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## Abstract

Content analysis is used to analyze 60 years of FOMC minutes. Since there is no unique algorithm to quantify content two different algorithms are applied. Wordscores compares content relative to a chosen benchmark while DICTION is an alternative algorithm that is specifically designed to capture various elements that capture the sentiment or tone conveyed in a text. The resulting indicators are then incorporated into a VAR. The content of FOMC minutes is found to be significantly related to the state of the economy, notably real GDP growth and changes in the fed funds rate. However, the relationship between content and macroeconomic conditions changes after 1993 when minutes are made public with a lag. Both content indicators also suggest substantive changes in the content of FOMC minutes since the 1950s in terms of the FOMC's dovishness or hawkishness.

#### **Keywords**

FOMC minutes, Wordscores, DICTION, monetary policy stance, vector autoregression

#### **JEL Classification**

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# U.S. Monetary Policy Since the 1950s and the Changing Content of FOMC Minutes

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#### 1. Introduction

Economists are generally inclined to evaluate monetary policy successes and failures via inferences drawn from models. Often, but not always, the data employed are observable macroeconomic and financial time series. Key indicators, such as the output and inflation gaps are unobserved. As a result, several proxies are used in practice. More importantly, there are risks in interpreting the motives and actions of policy makers based on this approach because decisions are made in real time and it is difficult to recreate the data environment decision makers face when they announce their monetary policy decisions. Nowadays, monetary policy decisions are also communicated in the form of press releases, minutes of meetings, monetary policy reports, to give three examples. In principle, this allows policy makers to influence expectations without having to change the policy rate. Economists have known for some time that what central bankers say and write can have implications for how the stance or strategy of monetary policy is interpreted (e.g., Bulíř et.al. 2014, Fracasso et.al. 2003, Schonhart-Bailey 2013, Holmes 2014).

Recent events have served to heighten interest about what central bankers say and write. Whereas most of these developments are recent the U.S. Federal Reserve has a long history of publishing information, often with a lag, that provides a window into the thinking of policy makers. There is a rich trove of documentary evidence concerning the internal discussions of the Fed's policy making committee, namely the federal Open Market Committee (FOMC).

This study analyzes the contents of FOMC deliberations since the early 1950s when, following the 1951 Fed-Treasury Accord, the Fed was freer to implement a monetary policy stance of its own choosing. An objective of this study is to quantify the contents of FOMC minutes from 1952 to 2013 and to empirically examine its interaction with macroeconomic conditions. Generally, the existing literature that seeks to numerically code policy statements relies on far shorter samples.<sup>1</sup>

Needless to say, quantifying the contents of central bank minutes creates many challenges. For example, appointments to the FOMC from the academic community may well have influenced the terminology used to explain the Committee's actions. There have also been considerable

<sup>&</sup>lt;sup>1</sup> I am not, of course, the first to mine the content of FOMC minutes (see below).

improvements in our knowledge and ability to monitor economic developments over the decades. Both of these developments are likely to have an influence over the discourse of monetary policy.

The focus on FOMC minutes is motivated by several factors. First, given the long historical record of available FOMC minutes, we can attempt to trace the evolution of what policy makers were thinking across a variety of policy regimes over the past 60 years. This stands in contrast with the usual approach that subjectively interprets central bank communication by relying on a few chosen statements made by select FOMC members at specific moments in time. There is the risk that by 'cherry picking' statements we give undue emphasis to some passages over others.

Second, the minutes offer a window into the thinking inside the FOMC as well as the extent to which its members' policy decisions are driven by data at their disposal, currently fashionable models, or other factors. In contrast, the language contained in other central bank publications (e.g., press releases or Inflation Reports) typically also incorporates staff or consensus views inside the FOMC. To be sure these publications are also interesting in their own right. However, we do not have a historical record that comes even close to matching the one contained in FOMC minutes.

Third, we are currently in an era when policy rates are changing slowly or hardly at all. As markets and the public wonder about when and whether policy will ever resemble conditions that prevailed before the financial crisis of 2007-8, this led central bankers to increasingly rely on verbal explanations to communicate their decisions. In parallel with these developments there has also been a greater emphasis from central banks on transparency. Even during the current exit stage from the zero lower bound back to some new equilibrium fed funds rate level how future policy rate changes will be verbally communicated matters. In all of these circumstances, words not deeds play a critical role.

The present paper does not aim to determine the extent to which FOMC members understood, or applied, economic theories in vogue at the time the stance of monetary policy was determined or the level of sophistication of the debate. The paper also does not seek to determine whether the language used in FOMC statements over the years has become more or less readable (see, however, Hernandez-Murillo and Shell 2014) although Fed clarity in its communication is a by-

product of the exercise reported below. The algorithms used here are able to capture the tone of the content of the meetings along different dimensions and this should, in principle, be affected by and, under certain circumstances, possibly influence the economic environment.

When choosing to study FOMC minutes over several decades the year 1993 is an important milestone when it became known that the Fed held transcripts of FOMC meetings previously not known to exist. The release of the transcripts, albeit with a five year lag, is thought to represent a 'structural' break of sorts in how FOMC members would henceforth conduct their deliberations (also, see Danker and Luecke 2005, and Hansen, McMahon and Prat 2018). Consequently, it has sometimes been alleged that since the transcripts would eventually be released this has served to stifle the discussion (e.g., Meade and Stasavage 2008). Not everyone, of course, shares this interpretation (e.g., Woolley and Gardner 2009). Therefore, an additional hypothesis consists in asking whether the link between the content of FOMC minutes and macroeconomic outcomes changes after 1993.

Unlike most comparable studies, I rely on two different methodologies to quantify the content of FOMC minutes. Between 1952 and 1992 these are referred to as 'historical minutes'. For convenience all such texts are henceforth referred to as minutes. Next, a small standard econometric model is estimated with the aim of empirically investigating how central bank communication, in the form of the content of the minutes, may have influenced or responded to the stance of monetary policy. Both forward-looking and real time elements of monetary policy decisions are also accounted for where possible.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the changing environment inside the FOMC since the 1950s as well as the challenges this poses in trying to gauge and quantify the evolution of the content of policy meetings. Section 3 outlines the two methodologies used in this paper to quantify the content of FOMC minutes. Some stylized facts are also provided as a prelude to the empirical evidence discussed in section 4. Section 5 concludes and summarizes the paper's findings and its potential implications.

Briefly, the paper finds that the impact of minutes does change after 1993. In addition, the most significant link found is between the proposed proxies for central bank communication and real GDP growth or changes in the stance of monetary policy, not inflation. The failure to find a

statistically significant link between central bank communication and inflation, especially before 1993, may well reflect differences between policy recommendations made in real time versus ones obtained using ex post revised data that Orphanides (2001) highlighted. Alternatively, this result could also reflect changing views about the level of inflation consistent with price stability. A direct relationship between the content of the minutes and changes in the fed funds rate is also found. However, the size of the response of the fed funds rate to indicators of the content of the FOMC's deliberations is smaller after 1993 than when the minutes were not made public.

Finally, interpreting the content of a document for signs of hawkishness or dovishness also depends on whether a benchmark is used to determine the tone of a document. In other words, content measured in relative rather than absolute terms will impact its interaction with observed macroeconomic time series.

#### 2. The Evolving Role and Functions of FOMC Minutes

#### The Evolution of the FOMC and its Minutes

The FOMC, the principal policy making committee of the U.S. Federal Reserve, consists of 12 members. Seven are from the Board of Governors while the remaining five are Reserve Bank Presidents. The Reserve Bank Presidents serve one term on a rotating basis from the 12 Reserve Banks in the system sub-divided into four groups. Only the President of the New York Federal Reserve Bank has a permanent seat on the FOMC<sup>2</sup> Members are appointed by the President and confirmed by the Senate for 14 year terms. The Chair of the FOMC currently serves a four year renewable term. Members from the Reserve Banks also serve renewable terms (5 years) but they are appointed by the Board of Directors in their own districts.

Figure 1 provides a stylized timeline of the evolution of key changes in the release of written and verbal documentation by the FOMC that are most germane to the present study. The minutes of the FOMC meetings are currently released 3 weeks after a policy decision. This has been the policy since December 2004. In 1993 the Board of Governors released minutes of the FOMC

<sup>&</sup>lt;sup>2</sup> See <u>http://www.federalreserve.gov/monetarypolicy/fomc.htm</u>.

meetings shortly after it emerged that transcripts, the most detailed account of FOMC meetings, had been recorded.<sup>3</sup>

Prior to 1967, the Record of Policy Actions and the Minutes of Actions were the only documents describing FOMC proceedings released to the public. The Memorandum of Discussion was discontinued beginning in May 1976. Until the late 1960s, the FOMC normally met every 3 weeks. Presently, the FOMC meets 8 times a year.<sup>4</sup> Until 1994 a press release did not even accompany FOMC decisions. Minutes provide a (filtered) account of the deliberations inside the FOMC (e.g., see Acosta and Meade 2015, Meade, Burk, and Josselyn 2015).

#### Interpreting and Quantifying FOMC Communication

Interpreting the words of policy makers over a 60 year period raises several challenges. For example, reading the minutes of meetings may not be as illuminating as observing the free flow of discussion inside the meeting. Indeed, some research (e.g., see Hansen, McMahon, and Prat 2018, Meade and Stasavage 2008) focuses on the verbatim discussion inside the FOMC in order to discern how much conformity exists in the meetings. Nevertheless, as former FOMC Chair Greenspan's remarked once: [Minutes are] "...as good a record of what actually occurs in these meetings as you can get from the point of view of those who have a serious interest in monetary policy and the history of monetary policy." (Mallaby 2016)

Another challenge is the changing usage and meaning of language over time and the interpretation of the Fed's mandate that is defined in several pieces of legislation since at least the Employment Act of 1946. The Fed has a dual mandate, namely to maintain output at potential and maintain stable prices.<sup>5</sup> Needless to say what potential output is, let alone

<sup>&</sup>lt;sup>3</sup> Until 1955 the minutes included the meetings of the Executive Committee which discussed the implementation of the FOMC's decisions. From 1955, when the Executive Committee ceased to exist (see <a href="http://www.federalreserve.gov/monetarypolicy/fomc\_historical.htm">http://www.federalreserve.gov/monetarypolicy/fomc\_historical.htm</a>) until 1967, the text was sub-divided into a part that minuted the FOMC's discussion ("Memorandum of Discussion") while a separate portion provided information about attendance and actions taken by the committee.

<sup>&</sup>lt;sup>4</sup> This does not include extraordinary meetings held on occasion, usually because of a crisis or other special factors.

<sup>&</sup>lt;sup>5</sup> The Fed itself states that "[T]hese objectives include economic growth in line with the economy's potential to expand; a high level of employment; stable prices (that is, stability in the purchasing

agreement on what constitutes price stability, has escaped a precise definition. One reason, of course, is that potential output is unobservable. In the case of inflation the norms of what are deemed acceptable, if not tolerable, has also eluded a precise definition let alone complete agreement about which price level definition one ought to focus on. It was not until 2012 that the FOMC judged 2% in the Personal Consumption Expenditures (PCE) index as consistent with the price stability portion of its dual mandate.<sup>6</sup> Indeed, for many years, during the Volcker era and before, Fed speak centered around the concepts of "stable" or "reasonable" inflation rates.<sup>7</sup>

The evolution of economic analysis may also have influenced the language used inside the FOMC for at least a couple of reasons. First, the background and education of FOMC members has changed over time. Whereas academics today are regularly appointed as FOMC or Board of Governor members, this was less common in the past though not unheard of.<sup>8</sup> Moreover, our understanding and acceptance of the role of theories of monetary policy has no doubt also had an influence on FOMC deliberations. The skepticism about the uses (and misuses) of economic models by FOMC Chairs from McChesney Martin through at least Paul Volcker, is well-known (e.g., see Meltzer (2009), and Bremner (2004)). How these attitudes influenced deliberations inside the FOMC is unclear. For example, Romer and Romer (2004) offer evidence that monetary policy in the 1950s was "actually sophisticated in its thinking" while Meltzer (2009) strongly disputes such a claim. It is also plausible that the personal experience, together with the education and background of policy makers, may also be reflected in influencing how the stance of policy is set. For example, Malmendier and Nagel (2015), and Malmendier, Nagel, and Yan (2017) argue that FOMC and Bank Presidents' experience with inflation influences their position on how monetary policy should be conducted.

power of the dollar); and moderate long-term interest rates." (<u>http://www.federalreserve.gov/pf/pdf/pf\_complete.pdf</u>, pg. 2). <sup>6</sup> http://www.federalreserve.gov/faqs/money 12848.htm.

<sup>&</sup>lt;sup>7</sup> According to Timberlake (1993, Chapter 25) the consensus in the early to mid-1980s was that 3-4% inflation was "reasonable".

<sup>&</sup>lt;sup>8</sup> Adolph (2013) is an interesting study of the career aspirations and strategies of senior central bankers. According to his data "[T]he most outstanding feature is the waning and waxing of financial sector experience." (op.cit., p. 78) In particular, he notes that economists and financiers have become more prominent in central banks since the 1950s.

Nevertheless, some of the questions debated inside the FOMC have not changed, even if the language used to describe them have evolved over time. One firmly held view over time is that an appropriate inflation rate must be balanced against adequate economic growth lest the FOMC be accused of failing to meet the dual mandate. This, of course, has been expressed in a number of ways over time. For example, the Fed's so-called "even keel" strategy, in place until the late 1960s and later referred to by some as the 'stop-go' strategy of monetary policy (e.g., Goodfriend (2005), Hetzel (2008)) represents the 1950s and 1960s version of what today might be called 'flexible' monetary policy (e.g., see Mishkin (2007), Svensson (2009)). It is also reflected in recent decades in reference to Taylor's rule where both inflation and real economic activity are central to setting the stance of monetary policy.

Even the current challenge faced by central banks to incorporate a response to asset price developments is not as novel as it might seem. Whereas the Zero Lower Bound (ZLB) and 'unconventional monetary policy' are not expressions found in the FOMC minutes prior to the last financial crisis the concern over asset price developments is not new (e.g., Bernanke and Gertler (1999), and Cecchetti, Genberg, Lipsky, and Wadhwani (2000)). For example, the FOMC minutes of a meeting held on July 7, 1954 refer to serious reservations expressed by then New York Fed President Alan Sproul about the state of the housing market which have an eerie resemblance to the debate inside the FOMC some fifty years later.<sup>9</sup> In both cases the potential connection between asset price movements and monetary policy was raised.

Other changes in the norms and usage of language likely stem from dramatic changes in our ability to diagnose economic problems, the strategies used to implement monetary policy, and changing views about transparency. Looking back it is unclear whether less judgment was used in setting the stance of monetary policy during, say, the 1950s than in the 2000s (Fischer 2017).

<sup>&</sup>lt;sup>9</sup> In a similar vein, while the word 'bubble' was not used, the state of the housing industry was described in terms that "...seem too good to be true" and would "..., spell some later difficulties if the funds were loosely lent..." Minutes of the executive committee of the FOMC, July 7, 1954, pages 3 and 4. The term 'bubble' became fashionable beginning in 2001 when the market for tech related equities collapsed subsequently leading to the twin worries about whether monetary policy should 'lean' or 'clean' (e.g., see White (2009)).

Indeed, there has been a debate among current and former FOMC members about the extent to which the FOMC is data-driven versus reliant on judgment (e.g., Yellen 2006, p.3).

Finally, the language of monetary policy has no doubt also been influenced by the strategy of monetary policy. Most obviously, the increased emphasis on inflation control, following the Great Inflation of the late 1960s through the mid-1980s (e.g., see Bordo and Orphanides (2013)), has pushed the Fed, if not most central banks around the world, to communicate the economic outlook more forcefully and transparently. As a result, monetary policy is conducted in a forward-looking manner, that is, conditional on the central bank's economic outlook. In earlier decades there is considerably less evidence that the FOMC developed a systematic way of thinking about the future (Meltzer (2009)). The foregoing is not meant to imply that monetary policy had no forward-looking elements at all prior to the availability, for example, of Greenbook forecasts.<sup>10</sup> Nevertheless, the further one goes back in time, the less the economic outlook seemed to be based on systematic analyses of what drove economic activity and inflation.

This paper is not the first to quantify the content of central bank communication. Illustrations of this line of research include Ehrmann and Fratzscher (2007, 2009), and Berger, Ehrmann and Fratzscher (2011). Essentially, the aim is to ask how a perceived tightening or loosening of policies, as interpreted either by the central bank or certain media outlets, might affect, say, selected asset prices (e.g., stock returns, market interest rates). Rosa (2013), Bernanke, Reinhart, and Sack (2004), and Romer and Romer (2004) are other examples of studies that rely on a subjective interpretation of the content of written or verbal statements by central bankers. Tudor and Vega (2014) review a small sample of papers that create quantitative indicators based on qualitative data and report that, while extremely useful, there remain several problems that need addressing. First, the appropriateness of the dictionaries used to create content type indices is important since Loughran and McDonald (2011) demonstrate that some words that may have a

<sup>&</sup>lt;sup>10</sup> The role and accuracy of Greenbook forecasts has been studied extensively. See, for example, Romer and Romer (2000) and Messina, Sinclair and Steckler (2014).

negative connotation in one context may be neutral in others and that expressions in finance are not the same as ones used in every day discussions.

The foregoing only scratches the surface of techniques that have been deployed to interpret the content of documents published by central banks. Some resort to case studies as these can illuminate how specific events put pressure on the form and content of communication (e.g., Meade et. al. 2015, Chappell, McGregor, and Vermilyea 2005, Havrilesky 1993). More recently, a growing number of algorithms have been applied to quantify the content of press releases and other documents. These algorithms, from simple word counts to more sophisticated programs that focus on changes in wording over time or other devices, are able to evaluate the semantic content of publications. Indeed, there exist well over a dozen algorithms of various kinds all of them claiming to most reliably quantify the content of textual material. <sup>11</sup> Luca and Trebbi (2009) and Hansen, McMahon, and Prat (2018) are two other examples of studies of FOMC policy statements, not the minutes of FOMC meetings, that rely on automated approaches to identify policy leanings of the Fed. In every case the samples investigated are short (e.g., since the late 1990s or later).

This paper continues in the same vein. However, unlike other comparable applications, I rely on two different algorithms as opposed to the single measurement approach common in other such studies. Hence, this paper offers a test of robustness in evaluating the content of FOMC minutes and over a much longer period than has heretofore been considered.

#### 3. Quantifying the Content of FOMC Minutes: Two Strategies

FOMC minutes are available from the Board of Governors. Minutes for the 2009-13 period are available from <u>http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm</u>. Historical minutes are available from <u>http://www.federalreserve.gov/monetarypolicy/fomc\_historical.htm</u>. The complete text is used when constructing the indicators of tone or content of the minutes.

<sup>&</sup>lt;sup>11</sup> Other candidates include Atlas, Alceste, General Inquirer, Leximancer, and even the narrative approach used in Romer and Romer (2004), and Holmes (2013). This list is far from exhaustive.

Wordscores is used for at least two reasons.<sup>12</sup> First, it offers a means of estimating relative policy positions expressed in texts as opposed to treating each text as if it was written starting from scratch. Stated differently, Wordscores compares texts where the policy position is thought to be known, that is, the 'reference' text against the text of all other minutes. The latter as referred to as 'virgin' texts (Laver, Benoit, and Garry (2003)). Since committee members change over time and their positions may also change, not to mention whether they consider themselves hawkish or dovish, it is not clear *a priori* which text serves as a reference point.<sup>13</sup> Accordingly, the minutes from the first meeting each year (usually January) between 1955-2007 serves as a potential reference document for all remaining minutes throughout the sample.<sup>14</sup> The reference scores (see below) were then averaged over time across the changing benchmarks and used as the summary indicator of the content of FOMC minutes.<sup>15</sup>

Wordscores has the distinct advantage that one can use historically comparable texts to estimate policy positions.<sup>16</sup> Indeed, by changing the reference text we may also obtain a glimpse of how policy positions may have changed since a policy position deemed hawkish in one era may not, in retrospect, appear so in a different one.<sup>17</sup> By comparing word frequencies between reference and virgin texts Wordscores is effectively equivalent to a Bayesian reading of texts. That is, given word frequencies in a reference text Wordscores asks what is the likelihood that a virgin

<sup>&</sup>lt;sup>12</sup> The software, one version of which is written for Stata, is available from <u>www.tcd.ie/Political</u> <u>Science/wordscores/</u>.

<sup>&</sup>lt;sup>13</sup> Unlike politics where the reference text might be a party's political manifesto there is no equivalent when it comes to the minutes of the FOMC. Accordingly, any of the minutes can potentially serve as a benchmark against which we can compare the content of other minutes. Moreover, we may want to guard against the possibility that we are exclusively interpreting monetary policy of the 1950s through the words used, say, several decades later. Of course, some expressions (e.g., tightening, recession) have been used for decades.

<sup>&</sup>lt;sup>14</sup> Minutes of 1993 meetings could not be used as a reference document since there were no changes in the fed funds rate. The same is true for the available minutes after 2008. See below.

<sup>&</sup>lt;sup>15</sup> It does not appear that using a median score significantly affects the empirical results (not shown).

<sup>&</sup>lt;sup>16</sup> As pointed out in Danker and Luecke (2005, p. 178) "[T]he minutes follow a structure that is fairly consistent from one meeting to the next." Every word in each text is recorded and the words are then grouped by frequency. The researcher can elect to omit certain words (e.g., the, or, that, and so on). Since words are used with different frequencies a wordscore is then a weighted average of the relative frequency with which different words are used.

<sup>&</sup>lt;sup>17</sup> An illustration is the case study of the 1994 and 2004 tightening of the monetary policy stance explored by Meade et. al. (2015).

text expresses the same position (i.e., produces the same distribution of word frequencies)? Each wordscore is converted into a score so that we can rank positions on a scale (e.g., tightening versus loosening).

As with all Bayesian forms of analysis there are potential drawbacks with the approach (e.g., see Clark, Evans and Scarborough (2007)). First, the analyst must choose a reference text. This problem is mitigated in the present context by selecting a large number of potential reference texts to avoid biasing the results. This also serves as a test of robustness. Second, one must take a stand concerning the bias or policy position of the reference text. The potential problem here can also be minimized by relying on (ex post) historical accounts to establish whether a consensus developed around the positions taken by policy makers at the time.

Once reference texts are selected Wordscores calculations proceed as follows. Define  $a_{rt}$  as the position taken in reference text *r* at time *t*. Next, let  $f_{rt}^w$  represent the relative frequency of some word, *w*, in the reference text, again at time *t*. We can then estimate a probability that we are reading words *w*, from text *r*, which is written  $p_{rt}^w = \frac{f_{rt}^w}{\sum f_{rt}^w}$ . Laver, Benoit and Garry (2003)

define

$$WS_{rt} = \sum_{w} p_{rt}^{w} a_{rt}$$
(1)

where WS represents the weighted average of the reference text scores over all words *w*. Using similar reasoning we can evaluate (1) based on the virgin text yielding  $WS_{vt}^w$ . The latter expression represents the *a priori* interpretation of the content of the text we are interested in.<sup>18</sup> In quantifying the FOMC minutes I take the view that, other things equal, a rise in the fed funds rate (FFR) represents a tightening of, or more hawkish, monetary policy. It seems reasonable to

<sup>&</sup>lt;sup>18</sup> Since the universe of words is finite Laver, Benoit and Garry (2003) observe that virgin test scores are more clustered than reference test scores. Therefore, to ensure comparability of the scores, it is necessary to transform the Wordscores of the virgin text so that both virgin and reference texts have the same standard deviations. Not everyone agrees that the resulting transformation is ideal. See, for example, Martin and Vanberg (2008).

assume that all FOMC meetings have in common the notion that a rise in the fed funds rate is seen as a signal of a more hawkish stance against inflation, an overheating economy, or both. The larger the change in the FFR the tighter is monetary policy (or looser, of course, in the event of a reduction in the FFR).<sup>19</sup> Therefore, a score of +1 was assigned to a rise of 25bp, +2 in the event of a 50bp rise, and so on, with scores of -1, -2, and so forth assigned for the case of looser policy. In this manner we can identify the position (i.e., tighter or looser) of the reference texts using actual policy rate changes as the 'anchor'. I use the effective fed funds rate from FRED (Federal Reserve Bank of St. Louis). Prior to availability of this series the figure mentioned in the "Record of Policy Actions" was used.<sup>20</sup> While the minutes of meetings occur at irregular intervals, especially in the 1950s and 1960s, the data are converted to the quarterly frequency by simple arithmetic averaging so that the series are amenable to time series analysis which also relies on the quarterly sampling frequency.

The second algorithm used is DICTION (see Hart, Childers, and Lind (2013)).<sup>21</sup> The objective of this algorithm is to transform a collection of words that quantify the *tone* of a document. Tone is "…, a tool people use (sometimes unwittingly) to create distinct special impressions via word choice." (op. cit., p. 9) Meade, Burk, and Joesselyn (2015) argue that US policy makers view the minutes "…as providing insight about the breadth of views…" Furthermore, since meeting participants provide input before the final draft is published (Danker and Luecke (2005)) the intention and, therefore, the tone of the document ought to reflect the views of FOMC members.

Content is interpreted on the basis of a dictionary of words that convey meaning along various dimensions. A total of 31 pre-defined dictionaries contains over 10,000 words. However, these were supplemented with words based on the financial dictionary used by Loughran and

<sup>&</sup>lt;sup>19</sup> Whether an increase in the policy rate translates into a demonstrably tighter monetary policy ultimately depends, of course, on whether the real interest rate changes. Meltzer (2009, p. 587) has argued that the failure to understand the distinction between nominal and real interest rates was a "long-standing" problem at the Fed. Indeed, the failure to respond aggressively enough to inflation developments is viewed by some (e.g., Taylor 2010) as one of the failures of the Fed in the years that led up to the Great Recession of 2008-9 (see, however, Bernanke 2010).

<sup>&</sup>lt;sup>20</sup> In deriving the values for  $WS_{rt}$  the reference text (r) changes annually from 1955 to 1993 as noted previously. Thereafter, given the relatively smaller number of fed funds rate changes averages of scores over a two year period (e.g., 1993-94, 1995-96, and so on) are used until 2006. <sup>21</sup> Version 6.0 was used in the empirical work. Diction 7 is the most recent incarnation of this software. See <u>www.dictionsoftware.com</u>.

McDonald (2011).<sup>22</sup> The actual words used in the minutes are then grouped into several master categories according to the message being conveyed. They are: *certainty*, that is, a collection of words indicating resoluteness and authority; *optimism*, namely language that endorses a position and is occasionally interpreted as indicating over-confidence or hubris; *activity*, are words suggesting ideas or stances being implemented with inertia avoided; and, finally, *commonality*, that is, language that conveys the degree to which a common position is taken.<sup>23</sup> DICTION calculates the frequency with which words capture the sentiments summarized above. However, unlike Wordscores, DICTION does not rely on a benchmark or reference text.

While statistics of the kind developed for Wordscores are not available in DICTION users have proposed some of their own relying on the fact that, for example, a change in the tone of a message over time can be identified by changes in the frequency or in the extent to which the balance or tilt of a text favours one of the content variables over another. The empirical results below follow both approaches.<sup>24</sup>

#### 4. Empirical Evidence

Stylized Facts and Quantifying FOMC Minutes

<sup>&</sup>lt;sup>22</sup> The language used in the minutes is likely to contain a combination of financial and everyday language. Loughran and McDonald (2016) point out that the choice of words included in the dictionaries matters. Hence, it is possible that words with ambiguous meaning (e.g., risk, unemployment) could have an impact on the results. This is more likely to be the case, however, for short samples. Over longer samples such ambiguity tends to reflect the importance, in this case by members of the FOMC, they attach to these phenomena. Some experimentation along these lines (also, see Lombardi, Siklos, and St. Amand 2019) supports this interpretation.

<sup>&</sup>lt;sup>23</sup> The measurement of tone is not limited to this set of words and their associated dictionaries. See, for example, Siklos (2014) for an illustration using DICTION 5.0 and Lombardi, Siklos, and St. Amand (2019) using DICTION 6.0. The period covered by these articles is the global financial crisis and a different set of words dealing with financial stability questions were considered.

<sup>&</sup>lt;sup>24</sup> Since the content of statements have been coded over a long period of time one might view standardization relative to some mean level, perhaps under a particular FOMC Chair, as a relative indicator. As a result, departures one or more standard deviations from the mean give rise to a "normality" score. Similarly, standardizing individual scores for the components of the content of a statement and then summing these provides another indication of the general properties of a document across time. These variants were also considered though, to conserve space, only one set of scores is reported since alternatives had no meaningful impact on the conclusions.

To investigate empirically the links between the content of minutes and macroeconomic outcomes I obtained as many time series as were available on a continuous basis since the mid-1950s from FRED (http://research.stlouisfed.org/fred2/). The series range from real and nominal GDP, CPI, PCE, commodity prices, money supply and banking reserves indicators, as well as interest rates and interest rate spreads. Next, in recognition of the important role played by real time data (e.g., Orphanides 2001), real time measures of the output gap are obtained from the Federal Reserve Bank of Philadelphia (http://www.philadelphiafed.org/research-and-data/real-time-center/real-time-data/). Finally, as the FOMC began to increasingly rely on forward looking indicators of economic activity I also include the Fed's Greenbook forecasts.<sup>25</sup>

Next, I turn to some evidence based on content analysis. Figure 2 plots the fed funds rate and WS, the Wordscores series that defines the position of the FOMC in the manner described above. The bars indicate the size of changes in the fed funds rate while the dashed line indicates the bias in favor of a hawkish (positive value) or a dovish (negative value) interpretation of the stance of monetary policy. One might expect the scores shown in Figure 2 should be in the same direction as the change in the fed funds rate. However, because the Wordscores relies on textual analysis the amplitude of the two series need not, of course, be the same. Hence, the FOMC may be more, or less, aggressive in changing the policy rate than the discussion implied by the minutes.

A priori it is unclear if the individual indicators defined earlier of the hawkish or dovish tone of FOMC minutes estimated by DICTION ought to be considered separately or, since statistical evidence reveals the characteristics to be related (results not shown), whether these should somehow be combined. To economize on the loss of degrees of freedom, a factor model is estimated based on the 4 characteristics that define tone in DICTION and the first principal component is extracted.<sup>27</sup> The resulting changes in factor scores are plotted in Figure 3 against

<sup>&</sup>lt;sup>25</sup> These are also available from the same source as the real time data. The quarterly data begin in 1965.

 <sup>&</sup>lt;sup>26</sup> Simple cross-correlations (not shown) suggest that past Fed tightening leads to more dovish content up to 8 quarters in the future. Current tightening is correlated with more hawkish content 2 quarters later but this is reversed 5 quarters later.
 <sup>27</sup> Maximum likelihood estimation indicates only one principal component (see appendix). The

<sup>&</sup>lt;sup>27</sup> Maximum likelihood estimation indicates only one principal component (see appendix). The principal component explains the factor loadings were as follows: -0.26 (activity), -0.53 (certainty), 0.73 (optimism), 0.88 (commonality). Therefore, more commonality and optimism

changes in the fed funds rate. Although a rise or fall in the common component of the tone indicators is often associated with a change in the fed funds rate the relationship need not be a close one especially if the contents of the Fed's minutes are meant to convey signals that differ from changes in the policy rate.<sup>28</sup>

#### Econometric Evidence

A series of small-scale VARs are estimated for a variety of samples motivated by the timeline shown in Figure 1. The objective of the exercise is to ascertain whether traditionally estimated links between changes in monetary policy, via the fed funds rate and macroeconomic conditions, are influenced by the addition of the content of FOMC minutes. Moreover, while the content of FOMC minutes post 1994 can conceivably influence economic conditions via expectations the same cannot be true for the period when only 'historical' minutes are available. Nevertheless, it is still of interest to ask whether there is a statistical relationship between the content of minutes and the stance of monetary policy, that is, whether macroeconomic conditions influence the content of FOMC meetings as measured by the two algorithms chosen for analysis. In any case, an assessment of the links between the content of the minutes, macroeconomic conditions, and the outlook must treat the pre and post 1994 eras as separate.

In the case of the pre-1994 sample I assume that while economic conditions may influence the content of the minutes the latter cannot influence macroeconomic conditions since there is no mechanism for the minutes to influence expectations due to their unavailability in public until years, if not decades, later. Consequently, although the content of minutes is treated as an endogenous variable it is also ordered below the usual macroeconomic time series in a VAR subject to a Cholesky decomposition. Estimates that rely on Wordscores are conventional VARs while the results that rely on DICTION are in effect factor-augmented or FAVARs because the

loads positively indicting a more hawkish stance while more activity and certainty load into a more dovish tone.

<sup>&</sup>lt;sup>28</sup> This interpretation is unchanged even if we use the level of the DICTION variable. The factor scores have a unit root based on the oft-used augmented Dickey-Fuller test statistic but not the KPSS test (results not shown). In any case the VARs discussed in the next section rely on the levels version of the DICTION indicator although the conclusions are unaffected when this variable enters in first difference form. It is worth noting that the standard deviation of the DICTION series is considerably smaller than WS. Summary statistics for the two series are provided in the appendix.

various characteristics that make-up the tone of FOMC minutes are combined via principal components estimation, to create a single factor that describes the content of the minutes.<sup>29</sup>

There remains the question of the ordering of the macroeconomic and monetary policy variables in the model. Traditionally, real GDP<sup>30</sup> is viewed as the most endogenous variable in all types of macroeconomic models used in practice. Similarly, monetary policy is seen as influencing current macroeconomic conditions with a lag and, at least in theory, is primarily dictated by expected macroeconomic conditions. Of course, the degree to which the central bank is forward-looking has long been the subject of debate. Yet, in typical macroeconomic models, the monetary policy instrument is placed last.

The pre-1994 VARs and FAVARs are based on the following vector of endogenous variables

PRE 1994: 
$$[\dot{y}_t, \Delta \pi_t^{PCE}, \Delta i_t^{FFR}, CM_t]$$
 (2)

 $\dot{y}$ ,  $\Delta \pi^{PCE}$ ,  $\Delta i^{FFR}$ , *CM* are, respectively, real GDP growth, the change in inflation in the Personal Consumption Expenditures index (both annualized)<sup>31</sup>, the change in the fed funds rate, and the proxy for the content of central bank minutes.<sup>32</sup> If the vector in (2) is defined as  $X_t$  then the estimated VAR is written in the conventional manner as

$$X_{t} = A_{0} + A_{1}X_{t-1} + BZ_{t-1} + u_{t}$$
(3)

where  $A_0$ ,  $A_1$ , and B are coefficient matrices and the inclusion of Z indicates that allowance is also made for exogenous variables to influence X.

<sup>&</sup>lt;sup>29</sup> The VARs were also estimated by separately including each one of the characteristics that define the tone of a document. Some additional results not reported here are in the appendix.

<sup>&</sup>lt;sup>30</sup> In the early decades of the sample real GNP would have been used. For convenience, however, we follow the usual current standard of using real GDP as the economy-wide measure of output.

<sup>&</sup>lt;sup>31</sup> One potential concern is the stationarity of some of the series. This is what prompted me to use the change in the fed funds rate as opposed to its level and the change in inflation in the pre-1994 period. The impulse responses shown below are only marginally impacted when  $\pi^{PCE}$  is used. See the appendix for unit root test results.

<sup>&</sup>lt;sup>32</sup>As discussed in Danker and Luecke (2005) since 2004 the minutes are released after 3 weeks. The lags were longer previously but within the quarterly sampling frequency.

As discussed above, WS from Wordscores and the factor model proxy from DICTION are used. The estimated specifications are also augmented by a vector of exogenous variables including oil price inflation lagged one period, accumulated revisions to the output gap lagged one period obtained from real-time data<sup>33</sup>, as well as dummy variables to control for possible differences between the McChesney Martin and Burns chairmanships.

The VARs and FAVARs for the post 1994 sample are similar to equation (2). However, since FOMC minutes are now made public these are now not only influenced by the existing state of the world but, in turn, may impact macroeconomic variables directly or indirectly via expectations.

POST 1994: 
$$[CM_t, \dot{y}_t, \pi_t^{PCE}, \Delta i_t^{FFR}]$$
 (4)

Economic theory is insufficiently clear about where the CM variable stands in the Cholesky decomposition. However, the earlier discussion would seem to suggest that all other shocks in the model are likely to impact the deliberations and, hence, either the DICTION or the Wordscores indicators of the content of the minutes. In other words, the content of the minutes are assumed not to respond contemporaneously to the real and monetary policy variables in the model since the series employed here would not, in the present form, have been available to FOMC members.<sup>34</sup>

<sup>&</sup>lt;sup>33</sup> Adding bank reserves to GDP to the list of exogenous variables did not change the results and are excluded. It made no difference to the conclusions when real oil prices are used instead of the nominal version. Hence, estimates rely on the rate of change in nominal oil prices. The same is true when changes in unemployment or an estimate of the unemployment gap is used instead of real GDP growth (or changes in the output gap).

<sup>&</sup>lt;sup>34</sup> This assumption could also be justified on grounds of data dependence or caution in responding to the most recently available data. As Bernanke (2015, p. 503) has also pointed out: "...economists are criticized for not being able to predict the future but, because the data are incomplete and subject to revision, we cannot even be sure what happened in the recent past." In (3) and (4) I also experimented with placing CM after  $\Delta i^{FFR}$  which effectively means that changes in the fed funds rate respond to changes in the content of the minutes. None of these variations materially affected the conclusions reported below. Finally, after 2008 the Fed engaged in unconventional monetary policies (also known as quantitative easing). To account for the possibility that the observed fed funds rate did not accurately convey the stance of monetary policy the fed funds rate data after 2008 are replaced with the Wu-Xia (2016) shadow policy rate.

The post-1994 sample list of exogenous variables (i.e.,  $Z_t$  in equation (2)) consists of: dummy variables to mark the Greenspan and Bernanke eras, the accumulated revisions in the output gaps, and oil price inflation, both lagged one period. The post-1994 sample list of exogenous variables now also includes as exogenous variables the Greenbook forecasts for inflation and real GDP growth to control for forward-looking data that might impact both macroeconomic conditions as well as the content of FOMC discussions, and the accumulated revisions in the output gap. Finally, lag lengths were chosen on the basis of the Hannan-Quinn (HQ) or Final Prediction Error (FPE) metrics though other variants were also examined. When these tests produced conflicting results VARs and FAVARs with different lag lengths were estimated. The results presented below are generally robust to changes in lag lengths.

Figures 4 and 5 display selected impulse response functions (IRF). As a further partial test of robustness we present estimated for two post-1994 samples: one that ends in 2008 and another that ends in 2012 to see whether the links between content and macroeconomic conditions are affected.<sup>35</sup> To allay fears that the precise ordering of the variables in the VAR might affect the results we present generalized impulse response functions (GIRF). These are invariant to the manner used for the Cholesky decomposition.<sup>36</sup> The top two plots in Figure 4A display the results using Wordscores for the CM variable in the sample that begins after the routine publication of the minutes starting in 1994 ends just before the Great Recession begins. A positive real GDP shock raises the score (RSCORE) which, under the circumstances, implies a shift towards tightening relative to the reference FOMC minutes after the 1<sup>st</sup>, 5<sup>th</sup>, and 8<sup>th</sup> quarters. The impact is larger than the one found relying on the DICTION indicator (see below, Figure 5A). Although it cannot be proven an intriguing possibility is that FOMC members were freer to

<sup>&</sup>lt;sup>35</sup> At the time the data set was constructed Greenbook forecasts end in 2012. Since the fed funds rate would not change until December 2015 the ability of the WS algorithm to capture the content of the minutes Is also impaired. A referee wondered much can be learned from the addition of four years of data. Nevertheless, it seems useful to obtain an indication of whether the longer sample changes the results. As noted below the size, but not the statistical significance of the impulse responses is affected.

<sup>&</sup>lt;sup>36</sup> In an earlier version of this paper I reported standard IRF. Overall, the main results shown below are largely unaffected when reasonable alternative orderings are considered. Standard IRFs are placed in the appendix.

use more hawkish language at a time when members thought the contents of the minutes would not be released.

The middle impulse responses in Figure 4A also reveal that a tightening via a shock coming from the fed funds rate also changes the content of FOMC minutes towards a more hawkish direction after 2, 4 and 5 quarters. Finally, in the pre-1994 sample, the IRF shown at the bottom of Figure 4A reveals on balance a tightening bias when the fed funds rate rises. However, the impact is of considerably larger size and persists over several quarters unlike the DICTION counterpart which vanishes after 3 quarters as we shall see in Figure 5A.

Figure 4B displays what happens when the post-1994 VAR is estimated to the end of the sample. There continues to be a significant positive response of RSCORE to a positive real GDP shock (top plot) though it is also smaller than when the period than when the financial crisis is excluded. The response of RSCORE to changes in the fed funds rate now resemble that of the pre-1994 sample although the size of the responses remains more muted than in the era when minutes were not published.

I now turn to estimates of the same VARs but where the DICTION created variable replaces RSCORE as the proxy for CM. Figure 5A reveals that a shock to real GDP growth raises the aggregate DICTION indicator through 5 quarters indicating that a more hawkish tone prevails inside the FOMC in response to a growing economy. This result is in spirit the same as the one reported using Wordscores. None of the other shocks were found to have a significant impact on FOMC minutes (not shown). Before and after the release of the minutes beginning in 1994 (middle and bottom plots) there is a modest response from the FOMC to a rise in the fed funds rate though the response is smaller in the sample prior to the public release of the minutes. This suggests that when the Fed tightened the policy stance (i.e., a positive fed funds rate shock) this was reinforced by a comparable change in the tone of FOMC minutes. The response is considerably smaller than when Wordscores is used. One possible explanation is that the resort to a benchmark to evaluate the impact of the content of the minutes plays a role in explaining the relationship between words and deeds by the Fed.

Figure 5B extends the results to the end of the sample. The content of FOMC minutes after two quarters is now seen as softening in response to a positive shock to real GDP growth. The link

between the content of FOMC minutes and changes in the fed funds rate is similar as when WS proxies the content of FOMC minutes (CM). Again, reliance on a benchmark to gauge hawkishness or dovishness may well be a determinant of the response.

Finally, Table 1 presents the variance decompositions (VD) for the content variables.<sup>37</sup> These provide information about the fraction of the total variation explained by each one of the endogenous variables in the model. Interestingly, RSCORE shows considerably less persistence than DICTION as reflected in the much more modest VD after 10 quarters. This is further evidence that, as we change the benchmark used to evaluate the hawkishness or dovishness of the tone of the minutes, there is less history dependence than when content is measured by the content of groups of certain expressions independently of the past history of the resort to these same expressions. On this basis observed changes in the fed funds rate provide a great deal of explanatory power for the content of the minutes regardless of whether the minutes are publicly available or not. This is comforting news for those who wish to see a strong connection between what central bankers say and how the stance of monetary policy is decided.

Turning to the VD based on the DICTION algorithm the connection between fed funds rate changes and content is considerably stronger in the sample since minutes were made public relative to the pre-1994 sample. The weak link pre-1994 may perhaps be explained by the argument that FOMC members felt freer to express their views in the committee knowing that their opinions would not be made public. Real GDP growth plays a modest roles in explaining the content of the minutes, regardless of the chosen algorithm. Other than for the post-1994 sample and only for the model based on the RSCORE variable, inflation explains a small portion of the variation in the content of the minutes. Similarly, inflation plays a small role pre-1994 when the DICTION variable is used and its explanatory power is only modestly higher in the post-1994 period. As noted earlier concepts of what is an acceptable inflation rate as well as the

<sup>&</sup>lt;sup>37</sup> We adopt the approach of Lanne and Nyberg (2016). They point out that conventional estimates of generalized forecast error variance decompositions (GFEVD) do not add up to 100%. Unlike their counterparts based on a Cholesky or other structural decomposition, GFEVD represent the response to a shock in a given equation. A simple modification is proposed so that the interpretation of the results becomes more convenient by ensuring that the proportions add up to 100.

preferred measure of inflation have changed substantially over time. Perhaps this can explain the results.<sup>38</sup>

#### 5. Conclusions

What central bankers say and think, as reflected in the minutes of their meetings, provides an additional piece of information that can supplement the usual approach of relying solely on movements in policy rates to assess changes in the stance of monetary policy. The challenge is to quantify words and their meaning in a manner that faithfully captures the content of policy making committee documents. The usual approach is to adopt a single methodology very often based on an interpretation or a particular coding of a document. In this paper two different methodologies are used not only as a test of robustness but also to provide different perspectives about the influence of the content of central bank communication.

The minutes of FOMC meetings since the early 1950s are quantified and used as an additional determinant in small scale macro models. Because FOMC minutes were not released to the public before 1994 separate estimates are generated for different sub-periods. Estimates reveal that proxies for the content of FOMC minutes are significantly influenced by the overall state of the economy. The strongest links are found between the proxies for the tone and content of FOMC meetings and either real GDP growth or changes in the fed funds rate.

Two broad conclusions emerge. First, despite substantive differences in how the content of FOMC minutes are quantified, the results are broadly comparable for each sample, that is, content responds to real GDP growth and responds to fed funds rate changes. The financial crisis (i.e., 2009-2012 in the data set) impacts the size but not the significance of the estimated responses. Second, ignoring a role for the content of FOMC minutes is tantamount to omitting a significant variable. This result holds both when FOMC minutes are public as well as when they were not available to outside observers. Changes in both the definitions of inflation that the Fed was concerned about and, until 2012, the absence of an explicit inflation objective likely contribute to this finding.

<sup>&</sup>lt;sup>38</sup> And may also account for the insignificant impulse responses (not shown).

At least three extensions of the present study ought to be considered. First, I have not considered the possibility that the proxies for the minutes are asymmetrically related to the state of the macro economy. What central bankers think is the appropriate stance of policy in upturns versus recessions may well be different. Second, it is possible that additional endogenous variables could be included in the VARs and FAVARs to better condition the estimates on structural breaks or other regime shift like events. Moreover, it might be possible to investigate the potential links between the content of FOMC minutes and policy uncertainty or uncertainty more generally. In addition, the finding that no significant link between inflation and the minutes needs to be investigated further. Concepts of inflation have changed considerably over time. It is, therefore, conceivable that varieties of inflation rates need to be examined. Finally, there may be finer changes in the relationship between content and macroeconomic time series that might emerge if some parameters are estimated in a time-varying fashion. I leave these extensions for future research.

#### References

Acosta, M., and E. Meade (2015), "Hanging on Every Word: Semantic Analysis of the FOMC's Postmeeting Statement", FEDS Notes, 30 September.

Adolph, C. (2013), *Bankers, Bureaucrats, and Central Bank Politics* (Cambridge, Mass.: Cambridge University Press).

Axilrod, S. H. (2009), Inside the Fed (Cambridge, Mass.: The MIT Press).

Bartash,, J. (2014), "Bernanke Reveals What Really Happens at Fed Meetings", *MarketWatch* 30 December.

Berger, H., M. Ehrmann, and M. Fratzscher (2011), "Monetary Policy in the Media", *Journal of Money, Credit and Banking* 43 (4): 689-709.

Bernanke, B.S. (2015), *The Courage to Act: A Memoir of a Crisis and Its Aftermath* (New York: W.W. Norton).

Bernanke, B. (2013), *The Federal Reserve and the Financial Crisis* (Princeton, N.J.: Princeton University Press).

Bernanke, B. (2010), "Monetary Policy and the Housing Bubble", speech at the Annual meeting of the American Economic Association, Atlanta, January.

Bernanke, B., and M. Gertler (1999), "Monetary Policy and Asset Price Volatility", Federal Reserve Bank of Kansas City *Economic Review* 84 (4): 17-51.

Bernanke, B. S., V. R. Reinhart, and B. P. Sack (2004): "Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment," *Brookings Papers on Economic Activity*, 70 (2004-2), pp. 1–100.

Bligh, M., and G. Hess (2013), "Deconstructing Alan: A Quantitative Assessment of the Qualitative Aspects of Chairman Greenspan's Communication", in P.L. Siklos and J-E. Sturm (Eds.), *Central Bank Communication, Decision Making, and Governance* (Cambridge, Mass: The MIT Press), pp. 123-148.

Blinder, A. (1998), *Central Banking In Theory and Practice* (Cambridge, Mass.: The MIT Press).

Bordo, M.D., and A. Orphanides, Eds. (2013), *The Great Inflation: The Rebirth of Modern Central Banking* (Chicago and London: University of Chicago Press for NBER).

Borio, C., and A. Filardo (2004), "Looking Back at the International Deflation Record", North American Journal of Economics and Finance 15 (December): 287-311.

Bremner, R. (2004), Chairman of the Fed (New Haven, Conn.: Yale University Press).

Bulíř, A., Hurnik, J., and K. Šmídková (2014),"Inflation Reports: How Well Do Cetral Bankers Really Write?, IMF working paper 14/91.

Burdekin, R., and P. Siklos, Eds. (2004), *Deflation: Current and Historical Perspectives* (Cambridge, Mass.: Cambridge University Press).

Cecchetti, S., H. Genberg, J. Lipsky, and S. Wadhwani (2000), *Asset Prices and Central Bank Policy*, Geneva Report on the World Economy No. 2, May.

Chappell, H.W., R.R. McGregor, and T.A. Vermilyea (2005), *Committee Decisions on Monetary Policy: Evidence from the Historical Records of the Federal Open Market Committee*, vol. 1 (Cambridge, Mass.: The MIT Press).

Dale, S., A. Orphanides, P. Österholm (2011), "Imperfect Central Bank Communication: Information Versus Distraction", *International Journal of Central Banking* 7 (June): 3-39.

Danker, D.J. and M.M Luecke (2005), "Background on FOMC Meeting Minutes", *Federal Reserve Bulletin* (Spring): 175-179.

Ehrmann, M., and M. Fratzscher (2009),"Explaining Monetary Policy in Press Conferences", *International Journal of Central Banking* 5 (June): 41-84.

Ehrmann, M., and M. Fratzscher (2007), "The Timing of Central Bank Communication", *European Journal of Political Economy* 23 (March): 124-145.

Eusepi, S., and B. Preston (2010), "Central Bank Communication and Expectations Stabilization", *American Economic Journal: Macroeconomics* 2 (July): 235-271.

Fischer, S. (2017), "Committee Decisions and Monetary Policy Rules", at 'The Structural Foundations of Monetary Policy', Hoover Institution Monetary Policy Conference, 5 May.

Fracasso, A., H. Genberg, and C. Wyplosz (2003), *How Do central Bankers Write: An Evaluation of Inflation Targeting Central Banks*, Geneva Reports on the World Economy Special Report 2.

Goodfriend, M. (2005), "The Monetary Policy Debate Since October 1979: Lessons for Theory and Practice", *Review* of the Federal Reserve Bank of St. Louis 87 (March): 243-262.

Hansen, S., M. McMahon, and A. Prat (2018), "Transparency and Deliberation within the FOMC: A Computational Linguistics Approach", *Quarterly Journal of Economics*, 133(2), 801-870.

Hart, R.P., J.P. Childers, and C.J. Lind (2013), *Political Tone: How Leaders Talk and Why* (Chicago: University of Chicago Press).

Havrilesky, T. (1993), *The Pressures on American Monetary Policy* (London: Kluwer Academic Publishers).

Hernández-Murillo, R., and H.G. Shell (2014), "The Rising Complexity of the FOMC Statement", *Economic Synopses*, Federal Reserve Bank of St. Louis, No.23.

Hetzel, R.L. (2008), *The Monetary Policy of the Federal Reserve: A History* (Cambridge, Mass.: Cambridge University Press).

Holmes, D.R. (2014), Economy of Words (Chicago: University of Chicago Press).

Jansen, D-J., and J. de Haan (2013), "An Assessment of the Consistency of ECB Communication", ", in P.L. Siklos and J-E. Sturm (Eds.), *Central Bank Communication*, *Decision Making, and Governance* (Cambridge, Mass: The MIT Press), pp. 183-202.

Klemmensen, R., S. B. Hobolt, and M. E. Hansen (2007), "Estimating Policy Positions Using Political Texts: An Evaluation of the Wordscores Approach", *Electoral Studies* 26: 746-755.

Lanne, M., and H. Nyberg (2016), "Generalized Forecast Error Variance Decomposition for Linear and Nonlinear Multivariate Models", *Oxford Bulletin of Economics and Statistics* 78 (4): 595-603.

Laver, M., K. Bnoit, and J. Garry (2003), "Extracting Policy Positions from Political Texts Using Words as Data", *American Political Science Review* 97 (May): 311-331.

Lombardi, D., P. Siklos, and S. St. Amand (2019), "Asset Price Spillovers From Unconventional Monetary Policy: A Global Empirical Perspective", *International Journal of Central Banking* (June).

Loughran, T., and B. McDonald (2016), "Textual Analysis on Accounting and Finance: A Survey", *Journal of Accounting Research* 54 (September): 1187-1230.

Loughran, T., and B. McDonald (2011), "When Is A Liability Not a Liability? Textual nalaysis, Dictionaries, and 10-Ks", *Journal of Finance* 66 (1): 35-65.

Mallaby, S. (2016), *The man Who Knew: The Life and Times of Alan Greenspan* (New York: Penguin).

Malmendier, U., S. Nagel, and Z. Yan (2017), "The Making of Hawks and Doves: Inflation Experiences on the FOMC", CEPR discussion paper 11902, March.

Malmendier, U., and S. Nagel (2016), "Learning from Inflation Experiences", *Quarterly Journal of Economics* 131 (1): 53-87

Martin, L., and G. Vanberg (2008), "A Robust Transformation Procedure for Interpreting Political Texts", *Political Analysis*, 16 (1): 93-100.

McChesney Martin, W. (1965), "Does Monetary History Repeat Itself?", address before the Commencement Day Luncheon of the Alumni Federation of Columbia University, 1 June, available from FRASER (Federal Reserve Archive).

Meade, E.E., N. A. Burk, and M. Josselyn (2015), "The FOMC Meeting Minutes: As Assessment of Counting Words and the Diversity of Views", FEDS Notes, 26 May.

Meade, E. E., Y. Nozawa, L. Petrasek, and J.K. Zickler (2015), "The Effects of FOMC Communications Before Policy Tightening in 1994 and 2004", FEDS Notes, 24 September.

Meade, E.E., and D. Stasavage (2008), "Publicity of Debate and the Incentive to Dissent: Evidence from the US Federal Reserve", *Economic Journal* 118 (528): 695-717.

Meltzer, A. (2009), A History of the Federal Reserve, vol. 2 (Chicago: University of Chicago Press).

Messina, J., T.M. Sinclair, and H.O. Steckler (2014), "What Can We Learn From Revisions to the Greenbook Forecasts?", working paper, George Washington University.

Meyer, L. H. (2004), A Term at the Fed (New York: Harper Business).

Mishkin, R. (2007), "Inflation Dynamics", International Finance 10 (January): 317-334.

Morris, S., amd H. S. Shin (2002), "Social Value of Public Information", *American Economic Review* 92 (December): 1521-1534.

Nelson, E. (2013), "Miton Friedman and the Federal Reserve Chairs, 1951-1979", working paper, October.

Orphanides, A. (2001), "Monetary Policy Rules Based on Real-Time Data", *American Economic Review* 91 (September): 964-985.

Romer, C.D., and D.H. Romer (2004), "A New Measure of Monetary Shocks: Derivation and Implications", *American Economic Review* 94(5): 1055-1084.

Romer, C., and D. Romer (2000), "Federal Reserve Information and the Behavior of Interest Rates", *American Economic Review* 90 (June): 429-457.

Rosa, C. (2013), "The Financial Market Effects of FOMC Minutes", *FRBNY Economic Policy Review* (December): 67-81.

Shonhart-Bailey, C. (2013), Deliberating Monetary Policy (Cambridge, Mass.: The MIT Press).

Siklos, P.L. (2014), "The Global Financial Crisis and Central Bank Speak", in R.P. Hart (Ed.), *Communication and Language Analysis in the Corporate World* (Hershey, PA: IGI Global), pp. 293-314.

Silber, W.L. (2012), Volcker: The Triumph of Persistence (New York: Bloomsbury Press).

Spicer, J., and L. Kihara (2014), "Central Banks Ending Era of Clear Promises, Return to 'Artful' Policy", Reuters, 7 July.

Staiger, D., J.H. Stock, and M.W. Watson (1997), "The NAIRU, Unemployment and Monetary Policy", *Journal of Economic Perspectives* 11 (Winter): 33-49.

Svensson, L. (2009), "Flexible Inflation Targeting – Lessons from the Financial Crisis", at the workshop 'Towards a New Framework for Monetary Policy? Lessons from the Crisis', Netherlands Bank, 21 September.

Taylor, J. (2010), "Getting Back on Track: Macroeconomic Policy Lessons from the Financial Crisis", *Review* of the Federal Reserve Bank of St. Louis (may/June): 165-176.

Thornton, D.L., and D. C. Wheelock (2014), "Making Sense of Dissents: A History of FOMC Dissents", *Review* of the Federal Reserve Bank of S. Louis (Third Quarter): 213-228.

Thornton, D.L. (2011), "What Does the Change in the FOMC's Statement of Objectives Mean?", *Economic Synopses*, Federal Reserve Bank of St. Louis, No.1.

Thornton, D., and D.C. Wheelock (2000), "A History of the Asymmetric Policy Directive", *Review* of the Federal Reserve Bank of St. Louis 82(5): 1-16.

Timberlake, R. H. (1993), *Monetary Policy in the United States* (Chicago: University of Chicago Press).

Tudor, C., and C. Vega (2014), "A Review of Textual Analysis in Economics and Finance", in R.P. Hart (Ed.), *Communication and Language Analysis in the Corporate World* (Hershey, PA: IGI Global), pp. 122-139.

Visser, B. and O.H. Swank (2007), "On Committees of Experts", *Quarterly Journal of Economics* 122 (1): 337-372.

Warsh, K. (2016), "Institutional Design: Deliberations, Decisions, and Committee Dynamics", in *Central bank Governance and Oversight Reform*, edited by J. Cochrane and J. Taylor (Stanford, CA: Hoover Institution Press), pp. 173-193.

Wessel, D. (2009), In Fed We Trust (New York: Crown Business).

Woolley, J., and J. Gardner (2009), "Does Sunshine Reduce the Quality of Deliberation? The Case of the Federal Open Market Committee", working paper, UC Santa Barbara.

White, W. R. (2009), "Should Monetary Policy "Lean or Clean"?" Globalization and Monetary Policy Institute working paper 34, August.

Woodford, M. (2012), "Methods of Policy Accommodation at the Interest-Rate Lower Bound", in *The Changing Policy Landscape*, Economic Policy Symposium Proceedings (Kansas City: Federal Reserve Bank of Kansas City), pp. 185-288.

Woodford, M. (2005), "Central Bank Communication and Policy Effectiveness", in *The Greesnpan Era: Lessons for the Future*, Economic Symposium, Federal Reserve Bank of Kansas City (Kansas City: Kansas City Federal Reserve), pp.399-474.

Wu., C. and F. Xia (2016), "Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound", *Journal of Money, Credit, and Banking* 48(2-3): 253-291.

Wynne, M.A. (2013), "A Short History of FOMC Communication", *Economic Letter*, Dallas Fed, 8 (September): 1-3.

Yellen, J. (2012), "Evolution and Revolution in Central Bank Communication", at the Haas School of Business, UC Berkeley, 13 November, http://www.federalreserve.gov/newsevents/speech/yellen20121113a.htm.

Yellen, J. (2006), "Minutes of the Federal Open Market Committee, June 28-29", <u>http://www.federalreserve.gov/fomc/minutes/20060629.htm</u>.

Pre-1994			<b>r</b>	
RCSC	GDP	Inflatio	FFR	RCSC
ORE	growth	n		ORE
1.000	0.768	1.095	4.608	93.529
2.000	0.752	2.231	15.455	81.562
3.000	2.070	4.070	32.960	60.900
4.000	2.222	3.757	39.748	54.273
5.000	1.077	3.053	68.118	27.751
6.000	1.130	3.742	67.376	27.752
7.000	2.384	3.967	66.826	26.823
8.000	2.462	4.926	65.253	27.358
9.000	2.498	4.948	65.242	27.312
10.000	2.424	4.834	66.214	26.528
Post-1994				•
RCSC	GDP	Inflatio	FFR	RCSC
ORE	growth	n		ORE
1.000	6.510	3.116	11.931	78.443
2.000	4.991	9.327	14.079	71.603
3.000	5.939	11.033	13.691	69.337
4.000	5.709	9.313	26.089	58.890
5.000	3.021	7.027	65.127	24.825
6.000	3.428	6.711	65.949	23.912
7.000	3.581	6.564	65.833	24.023
8.000	6.301	9.613	61.826	22.260
9.000	6.473	10.869	60.613	22.045
10.000	6.423	12.461	59.318	21.797
Pre-1994				
DICTI	GDP	Inflatio	FFR	DICTI
ON	growth	n		ON
1.000	0.706	0.205	2.070	97.019
2.000	2.073	0.207	1.781	95.939
3.000	2.063	0.205	2.670	95.061
4.000	2.054	0.209	2.976	94.761
5.000	1.797	0.237	2.703	95.262
6.000	1.775	0.282	2.661	95.282
7.000	1.780	0.285	2.648	95.287
8.000	1.780	0.283	2.740	95.198
9.000	1.783	0.308	2.683	95.226
10.000	1.834	0.315	2.787	95.063

Table 1 Generalized Variance Decompositions<sup>a</sup>

Post-1994				
DICTI	GDP growth	Inflatio	FFR	DICTI
ON		n		ON
1.000	1.567	0.031	5.380	93.021
2.000	3.663	0.567	5.542	90.228
3.000	4.062	1.726	4.559	89.653
4.000	3.794	2.857	4.803	88.547
5.000	3.380	4.672	8.447	83.501
6.000	3.154	4.689	12.934	79.223
7.000	3.096	4.223	16.143	76.538
8.000	2.974	3.963	18.266	74.798
9.000	2.958	3.865	19.063	74.114
10.000	2.952	4.061	19.136	73.851

<sup>a</sup> The top two portions correspond to the VARs at the bottom of Figure 4A and Figure 4B, respectively. The bottom two portions correspond to the VARs at the Bottom of Figure 5A and Figure 5B. The VD were estimated according to Lanne and Nyberg (2016).

#### Figure 1 Stylized Timeline of FOMC Releases



Note: From <u>https://www.federalreserve.gov/monetarypolicy/fomc\_historical.htm</u>. Prior to 1994 the transcripts made from audio recordings were lightly edited but not reviewed by committee members. After 1993 the transcripts are lightly edited with review from committee members. Between 1993 and 2004 the minutes were released 3 days after the subsequent FOMC meeting; beginning in 2005, 3 weeks after the decision. The Bluebook was the document where monetary policy alternatives are discussed; the Greenbook provides a discussion of current economic and financial conditions (and forecasts). These were merged into the Tealbooks in 2010.



Sources: Author's calculations and FRED. WS represents a variable constructed as multiples of 25bp changes based on Wordscores based on rolling estimates, year by year between 1955 and 1993 and then in two year intervals thereafter, of equation (2). See the text for the details. Data are quarterly.



Note: The DICTION indicator is based on the first principal component in a factor model that includes activity, certainty, optimism, and commonality as the constituents of the tone of a document. The single factor is estimated via the Kaiser-Guttman approach using maximum likelihood.

### Figure 4A Select Generalized Impulse Responses: Communication (Wordscores) and Economic Activity, Pre and Post 1994 to 2008Q4



Post-1994 Sample: response of RSCORE ro GDP growth

Note: Based on a VAR for the 1955Q1-1993Q4 (pre) and 1994Q1-2008Q4 (post) samples. The text provides the details of the VARs. 1 lag is used for the post sample and 5 lags in the pre-1994 sample. Generalized impulse responses are shown. RSCORE is the proxy for Fed communication (CM) obtained from Wordscores. FFR is the fed funds rate.



Post-1994 Sample: response of RSCORE to GDP growth



Note: Same VAR as in Figure 4A (top 2 Figures) except 4 lags are used. Also, see note to Figure 4A.



#### Communication (DICTION) and Economic Activity: Post-1994 Ends 2008Q4



Note: Based on a VAR for the 1955Q1-1993Q4 (pre) and 1994Q1-2008Q4 (post) samples. The text provides the details of the FAVARs. 1 lag is used for the post sample and 5 lags in the pre-1994 sample. DICTION is the proxy for Fed communication obtained from DICTION 6.0 based on the first principal component of the four elements of tone in documents (certainty, optimism, activity, and commonality). For the pre-1994 sample the level of the factor score is used. The post-1994 sample the level is stationary.





Post-1994 Sample: response of DICTION to GDP growth

Note: Same VAR as in Figure 5A except 2 lags are used. Also, see note to Figure 5A.