutes do not indicate instances of agreement between committee members. Furthermore, performing our own annotations on a sufficiently large dataset would be prohibitively costly. Thus, we do not have a dependent variable that captures the degree of agreement between committee members that we can use in a text regression. For this reason, we follow a different approach by performing deep transfer learning on a related dataset in which natural measures of agreement are available. This allows us to measure agreement in FOMC transcripts without first obtaining labels for agreement in FOMC transcripts.

More specifically, we employ a "transductive" form of transfer learning, which was first formalized by Arnold et al. (2007). Pan and Yang (2010), which provides an early survey of the transfer learning literature, offers the following definition:

> Given a source domain D_S and a corresponding learning task T_S, a target domain D_T and a corresponding learning task T_T , transductive transfer learning aims to improve the learning of the target predictive function $f_T()$ in D_T using the knowledge in D_S and T_S, where $D_S \neq D_T$ and $T_S = T_T$.

In our case, D_T is the corpus of FOMC transcripts and T_T is the task of predicting agreement in those transcripts. Since we do not have labels for D_T, it is not possible to train $f_T()$ directly. Consequently, we instead train $f_S()$ with D_S and then transfer the learned relationships to $f_T()$. Our source domain consists of a dataset of annotated U.S. congressional debates, which was introduced by Thomas et al. (2006). Each observation in this dataset consists of a congressperson's statement about a bill, coupled with an indicator for whether he or she supported or opposed the bill.

Next, we specify the functional form for $f_S()$. Since we do not know which features of the text are likely to capture agreement, we will employ a deep learning model that can learn both the features themselves and the relationship between those features and agreement.[12] More specifically, we use a neural network with a long short-term

[12]In contrast to "shallow" learning, where the econometrician specifies the set of variables or

memory (LSTM) architecture and word embeddings. For an overview of word embeddings, see Gentzkow et al. (2019), which covers them outside of the context of deep learning models.

The deep learning model we use takes sequences of word vectors and converts them into integer indices, which are used as inputs. Each integer is then mapped to a dense vector in a word embeddings layer. The embeddings layer enables the model to learn dense, low-dimensional representations of words from sparse, high-dimensional inputs. The dense representations allow the model to capture relationships between words based on the context in which they are used. For instance, the dense vector representation of the word "inflation" is likely to be located close to the representation of the word "price." This differs from the sparse representation, where inflation and price will be captured by orthogonal vectors.

The embeddings are then connected to a layer of long short-term memory (LSTM) cells. These are a type of recurrent neural network (RNN) cell that processes sequences of dense word vector representations. The advantage of LSTM cells over simpler RNN cells is that they correct for a common numerical problem in the training process.[13] Finally, we flatten the output of the LSTM cells into a vector and connect them to the output layer via a dense layer. We use a binary crossentropy loss function and encode "agree" as 1 and "disagree" as 0. We use the adaptive moment (Adam) optimizer and train the model on 80% of our training sample while using the remaining 20% for validation purposes. We terminate the training process, which is shown in Figure 4, when out-of-sample performance begins to degrade around the 55th epoch.[14] Furthermore, note that we cannot overfit $f_T()$, since the learned relationships are transferred from a different domain.

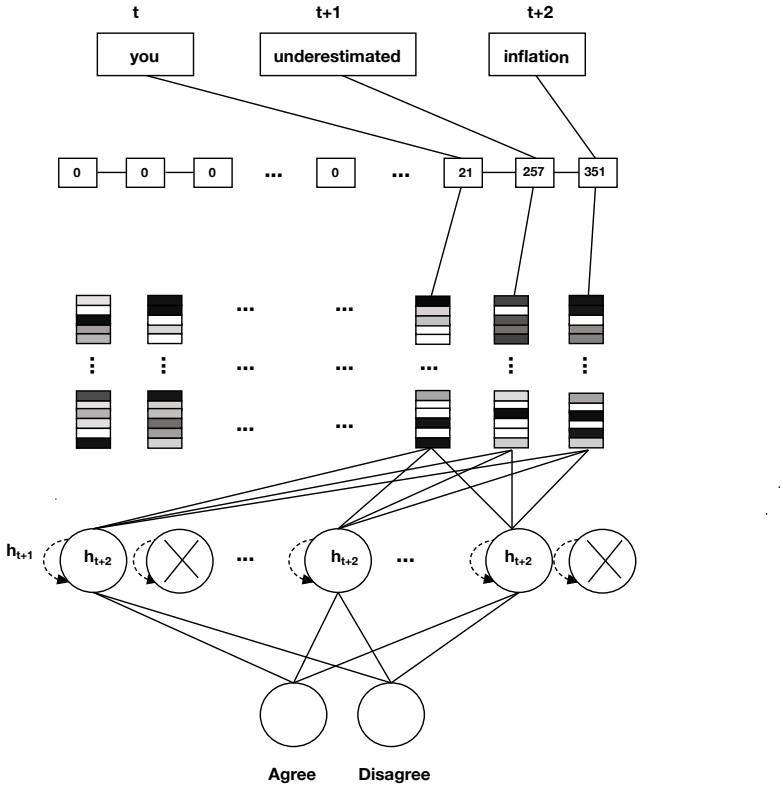
The model's accuracy reaches 68% in-sample and 65% out-of-sample; however,

"features," deep learning uses the input variables to create successively higher level features. Thus, deep learning both discovers the relevant features and estimates their relationship with the dependent variable or target.

[13]We use a sequence length of 100 words and pad shorter statements with zeros.

[14]We also use rectified linear unit activation (relu) functions on all hidden layers and apply 25% dropout to the final dense layer. Relu activation functions are the most common choice in the deep learning literature. They introduce nonlinearities into the model, but do not increase the training time as much as sigmoid or hyperbolic tangent activation functions. Dropout drops all edges that connect to randomly-selected nodes during the training process to reduce reliance on certain features. This forces the model to learn more robust relationships, which prevents overfitting.

Figure 3: Long Short-Term Memory Model Architecture



Notes: The figure above shows the architecture for a long short-term memory model (LSTM), which we use to perform transfer learning. The model first takes words represented by sparse vectors as inputs. It translates these into integers, which are then mapped to word embeddings. The word embeddings are then connected to a layer of LSTM cells, which sequentially process the embeddings. Finally, they are connected to a dense output layer. The model's output is the probability that the input sequence contains an input sequence in which the speaker is agreeing, rather than disagreeing.

these values are derived from the classification of all statements, whether or not they contain signs of agreement. In many cases, the model is roughly indifferent for such statements and generates a probability of agreement near 0.50. If we exclusively retain predictions for cases where the model is not approximately indifferent, accuracy rises substantially; however, we chose to include such cases, since we intend to assign probabilities to all text in FOMC transcripts. This allows many neutral statements in a transcript to dilute the impact of a handful of extreme statements.

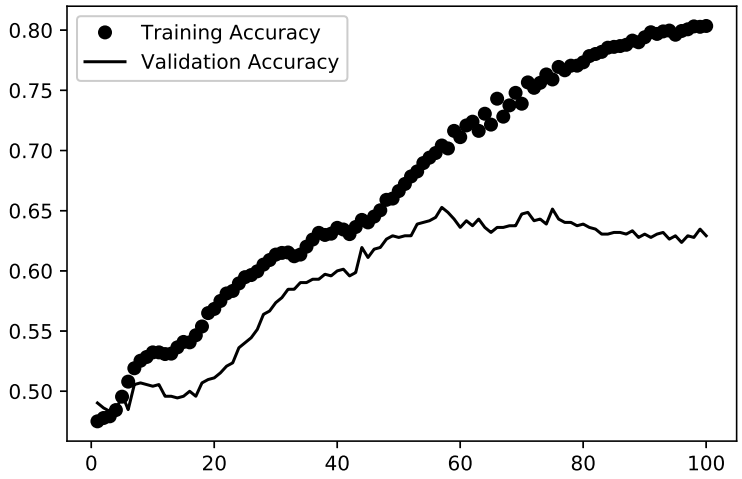
After terminating the training process, we use the estimated model to generate probabilities of agreement for each transcript. We do this by using the model to predict a probability of agreement for each FOMC member's statements. We then average over the statements to compute a mean probability for an entire transcript. The measure that we construct is shown in Figure 5. One interesting feature of our text-based measure of agreement is that it tends to rise prior to and during rate hikes, suggesting that it may be important to build a strong consensus while raising rates. We speculate that this may be related to media coverage, which tends to be more critical for federal funds rate increases.

The statements below are given as examples of the model's classification decisions. The first is taken from the training set and was classified as capturing agreement. Note that the classification is based on the first 100 words of the statement; however, the final words, which were not classified, indicate that the observation was correctly classified. The second is taken from the test set and was also classified as capturing agreement.

> ***Train Set:*** *I thank the gentleman for yielding me this time and for his great work on this bill. Mr. chairman, this country needs to create a new energy landscape that begins shrinking our disproportionate reliance on foreign energy sources and begins building one that places American ingenuity, producers and consumers at the forefront. I want to highlight one provision and that is the provision that significantly strengthens the important leaking underground storage tank program. The bill increases state funding... I urge their support and the support of the bill.*

> ***Test Set:*** *Based on research from my staff, I have also lowered my esti-*

Figure 4: Training and Validation Accuracy



Notes: The plot above shows accuracy in the training and validation sample over 100 epochs. Around the 55th epoch, accuracy in the training set continues to improve while accuracy in the validation set does not. We use the model parameters from the 55th training epoch.

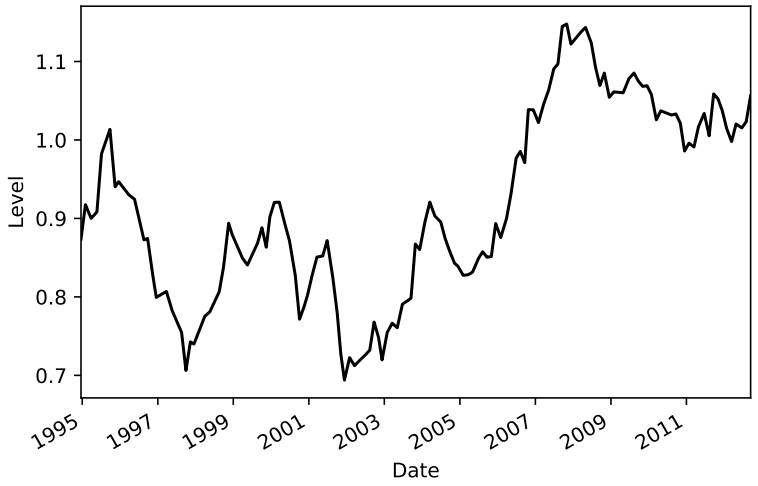
> *mate of ... real gdp growth ... reflecting lower expectations of trend growth for both the labor force and labor productivity.*

As far as we are aware, we are the first to use deep transfer learning in the economics literature. While our application is focused narrowly on measuring agreement in central bank transcripts, the exact same approach could be used to extract features from a variety of corpuses when the data available is unlabelled or insufficient for model training.

3 Empirical Section

In the previous section, we discussed how we measured three variables of interest in central bank texts: 1) the committee's hawkishness; 2) the chairperson's hawkishness; and 3) the level of committee agreement. In this section, we will determine whether those variables have any predictive value and, ultimately, whether the transcripts

Figure 5: Rolling Measure of Agreement



Notes: The plot above shows the 6-month rolling average of FOMC member agreement, measured using transcripts. We construct a deep learning model to predict agreement in U.S. congressional debates. We then use the model to predict agreement in FOMC transcripts.

contain information about future policy that is not included in the minutes and cannot be captured by macroeconomic and financial controls.

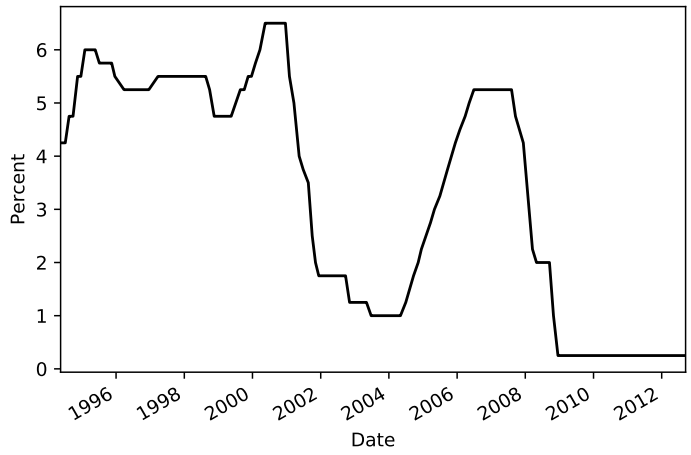
3.1 Baseline Specification

To assess how informative FOMC minutes and transcripts are about future policy, we estimate the baseline specification shown in equation (2). We use an ordered probit, where our dependent variable is a discrete measure of policy decision, $Policy_t$, which can take three values: -1 for a monetary policy easing; 0 for no change; and +1 for a monetary tightening.

$$\begin{aligned} Policy_t = \alpha + \beta_1 Transcripts_{t-1} + \beta_2 Minutes_{t-1} \\ + \beta_4 Agreement_{t-1} + \beta_5 Chair_{t-1} + \beta_6 X_{t-1} \end{aligned} \tag{2}$$

Note that $Transcripts_{t-1}$ is the level of the net hawkishness index for the tran-

Figure 6: Target Federal Funds Rate



Notes: The plot above shows the target federal funds rate (TFFR) over the 1993-2012 period. The dependent variable in most of our empirical exercises is a transformation of the TFFR. We use -1 to denote a decrease in the TFFR, 0 to indicate no change, and +1 to indicate an increase.

scripts, $Minutes_{t-1}$ is the level of the net hawkishness index for the minutes, $Agreement_{t-1}$ is a measure of agreement among committee members, $Chair_{t-1}$ is a measure of the chairperson's net hawkishness, and X_{t-1} is a vector of controls.

Our sample period is 1993–2012, which includes the 2001 recession, as well as the 2007-2008 global financial crisis. The target federal funds rate (TFFR) for this period is shown in Figure 6. During the financial crisis, changes in monetary policy were first implemented through the conventional channel of changing the target federal funds rate. When the federal funds rate was lowered to 0.25 percent and thus came close to the previously presumed lower bound of zero, the Fed continued to stimulate the economy through purchases of assets and securities in a series of programs, known as quantitative easing (QE) or unconventional monetary policy. In our baseline specification, $Policy_t$ reflects changes in the federal funds rate; however, in robustness exercises, we incorporate quantitative easing (QE).

In the wake of the financial crisis, the Federal Reserve implemented three QE programs, which are described in Table 1. In late 2008 and early 2009, the Federal Reserve purchased over $1.25 trillion of long-term government bonds and mortgage-

backed securities, a step subsequently labelled QE1. In November 2010, the FOMC announced additional purchases, QE2; and, in September 2012, the FOMC launched a third program of monthly purchases of Treasury bonds and mortgage-backed securities, QE3.[15] In September 2011, the Federal Reserve announced that it would buy long-dated treasury bonds financed by the sale of short-term bonds. This program, called Operation Twist, lasted until December 2012.

Table 1: Timeline of the Federal Reserve QE programs

Program	**Dates**	**Value**	**Instruments**
QE1	November 2008 – March 2010	$1.25 trillion	Long-term Treasury securities, agency securities, and mortgage-backed securities
QE2	November 2010 – June 2011	$600 billion	Long-term Treasury securities
Operation Twist	September 2011 – December 2012	-	Fed sold short-term and bought long-term securities
QE3	September 2012 – October 2014	$40 billion	Mortgage-backed securities
QE4	December 2012 – October 2014	$45 billion	Long-term Treasury securities

During our sample period, the FOMC held 136 meetings. The interest rate was increased in 26 meetings: 21 times by 25 basis points (bps), four times by 50bps, and one time by 75bps. The FOMC decreased the policy rate seventeen times: five times by 50 basis points and one time by 100 basis points. Note that our dependent variable, $Policy_t$, captures the decision to ease or tighten policy and does not distinguish between degrees of easing and tightening. This is also true in the robustness exercises, where any form of QE is denoted simply as a decision to ease without explicitly taking the size of the program into account.

3.2 Controls

The objective of this paper is to test whether transcripts contain information that is not included in minutes and is informative for the purpose of forecasting policy decisions. The weak version of this hypothesis could be tested without controls. It would be sufficient to demonstrate that transcripts contain information that is not carried over to the minutes. The stronger version requires the inclusion of controls to demonstrate that transcripts not only provide information not contained in minutes,

[15] Unlike the two previous programs, the Federal Reserve did not announce when the QE3 would end or its ultimate size. In December 2013, it began its "tapering off."

but also provide predictive value beyond what could be achieved with the minutes and other publicly available information. We test the stronger version of the hypothesis.

To control for economic information available at the time of the monetary policy decision, we add a set of variables, X_{t-1}, to our specification in equation (2). If FOMC communication – in the form of either transcripts or minutes – does not add any additional information to macroeconomic and financial data, then neither one of the two indices should have any predictive power for the monetary policy decision. To the contrary, if our measure of hawkishness does convey relevant information, then we expect to find a positive association with rate increases. More hawkish (dovish) communication content, i.e. an increase (decrease) in the net hawkishness index, should be associated with a more hawkish (dovish) monetary policy stance.

Our aim is to capture a broad spectrum of dynamics that are relevant to monetary policy decisions and therefore relate to both macroeconomic variables and financial markets. For this reason, we include forward looking data, such as inflation expectations, as controls. We also use nonfarm payroll employment, which is perceived to be one of the best indicators of future developments. Strong nonfarm payroll employment numbers are generally associated with buoyant economic conditions and could trigger a more hawkish stance. Inflation expectations are central to the conduct of monetary policy and are highly relevant for policy decisions. Higher inflation expectations are usually also associated with a more hawkish stance.

With respect to financial variables, we include both house price growth and stock price growth. Historically, monetary policy would not be expected to react to developments in housing prices beyond taking into account their implications for inflation and output growth.[16] However, the experience from the global financial crisis has revived a debate about whether or not central banks should react to house prices.[17] Asset prices – including house prices – are not discussed in the Federal Reserve's dual mandate, but it is clear that swings in house prices may have implications for the transmission of monetary policy independently of their direct impact on inflation. As such, they can affect the policy makers' stance.[18]

[16]In addition, house prices have historically tended to move with output growth and inflation.
[17]See, for instance, Kashkari (2017).
[18]See, for instance, Bernanke (2007).

Stock prices are among the most closely monitored asset prices in the economy and are commonly regarded as highly sensitive to economic conditions. In addition, as Bernanke and Kuttner (2005) point out, market participants tend to view the stock market as an independent source of macroeconomic volatility to which policymakers may wish to respond.

Finally, we include lagged transformations of the policy rate to control for monetary policy smoothing. In the baseline specification, we include the lagged target federal funds rate. In a separate robustness check, we use an alternative specification with the lagged first difference in the target federal funds rate instead.

3.3 Descriptive Statistics

We have now introduced the three measures of policy inclination we employ in this paper, along with the set of controls we include in our regressions. The descriptive statistics for the dependent variable and controls are given in Table 2. And the descriptive statistics for the measures of policy inclination are given in Table 3.

Table 2: Descriptive Statistics: Controls and Dependent Variable

	Policy	Inflation	Nonfarm Payrolls	House Prices	Stock Prices	Inflation Expectations
Mean	0.03	3.07	1.27	5.10	11.34	2.99
Std	0.60	1.49	2.20	8.50	19.44	0.62
25%	0.00	2.26	-0.02	-0.38	-1.019	2.70
50%	0.00	3.02	2.03	5.34	15.34	3.00
75%	0.00	4.27	2.87	10.31	24.99	3.20
Count	136	136	136	136	136	136

Notes: The table above shows descriptive statistics for the dependent variable, *Policy*, and the set of control variables. Inflation, nonfarm payrolls, house prices, and stock prices are given in year-over-year percentage changes. Inflation expectations provide the median 12-month ahead household forecast of inflation, as measured by the University of Michigan's Survey of Consumers. All descriptive statistics are computed over the full sample, which spans the 1993-2012 period.

The variable *Policy* codes the FOMC's policy decision as an ordinal variable that can take on values of -1, 0, and 1. Figure 7 shows a plot of this variable over our sample period. From the *Policy* column in Table 2, we can see that the median value of *Policy* over our sample is 0. Furthermore, the 25th percentile and 75th percentile

values are also 0, indicating that tightening (+1) and easing (-1) are relatively rare in our sample.

Following *Policy*, the next column in Table 2, $Inflation$, measures the year-over-year percentage change in the monthly consumer price index. Next, in column $Nonfarm\ Payrolls$, we show the year-over-year percentage change in nonfarm payroll employment. The column labelled *House Prices* shows the year-over-year percentage change in the monthly Case-Shiller National Home Price Index. *Stock Prices* shows the year-over-year percentage change in the total share value of all U.S. stocks. And, finally, $Inflation\ Expectations$ shows the median expected price change over the next 12 months, which is taken from the University of Michigan's Survey of Consumers. Additionally, for all the aforementioned controls variables, we use the latest available values prior to the FOMC's meeting date.

Next, we consider Table 3, which contains descriptive statistics for our measures of policy inclination: the net hawkishness of minutes, transcripts, and the chairperson's text; and a measure of agreement based on transfer learning. We can see that mean net hawkishness in the $Minutes$ is approximately the same as in the $Transcripts$; however, the minutes have a higher standard deviation. The $Chairperson$ variable, which also uses the same net hawkishness measure, is constructed exclusively using the chairperson's text. The mean level of hawkishness appears to be lower; however, the variation in net hawkishness is higher than for either minutes or transcripts. Finally, *Agreement*, which is a measure of agreement among committee members has a mean of 0.92 and a standard deviation of 0.16.

4 Results

In this section, we will discuss our results, starting with the main findings from the specification we described in the empirical section. We will then consider a number of robustness tests, including the expansion of the dependent variable to include quantitative easing.

Table 3: Descriptive Statistics: Policy Inclination Measures

	Minutes	Transcripts	Chairperson	Agreement
Mean	1.17	1.18	1.13	0.92
Std	0.31	0.27	0.40	0.16
25%	1.00	0.97	0.87	0.79
50%	1.20	1.19	1.10	0.94
75%	1.37	1.39	1.41	1.03
Count	136	136	136	136

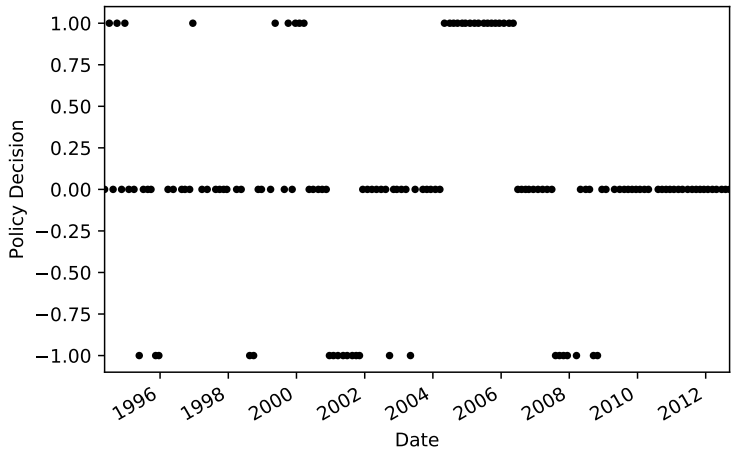
Notes: The table above provides descriptive statistics for the three measures of hawkishness we construct, along with our measure of committee agreement. All descriptive statistics are computed over the full sample, which spans the 1993-2012 period.

4.1 Main Findings

Our main findings are shown in Table 7. All columns report the marginal effects from an ordered probit model, where the dependent variable is the policy decision at the following monetary policy meeting. In column (1), we include the net hawkishness measure for minutes, along with a full set of controls: inflation, nonfarm payroll growth, house price growth, stock price growth, inflation expectations, and the lagged target federal funds rate. We find that higher net hawkishness is associated with future tightening and negatively associated with future easing. In column (2), we introduce the chairperson's net hawkishness to the specification and find that both the magnitude and significance of the minutes is reduced. The chairperson's net hawkishness is a marginally statistically significant predictor of both policy rate increases and decreases; however, when we introduce the net hawkishness of transcripts in column (3), both the minutes and chairperson become statistically insignificant.

The preferred specifications, which are shown in columns (4) and (5), add the agreement measure to the specification in column (3). Both columns use a full set of controls. Column (5) swaps out one control: the lagged target federal funds rate is replaced with the lag of the first difference of the target federal funds rate. In column (4), the net hawkishness index for transcripts and the measure for agreement are both statistically significantly associated with with both easing and tightening decisions. Neither is significantly associated with no policy change. Furthermore, minutes and

Figure 7: The FOMC's Policy Decision



Notes: The plot above shows the dependent variable in most of our empirical exercises, which is a transformation of the TFFR. We use -1 to denote a decrease in the TFFR, 0 to indicate no change, and +1 to indicate an increase. We do not differentiate between changes of different sizes.

the chairperson's net hawkishness are not statistically significantly associated with any policy decision. Net hawkishness in transcripts remains negatively associated with future easing and positively associated with future tightening. This suggests that our proposed dictionary accurately captures relevant information in the data and correctly identifies the direction of sentiment. Furthermore, the lack of significance for minutes suggests that transcripts, publicly available documents, and agreement contain all of the latent policy inclination that can be extracted from minutes; however, transcripts contain additional information about the committee's policy inclination that cannot be extracted from minutes or publicly available information.

Beyond the net hawkishness of transcripts, agreement is the only variable of interest that is statistically significant. Heightened agreement appears to predict monetary tightening and is significant at the 5% level. Furthermore, a lack of agreement is associated with monetary easing; however, this result is only significant at the 10% level. As we will show in a robustness exercise, agreement exclusively has an impact on tightening if we loosen the ordinality assumption. This may reflect the importance of building agreement when making a policy decision that is likely to be less popular

among the public – that is, hiking the policy rate. Policy rate decreases may be less problematic as the public tends to see them more favorably and, thus, less effort is needed for building agreement among the committee members.

The chairperson's net hawkishness has only marginal predictive value for policy in a specification with minutes and controls, but none in specifications (3)-(5), which include transcripts. Our results suggest that the chairperson's comments do not appear to be an important predictor of policy decisions when taken together with the broader discussion within the transcripts. At first sight, this may be perceived as being somewhat at odds with the general perception of the power of the chair. On the other hand, our results are closer to insights from decision-making theory and the role of the chairperson within monetary policy committees. As Gerlach-Kristen (2008) finds, the influence of the chairman on the quality of policy itself is limited, and the chairperson's main impact is to help build consensus in the committee.

Notably, the minutes are significant in specifications (1) and (2), both of which contain the full set of controls, but become insignificant upon the inclusion of transcripts. This suggests that minutes may reflect a streamlined and simplified version of the transcripts that could hold valuable information that complements the chair's speech in isolation. But again, when the information from transcripts is included instead, both the chair and minutes lose their significance, supporting our original hypothesis that transcripts provide more valuable information for predicting monetary policy decisions.

All results are given as marginal effects evaluated at the mean values of the controls. In our main specification in column (4), for instance, the marginal effect of transcripts on future tightening is 0.51. This means that a unit increase in the net hawkishness of sentiment is associated with a 0.51 probability increase in future tightening. The standard deviation of net hawkishness of transcripts is 0.27, so a one standard deviation increase in net hawkishness is associated with a 0.14 increase in the probability of tightening. Similarly, the standard deviation of agreement is 0.16, which means that a one standard deviation increase in agreement is associated with a 0.04 increase in the probability of tightening. As we will see in the robustness section, easing the ordinality assumption increases this to 0.11 for agreement.

4.2 Robustness

In addition to our main empirical exercise, we also consider four robustness exercises in Table 8. The first modifies the dependent variable to include quantitative easing decisions. The second removes the zero lower bound (ZLB) period from the sample, the third uses hawkish sentiment measures exclusively, and the fourth uses a multinomial model, rather than an ordinal one, as is done in the main empirical exercises.

Column (1) of Table 8 contains the results for the quantitative easing exercise. The Fed implemented its quantitative easing (QE) program at about the same time the federal funds rate neared the zero lower bound (ZLB). QE was aimed at putting downward pressure on longer-term interest rates. We modify our dependent variable by incorporating the effects of the QE programs. Whenever QE was announced with the intention of lowering long term rates, we set the dependent variable to -1. Our results for this exercise are nearly identical to our main findings.

The results for the zero lower bound (ZLB) exercise are shown in column (2). We truncate the sample by removing the ZLB period, which started in December of 2008. This allows us to evaluate the sensitivity of our main findings to the removal of an extended period in which policy was constrained. As with the QE exercise, we find no substantive differences from our main specifications.

In addition to the QE and ZLB exercises, we also evaluate the hawkish component of the index separately in column (3). Tetlock (2007) demonstrated that positive words do not carry the same weight as negative ones in sentiment analysis. That insight applies also more broadly to the finance literature. As Loughran and McDonald (2011) discuss, the measured positive sentiment in financial text is often ambiguous because negative sentiment is frequently softened by adding positive words. By contrast, negative words tend to convey a clear negative sentiment.

We investigate whether such an insight also applies to central banking and the FOMC by examining the hawkish component of the net sentiment index in isolation in column (3). Hawkishness can be interpreted as equivalent to positivity in that it indicates that the committee perceives the economic outlook to be sufficiently strong to warrant monetary tightening. We find that hawkishness helps to predict the next policy decision when based on the information extracted from the transcripts. As

in the main results, the content of the minutes does not add value, even when only hawkish language is used.

Notably, using hawkish sentiment in isolation strengthens our results for both monetary tightening and easing. In both cases, the estimated marginal effects increase in both magnitude and significance. Thus, for central banking, one of the main results of the finance literature does not appear to apply. One possible explanation is that no such asymmetry in communication exists for central banks. When the economic outlook is negative, central banks dampen the negativity by discussing the possibility of monetary easing. And when the economic outlook is positive, central banks will instead discuss the possibility of tightening to prevent inflation from accelerating. In both cases, the central bank will use communication to dampen news, rather than amplifying it.

In column (4), we treat the dependent variable as categorical, rather than ordinal. The purpose of this is to relax the assumption that the impact of variables of interest is ordinal in the dependent variable. This is especially relevant for agreement, where it is not obvious that its impact should be ordered over the policy decision categories. While we do not find any sign flips, we do find a substantial increase in both the estimated magnitude and significance of agreement on tightening. We also find that agreement no longer has a statistically significant effect on loosening. This aligns well with our hypothesized explanation for this finding – namely, that the FOMC prefers to build an internal consensus before tightening, since this is more likely to generate a negative response from the media and general public.

Finally, in addition to our robustness exercises, we also evaluate the extent to which multicollinearity is an issue, since three of our variables of interest are text-based measures constructed using the same dictionary. It could be the case, for instance, that the minutes and the chairperson's text are highly collinear with the other variables, such as the transcripts. We evaluate this by examining the stability of the standard errors across specification, the conditioning of the covariance matrix, and the variance inflation factors for the regressors of interests. We do not find evidence of high levels of multicollinearity.

5 Conclusion

The purpose of central bank minutes is to give an account of the discussion during the monetary policy meetings. One aim of providing such information is to enable outside observers to draw informed conclusions about future policy. Central bank minutes do indeed attract a great deal of interest in the media and among financial market participants, suggesting that they are regarded as a valuable source of information about the bank's intentions.

However, minutes are by necessity an edited representation of a much broader discussion. They are intended to sum up all the pertinent information from the discussion, but to what extent is this really the case? To investigate this, we compare minutes and transcripts, specifically focusing on three components of transcripts that are unlikely to have been conveyed perfectly to minutes: 1) the committee's degree of hawkishness; 2) the chairperson's degree of hawkishness; and 3) the level of agreement within the committee. We measure the first two using a new dictionary that measures hawkishness in central bank texts. We measure the third by performing deep learning on U.S. congressional debate transcripts to construct a model that can identify agreement in texts. We then use this model to measure the degree to which committee members agree in FOMC transcripts.

We find that the transcripts are in general more informative about future policy than the minutes. The measure of policy inclination we introduce, which is a measure of hawkishness, is a strongly statistically significant predictor of policy decisions when applied to transcripts, but not when applied to minutes. In addition to this, we find that heightened committee agreement appears to precede monetary tightening, suggesting that monetary policy committees may be more reluctant to raise rates and face negative media coverage until they have achieve an internal consensus.

Importantly, our finding that transcripts are more informative than minutes does not necessarily suggest that central banks should publish extensive and detailed minutes. If minutes are published mainly for accountability reasons, a brief account of the policy discussion may suffice. Moreover, as discussed in the introduction, being transparent about central banks' internal discussions is not always beneficial. A high degree of transparency may distort the board members' behavior and, thus, result in

inferior policy decisions.[19]

However, the results do suggest that there is a positive relationship between the degree of transparency about a central bank's internal deliberations and the prospect of outside observers being able to predict future policy. Depending on how important the central bank considers the latter to be, the design of the minutes may be regarded as an important policy variable, perhaps more so than hitherto recognized.

[19]To the contrary, it may also have a positive discipline effect, which Hansen et al. (2018) find dominates.

References

Acosta, M., "FOMC Responses to Calls for Transparency," *Finance and Economics Discussion Series 2015-60, Board of Governors of the Federal Reserve System (US)*, 2015.

Apel, M. and M. Blix Grimaldi, "The Information Content of Central Bank Minutes," *Sveriges Riksbank Working Paper Series No. 261*, 2012.

_ and _ , "How Informative Are Central Bank Minutes?," *Review of Economics – Jahrbuch für Wirtschaftswissenschaften*, 2014, *65.*

_ , P. Lennartsdotter C. Claussen, and Ø. Røisland, "Monetary Policy Decisions – Comparing Theory and 'Inside' Information," *International Journal of Central Banking*, 2015, *11*, 47–89.

Arnold, A., R. Nallapati, and W.W. Cohen, "A Comparative Study of Methods for Transductive Transfer Learning," *Proceedings of the 14th International Conference on Machine Learning*, 2007, *131*, 77–82.

Baker, S.R., N. Bloom, and S.J. Davis, "Measuring Economic Policy Uncertainty," *Quarterly Journal of Economics*, 2016, *131*, 1593—-1636.

Bennani, H. and M. Neunkirch, "The (home) bias of European central bankers: new evidence based on speeches," *Applied Economics*, 2017, *49*, 1114–1131.

Bernanke, B., "Housing, Housing Finance, and Monetary Policy," *speech at the Federal Reserve Bank of Kansas City's Economic Symposium, Jackson Hole, Wyoming, August 31*, 2007.

Bernanke, B.S. and K.N. Kuttner, "What explains the stock market's reaction to Federal Reserve policy?," *Journal of Finance*, 2005, *60*, 1221–1257.

Birz, G. and J.R. Lott, "The Effect of Macroeconomic News on Stock Returns: New Evidence from Newspaper Coverage," *Journal of Banking and Finance*, 2011, *35*, 2791–2800.

Blinder, A.S., "International Finance," *Making Monetary Policy by Committee*, 2009, *12*, 171–194.

Chappell, H.W., R.R. McGregor, and T. Vermilyea, "Majority Rule, Consensus Building, and the Power of the Chairman: Arthur Burns and the FOMC," *Journal of Money, Credit and Banking*, 2004, *36*, 407–422.

_ , _ , and _ , "The Persuasive Power of a Committee Chairman: Arthur Burns and the FOMC," *Journal of Money, Credit and Banking*, 2007, *132*, 103–112.

_ , _ , and _ , "The Role of the Bias in Crafting Consensus: FOMC Decision Making in the Greenspan Era," *Journal of Money, Credit and Banking*, 2007, *3*, 39–60.

_ , _ , **and** _ , "Power-Sharing in Monetary Policy Committees: Evidence from the United Kingdom and Sweden," *Journal of Money, Credit and Banking*, 2014, *46*, 665–692.

Claussen, C. A., E. Matsen, Ø. Røisland, and R. Torvik, "Overconfidence, Monetary Policy Committees and Chairman Dominance," *Journal of Economic Behavior and Organization*, 2012, *81*, 699–711.

Correa, R., K. Garud, J.M. Londono, and N. Mislang, "Constructing a Dictionary for Financial Stability," *IFDP Notes, 2017-06-28, Board of Governors of the Federal Reserve System (U.S.)*, 2017.

Egesdal, M., M. Gill, and M. Rotemberg, *SSRN Research Paper*, 2015.

El-Shagi, M. and A. Jung, "Does the Greenspan Era Provide Evidence on Leadership in the FOMC?," *Journal of Macroeconomics*, 2015, *43*, 173–190.

_ **and** _ , "Have minutes helped markets to predict the MPC's monetary policy decisions?," *European Journal of Political Economy*, 2015, *39*, 222–234.

Gentzkow, M., B. Kelly, and M. Taddy, "Text as Data," *Journal of Economic Literature*, 2019, *57*, 535–574.

Gerlach-Kristen, P., "Is the MPC's Voting Record Informative About Future UK Monetary Policy?," *Scandinavian Journal of Economics*, 2004, *106*, 299–313.

_ , "The Role of the Chairman in Setting Monetary Policy: Individualistic vs. Autocratically Collegial MPCs," *International Journal of Central Banking*, 2008, *4*, 119–143.

_ **and E. Meade**, "Is There a Limit on FOMC Dissents? Evidence from The Greenspan Era," *Working Paper No. 2010-16, American University, Department of Economics.*, 2010.

Gersbach, H. and V. Hahn, "Information Acquisition and Transparency in Committees," *International Journal of Game Theory*, 2012, *41*, 427–453.

Hansen, S. and M. McMahon, "Shocking Language: Understanding the Macroeconomic Effects of Central Bank Communication," *Journal of International Economics*, 2016, *99*, 114–133.

_ , _ , **and A. Prat**, "Transparency and Deliberation within the FOMC: a Computational Linguistics Approach," *Quarterly Journal of Economics*, 2018, *133*, 801–870.

Henry, E. and A.J. Leone, "Measuring Qualitative Information in Capital Markets Research: Comparison of Alternative Methodologies to Measure Disclosure Tone," *The Accounting Review*, 2010, *91*, 153–178.

Horváth, R. and J. Jonášová, "Central banks' voting records, the financial crisis and future monetary policy," *European Journal of Political Economy*, 2015, *38*, 229–243.

_ , K. Šmídková, and J. Zápal, "Is the U.S. Fed Voting Record Informative about Future Policy?," *Czech Journal of Economics and Finance*, 2012, *62*, 478–484.

Hubert, P. and F. Labondance, "Central bank sentiment and policy expectations," *Staff Working Paper No. 648, Bank of England*, 2017.

Jung, A., "Have minutes helped to predict fed funds rate changes?," *Journal of Macroeconomics*, 2016, *49*, 18–32.

Kashkari, N., "Monetary Policy and Bubbles," *Messages, Federal Reserve Bank of Minneapolis, May 17*, 2017.

Levy, G., "Anti-Herding and Strategic Consultation," *European Economic Review*, 2004, *48*, 503–525.

_ , "Decision Making in Committees: Transparency, Reputation, and Voting Rules," *American Economic Review*, 2007, *97*, 150–168.

Lindsey, D., "A Modern History of FOMC Communication: 1975–2002," *Federal Reserve Board of Governors, Washington DC*, 2003.

Loughran, T. and B. McDonald, "When Is a Liability Not a Liability? Textual Analysis, Dictionaries, and 10Ks," *Journal of Finance*, 2011, *LXVI*, 35–36.

Malmendier, U., S. Nagel, and Z. Yan, "The Making of Hawks and Doves: Inflation Experiences on the FOMC," *NBER Working Paper No. 23228*, 2017.

Meade, E., "Regional Influences on U.S. Monetary Policy: Some Implications for Europe," *International Finance Discussion Papers, No. 721*, 2002.

_ **and D. Stasavage**, "Publicity of Debate and the Incentive to Dissent: Evidence from the US Federal Reserve," *Economic Journal*, 2008, *118*, 695–717.

Neuenkirch, M., "Predicting Bank of England's Asset Purchase Decisions with MPC Voting Records," *Applied Economics Letters*, 2013, *20*, 1275–1279.

Pan, S.J. and Q. Yang, "A Survey on Transfer Learning," *IEEE Transactions on Knowledge and Data Engineering*, 2010, *22*, 1345–1359.

Picault, M. and T. Renault, "Words are not all created equal: A new measure of ECB communication," *Journal of International Money and Finance*, 2017, *79*, 136–156.

Prat, A., "The Wrong Kind of Transparency," *American Economic Review*, 2005, *95*, 862–877.

Riboni, A. and F. Ruge-Murcia, "Dissent in Monetary Policy Decisions," *Journal of Monetary Economics*, 2014, *66*, 137–154.

Schonhardt-Bailey, C., "Deliberating American Monetary Policy: A Textual Analysis," *MIT Press, Cambridge, MA*, 2013.

Shapiro, A.H. and D. Wilson, "Taking the Fed at its Word: A New Approach to Estimating Central Bank Objectives using Text Analysis," *Federal Reserve Bank of San Francisco Working Paper 2019-02*, 2019.

Sirchenko, A., "Policymakers' Votes and Predictability of Monetary Policy," *EUI Working Papers ECO 2011/05, European University Institute, Florence*, 2011.

Swank, O.H. and B. Visser, "On Committees of Experts," *Quarterly Journal of Economics*, 2007, *112*, 337–372.

__ and __ , "Is Transparency To No Avail?," *Scandinavian Journal of Economics*, 2013, *115*, 967–994.

Tetlock, P.C., "Giving Content to Investor Sentiment: The Role of Media in the Stock Market," *Journal of Finance*, 2007, *62*, 1139–1168.

Thomas, M., B. Pang, and L. Lee, "Get Out the Vote: Determining Support or Opposition from Congressional Floor-Debate Transcripts," *Proceedings of the EMNLP*, 2006, pp. 327–335.

Thornton, D.L. and D.C. Wheelock, "Making Sense of Dissents: A History of FOMC Dissents," *Federal Reserve Bank of St. Louis Review, Third Quarter*, 2014, *96*, 213–227.

Woolley, J.T. and J. Gardner, "The Effect of "Sunshine" on Policy Deliberation: The Case of the Federal Open Market Committee," *The Social Science Journal*, 2017, *54*, 13–29.

6 Appendix

Table 4: Central Bank Communication Dictionary: Inflation.

TERM	HAWKISH MODIFIER	DOVISH MODIFIER
consumer prices	accelerat*	decelerat*
inflation	boost*	declin*
	elevated	decreas*
	escalat*	down*
	high*	drop*
	increas*	fall*
	jump*	fell
	pickup	low*
	rise*	muted
	rose	reduc*
	rising	slow*
	run-up/runup	stable
	strong*	subdued
	surg*	weak*
	up*	contained
inflation pressure	accelerat*	abat*
	boost*	contain*
	build*	dampen*
	elevat*	decelerat*
	emerg*	declin*
	great*	decreas*
	height*	dimin*
	high*	eas*
	increas*	fall*
	intensif*	fell
	mount*	low*
	pickup	moderat*
	rise	reced*
	rose	reduc*
	rising	subdued
	stok*	temper*
	strong*	
	sustain*	

Notes : This table shows the subdictionary on terms related to the price level. Since we allow for the modifier to appear in a window around the noun, using the unigram "inflation," coupled with accelerat* will pick up "inflation accelerated," "core inflation accelerated," and "accelerating inflation rate." For this reason, we have omitted three bigrams that were determined to be important, but had the same list of modifiers as "inflation": core inflation, inflation rate, and inflation expectations. The symbol '*' indicates that we include all words with the same stem.

Table 5: Central Bank Communication Dictionary: Economic Activity.

TERM	HAWKISH MODIFIER	DOVISH MODIFIER
consumer spending	accelerat* edg* up expan* increas* pick* up pickup soft* strength* strong* weak*	contract* decelerat* decreas* drop* retrench* slow* slugg* soft* subdued
economic activity economic growth	accelerat* buoyant edg* up expan* increas* high* pick* up pickup rise* rose rising step* up strength* strong* upside	contract* curtail* decelerat* declin* decreas* downside drop fall* fell low* moderat* slow* slugg* weak*
resource utilization	high* increas* rise rising rose tight*	declin* fall* fell loose* low*

Notes : This table shows the subdictionary on terms related to economic activity. Since we allow for the modifier to appear in a window around the noun, using the unigram "inflation," coupled with accelerat* will pick up "inflation accelerated," "core inflation accelerated," and "accelerating inflation rate." The symbol '*' indicates that we include all words with the same stem.

Table 6: Central Bank Communication Dictionary: Employment.

TERM	HAWKISH MODIFIER	DOVISH MODIFIER
employment	expand*	slow*
	gain*	declin*
	improv*	reduc*
	increas*	weak*
	pick* up	deteriorat*
	pickup	shrink*
	rais*	shrank
	rise*	fall*
	rising	fell
	rose	drop*
	strength*	contract*
	turn* up	sluggish
labor market	strain*	eased
	tight*	easing
		loos*
		soft*
		weak*
unemployment	declin*	elevat*
	fall*	high
	fell	increas*
	low*	ris*
	reduc*	rose*

Notes : This table shows the subdictionary on terms related to employment. Since we allow for the modifier to appear in a window around the noun, using the unigram "inflation," coupled with accelerat* will pick up "inflation accelerated," "core inflation accelerated," and "accelerating inflation rate." The symbol '*' indicates that we include all words with the same stem.

Table 7: Main results: Marginal Effects

	(1) (Net)	(2) (Net)	(3) (Net)	(4) (Net)	(5) (Net)
Policy Decision = -1.					
Minutes	-0.20**	-0.16**	-0.03	-0.04	0.05
	(0.080)	(0.077)	(0.059)	(0.055)	(0.063)
Transcripts			-0.37***	-0.37***	-0.28***
			(0.123)	(0.125)	(0.107)
Chair		-0.08*	0.027	0.02	0.04
		(0.047)	(0.041)	(0.038)	(0.042)
Agreement				-0.15*	-0.15*
				(0.087)	(0.091)
Policy Decision = 0.					
Minutes	-0.04	-0.04	-0.01	-0.01	0.01
	(0.09)	(0.054)	(0.024)	(0.026)	(0.024)
Transcripts			-0.13	-0.14	-0.07
			(0.158)	(0.165)	(0.113)
Chair		-0.02	0.01	0.00	-0.01
		(0.029)	(0.018)	(0.019)	(0.170)
Agreement				-0.06	-0.04
				(0.078)	(0.064)
Policy Decision = +1.					
Minutes	0.24***	0.20**	0.05	0.05	-0.06
	(0.094)	(0.092)	(0.079)	(0.074)	(0.078)
Transcripts			0.51***	0.51***	0.34***
			(0.153)	(0.158)	(0.130)
Chair		0.10*	-0.04	-0.03	0.04
		(0.058)	(0.055)	(0.052)	(0.050)
Agreement				0.23**	0.19*
				(0.052)	(0.110)
Controls	YES	YES	YES	YES	YES
TFFR	YES	YES	YES	YES	NO
Δ TFFR	NO	NO	NO	NO	YES
Log-Likelihood	-90.09	-88.44	-77.72	-75.11	-73.52
McFadden's R^2	0.26	0.27	0.36	0.38	0.41
N	136	136	136	136	135

Notes: All specifications use an ordered probit. The dependent variable is an ordinal variable that can take on one of three values: -1 when the target federal funds is lowered; 0 when the rate remains unchanged; and +1 when it rises. The set of controls includes inflation, non-farm payroll growth, house price growth, stock price growth, and inflation expectations. We also control for the lagged target federal funds rate target in specifications (1)-(4) and the first difference of the lagged federal funds rate target in (5). * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 8: Robustness exercises: Marginal effects

	(1) (Net)	(2) (Net)	(3) (Hawk)	(4) (Net)
Policy Decision = -1.				
Minutes	-0.03	-0.06	-0.08	0.11
	(0.058)	(0.060)	(0.110)	(0.120)
Transcripts	-0.42***	-0.38***	-0.74***	-0.66***
	(0.136)	(0.140)	(0.250)	(0.170)
Chair	0.03	0.016	-0.04	0.057
	(0.040)	(0.041)	(0.076)	(0.205)
Agreement	-0.18*	-0.179*	-0.169*	-0.236
	(0.091)	(0.094)	(0.087)	(0.21)
Policy Decision = 0.				
Minutes	-0.01	-0.03	-0.03	-0.25
	(0.018)	(0.019)	(0.051)	(0.157)
Transcripts	-0.08	-0.17	-0.27	0.35*
	(0.175)	(0.180)	(0.033)	(0.212)
Chair	0.01	0.01	-0.02	-0.15
	(0.010)	(0.020)	(0.034)	(0.107)
Agreement	0.03	-0.08	-0.06	-0.45
	(0.076)	(0.090)	(0.078)	(0.303)
Policy Decision = +1.				
Minutes	0.07	0.09	0.11	0.14
	(0.068)	(0.090)	(0.149)	(0.115)
Transcripts	0.50***	0.56***	1.01***	0.31**
	(0.160)	(0.180)	(0.316)	(0.146)
Chair	-0.03	-0.024	0.059	0.095
	(0.050)	(0.059)	(0.100)	(0.080)
Agreement	0.21**	0.26**	0.23**	0.69***
	(0.110)	(0.128)	(0.042)	(0.238)
Controls	YES	YES	YES	YES
TFFR	YES	YES	YES	YES
QE	YES	NO	NO	NO
NO ZLB	NO	YES	NO	NO
Multinomial	NO	NO	NO	YES
Log-Likelihood	-75.20	-67.83	-75.11	-58.88
McFadden's R^2	0.38	0.41	0.38	0.52
N	136	121	136	136

Notes: The dependent variable is treated as ordinal in columns (1)-(3) and categorical in column (4). Columns (2)-(4) uses a specification without QE and code the dependent variable as taking on three values: -1 when the target federal funds is lowered; 0 when the rate remains unchanged; and +1 when it rises. Column (1) modifies the dependent variable by coding QE events with a -1. The set of controls includes inflation, non-farm payroll growth, house price growth, stock price growth, inflation expectations, and the lagged federal funds rate. Column (2) uses a subsample without he ZLB. Column (3) exclusively uses hawkish sentiment. Column (4) treats the dependent variable as a categorical variable. * $p < .1$, ** $p < .05$, *** $p < .01$.

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