The effect of FOMC dissent on financial markets

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Abstract

This article shows that since votes of FOMC members have been included in press statements, stock prices increase when votes are unanimous but fall when dissent occurs. This pattern remains even controlling for monetary policy and market conditions prior to the announcement. We find no differences between unanimity and dissent with respect to impact on expectations of inflation, market risk and Treasury securities. Announcements with dissent show a higher increase in trading volume than unanimity. This suggests that a plausible cause for the differences in reactions of equity prices could be increased dispersion of opinion in investors due to dissent.

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1 Introduction

Economic theory and empirical studies show that monetary policy has a strong 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). 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 both daily and 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). 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 members's 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 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 not with unanimity (in this period, investors made losses in 67.4% of meetings with dissent, while losses happened in only 22.8% of meetings with unanimity). This stock market pattern of appreciation and depreciation of unanimity versus dissent FOMC meetings is observed both in the daily data and in narrow time windows around the statement release. The negative impact of dissent on stock returns is only observed after the announcement time, which points to a causal effect of public dis-

sent.[1] 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 excess returns between unanimity and dissent votes are still present even when controlling for changes to monetary policy (both expected and surprise changes as in Kuttner, 2001) and market conditions prior to the announcement, namely: volatility, trading volume, stage of the business cycle and US Treasury yields at longer horizons (one and five years) in order to control for the expected long run monetary policy. 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, the last recession and the zero-lower-bound period.

We then test how dissent and unanimity affect inflation expectations (estimated from Treasury Inflation Protected Securities' data), 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 then show that the increase in trading volume due to dissent is higher than that of unanimity in windows of 30m and 60m around announcements. Using the number of price updates as a proxy for trading volume (because of lack of availability of trading volume at the intraday frequency prior to 2003) we show that this did not occur prior to March 2002 when the vote information was absent from statements.

Our findings that public dissent announcements imply a negative impact on stock prices and a surge in trading volume, while having no significant impact on price volatility and Treasury yields, may be explained by an increase in differences of opinion among investors. This is consistent with theoretical asset pricing models showing that dispersion of opinions imply lower stock prices (Varian, 1985), ambiguous effect on volatility (Shalen, 1993), a higher trading volume (Cao and Ou-Yang, 2009) and an increase of the equity premium relative to bonds (Abel, 1989). It is also consistent with theoretical and empirical evidence about the impact of policy uncertainty on the equity risk premium (Pástor and Veronesi, 2013). Empirical stud-

[1] Also, Rigobon and Sack (2004) and Rosa (2011) confirm the validity of the event study approach to measure asset price responses to monetary policy announcements.

ies also consider that monetary policy news are associated with increases in the risk premium (Bernanke and Kuttner, 2005, Cieslak, Morse and Vissing-Jorgensen, 2015). Namely, after a dissent announcement some investors may consider that the Chair will deviate from his intended policy direction in order to accommodate the views of dissenting members (since the FOMC decides monetary policy by consensus, see Riboni and Ruge-Murcia, 2010). Hansen, McMahon and Rivera (2014) found that Bank of England committee members votes reflect heterogeneous individual assessments of the economy. Also, uncertainty about the impact of policy actions is typically viewed as a determinant of dissent votes (Belden, 1989), therefore dissent votes may increase dispersion of opinion as to the state of the economy. This is consistent with views by several Fed watchers (see Costa, 2015) that dissenting voices "have devolved into a cacophony of often-contradictory statements that do more to obfuscate than to clarify". Concerns have also been expressed by Bernanke (2015: 562) who in his Chair farewell address urged "assembled FOMC members to be more constructive and less strident in their public remarks".

Previous studies found that FOMC announcements are associated with strong equity price appreciation (Tori, 2001, Lucca and Moench, 2015), which are unaccounted by changes in monetary policy decisions (Bernanke and Kuttner, 2005). 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 (2005) shows that disagreement voiced during meetings is much larger than that expressed in votes while 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 due to awareness of negative effects on financial markets and in expectations of agents.

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).[2] Committee meetings are scheduled eight times per year at regular intervals (approximately once every six weeks).[3]

Voting composition has only been made public through the minutes or press statements, which have only been published since 1993 and 1994, respectively. Therefore we consider the FOMC meetings from February 1993 to January 2015. 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 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.

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

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

The first policy statement (announcement of a meeting's outcome) of the FOMC occurred in February 1994. 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 use several data sources. From the Federal Reserve Board website we obtain 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 six month to five year zero-coupon Treasury yields (see Gurkaynak, Sack, and Wright, 2007). From the Federal Reserve Bank of St. Louis we obtain 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 obtain daily frequency data on the VIX index (VIX_t), 10 year Treasury note yields ($TY_{10,t}$), S&P stock market index price level and trading volume (TV_t^{SP}). From Quandl we obtain federal funds future data to construct a measure of "surprise" rate changes (FFS_t) as in Kuttner (2001). Finally, from Tick Data we obtain intraday data on trading volume and tick count for the E-mini S&P futures (respectively TV_t^{ES} and TC_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 $TN_{10,t}$).

We start by calculating annualized cumulative excess returns (cer_t) for the S&P stock market index at the daily frequency for a window starting at time T. Cumulative excess

returns are zero on the first day of the window and given on the remaining days by

$$cer_t = \ln(\frac{P_t}{P_T}) - \sum_{h=T+1}^{t} TY_{3M,h}. \quad (1)$$

Because FOMC releases are consistently made at 2pm or a few minutes afterwards, we calculate returns using 2pm to 2pm S&P price changes, as in Lucca and Moench (2015).

The advantage of using data at the daily frequency is that we have access to a greater number of variables and a longer time series for some variables. However, one issue with daily data is that FOMC announcements have often occurred on days with other important information releases (Gurkaynak, Sack and Swanson, 2005). Therefore our analysis uses both intraday and daily data. We calculate the intraday S&P returns as follows:

$$r_t = \ln(\frac{P_t}{P_T}). \quad (2)$$

We consider both a "tight" and a "wide" intraday window as defined in the previous literature (Gurkaynak, Sack and Swanson, 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 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 1993 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 2015, when the voting composition was disclosed in the FOMC press statement and therefore was known jointly with the federal funds rate target.

3.2 Summary of facts on FOMC dissent

We start with a basic overview of the patterns in voting dissent. Table 1 shows that dissent represents only a small fraction of Committee votes (less than 6% in either of the two periods considered). Nonetheless meetings in which dissent occurs are far from rare, having occurred

in 40.76 % of the meetings from 1993 to 2015. Between February 1993 and January 2002 dissent occurred in 26 of the 78 FOMC meetings of the period. After March 2002 dissent votes were cast in 49 of the 106 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 22 of the 26 meetings with dissent before March 2002 and on 40 of the 49 dissent meetings in the period afterwards. Dissent for an "easier" policy (preference for a lower interest rate) is much less frequent, occurring only once in the period before March 2002 and on 11 of the 49 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. Table 1 shows that even the most frequent dissenters only do so in less than one third of their votes.

In Table 2 we show some empirical regressions for the dissent vote decision with explanatory variables including individual characteristics of FOMC members and the macroeconomic outlook, reporting a standard logit, a logit with normal random effects (logit-RE) and a logit with fixed effects (logit-FE). The random and fixed effects specifications help control for a variety of unobserved factors that are correlated with the individual governors (Wooldridge, 2001), such as preferences to conform with the majority.

In the standard logit model the probability of a FOMC member dissenting decreases with his/her experience ($E_{i,t}$), but this effect disappears with the random and fixed effects models. The average experience of the Committee members ($\bar{E}_t$) and the average experience of previously dissenting members ($\bar{E}_{d,t}$) present at the meeting are not statistically significant. Dissent is less likely during periods of higher Treasury bond yields (consistent with the tendency of dissenters for tighter policy), a finding which is robust across logit regressions. Market volatility (as measured by the VIX index in levels) and higher trading volumes (S&P index), however, are not a statistically significant determinant of vote decisions.

Voting dissent is not easily predictable (as indicated by the low Pseudo R^2 values of Table 2). Thornton and Wheelock (2014) find that dissent in the FOMC has happened

almost every year since the 1950s (2000 and 2004 were the only exceptions) and that its occurrence is not easily predictable by macro variables such as inflation and unemployment.

3.3 The effect of dissent on the S&P index

Figure 1 shows the annualized S&P average cumulative excess returns around a two day window of FOMC meetings. The window starts at 2pm the day before the announcement and ends at 2pm the day after the announcement (0 corresponds to 2pm of the announcement day). Panel A shows the period before votes of FOMC members were made available in the statement (between February 1993 and January 2002). We see a strong increase in the S&P, in particular for the day prior to the announcement of monetary policy decisions, which is in line with Lucca and Moench (2015). Importantly, we do not see much of a difference in the pattern of cumulative returns around FOMC meetings between cases in which the vote was unanimous and cases in which dissent occurred. Since in this period markets only learned whether dissent occurred several weeks afterwards, this result is not surprising.

Panel B of Figure 1 shows the S&P mean cumulative excess returns around the FOMC meetings for the period when the votes of FOMC members were publicly disclosed in the statement (which started in March 2002). We observe that meetings with unanimity meetings are still associated with large positive excess returns for the S&P index. However, the pattern for meetings with dissent is now different. Similarly to unanimity and what occurred prior to March 2002, there is still a positive effect on the day prior to the announcement. But unlike what is observed with unanimity or with dissent meetings in the preceding period there is now a post-announcement negative effect associated with dissent meetings.

We now analyze the data through an ordinary least squares (OLS) regression of cumulative excess returns (cer_t) around a two day window (starting at 2pm in the day before the announcement and ending at 2pm the day after the announcement) of FOMC meetings:

$$cer_t = \beta_D D_t + \beta_U U_t + \varepsilon_t, \tag{3}$$

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 results are shown in Panel A of Table 3. As expected the coefficients of the unanimity and dissent dummy variables are both positive for the period between February 1993 and January 2002.[4] The coefficient for the dissent dummy is quantitatively larger than that of unanimity for this period (consistent with what is shown in Figure 1, Panel A) but not in a statistically significant way. Table 3 shows that for the period since March 2002 that the coefficient of the unanimity dummy is positive (and statistically significant at the 1% level) while the coefficient of the dissent dummy is negative (and statistically significant at the 1% level). Moreover, the coefficients on both dummy variables are also quantitatively quite large. The average annualized cumulative excess return on a 2 day window is of plus 83 basis points in the case of unanimity and minus 73 basis points in the case of dissent.

One could think that the findings may simply be the result of other coincident events such as a prolonged period of bad news (the financial crisis) or something specific to a period of low interest rates (such as the zero-lower-bound). In our view this is not a good explanation for the phenomenon we report, since we compare the excess returns of financial markets in a window around the FOMC meetings and events such as the financial crisis are already known in the days previous to the window around the FOMC meeting.

To further dismiss the possibility of our findings being the result of other coincident events, we look at the effects of dissent on returns over several subperiods for the time in which the vote has been made public. The first period we consider is that between March 2002 and January 2007. This was a period of business cycle expansion and of rising interest rates by the FOMC (the federal funds rate target increased from 1% to 5.25% over this period). The next period we consider is that from February 2007 until June 2009. This was

[4]In Table A1 of the web appendix we examine the impact on stock markets from FOMC minutes announcement in the period prior to March 2002. We found that neither unanimity or dissent have a statistically significant impact on either returns or cumulative excess 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).

mostly a period of economic recession (the financial crisis) and of interest rate reductions by the FOMC (the federal funds rate target decreased from 5.25% to an interval of 0-0.25% over this period). The third period we consider is from July 2009 until January 2015 (after the financial crisis and until the end of our sample). This was the zero-lower-bound period for which the federal funds rate target remained unchanged at an interval between 0-0.25%.

The results are also in Panel A of Table 3. The findings show that a positive impact of unanimity and negative impact of dissent on stock markets is present over all the subperiods in which the FOMC vote was made public (and these differences are statistically significant).

We repeat the same OLS regressions of equation (3) using only the sign of cer_t as a dependent variable, that is $\text{sgn}(cer_t) = 1$ if $cer_t > 0$, $\text{sgn}(cer_t) = -1$ if $cer_t < 0$, and 0 otherwise (although a 0 cumulative excess return is never observed). This sign regression is more robust to outliers, since it does not include whether some events have a large magnitude or not. The results are shown in the last two columns of Table 3 in Panel A. Again, prior to March 2002 both unanimity and dissent were associated with a positive impact on stock markets (with differences between the coefficients not being statistically significant). From March 2002 onwards the coefficient on unanimity is positive (and highly statistically significant) while that of dissent is negative (and highly statistically significant).

Investors are indeed much more likely to experience losses when dissent is observed rather than unanimity, as shown in Panel B of Table 3. Between 2002 and 2015 investors made losses in 67.4% of the meetings in which dissent occurred, while they made losses in only 22.8% in the meetings in which unanimity occurred. Investors experienced losses more often with dissent in any of the periods considered. This did not occur prior to the release of vote information in the statement. Between 1993 and 2002 investors actually experienced fewer losses around FOMC meetings with dissent than with unanimity.

In the web appendix we show that the results in Table 3 are robust to using cumulative stock returns as the dependent variable without subtracting the risk-free yield (see Table A2) and that the 3 month Treasury bill yield is not much affected by either unanimity or dissent (see Table A3). The results are also robust to using a 4 day window with 2pm-to-2pm prices

(see Table A4) or Bloomberg close S&P prices (see Table A5).

We now move our analysis to the intraday frequency. We re-estimate equation (3) but using returns calculated for both a "tight" window of 30 minutes (that starts 10 minutes prior to the announcement) and a "wide" window of 60 minutes (that starts 15 minutes prior to the announcement). We use data starting only in 1994 because before that period there were no statement releases (and therefore it is not possible for us to identify exactly the start of the 30m or 60m windows). Table 4 shows the results. We find that prior to the inclusion of the vote in FOMC statements neither unanimity or dissent had a statistically significant impact on stock returns, which is consistent with Gorodnichenko and Weber (2016). Just as with the daily data we find that the pattern around FOMC meetings changed with the introduction of the vote information in the statement. From March 2002 onwards the coefficient of the dissent dummy is negative (and statistically significant 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) while that of the unanimity dummy is positive. This is the case for both the tight and wide windows. The results are robust to excluding the meetings of 22 of January 2008 and 8 of October of 2008 for which the announcement was done outside trading hours. In all cases the differences between unanimity and dissent are statistically significant.

3.4 Potential explanations

We now explore several possible causes for the negative impact of dissent on stock returns. To support our analysis we estimate a regression with daily S&P excess returns ($er_t = \ln(P_t/P_{t-1}) - TY_{3M,t}$) as the dependent variable and dummies for unanimity or dissent in the vote around a two day window of FOMC statement releases:

$$er_t = \beta_0 + \beta_1[\bar{U}_t, \bar{D}_t, \bar{F}_t] + \beta_x X_t + \varepsilon_t, \tag{4}$$

where X_t is a vector with additional control variables. We estimate (4) with OLS (which assumes $E[\varepsilon_t \mid X_t] = 0$) and median quantile (MQ) regression (which assumes $Q_{50}[\varepsilon_t \mid X_t] = 0$).[5]

Let $\bar{U}_t$ be a set of two dummy variables (period after March 2002) for whether it is the day after ($U_t^{pub} = 1$) unanimity was communicated in the FOMC statement or the day before such statement ($U_{t+1}^{pub} = 1$). $\bar{D}_t$ is a set of two dummy variables (period after March 2002) for whether it is the day after ($D_t^{pub} = 1$) dissent was communicated in the FOMC statement or the day before such statement ($D_{t+1}^{pub} = 1$). $\bar{F}_t$ is a set of two dummy variables (period prior to March 2002) for whether it is the day after ($F_t^{npub} = 1$) a FOMC statement with no vote information or the day before such statement ($F_{t+1}^{npub} = 1$).

The vector of additional controls is given by

$$X_t = \left\{ \begin{array}{c} \ln(TV_{t-2}^{SP}/TV_{t-3}^{SP}), \ln(TV_{t-3}^{SP}), \Delta VIX_{t-2}, VIX_{t-3}, FFS_t, FFR_t, \\ TY_{1,t-2}, TY_{5,t-2}, Recession_t, Tightening_t, Easing_t, Unscheduled_t, \\ Greenspan_t, Yellen_t, Unscheduled_t, \overline{CD}_t, PD_t^{pub}, MD_t^{pub}, DE_t^{pub} \end{array} \right\}.$$

We therefore control for the lagged S&P trading volume (TV^{SP}) level and growth, the lagged VIX index (VIX) level and change, the federal funds rate and surprise (FFR_t and FFS_t) announced in the statement and lagged values for Treasury note yields for one and five year maturities ($TY_{1,t-2}$ and $TY_{5,t-2}$) obtained using the method developed by Gurkaynak, Sack, and Wright (2007). We used lagged values of market variables to avoid any possible endogeneity concerns. We also include several dummy variables. $Recession_t$ is an NBER recession dummy indicator. $Tightening_t$ is a dummy variables that equals one if the observation occurs in a period of monetary tightening. $Easing_t$ is a dummy variables that equals one if the observation occurs in a period of monetary easing. $Unscheduled_t$ is a dummy variable for whether the meeting was unscheduled. $Greenspan_t$ is a dummy variable that takes a value of one during Greenspan's term as Chair, $Yellen_t$ is a dummy variable that

[5] 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). Our application of quantile regression to explain market excess returns is close to the approach suggested by Engle and Manganelli (2004).

takes a value of one during Yellen's term as Chair. $\overline{CD}_t$ is a set of dummy variables ($CD^{pub}_{2,t}$, $CD^{pub}_{3,t}$ and $CD^{pub}_{4,t}$) that captures consecutive dissent episodes (period after March 2002). $CD^{pub}_{2,t}$ is a dummy 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), $CD^{pub}_{3,t}$ is a dummy for three or more consecutive dissent meetings, and $CD^{pub}_{4,t}$ is a dummy for four or more consecutive dissent meetings. PD^{pub}_t is the mean 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^{pub}_t is a dummy for two or more dissenting votes (period after March 2002). DE^{pub}_t is a dummy of dissent for easier policy (period after March 2002).

The estimation results are shown in Table 5. We report in the OLS-1 columns linear regression estimates of (4) without including the dummies $\overline{CD}_t$, PD^{pub}_t, D^{pub}_t, and DE^{pub}_t. We then re-estimate (4) using all the controls with both linear (OLS-2) and median quantile (MQ-2) regression. All the regressions confirm that dissent has a negative and statistically significant post-announcement effect on excess returns. The coefficient estimate for the post-announcement dissent dummy is also always statistically different from the unanimity dummy (the p-values for the Wald test of $U^{pub}_t = D^{pub}_t$ are 0.066, 0.000 and 0.008 for the OLS-1, OLS-2 and MQ-2 estimates respectively). For the dummy variables in the day prior to the announcement we do not observe statistically significant differences between the periods before and after March 2002 either for unanimity (the p-values for the Wald test of $U^{pub}_{t+1} = F^{npub}_{t+1}$ are 0.535, 0.529 and 0.306 for the OLS-1, OLS-2 and MQ-2 estimates, respectively) or dissent (the p-values for the Wald test of $D^{pub}_{t+1} = F^{npub}_{t+1}$ are 0.655, 0.656 and 0.294 for the OLS-1, OLS-2 and MQ-2 estimates, respectively).

Table 5 shows that the negative dissent effect observed since March 2002 cannot be accounted for by market conditions prior to the announcement since we control for measures of liquidity (i.e., TV^{SP}) and market risk (i.e., VIX). Also, the negative effect of dissent cannot be explained by expectations prior to the announcement regarding the future path of monetary policy (which is taken into account with the inclusion of $TY_{1,t-2}$ and $TY_{5,t-2}$) or changes in the announcement to the current stance of monetary policy (measured by

FFR_t and FFS_t). The negative impact of dissent on stocks is also robust to the inclusion of variables that capture the business cycle (i.e., $Recession_t$, $Tightening_t$ and $Easing_t$).

We now examine variables which account for the FOMC decision process. We do not observe statistically significant differences between the periods of different Chairs or with respect to whether the meeting was unscheduled. We also control for consecutive dissent episodes since these would potentially communicate less information to markets. Consistent with this hypothesis we find that dissent has less of a negative effect for two or more consecutive dissent episodes in a row. Curiously, the negative effect of dissent becomes stronger with four or more consecutive dissents in a row. This suggests that perhaps investors may be concerned that in such situations the desire to achieve consensus could lead the majority to not pursue its preferred policy course.[6] However, the results with respect to consecutive dissent are not very robust (in Table A6 of the web appendix we re-estimate (4) using a slightly different combination of controls and the coefficients cease to be significant for the MQ case). The difficulty in reaching firm conclusions could be due to the relatively small number of observations since 57.7% of dissent episodes last a single meeting.

The coefficient on PD_t^{pub} is not statistically significant and therefore it is not possible to say whether markets view differently the votes of members that dissent frequently (in Table A6 of the appendix we show that this conclusion is robust 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). The coefficient on the multiple dissenters dummy MD_t^{pub} is negative but only statistically significant for the MQ regression. On the other hand, the coefficient on the dissent for easier dummy is significant for the OLS but not for the MQ regression. The reason for the mixed evidence is likely due to the small number of observations associated with these dummies (in the period after March 2002 there are only 11 episodes with dissent for easier and only 8 episodes with multiple dissent votes).

In the appendix we show that our results are robust to using a different combination of controls for consecutive dissent (Table A6), introducing a dummy variable for the second day

[6]Riboni and Ruge-Murcia (2010) show that a preference for consensus fits well the policy decisions of the US Federal Reserve, Bank of Canada, Bank of England, European Central Bank and Swedish Riksbank.

after the announcement (Table A7), starting our sample only in 1994 which is the period after which all meetings were followed by a statement (Table A8), and using close to close excess returns and post-announcement values for market variables (see Table A9).

In Table 6 we show multivariate OLS regressions of intraday stock returns (r_t) around 30 and 60 minutes windows, with a vector of additional controls X_t:

$$r_t = \beta_1[U_t^{pub}, D_t^{pub}, F_t^{npub}] + \beta_x X_t + \varepsilon_t. \tag{5}$$

We first estimate (5) including only the FFS_t and $Unscheduled_t$ as controls (column OLS-1). The results show that the dissent in the period since March 2002 has a negative coefficient in both windows that is statistically significant at the 10% level. The coefficient on the unanimity dummy is positive for both windows but only statistically significant for the wide window. 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 statistically significant post-announcement effect. The coefficient on the FFS_t is not statistically significant which differs from the findings of Bernanke and Kuttner (2005) and Gurkaynak 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 contrast with the daily regressions, the coefficient for $Unscheduled_t$ is positive and statistically significant.

Adding controls for consecutive dissent ($CD_{2,t}^{pub}$ and PD_t^{pub}), multiple dissenters and dissent for easier policy does not change the results (column OLS-2 of Table 6). The coefficient for the unscheduled dummy remains positive while that on the FFS_t is now negative, with both coefficients being statistically significant. The dissent dummy coefficient is still negative but is now substantially larger in absolute value. The differences between unanimity and dissent remain statistically significant.

To search for a potential "mechanism" for the impact of dissent versus unanimity, we now look at their effect on other variables since March 2002. Table 7 shows the results of

re-estimating (3) for windows of 30m, 60m and two days around FOMC announcements using as dependent variables: the 5 year forward inflation expectation rate ($T5YIFR_t$); 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}). In the case of the risk measures the regressions use a constant instead of a unanimity dummy (because it makes more sense to test the difference of squared returns with dissent relative to other events, rather than testing whether these differ from 0).

We found that neither unanimity or dissent have an impact on the 5 year forward inflation expectation rate around a two day window of FOMC announcements. In Table A10 of the appendix we also show that there is no impact of dissent and unanimity on the prices of 5 and 10 year TIPS (which are used to estimate the $T5YIFR_t$ variable). We now explore whether there is a connection of dissent or unanimity and expectations of the path of future monetary policy. Unanimity and dissent has no statistically significant impact on the 2, 5 and 10 year Treasury notes' futures ($TN_{2,t}$, $TN_{5,t}$, $TN_{10,t}$) on any of the windows (30m, 60m and two days). In the appendix we also show that unanimity and dissent do not impact the prices of Eurodollar futures (which are determined by the market's forecast of the 3 month USD LIBOR interest rate expected to prevail on the settlement date - see Table A11) or the Treasury yields (using close price daily data) for 6 months, 1 year, 18 months, 3 and 5 year maturities (see Table A12) around windows of several sizes of FOMC announcements. So the differences in the impact on stock returns of unanimity and dissent in the period since March 2002 cannot be explained by expectations of the path of future monetary policy.[7]

The results in Table 7 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

[7]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 an "individualistic MPC". Since dissent votes have a different importance in the US and the UK, there is no reason to expect 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.

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, 60m and two days. In Table A11 of the web 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). In the appendix we also examined the pattern of intraday volatility inside a 30 minute window of FOMC statement releases (the empirical exercises in Table 7 and Table A10 of the appendix test whether volatility at the end of the window differs from that at the beginning of the window). We find that both dissent and unanimity statements substantially increase intraday volatility inside the 30m window (which indicates that FOMC statements are informative announcements), but differences between unanimity and dissent are not statistically significant (see Table A13).

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). The pattern around FOMC statements since 2003 (there is no TV_t^{ES} data before then) for trading volume using daily observations at 2pm is shown in Figure 2. Trading volume increases substantially for both unanimity and dissent at 2pm on the announcement day (and reverts back by the next day), with dissent events showing a larger increase than unanimity. In Table 7 we confirm that both unanimity and dissent increase trading volume for the E-mini S&P futures on windows of 30m, 60m and two days around the announcement. The differences between the unanimity and dissent coefficients are statistically significant for the 30m and 60m windows but not for the two day window (the p-values for the Wald test of $U_t = D_t$ are 0.008, 0.015 and 0.289 for the 30m, 60m and two day windows, respectively), which is consistent with the reversal in trading volume after the announcement shown in Figure 2.

We have therefore determined that unanimity and dissent statements differ with respect

to their impact on both stock returns and trading volume. We also know from tables 3 and 4 that unanimity and dissent stock returns did not differ prior to the inclusion of votes in the statement (March 2002). We now explore whether differences between unanimity and dissent events were also absent with respect to trading volume prior to March 2002. There is no intraday data for the E-mini S&P futures trading volume prior to 2003 but we do have intraday data on the tick count for the E-mini S&P futures (TC_t^{ES}) going back to 1997. The tick count is the number of price updates per unit of time, which is used as a proxy for trading volume due to the sparsity of real time trading volume information. We have verified that for the period from 2003 onwards (for which we have data on both TV_t^{ES} and TC_t^{ES}) that trading volume and tick count for the E-mini S&P futures are highly correlated (0.765 correlation using 2pm daily data and 0.797 using intraday data with 5m frequency). This indicates that tick count should also be a good proxy for trading volume with respect to E-mini S&P futures, which confirms the results found by Marney (2011) in relation to tick counts being a valid proxy for trading volume in the foreign exchange (FX) market.

Estimating equation (3) with the tick count for the E-mini S&P futures as a dependent variable, we find that dissent has a higher impact than unanimity on tick count since votes are public (see Table 8). As with trading volume, the differences are highly statistically significant for the 30m and 60m windows but not for the two day window. In the period before votes were included in the statement, both dissent and unanimity are associated with increased tick counts at the 30m and 60m windows. However, in contrast to what occurred from March 2002 onwards, there are no statistically significant differences between unanimity and dissent at either the 30m, 60m or two day windows.

The findings in this section suggest increased dispersion of opinion as a potential explanation for the observed differences between dissent and unanimity since the vote has been made public in the statement. Votes of central bank committee members reflect heterogeneous views of economic conditions (see Hansen, McMahon and Rivera, 2014). Because a vote of dissent is costly (see Meade and Stasavage, 2008) it is natural that some market participants will revise expectations while others will not (after all, dissenters represent a

minority of members). Increased dispersion of opinion after statements with dissent is a plausible explanation as it can account not only for a post-announcement negative impact on stock prices (Varian, 1985) but also for a lack of an effect on TIPS and Treasury notes (Abel, 1989). Moreover, increased dispersion of opinion can also account for no observed impact on market risk (as the effect is ambiguous, see Shalen, 1993) and the higher trading volume relative to statements with unanimity (Cao and Ou-Yang, 2009).

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 only when the vote was unanimous, with markets losing value when dissent occurred. The negative effect of dissent in the period with votes in the statement persists even if one controls for market conditions (risk, liquidity, monetary policy and business cycle) prior to the release. Moreover, the differences between unanimity and dissent are present in several subperiods, namely: i) the expansion prior to the financial crisis; ii) the financial crisis and the recession that followed; and iii) the period of the zero-lower-bound.

We find that neither dissent or unanimity impact inflation expectations, market risk and Treasury yields at several maturities. Also, statements with dissent lead to higher trading volume than unanimity after March 2002. Using tick counts to proxy for trading volume indicates this did not occur prior to the inclusion of votes in the statement in March of 2002.

A plausible explanation for our findings is that dissent increases dispersion of views in market participants since it can account for all the observed effects documented (negative impact of dissent statements on equity prices but not bonds, no changes in market risk and higher trading volume relative to unanimity statements).

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5 Tables

Table 1: Summary statistics on FOMC meetings and frequency of dissent

	1993-02	2002-15
Fraction of dissent votes	3.69%	5.31%
Number of FOMC meetings	78	106
Number of meetings with dissent	26	49
Number of meetings with dissent for tighter policy	22	40
Number of meetings with dissent for easier policy	5	11
Number of FOMC members	33	46
Number of dissenting members	13	17
p25: $E(D_{i,t} \mid \max_t(D_{i,t} = 1))$	3.0%	5.6%
p50: $E(D_{i,t} \mid \max_t(D_{i,t} = 1))$	5.5%	9.5%
p75: $E(D_{i,t} \mid \max_t(D_{i,t} = 1))$	15.0%	28.0%

$D_{i,t} = 1$ if FOMC member i voted dissent.

Table 2: Logit model of decision $\Pr(D_{i,t}=1)$ of FOMC member i in period t

	Logit	Logit-RE	Logit-FE
$E_{i,t}$ = number of previously	-0.021***	0.006	0.015
attended FOMC meetings	(0.007)	(0.012)	(0.016)
$\bar{E}_t = \frac{\sum_i E_{i,t}}{12}$	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)
$\bar{E}_{d,t} = \frac{\sum_i E_{i,t} 1(\max_{m<t}\{D_{i,m}\}=1)}{\sum_i 1(\max_{m<t}\{D_{i,m}\}=1)}$	-0.001	-0.006	-0.010*
	(0.004)	(0.006)	(0.006)
$TY_{10,t}$	-0.350***	-0.456***	-0.429**
	(0.078)	(0.155)	(0.199)
VIX_t	0.009	0.008	0.007
	(0.014)	(0.017)	(0.012)
$\ln(TV_t^{SP})$	-0.390	-0.445	-0.385
	(0.241)	(0.330)	(0.349)
Constant	7.273	6.672	
	(4.657)	(6.303)	
Pseudo R^2	0.065	0.037	0.057

$D_{i,t}=1$ if FOMC member i voted dissent.

MLE Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

1971 votes, 184 FOMC events.

Table 3: S&P cer_t (2pm daily data) around a two day window of FOMC announcements for several periods

A. OLS regressions with no controls							
	cer_t as dep. var.					sgn(cer_t) as dep. var.	
	1993-02	2002-15	2002-07	2007-09	2009-15	1993-02	2002-15
D_t	0.570*	-0.730***	-0.533	-0.798	-0.753***	0.462**	-0.347***
	(0.306)	(0.198)	(0.341)	(0.681)	(0.243)	(0.191)	(0.128)
U_t	0.314	0.829***	0.800***	1.310**	0.428	0.115	0.544***
	(0.217)	(0.183)	(0.157)	(0.590)	(0.403)	(0.135)	(0.118)
P-value of $U = D$	0.495	0.000***	0.000***	0.019**	0.012**	0.138	0.000***
R^2	0.068	0.247	0.428	0.249	0.200	0.080	0.215
B. % of announcements with $cer_t < 0$							
	1993-02	2002-15	2002-07	2007-09	2009-15		
D_t	26.9%	67.4%	85.7%	66.7%	63.6%		
U_t	44.2%	22.8%	21.2%	16.7%	33.3%		
Observations	78	106	40	21	45	78	106

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table 4: S&P r_t in percent (intraday data) around FOMC announcements

	Tight window (30m)			Wide window (60m)		
	1994-2002	2002-15	2002-15[a]	1994-2002	2002-15	2002-15[a]
D_t	0.161	-0.145*	-0.153*	0.175	-0.164*	-0.172*
	(0.163)	(0.079)	(0.078)	(0.184)	(0.098)	(0.098)
U_t	0.165	0.136*	0.158**	0.113	0.304***	0.329***
	(0.111)	(0.073)	(0.073)	(0.126)	(0.091)	(0.090)
P-value of $U = D$	0.985	0.011**	0.004***	0.781	0.001***	0.000***
R^2	0.045	0.061	0.078	0.025	0.119	0.138
Observations	69	106	104	69	106	104

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

a Excludes 22jan2008 and 08oct2008 announcements.

Table 5: Regressions (OLS and MQ) of S&P excess returns (2pm daily data) with controls

	OLS-1	OLS-2	MQ-2		OLS-1	OLS-2	MQ-2
U^{pub}_{t+1}, Day before the	0.665*	0.659*	1.003**	$Recession_t$	-0.201	-0.205	0.249
FOMC announcement	(0.395)	(0.394)	(0.419)		(0.202)	(0.202)	(0.215)
U^{pub}_{t}, Day after the	0.110	0.114	-0.113	$Tightening_t$	-0.0150	-0.0176	0.030
FOMC announcement	(0.399)	(0.398)	(0.423)		(0.163)	(0.163)	(0.173)
D^{pub}_{t+1}, Day before the	0.744*	0.743*	-0.185	$Easing_t$	-0.111	-0.108	-0.313
FOMC announcement	(0.432)	(0.431)	(0.457)		(0.187)	(0.187)	(0.199)
D^{pub}_{t}, Day after the	-0.966**	-4.113***	-3.365***	$Greenspan_t$	0.055	0.051	-0.152
FOMC announcement	(0.427)	(1.087)	(1.154)		(0.151)	(0.151)	(0.160)
F^{npub}_{t+1}, Day before the	0.992***	0.990***	0.432	$Yellen_t$	0.142	0.133	0.0194
FOMC announcement	(0.349)	(0.348)	(0.369)		(0.236)	(0.237)	(0.251)
F^{npub}_{t}, Day after the	0.554	0.578	0.974**	$Unscheduled_t$	0.053	-0.399	-0.979
FOMC announcement	(0.358)	(0.358)	(0.380)		(1.149)	(1.166)	(1.237)
$\ln(TV^{SP}_{t-2}/TV^{SP}_{t-3})$	0.079	0.050	-0.039	$CD^{pub}_{2,t}$		2.832*	3.429**
	(0.207)	(0.207)	(0.219)			(1.648)	(1.749)
$\ln(TV^{SP}_{t-3})$	-0.067	-0.062	-0.026	$CD^{pub}_{3,t}$		3.209	2.736
	(0.0901)	(0.091)	(0.096)			(1.955)	(2.076)
ΔVIX_{t-2}	0.050*	0.054*	0.037	$CD^{pub}_{4,t}$		-3.345**	-4.556***
	(0.029)	(0.029)	(0.031)			(1.534)	(1.628)
VIX_{t-3}	0.011	0.012*	0.012	PD^{pub}_{t}		0.617	1.038
	(0.00686)	(0.00685)	(0.00727)			(1.723)	(1.829)
FFS_t	-0.007	-0.007	-0.002	MD^{pub}_{t}		-1.315	-4.589***
	(0.007)	(0.007)	(0.007)			(1.199)	(1.272)
FFR_t	-0.106	-0.113	-0.071	DE^{pub}_{t}		3.052***	1.429
	(0.189)	(0.189)	(0.200)			(1.103)	(1.171)
$TY_{1,t-2}$	22.56	23.31	13.56	Constant	1.530	1.407	0.718
	(27.02)	(26.98)	(28.64)		(1.869)	(1.867)	(1.982)
$TY_{5,t-2}$	-19.24	-19.03	-9.865	R^2	0.008	0.014	0.007
	(12.800)	(12.790)	(13.580)	Observations	4,275	4,275	4,275

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table 6: S&P r_t (percent, intraday data) around FOMC announcements with controls

	Tight window (30m)		Wide window (60m)	
	OLS-1	OLS-2	OLS-1	OLS-2
D_t^{pub}	-0.179**	-0.434**	-0.198*	-0.405
	(0.082)	(0.211)	(0.101)	(0.256)
U_t^{pub}	0.110	0.110	0.278***	0.279***
	(0.076)	(0.076)	(0.093)	(0.092)
F_t^{npub}	-0.023***	0.080	-0.022***	0.052
	(0.005)	(0.070)	(0.006)	(0.085)
FFS_t	0.080	-0.022***	0.050	-0.021***
	(0.071)	(0.005)	(0.086)	(0.006)
$Unscheduled_t$	0.820***	0.834***	0.817**	0.835***
	(0.257)	(0.256)	(0.315)	(0.311)
$CD_{2,t}^{pub}$		0.204		0.216
		(0.215)		(0.261)
PD_t^{pub}		0.444		0.498
		(0.316)		(0.384)
MD_t^{pub}		-0.156		-0.441
		(0.225)		(0.273)
DE_t^{pub}		-0.064		-0.175
		(0.212)		(0.257)
P-value of $U^{pub} = D^{pub}$	0.010***	0.015**	0.001***	0.012**
R^2	0.252	0.278	0.210	0.250
Observations	175	175	175	175

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table 7: OLS regressions with other variables (period 2002-15)

	$T5YIFR_t$	$TN_{2,t}$	$TN_{5,t}$	$TN_{10,t}$	r_t^2	$\|r_t\|$	TV_t^{ES}
			A. Tight intraday window (30m)				
D_t		-0.000	0.004	-0.004	-0.007	0.0230	148,526***
		(0.015)	(0.043)	(0.071)	(0.146)	(0.080)	(9,782)
U_t		0.010	0.013	0.034			111,836***
		(0.014)	(0.040)	(0.066)			(9,677)
Constant					0.323***	0.385***	
					(0.010)	(0.054)	
R^2		0.005	0.001	0.003	0.000	0.001	0.800
			B. Wide intraday window (60m)				
D_t		0.003	0.011	0.010	-0.116	-0.046	320,698***
		(0.019)	(0.055)	(0.086)	(0.264)	(0.103)	(21,415)
U_t		0.012	0.035	0.044			247,543***
		(0.018)	(0.051)	(0.080)			(21,186)
Constant					0.577***	0.522***	
					(0.179)	(0.070)	
R^2		0.005	0.005	0.003	0.002	0.002	0.799
			C. Two day window				
D_t	-0.000	-0.007	-0.079	-0.107	0.187	0.037	127,491***
	(0.013)	(0.022)	(0.072)	(0.132)	(1.108)	(0.214)	(38,711)
U_t	-0.004	0.013	0.090	0.121			69,737*
	(0.012)	(0.020)	(0.067)	(0.122)			(38,306)
Constant					2.609***	1.211***	
					(0.753)	(0.146)	
R^2	0.001	0.005	0.028	0.015	0.000	0.000	0.132
Observations	99	106	106	106	106	106	95

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table 8: TC_t^{ES} (intraday data and 2pm daily data) around FOMC announcements

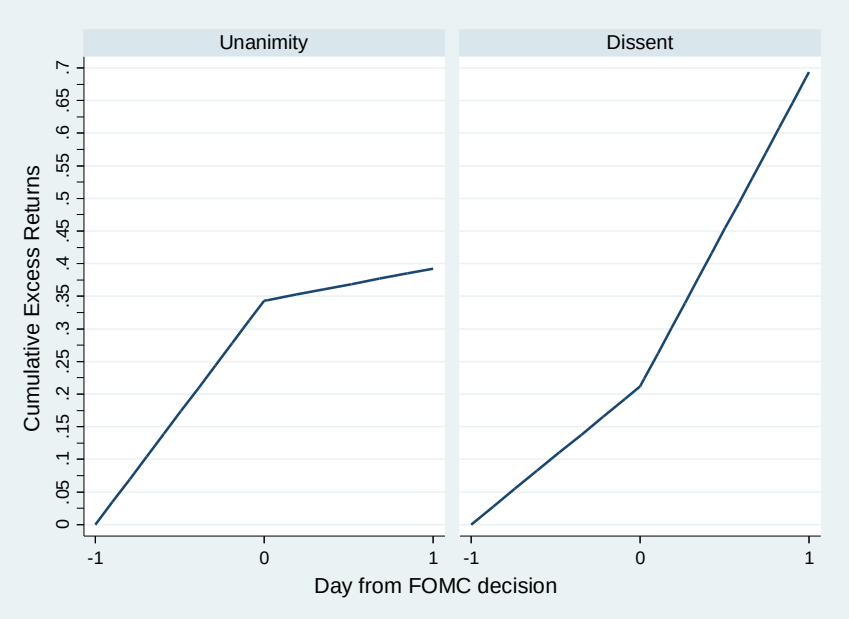
	Tight window (30m)		Wide window (60m)		Two day window	
	1997-2002	2002-15	1997-2002	2002-15	1997-2002	2002-15
D_t	1,258***	29,838***	2,893***	63,961***	1,161	18,873***
	(323)	(2,277)	(729)	(4,895)	(764)	(6,012)
U_t	1,782***	13,782***	4,076***	30,126***	1,023*	8,843
	(216)	(2,108)	(486)	(4,532)	(509)	(5,574)
P-value of $U = D$	0.178	0.000***	0.177	0.000***	0.881	0.221
R^2	0.693	0.678	0.699	0.678	0.146	0.106
Observations	39	106	39	106	39	106

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

6 Figures

Figure 1: S&P average cumulative excess returns around the FOMC vote

A. Period without votes in the statement (1993-02)



B. Period with votes in the statement (2002-15)

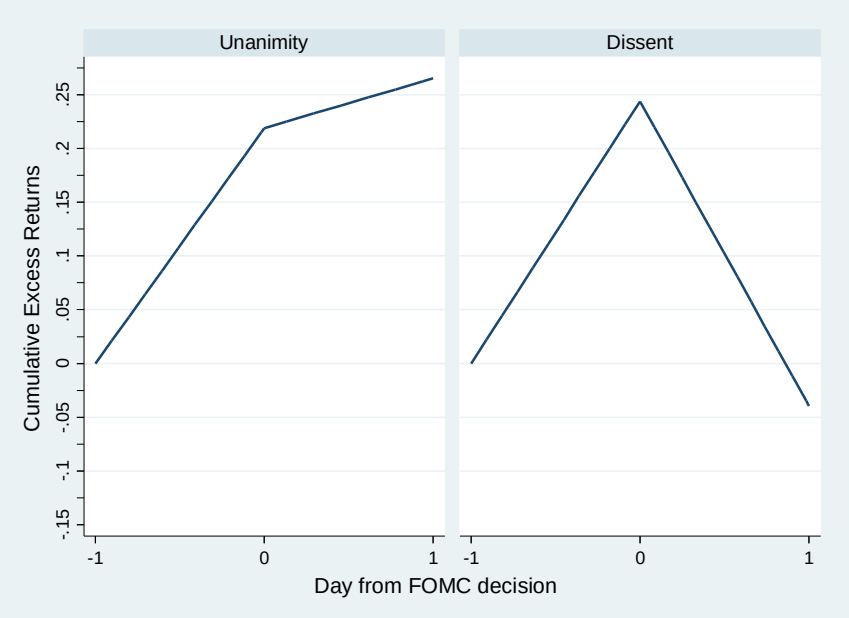
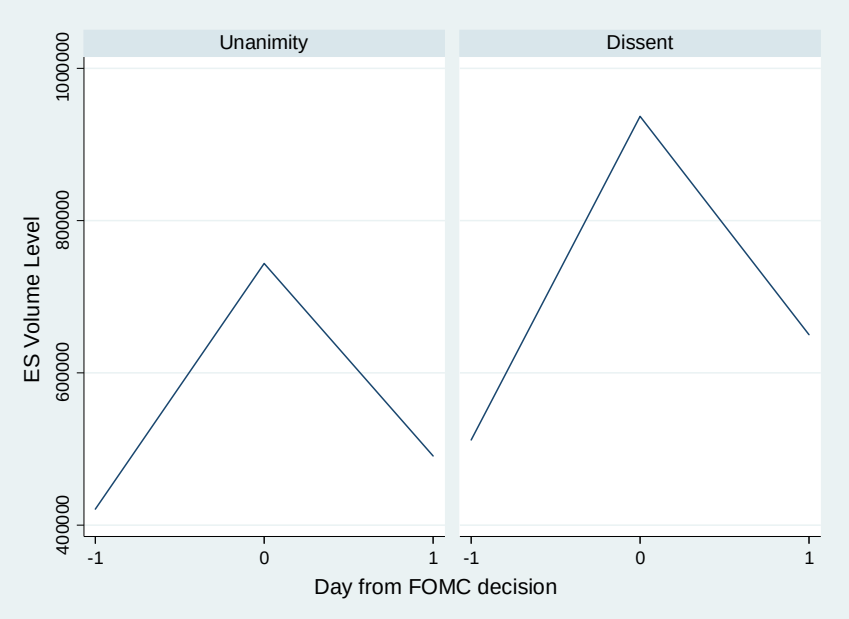


Figure 2: E-mini S&P futures trading volume around the FOMC vote (2003-15)



Web appendix to "The effect of FOMC dissent on financial markets"

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Abstract

This article shows that since votes of FOMC members have been included in press statements, stock prices increase when votes are unanimous but fall when dissent occurs. This pattern remains even controlling for monetary policy and market conditions prior to the announcement. We find no differences between unanimity and dissent with respect to impact on expectations of inflation, market risk and Treasury securities. Announcements with dissent show a higher increase in trading volume than unanimity. This suggests that a plausible cause for the differences in reactions of equity prices could be increased dispersion of opinion in investors due to dissent.

JEL Classification: E50, E58, G10, G12.

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

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1 Appendix

Table A5 uses close price data for the S&P from Bloomberg.

Tables A6 is similar to Table 5 of the paper but we use $D_{p,t}^{pub}$ and LGD_t^{pub} as alternative controls for serial dissenting instead of $CD_{2,t}^{pub}$ and PD_t^{pub}. $D_{p,t}^{pub}$ is a dummy variable for whether it is within a day before or after a FOMC meeting for which the previous FOMC meeting's statement communicated a dissent vote. LGD_t^{pub} is a dummy for whether a dissent vote came from Mr. Lacker or Ms. George, who were the only FOMC members with more than 50% of dissenting votes.

Table A7 is similar to the OLS-1 regression in Table 5 of the paper but we added dummy controls also for the second day after the FOMC announcement. Table A8 is similar to A7 but the sample period is only from 1994 to 2015. Table A9 is similar to A7 but uses close S&P price data.

From the Federal Reserve Bank of St. Louis we obtain daily (market close) data on 5 year and 10 year Treasury Inflation Protected Securities (TIPS). Table A10 shows that unanimity and dissent announcements do not have a statistically significant impact on changes to TIPS.

From the Federal Reserve Board website we obtained data on zero-coupon yields (market close data) which we used to calculate Treasury yields with maturities from six months to five years (see Gurkaynak, Sack, and Wright, 2007). Figure A3 shows that unanimity and dissent episodes are associated with a quantitatively small impact on yields. Table A12 shows that differences on windows of several sizes between unanimity and dissent on yields are not statistically significant.

2 Tables

Table A1: S&P around FOMC minutes releases (1996-2002)

	OLS	MQ	OLS	MQ
A. S&P r_t in percent (intraday data)				
	Tight Window (30m)		Wide Window (60m)	
D_t^{Minute}	-0.0741	0.0237	-0.0784	0.0838
	(0.0746)	(0.131)	(0.124)	(0.164)
U_t^{Minute}	-0.0591	-0.0643	-0.153	-0.0960
	(0.0527)	(0.0757)	(0.103)	(0.0945)
Observations	45	45	45	45
B. S&P cer_t (2pm daily data)				
U_{t+1}^{Minute}, Day before the	-0.184	0.326		
FOMC minutes release	(0.616)	(0.655)		
U_t^{Minute}, Day after the	0.666	0.559		
FOMC minutes release	(0.616)	(0.655)		
D_{t+1}^{Minute}, Day before the	-0.117	-0.750		
FOMC minutes release	(0.898)	(0.954)		
D_t^{Minute}, Day after the	0.195	-0.288		
FOMC minutes release	(0.931)	(0.990)		
Constant	-0.00197	0.0200		
	(0.0826)	(0.0878)		
Observations	1,727	1,727		

Table A1 shows that FOMC minutes released prior to 2002 did not have an impact on stock returns and excess stock returns (the sample only starts in 1996 because before minutes were released only several years after the meeting). It could be however possible that FOMC minutes released during that period were informative but did not contain on average either positive or negative information. We therefore explored whether the pattern of intraday volatility around FOMC minutes released for that period suggests such announcements to be informative.

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) and as can be seen from Figure A1 which displays the reaction of intraday volatility (measured as a 5 minute moving average of S&P r_t^2 in percent using observations at frequency of 1 minute) to the first FOMC statement in the public period (March 19 of 2002). Figure A1 shows that outside a relatively small window after the FOMC statement release that the pattern of intraday volatility is similar to that of a typical trading day (higher during the first trading hour and in the last trading hour than during the rest of the day).

FOMC minutes since 2005 have been released 3 weeks after the meeting took place. Rosa (2013) shows that FOMC minutes since 2005 are also associated with an impact on intraday volatility at the time of the release. Rosa (2013) excluded FOMC minutes prior to 2005 from his study because the timing of their release rendered "them largely of historical interest". The reason for this is that minutes before 2005 were released 6 weeks after FOMC meetings and only after the subsequent meeting. FOMC minutes prior to 2005 would therefore be unlikely to convey useful information to markets either regarding Committee members views on the direction of future policy or on the state of the economy (differences in views expressed during the meeting would also be unlikely to lead to dispersion of opinion among investors since the subsequent meeting would have clarified matters).

Figure A2 shows the intraday volatility for the minutes released on March 21 of 2002.

These were the minutes for the last FOMC statement (that of January 30 of 2002) which did not include the votes. Figure A2 does not suggest a reaction of intraday volatility to the FOMC minutes announcement. There is a substantial "peak" in volatility which was observed during trading hours on that day but this occurred prior to the release. Figure A2 confirms the judgment of Rosa (2013) that FOMC minutes prior to 2005 did not constitute informative releases to financial markets.

Indeed, there are several reasons to question if prior to 2002 markets would only learn if there was unanimity or dissent at the release of minutes.[1] FOMC members can make statements to the media, prior to the release of the minutes (but are prevented of doing so prior to the release of statements), which could reveal the direction of their vote to markets. In a recent paper Cieslak, Morse and Vissing-Jorgensen (2015) present evidence that informal communication does take place. Moreover, Lindsey (2003: 192, 193) reveals that market participants and journalists had prior to March 2002 used the number of Reserve Banks requesting discount rate changes as a "proxy" although often "inaccurate" to gauge the Committee's vote before it was released as part of the minutes.

[1] Also, the distinction between a vote with dissent an unanimity would be less clear when communicated through the minutes. The reason for that is that in the FOMC often members vote with the Chair despite expressing opposing views during the meeting (such information is absent from statements but included in minutes).

Table A2: OLS regressions of S&P cumulative returns (2pm daily data) around a two day window of FOMC announcements for several periods

	1993-02	2002-15	2002-07	2007-09	2009-15
D_t	0.614**	-0.719***	-0.492	-0.778	-0.751***
	(0.306)	(0.198)	(0.343)	(0.681)	(0.243)
U_t	0.361*	0.847***	0.820***	1.336**	0.429
	(0.216)	(0.184)	(0.158)	(0.590)	(0.403)
R^2	0.082	0.249	0.433	0.253	0.199
Observations	78	106	40	21	45

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table A3: OLS regressions of $TY_{3M,t}$ around a two day window of FOMC announcements for several periods

	1993-02	2002-15	2002-07	2007-09	2009-15
D_t	-0.026	0.030	-0.002	0.190	-0.007
	(0.151)	(0.040)	(0.111)	(0.166)	(0.005)
U_t	-0.026	-0.046	-0.061	-0.041	-0.010
	(0.107)	(0.038)	(0.051)	(0.144)	(0.008)
R^2	0.001	0.019	0.036	0.068	0.073
Observations	78	106	40	21	45

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table A4: S&P cer_t (2pm daily data) around a 4 day window of FOMC announcements for several periods

A. OLS regressions with no controls					
	cer_t as dep. var.				sgn(cer_t) as dep. var.
	2002-15	2002-07	2007-09	2009-15	2002-15
D_t	-0.556***	-0.556*	-0.523	-0.565**	-0.265**
	(0.211)	(0.292)	(0.849)	(0.227)	(0.128)
U_t	0.757***	0.665***	1.441*	0.326	0.579***
	(0.196)	(0.135)	(0.736)	(0.376)	(0.119)
R^2	0.174	0.425	0.182	0.139	0.213
B. % of announcements with $cer_t < 0$					
	2002-15	2002-07	2007-09	2009-15	
D_t	63.3%	85.7%	66.7%	57.6%	
U_t	21.1%	18.2%	16.7%	33.3%	
Observations	106	40	21	45	106

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

window: 2 days before announcement and 2 days after announcement

Table A5: S&P cer_t (close daily data) around a 4 day window of FOMC announcements for several periods

A. Regressions with no controls					
	cer_t as dep. var.				sgn(cer_t) as dep. var.
	2002-15	2002-07	2007-09	2009-15	2002-15
D_t	-0.546**	-0.549*	-0.490	-0.561**	-0.265**
	(0.210)	(0.291)	(0.836)	(0.228)	(0.130)
U_t	0.736***	0.663***	1.414*	0.256	0.544***
	(0.194)	(0.134)	(0.724)	(0.377)	(0.120)
R^2	0.169	0.424	0.180	0.132	0.192
B. % of announcements with $cer_t < 0$					
	2002-15	2002-07	2007-09	2009-15	
D_t	63.30%	85.70%	66.70%	57.60%	
U_t	22.80%	18.20%	16.70%	41.70%	
Observations	106	40	21	45	106

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

window: 2 days before announcement, FOMC announcement = 0, 2 days after announcement

Table A6: Regressions (OLS and MQ) of S&P excess returns (2pm daily data) with controls

	OLS	MQ		OLS	MQ
U^{pub}_{t+1}, Day before the	0.661*	1.001**	$Recession_t$	-0.195	0.244
FOMC announcement	(0.395)	(0.419)		(0.202)	(0.215)
U^{pub}_{t}, Day after the	0.233	-0.185	$Tightening_t$	-0.021	0.017
FOMC announcement	(0.428)	(0.455)		(0.163)	(0.173)
D^{pub}_{t+1}, Day before the	0.741*	-0.191	$Easing_t$	-0.114	-0.310
FOMC announcement	(0.431)	(0.457)		(0.187)	(0.199)
D^{pub}_{t}, Day after the	-2.759***	-3.265***	$Greenspan_t$	0.048	-0.153
FOMC announcement	(0.991)	(1.052)		(0.151)	(0.160)
F^{npub}_{t+1}, Day before the	0.991***	0.441	$Yellen_t$	0.134	0.041
FOMC announcement	(0.348)	(0.369)		(0.237)	(0.251)
F^{npub}_{t}, Day after the	0.585	0.948**	$Unscheduled_t$	-0.458	-0.928
FOMC announcement	(0.358)	(0.380)		(1.166)	(1.238)
$\ln(TV^{SP}_{t-2}/TV^{SP}_{t-3})$	0.058	-0.066	$D^{pub}_{p,t}$	-0.648	1.002
	(0.207)	(0.219)		(0.871)	(0.924)
$\ln(TV^{SP}_{t-3})$	-0.062	-0.014	$CD^{pub}_{3,t}$	5.677***	2.823
	(0.091)	(0.096)		(1.689)	(1.793)
ΔVIX_{t-2}	0.052*	0.033	$CD^{pub}_{4,t}$	-3.316**	-2.080
	(0.029)	(0.031)		(1.515)	(1.608)
VIX_{t-3}	0.011	0.012	LGD^{pub}_{t}	-0.190	0.583
	(0.007)	(0.007)		(0.978)	(1.038)
FFS_t	-0.007	-0.002	MD^{pub}_{t}	-0.944	-4.751***
	(0.007)	(0.007)		(1.212)	(1.286)
FFR_t	-0.111	-0.069	DE^{pub}_{t}	2.547**	3.696***
	(0.189)	(0.200)		(1.098)	(1.165)
$TY_{1,t-2}$	23.100	14.640	Constant	1.425	0.476
	(27.000)	(28.660)		(1.868)	(1.982)
$TY_{5,t-2}$	-19.030	-10.750	Observations	4,275	4,275
	(12.810)	(13.600)	R^2	0.013	0.007

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance.

Table A7: Regressions (OLS and MQ) of S&P excess returns (2pm daily data) with controls

	OLS	MQ		OLS	MQ
U^{pub}_{t+1}, One day before	0.306	-0.163	$\ln(TV^{SP}_t/TV^{SP}_{t-1})$	0.909***	0.525***
the FOMC announcement	(0.328)	(0.323)		(0.155)	(0.153)
U^{pub}_t, First day after	-0.315	0.169	$\ln(TV^{SP}_{t-1})$	-0.064	-0.082
the FOMC announcement	(0.236)	(0.232)		(0.053)	(0.052)
U^{pub}_{t-1}, Second day after	0.119	0.094	ΔVIX_t	-1.652***	-1.727***
the FOMC announcement	(0.237)	(0.234)		(0.018)	(0.018)
D^{pub}_{t+1}, One day before	-0.371	-0.316	VIX_{t-1}	0.015***	0.010***
the FOMC announcement	(0.368)	(0.362)		(0.004)	(0.004)
D^{pub}_t, First day after	-0.867***	-0.779**	FFS_t	-0.016***	-0.013***
the FOMC announcement	(0.326)	(0.321)		(0.004)	(0.004)
D^{pub}_{t-1}, Second day after	-0.620*	-0.475	FFR_t	0.060	0.075
the FOMC announcement	(0.325)	(0.319)		(0.108)	(0.106)
F^{npub}_{t+1}, One day before	0.365	0.267	$TY_{1,t-1}$	-3.646	-3.869
the FOMC announcement	(0.393)	(0.386)		(15.310)	(15.060)
F^{npub}_t, First day after	0.208	-0.120	$TY_{5,t-1}$	-7.064	-10.810
the FOMC announcement	(0.204)	(0.201)		(6.743)	(6.633)
F^{npub}_{t-1}, Second day after	0.017	0.094	$Recession_t$	-0.013	0.008
the FOMC announcement	(0.205)	(0.202)		(0.113)	(0.111)
$D^{pub}_{p,t}$	0.673**	0.482*	$Tightening_t$	-0.048	0.004
	(0.265)	(0.260)		(0.094)	(0.093)
$Unscheduled_t$	0.650	1.660***	$Easing_t$	-0.232**	-0.205*
	(0.480)	(0.472)		(0.108)	(0.106)
P-value Wald Test ($D^{pub} \neq U^{pub}$)	0.015**	0.035**	Constant	1.084	1.585
P-value Wald Test ($D^{pub} \neq 0$)	0.019**	0.044**		(1.080)	(1.063)
Observations	4,278	4,278	R^2 or Pseudo R^2	0.668	0.420

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance. Sample 1993-15.

Table A8: Regressions (OLS and MQ) of S&P excess returns (2pm daily data) with controls

	OLS	MQ		OLS	MQ
U^{pub}_{t+1}, One day before	0.304	-0.149	$\ln(TV^{SP}_t/TV^{SP}_{t-1})$	0.901***	0.546***
the FOMC announcement	(0.332)	(0.329)		(0.161)	(0.160)
U^{pub}_{t}, First day after	-0.317	0.153	$\ln(TV^{SP}_{t-1})$	-0.0884	-0.106*
the FOMC announcement	(0.239)	(0.237)		(0.0559)	(0.0553)
U^{pub}_{t-1}, Second day after	0.119	0.0812	ΔVIX_t	-1.657***	-1.736***
the FOMC announcement	(0.240)	(0.238)		(0.0184)	(0.0182)
D^{pub}_{t+1}, One day before	-0.368	-0.329	VIX_{t-1}	0.0147***	0.00803**
the FOMC announcement	(0.372)	(0.369)		(0.00402)	(0.00398)
D^{pub}_{t}, First day after	-0.871***	-0.815**	FFS_t	-0.0161***	-0.0127***
the FOMC announcement	(0.330)	(0.327)		(0.00436)	(0.00431)
D^{pub}_{t-1}, Second day after	-0.618*	-0.478	FFR_t	0.0757	0.0504
the FOMC announcement	(0.329)	(0.325)		(0.111)	(0.110)
F^{npub}_{t+1}, One day before	0.340	0.248	$TY_{1,t-1}$	-7.472	-1.183
the FOMC announcement	(0.398)	(0.394)		(15.86)	(15.70)
F^{npub}_{t}, First day after	0.174	-0.161	$TY_{5,t-1}$	-4.178	-11.12
the FOMC announcement	(0.219)	(0.216)		(7.105)	(7.034)
F^{npub}_{t-1}, Second day after	-0.0668	0.0900	$Recession_t$	-0.00325	0.0107
the FOMC announcement	(0.220)	(0.217)		(0.115)	(0.114)
$D^{pub}_{p,t}$	0.670**	0.475*	$Tightening_t$	-0.0606	-0.0394
	(0.268)	(0.265)		(0.0958)	(0.0948)
$Unscheduled_t$	0.683	1.672***	$Easing_t$	-0.242**	-0.186*
	(0.487)	(0.482)		(0.110)	(0.109)
P-value Wald Test ($D^{pub} \neq U^{pub}$)	0.0161**	0.0344**	Constant	1.572	2.150*
P-value Wald Test ($D^{pub} \neq 0$)	0.0202**	0.0404**		(1.146)	(1.135)
Observations	4,089	4,089	R^2 or Pseudo R^2	0.672	0.427

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance. Sample 1994-15.

Table A9: Regressions (OLS and MQ) of S&P excess returns

(close daily data) with controls

	OLS	MQ	Regressors	OLS	MQ
$U^{pub}_{t+1}=1$, One day before	0.347	0.111	$Unscheduled_t$	0.408	0.728*
the FOMC announcement	(0.242)	(0.253)		(0.414)	(0.433)
$U^{pub}_{t}=1$, The same day of	-0.213	0.069	ΔVIX_t	-1.616***	-1.622***
the FOMC announcement	(0.243)	(0.254)		(0.016)	(0.016)
$U^{pub}_{t-1}=1$, One day after	-0.093	-0.071	VIX_{t-1}	0.009***	-0.017***
the FOMC announcement	(0.245)	(0.256)		(0.003)	(0.003)
D^{pub}_{t+1}, One day before	-0.115	-0.213	$\ln(TV^{SP}_t/TV^{SP}_{t-1})$	0.184**	0.026
the FOMC announcement	(0.328)	(0.344)		(0.073)	(0.073)
D^{pub}_{t}, The same day of	-0.688**	-0.802**	$\ln(TV^{SP}_{t-1})$	-0.053	-0.102***
the FOMC announcement	(0.327)	(0.342)		(0.037)	(0.037)
D^{pub}_{t-1}, One day after	-0.519*	-0.219	FFS_t	-0.015***	-0.014***
the FOMC announcement	(0.311)	(0.342)		(0.004)	(0.004)
F^{npub}_{t+1}, One day before	1.049***	0.970***	FFR_t	0.003	0.053
the FOMC announcement	(0.208)	(0.217)		(0.068)	(0.071)
F^{npub}_{t}, One day after	0.075	-0.272	$TY_{1,t}$	4.933	4.236
the FOMC announcement	(0.206)	(0.216)		(9.499)	(9.937)
F^{npub}_{t-1}, The same day of	-0.142	-0.072	$TY_{5,t}$	-8.794*	-15.100***
the FOMC announcement	(0.207)	(0.217)		(4.759)	(4.979)
D^{p}_{t}	0.357	0.339	Constant	1.029	2.694***
	(0.256)	(0.268)		(0.726)	(0.760)
Observations	5763	5763	R^2 or Pseudo R^2	0.652	0.390

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance. Sample 1993-15.

Table A10: OLS regressions of changes in TIPS (close daily data, 2003-2015)

	A. Regressions with no controls		B. Regressions with controls	
	5 year TIPS	10 year TIPS	5 year TIPS	10 year TIPS
U_{t+1}^{pub}	-0.009	-0.006	-0.009	-0.005
	(0.010)	(0.008)	(0.011)	(0.008)
U_{t}^{pub}	-0.014	-0.009	-0.014	-0.008
	(0.010)	(0.008)	(0.011)	(0.008)
D_{t+1}^{pub}	-0.001	-0.001	0.006	0.009
	(0.010)	(0.008)	(0.015)	(0.011)
D_{t}^{pub}	0.001	0.006	0.007	0.017
	(0.010)	(0.008)	(0.015)	(0.011)
Constant	-0.000	-0.006	-0.011	-0.016
	(0.001)	(0.001)	(0.014)	(0.010)
Observations	3,335	3,335	2,972	2,972
R^2	0.001	0.001	0.014	0.013

The added controls included in the regressions in B are $Unscheduled_t$, $\ln(TV_{t-2}^{SP}/TV_{t-3}^{SP})$, $\ln(TV_{t-3}^{SP})$, ΔVIX_{t-2}, VIX_{t-3}, FFS_t, FFR_t, $TY_{1,t-2}$, $TY_{5,t-2}$, $Recession_t$, $Tightening_t$, $Easing_t$, $Greenspan_t$ and $Yellen_t$.

Table A11: OLS regressions with other variables (2002-15)

	ED_t	$(r_t - \bar{r})^2$	$\lvert r_t - \tilde{r}\rvert$	$(r_t - \bar{r}^c)^2$	$\lvert r_t - \tilde{r}^c\rvert$
A. Tight intraday window (30m)					
D_t	0.002	-0.009	0.009	-0.023	-0.011
	(0.008)	(0.129)	(0.078)	(0.109)	(0.077)
U_t	0.008				
	(0.007)				
Constant		0.305***	0.378***	0.291***	0.378***
		(0.088)	(0.053)	(0.074)	(0.052)
R^2	0.013	0.000	0.000	0.000	0.000
B. Wide intraday window (60m)					
D_t	0.001	-0.051	-0.009	-0.036	-0.028
	(0.009)	(0.221)	(0.097)	(0.193)	(0.096)
U_t	0.010				
	(0.008)				
Constant		0.485***	0.475***	0.447***	0.474***
		(0.150)	(0.066)	(0.131)	(0.066)
R^2	0.014	0.001	0.000	0.000	0.001
C. Two day window					
D_t	0.012	0.249	0.104	0.291	0.148
	(0.015)	(1.151)	(0.221)	(1.187)	(0.232)
U_t	0.004				
	(0.013)				
Constant		2.545***	1.143***	2.519***	1.099***
		(0.782)	(0.150)	(0.807)	(0.158)
R^2	0.008	0.000	0.002	0.001	0.004
Observations	102	106	106	106	106

Standard-errors in (). *, **, ***, 10%, 5%, 1% significance. $\bar{r}$ and $\tilde{r}$ denote the mean and median of returns respectively. $\bar{r}^c$ and $\tilde{r}^c$ denote the mean and median of returns respectively conditional on the vote outcome

Table A12: P-values of the T-statistic for the difference in change in yields around a FOMC meeting with dissent relative to unanimity after March 2002

Index / Day	-2	-1	0	1	2	3
6 months	0.431	0.595	0.729	0.370	0.239	0.111
1 year	0.826	0.821	0.850	0.684	0.414	0.163
18 months	0.986	0.816	0.732	0.954	0.688	0.288
3 years	0.950	0.494	0.785	0.670	0.727	0.655
5 years	0.872	0.262	0.954	0.611	0.552	0.781
106 FOMC events						

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) and as can be seen from Figure A1 which displays the reaction of intraday volatility to the first FOMC statement in the public period (March 19 of 2002). The "peak" of intraday volatility (measured as a 5 minute moving average of S&P r_t^2 in percent using observations at frequency of 1 minute) on March 19 of 2002 was 0.014 and occurred at 14:25, just 10 minutes after the FOMC statement. At 14:35 the observed value for intraday volatility was only 0.007 and at 14:45 only 0.001.

The empirical exercises in Table 7 of the paper and Table A10 of the appendix test 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, staring 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 intraday volatility value at the start of the window (10m prior to the announcement). The results are shown in Table A13 below. 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.

Table A13: S&P intraday volatility (five minute moving average of r_t^2 using observations of 1m frequency) around 30m of FOMC statements for the period after March 2002

	Unanimity	Dissent
Average peak of intraday volatility inside 30m window	0.059	0.060
	(0.149)	(0.149)
P-value of Welch's T-Test (Peak $U \neq$ Peak D)	0.494	
Average intraday volatility at the start of the window	0.002	0.001
	(0.000)	(0.000)
P-value of Welch's T-Test (Peak $\neq$ Start of window)	0.003***	0.004***
Average increase in intraday volatility inside 30m window	0.058	0.059
	(0.146)	(0.148)
P-value of Welch's T-Test (Increase $U \neq$ Increase D)	0.485	
106 FOMC events		

Standard-deviation in (). *, **, ***, 10%, 5%, 1% significance.

3 Figures

Figure A1: S&P intraday volatility (five minute moving average of r_t^2 using observations of 1m frequency) for the first statement following FOMC meetings released in the period with public voting

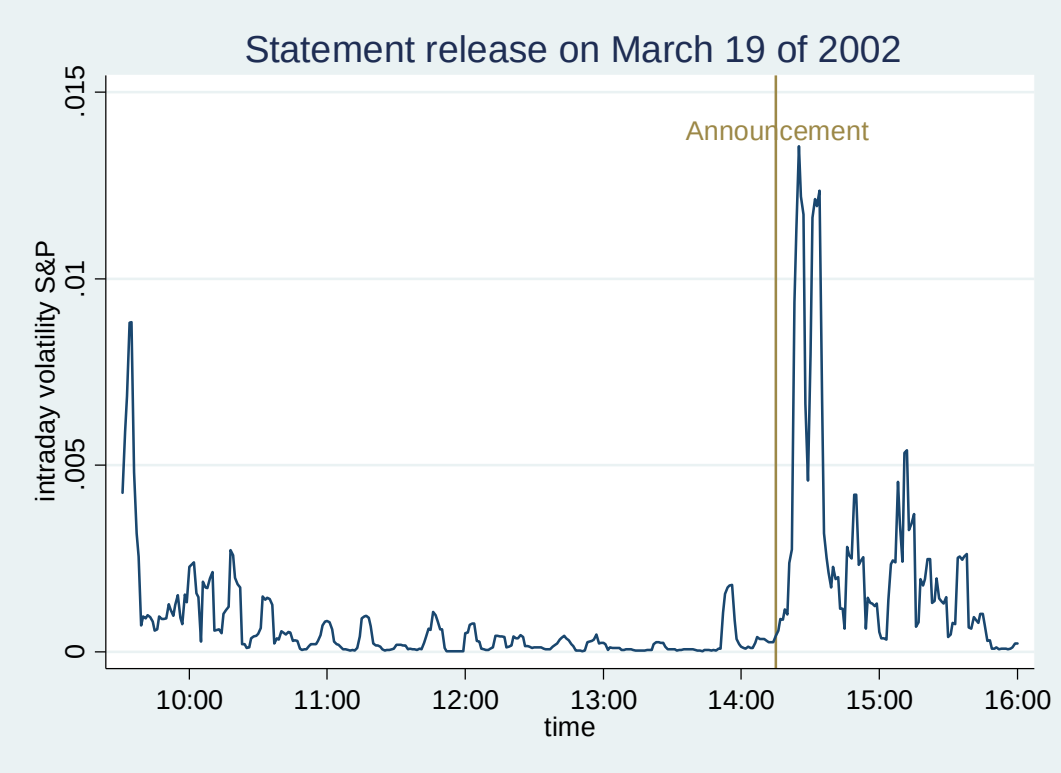


Figure A2: S&P intraday volatility (five minute moving average of r_t^2 using observations of 1m frequency) for the last minutes release of FOMC meetings in the period before votes were included in statements

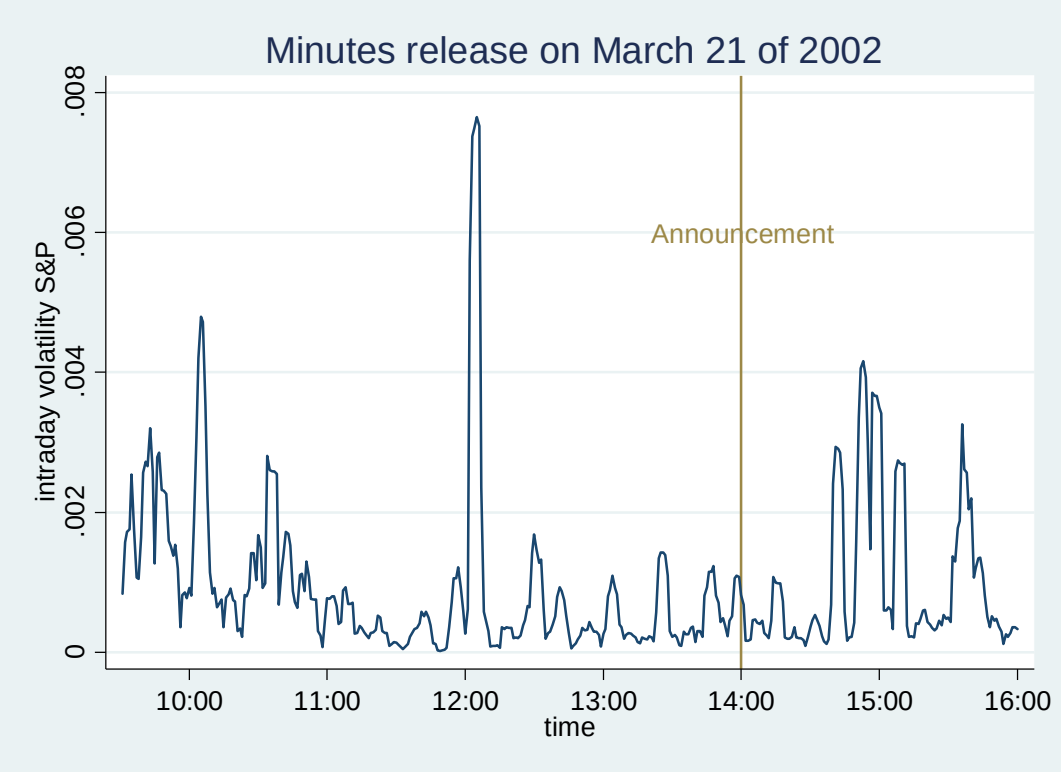
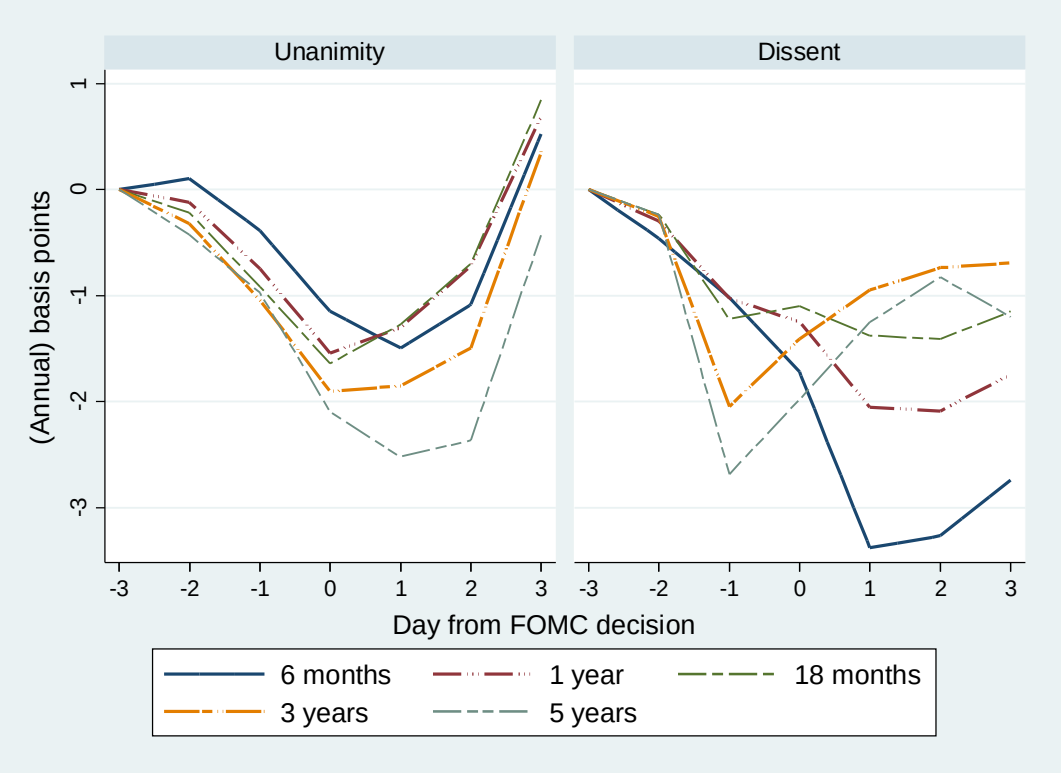


Figure A3: Average change in yields around the FOMC vote in the period with votes in the statement (March 2002-January 2015)



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