Pontifícia Universidade Católica
do Rio de Janeiro

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Leadership in Policy-Making: Evidence from FOMC Speeches

Dissertação de Mestrado

Masters dissertation presented to the Programa de Pós–graduação em Economia, do Departamento de Economia da PUC-Rio in partial fulfillment of the requirements for the degree of Mestre em Economia.

Advisor: Prof. Carlos Viana de Carvalho

Rio de Janeiro
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Abstract

Brandão Ferreira de Carli, Francesco; Viana de Carvalho, Carlos (Advisor). **Leadership in Policy-Making: Evidence from FOMC Speeches**. Rio de Janeiro, 2025. 52p. Dissertação de Mestrado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

We study leadership in policy-making using the Federal Open Market Committee as a particular setting. We leverage data on all FOMC members' speeches from 2000 to 2024 and natural language processing algorithms to construct measures of desired interest rates signalled by their communication. We use residuals of these interest rates estimated from Taylor reaction functions as our measure of speeches' shocks. Our identification strategy uses narrow windows of days around members' speeches to estimate their effect on other members' policy stance. First, we show that the Chairman influences other committee members, mainly those less experienced. We also find that this influence greatly increases during periods of high uncertainty. Next, we decompose the content of the speeches to study mechanisms. The Chair leads mainly when suggesting the appropriate policy path of interest rates. On the other hand, both the Chairman and Regional Presidents influence other members when speaking about the economic activity. These findings are consistent with an information aggregation mechanism and explained by a simple Bayesian Learning Model.

Keywords

Monetary Policy; Information Aggregation; Leadership.

Resumo

Brandão Ferreira de Carli, Francesco; Viana de Carvalho, Carlos. **Liderança na Formulação de Políticas: Evidência de Discursos do FOMC**. Rio de Janeiro, 2025. 52p. Dissertação de Mestrado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

Nós estudamos liderança na formulação de políticas utilizando como contexto particular o Federal Open Market Committee (FOMC). Nós utilizamos dados de todos os discursos de membros do FOMC entre 2000 e 2024 e algoritmos de processamento de linguagem natural para construir medidas de taxas de juros sinalizadas por sua comunicação. Nós utilizamos resíduos dessas taxas de juros estimados de funções de reação de Taylor como nossa medida dos choques dos discursos. Nossa estratégia de identificação utiliza pequenas janelas de dias ao redor dos discursos dos membros para estimar seus efeitos no posicionamento de outros discursos. Primeiro, nós mostramos que o Chairman influencia outros membros do comitê, principalmente os menos experientes. Nós também encontramos que essa influência aumenta consideravelmente durante períodos de incerteza elevada. Em seguida, nós decompos o conteúdo dos discursos para estudar mecanismos. O Chair lidera principalmente quando sugere a trajetória apropriada das taxas de juros. Por outro lado, tanto o Chairman como os Presidentes Regionais influenciam os outros membros quando discutem sobre a atividade econômica. Esses resultados são consistentes com um mecanismo de agregação de informação e explicados por um modelo simples de Aprendizado Bayesiano.

Palavras-chave

Política Monetária; Agregação de Informação; Liderança.

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1
Introduction

Public policies are usually decided on a collective basis, by means of committees, boards or hierarchical chains of command. Naturally, different policymakers have different opinions regarding the optimal policy path. How are these different preferences aggregated into the final policy outcome? This paper studies a particular hypothesis: the existence of leaders who use their influence to steer other policymakers in their direction, coordinating the preference aggregation process.

To study leadership in policy-making, we use as our environment the Federal Open Market Committee (henceforth, FOMC), the policy board that decides the target range for the Federal Reserve System (FED) funds interest rate. Despite committee members voicing divergent opinions about the optimal path for interest rates, decisions are typically taken unanimously, with rare dissent votes (THORNTON; WHEELOCK et al., 2014). Indeed, Donald L. Kohn, former Governor and Vice-Chairman of the FOMC, points to the importance of leadership in coordinating preferences: "the Committee is so large–in effect nineteen people–that strong leadership is required to construct a policy position that can command a substantial majority and to present a coherent rationale for that policy to the public." (KOHN, 2008). [1]

Monetary policy provides a good setting in which to measure effective leadership. Firstly, there is a well-defined, measurable, and easily interpretable policy outcome that summarizes distinct policy opinions on a unidimensional scale: the target for the FED funds interest rate. Secondly, decisions are made collegially, with each participant voting for his or her preferred outcome. Finally, members often publicly express their opinions on the correct policy path through speeches and interviews. In other words, we see policymakers' preferences before the aggregation process that occurs in the meeting. [2]

We leverage the informational content of FOMC members' communication analyzing data on all official speeches given by the committee members between January 2000 and June 2024. To quantify these speeches, we build on previous work by Zaniboni, Carvalho and Medeiros (2019). More specifically, we employ Latent Dirichlet Allocation (LDA), an unsupervised language clustering algorithm, to uncover latent topics within the language of the speeches and FOMC minutes. Next, we use shrinkage econometric methods to map what these language topics imply for the chosen interest rates in the

[1] Another Vice-Chairman, Blinder (1999) observes that "While serving on the FOMC, I was vividly reminded of a few things all of us probably know about committees: that they laboriously *aggregate* individual preferences; that they need to be *led*; that they tend to adopt compromise positions on difficult questions..."

[2] There is evidence that FOMC members aggregate preferences even before the meeting. As Bauer and Swanson (2023) observe, "Many forecasters noted that they rarely revised their forecast in response to FOMC announcements because the FOMC typically communicated the outcome of each meeting well in advance through speeches by FOMC members.(...)some forecasters said that the announcements have not been a surprise for many, many years and are just not informative about monetary policy, relative to FOMC member speeches and press conferences"

FOMC meetings, recovering a coefficient associated with each topic. Using the probability distribution of the speeches in terms of the language topics, we can then construct implied interest rates signalled by each speech in our database. Finally, to identify the "innovation" in each speech – the deviation of the signalled interest rate from what would be expected – we estimate a Taylor Rule using vintage macroeconomic data that was available to members at the time of their speeches, as well as member and time fixed effects. The residuals from this estimation provide our main measure of speeches' shocks.

First, we ask whether there are leaders in the committee who influence other members toward their preferred policy path. To mitigate endogeneity concerns, we adopt a high frequency approach on narrow windows of days: we identify the effect of a member's speech as the difference in the policy stance of committee members that spoke a few days before him and that spoke again some days after his speech. Assuming that, conditional on all economic indicators included in the Taylor rule and several fixed effects, there are no remaining omitted variables in these windows of days, our estimates have a causal meaning.

Our results support the anecdotal evidence that the Chairman is the main leader of the committee. We estimate that an increase of 1 pt. in the innovation of the Chairman's speech leads to a 0.12-point increase in the innovations of speeches delivered in the next few days. This influence is concentrated on less experienced members and increases during periods of high uncertainty. In fact, an increase of one standard deviation in the Vix index more than doubles the influence of the Chair on other policymakers, while the effects of the Chairman's speech on a member who has just entered the committee are almost three times as big relative to the effects on a median member. We show that our results are not driven by the release of important economic data in the windows around speeches, excluding dates when CPI, Payroll, PCE, GDP, PPI, Employment Cost and House Price indicators, the main indicators for monetary policy, were released.

We propose two explanations for the influence effects we find in the data. First, members could be transmitting information about the state of the economy to other members, such as regional conditions in the district of a FED President or anecdotal evidence collected from informal contacts[3]. Alternatively, the effect could be due to pure influence arising from respect and deference accorded to the Chairman, or from persuasive arguments made by him, what we denote leadership in policy-making. In this case, the Chair could persuade members to change their innate policy preferences, given a fixed information set.

To separately identify these mechanisms, we decompose the language content of the topics identified by the LDA analysis into three groups: discussion about the economic activity; policy recommendations (such as raising or lowering the interest rate); and unconventional monetary policy recommendations (Quantitative Easing). We compute implied interest rates of the members'

[3]As put by one former committee member, William Poole, "over the years I have become impressed by how often my own position would change even in the days just before a meeting as a consequence of the arrival of new information, including staff analysis and sound arguments by my FOMC colleagues." (POOLE, 2008)

speeches for each of these topics separately.

First, we show that both the Chairman and regional Presidents influence other members when speaking about the economic activity. This evidence is consistent with members having different information sets and transmitting information to each other when speaking. In particular, regional Presidents have special knowledge about their own districts' economic and financial conditions that may not be known by the rest of the committee. To further address endogeneity concerns, we leverage the annual rotation of voting presidents in the FOMC and the difference between districts and national unemployment as instruments for Presidents' shocks, and show that the Presidents' influence occurs specifically when they speak about regional economic conditions, growth, and financial stability.

The Chair's analysis of economic conditions, additionally, becomes more influential during uncertain times, when assessing the true state of the economy from incoming data may become harder.[4] We show that these mechanisms are consistent with a simple Bayesian Learning Model where members learn about the state of the economy by observing each other's speeches.

We also find that the Chairman influences other members when suggesting the appropriate policy path for interest rates, given economic conditions. Since this section of speeches is usually separated from the section discussing economic activity, this influence can be considered orthogonal to information transmission. However, the Chair still could be choosing what to speak by observing the median of the committee, or his expectations of what would be accepted by other committee members[5]. In this case, this influence could not be interpreted as pure leadership.

We address this concern in two manners. First, our main regressions control for the median of the committee preferences, what should alleviate backward-looking behavior. Second, in order to isolate an exogenous policy suggestion, we analyze the beginning of the policy of large-scale asset purchases (also known as Quantitative Easing) during the 2008 crisis. We present narrative evidence that Bernanke persuaded other members to start the policy of buying mortgage-backed securities (MBS) and long-term treasuries. We adopt an event study approach around the main speech of Bernanke suggesting to systematically purchase long-term treasuries in December of 2008, and show that in the next few months other members also started discussing quantitative easing policies.

Related Literature We contribute to three literatures. First, we contribute to the literature that studies decision-making in monetary policy and in public policies more generally (BARON; FEREJOHN, 1989; BLINDER; MORGAN, 2008; RIBONI; RUGE-MURCIA, 2010; CHAPPELL; MCGREGOR; VERMILYEA, 2012; RIBONI; RUGE-MURCIA, 2023). This literature

[4] "uncertainty means there is always a vital role for judgment in setting monetary policy(...)In such circumstances, it is even more important than usual to gather information from diverse sources and from multiple perspectives." - Minehan (2006), former President of the Federal Reserve Bank of Boston

[5] According to Blinder, "The strong desire for *de facto* consensus therefore empowers the rest of the committee to serve as a kind of check on the chairman, who cannot easily pursue extreme policies, follow highly idiosyncratic procedures, or base policy on controversial theories that the rest of the committee does not accept." (BLINDER; MORGAN, 2005)

generally uses data on the voting records of policymakers during committee meetings or legislative sessions to estimate and discriminate between structural models of decision-making.

Part of the literature that studies monetary policy decision-making focuses on the influence of the Chairman on other committee members. Chappell, McGregor and Vermilyea (2004) find that Arthur Burns' influence accounted for around 40% to 50% of individual member positions during his tenure as Chairman of the FED. El-Shagi and Jung (2015) analyze FOMC meeting transcripts during the Greenspan period and use Greenbook forecasts to estimate individual Taylor reaction functions for the committee members. They find no significant differences between the Taylor Rule parameters for Regional Bank Presidents and the Chairman, concluding that this arises from the Chairman's influence. Blinder and Morgan (2008) is the only paper, to the best of our knowledge, to try to isolate causality in leadership by analyzing the role of leaders in monetary policy committees using a laboratory experiment with university students. The authors do not find any significant differences in the performance of groups with and without designated leaders.

Contrarily to these papers, Riboni and Ruge-Murcia (2010) estimate structural models for five different central banks (Bank of Canada, the Bank of England, the European Central Bank, the Swedish Riksbank, and the U.S. Federal Reserve) and find that a consensus-achieving model has the best explanatory power. Additionally, Chappell and McGregor (2018) analyze the Riksbank of Sweden and suggest that the Chairman's influence on the Committee is minimal, with the median voter's opinion being more significant. Riboni and Ruge-Murcia (2023) estimate a structural model for the FOMC that includes bargaining between the Chair and the rest of the committee, finding that it is better suited to explain the data of FOMC transcripts than dictatorial-type models.

Another strand of the literature focuses on understanding the information aggregation that occurs in the meetings[6]. Chappell, McGregor and Vermilyea (2012) leverage the order of speakers' presentations during FOMC meetings to test a Bayesian Learning Model, where each speaker learns about the state of the economy from previous speakers, and a Consensus-Achieving model, where each speaker acts so as to approximate the policy opinion of previous members. However, the authors find no support in the data for both hypotheses. Hansen, McMahon and Velasco Rivera (2014) use voting records from the BoE and a model where members differ both in their private assessments of the economy and in their preferences. The authors conclude that the marginal gain from aggregating information arising from adding more members is small for committees of more than 5 members. Riboni and Ruge-Murcia (2019) explain the change in preferences of members during the meeting - that is, declaring an interest rate preference in the first part of the policy go-around, but then voting for the committee's consensus - through the

[6]Similarly, there is a large literature on collective decision-making that further addresses these issues in other contexts, discussing bargaining between members of a decision-making body (BARON; FEREJOHN, 1989), sequential decision-making (DUGGAN; MARTINELLI, 2001; IARYCZOWER; SHUM, 2012; SPENKUCH; MONTAGNES; MAGLEBY, 2018), or even the effects of communicating prior to deciding an outcome (AGRANOV; TERGIMAN, 2014; IARYCZOWER; SHI; SHUM, 2018)

information learning that occurs during the discussion.

We contribute to this literature in four manners. First, we study the preference and information aggregation processes *before* the meeting occurs, analyzing FOMC members' speeches. Indeed, there is increasing evidence on the importance of speeches and interviews of monetary policymakers as a source of monetary policy shocks relative to meetings' decisions (SWANSON; JAYAWICKREMA, 2023), but the aggregation of preferences before FOMC meetings has not yet been studied, to the best of our knowledge. Second, we provide evidence of direct influence effects in small windows of days around members' speeches, a novel approach in relation to the literature. Third, we decompose the content of the speeches to separately identify influence through information transmission and influence through the suggestion of the appropriate policy path. Finally, we provide evidence of pure influence - or leadership - in policy-making, arguably not related to either information transmission or strategic motives, by exploring the beginning of QE policies during the 2008 crisis. To the best of our knowledge, our paper is the first to provide causal evidence of influence between FOMC policymakers, as well as the first to explore speeches' language content to better discriminate the mechanisms of influence.

We also contribute to the growing literature that studies learning and belief formation in monetary policy (BORDALO et al., 2020; BAUER; PFLUEGER; SUNDERAM, 2024b; BAUER; PFLUEGER; SUNDERAM, 2024a). Bauer and Swanson (2023) argue that the FED information effect commonly found by the literature actually occurs because market agents have imperfect information about the FED's policy rule, and not because of assymetric information between the FED and the markets. Bauer, Pflueger and Sunderam (2024b) construct a perceived FOMC's monetary policy rule from panels of professional forecasters, and show that these forecasters learn about the parameters of the rule by observing the committee's actions. In a follow-up working paper, the same authors show that the perceived FED's response to inflation has substantially shifted after the pandemics and the lift-off period of interest rates that began in march 2022 (BAUER; PFLUEGER; SUNDERAM, 2024a). We contribute to this literature by showing that policy-makers also learn about the state of the economy by observing each other's communication.

Finally, we also contribute to the literature on monetary policy communication (HANSEN; MCMAHON, 2016; ARUOBA; DRECHSEL, 2024; SWANSON; JAYAWICKREMA, 2023). Hansen and McMahon (2016) employ natural language processing techniques to study shocks to the FOMC's forward guidance policy. Hansen, McMahon and Prat (2017) study how transparency affected the FOMC's decisions by leveraging the 1993 policy that made the meetings' transcripts public after 5 years, and show that this policy changed the communication patterns of members during the meeting. Swanson and Jayawickrema (2023) extend the measure of high-frequency monetary shocks to speeches by the FED Chair and Vice-Chair, and show that they are more relevant to market outcomes than FED announcements themselves. Aruoba and Drechsel (2024) apply computational linguistics algorithms to the FOMC's staff documents in order to identify the FED's information set prior to each

decision and thus better identify monetary policy shocks. We contribute to this literature by showing that FOMC members' communication is not exogenous, and rather responds to macroeconomic variables and to influence from other policymakers.

This article is divided in the following manner. Section 2 describes the institutional framework in which the FOMC operates and our data. Section 3 describes our empirical strategy. Section 4 discusses our main results. Section 5 studies mechanisms and explains them through a simple model. Section 6 discusses results when identifying the language topics in the speeches directly, and also analyses the beginning of the QE policies in the 2008 crisis. Finally, Section 7 concludes.

2
Institutional Context and Data

2.1
Institutional Context

The Federal Open Market Committee (FOMC) decides the appropriate monetary policy of the Federal Reserve System (FED), the central bank of the United States. The committee usually meets at eight regularly scheduled meetings per year, to decide on the target range for the FED funds rate and other monetary policy tools. The FOMC is composed of the Chairman, the six other members from the Board of Governors, the President of the New York FED, and four of the Regional FED Presidents, who alternate annually on a rotating basis on the committee.

Blinder (2007), a former member of the Board of Governors and Vice-Chairman of the Committee from 1994 to 1996, categorizes monetary committees into three types: individualistic, genuinely collegial, and autocratically collegial. He describes the FED as an autocratically collegial committee, where "the chairman more or less dictates the group consensus. He may begin the meeting with the decision already made and simply inform the other members. Or he may listen to the debate and then announce the group's consensus, expecting everyone else to fall in line. But in either case, the group's decision is essentially the chairman's decision, hopefully informed by, and perhaps even influenced by, the views of other committee members."

However, Blinder (2007) also observes the reciprocal influence that other committee members have on the Chairman, limiting his *de facto* power to implement his desired policies: "the chairman knows that, if push ever comes to shove, rebellion is always possible if he tries to steamroll his committee into doing something it finds repugnant. As a formal matter, he lacks the *de jure* authority to force his committee members to accept his position. The strong desire for *de facto* consensus therefore empowers the rest of the committee to serve as a kind of check on the chairman, who cannot easily pursue extreme policies, follow highly idiosyncratic procedures, or base policy on controversial theories that the rest of the committee does not accept."

However, there is also evidence of decision being achieved by means of collective deliberation. In his autobiography, Bernanke (2015) recalls several episodes where FOMC's decisions were discussed between members prior to meetings: "Indeed, two days prior to my departure for Jackson Hole, I had been debating with Don and Tim whether to cut rates without waiting for the next scheduled FOMC meeting on September 18" (BERNANKE, 2015). Bernanke also writes about his concessions during meetings in order to accommodate different positions within the committee: "However, in a concession to the hawks that I would later regret, I agreed to a shift in language that signaled we weren't eager to cut rates again absent a change in the data".

There is also anecdotal evidence on the influence of other committee members. Kohn (2008) says that "Individual members can exert considerable influ-

ence over time through the cogency of their arguments(...)Any member needs to understand the basic framework to have influence on the debate. But you don't need to be a monetary policy expert. Those who come on the Committee with policy credentials can be very effective immediately. But judgment and experience count". Indeed, the Chair's leadership sometimes involves influencing other influential committee members: "If Don, who commanded enormous respect from his colleagues, could find ways to alleviate his own concerns, he would move toward my position and others would follow." (BERNANKE, 2015).

Some points are noteworthy in the anecdotal evidence presented above. First, there is not only suggestive evidence of the Chairman's influence on the committee, but also of the Chairman himself being influenced by other members' opinions. This introduces a obvious endogeneity concern in the problem of identifying causality in leadership. If a leader collects and summarizes opinions of the committee, then it will seem to an outsider viewer that he actually leads the board. The literature on monetary policy decision-making, to the best of our knowledge, has not yet found credible causal evidence on the direction of this relationship.

Additionally, most of the literature focuses on meetings' transcripts and voting records, while largely ignoring the content of public speeches of committee members. However, most of the influencing and convincing process probably takes place between meetings. In fact, there is anecdotal evidence that the chair held meetings with other members prior to meetings in order to share his opinions and build consensus (MEYER, 2004). Besides that, members hardly dissent in the meetings, even if they disagree with the proposal by some extent. In fact, Bernanke (2015) says that "FOMC tradition called for consensus decision making, and in that context a "no" vote represents a strong statement of disagreement". In other words, speeches made before meetings occur probably reflect a more innate preference of each member rather than his actual voting record. This is in line with a speech by former President of the Federal Reserve Bank of St. Louis William Poole (2002): "At the end of the day, there can be only one monetary policy; although I may dissent publicly, and believe I have an obligation to dissent if I feel strongly enough, I also have the responsibility to support the monetary policy decisions of the FOMC." Therefore, papers that only analyze the content of transcripts to search for members' preferences are probably biased in direction of finding convergence of opinions. By utilizing speeches made between meetings, our analysis addresses those concerns.

2.2 Data

Our main dataset is comprised of all official speeches given by FOMC members between January 2000 and June 2024. This data was scrapped from the Federal Reserve's website and from the Regional FEDs' websites. For each speech, we have its textual content and the day it was given. Our dataset has 4386 speeches.

We also scrape all minutes released after FOMC meetings between May 1995 and March 2024. This gives us a sample of 232 minutes released during this period. Minutes are a detailed description of the matters discussed in

the meeting (usually released 3 weeks after the statement), including the discussions of economic situation and appropriate monetary policy, although they are not exact transcripts of the meetings.

We use vintage data for inflation (core CPI excluding food and energy, seasonally adjusted) and employment (total nonfarm payroll), collected at the St. Louis FED database. This means that, for each speaker in out database, we use the CPI and payroll series that were known to him at the time of his speech, excluding posterior revisions. From the St. Louis FED database, we also obtain other macroeconomic data at the time of each speech: monthly 1-year expected inflation (calculated by the Cleveland FED); The Vix Market Volatility Index; and the Chicago FED National Financial Conditions Index. We also obtain from this database the release dates of several economic indicators, which we use in our robustness analysis.

Finally, to construct our measure of members' years of experience in the committee, we compiled their biographies, for which the main sources were the website of the FED history[1] and the Regional FED websites. We exclude from our calculation any period during which a member served in the Federal Reserve but not on the FOMC, as our aim is to capture experience specifically at the decision-making level of monetary policy.

[1] https://www.federalreservehistory.org

3
Empirical Strategy

3.1
Latent Dirichlet Allocation

This section and the next one draw on the empirical analysis of Zaniboni, Carvalho and Medeiros (2019), which developed a novel way to quantify speeches from FOMC members into "signalled" interest rates implied by those speeches.

In order to analyze the speeches of the committee members, we employ a Natural Language Processing algorithm called Latent Dirichlet Allocation (henceforth, LDA). LDA is an unsupervised soft clustering algorithm first introduced by Blei, Ng and Jordan (2003).[1] LDA uncovers hidden latent topics in language, reducing the dimensionality of the feature space from a collection of unique words to topics of words that commonly occur together. To improve the algorithm's efficiency, we preprocess our minutes and speeches in four steps:

1. We replace bigrams (or trigrams) of words regarding the economic situation for single words. For example, "financial market" becomes "finmkt", while "monetary policy" becomes "monpol".

2. We remove common english stop words - such as "the", "on", "by" and "is", as well as punctuation, single-letter characters and numeric characters. We also normalize all words in lower case notation.

3. We stem words to their root form in the language. For example, "pandemics" becomes "pandem", "banking" becomes "bank", and "anticipate" becomes "anticip". This helps reduce noise by standardizing words with similar meanings.

4. We exclude rare words by removing those that appear in less than 5% of the minutes in our database.

We will apply the LDA algorithm to the preprocessed text of the minutes of FOMC meetings. LDA works by assuming that each word in a text is drawn according to two probabilistic steps: first, a topic τ is drawn independently from a list $\tau = 1, 2, ..., \mathcal{T}$ of possible topics. Next, a word is drawn independently from a second distribution μ_τ of the topic $\mathcal{T}$ over the collection of all unique words in the dataset. Therefore, each text (a minute or speech) in our database is assigned a probability distribution over latent topics; and each topic, on its turn, is assigned a probability distribution over words.

We first apply LDA to the texts of the minutes of each meeting. From the text of the minutes, we can build a $D \times V$ matrix A (denoted term-document-matrix), where D is the number of documents (where each document is a

[1] some papers that use LDA to analyze central bank communication include Moniz and Jong (2014), Hansen and McMahon (2016), Hansen, McMahon and Prat (2017), and Zaniboni, Carvalho and Medeiros (2019)

minute) and V is the number of unique words in our dataset. In this matrix, each entry $A_{d,v}$ counts the number of times word v appears in document d. Obviously, this is a high-dimensional and sparse matrix. The objective of the algorithm is to identify common factors (the topics), which are groups of words which occur together, to reduce the dimensionality of the space.

The specifics of the LDA algorithm assume that both the distribution of each document over topics, and of each topic over words, follow a prior Dirichlet distribution. First, the topic distribution for document d is drawn for $d = 1, \ldots, D$ from a Dirichlet distribution ($\boldsymbol{\alpha}$) with $\mathcal{T}$ dimensions. Next, for each topic $\tau = 1, \ldots, \mathcal{T}$, the distribution of words follows a Dirichlet distribution ($\boldsymbol{\eta}$) with V dimensions. The model has parameters α and η, which, following the literature (HANSEN; MCMAHON; PRAT, 2017; ZANIBONI; CARVALHO; MEDEIROS, 2019), we set at $\alpha = \frac{50}{\mathcal{T}}$ and $\eta = 0.025$. A second concern with the LDA algorithm is that, despite being an unsupervised algorithm, it requires the researcher to specify the number of topics to be found in the data. Following the literature and the work by Zaniboni, Carvalho and Medeiros (2019), we set $\mathcal{T} = 32$.

Figure 3.1: Wordclouds representing the probability distribution of words across 4 topics estimated in the 32 topics LDA model applied over FOMC minutes between 1995 and 2024. The topics are, in counterclockwise order, those of numbers 1, 13, 3, and 4.

Note that, in this first step, we only run the LDA in the text corpus of minutes, and not of speeches. We can think of the minutes as our "training" set, and the speeches as our "test" set. Figure 1 represents some topics identified in the minutes by LDA. As can be seen, topic 3 seems to be related to Quantitative Easing, including stemmed words such as "purchas", "term", "committee", "continu" and "longer". Conversely, topic 4 seems to be related to the Covid-19 pandemic, including terms like "pandem", "viru", "covid" and "support". We plot two more representative topics: while Topic 1 seems to concern inflationary pressures, Topic 13 seems to be related to discussion about growth and the economy.

3.2
Computing Signalled Interest Rates from Speeches

The product of our LDA analysis was a probabilistic distribution over latent topics for each minute in our database. To quantify these distributions into implied interest rates, again following Zaniboni, Carvalho and Medeiros (2019), we run regressions of the FED funds target rate chosen at each meeting against the distribution of topics in the meeting's minutes. Given the high number of covariates (32 topics plus an intercept) for a relatively small dataset (232 minutes), we employ a shrinkage econometric method: the Elastic Net Operator (henceforth, ENO). The estimated equation is[2]:

$$i_t = \alpha_0 + \gamma' \hat{\theta}_{m,t} + \epsilon_t \tag{3-2}$$

Where i_t is the upper point of the target range for the nominal interest rate chosen by the FED at meeting t, γ is the vector of coefficients of the topics, $\hat{\theta}_{m,t}$ is the distribution over topics of the minute m in time t, and ϵ_t is an idiosyncratic error. Due to the penalty parameter, the ENO drives the coefficients of some parameters towards zero, selecting the topics which are most relevant in explaining the chosen interest rates.

Once we have the topic coefficients ($\hat{\gamma}$), we estimate for each speech its distribution over the *same* set of topics identified in the minutes. We then multiply these distributions by our vector of coefficients, giving us a "fitted" interest rate:

$$\hat{i_s} = \hat{\alpha_0} + \hat{\gamma}' \hat{\theta}_s \tag{3-3}$$

Where $\hat{\theta}_s$ is the distribution over topics of speech s, and we consider $\hat{i_s}$ as a "signalled" interest rate implied by speech s.

[2]ENO minimizes a sum of least squares with a penalty function, penalizing the absolute size and the squared absolute size of coefficients, in a loss function of the following form:

$$\hat{\gamma^*} = \arg\min_{\gamma} \sum_t (i_t - \gamma' \theta_t)^2 + (1-\nu)\lambda \sum_{j=1}^{p} \gamma_j^2 + \nu\lambda \sum_{j=1}^{p} |\gamma_j| \tag{3-1}$$

Where we set ν equal to 0.5. To select λ, we select the value that minimizes the *Bayesian Information Criterion* (BIC), which is a common choice in the literature. The value is then set at 0.0306.

3.2.1
Estimating Innovations

In this section we estimate a Taylor Rule process for the speeches' interest rates. The residual from this process will be our measure of speeches' innovations – the deviation of the signalled interest rate from what would be expected from that speaker, at the time of his speech, given the latest macroeconomic data available to him and his response function to this data.

We assume that the committee members follow a common Taylor Rule, with the same coefficients in response to macroeconomic variables. As our measure of unemployment, we use the seasonally adjusted non-farm payroll data, a measure of variation in new hires in the United States. As for inflation, we use the seasonally adjusted core CPI excluding food and energy, which are more volatile items. For these two variables, we use the year-over-year variation from vintage data - that is, the latest release of the data that was known to speakers, at the moment of their speeches. This excludes posterior revisions of the data that were unknown to members. Finally, we also use monthly 1-year inflation expectations data that was available at the time of the speeches.

Since during a large period of our time sample there was little variation in the US inflation rates, as well as in the expected inflation rates (since inflation was largely anchored at the FED's implicit 2% target), members could be reacting systematically to other developments in markets besides the inflation and unemployment data. Therefore, we also include in our specification daily data for market volatility (the Vix Market Volatility Index) and financial market conditions (the Chicago National Financial Conditions Index). Finally, we also include a lag in the rule to account for persistence. Hence, the Taylor function we estimate is:

$$\begin{aligned}\hat{i_{i,s}} =& \beta_0 + \hat{i_{i,s-1}} + \beta_2 Payroll_{i,s} + \beta_3 CPI_{i,s} + \beta_4 ExpInfl1Year_{i,s} \\ &+ \beta_5 VixVolatility_{i,s} + \beta_6 FinConditions_{i,s} + \alpha_y + \alpha_i + \epsilon_{i,s}\end{aligned} \tag{3-4}$$

Where $\hat{i_s}$ is the signalled interest rate from speaker i's speech s, $\hat{i_{s-1}}$ is the interest rate signalled by the last speech from member i before speech s, $Payroll_{i,s}$, $CPI_{i,s}$, $VixVolatility_{i,s}$, $FinConditions_{i,s}$ are the year-over-year payroll variation, the year-over-year CPI variation, the market volatility index and the financial conditions index, all known at the day the speech is delivered, and $ExpInfl1Year_{i,s}$ is the expectation of inflation 1 year forward, known at the month the speech is delivered. The year fixed effect α_y controls for tendencies in the committee's overall opinion, or for an evolution of the natural interest rate over time. The members' fixed effects α_i control for members that are known to me more hawkish or more dovish, or who have different guesses about the natural interest rate.

The results of the estimation are shown at Table 3.1, where we report standard errors robust to heteroscedasticity and clustered at the speaker level - that is, we allow correlation through time for the same member.

In Figure 3.2, we plot the speeches' signalled interest rates (rolling average of 3 speeches) and the fitted Taylor Rules for the Chairmans in our dataset: Alan Greenspan, Ben Bernanke, Janet Yellen and Jerome Powell. Throughout the paper, we utilize the residuals from this Taylor Rule as our measure of

Table 3.1: Taylor Rule for Speeches' Signalled Interest Rates

	Speech Interest Rate
Lag Speech Interest Rate	0.066^{***}
	(0.017)
Payroll % yoy	0.020^{***}
	(0.006)
CPI % yoy	0.049^{*}
	(0.029)
Inflation Expec 1 y	0.073^{**}
	(0.031)
Vix Volatily Index	-0.005^{**}
	(0.002)
Chicago Financial Conditions Index	-0.031
	(0.060)
Intercept	1.565^{***}
	(0.215)
Year Fixed effects	Yes
Speaker Fixed Effects	Yes
Observations	4,273
R^2	0.271

This table presents OLS estimates of Taylor Rule Equation (3-4). Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

speeches' innovations, defined as:

$$I_s = \hat{i}_s - \hat{\hat{i}}_s \tag{3-5}$$

where $\hat{\hat{i}}_s$ is the fitted speech interest rate from the Taylor Rule.

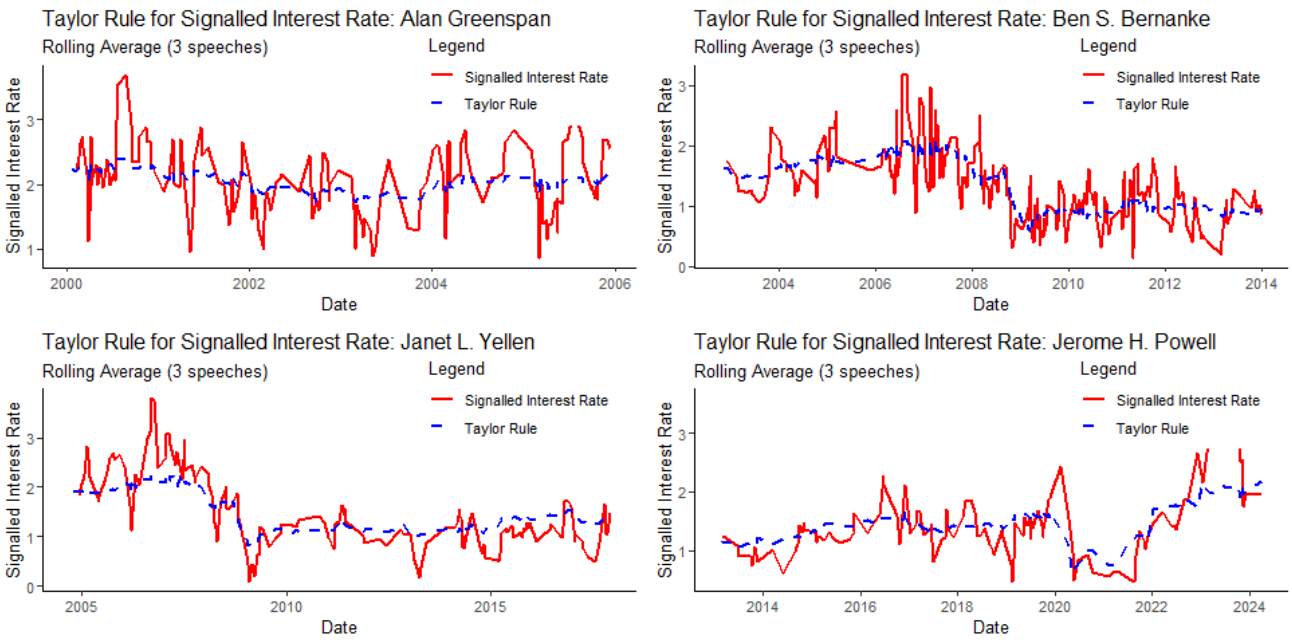

Figure 3.2: Estimated Taylor Rules.

3.3
High Frequency Effects of Speeches

In this section we explain our identification strategy to isolate the influence of members' speeches on the rest of the committee. Trying to isolate causality in this framework is a difficult task: we only observe a sequence of speeches over time, which are themselves endogenous shocks. Each speech not only impacts subsequent speeches but is also influenced by preceding ones. Even in the absence of influence effects between members, we could find spurious correlations based only on the fact that a member is rightly foreseeing the committee's or the economy's tendency. Even the expectation of future speeches can affect a present speech. Additionally, it's reasonable to assume that, every time there is a meeting, members update their opinions following the committee's new policy. This means that any attempt to identify causality when there are meetings between speeches is questionable.

Our approach leverages the ordering of speeches between meetings. More specifically, we compare the variation in speeches' policy stance in narrow windows of days around other members' speeches. Figure 3.3 shows the timeline of events between two meetings m and m+1, as well as the variables we use in our main specification.

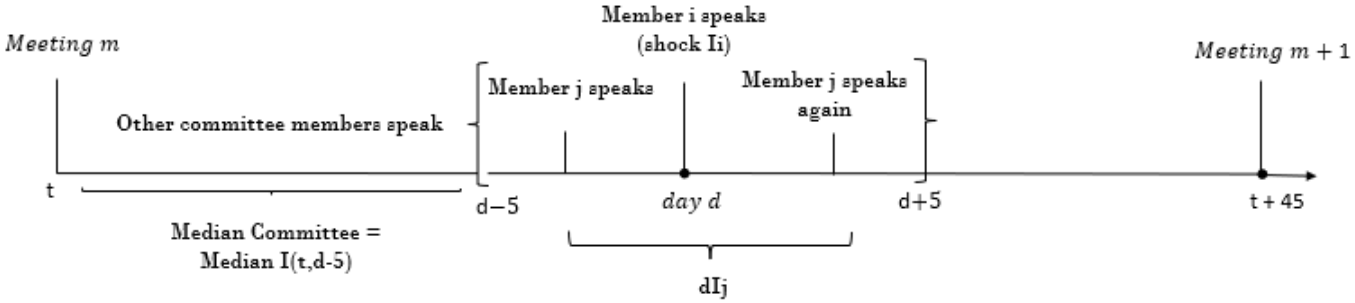

Figure 3.3: Timeline of Events

Since there are regularly scheduled 8 meetings per year, there is an interval of approximately 45 days between meetings. We identify all instances in our database where the following sequence of events happened: a speaker j speaks; less than five days later, another speaker i speaks; and, again, less than five days later, speaker j speaks again. Our dependent variable is the shock I_i of member i's speech at day d. We use as the dependent variable dI_j, which is defined as the difference between the innovations in the speeches of speaker j, right after and right before the speech of speaker i.

Since a member's opinion can be affected by the overall preferences of the committee, we control for the median of innovations in speeches that were made between the last meeting and day $d-5$. We also want to allow the effect of the speech of a member to differ if he is the Chairman. Hence we interact our shocks with a *dummy* equal to 1 if member i is the Chairman. Thus, our baseline specification is:

$$\begin{aligned} dI_{j,t} =& \beta_0 + \beta_1 I_{i,t} + \beta_2 I_{i,t} Chairman + \beta_3 MedianCommittee_{i,t} \\ &+ \beta_4 \alpha_{meeting} + \beta_5 \alpha_{week-year} + \beta_6 \alpha_{speakerj} + \epsilon_{i,t} \end{aligned} \tag{3-6}$$

We also include year-week $\alpha_{week-year}$ fixed effects, which control for any weekly tendency between meetings; meeting $\alpha_{meeting}$ fixed effects; and treated speaker $\alpha_{speakerj}$ fixed effects. This means our variation comes from comparing differences in speeches made after and before member i by the same member j, relative to what would be expected in that specific week, for that specific speaker j, given the latest available macroeconomic data and the responses of speakers i and j to this data[3].

Our identification strategy relies on the assumption that, conditional on all of the variables above, there are no omitted variables in the window of days around member i's speech that would affect member i and member j's speeches in the same direction. This assumption may not hold if, for instance, members strategically time their speeches. It's possible that more hawkish members choose to speak immediately after a dovish member, for example. Moreover, the size of each shock is not exogenous: a member may adjust the tone of his speech in response to expectations about future speeches. If any of these concerns is valid, we cannot assign a causality interpretation to our findings. However, we'll present several robustness checks to validate our findings in a causal direction.

[3]Remember we included member fixed effects and macroeconomic variables in our Taylor Rule specification

4
Main Results

Estimates of equation (3-6) are reported in Table 4.1. We introduce one covariate at a time to assess the stability of the estimated coefficients. All reported standard errors are robust to heteroscedasticity and clustered at the speaker level, allowing for serial correlation over time for the same member.

Table 4.1: Effects of Speeches on dI_j

	dI_j				
Shock Speaker	0.032	0.007	0.005	−0.005	−0.005
	(0.037)	(0.044)	(0.028)	(0.026)	(0.026)
Shock Speaker * Chair	−0.080	−0.034	0.127*	0.116*	0.116*
	(0.070)	(0.083)	(0.076)	(0.070)	(0.070)
Median Shocks Last Speeches		0.125	0.242	0.694***	0.694***
		(0.116)	(0.255)	(0.251)	(0.251)
Year-Week Fixed effects	No	No	Yes	Yes	Yes
Treated Speaker Fixed effects	No	No	No	Yes	Yes
Meeting Fixed Effects	No	No	No	No	Yes
Observations	1,989	1,695	1,695	1,695	1,695
R^2	0.001	0.002	0.553	0.664	0.664

This table presents OLS estimates of Equation (3-6). Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Although the effect of a random member's shock is essentially zero, the shocks linked to the Chairman are both positive and significant at the 10% level when we add more controls. Our preferred specification, which includes all covariates, implies that an increase of 1 pt. in the interest rate signalled by the Chairman's speech increases the interest rates signalled by subsequent members by 0.12 points, a substantial effect.

We also find a strong effect from the median innovations of the committee on dI_j. The fact that both the Chairman's innovation and the median innovations of the committee are explanatory is consistent with a model of collective choice in a committee by simple majority rule, where the fact that the Chairman has agenda-setting power gives more weight to his opinion in the final policy chosen.

One could be worried that our results are being driven by the release of important economic data. For instance, it may be the case that, right before very hawkish speeches from the Chairman, there are releases of macroeconomic data that suggest a strong economy or inflationary pressures, thus driving the Chairman's and next members' opinions in the same direction. To address this concern, we gather the release dates of CPI, Payroll, PCE, GDP, PPI, House Price and Employment Cost data during our sample period, the most important economic indicators watched by the FOMC and market participants.

Table 4.2 progressively excludes from the sample observations when one of these indicators was released in the windows of days around speeches. Our estimates increase in significance and size as we restrict our sample.

Table 4.2: Effects of Speeches on dI_j (Excluding Release Dates)

	dI_j			
	Sample 1	Sample 2	Sample 3	Sample 4
Shock Speaker	-0.005	-0.028	-0.044	-0.036
	(0.026)	(0.033)	(0.033)	(0.036)
Shock Speaker * Chair	0.116^{*}	0.220^{***}	0.210^{**}	0.198^{**}
	(0.070)	(0.080)	(0.084)	(0.090)
Median Shocks Last Speeches	0.694^{***}	0.342	0.368	0.339
	(0.251)	(0.384)	(0.242)	(0.223)
Year-Week Fixed effects	Yes	Yes	Yes	Yes
Treated Speaker Fixed effects	Yes	Yes	Yes	Yes
Meeting Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,695	813	484	455
R^2	0.664	0.815	0.856	0.863

This table presents OLS estimates of Equation (3-6). Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively. Sample (1) is the entire sample. Sample (2) excludes CPI and Payroll releases; Sample (3) excludes CPI, Payroll, PCE and GDP releases; and Sample (4) excludes CPI, Payroll, PCE, GDP, House Price, Employment Cost, and PPI releases

Another source of concern is the possibility that the first speech made my member j, less than five days before member i, somehow influences member i's speech, what would bias our main estimate. However, note that, if this influence is positive, then any bias arising from this fact would be negative, and therefore would bias our estimate towards zero or negative values [1]. Therefore, we believe this isn't a significant concern with our results.

Next, we analyse whether the Chair's influence increases during uncertain periods, when the committee needs to show a united front to the public. As Bernanke (2015) says in his autobiography, "I had emphasized the importance of considering all points of view and developing consensus. But, in a crisis, collaboration must give way to stronger direction. I was determined to offer that direction as needed".

Table 4.3 tests whether the shock of the Chairman becomes more relevant during uncertain times, which we measure by the standardized Vix index. The estimates show that the Chair's influence on other members greatly increases when uncertainty is higher. In fact, an increase of one standard deviation in the Vix index more than doubles the coefficient associated to the Chair's shock, and this estimative is significative at the 1% level. Column (3) of Table 4.3

[1] Since the innovation of the first speech by member j enters with a negative signal in the dependent variable

adds an interaction with a *dummy* for the 2008 and 2020 crises, showing that the results are not driven by these specific episodes.

Table 4.3: Effects of Speeches on dI_j (Effects of Uncertainty)

	dI_j		
Shock Speaker	-0.005	-0.003	-0.003
	(0.026)	(0.026)	(0.026)
Shock Speaker * Chair	0.116^{*}	0.131^{*}	0.143^{**}
	(0.070)	(0.068)	(0.073)
Shock Speaker * Vix		0.008	0.008
		(0.021)	(0.021)
Shock Speaker * Chair * Vix		0.168^{***}	0.184^{***}
		(0.055)	(0.053)
Vix		-0.103	-0.105
		(0.231)	(0.229)
Shock Chair * Crisis			-0.145
			(0.195)
Median Shocks Last Speeches	0.694^{***}	0.705^{***}	0.704^{***}
	(0.251)	(0.241)	(0.241)
Year-Week Fixed effects	Yes	Yes	Yes
Meeting Fixed effects	Yes	Yes	Yes
Treated Speaker Fixed effects	Yes	Yes	Yes
Observations	1,695	1,695	1,695
R^2	0.664	0.665	0.665

This table presents OLS estimates of Equation (3-6), with additional interactions with the Vix Index. The Vix Index is standardized. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

As an additional exercise, we test whether this influence is concentrated on less experienced members of the committee. More rookie members may feel compelled to follow the leadership of the Chairman and not diverge from his guidance publicly, due to career concerns. Additionally, as members acquire more experience with monetary policy-making, they may become more confident in their own analyses of the economy and the appropriate policy path, and therefore less influentiable[2].

Table 4.4 tests the hypothesis that the experience of the treated speaker matters for how he is influenced, where experience is measured by years serving at the committee. By only measuring experience in the FOMC, we seek to capture experience with actual monetary policy-making. Each column in Table 4.4 uses a different measure of experience: years of experience; years of experience plus years of experience squared; the logarithm of years of experience; and a *dummy* indicating whether that member what above the median of experience of the committee in that year. In all cases, the history is the same: the Chair influences considerable less more experienced members. In

[2]We formalize this proposition in the model in next section.

Table 4.4: Effects of Speeches on dI_j (Experience of Treated Speaker)

	dI_j				
Shock Speaker	-0.005	-0.004	-0.004	-0.005	-0.005
	(0.026)	(0.026)	(0.025)	(0.026)	(0.026)
Shock Speaker * Chair	0.116^{*}	0.261^{***}	0.341^{***}	0.339^{***}	0.191^{***}
	(0.070)	(0.082)	(0.096)	(0.094)	(0.071)
Shock Speaker * Chair * Years Exp		-0.023^{*}	-0.052^{**}		
		(0.012)	(0.023)		
Shock Speaker * Chair * Years Exp Squared			0.002^{*}		
			(0.001)		
Shock Speaker * Chair * Log(Years Exp)				-0.154^{**}	
				(0.060)	
Shock Speaker * Chair * Dummy Exp					-0.141
					(0.101)
Meeting effects	Yes	Yes	Yes	Yes	Yes
Year Week effects	Yes	Yes	Yes	Yes	Yes
Treated Speaker effects	Yes	Yes	Yes	Yes	Yes
Observations	1,695	1,695	1,695	1,695	1,695
R^2	0.664	0.665	0.666	0.665	0.664

This table presents OLS estimates of Equation (3-6), with additional interactions with measures of experience of the treated speaker. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

fact, an increase of 1pt in the innovation of the Chair's speech leads to a 0.26pt increase in the innovation of members who have just entered the committee in our preferred specification. In comparison, this effect would almost disappear for a member that has been in the committee for eleven years.

Table 4.5: Heterogeneity: Experience and Position of Speaker

	dI_j		
Shock Speaker	−0.041	−0.062	−0.065
	(0.058)	(0.062)	(0.051)
Shock Speaker * Chair	0.190	0.185*	0.147*
	(0.100)	(0.098)	(0.081)
Shock Speaker * President	0.075	0.065	0.060
	(0.062)	(0.060)	(0.064)
Shock Speaker * Years Exp	−0.003	0.005	
	(0.006)	(0.009)	
Shock Speaker * Years Exp Squared		−0.000	
		(0.000)	
Shock Speaker * Dummy exp			0.030
			(0.053)
Year-Week Fixed effects	Yes	Yes	Yes
Treated Speaker Fixed effects	Yes	Yes	Yes
Meeting Fixed Effects	Yes	Yes	Yes
Observations	1,695	1,695	1,695
R^2	0.664	0.665	0.664

This table presents OLS estimates of Equation (3-6), where we add interactions with a *dummy* indicating whether member i is a Regional Bank President, as well as interactions with measures of experience of speaker i. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Finally, one may ask whether experienced members influence other committee members more. Apart from actual experience, there could also be differences associated to members' roles in the committee. Hence, in Table 4.5, we test both hypothesis at once, adding interactions of member i's shock with measures of his experience, as well as with a *dummy* indicating whether he is a Regional Bank President. While both interactions are not significative, the estimated interactions with experience are close to zero, while the coefficients associated to Presidents are at least positive. In the next section, we'll delve deeper into the possible mechanisms why Presidents could influence other members.

5
Mechanisms

5.1
Model

In this section we outline a simple model in order to illustrate the information transmission mechanism between speeches. Our model has two policy-makers who speak in sequence: Chairman c and Committee's Member i.[1] In every period t, there is a realization of an economic variable that affects monetary policy, unobserved by policymakers, $\varepsilon_t \sim N(0, \tau_\epsilon^{-1})$. More generally, one can think of ϵ_t as any measure of the economic activity that is unobserved by policymakers, such as the true slope of the Phillips Curve, the persistence of inflationary pressures, or even the idiosyncratic component of incoming data that has not yet been captured by some public statistics. For simplicity, we'll refer to ε_t as the unobserved output gap.

Members differ in their priors about the output gap, which they believe is $\varepsilon_t \sim N(0, \tau_{\epsilon i}^{-1})$, where $\tau_{\epsilon i} = \tau_\epsilon + \gamma_i$. We assume more experienced members are overconfident about their priors, that is, $\gamma_i > 0$. We assume that, when each policy-maker j ($j = c, i$) speaks, he or she observes an information signal $e_j \sim N(\epsilon_t, \tau_j^{-1})$ of the output gap. Member j's preferred interest rate is $i_j = z_j + \mathbb{E}[\varepsilon_t \mid I_j]$, where I_j is his information set and z_j is his private policy preference.

Before a fixed meeting t, we assume there are two periods. In the first period, the Chairman receives his information signal and then speaks. In the second period, member i observes the signal emitted by the Chairman, receives his own information signal, redefines his prior about ϵ_t, and then speaks. After the speeches, members meet and decide the interest rate.

In the first period before the meeting, the Chairman receives an information signal $e_c \sim N(\varepsilon_t, \tau_c^{-1})$, centered around the true output gap, and then speaks. We'll assume for simplicity that the Chair doesn't have a bias in his prior about the economy ($\gamma_c = 0$). The Chair's inference about the output gap is then:

$$\mathbb{E}[\varepsilon_t \mid e_c] = \frac{\tau_c}{\tau_\epsilon + \tau_c} e_c$$

Notice that $\mathbb{E}[\varepsilon_t \mid e_c]$ is a weighted average between the Chair's prior (0) and the Chair's signal (e_c), where the weights are the prior and signal's precisions, respectively. The Chair's signalled interest rate will then be:

$$i_c = E(\varepsilon_t | e_c) + z_c \tag{5-1}$$

We can think of $\mathbb{E}[\varepsilon_t \mid e_c]$ as the speech of the Chair concerning economic activity, and of z_c as his speech concerning policy suggestions. In the second

[1] We restrict the first member to be the Chairman just to facilitate interpretability of results, but one can think more generally as any two committee members speaking in sequence

period before the meeting, member i also receives his information signal $e_i \sim N(\varepsilon_t, \tau_i^{-1})$ before speaking. Member i observes both the economic activity and the policy speeches of the Chairman. We assume that, despite member i's bias in his prior about the economy ($\gamma_i \neq 0$), he can recover the signal received by the Chair e_c from his speech. Member i's inference about the output gap (his economic activity speech) is then:

$$\mathbb{E}[\varepsilon_t \mid e_c, e_i] = \frac{\tau_c}{\tau_{\epsilon i} + \tau_c + \tau_i} e_c + \frac{\tau_i}{\tau_{\epsilon i} + \tau_c + \tau_i} e_i$$

The covariance between the economic activity speeches will be:

$$\mathbb{E}[E(\varepsilon_t | e_c)\mathbb{E}[\varepsilon_t \mid e_c, e_i]] = \frac{\tau_c}{\tau_\epsilon(\tau_c + \tau_\epsilon)} \frac{\tau_c + \tau_\epsilon + \tau_i}{\tau_c + \tau_\epsilon + \tau_i + \gamma_i}$$

Hence, we get covariance in the speeches from the bayesian updating about the state of the economy of member i after receiving information from the Chairman's speech. Note that:

1. $\frac{\partial E[u_i u_c]}{\partial \tau_c} > 0$, the covariance is increasing in the precision of the Chair's signal
2. $\frac{\partial E[u_i u_c]}{\partial \tau_\epsilon} < 0$, the covariance is greater when uncertainty is higher (τ_ϵ is lower)
3. $\frac{\partial E[u_i u_c]}{\partial \gamma i} < 0$, the covariance is decreasing in the confidence member i has on his prior

The first derivative points to the fact that, the better the private information the Chair has (or whoever is speaking first), the greater will be the correlation between the speeches, since members will put a greater weight on the information received from the speech. Members' private information may reflect anecdotal evidence they collect[2], differences in forecasts[3], or the information FED Presidents have of their own districts[4]. This precision may also come from a better analysis of the economic situation given observable data, what Bernanke (2005) describes as "what central bankers call "current analysis(...)getting an accurate assessment of the current economic situation. Doing this well requires a deep knowledge of the data mixed with a goodly dose of economic theory and economic judgment".

[2] "staff and policymakers alike spend a lot of time collecting and using anecdotal information that we gather from an extensive network of contacts. This anecdotal information helps us to see what is going on in the economy almost as it is happening.(...)A well-known example of this hands-on approach is that the president of the Minneapolis Fed has been known to make regular visits to local shopping malls to count the cars in the parking lots." (POOLE, 2002)

[3] "some of the differences in policy choices probably reflect underlying differences in forecasts, not just differences in Taylor-rule parameters" (KOHN, 2008)

[4] "The current practice is that Bank presidents generally go first, because they have information that the governors do not have–information about developments in their own regions. The presidents, in addition to having regional information, also tend to have real-time information about consumer spending, business investment, and wage and price developments, for example, gathered from speaking to firms in their Districts." (MEYER, 1998)

The fact that members adjust their information sets by observing information released by other members is supported by anecdotal evidence. William Poole, former President of the Federal Reserve Bank of St. Louis, observes that "over the years I have become impressed by how often my own position would change even in the days just before a meeting as a consequence of the arrival of new information, including staff analysis and sound arguments by my FOMC colleagues" (POOLE, 2008). This has also been pointed by Stanley Fischer, former Vice-Chairman of the committee: "A member of a committee may well have valuable economic information not known by their colleagues until he or she relays it..." (FISCHER, 2017).

The second derivative says that the information aggregation mechanism will become more important during uncertain times, when assessing the true state of the economy from incoming data may become harder. As put by Minehan (2006), former President of the Federal Reserve Bank of Boston, "uncertainty means there is always a vital role for judgment in setting monetary policy(...)In such circumstances, it is even more important than usual to gather information from diverse sources and from multiple perspectives."

The third derivative is meant to capture the importance of experience to how much a member is influenceable. If more experienced members have greater confidence on their priors about the economy, then they will give less weight to the new information received by other members' speeches.

However, a second source of correlation between the policy speeches could arise from pure influence, or leadership, arising from some policymakers. We model this influence as the first member who speaks persuading member i to adjust his private policy preference by some parameter α, so that member i's signalled interest rate will be: $i_i = (z_i + \alpha) + \mathbb{E}[\varepsilon_t \mid I_j]$ Here we adopt a simple approach to illustrate the mechanism, but a possible way to model the persuasion mechanism would be the sender proposing models to influence the receiver's beliefs that better suit the data than the receiver's priors. See for example Schwartzstein and Sunderam (2021).

5.2
Discussion of Economic Activity and Policy

In this section, we try to identify the different channels through which members influence each other when making speeches. To do this, we analyze the language content of the topics identified in the minutes and speeches by the LDA analysis. For each topic, we analyze its 10 most probable words selected by the LDA algorithm. Then, according to these most common words, we classify the topic as related to either economic activity[5], policy suggestions[6], or unconventional policy suggestions (quantitative easing)[7].

Figures 5.1, 5.2 and 5.3 display representative topics of each of these

[5] "inflat", "condit", "product", "price", "consum", "spend", "busi", "econom", "pandem", "remain", "level", "growth", "finmkt", "credit", "economicoutlook", "trade", "global", "forecast", "project", "current"

[6] "support", "accommod", "tighten", "appropri", "targetrang", "fedfund", "term", "polici", "pace", "particip", "committe", "support", "employ", "goal", "rise", "measur", "monpol"

[7] "sale", "secur", "matur", "oper", "treasuri", "purchas", "assetpurchas", "longer", "guidanc", "mortgag", "balanc"

categories.

Figure 5.1: Wordclouds representing the probability distribution over words. These topics were selected as regarding the discussion of the economic situation

Figure 5.2: Wordclouds representing the probability distribution over words. These topics were selected as regarding the discussion of QE measures

Figure 5.3: Wordclouds representing the probability distribution over words. These topics were selected as regarding the discussion of policy measures

The economic activity topics arguably capture the information content in the members' speeches, since they are mostly related to the discussion of the economic conjuncture, state of inflation, unemployment and financial markets. The policy topics arguably capture the preference content of speeches, since they concern the raising or lowering of interest rates, the pace of monetary policy, or the provision of support measures. Finally, the QE topic captures preferences in a different manner, since it relates to a specific monetary policy tool that only began to be used after the 2008 crisis, therefore representing "unconventional" monetary policy measures.

For each group of topics τ = "economic situation", "policy", "QE", we compute a signalled interest rate for each speech in our database using only the portion of that speech that concerns topics of this group. Remembering equation (3-3) of section 3.2, and letting $\hat{\theta}_{\tau,s}$ and $\hat{\gamma_\tau}$ denote the vector of probabilities of speech s over the topics in group τ and the vector of coefficients of topics in group τ, respectively, we calculate the policy stance of speech s regarding topic τ as:

$$\hat{i_{\tau,s}} = \hat{\alpha_0} + \hat{\gamma_\tau}'\hat{\theta}_{\tau s} \tag{5-2}$$

Similarly to section 3.3, we estimate the same Taylor Rule for each group interest rate and use the residuals in our analysis:

$$I_{i,\tau,s} = \hat{i_{i,\tau,s}} - \widehat{i_{i,\tau,s}} \tag{5-3}$$

Where $\widehat{i_{i,\tau,s}}$ is the fitted Taylor Rule for the portion of speech s discussing group of topics τ of speaker i. We reproduce our main specification by estimating equation (3-6) with the Chair's shocks disaggregated. The results are shown in Table 5.1, where we also add an interaction with a standardized Vix Index to account for uncertainty.

As can be seen in Table 5.1, the Chair has a strong influence on other

Table 5.1: Effects of Speeches on dI_j (Decomposition of Speeches)

	dI_j	
Shock Speaker	-0.005	-0.003
	(0.026)	(0.027)
Shock Speaker (Economic Activity) * Chair	0.105	0.119
	(0.090)	(0.084)
Shock Speaker (Policy) * Chair	0.283^{**}	0.273^{**}
	(0.135)	(0.129)
Shock Speaker (QE) * Chair	-0.021	0.010
	(0.269)	(0.262)
Shock Speaker (Economic Activity) * Chair * Vix		0.183^{***}
		(0.065)
Shock Speaker (Policy) * Chair * Vix		0.270
		(0.277)
Shock Speaker (QE) * Chair * Vix		-0.029
		(0.305)
Year-Week Fixed effects	Yes	Yes
Meeting Fixed effects	Yes	Yes
Treated Speaker Fixed effects	Yes	Yes
Observations	1,695	1,695
R^2	0.664	0.666

This table presents OLS estimates of Equation (3-6), with the Chairman's shocks disaggregated. The regressions include the standardized Vix, whose coefficient is not reported. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Table 5.2: Effects of Speeches on dI_j (Disaggregated)

	dI_j (Activity)	dI_j (Policy)	dI_j (QE)
Shock Speaker	-0.002	0.001	-0.003
	(0.022)	(0.010)	(0.006)
Shock Speaker (Economic Activity) * Chair	0.079	-0.007	0.047
	(0.075)	(0.026)	(0.029)
Shock Speaker (Policy) * Chair	0.078	0.164^{**}	0.031
	(0.092)	(0.083)	(0.026)
Shock Speaker (QE) * Chair	-0.059	0.175	-0.107
	(0.224)	(0.151)	(0.125)
Shock Speaker (Economic Activity) * Chair * Vix	0.133^{**}	0.023	0.027
	(0.062)	(0.028)	(0.021)
Shock Speaker (Policy) * Chair * Vix	0.235	-0.001	0.037
	(0.192)	(0.075)	(0.048)
Shock Speaker (QE) * Chair * Vix	0.154	-0.037	-0.146
	(0.228)	(0.081)	(0.108)
Median Shocks Last Speeches	0.507^{***}	0.097	0.091
	(0.179)	(0.114)	(0.078)
Year-Week Fixed effects	Yes	Yes	Yes
Meeting Fixed effects	Yes	Yes	Yes
Treated Speaker Fixed effects	Yes	Yes	Yes
Observations	1,695	1,695	1,695
R^2	0.645	0.583	0.636

This table presents OLS estimates of Equation (3-6), where we disaggregate both the Chair's and the treated speaker's shocks. The regressions include the standardized Vix, whose coefficient is not reported. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

members specifically when he suggests the appropriate policy path of interest rates. His policy suggestions also seem to become more influent during uncertain times, although the coefficient is not significative. On the other hand, the opposite happens when the Chair speaks about economic conditions. This portion of speeches has a positive but not significative coefficient during normal times, but becomes highly influential, at the 1% significance level, during uncertain times. This finding is consistent with the model we presented, where private information and accurate analyses of the economy's state become more relevant when the prior about the economy becomes more uncertain.

In Table 5.2, we also disaggregate the response of speaker j. As can be seen, when the Chair suggests the policy path, speaker j also responds by changing his speech's stance on the appropriate policy path. Similarly, when the Chair speaks about economic conditions, member j accordingly adjusts his speech's stance discussing activity.

Table 5.3 tests whether Regional Presidents also have influence on other members when speaking about economic conditions, since they possess private information about the economy in their own districts possibly not known by other members. As can be seen, the portion of Presidents' speeches discussing economy activity is highly influential on other members' stance on economic activity, at the 1% level. However, unlike the Chair, there is not a differential effect of the Presidents' influence during uncertain times. This probably occurs because the Vix Index captures uncertainty at the national level.

Table 5.3: Effects of Speeches on dI_j (Decomposition of Speeches)

	dI (Activity)	
Shock Speaker	-0.087^{***}	-0.085^{***}
	(0.033)	(0.032)
Shock Speaker (Economic Activity) * Chair	0.139	0.158^{*}
	(0.093)	(0.090)
Shock Speaker (Policy) * Chair	0.171^{*}	0.161^{*}
	(0.095)	(0.088)
Shock Speaker (QE) * Chair	0.044	0.036
	(0.234)	(0.224)
Shock Speaker (Economic Activity) * President	0.132^{***}	0.133^{***}
	(0.045)	(0.045)
Shock Speaker (Policy) * President	0.088	0.085
	(0.060)	(0.059)
Shock Speaker (QE) * President	0.054	0.046
	(0.076)	(0.080)
Shock Speaker (Economic Activity) * Chair * Vix		0.130^{**}
		(0.061)
Shock Speaker (Policy) * Chair * Vix		0.226
		(0.194)
Shock Speaker (QE) * Chair * Vix		0.157
		(0.224)
Shock Speaker (Economic Activity) * President * Vix		0.021
		(0.025)
Shock Speaker (Policy) * President * Vix		-0.036
		(0.053)
Shock Speaker (Policy) * President * Vix		-0.020
		(0.081)
Year-Week Fixed effects	Yes	Yes
Meeting Fixed effects	Yes	Yes
Treated Speaker Fixed effects	Yes	Yes
Observations	1,695	1,695
R^2	0.646	0.647

This table presents OLS estimates of Equation (3-6), where we disaggregate both the Chair's and Presidents' shocks. The regressions include the standardized Vix, whose coefficient is not reported. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

6
Exogenous Shocks

6.1
Identifying Topics in Speeches

In this section, we present a robustness exercise concerning how we analyse members' communication. More specifically, instead of applying the Latent Dirichlet Allocation (LDA) algorithm to the minutes' text corpus, and then estimating the posterior distribution of these topics in the speeches, we apply the LDA algorithm to identify the topics directly in the speeches. This approach has two benefits. First, the algorithm works better in separately identifying the topics when applied directly to speeches. Second, we can identify a more diverse range of themes in the speeches, apart from those that appear in the minutes of the meetings. As an example, Figures 6.1, 6.2 and 6.3 show representative topics we identified in the speeches, concerning a very diverse range of themes: regional economic conditions, productivity and technology, the fiscal situation, the job market, the housing market, global conditions, among others. Additionally, the topics that discuss policy suggestions are better identified, as shown in Figure 6.3.

The disadvantage of this approach is that we don't have a mapping indicating what each topic signals in terms of interest rates. In other words, we can't project members' preferences in a unidimensional scale. Therefore, we'll proceed our exercise analysing the shares of each topic in members' speeches.

Figure 6.1: Wordclouds representing the probability distribution over words. These topics seem to discuss regional economic conditions, investment and growth, productivity and technology, and the fiscal situation

Figure 6.2: Wordclouds representing the probability distribution over words. These topics seem to discuss financial stability, the job market, global conditions and the housing market

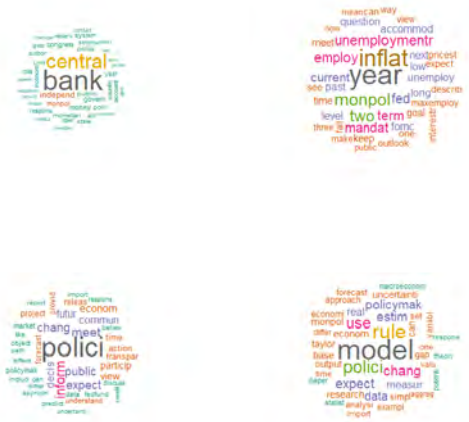

Figure 6.3: Wordclouds representing the probability distribution over words. These topics seem to discuss policy sugestions and the FED's monetary policy

As we did in the previous section, we separate the language topics into groups. Since we were able to gain a more granular division of topics, we separate them into a more diverse range of themes.[1]

First, we reproduce our main specification using topics' shares instead of speeches' signalled interest rates. The timeline of events is shown in Figure 6.4.

[1]More specifically, we separate them into regional conditions, financial stability, productivity and technology, fiscal situation, labor market, global conditions and trade, household income and wealth, housing market, inflation, growth and consumption, forecasting, education, pandemics, QE, policy suggestions, and "noisy" topics without informational content

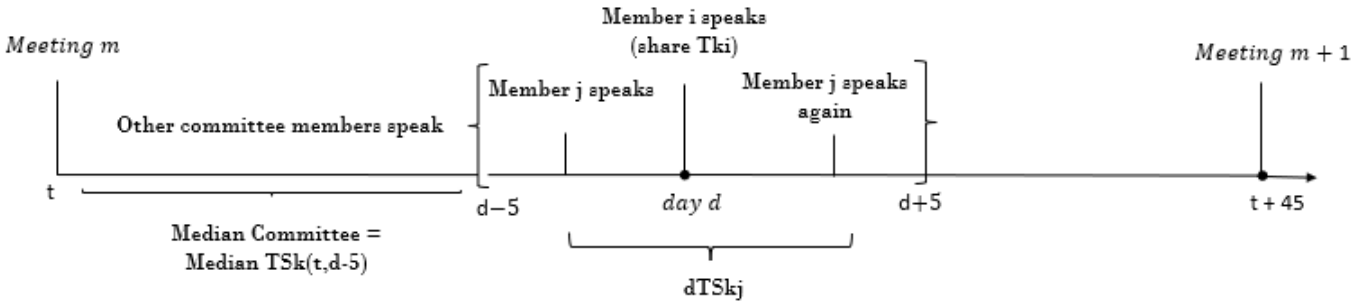

Figure 6.4: Timeline of Events

We estimate:

$$dTS_{k,j} = \beta_0 + \beta_1 TS_{k,i} + \beta_2 TS_{k,i} Chairman + \beta_3 MedianTopicsCommittee_k + \beta_4 \alpha_{meeting} + \beta_5 \alpha_{week-year} + \beta_6 \alpha_{speakerj} + \epsilon_{i,t} \quad (6\text{-}1)$$

where $TS_{k,i}$ is the share of topics of group k in the speech of member i, and $dTS_{k,j}$ is the difference in the share of topics in group k between the speeches of member j that were made right after and right before the speech by member i. Our results are shown in Tables 6.1 and 6.2. Besides the fixed effects, we also add as covariates the same macroeconomic controls we used in our Taylor Rule in the previous sections, as well as macroeconomic news in these indicators in the windows around speeches.

Table 6.1: Effects of Speeches on $dTopic$ (Disaggregated Topics)

	dTopic					
	Policy	Growth	Inflation	Labor	Productivity	QE
Topic Speaker	−0.007	0.021	0.001	−0.014	0.047	−0.011
	(0.010)	(0.017)	(0.032)	(0.025)	(0.032)	(0.021)
Topic Speaker * Chair	0.082*	−0.040	0.053	0.055	0.017	−0.400***
	(0.050)	(0.047)	(0.059)	(0.087)	(0.033)	(0.107)
Topic Speaker * Vix	−0.001	−0.018	−0.026	0.017	0.065	0.042*
	(0.010)	(0.014)	(0.039)	(0.044)	(0.055)	(0.023)
Topic Speaker * Chair * Vix	−0.054	0.082*	0.141**	0.183	0.198***	0.111***
	(0.033)	(0.045)	(0.069)	(0.152)	(0.056)	(0.032)
Median Topics	−0.172	0.005	−0.015	0.174	0.036	−0.130
	(0.112)	(0.101)	(0.092)	(0.344)	(0.049)	(0.117)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro surprises controls	Yes	Yes	Yes	Yes	Yes	Yes
Week, Meeting, Speaker effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,028	11,352	5,676	1,892	3,784	3,784
R^2	0.097	0.183	0.288	0.588	0.365	0.379

This table presents OLS estimates of Equation (6-1), with the Chairman's shocks disaggregated. The regressions include the standardized Vix, whose coefficient is not reported. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Table 6.1 shows that our results are robust to this alternative framework. More specifically, when the Chair speaks more about the appropriate policy path, other members also speak more about policy. On the other hand, themes

related to economic conditions, such as growth, inflation, the labor market and productivity, are only significative during uncertain times. Finally, the coefficient associated to the share of the Chair's speech about quantitative easing is negative during normal times, but becomes less negative when uncertainty rises. This may suggest resistance from other members in accepting unconventional monetary policy suggestions from the Chairman except in a crisis period.

Table 6.2 shows that the portion of the Chairman's speech for other topics (financial conditions, fiscal situation, global and trade, household income and wealth, real state and regional conditions) is not significative either during normal or uncertain times in explaining other members' speeches.

Table 6.2: Effects of Speeches on Topics

	dTopic					
	Financial	Fiscal	Global	HH Income	Real Estate	Regional
Topic Speaker	0.020	0.103*	−0.029	−0.000	−0.032	−0.033
	(0.013)	(0.057)	(0.022)	(0.051)	(0.025)	(0.023)
Topic Speaker * Chair	−0.052	−0.067	−0.106	0.450	0.081	−0.148
	(0.036)	(0.062)	(0.156)	(0.295)	(0.065)	(0.141)
Topic Speaker * Vix	−0.016	0.024	−0.007	−0.043	0.038**	−0.020
	(0.013)	(0.091)	(0.023)	(0.066)	(0.018)	(0.019)
Topic Speaker * Chair * Vix	−0.053	0.028	0.094	0.155	−0.152***	−0.022
	(0.036)	(0.071)	(0.086)	(0.219)	(0.035)	(0.254)
Median Topics	−0.099**	0.737	−0.005	0.262**	0.410	0.309
	(0.049)	(0.539)	(0.076)	(0.105)	(0.291)	(0.350)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro surprises controls	Yes	Yes	Yes	Yes	Yes	Yes
Week, Meeting, Speaker effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,812	1,892	5,676	1,892	3,784	1,892
R^2	0.075	0.577	0.208	0.482	0.380	0.624

This table presents OLS estimates of Equation (6-1), with the Chairman's shocks disaggregated. The regressions include the standardized Vix, whose coefficient is not reported. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

6.2
Instrumenting Presidents' Shocks

In this section we try to identify exogenous sources of variation in the Regional Presidents' speeches about economy activity. The first is the voting status. Although all Regional Presidents participate in the FOMC meetings, they rotate annually as voters. The President of the New York FED is always a voting member. However, four of the other eleven Presidents vote each year, in a rotating scheme. In Table 6.3, we show how the voter's status affects the share of each topic in Presidents' speeches, where we select the topics most related to economic conditions. As can be seen in Table 6.3, voting Presidents speak more about inflation and regional conditions in their speeches, while speaking less about productivity. The voting status doesn't seem to affect how much they speak about the financial stability, the labor market, and economic growth.

Our second source of exogenous variation in Presidents' speeches about economic conditions comes from the fact that they care more about their district's economic conditions relative to national economic conditions (JUNG;

Table 6.3: First Stage: Voting Presidents

	Topic Share					
	Growth	Inflation	Labor	Technology	Regional	Financial Stab.
Voter	−0.002	0.005***	−0.005	−0.006***	0.007***	−0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)
Constant	0.025***	0.025***	0.026***	0.019***	0.022***	0.015***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)
Observations	7,656	3,828	1,276	2,552	1,276	14,036
R^2	0.001	0.002	0.003	0.005	0.006	0.000
F Statistic	4.172**	7.774***	3.755*	13.306***	8.145***	0.515

This table presents the first stage estimates of how the voter status affects the shares discussing each topic in Presidents' speeches. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

LATSOS, 2015; BENNANI; FARVAQUE; STANEK, 2018)). Therefore, we use the difference between a Regional President's district and national unemployments as a second instrument[2]. The first stage regression in shown in Table 6.4. In particular, as relative unemployment increases in the district of a President, he speaks more about growth and inflation and less about financial stability, although this doesn't affect how much he speaks about the labor market, productivity and, surprisingly, regional conditions.

Table 6.4: First Stage: Difference between district and national unemployment

	Topic Share					
	Growth	Inflation	Labor	Technology	Regional	Financial Stab.
Diff Unemp	0.003***	0.007***	0.003	−0.002	0.001	−0.005***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Constant	0.024***	0.028***	0.024***	0.016***	0.025***	0.014***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Observations	7,758	3,879	1,293	2,586	1,293	14,223
R^2	0.001	0.006	0.001	0.001	0.000	0.007
F Statistic	9.965***	23.981***	1.841	2.313	0.112	98.186***

This table presents the first stage estimates of how the difference between district and national unemployments affects the shares discussing each topic in Presidents' speeches. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

In Table 6.5, we test a first stage using the voter's status, the difference between the district and national unemployment, and the interaction between these two variables. Here we seek to leverage the fact that voting presidents may react differently to regional conditions than non-voting presidents to obtain an additional source of exogenous variation. The interactions are significative for the discussion of growth, regional conditions and financial stability, suggesting that voting presidents react differently to unemployment in their districts relative to non-voting Presidents.

Table 6.6 presents our 2SLS estimates of Equation (6-1), restricting our sample to Presidents and using as instruments the voting status, the difference between districts and national unemployments, and the interaction between these variables. We only present results for the topics where the estimated coefficients were significative. As can be seen, while the OLS estimates are

[2]The districts' unemployment series were discontinued in 2015. As an alternative, we construct a district's unemployment series weighting the unemployment rates of states whose at least a region is part of that district.

Table 6.5: First Stage: Interaction

	Topic Share					
	Growth	Inflation	Labor	Technology	Regional	Financial Stab.
Diff Unemp	0.005^{***}	0.006^{***}	0.003	-0.003	0.002	-0.007^{***}
	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)
Voter	-0.003^{*}	0.004^{**}	-0.005^{*}	-0.006^{***}	0.007^{***}	0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)
Diff Unemp * Voter	-0.006^{***}	0.002	0.001	0.003	-0.006^{*}	0.005^{***}
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)
Constant	0.025^{***}	0.026^{***}	0.026^{***}	0.019^{***}	0.023^{***}	0.014^{***}
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.000)
Observations	7,656	3,828	1,276	2,552	1,276	14,036
R^2	0.004	0.008	0.005	0.006	0.009	0.009
F Statistic	9.241^{***}	10.418^{***}	2.009	5.327^{***}	3.657^{**}	41.384^{***}

This table presents the first stage estimates of how the difference between district and national unemployments, the voter status and the interaction between those variables affect the shares discussing each topic in Presidents' speeches. Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

essentially zero and non-significative (except for a small significance when they speak about growth), all estimates are positive, greater in size, and significative when using the instrumental variables. Reassuringly, the topics which have positive estimates relate to when Presidents speak about regional conditions, growth and financial stability, precisely the themes in which they probably have better private information than the rest of the committee.

Table 6.6: Effects of President Speeches on $dTopic$: Instrumental Variables Estimation

	dTopic					
	OLS	*IV*	*OLS*	*IV*	*OLS*	*IV*
	Regional		Growth		Financial Stability	
Topic President	0.002	0.457^{*}	0.027^{*}	0.570^{***}	0.028	0.380^{**}
	(0.016)	(0.243)	(0.015)	(0.201)	(0.024)	(0.175)
Median Last Topics	-0.193	-0.244	-0.055	-0.371^{**}	-0.123^{**}	-0.199^{***}
	(0.202)	(0.224)	(0.098)	(0.171)	(0.057)	(0.076)
Economic Indicators	Yes	Yes	Yes	Yes	Yes	Yes
Economic Surprises	Yes	Yes	Yes	Yes	Yes	Yes
Week, meeting, speaker effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,198	1,181	7,188	7,086	13,178	12,991

This table presents OLS and 2SLS estimates of Equation (6-1). Reported standard errors are robust to heteroscedasticity and clustered at the speaker level. Numbers in parentheses are the coefficients' standard errors. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

6.3
Exogenous Introduction of QE during 2008 crisis

While the last section was concerned with identifying exogenous sources of variation in the information transmission channel of influence, in this section we try to identify an exogenous variation in the policy persuasion channel of influence. Influence orthogonal to information transmission could be related to

two mechanisms: strategic alignment - that is, the Chair calibrating the tone of his speech in order to accommodate other committee's members and members following the Chair to minimize dissent - or pure influence, or leadership in policy-making, arising from persuasive arguments and respect from the other policymakers.

We address the concern with the fact that the Chair could be backward-looking and observe the median of the committee's preferences before making his policy suggestion by including the median as a control in our main specifications. Our regressions could still be vulnerable to biases arising from forward-looking behavior, however. In particular, the Chair could only suggest what he already knows will be accepted by other members.

In order to identify an exogenous policy suggestion, we look at the beginning of the large-scale asset purchases (Quantitative Easing, or QE) policies during the 2008 crisis. Figure 6.5 shows the two topics related to QE purchases that were identified by the LDA directly in the speeches' textual corpus.

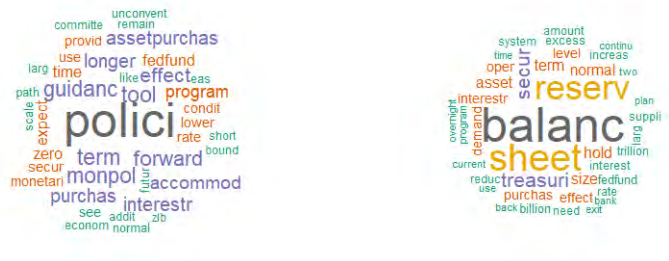

Figure 6.5: Wordclouds representing the probability distribution over words. These topics were selected as regarding the discussion of quantitative easing policies

Note that, by construction, the LDA algorithm will always assign a positive probability to all topics in all speeches. Therefore, using a threshold helps delimiting when a speech actually first introduced a certain topic. We consider the threshold of 10% to plausibly identify a speech as discussing quantitative easing. Before 2008, 12 speeches in our database reach this threshold. By manually inspecting the speeches, however, they were not related to the discussion of QE measures, though some of them discussed the possible purchases of assets other than treasuries in a context of conducting traditional monetary policy in an environment of government surpluses and consequently scarcity of treasuries. There were two speeches, however, by Ferguson (2003) and Bernanke (2003) that discussed the adoption of QE policies in the possibility of a zero lower bound scenario in the United States.

Figures 6.6 and 6.7 analyze the crisis period (2008-2009) and highlight the first date in which each member made a speech whose share of QE topics exceeded 10%. We order members by the first date when they crossed the threshold of a speech whose QE topic exceeded 10%[3]. The first member was Ben Bernanke, Chairman at the time, in December 1st of 2008. Other members

[3]We exclude a speech by Frederic S. Mishkin, dated february 15, since it was not related

followed: Janet Yellen in 4th of January, Dennis Lockhart in 12th of January, Eric Rosengren in 27 of February, and so on.

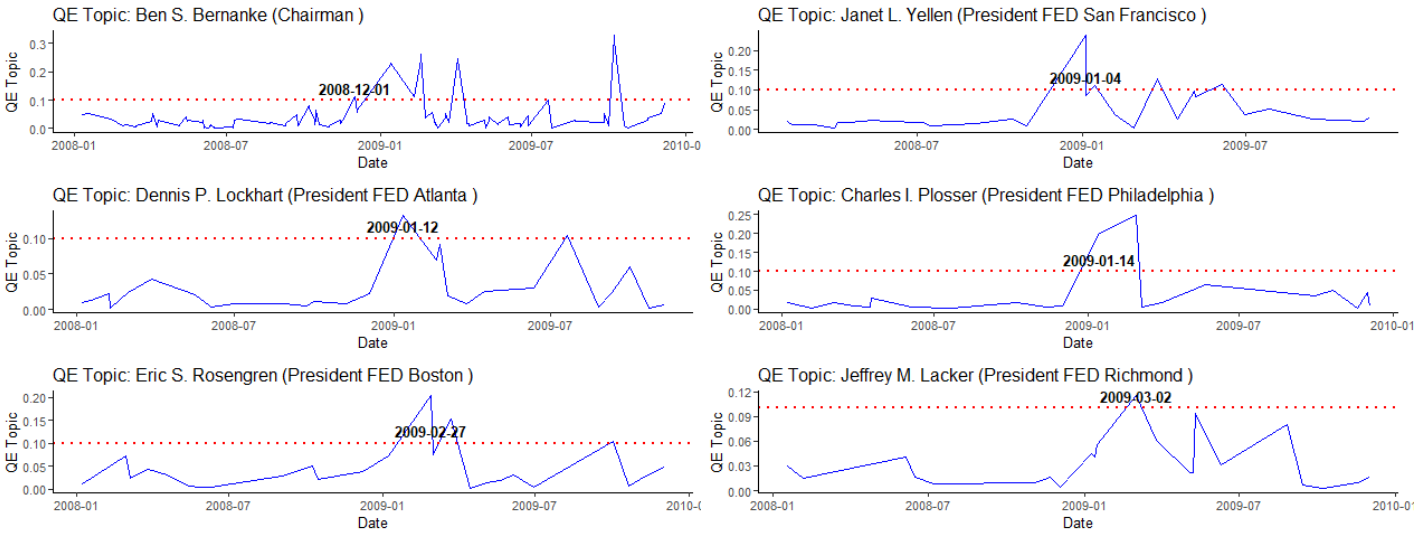

Figure 6.6: Timeline of Events (QE)

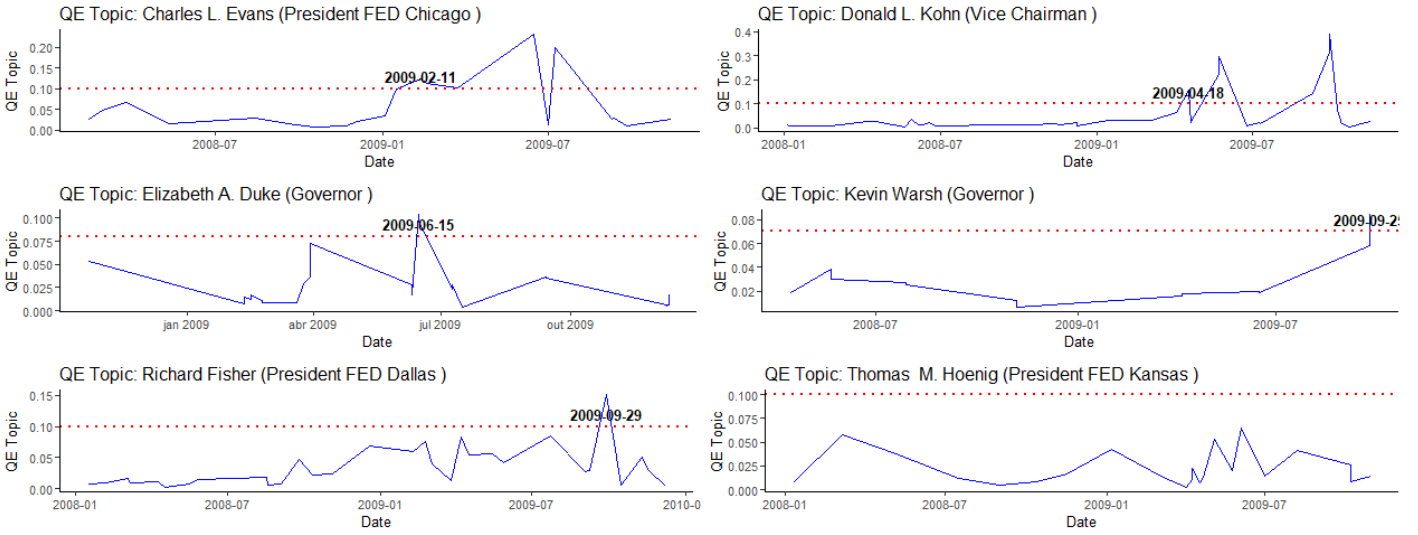

Figure 6.7: Timeline of Events (QE)

But is this timeline of events suggestive of a causal leadership from Bernanke to other members? In his autobiography, Bernanke (2015) says that "Before becoming Chairman, I had spoken about monetary policy after short-term interest rates reached zero. I was responding to a fairly widely held view that, once rates hit zero, it marked the exhaustion of monetary policy options. I had argued then to the contrary. Now the time had come to put my ideas into practice."

The large-scale asset purchases (LSAPs) of the FOMC were first announced in 25 of November of 2008. The policy began with the purchase of

to the adoption or suggestion of QE measures. We also don't include members who made few speeches during this period in the graphs

debt held by the government-sponsored enterprises Fannie Mae and Freddie Mac in December 2008 and of mortgage-backed securities (MBS) in January 2009. The purchase of long-term Treasuries began in March 2009. In his life remarks, Bernanke (2015) observes that he had wanted to pursue this policy, but had to convince other committee members: "With the mortgage market deteriorating, I had wanted to announce the MBS purchases as soon as possible.(...) No further FOMC approval was needed(...)But the Board's general counsel, Scott Alvarez, argued, and Brian and I were persuaded, that a program of this size and importance should be undertaken with FOMC approval, if only to maintain good relations. I had not forgotten the Reserve Bank presidents' concerns about insufficient consultation. We briefed the FOMC in a video conference about the proposal and its rationale. Afterward, Don and I worked the phones to see if FOMC participants would support it and, if so, whether they would be okay with an announcement before the next meeting. Confident that we had the Committee's support, we announced the plan to purchase MBS.(...)Despite Don's and my calls before the announcement, several presidents remained unhappy. They believed that, given the significance of the decision, I should not have announced the program before the FOMC formally voted".

The FOMC lowered interest rates to a range between 0% and 0.25% in the December 16 Meeting, officialy entering the zero lower bound restraint. Bernanke (2015) observes that "I had broached the possibility of systematically buying large quantities of Treasuries in a speech a few weeks earlier in Austin, Texas, and we said in our December FOMC statement that we would evaluate the possibility—a fairly strong hint to the market." This speech, given at December 1st of 2008, is the same speech our LDA analysis identified as the first of Bernanke that crossed the threshold of at least 10% of a QE share, titled "Federal Reserve Policies in the Financial Crisis". In this speech, Bernanke discussed the policy options of the FED in the zero lower bound: "Although conventional interest rate policy is constrained by the fact that nominal interest rates cannot fall below zero, the second arrow in the Federal Reserve's quiver– the provision of liquidity–remains effective. Indeed, there are several means by which the Fed could influence financial conditions through the use of its balance sheet, beyond expanding our lending to financial institutions. *First, the Fed could purchase longer-term Treasury or agency securities on the open market in substantial quantities. This approach might influence the yields on these securities, thus helping to spur aggregate demand.*" (BERNANKE, 2008)

In Figure 6.8, we implement an event study approach around the first speech of Bernanke suggesting to systematically purchasing long-term Treasuries, where the dependent variable is the share of members' speeches discussing Quantitative Easing measures. Each dot represents a 30 day window after or before the day when the speech was made (where december 1st is considered as the first day of the 30-day window of "month 1").

As can be seen, before the speech, this share was essentially zero. However, following the speech, specially in the first months of 2009 (the period later known as QE1), members started following Bernanke and speaking about QE in their speeches.

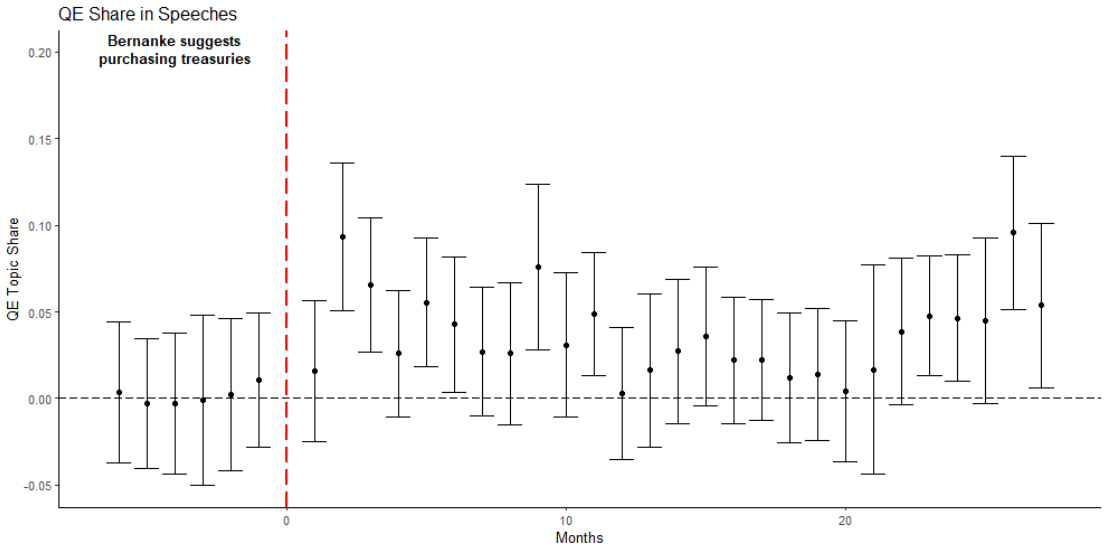

Figure 6.8: Event Study: Monthly Estimates

A limitation of this analysis is that we can't know whether members were supporting the same QE policies, or were speaking against it. We only know that the share of QE topics in members' speeches increased considerably after the introduction of the policy by Bernanke. We consider this as an evidence of pure influence arising from Bernanke during a crisis period.

7
Conclusion

In this paper we study leadership in policy-making using the FOMC as a particular setting. We present evidence that the Chairman of the committee systematically influences other members, using a novel approach in relation to the literature: the quantification and analysis of the effects of members' speeches on narrow windows of days. We also present evidence that the Chairman's influence is concentrated on less experienced members and greatly increases during periods of high uncertainty.

We propose a simple model illustrating the information transmission channel of influence and differentiating it from the persuasion channel. We are able to separately identify information transmission from pure influence by analyzing the language content of the speeches. Finally, to present evidence of an exogenous policy suggestion, we look at the beginning of the QE policies during the 2008 crisis.

Further work could study leadership in policy-making in other settings, such as speeches by politicians and other policymakers.

8
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