
Article:
Madeira, Carlos and Rodrigues Madeira, Joao Antonio (2019) The effect of FOMC votes on financial markets. Review of economics and statistics. pp. 921-932. ISSN: 0034-6535

https://doi.org/10.1162/rest_a_00770

The effect of FOMC votes on financial markets

Carlos Madeira*and João Madeira†

August 2018

Abstract

This article shows that since votes of FOMC members have been included in press statements, stock prices increase after the announcement when votes are unanimous but fall when dissent (which typically is due to preference for higher interest rates) occurs. This pattern started prior to the 2007–2008 financial crisis. The differences in stock market reaction between unanimity and dissent remain even controlling for the stance of monetary policy and consecutive dissent. Statement semantics also do not seem to explain the documented effect. We find no differences between unanimity and dissent with respect to impact on market risk and Treasury securities.

JEL Classification: E50, E58, G10, G12.

*Central Bank of Chile; Email: *cmadeira@bcentral.cl.* The opinions expressed are those of the authors alone, and do not represent the views of the Central Bank of Chile.

†University of York; Tel: +44 (0)7531704978; Email: *joao.madeira@york.ac.uk.* We would like to express our special gratitude to Álvaro González for data assistance, Miguel Acosta for providing us codes on semantic analysis of FOMC statements, and Refet Gürkaynak for help in obtaining monetary policy factors. We are also grateful to John Y. Campbell, Lawrence Christiano, Adriana Cornea-Madeira, Luca Dedola, Cosmin Ilut, Pete Klenow, David Lucca, Michael McMahon, Virgiliu Midrigan, Emanuel Moench, Carola Moreno, Stephen Morris, Evi Pappa, Luboš Pástor, Romina Oses, Claudio Raddatz, the editor Yuriy Gorodnichenko and three anonymous referees for useful discussions and comments. We also benefited from the insight of participants of the MMF (2014), IAAE (2015), PEJ (2015) and ERMAS (2015) conferences and of seminars at the University of York, Paris School of Economics and Central Bank of Chile. Any mistakes are ours alone.

Keywords: Dissent; returns; monetary policy committees; transparency; central bank communication.

1 Introduction

Economic theory and empirical studies show that monetary policy has an important impact on the economy (Bernanke and Blinder, 1992), with its most immediate effects seen on financial markets (Bernanke and Kuttner, 2005). There is therefore great interest in how monetary policy decisions are taken by central banks, particularly whether their decision committees focus on consensus or whether these reflect heterogeneous policy views (Riboni and Ruge-Murcia, 2010).[1] The decision process of central bank committees and the communication of monetary policy to the markets are still greatly debated in policy circles and academia, with no consensus or significant evidence on what constitutes an optimal strategy or the best practice (Blinder et al., 2008, Ehrmann et al., 2012).

This paper studies how the communication of the vote of individual members of the Federal Open Market Committee (FOMC or Committee) impacts financial markets using intraday data. In particular, we distinguish between the impact of unanimous meetings versus those with dissent (one or more members in disagreement with the FOMC's decision, usually because dissenting members favor the setting of a higher interest rate). To do this we explore the fact that only from March 2002 onwards has the vote of FOMC members been disclosed through the press statement, that is, at the same time as the Committee's decision over the federal funds rate. Before this date FOMC member votes were only published several weeks after the decision and days after the subsequent meeting.

We show that, for the period before votes were included in press statements, there was no difference in the pattern of the S&P500 (hence S&P) stock returns between the cases of

[1] In this context the work of Hansen et al. (2014) is relevant since it shows that Bank of England committee members votes reflect heterogeneous individual assessments of the economy.

FOMC unanimity and dissent, with both events being associated with statistically insignificant effects in a period of 30 or 60 minutes around the press announcement. After March 2002 markets lose value after dissent occurs but increase in value with unanimity. These conclusions are robust to the choice of econometric methodology, with similar findings in both ordinary least squares and median quantile regression (which is less sensitive to outliers).

We also show that the differences in returns between unanimity and dissent votes are still present even when controlling for surprise changes to monetary policy (Kuttner, 2001), consecutive meetings with dissent, multiple votes of dissent and reasons for dissent. Moreover, a positive impact of unanimity and a negative impact of dissent on returns exists for different time periods, including the 2002-07 economic expansion prior to the financial crisis of 2007-2008. We went further and applied a structural break test with an unknown break date in the constant of an OLS regression with S&P returns. We encountered break dates which are consistent with the hypothesis that the cause for the differences in unanimity and dissent on stock markets documented for the period after March 2002 were the result of the change in communication policy in FOMC votes.

We also studied whether the opposing effects of unanimity and dissent on stock returns could be due to differences in the semantics of the statements. We found that dissent statements have on average a larger number of words than unanimity statements. However, this is the case because a larger fraction of dissent events occurred after the start of unconventional monetary policy (when statements became longer). Once one divides statements into subperiods before and after the start of unconventional monetary policy, then differences in semantics between unanimity and dissent cease to be statistically significant. This suggests that differences in the impact of financial markets between unanimity and dissent statements after March 2002 do not arise from semantics.

We then test how dissent and unanimity affect prices of futures of Treasury notes for several maturities, measures of market risk and trading volume. Dissent and unanimity are both associated with an increase in trading volume and no impact on the remaining variables.

We therefore do not find strong evidence to support that changes to market volatility and trading volume can explain the observed differences between unanimity and dissent.

We find that although less than 5% of the votes cast are against the FOMC's policy, decisions made with dissent are far from rare (which is also shown in Thornton and Wheelock, 2014) and represent about 40% of meetings. Furthermore, over one third of the FOMC's members expressed dissent at least once over their terms. The finding that there is a different impact on financial markets when dissent votes are observed even though FOMC members overwhelmingly vote in favor can therefore be surprising. However, Blinder et al. (2001) note that "Fed traditions dictate that a member should 'dissent' only if they find the majority's (that is, the chairman's opinion) unacceptable." This makes a dissenting vote as something "noteworthy" (Blinder, 2007) and suggests that dissent votes understate the true degree of disagreement within the FOMC.[2] Meade (2005) does in fact show that disagreement voiced during meetings is much larger than that expressed in votes.

Previous studies found that FOMC announcements are associated with strong equity price appreciation (Tori, 2001, Lucca and Moench, 2015), which are not fully accounted by changes in monetary policy decisions. Cieslak et al. (2015) also show evidence that the Fed affects stocks in between FOMC meetings. Our paper contributes to the literature by showing that statements of public unanimity and dissent have a very different impact on stock markets.

Our paper is also related to works on the communication policy of central banks. Policy makers and academics debate about whether greater public disclosure is necessarily welfare increasing (Morris and Shin, 2002, Svensson, 2006). Meade and Stasavage (2008) study how transparency in the monetary decision making process can make members reluctant to dissent. Our paper shows that reluctance to dissent in FOMC members could in addition be

[2]Blinder (2007) considers that it is indeed "quite possible for the Fed to adopt one policy even though the (unweighted) majority favoured another" and describes a particularly revealing episode of this, in which the transcripts show that a clear majority preferred a different decision from the actual policy.

due to awareness of negative effects on financial markets.

Our results have important policy implications. The Federal Reserve and other central banks have become increasingly more transparent in the last decades (Blinder et al., 2008). A recent example of this is the announcement of plans to publish European Central Bank minutes (Bryant, 2014). The negative impact of public dissent on stock markets indicates that greater openness may not always be beneficial.

The paper is organized as follows: Section 2 describes the FOMC's announcements policy, the results are shown in Section 3 and Section 4 concludes.

2 The communication policy of FOMC votes

The Federal Open Market Committee oversees US monetary policy and the open market operations (i.e., purchases and sales of US Treasury securities) of the Federal Reserve System. The FOMC is composed of twelve members: the seven members of the Federal Reserve Board (who are nominated by the president), the New York Federal Reserve president and four of the remaining eleven Federal Reserve bank presidents (who serve one year terms on a rotating basis). Currently, the Committee specifies policy in terms of a target level for the federal funds rate (the weighted average of interbank overnight loans).[3] Committee meetings are scheduled eight times per year at regular intervals (approximately once every six weeks).[4]

Voting composition has only been made public through the minutes or press statements, which have only been published since 1993 and 1994, respectively. The minutes record the decisions of the FOMC over policy issues, including which Committee members voted in favor and against (dissent) the decision of the federal funds rate target level, plus the reasons that justify the dissent vote of each FOMC member. The minutes of FOMC meetings are

[3]Effective federal funds rate targeting has been in place since the late 80s (Meulendyke, 1998).

[4]Unscheduled meetings are uncommon. From February of 1993 to January of 2015 there were only eight unscheduled meetings of the FOMC with vote on interest rates (one in 1994, one in 1998, three in 2001, one in 2007 and two in 2008).

released with a lag, with their release date until December of 2004 being about six weeks after the Committee's meeting (or approximately three days after the Committee's subsequent meeting). Since 2005 minutes are released only three weeks after the meeting.

The first policy statement (announcement of a meeting's outcome) of the FOMC occurred in February 1994. Therefore, we consider the FOMC meetings from February 1994 to January 2018. Previously, the Committee did not reveal policy decisions and agents had to infer the federal funds target from the size and type of open market operations. Starting in February 1995 the FOMC has immediately communicated to the public all changes to monetary policy. From January 2000 the Committee has issued a statement following each scheduled meeting (regardless of whether a change in policy was made or not). From 1994 until January 2002 statements did not include the voting composition of the FOMC's decision. From March 2002 the press statements also disclose the vote of each individual FOMC member and the reasons justifying the vote of each member that chose to dissent.

3 Empirical results

3.1 Data

We used several data sources. From the Federal Reserve Board website we obtained data on the decisions of the federal funds rate target level (FFR_t), voting composition of FOMC members, plus daily 3 month Treasury bill yields ($TY_{3M,t}$) and one to five year zero-coupon Treasury yields (see Gürkaynak et al., 2007). From the New York Fed we obtained data on the overnight Treasury general collateral repo rate. From the Federal Reserve Bank of St. Louis we obtained daily data on the 5 year forward inflation expectation rate ($T5YIFR_t$), 5 year and 10 year Treasury Inflation Protected Securities (TIPS). From Bloomberg we obtained daily frequency data on the VIX index (VIX_t) and the S&P trading volume (TV_t^{SP}). From Quandl we obtained federal funds future data to construct a measure of "surprise" rate changes (FFS_t) as in Kuttner (2001). Finally, from Tick Data we obtained intraday data

on trading volume (total number of transactions) for the E-mini S&P futures (respectively TV_t^{ES}), Eurodollar futures (ED_t), the S&P stock market index price level (P_t), futures price data of the 2 year, 5 year and 10 year Treasury notes (respectively $TN_{2,t}$, $TN_{5,t}$, and $TN_{10,t}$).

FOMC announcements have often occurred on days with other important information releases (Gürkaynak et al., 2005). Therefore, our analysis focuses on intraday data. We calculate the intraday S&P returns as follows:

$$r_t = \ln(\frac{P_t}{P_T}). \tag{1}$$

We consider both a "tight" and a "wide" intraday window as defined in the previous literature (Gürkaynak et al., 2005, Gorodnichenko and Weber, 2016): the tight window is 30 minutes and starts 10 minutes before the announcement, while the wide window is 60 minutes and starts 15 minutes before the announcement. We report the times of each FOMC announcement since 1994 in Table A1 of the online Appendix.

We study the impact on financial markets of FOMC meetings where there was unanimity versus one or more dissent votes in two different periods. The first period consists of the meetings between February 1994 and January 2002, when the voting composition only became public several weeks after the FOMC decision. The second period includes the meetings between March 2002 and January 2018, when the voting composition was disclosed in the FOMC press statement and therefore was known jointly with the federal funds rate target.

Table 1 reports descriptive statistics for intraday frequency data of several variables for both the tight and wide windows of all FOMC announcements between 1994 and 2018. The variables included are: S&P returns (r_t) and the change in the yield value for 2 year, 5 year and 10 year Treasury notes futures (respectively $\Delta TNY_{2,t}$, $\Delta TNY_{5,t}$, and $\Delta TNY_{10,t}$).

On average S&P returns around FOMC meetings were positive for both unanimity and dissent meetings prior to March 2002. In this period meetings with dissent had a higher average and median than unanimity (the median in this period for unanimity was actually

negative in both windows). Meetings with dissent also had lower standard-deviation than unanimity in this period. This is true for both the tight and wide windows, for which there is a substantial degree of correlation (in excess of 85%). After March 2002 the average and median of returns on meetings with unanimity was positive for both windows. The opposite happened with dissent (negative average and median for r_t in this period for both windows). Meetings with dissent had higher standard-deviation in this period.

Table 1 also shows that in the period prior to March 2002 there were greater increases (higher average and median) in the yields of Treasury notes of the 2 year, 5 year and 10 year maturities with dissent than with unanimity. This is true for both the tight and wide windows. After March 2002 there were greater increases (higher average and median) in the yields of Treasury notes of the 2 year, 5 year and 10 year maturities with unanimity than with dissent for the tight window. This is also true for the most part in the wide window (except that at the median there was a larger increase in $\Delta TNY_{2,t}$ and $\Delta TNY_{10,t}$ with dissent than with unanimity). For both windows and periods, regardless if there was unanimity or dissent, standard-deviations increase for changes in the yield of Treasury notes with higher maturity.

In Table A2 of the online Appendix we also include descriptive statistics for intraday frequency data of changes in trading volume for the E-mini S&P futures (ΔTV_t^{ES}) and the change in the yield value for Eurodollar futures (ΔEDY_t).

3.2 Summary of facts on FOMC voting

We start with a basic overview of the patterns in voting dissent. Table 2 shows that dissent represents only a small fraction of Committee votes (less than 6% in both the period before and after votes were included in the FOMC statement). Nonetheless meetings in which dissent occurs are far from rare, having occurred in 40.30 % of the meetings from 1994 to 2018. Between February 1994 and January 2002 (when votes were not included in the statement) dissent occurred in 22 of the 70 FOMC meetings of the period. After March 2002

(when votes were included in the statement) dissent votes were cast in 59 of the 131 FOMC meetings of the period.

Most episodes are motivated by a desire for "tighter" monetary policy (that is, preference for a higher interest rate), which occurred in 18 of the 22 meetings with dissent before March 2002 and on 47 of the 59 dissent meetings in the period afterwards. Dissent for an "easier" policy (preference for a lower interest rate) is much less frequent, occurring only 4 times in the period before March 2002 and on 14 of the 59 meetings with dissent in the period afterwards.

Many different FOMC members have expressed votes of dissent (more than 35% of FOMC members expressed votes of dissent in both the periods before and after March 2002). However, there has been no Committee member that always dissented. The median dissenter does so less than 15% of the time in either of the two periods. Table 2 also shows that frequent dissenters (defined as those on the 75 percentile) do so in less than one third of their votes.

Figure 1 shows the time series for the fraction of dissenting FOMC members per meeting. The figure shows that the pattern of dissent changed at about the time of the start of the financial crisis. From October 2007 onwards there was an uptick in dissents. Whereas the preceding period saw an unusual degree of agreement, with 2000 and 2004 being the only calendar years since 1957 without meetings with votes for dissent (Thornton and Wheelock, 2014). Between February 1994 and October 2007 most dissent episodes included only one dissenter (there were only three dates with two dissenters and none with more than two dissenters).[5] Also in that period most dissent episodes tended to be short (the two longest episodes occurred in 1996 and 2006 and lasted for 3 and 4 meetings respectively). From October 2007 onwards dissent became more frequent. The longest of such episodes lasted 20 meetings (from August 2011 to December 2013) and there were two episodes that lasted

[5]Meyer (2004), a former FOMC member, states that according to internal meeting practices that once two members had dissented with the Chair's proposed policy, the remaining were expected not to disagree.

8 meetings (from October 2007 to August 2008 and from January 2010 to December 2010). There was also an increase in observations with multiple dissenters, with meetings with three dissenters observed in 2011 (twice), 2014 (once) and 2016 (once).

There is a considerable amount of literature on the determinants of FOMC dissent. Bank presidents typically dissent because of a preference for tighter monetary policy, whereas governor votes of dissent are typically for easier monetary policy (Belden, 1989, Thornton and Wheelock, 2014). However, Tootell (1991) did not find statistically significant differences in the voting of bank presidents and governors. Thornton and Wheelock (2014) find that dissent in the FOMC is not easily predictable by macro variables such as inflation and unemployment. However, Havrilesky and Gildea (1991) and Malmendier et al. (2017) found that some individual characteristics are helpful in predicting votes of dissent. Havrilesky and Gildea (1991) show that training background and career experience in private banking help explain why bank presidents tend to dissent for tighter monetary policy. Malmendier et al. (2017) find that FOMC members personal experiences of inflation have significant predictive power for their voting decisions.

3.3 The effect of FOMC voting on the S&P index

We now analyze the data through an ordinary least squares (OLS) regression of S&P returns (r_t) around tight (30 minutes) and wide (60 minutes) windows of FOMC meetings:

$$r_t = \beta_D D_t + \beta_U U_t + \varepsilon_t, \tag{2}$$

where D_t and U_t are dummy variables for whether there was a vote of dissent on the date of the FOMC meeting or a vote of unanimity respectively. The regression results with robust standard-errors (which has become common practice in economics, see Angrist and Pischke, 2009) are shown in Panel A of Table 3.

The coefficients of the unanimity and dissent dummy variables are both positive (with

that for the dissent dummy quantitatively larger than that of unanimity) for the period between February 1994 and January 2002. For the tight window neither unanimity nor dissent are associated with statistically significant coefficients in this period. For the wide window the unanimity dummy is not statistically significant while dissent is statistically significant at the 10% level. In the period with votes not included in the statement, for both the tight and wide windows the coefficients of unanimity and dissent do not differ from each other at any conventional significance level.

For the period since March 2002 Panel A of Table 3 shows that the coefficient of the unanimity dummy is positive while the coefficient of the dissent dummy is negative. For the tight window both the unanimity and dissent coefficients are statistically significant at the 5% level, whereas for the wide window unanimity is significant at the 1% level and dissent at the 10% level (which is also an adequate testing level given the relatively small number of meetings with dissent, for a detailed discussion of this argument see Hendry, 1995).[6] In this period differences between unanimity and dissent coefficients are statistically significant at the 1% level for both tight and wide windows. We reach alike results if we exclude the observations for 22 of January 2008 and 8 of October of 2008 in which the announcements occurred outside of trading hours.

In the period with public votes, investors experienced losses much more frequently when dissent was observed rather than unanimity (as shown in Panel B of Table 3). In the tight window around FOMC meetings, between 2002 and 2018, investors made losses in 62.7% of the meetings in which dissent occurred, while they made losses in only 38.9% in the meetings in which unanimity occurred. In the wide window around FOMC meetings, between 2002

[6]In Table A3 of the online Appendix we examine the impact on stock markets from FOMC minutes announcement in the period prior to March 2002. We found that neither unanimity nor dissent have a statistically significant impact on stock returns. We also show that, unlike what typically happens with informative releases (see Ederington and Lee, 1993), minutes announcements for FOMC meetings prior to March 2002 do not seem to impact intraday volatility. The likely reason for this is that prior to 2005 minutes were released with a delay of six weeks and only days after the subsequent scheduled FOMC meeting. This timing rendered "them largely of historical interest" as argued by Rosa (2013).

and 2018, investors made losses in 57.6% of the meetings in which dissent occurred, while they made losses in only 29.92% in the meetings in which unanimity occurred. This did not occur prior to the release of vote information in the statement. Between 1994 and 2002 investors actually experienced fewer losses around FOMC meetings with dissent than with unanimity.

In Figure A3 of the online Appendix we show that the differences between unanimity and dissent in the impact of S&P returns only appear after the announcement. We obtain similar significance levels to those reported in Panel A of Table 3 using conventional standard-errors (see Table A4 of the online Appendix) and 5000 replicas bootstrap standard-errors (see Table A5 of the online Appendix). We also obtain similar results if one uses median quantile (MQ) regression instead of OLS (see Table A6 of the online Appendix). The reason for also considering MQ is that it is more robust to outliers than OLS (for an extended treatment of the subject see Koenker, 2005). In Table A7 of the online Appendix we show the results are robust to excluding unscheduled meetings and monetary policy turning points. In Table A8 of the online Appendix we show that differences between unanimity and dissent are not statistically significant even if one considers FOMC meetings from 1990 onwards (as in Gürkaynak et al., 2005).[7] Moreover, as shown in tables A9 and A10 of the online Appendix, the results are robust to using 1 day windows from 2pm of the announcement day (because FOMC releases are consistently made at 2pm or a few minutes afterwards) to 2pm of the day after the announcement. The conclusions are similar whether one uses daily returns (Table A9), excess returns calculated with the 3 month Treasury bill yield (Table A9) or excess

[7]Prior to 1994 the FOMC did not issue statements, investors learned of federal funds target rate decisions through the implementation of open market operations of the New York Fed's trading desk. However, as discussed in Bernanke and Kuttner (2005), ahead of some meetings prior to 1994 the New York Fed's trading desk seems to have let the federal funds rate drift in the direction of a new target level. Investors interpreted this inaction as signaling a policy change. Following Gorodnichenko and Weber (2016), in order to avoid almost all timing ambiguity in the main results of the paper we use only meetings from 1994 onwards (which we find particularly relevant due to the use of intraday data). We decided to only have results which included meetings starting in 1990 as a robustness check in the online Appendix.

returns calculate with the overnight Treasury general collateral repo rate (Table A10).

3.4 Potential explanations

We now explore several possible causes for the differences in the effect on stock returns between FOMC meetings with dissent and unanimity since votes have been made public in the statement.

3.4.1 Monetary policy

We first start by exploring if monetary policy can account for the difference between unanimity and dissent meetings observed since March 2002. To support our analysis we estimate several OLS regressions using as dependent variable S&P returns around tight and wide windows of FOMC meetings and as independent variables dummies for FOMC meetings ($U_t^{pub}, D_t^{pub}, F_t^{npub}, Unscheduled_t$) and a vector of additional controls ($\mathbf{X}_t$):

$$r_t = \boldsymbol{\beta}_1[D_t^{pub}, U_t^{pub}, F_t^{npub}, Unscheduled_t] + \boldsymbol{\beta}_x \mathbf{X}_t + \varepsilon_t. \tag{3}$$

D_t^{pub} is a dummy variable that takes a value of 1 if the FOMC statement communicated there was dissent in the vote (period after March 2002). U_t^{pub} is a dummy variable that takes a value of 1 if the FOMC statement communicated there was unanimity in the vote (period after March 2002). F_t^{npub} is a dummy variable that takes a value of 1 if the FOMC statement did not have vote information (period prior to March 2002). $Unscheduled_t$ is a dummy variable that takes a value of 1 if the FOMC meeting was unscheduled. The controls for monetary policy are included in $\mathbf{X}_t$. The estimation results with robust standard-errors are in Table 4.

In the first regression of Table 4 we control for monetary policy using the federal funds surprise (FFS_t) which measures the unanticipated component of the change in the federal funds rate in the FOMC announcement (Kuttner, 2001, shows that bond rates respond

to unanticipated changes but not to anticipated changes). The results show that in both windows dissent in the period since March 2002 has a negative coefficient that is statistically significant (at the 1% level for the tight window and at the 5% level for the wide window). The coefficient on the unanimity dummy in the period since March 2002 is statistically significant (at the 5% level for the tight window and at the 1% level for the wide window) and positive for both windows. The differences between unanimity and dissent coefficients are statistically significant at the 1% level in both windows. Prior to 2002, FOMC meetings were associated with a small but not statistically significant positive post-announcement effect. The coefficient for $Unscheduled_t$ is positive but not statistically significant. The coefficient on the FFS_t is not statistically significant which differs from the findings of Bernanke and Kuttner (2005) and Gürkaynak et al. (2005) with a smaller sample of meetings. This is however consistent with the results of Gorodnichenko and Weber (2016) who also did not obtain a statistically significant coefficient for the federal funds surprise on a 30 minute window around FOMC statement releases from 1994 to 2009.

In the second regression of Table 4 we control for monetary policy using two monetary policy factors ($MF_{1,t}$ and $MF_{2,t}$) which Gürkaynak et al. (2005) showed to adequately capture the effects of U.S. monetary policy on asset prices. This regression does not include the last FOMC announcement with Yellen as Chair (which happened in 31 of January 2018) because we only have data available for the factors until the end of 2017. The results are very similar to those obtained with the first regression. The coefficient on the dissent dummy in the period since March 2002 is statistically significant (at the 5% level for the tight window and at the 10% level for the wide window) and negative for both windows. The coefficient on the unanimity dummy in the period since March 2002 is statistically significant (at the 5% level for the tight window and at the 1% level for the wide window) and positive for both windows. The differences between unanimity and dissent coefficients are again statistically significant at the 1% level in both windows. Prior to 2002, FOMC meetings were associated with a small positive coefficient (which is statistically significant at the 10% level in the

tight window but not in the wide window). Unlike with the first regression the coefficient for $Unscheduled_t$ is negative (but, as previously, not statistically significant). Consistent with the results in Gürkaynak et al. (2005) both monetary policy factors have a negative effect on S&P returns and only one factor has a statistically significant coefficient.

In the third regression of Table 4 we control for monetary policy by having several dummy variables: $Recession_t$ is an NBER recession dummy indicator; $Tightening_t$ is a dummy variable that equals one if the observation occurs in a period of monetary tightening and $Easing_t$ is a dummy variable that equals one if the observation occurs in a period of monetary easing.[8] The results are similar to the previous regressions. Dissent has a negative effect on S&P returns while unanimity has a positive effects (both are statistically significant at the 5% level for the tight window and at the 10% and 1% levels for the wide window for dissent and unanimity respectively). The differences between unanimity and dissent coefficients are again highly statistically significant in both windows. Again, prior to 2002, FOMC meetings were associated with a small positive coefficient (which is statistically significant at the 10% level in the tight window but not in the wide window). None of the coefficients for the $Unscheduled_t$, $Recession_t$, $Tightening_t$ and $Easing_t$ dummies are statistically significant.

The result of a negative effect of dissent in the period with public voting is robust to using multiple controls for monetary policy in daily data with 2pm returns (see Table A11 of the online Appendix) for both OLS and MQ regressions. In Table A12 of the online Appendix we do another exercise that again indicates there is not much support for the hypothesis that the stance of monetary policy accounts for the differences between unanimity and dissent in the period with votes in the statement. We re-estimate (2) but using as dependent variable changes in the 3 month Treasury bill yield ($TY_{3M,t}$) around a one day window (closing hour of the previous day to the closing hour of the announcement day) instead of S&P returns. The OLS estimates with robust standard-errors show that both dissent and unanimity meetings

[8]We define tightening cycles as periods between local troughs and peaks of the target federal funds rate and easing cycles as periods between local peaks and troughs of the target rate.

are associated with quantitatively small effects (one basis point or less) and which do not statistically differ from zero.

3.4.2 The financial crisis of 2007-2008

One might conjecture that the differences found in the impact on stock returns of unanimity and dissent between the periods before and after March 2002 could be the result of something other than the change in communication policy of the FOMC (the inclusion of votes in the statement from March 2002 onwards). In particular, it can be tempting to think that the negative coefficient associated with dissent may simply be the result of a prolonged period of bad news (say the financial crisis of 2007-2008). In our view this is not a good explanation for the phenomenon we report, since we compare stock price returns in a window around the FOMC announcements and events such as the financial crisis are already known in the previous days.

To dismiss the possibility of our findings being the result of the financial crisis of 2007-2008, we look at the effects of dissent and unanimity on returns over the subperiods before and after February 2007 (the starting date of the timeline of the financial crisis in the St. Louis Fed website) for the time in which the vote has been made public. The results of re-estimating (2) using OLS with robust standard-errors for the two sub-periods are shown in Table 5.

The estimates of Table 5 show that the negative impact of dissent on stock markets is already present in the subperiod prior to February 2007. In this subperiod the coefficient for dissent is negative and statistically significant at the 1% level for both windows. The coefficient on the unanimity dummy in this period is positive in both windows but only statistically significant (at the 10% level) for the wide window. In this period the differences between unanimity and dissent coefficients are statistically significant at the 5% level for the tight window and at the 1% level for the wide window. Table 5 also shows that, in the period prior to the financial crisis, 85.7% of announcements with dissent were associated

with negative returns for both windows (whereas for unanimity only 42.4% and 30.3% of announcements were associated with negative returns in the tight and wide windows respectively). Table 5 also shows that dissent had a negative effect on stock returns and unanimity a positive effect for the period after February 2007. In this subperiod the differences between unanimity and dissent coefficients are statistically significant at the 1% level for both windows. We obtain similar significance levels to Table 5 using conventional standard-errors and 5000 replicas bootstrap standard-errors (see tables A13 and A14 of the online Appendix respectively).

We now do another exercise to provide further support that the observed differences between the period before and after March 2002 in the impact of FOMC unanimity and dissent meetings were the result of changes in the communication of FOMC votes. The exercise consists of testing for a structural break with an unknown break date in the constant of an OLS regression with S&P returns around intraday windows of FOMC meetings with dissent (r_t^D) as dependent variable. We applied a wild bootstrap supWald test (Boldea et al., 2017) to test for the null of no break in the OLS constant against the alternative of a break in the constant.[9] The OLS regression is shown below and includes dummy variables to control for monetary policy (these were the regressors which in Table 4 were associated with the smaller coefficients in absolute value for dissent in the period after March 2002):

$$r_t^D = \beta_0 + \beta_1 Recession_t + \beta_2 Tightening_t + \beta_3 Easing_t + \varepsilon_t. \tag{4}$$

For both windows the date break identified was 24 of September of 2018, which is the first FOMC announcement with a vote of dissent in the statement. The break is statistically

[9]The trimming parameter of the supWald test is 0.25 which is a typical value in the literature. The number of bootstrap replications is 200. We applied two versions of the wild bootstrap: the fixed regressor wild bootstrap that uses the conditional OLS mean and the residuals to generate the bootstrap samples, and the fixed regressor wild bootstrap that uses only the OLS residuals (as in Hansen, 2000) to generate the bootstrap samples. For details see Boldea et al. (2017).

significant at the 5% level for the tight window and at the 10% level for the wide window using the fixed regressor wild bootstrap. We also estimated (4) but using S&P returns around intraday windows of FOMC meetings with unanimity (r_t^U) as dependent variable instead of r_t^D. For the tight window the date break identified was 3 of January of 2001 (statistically significant at the 1% level using the fixed regressor wild bootstrap) and for the wide window the date break identified was 4 of May of 2004 (statistically significant at the 5% level using the fixed regressor wild bootstrap). The first FOMC announcement with a vote of unanimity was on 18 of March 2002, which is between these two break dates identified. One likely reason why it is harder for the test to detect the exact break date of the policy change is that in the case of unanimity there is no sharp contrast in the effect on stock returns between the two periods. Dissent is associated with average positive returns prior to the policy change and negative afterwards (see Table 3). However, unanimity is associated with average positive returns before and after the change in communication of votes in the statement (the impact of the policy was only an increase in the average, as shown on Table 3).

The structural break test results are robust to the choice of methodology. We obtain identical break dates and significance levels if we instead adopt the Hansen (2000) wild bootstrap.

3.4.3 Other variables related to FOMC voting

We now examine whether the finding of a negative effect of dissent and a positive effect of unanimity continues to be present after accounting for multiple dissent, consecutive dissent and reasons for dissent. To do this we re-estimate (3) with a vector of additional controls ($\mathbf{X}_t$) that includes not just the federal funds surprise (FFS_t) to account for monetary policy as in the baseline regression but also the following variables: $CD_{2,t}^{pub}$ which is a dummy (period after March 2002) for whether dissent happened in the current meeting and the previous meeting or more (that is, two or more consecutive dissent meetings in a row); PD_t^{pub} which is the mean (period after March 2002) for FOMC members that voted dissent in a meeting

of their fraction of past dissent votes (for unanimity meetings the variable therefore takes the value of 0); MD_t^{pub} which is a dummy for two or more dissenting votes (period after March 2002); and DE_t^{pub} which is a dummy (period after March 2002) of dissent for easier policy.

The estimates for OLS regressions with robust standard-errors are shown in Table 6. We again find a negative coefficient for dissent and a positive coefficient for unanimity in the period with votes in the statement for both windows. The differences between unanimity and dissent are again highly statistically significant in both windows (at the 1% level for the tight window and at the 5% level for the wide window). None of the coefficients on the dummies for consecutive dissent ($CD_{2,t}^{pub}$), multiple dissent (MD_t^{pub}) and dissent for easier (DE_t^{pub}) are statistically significant. The coefficient for PD_t^{pub} is found to be positive and statistically significant at the 1% level. This indicates that markets find less reasons for concern when present dissent is from members who dissented often in the past.

The result of a negative effect of dissent in the period with public voting is robust to using controls for multiple dissent, consecutive dissent and reasons for dissent in daily data with 2pm returns (see tables A15 and A16 of the online Appendix) for both OLS and MQ regressions. However, the coefficient for PD_t^{pub} is no longer statistically significant when using daily data (Table A15). Therefore, there is no strong support for the hypothesis that markets view differently the votes of members that dissent frequently. This is also the case if we instead use a dummy for whether the dissent vote was made by Ms. George or Mr. Lacker (who were the only members who disagreed on more than 50% of their meetings in our sample). Table A16 of the online Appendix shows that measuring serial dissenting in that manner also results in nonstatistically significant results.

3.4.4 Semantic Analysis of FOMC statements

We now do a semantic analysis of FOMC dissent and unanimity statements in the period with voting included in the statement (March 2002 onwards). In doing this we make use of the data produced by Meade and Acosta (2015) in their study of the semantics of FOMC

statements. Panel A of Table 7 shows the average number of words for unanimity and dissent statements for the period from March 2002 to December 2014 (this is the last statement included in the work of Meade and Acosta, 2015).[10] The table shows that, between March 2002 and December 2014, dissent statements have on average been substantially longer than unanimity statements (average of about 409 words for dissent statements and 249 for unanimity statements) and that the difference in length is statistically significant. However, researchers (Hernandez-Murillo and Shell, 2014, and Meade and Acosta, 2015) have identified that FOMC statements became substantially longer from January 2009 onwards (the beginning of so-called unconventional monetary policy). It is therefore possible that the average difference in number of words between dissent and unanimity statements can simply be accounted by the high frequency of dissent after 2009, whereas the period between 2000 and the onset of the financial crisis saw an unusual degree of consensus (Wynne, 2013). Our analysis seems to confirm such a hypothesis. Prior to January 2009 the average number of words in a dissent statement was 174 and unanimity statements had an average of about 163. From January 2009 onwards the average number of words of dissent statement was 508 and that of unanimity statement was 484. In both sub-periods (2002-08 and 2009-14) there are no statistically significant differences in number of words between unanimity and dissent statements.

Panel B of Table 7 shows the semantic similarity of raw consecutive FOMC statements. "Raw" means that no preprocessing of the text was done for this measure of semantic similarity by Meade and Acosta (2015). The results show that for both dissent and unanimity statements the degree of similarity with the previous statement is very high. The differences in similarity with the previous statement between dissent and unanimity are statistically significant at the 5% level for the sample from 2002 to 2014. However, dissent statements became more frequent from 2009 onwards, which corresponds to a period of a very high

[10] Words in statements on voting information were excluded from the analysis of Meade and Acosta (2015) and they also did not include unscheduled meetings. Because we use Meade and Acosta (2015) work as our starting point, the same applies here.

level of similarity in statements (Meade and Acosta, 2015). Differences in similarity with the previous statement between dissent and unanimity are no longer statistically significant once one splits the data in two subperiods (before and after January 2009).

It is not unusual to observe periods of several consecutive unanimity statements or several consecutive dissent statements. Therefore, it may be possible that the numbers in Panel B of Table 7 simply indicate that dissent statements are similar to previous dissent statements but could nonetheless be very different from previous unanimity statements. For this reason, in Panel C of Table 1 we only consider observations of dissent statements which were preceded by unanimity statements. The numbers show that the similarity between a statement of dissent and a preceding unanimity statement is not any different (at any conventional significance level) to the similarity between consecutive unanimity statements which precede votes of dissent. This is true not just for the subperiods before and after January 2009 but also for the entire period with voting included in the statement.

In summary, we show that there are no statistically significant differences between dissent and unanimity statements in number of words and semantic similarity to the previous statement, once one takes into account the overall increase in number of words and semantic similarity in FOMC statements after the start of unconventional monetary policy. We also show that the similarity between a dissent statement and a preceding unanimity statement is just as high as that between consecutive unanimity statements prior to a statement of dissent. Our analysis indicates that differences in the impact of financial markets between unanimity and dissent statements after March 2002 do not arise from semantics. In the online Appendix, we show that this assessment is robust to using a measure of semantic similarity after standard preprocessing steps of text (Table A17). The findings are also robust to using both standard preprocessing steps of text and to giving lower weight to terms that occur in many statements (Table A18 of the online Appendix) because such words do not help to distinguish semantic content between documents.

3.4.5 Market volatility, trading volume and Treasury notes

To search further for a potential "mechanism" for the different impact of dissent versus unanimity, we now look at their effect on other variables since March 2002. Table 8 shows the results of re-estimating (2) for windows of 30m and 60m around FOMC announcements using as dependent variables: prices of futures of the 2 year, 5 year and 10 year Treasury notes ($TN_{2,t}$, $TN_{5,t}$, and $TN_{10,t}$); squared returns and absolute returns (r_t^2 and $|r_t|$); and the trading volume for the E-mini S&P futures (TV_t^{ES}). Note that the risk and trading volume variables are always positive, therefore it does not make sense to test whether both unanimity and dissent are different from 0. Therefore, the regressions for those dependent variables use a constant instead of a unanimity dummy. A regression with a constant (same as the coefficient for unanimity) and dissent dummy gives a clear test of whether dissent differs from unanimity.

We first explore whether there is a connection between dissent or unanimity and expectations of the path of future monetary policy. Unanimity and dissent have no statistically significant impact on the 2, 5 and 10 year Treasury notes' futures ($TN_{2,t}$, $TN_{5,t}$, $TN_{10,t}$) on both windows. In the online Appendix (Table A19) we show the same occurs for these variables in a one day window after the announcements. In the one day window we also show that unanimity and dissent have no impact on the 5 year forward inflation expectation rate. In the online Appendix we also show that unanimity and dissent do not impact the prices of Eurodollar futures (see Table A20) or the Treasury yields (using close price daily data) for 1 year, 18 months, 3 and 5 year maturities (see Table A21) in the days of FOMC announcements (and in the day after). So the differences in the impact on stock returns of unanimity and dissent in the period since March 2002 do not seem to be explained by expectations of the path of future monetary policy.[11]

[11]The finding that dissent and unanimity do not reveal much information regarding the future path of monetary policy may seem in contradiction with the results in Gerlach-Kristen (2004) for the Bank of England's monetary policy committee (MPC). However Blinder (2007) shows that the US central bank typology is more "autocratical", while the UK's is more of

The results in Table 8 also show that changes to market risk are not a likely explanation for the negative effect of dissent on stock prices. Asset pricing theory predicts that investors require higher returns for exposure to market risk, therefore higher market volatility should have a negative impact on returns (as shown in Campbell and Hentschel, 1992). However, we do not find an effect of dissent statements for either squared returns or absolute returns on windows of 30m and 60m. In the online Appendix (Table A19) we show the same occurs for these variables in a one day window after the announcements. In Table A20 of the online Appendix we show that dissent also does not have an impact on the demeaned squared returns and the absolute value of the deviation of returns from the median (since dissent and unanimity have an impact on the mean and median returns, then these definitions measure the variance or absolute deviation of the returns conditional on the vote outcome).

It is known that informative announcements have a strong effect on intraday volatility (for a brief summary of this research see Hautch and Hess, 2007) which persists substantially higher than normal for 15 minutes after the announcement (Ederington and Lee, 1993). This too is the case of FOMC statements as shown in Figure 3 of Lucca and Moench (2015). The empirical exercises in Table 8 tests whether volatility at the end of the window differs from that at the beginning of the window. Even the tight intraday window considered (30 minutes, starting 10 minutes before the announcement and ending 20 minutes after) would therefore be unlikely to capture this rapid increase and fall in volatility. For this reason, we also examined whether there are differences between unanimity and dissent with respect to the observed peak for intraday volatility inside a window of 30 minutes around FOMC statement releases. We measure the peak as the maximum value observed inside the tight intraday window (30m around the announcement). We measure the increase in intraday volatility due to the FOMC statement as the maximum intraday volatility value minus the

an "individualistic MPC". Since dissent votes have a different importance in the US and the UK, there is reason to doubt that dissent in these central banks should be associated with a similar impact on expected future monetary policy. Also dissent is a much larger fraction of votes in the UK than in the FOMC (see Horvath et al., 2014). This implies that the FOMC's Chair has less incentives to adjust policy to satisfy the views of dissenting members.

intraday volatility value at the start of the window (10m prior to the announcement). The results are shown in Table 9. We find that both unanimity and dissent increase intraday volatility inside a 30m window (the difference between volatility at the peak and at the start of the window is statistically significant at the 1% level for both). However, there are no statistically significant differences between unanimity and dissent measured at the peak or in the increase of intraday volatility inside a 30m window around FOMC announcement.

Finally, we look at the impact of FOMC unanimity and dissent announcements on trading volume (TV_t^{ES}). Because there is no intraday data for the S&P index trading volume, we use instead data for the E-mini S&P futures, as in Lucca and Moench (2015). In Table 8 we confirm that dissent increases trading volume for the E-mini S&P futures for both the tight and wide windows (the same occurs in a one day window after the announcement, as shown in Table A19 of the online Appendix). Amihud (2002) documents a negative relationship between contemporaneous unexpected illiquidity and excess returns on U.S. equities. So the higher trading volume associated with dissent should have a positive effect on returns. Therefore, differences in liquidity do not seem to account for why dissent is associated with a negative effect on stock markets.

4 Conclusion

We find that the pattern of excess stock returns around FOMC announcements changed when the vote of individual members became publicly available at the same time as the decision over the federal funds target rate. In this period (from March 2002 onwards) stock prices on average increased when the vote was unanimous, with markets losing value when dissent (usually because of preference for tighter monetary policy) occurred, whereas previously both dissent and unanimity were associated with average positive returns.

The negative effect of dissent in the period with votes in the statement persists even if one controls for monetary policy or for consecutive and multiple dissent episodes. We

also find that the differences between unanimity and dissent are already present prior to the financial crisis of 2007-2008 (and structural break tests with unknown date support the hypothesis that the changes occurred at the time of the change in communication policy of FOMC votes). Moreover, a semantic analysis of FOMC statements does not seem to account for the differences in effect on stock returns between unanimity and dissent observed since March 2002.

We explore other hypotheses for the results such as differences between unanimity and dissent announcement in market volatility, liquidity and expectations of future monetary policy but do not find strong evidence for any of them. Thus, as of this paper's writing, a clear mechanism that explains the findings remains elusive.

References

[1] Amihud, Y., "Illiquidity and stock returns: cross-section and time-series effects," *Journal of Financial Markets* 5 (2002), 31-56.

[2] Angrist, J., and J. Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion* (Princeton: Princeton University Press, 2009)

[3] Belden, S., "Policy Preferences of FOMC Members as Revealed by Dissenting Votes," *Journal of Money, Credit and Banking* 21 (1989), 432-441.

[4] Bernanke, B., and A. Blinder, "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review* 82 (1992), 901-21.

[5] Bernanke, B., and K. Kuttner, "What explains the stock market's reaction to federal reserve policy?" *Journal of Finance* 60 (2005), 1221-1257.

[6] Blinder, A., 2007. "Monetary policy by committee: Why and how?" *European Journal of Political Economy* 23 (1), 106-123.

[7] Blinder, A., M. Ehrmann, M. Fratzscher, J. Haan, and D. Jansen, "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence," *Journal of Economic Literature* 46 (2008), 910-45.

[8] Blinder, A., C. Goodhart, P. Hildebrand, D. Lipton, and C. Wyplosz, "How Do Central Banks Talk?" Geneva Reports on the World Economy 3, London: Centre for Economic Policy Research (2001).

[9] Boldea, O., A. Cornea-Madeira, and A. Hall, "Bootstrapping Structural Change Tests," The School of Economics Discussion Paper Series 1704, Economics, The University of Manchester (2017).

[10] Bryant, C., "Mario Draghi backs plans to publish European Central Bank minutes," *Financial Times* 24 April 2014 (2014).

[11] Campbell, J., and L. Hentschel, "No news is good news: An asymmetric model of changing volatility in stock returns," *Journal of Financial Economics* 31 (1992), 281-318.

[12] Cieslak, A., A. Morse, ,and A. Vissing-Jorgensen, "Stock Returns over the FOMC Cycle," Working paper (2015).

[13] Ederington, L., and J. Lee, "How markets process information: News releases and volatility," *Journal of Finance* 48 (1993), 1161-1191.

[14] Ehrmann, M., S. Eijffinger, and M. Fratzscher, "The role of central bank transparency for guiding private sector forecasts," *Scandinavian Journal of Economics* 114 (2012), 1018-1052.

[15] Gerlach-Kristen, P., "Is the MPC's voting record informative about future UK monetary policy?" *Scandinavian Journal of Economics* 106 (2004), 299–313.

[16] Gorodnichenko, Y., and M. Weber, "Are Sticky Prices Costly? Evidence from the Stock Market," *American Economic Review* 106 (2016), 165-199.

[17] Gürkaynak, R., B. Sack, and E. Swanson, "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements," *International Journal of Central Banking* 1 (2005), 55-93.

[18] Gürkaynak, R., B. Sack, and J. Wright, "The U.S. treasury yield curve: 1961 to the present," *Journal of Monetary Economics* 54 (2007), 2291-2304.

[19] Hansen, B., "Testing for structural change in conditional models," *Journal of Econometrics* 97 (2000), 93-115.

[20] Hansen, S., M. McMahon, and C. Velasco Rivera, "Preferences or private assessments on a monetary policy committee?" *Journal of Monetary Economics* 67 (2014), 16-32.

[21] Hautsch, N., and D. Hess, "Bayesian Learning in Financial Markets: Testing for the Relevance of Information Precision in Price Discovery," *Journal of Financial and Quantitative Analysis* 42 (2007), 189-208.

[22] Havrilesky, T., and J. Gildea., "The Policy Preferences of FOMC Members as Revealed by Dissenting Votes: Comment," *Journal of Money, Credit, and Banking* 23 (1991), 130-138.

[23] Hendry, D., *Dynamic econometrics* (Oxford: Oxford University Press, 1995).

[24] Hernandez-Murillo, R., and H. Shell, "The Rising Complexity of the FOMC Statement," *Economic Synopses* 23 (2014).

[25] Horvath, R., M. Rusnak, K. Smidkova, and J. Zapal, "The dissent voting behaviour of central bankers: what do we really know?" *Applied Economics* 46 (2014), 450-461.

[26] Koenker, R., *Quantile Regression* (Cambridge: Cambridge University Press, 2005).

[27] Kuttner, K., "Monetary policy surprises and interest rates: Evidence from the Fed funds futures market," *Journal of Monetary Economics* 47 (2001), 523-544.

[28] Lucca, D., and E. Moench, "The pre-FOMC announcement drift," *Journal of Finance* 70 (2015), 329-371.

[29] Malmendier, U., S. Nagel, and Z. Yan, "The Making of Hawks and Doves: Inflation Experiences on the FOMC," NBER Working Papers 23228 (2017).

[30] Meade, E., "The FOMC: preferences, voting, and consensus," Federal Reserve Bank of St. Louis *Review* 87 (2005), 93-101.

[31] Meade, E., and M. Acosta, "Hanging on Every Word : Semantic Analysis of the FOMC's Postmeeting Statement," *FEDS Notes* 2015-09-30 (2015).

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

[33] Meulendyke, A., "*US monetary policy and financial markets*," Federal Reserve Bank of New York (1998).

[34] Meyer, L., *A Term at the Fed* (New York: Harper Business, 2004).

[35] Morris, S., and H. Shin, "Social Value of Public Information," *American Economic Review* 92 (2002), 1521-1534.

[36] Riboni, A., and F. Ruge-Murcia, "Monetary Policy by Committee: Consensus, Chairman Dominance, or Simple Majority?" *The Quarterly Journal of Economics* 125 (2010), 363-416.

[37] Rosa, C., "The financial market effect of FOMC minutes," *Economic Policy Review* December issue (2013), 67-81.

[38] Svensson, L., "Social Value of Public Information: Comment: Morris and Shin (2002) Is Actually Pro-Transparency, Not Con," *American Economic Review* 96 (2006), 448-452.

[39] Thornton, D. and D. Wheelock, "Making Sense of Dissents: A History of FOMC Dissents," Federal Reserve Bank of St. Louis *Review* 96 (2014), 213-27.

[40] Tootell, G., "Are district presidents more conservative than board governors?" *New England Economic Review* (1991), 3-12.

[41] Tori, C., "Federal Open Market Committee meetings and stock market performance," *Financial Services Review* 10 (2001), 163-171.

[42] Wynne, M., "A Short History of FOMC Communication," Federal Reserve Bank of Dallas *Economic Letter* 8 (2013), 1-4.

5 Tables

Table 1: Descriptive statistics of financial markets intraday data around tight (30m) and wide (60m) windows of FOMC announcements

	Tight window (30m)				Wide window (60m)			
	1994-02		2002-18		1994-02		2002-18	
	U	D	U	D	U	D	U	D
A. S&P log returns in percentage (r_t)								
Mean	0.144	0.156	0.157	-0.225	0.068	0.174	0.270	-0.205
Median	-0.070	0.079	0.065	-0.092	-0.111	0.027	0.138	-0.054
Standard-deviation	0.876	0.453	0.570	0.714	0.905	0.488	0.682	0.792
Correlation	92.4	85.0	85.3	91.1	92.4	85.0	85.3	91.1
B. Change in yield of 2 year Treasury notes futures in basis points ($\Delta TN2Y_t$)								
Mean	-1.854	5.213	1.285	0.824	-0.514	6.108	1.612	1.311
Median	-1.563	1.563	2.734	0.781	0.000	1.875	0.000	0.781
Standard-deviation	9.749	11.487	11.629	8.102	12.481	14.444	14.342	10.265
C. Change in yield of 5 year Treasury notes futures in basis points ($\Delta TN5Y_t$)								
Mean	-5.452	12.784	1.942	2.185	-3.391	13.707	4.362	3.522
Median	-4.688	4.688	5.078	0.000	-3.125	7.031	1.953	-1.563
Standard-deviation	19.161	23.914	32.428	24.662	26.633	30.344	41.150	30.535
D. Change in yield of 10 year Treasury notes futures in basis points ($\Delta TN10Y_t$)								
Mean	-7.879	12.571	3.928	2.304	-5.020	14.986	5.538	4.317
Median	-6.250	3.125	3.906	3.125	-1.563	4.688	2.500	3.125
Standard-deviation	22.741	27.727	55.597	33.058	33.782	42.249	65.632	43.157
FOMC events	47	22	72	59	47	22	72	59

Notes: U denotes FOMC meetings with unanimity in the vote. D denotes FOMC meetings with one or more votes of dissent. Correlation indicates the degree of correlation for r_t between the tight and wide windows. The release of September 17, 2001 was excluded.

Table 2: Summary statistics on FOMC meetings and frequency of dissent

	1994-02	2002-18
Fraction of dissent votes	3.22%	5.39%
Number of FOMC meetings	70	131
Number of meetings with dissent	22	59
Number of meetings with dissent for tighter policy	18	47
Number of meetings with dissent for easier policy	4	14
Number of FOMC members	30	52
Number of dissenting members	13	19
p25: $E(D_{i,t} \mid \max_t(D_{i,t} = 1))$	3.0%	4.2%
p50: $E(D_{i,t} \mid \max_t(D_{i,t} = 1))$	5.5%	14.3%
p75: $E(D_{i,t} \mid \max_t(D_{i,t} = 1))$	15.0%	29.0%

Notes: $D_{i,t} = 1$ if FOMC member i voted dissent. p25, p50 and p75 denote respectively the 25, 50 and 75 percentiles.

Table 3: S&P r_t (in percent) around FOMC announcements with no controls

	Tight window (30m)			Wide window (60m)		
	1994-2002	2002-18	2002-18[a]	1994-2002	2002-18	2002-18[a]
A. OLS regressions with no controls						
D_t	0.160	-0.225**	-0.162**	0.184*	-0.205**	-0.141*
	(0.100)	(0.093)	(0.069)	(0.108)	(0.103)	(0.082)
U_t	0.099	0.157**	0.145**	0.068	0.270***	0.261***
	(0.123)	(0.067)	(0.059)	(0.133)	(0.081)	(0.075)
P-value $U = D$	0.704	0.001	0.001	0.501	0.0004	0.0004
R^2	0.027	0.083	0.084	0.021	0.100	0.107
B. Fraction of announcements with $r_t < 0$						
D_t	0.429	0.627	0.621	0.429	0.576	0.569
U_t	0.609	0.389	0.386	0.574	0.292	0.286
FOMC events	69	131	128	69	131	128

Notes: Robust standard-errors in (). *, **, ***, 10%, 5%, 1% significance. S&P returns (r_t) is the dependent variable. D_t is a dummy variable that takes a value of 1 if there was dissent in the FOMC vote. U_t is a dummy variable that takes a value of 1 if there was unanimity in the FOMC vote. The release of September 17, 2001 was excluded. *a* excludes January 22, 2008 and October 8, 2008 announcements.

Table 4: OLS regressions of S&P r_t (in percent) around FOMC announcements with controls for monetary policy (period 1994-18)

	Tight window (30m)			Wide window (60m)		
	(1)	(2)[a]	(3)	(1)	(2)[a]	(3)
D_t^{pub}	-0.236***	-0.192**	-0.185**	-0.215**	-0.172*	-0.159*
	(0.088)	(0.095)	(0.082)	(0.098)	(0.104)	(0.095)
U_t^{pub}	0.142**	0.155***	0.201**	0.252***	0.272***	0.327***
	(0.066)	(0.053)	(0.094)	(0.081)	(0.071)	(0.112)
F_t^{npub}	0.092	0.113*	0.142*	0.068	0.071	0.128
	(0.075)	(0.063)	(0.076)	(0.089)	(0.073)	(0.096)
$Unscheduled_t$	0.519	-0.033	0.667	0.644	-0.076	0.697
	(0.939)	(0.959)	(1.095)	(0.841)	(0.823)	(0.917)
FFS_t	-0.002			0.001		
	(0.023)			(0.022)		
$MF_{1,t}$		-0.328***			-0.331***	
		(0.045)			(0.053)	
$MF_{2,t}$		-0.055			-0.039	
		(0.098)			(0.111)	
$Recession_t$			-0.157			-0.211
			(0.365)			(0.387)
$Tightening_t$			-0.079			-0.141
			(0.079)			(0.103)
$Easing_t$			-0.106			-0.043
			(0.216)			(0.223)
P-value of $U^{pub} = D^{pub}$	0.001	0.004	0.004	0.001	0.001	0.002
R^2	0.081	0.264	0.092	0.092	0.246	0.103
FOMC events	200	199	200	200	199	200

Notes: Robust standard-errors in (). *, **, ***, 10%, 5%, 1% significance. S&P returns (r_t) is the dependent variable. D_t^{pub} is a dummy variable that takes a value of 1 if there was dissent in the FOMC vote in the period with votes in the statement (since March 2002). U_t^{pub} is a dummy variable that takes a value of 1 if there was unanimity in the FOMC vote (period since March 2002). F_t^{npub} is a dummy variable that takes a value of 1 if there was an FOMC meeting (period before March 2002). $Unscheduled_t$ is a dummy variable that takes a value of 1 if the meeting was unscheduled. (1), (2) and (3) differ with respect to the use of controls for monetary policy: (1) uses the Kuttner (2001) federal funds rate surprise (FFS_t); (2) uses the Gürkaynak et al. (2005) monetary policy factors ($MF_{1,t}$ and $MF_{2,t}$); and (3) uses dummies for the business cycle ($Recession_t$) and for the stance of monetary policy ($Tightening_t$ and $Easing_t$). The release of September 17, 2001 was excluded. a excludes January 31, 2018.

Table 5: S&P r_t (in percent) around FOMC announcements in sub-periods

	Tight window (30m)		Wide window (60m)	
	2002-07	2007-18	2002-07	2007-18
A. OLS regressions with no controls				
D_t	-0.385**	-0.204*	-0.425***	-0.175
	(0.162)	(0.103)	(0.132)	(0.115)
U_t	0.029	0.265**	0.154*	0.368***
	(0.056)	(0.112)	(0.082)	(0.130)
P-value $U = D$	0.021	0.003	0.001	0.002
R^2	0.193	0.095	0.207	0.102
B. Fraction of announcements with $r_t < 0$				
D_t	0.857	0.596	0.857	0.538
U_t	0.424	0.359	0.303	0.282
FOMC events	40	91	40	91

Notes: Robust standard-errors in (). *, **, ***, 10%, 5%, 1% significance. S&P returns (r_t) is the dependent variable. D_t is a dummy variable that takes a value of 1 if there was dissent in the FOMC vote. U_t is a dummy variable that takes a value of 1 if there was unanimity in the FOMC vote.

Table 6: OLS regressions of S&P r_t (in percent) around FOMC announcements with controls for consecutive dissent, multiple dissenters and reasons for dissent (period 1994-18)

	Tight window (30m)	Wide window (60m)
D_t^{pub}	-0.464**	-0.415*
	(0.190)	(0.244)
U_t^{pub}	0.144**	0.259***
	(0.068)	(0.082)
F_t^{npub}	0.090	0.068
	(0.073)	(0.088)
$Unscheduled_t$	0.549	0.667
	(0.936)	(0.842)
FFS_t	-0.003	0.002
	(0.022)	(0.022)
$CD_{2,t}^{pub}$	-0.027	0.011
	(0.173)	(0.236)
PD_t^{pub}	0.768**	0.766**
	(0.367)	(0.370)
MD_t^{pub}	-0.107	-0.223
	(0.219)	(0.265)
DE_t^{pub}	0.082	-0.057
	(0.228)	(0.283)
P-value of $U^{pub} = D^{pub}$	0.003	0.011
R^2	0.110	0.126
FOMC events	200	200

Notes: Robust standard-errors in (). *, **, ***, 10%, 5%, 1% significance. S&P returns (r_t) is the dependent variable. D_t^{pub} is a dummy variable that takes a value of 1 if there was dissent in the FOMC vote in the period with votes in the statement (since March 2002).

U_t^{pub} is a dummy variable that takes a value of 1 if there was unanimity in the FOMC vote (period since March 2002). F_t^{npub} is a dummy variable that takes a value of 1 if there was an FOMC meeting (period before March 2002). $Unscheduled_t$ is a dummy variable that takes a value of 1 if the meeting was unscheduled. FFS_t is the Kuttner (2001) federal funds rate surprise. $CD_{2,t}^{pub}$ is a dummy for two or more consecutive dissent meetings in a row (period after March 2002). PD_t^{pub} is the mean for FOMC members that voted dissent in a meeting of their fraction of past dissent votes (period after March 2002); MD_t^{pub} is a dummy for two or more dissenting votes (period after March 2002). DE_t^{pub} is a dummy of dissent for easier policy (period after March 2002). The release of September 17, 2001 was excluded.

Table 7: Statistics on semantic analysis of FOMC statements

	2002-14	2002-08	2009-14
A. Average number of words			
D_t	408.596	174	508.121
	(204.425)	(30.309)	(159.395)
U_t	248.893	162.732	484.400
	(168.102)	(32.800)	(163.631)
P-value of $U = D$	0.000	0.126	0.321
B. Semantic similarity (raw) of consecutive statements			
D_t	0.952	0.907	0.971
	(0.048)	(0.061)	(0.023)
U_t	0.927	0.912	0.968
	(0.057)	(0.059)	(0.024)
P-value of $U = D$	0.010	0.397	0.381
C. Semantic similarity (raw) between contiguous dissent and unanimity statements			
D_t^*	0.920	0.888	0.973
	(0.060)	(0.052)	(0.018)
U_t^*	0.901	0.867	0.958
	(0.079)	(0.080)	(0.034)
P-value of $U^* = D^*$	0.298	0.317	0.274

Notes: Standard-deviation in (). Measure of semantic similarity between statements obtained from Meade and Acosta (2015). D_t is a dummy variable that takes a value of 1 if there was dissent in the FOMC vote. U_t is a dummy variable that takes a value of 1 if there was unanimity in the FOMC vote. D_t^* denotes semantic similarity between a dissent statement and the preceding unanimity statement. U_t^* denotes semantic similarity between consecutive unanimity statements preceding a vote of dissent.

Table 8: OLS regressions with other variables (in percent) in intraday windows of FOMC announcements (period 2002-18)

	$\Delta TNY_{2,t}$	$\Delta TNY_{5,t}$	$\Delta TNY_{10,t}$	r_t^2	$\lvert r_t \rvert$	ΔTV_t^{ES}
A. Tight window (30m)						
D_t	0.008	0.022	0.023	0.207	0.077	36,116***
	(0.011)	(0.032)	(0.043)	(0.288)	(0.095)	(11,947)
U_t	0.013	0.019	0.039			
	(0.014)	(0.038)	(0.066)			
Constant				0.345***	0.368***	103,318***
				(0.108)	(0.054)	(6,971)
R^2	0.012	0.005	0.005	0.005	0.005	0.075
B. Wide window (60m)						
D_t	0.013	0.035	0.043	0.133	0.018	71,458***
	(0.013)	(0.0397)	(0.0561)	(0.324)	(0.106)	(26,071)
U_t	0.016	0.044	0.055			
	(0.017)	(0.049)	(0.077)			
Constant				0.526***	0.480***	228,859***
				(0.151)	(0.065)	(15,832)
R^2	0.014	0.012	0.008	0.001	0.000	0.062
FOMC events	131	131	131	131	131	120

Notes: Robust Standard-errors in (). *, **, ***, 10%, 5%, 1% significance. D_t is a dummy variable that takes a value of 1 if there was dissent in the FOMC vote. U_t is a dummy variable that takes a value of 1 if there was unanimity in the FOMC vote. $\Delta TNY_{2,t}$, $\Delta TNY_{5,t}$, $TNY_{10,t}$ denote the change in yield of 2, 5 and 10 year Treasury notes' futures respectively (0.01 corresponds to one basis point). r_t are S&P returns. ΔTV_t^{ES} is the change in trading volume (total number of transactions) for the E-mini S&P futures. Note that r_t^2, $|r_t|$ and ΔTV_t^{ES} are always positive, therefore it does not make sense to test whether both

unanimity and dissent are different from 0. The regression with constant and dissent gives a clear test of whether dissent differs from unanimity.

Table 9: S&P intraday volatility (five minute moving average of r_t^2 using observations of 1m frequency) around 30m of FOMC statements (period 2002-18)

	U	D
Average peak of intraday volatility inside 30m window	0.053	0.052
	(0.135)	(0.136)
P-value of Welch's T-Test (Peak $U \neq$ Peak D)	0.493	
Average intraday volatility at the start of the window	0.001	0.001
	(0.005)	(0.002)
P-value of Welch's T-Test (Peak $\neq$ Start of window)	0.001	0.003
Average increase in intraday volatility inside 30m window	0.051	0.051
	(0.132)	(0.135)
P-value of Welch's T-Test (Increase $U \neq$ Increase D)	0.498	
131 FOMC events		

Notes: Standard-deviation in (). U denotes FOMC meetings with unanimity in the vote. D denotes FOMC meetings with one or more votes of dissent. r_t are S&P returns.

6 Figures

Figure 1: Fraction of dissenting FOMC members per meeting