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# Words speak as loudly as actions: Central bank communication and the response of equity prices to macroeconomic announcements☆

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ABSTRACT

While the literature has already widely documented the effects of macroeconomic news announcements on asset prices, as well as their asymmetric impact during good and bad times, we focus on the reaction to news based on the description of the state of the economy as painted by the Federal Open Market Committee (FOMC) statements. We develop a novel FOMC sentiment index using textual analysis techniques, and find that news has a bigger (smaller) effect on equity prices during bad (good) times as described by the FOMC sentiment index. Our analysis suggests that the FOMC sentiment index offers a reading on current and future macroeconomic conditions that will affect the probability of a change in interest rates, and the reaction of equity prices to news depends on the FOMC sentiment index which is one of the best predictors of this probability.



## 1. Introduction

Is the stock market ignoring the economy and news about its fundamentals? According to recent discussions in some media outlets and private-sector studies, equity prices may be disconnected from economic news and fundamentals,

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validating the views of Schwert (1981), Pearce and Roley (1985), and Cutler et al. (1989), among others.[1] But extensive literature since McQueen and Roley (1993) has claimed that equity prices react to macroeconomic news and that this reaction depends on the state of the economy. Two opposite predictions have been put forward to describe how exactly the reaction depends on the state of the economy.[2] On the one hand, McQueen and Roley (1993), Boyd et al. (2005), Andersen et al. (2007), and Law et al. (2020), among others, argue that news has a **bigger** impact on equity prices during bad times—as measured by economic recessions or the unemployment rate gap—because the Federal Open Market Committee (FOMC) is less likely to raise interest rates during a downturn. According to this literature, during bad times, the FOMC will do nothing when there is positive macro news and cannot do much when there is negative news because interest rates quickly reach, or already are at, the effective lower bound.[3] In contrast, during expansions, the FOMC is more likely to raise interest rates, and positive cash flow news is offset by an opposing discount rate effect due to an increased probability of higher interest rates. On the other hand, Veronesi (1999) argues that good news has a **lower** impact on equity prices during bad times. In such situations, the positive effect spurred by the optimistic cash flow information linked to positive news is damped by increased uncertainty regarding the state of the economy, with risk-averse investors wanting to be compensated for bearing more risk by requiring a discount on the price of the asset. This mechanism implies that agents overreact to bad news in good times and underreact to good news in bad times.

In this paper, we present evidence in favor of the first prediction and contribute to the debate by showing that the response of equity prices to macroeconomic news depends on the state of the economy as described by the FOMC statement, rather than on the state of the economy as measured by a recession indicator variable or real-time economic indicators, as the previous literature suggests. In particular, we show that a positive FOMC sentiment index damps the effect that better-than-expected important macroeconomic releases—namely, nonfarm payroll, initial jobless claims, ISM manufacturing, and the Conference Board consumer confidence index—have on equity prices. The FOMC sentiment index turns out to be one of the best predictors of the sensitivity of equity prices to macroeconomic news, performing better than a number of other macroeconomic variables, consistent with the view that the text of the FOMC statement is informative beyond asset price information, because asset prices embed risk premia and/or failures of financial markets to process all information. Our findings are important for at least two reasons. First, they demonstrate the importance of words in central bank communication. Second, they reveal that equity prices do respond to macroeconomic news, but that this relationship is complex. Importantly, our results do not completely disqualify (Veronesi, 1999)'s theory. It is possible that both effects are at play, with the FOMC effect dominating the uncertainty effect on average during our sample, and the uncertainty channel becoming dominant during the COVID-19 pandemic, as discussed in the Robustness section.

To measure the state of the economy as described by the FOMC statement we use textual analysis techniques and extract a novel FOMC sentiment index. Specifically, we develop a dictionary based on the most common words that appear in the FOMC statements over the January 2000 to December 2020 period related to five topics: labor market, output, inflation, and financial conditions as well as future monetary policy actions. The dictionary contains two separate lists of words: a list of topic keywords (e.g., "GDP", "unemployment") and a list of modifiers (e.g., "increasing", "decreasing"). The algorithm pairs each keyword with the closest modifier and determines whether the combination of topic-modifier communicates good (tightening), neutral, or bad (easing) news about these five topics. While we compute the FOMC sentiment index on the 2000–20 sample, throughout the paper we focus our analysis on the 2000–19 pre-pandemic period and the overall FOMC sentiment index (a combination of all five topics). We discuss the pandemic period and the predictive power of the five indexes separately in the Robustness section.[4]

To understand the properties of the FOMC sentiment index and its role in affecting the response of macroeconomic news to equity prices, we estimate the response of interest rates to the FOMC sentiment index, and we test the ability of our index to forecast future monetary policy decisions and investors' beliefs about future economic activity. We find that the FOMC sentiment index is an important predictor of FOMC decisions along with rate change expectations estimated using federal funds futures, the VIX, and the Aruoba et al. (2009) business conditions index. We also find that the FOMC sentiment complements target rate surprises and that it is highly correlated with news related to the future path of monetary policy. In addition, we find that professional forecasters revise their beliefs about future economic activity after reading FOMC statements. Overall, these results indicate that the FOMC sentiment index contains relevant information about the probability of an increase in rates through its description of the state of the economy. The index represents text-based information, which complements the more traditional interest-based information, like the target and forward-guidance (path) variables previous literature has investigated.

[1] While the topic of whether there is a disconnect between equity prices and macroeconomic news is not new, the pandemic has brought it back to the forefront; see for example the *Wall Street Journal* article "The Stock Market Is Ignoring the Economy" by Gunjan Banerji, April 17, 2020.

[2] The online Appendix presents both predictions in more detail.

[3] Negative news has a bigger impact during bad times than during good times because the effective lower bound (ELB) mechanically prevents interest rates from being lowered further during bad times when rates are already low. Thus, during bad times the negative effect of news is not offset by the positive effect of a lower discount rate. In contrast, during good times, the negative effect of news is offset by the positive effect of a lower discount rate. This asymmetry is therefore related to the inherent asymmetry in the Federal Reserve's reaction function due to conducting monetary policy in a low $r*$ environment with an ELB constraint that binds in economic downturns. In our sample, even in the early 2000s, the federal funds rate was as low as 1 percent, effectively reaching a level that would make it harder for the Fed to act in a downturn.

[4] In the Robustness section, we will show that results are robust to extending the sample to December 2020. Results are also robust to excluding intermeeting decisions.

This paper contributes to several strands of the literature. First, we contribute to the literature that studies time variation in the response of equity prices to macroeconomic news (McQueen and Roley, 1993; Veronesi, 1999; Boyd et al., 2005; Andersen et al., 2007; Law et al., 2020). Prior studies argue that the equity response to news depends on the state of the economy measured by either a recession indicator variable or a real-time economic indicator. We argue that the equity response to news depends on the state of the economy as described by the FOMC. We find that news has a bigger (smaller) effect on equity prices during bad (good) times as described by the FOMC sentiment index. Our analysis suggests that the FOMC sentiment index offers a reading on current and future macroeconomic conditions that will affect the probability of a change in interest rates, and the reaction of equity prices to news depends on the FOMC sentiment index, which is one of the best predictors of this probability.

Second, we contribute to the literature that uses textual analysis techniques to extract useful variables that have predictive power. Textual analysis has gained significant ground in recent years, particularly in the study of uncertainty and of central bank and political deliberations. These analyses use a combination of methods including news search (Baker et al., 2016; Caldara and Iacoviello, 2018; Demiralp et al., 2019; Shapiro et al., 2020), Latent Dirichlet Allocation (Hansen and McMahon, 2016; Hansen et al., 2017; Larsen and Thorsrud, 2019), dictionary methods (Loughran and McDonald, 2011; Sharpe et al., 2017; Banerjee et al., 2019; Shapiro et al., 2020), or semantic orientation (Lucca and Trebbi, 2009). We contribute to this literature by developing a Federal Reserve-specific dictionary to sign FOMC statements and demonstrating that it works better than using the general dictionary of financial market positive and negative words of Loughran and McDonald (2011), consistent with the findings of Picault and Renault (2019).

Third, we contribute to the literature that emphasizes the importance of words in central bank communications, e.g. Gürkaynak et al. (2005), Lucca and Trebbi (2009), and Swanson (2020). While these authors focus on the effect central bank communication has on interest rates, Gürkaynak et al. (2005) and Swanson (2020) do not use textual analysis to measure the information content of FOMC statements. Instead, they use changes in long-term interest rates orthogonal to short-term interest rate changes. The advantage of such an approach is that it is easy to implement. The disadvantage, as highlighted earlier, is that asset prices embed risk premia and failures of financial markets to process all information. In contrast, we summarize information conveyed in FOMC statements using textual analysis and focus on the effect this communication has on the reaction of equity prices to macroeconomic news. We provide evidence that supports the idea that the FOMC statements, as summarized by the FOMC sentiment index, complement information from point forecasts that are provided by asset prices such as federal funds futures expectations.

Finally, and related to what we previously discussed, we also contribute to the literature that investigates the "Fed information effect". Starting with Romer and Romer (2000) and Faust et al. (2004b), the literature has zoomed in to the issue of whether the Fed's monetary policy announcements can improve private-sector forecasts of upcoming macroeconomic data releases, such as GDP, retail sales, CPI, etc. This analysis, which has taken on a variety of different forms over the years (Campbell et al., 2012; Nakamura and Steinsson, 2018; Cieslak and Schrimpf, 2019; Bauer and Swanson, 2020; Hoesch et al., 2020), has had mixed results as to whether the Fed has substantial information about future economic conditions that private forecasters do not have. Our analysis shows that the FOMC sentiment index affects future Blue Chip forecast revisions even when controlling for monetary policy surprises (target and path surprises) and for omitted news variables as in Bauer and Swanson (2020). We provide evidence that the FOMC sentiment index offers a reading on current and future macroeconomic conditions that will affect the probability of a change in interest rates.

The paper proceeds as follows. Section 2 introduces the data used in this study, including the derivation of the FOMC sentiment index. Section 3 focuses on the effect of macroeconomic news announcements on equity prices and the role of the FOMC sentiment index. In Section 4, we investigate the properties of the FOMC sentiment index: Section 4.1 studies whether the FOMC sentiment is a good predictor of future monetary policy, Section 4.2 investigates the response of interest rates to the FOMC sentiment, and Section 4.3 focuses on the ability of our index to forecast investors' beliefs about future macroeconomic variables like GDP, inflation, and the unemployment rate. Section 5 discusses in detail the information content of the index. In Section 6, we investigate the robustness of our results. Finally, we conclude in Section 7.

## 2. Data

In this section, we describe the data that we use in the analysis. First and foremost, we explain the construction of the FOMC sentiment index. We then discuss equity prices and macroeconomic news announcements. Finally, we consider a set of variables describing monetary policy actions and the state of the economy, as well as other variables that have been used in the literature when analyzing the time-varying response of equity prices to macroeconomic news announcements—a summary of these variables can be found in Table A4 in the online Appendix. Throughout the paper we focus on the period prior to the pandemic 2000–19.[5] We discuss the pandemic period in the Robustness section, Section 6.

[5] Our sample period starts in January 2000. We could possibly start the analysis in September 1998, when the Federal Reserve started to release a statement, albeit not consistently, along with the decision. However, the statements in the early part of the period were not very informative, and therefore we decided to start in 2000. Nevertheless, we note that our results are robust to including statements from September 1998 to December 1999.

### 2.1. FOMC sentiment index

We construct the FOMC sentiment index using a user-defined dictionary of *topic-keywords*, *modifier-keywords* and phrases. We separate topic-keywords and phrases into five topics—labor, output, inflation, financial conditions, and future monetary policy (e.g., labor market, business conditions, inflationary, etc.)—based on our reading of the FOMC statements over the 2000–19 period. Words or phrases are added to each topic-keyword dictionary based on their relative frequency in a list of most frequently used words that appear in FOMC statements after dropping common stop words such as "a", "the", etc. Because of the predictable pattern of FOMC communication, we were able to generate a representative set of topic-keywords (7 for labor, 18 for output, 3 for inflation, and 3 for financial conditions) and phrases (24 for future monetary policy).

Fig. 1 shows the frequency of output, labor, inflation, financial conditions, and future monetary policy topic-keywords or phrases over our sample period. The figure shows that from 2000 to 2010, the FOMC rarely mentioned labor and financial market conditions. Using a similar methodology, we create a dictionary for modifier-keywords (e.g., "rising", "deteriorated", "strengthened", etc.). That is, we create a list of most frequently used modifiers that are associated with our topic-keywords.

For the first four topics—labor, output, inflation, and financial conditions—we pair a topic-keyword (listed in Table A5) with the closest modifier-keyword (listed in Table A6 and Table A7) within a sentence to get the *topic-modifier* pair. Distance is measured by the number of words from the beginning of a topic-keyword to the beginning of a modifier-keyword. We then use this topic-modifier pair to sign FOMC communication depending on whether the statement indicates that the economy (output, employment, financial conditions) is expanding, neutral, or contracting, or that inflation is increasing, neutral, or decreasing. A simple mention of the word "unemployment" does not provide much information about what the FOMC believes regarding the state of the economy; similarly, using modifiers independently of the keyword might be misleading because they can have positive or negative connotations according to the keyword to which they refer. Importantly, including the context of "unemployment rate has declined" allows us to assign a signed score. By separating words into topic and modifier categories, our algorithm is more flexible at recognizing a variety of possible pairs like "unemployment rate has declined" and "unemployment rate to resume the gradual decline" without having to identify and score every possible permutation of those two words. Topics and modifiers take on values of 1, 0, and $-1$ based on our assessment of whether they communicate good, neutral, or bad information about economic conditions. In the Appendix, we have separated modifiers depending on the topic, because certain modifiers are more likely to be used with certain topics, but our results are robust to using a "global" modifier dictionary.

We calculate the *topic-modifier pair sentiment* by multiplying the topic score with the modifier score. For example, in the aforementioned phrase "unemployment rate has declined", "unemployment rate" and "has declined" both receive a score of $-1$ for an overall score of 1. In contrast, the phrase "labor market conditions have deteriorated" from the December 16, 2008, press release receives an overall score of $-1$, because the topic "labor market" is scored as 1 and the modifier "deteriorated" is scored as $-1$. Tables A5 and A6 in the Appendix list the keywords, modifiers, and their respective scores.

To generate the future monetary policy index, we use a combination of phrases, instead of topic-modifier matches. This is in line with the narrative approach used by Hansen and McMahon (2016), who identify in each statement the relevant paragraphs where there are mentions of future decisions. In our case, however, we look at information specifically regarding changes in—rather than the levels of—rates and asset purchases. Because the FOMC is predictable in its speech pattern, we use different rules (found in Table A9) to uniquely identify and score actions throughout the entire period. The rules are formatted as lists of words common to the FOMC's explanations of future monetary policy decisions but allow for different ordering and word tenses as necessary. For example, the rule "complete, purchase, improvement" signals the end of asset purchases and is scored with a 1 to indicate the end of an accommodative period, whereas the rule "ready to expand, purchases" (scored as $-1$) indicates that the current, weak economic state justifies an expansion of the asset purchase program.

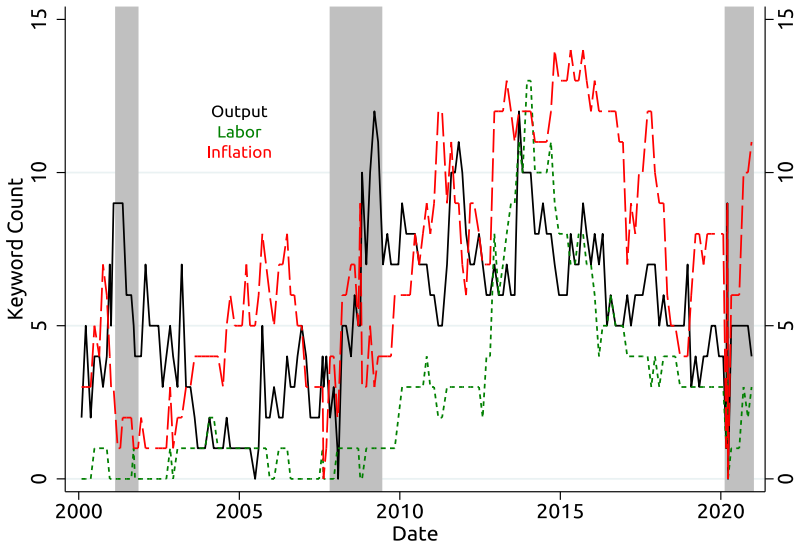
The sentiment index for each topic is the sum of each topic sentiment divided by the square root of the number of words in the statement after having deleted uninformative sentences (see the Appendix for a description of how we identify uninformative sentences). Our overall FOMC sentiment index is the sum of each topic sentiment and takes on values between $-1$ and 1.[6] In other words, every topic-modifier pair is evaluated independently, and its score is then combined with all of the others. That is, for example, the topic-modifier pair "expanding output" would receive a score of $+1$; when combined with "increasing inflation", the overall score for the FOMC sentiment index would be $+2$, but when combined with "stable inflation", the overall score would still be a $+1$ because the latter topic-modifier pair would be scored as zero. Of course, different weighting schemes could be considered.[7]

Fig. 2 displays FOMC sentiment indices for our five topics and the overall sentiment. The output (black solid line), labor (green dotted line), and inflation (red dashed line) sentiment indices are shown in the top panel, panel (a). The financial markets (orange solid line), monetary policy (blue dotted line), and overall (red dashed line, secondary axis) sentiment

[6] The textual analysis program is written in R and is available upon request.

[7] In the Robustness section, Section 6, we consider the case of extracting a principal component rather that additively combining the different subcomponents.

(a) Output, Labor, and Inflation Sentiment




(b) Financial Conditions, Monetary Policy, and Overall FOMC Sentiment Index

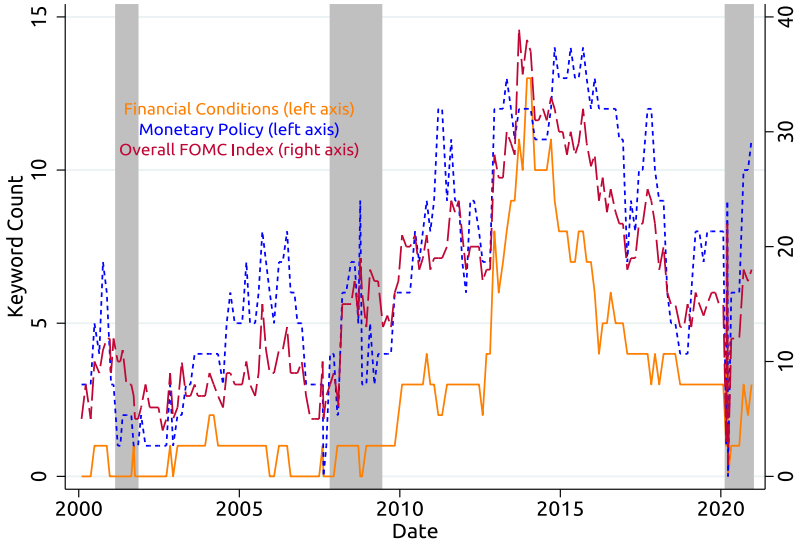
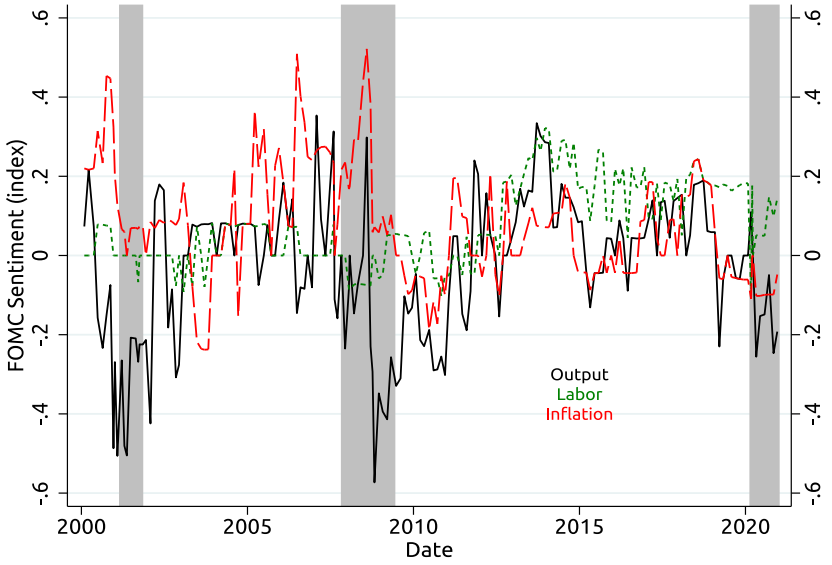



**Fig. 1.** Keyword count. Notes: The top panel (panel a) of the figure shows the count of keywords related to output (black solid line), labor (green dotted line), and inflation (red dashed line). The bottom panel (panel b) shows the count of keywords related to financial conditions (orange solid line) and monetary policy (blue dotted line) as well as the overall keyword count (red dashed line, secondary axis). The sample covers the FOMC statements over the 2000–20 period. The shaded areas denote NBER recession periods.
*Source:* Authors' calculations based on FOMC statements from www.federalreserve.gov.

indices are shown in the bottom panel, panel (b). As shown in Fig. 1, there is a distinct shift in the FOMC communication content around 2010 with the introduction of comments about the state of the labor market. Before 2010, the FOMC rarely mentioned labor markets; thus, our labor sentiment score prior to 2010 is close to zero, and it misses the 2001 recession. In contrast, the output sentiment score goes down prior to the 2001 recession. After 2010, all five sentiment scores are positively correlated. The correlation across all five topics ranges from 0.16 to 0.5 (not shown), and the correlation of

(a) Output, Labor, and Inflation Sentiment




(b) Financial Conditions, Monetary Policy, and Overall FOMC Sentiment Index

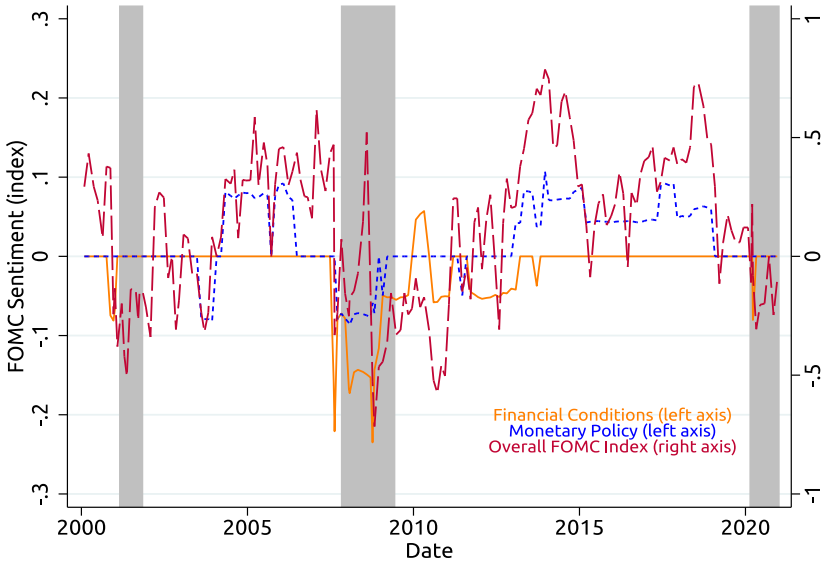



**Fig. 2.** FOMC sentiment index subcomponents. Notes: The figure shows the meeting-by-meeting FOMC sentiment index and its subcomponents, computed as described in Section 2.1 of the paper. The output (black solid line), labor (green dotted line), and inflation (red dashed line) sentiment indices are shown in the top panel (panel a). The financial conditions (orange solid line), monetary policy (blue dotted line), and overall (red dashed line, secondary axis) sentiment indices are shown in the bottom panel (panel b). The sample covers the FOMC statements over the 2000–20 period. The shaded areas denote NBER recession periods.
*Source:* Authors' calculations based on FOMC statements from www.federalreserve.gov.

the FOMC sentiment index (the sum of all five sentiments) with respect to each topic ranges from 0.16 to 0.7, with the highest correlation being that of the FOMC sentiment index and the FOMC output sentiment.[8]

[8] The correlation between the FOMC sentiment index and the FOMC output sentiment is 0.7 from 2010 to the present and 0.45 when computed over the full sample.

### 2.2. Equity prices

Following prior literature that uses high-frequency (minute-by-minute) data to estimate the response of asset prices to macroeconomic news announcements to better identify the effect, we use intraday data on the E-mini S&P 500 futures contract bid and ask quotes from Thomson Reuters Tick History. A new futures contract is issued every three-months—in March, June, September, and December. The most recently issued, or "front-month", contract is the most heavily traded contract and is a close substitute for the underlying spot instrument. Thus, in our tests, we use the front-month futures contract so that our results carry over to the spot S&P 500 index. When a new contract is issued, there are a few days when the recently issued contract is slightly less liquid than the previously issued contract. We switch contracts when the trading volume of the recently issued contract is bigger than that of the previously issued contract. Once we switch contracts, we do not switch back. We consider futures contracts for the asset prices in our analysis because futures contracts allow us to capture the effect of announcements that take place at 8:30 a.m. eastern time, before the equity market opens.

### 2.3. Macroeconomic news announcements

There are many macroeconomic news announcements, but not all of these announcements have a significant impact on asset prices.[9] For example, out of 36 announcements, Gilbert et al. (2017) find that only one—namely, nonfarm payroll—explains more than 20 percent of the variation in daily two-year and five-year U.S. Treasury yield changes. Law et al. (2020) focus on four macroeconomic news announcements: nonfarm payroll, initial claims, ISM manufacturing, and the Conference Board consumer confidence index. For ease of comparison, we focus on these four announcements, but our results are robust to focusing on the announcements Gilbert et al. (2017) consider important.[10]

We use Bloomberg real-time data on the expectations and realizations of these four U.S. macroeconomic announcements to estimate surprises. Table A11 in the Appendix provides a brief description of the most salient characteristics of the news announcements in our sample: the total number of observations in our sample (2000–19 and 2000–20), the time of the announcement release (in eastern time), and the agency reporting each announcement.

We define announcement surprises as the difference between announcement realizations and their corresponding expectations. More specifically, since units of measurement vary across macroeconomic variables, we standardize the resulting surprises by dividing each of them by their sample standard deviation. The standardized news associated with the macroeconomic indicator $i$ at time $t$ is therefore computed as

$$Surprise_{it} = \frac{A_{it} - E_{it}}{\widehat{\sigma}_i}, \tag{1}$$

where $A_{it}$ is the announced value of indicator $i$; $E_{it}$ is its Bloomberg median forecast, as a proxy for its market expected value; and $\widehat{\sigma}_i$ is the sample standard deviation of $A_{it} - E_{it}$.[11] Eq. (1) facilitates meaningful interpretation of the response of equity prices to news and allows us to pool all four announcements to have more observations per year when estimating time-varying coefficients.

### 2.4. Different measures of the state of the economy

In the analysis, we consider a number of variables that proxy for the current state of the economy. Even though the NBER does not announce expansions and recessions on a real-time basis, we consider an indicator variable equal to 1 when the economy is in recession, and zero otherwise.[12] As a real-time proxy of the current state of the economy, we use the ADS business conditions index from Aruoba et al. (2009). This index is updated in real time as new macroeconomic data become available and may be used to compare business conditions at different times. Progressively bigger positive values indicate progressively better-than-average conditions, whereas progressively more negative values indicate progressively worse-than-average conditions.[13] We also consider real-time measures of inflation and the unemployment gap. For inflation, we use the Bloomberg real-time GDP price deflator index. We compute the unemployment gap as the difference between the real-time quarterly average of the monthly unemployment rate and the Congressional Budget Office's estimate of the natural rate.[14]

A second set of proxies that we consider are those that have been shown to be able to predict the future state of the economy. In particular, we include in our analysis the excess bond premium (EBP) suggested by Gilchrist and Zakrajšek

9 See Gilbert et al. (2017) for an explanation of why this is the case.

10 An alternative could be to use a macro surprise index like the one developed by Scotti (2016).

11 In the year 2020, some macroeconomic surprises were extremely large. In order to avoid these surprises to have an unduly effect, we standardize surprises using the standard deviation estimated from 2000 to 2019.

12 The NBER defines a recession as a significant decline in economic activity spread across the economy, lasting more than a few months, and normally visible in real GDP, real income, employment, industrial production, and wholesale–retail sales.

13 The Aruoba et al. (2009) index is maintained by the Federal Reserve Bank of Philadelphia at https://www.philadelphiafed.org/research-and-data/real-time-center/business-conditions-index.

14 The natural unemployment rate estimate is from the Congressional Budget Office website at https://www.cbo.gov/data/budget-economic-data.

(2012), an indicator of the effective "risk-bearing capacity" of the financial intermediary sector.[15] Lopez-Salido et al. (2017), using U.S. data from 1929 to 2015, show that elevated credit market sentiment is associated with a decline in economic activity in future years. In addition, we include an inverted yield curve dummy—that is, an indicator variable equal to 1 if the long-term spread, the difference between the 10-year bond yield and the 2-year bond yield-is negative, and zero otherwise.[16]

Finally, we also consider private-sector forecasts from the Blue Chip Economic Indicators, which is a monthly survey-based dataset containing consensus forecasts—the arithmetic mean of the forecasts across approximately 50 institutions—for a number of macroeconomic variables. In particular, we use not only the annualized quarter-over-quarter consensus forecasts of real GDP growth and the GDP deflator, but also the quarterly average of the unemployment rate in percentage points. Economic forecasting firms have been surveyed about their predictions for the current and next calendar years once per month, over the first three business days of each month, since 1976.[17] Thus, the maximal forecast horizon ranges from four quarters (when the survey is conducted in the last quarter of a calendar year) to seven quarters (when it is conducted in the first quarter of the year).

### 2.5. Monetary policy and other variables

Another group of variables considered in our analysis are those that refer to monetary policy decisions or that are believed to affect such decisions. One such variable is the level of the federal funds rate (FFR). Indeed, Goldberg and Grisse (2013) argue that the Federal Open Market Committee (FOMC) is less likely to raise interest rates in response to positive nonfarm payroll surprises when the FFR is already high. Thus, in this situation, positive nonfarm payroll surprises should have a bigger impact on equity prices.

Because our sample contains the effective lower bound (ELB) period, in addition to the change in the FFR, we also consider a policy stance indicator that takes the value $s = -1,\ 0$, or 1 according to whether the FOMC decreases, leaves unchanged, or increases the FFR and to whether it announces other unconventional policies that are accommodative, neutral, or tightening, respectively. During our sample period, February 2000 to December 2019, there were, as shown in Table A12, 166 FOMC meeting press releases, some of which were intermeeting press releases.[18]

In the paper, we also evaluate which variables best predict FOMC decisions. Indeed, Law et al. (2020) show that the equity price response to macroeconomic news not only depends on the current level of the federal funds rate, but also depends on variables that predict future FOMC decisions. Following Orphanides (2005) and Board of Governors (2018), we relate the change in the federal funds target rate (as captured more generally by our monetary policy stance dummy) to a real-time measure of the inflation rate (minus a 2 percent long-run objective) and a real-time change in the unemployment gap. We also consider variables examined by Law et al. (2020): 5-year bond yield level and changes, the price-to-dividend ratio, and the VIX as a proxy for uncertainty.[19] While the 5-year bond yield level and changes can be considered a measure of forward-guidance information, we also include in the analysis more direct measures of *expectations* and *surprises* related to both the target rate and the forward-guidance components of monetary policy. In particular, as measures of the market's expectation of future target rate changes and forward-guidance changes, we employ the expected change in the FFR implied by fed funds futures and the expected change in the FFR one year hence implied by Eurodollar futures or the Blue Chip Financial Indicators forecast for the FFR over the next four quarters.[20] When the specification requires us to look at target rate and forward-guidance surprises during FOMC announcements, we define the target rate surprise as the change in expectations derived from fed funds futures contracts (see Kuttner2001) over a 30-min window (from 10 min before the FOMC announcement to 20 min afterward), and the forward-guidance or path surprise is the residual from a regression of the change in yield for the fourth Eurodollar futures contract (from 10 min before the time of the announcement to 20 min afterward) onto the target rate surprise. Finally, we also use U.S. Treasury bills with maturities of 3 and 6 months as well as U.S. Treasury notes with maturities of 2, 5, and 10 years from Bloomberg.

In a robustness exercise (not shown), we replaced the VIX with the economic uncertainty index of Baker et al. (2016) and the monetary policy uncertainty index of Husted et al. (2020), and the results for our FOMC sentiment index are similar.

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15 The EBP is updated regularly, following Favara et al. (2016) at https://www.federalreserve.gov/econresdata/notes/feds-notes/2016/updating-the-recession-risk-and-the-excess-bond-premium-20161006.html.

16 Alternatively, one could use the near-term forward spread of Engstrom and Sharpe (2018), which can be interpreted as a measure of market expectations for the near-term trajectory of conventional monetary policy rates and has been shown to be successful in recession prediction models.

17 Beginning in December 2000, the Blue Chip survey is completed by the second business day of each month.

18 The FOMC press release dates shown in Table A12 are taken from www.federalreserve.gov. We confirmed the release dates using Bloomberg, the Internet Appendix Table IA.I in Boguth et al. (2019), and the dates from Rogers et al. (2014, 2018) updated to December 2020.

19 In our regressions, we use the value of the VIX at the close of the day preceding the macroeconomic announcement because options used to construct the index trade from 9:15 am to 4:15 pm ET.

20 More details on the computation of expectations on target rate changes following Kuttner (2001) and expectations of forward guidance changes are in Appendix. For the Blue Chip forecast, we use the change in the monthly forecast.

## 3. Reaction of equity prices to macroeconomic news

In this section, we focus on understanding what can explain the time-varying response of equity prices to macroeconomic announcements. We estimate the time-varying effect of news by allowing the response to vary year by year and across news announcements, similar to the framework of Swanson and Williams (2014) and Law et al. (2020), and estimate the following nonlinear least-squares equation:

$$r_t = \alpha_j + \sum_{j=2000}^{2020} \sum_{k=1}^{4} \beta_{Sj}\gamma_k Surprise_{kt} \times Year_j + \epsilon_t, \tag{2}$$

where $r_t$ is the 30-min percent change in the E-mini S&P500 futures contract, $Surprise_{kt}$ are the standardized surprises of four macroeconomic news announcements indexed by $k$ (nonfarm payroll, initial claims, ISM manufacturing, and the Conference Board consumer confidence index), $\alpha_j$ and $Year_j$ are indicator variables equal to 1 during year $j = 2000, 2001, \ldots, 2020$.[21] We use observations only when there is a macroeconomic news release. In Appendix Table A13, we show the coefficient estimates for both $\beta$'s and $\gamma$'s and in Fig. 3, we plot the estimates of $\beta_{Sj} \times \frac{\sum_{k=1}^{4}\gamma_k}{4}$ for each year, along with 95 percent confidence error bands, the FOMC sentiment index, and shaded areas indicating NBER recessions. The figure shows that equity prices are more sensitive to macroeconomic news announcements (red line) when the FOMC sentiment index (blue line) is low. The effect on equity prices of a one-standard-deviation surprise in macroeconomic announcements can be as low as zero (or even negative) amid expansionary periods and as high as 0.4 following recessions.[22] Conversely, the FOMC sentiment index ranges from values around 3 or 4 during expansions to $-2$ or $-3$ following recessions.

To formally test whether the effect news has on equity prices depends on the state of the economy or the FOMC's description of the state of the economy, we interact each surprise with different proxies. In particular, we estimate the following equation:

$$r_t = \alpha + \sum_{k=1}^{4} \beta_k Surprise_{kt} + \sum_{k=1}^{4} \beta_{Xk} Surprise_{kt} \times X_t + \beta_X X_t + \epsilon_t, \tag{3}$$

where $r_t$ is the 30-min percent change in the E-mini S&P 500 futures contract, $Surprise_{kt}$ are the standardized surprises of the four macroeconomic news announcements indexed by $k$, and $X_t$ will be different proxies for the state of the economy, monetary policy, and uncertainty measures we described in Section 2. A significant $\beta_{Xk}$ will tell us that the effect of macroeconomic surprise $k$ on equity prices changes depending on the values of the other independent variables $X_t$. For continuous variables, we standardize $X_t$ by subtracting the mean and dividing by its standard deviation so that the coefficients are easily interpreted. As before, we use observations only when there is a macroeconomic news release.

Table 1 shows the estimation results of Eq. (3) when we consider each $X_t$ at a time. For parsimony, we report only the average impact across all four announcements along with the statistical significance. The first column of panel A shows the estimation results when macroeconomic surprises are interacted with the FOMC sentiment index. As expected, a positive macro surprise lifts equity prices: a one-standard-deviation increase in the macroeconomic surprise increases equity prices by 0.49 percentage point, on average, across all four announcements. Importantly, this effect is lower when the FOMC sentiment index is high, as shown by the negative coefficient on the interaction term. Specifically, a one-standard-deviation increase in the FOMC sentiment index (corresponding to approximately a 0.3 increase in the index) lowers the effect of the surprise by 0.32 percentage point. This is consistent with Fig. 3 and supports the view that the macro news discount rate effect diminishes the cash flow effect when the FOMC has a bullish view of the economy and is more likely to increase rates, i.e., the impact of macro news on equity prices is lower when the probability of a rate increase is higher.

The remainder of the columns in panels A and B of Table 1 show the results of a similar analysis when different variables are interacted, one by one, with macroeconomic surprises. For example, column 2 in panel A shows that when the federal funds futures market expects an increase in the federal funds target rate of 25 basis points at the next meeting (corresponding approximately to a one-standard-deviation increase), the equity price response to a one-standard-deviation macroeconomic surprise is 0.39 percentage point ($0.55 - 0.16$) compared with 0.55 percentage point when the expectation is no change in the federal funds target rate. Columns 3–7 in panel A show that the response of equity markets to macroeconomic news is lower when the unemployment gap decreases and when inflation is higher. Columns 1–7 in panel B show that the equity price response to macroeconomic announcements is lower when the economy is expanding, when the federal funds rate is higher, when 5-year yields are increasing, etc.

[21] In more detail, $r_t$ is the 30-min percent change in the E-mini S&P 500 futures contract using bid and offer quotes 1 min before the release of the announcement as well as bid and offer quotes 29 min after the announcement—that is, $100 \times [ln(mq_{t+29}) - ln(mq_{t-1})]$.

[22] Of note, these coefficients are not comparable with Law et al. (2020) because they standardize surprises by the standard deviation across professional forecasters, rather than the standard deviation of the surprise. However, the coefficients are comparable with those reported in Andersen et al. (2007). The range of the variation in the magnitude of the response of equity prices to macroeconomic news shown in Fig. 3 is somewhat smaller than that documented in Andersen et al. (2007), who find that a one-standard-deviation surprise in nonfarm payroll increases stock prices by 0.3 percentage point during recessions, and it decreases stock prices by $-0.2$ percentage point during expansions.

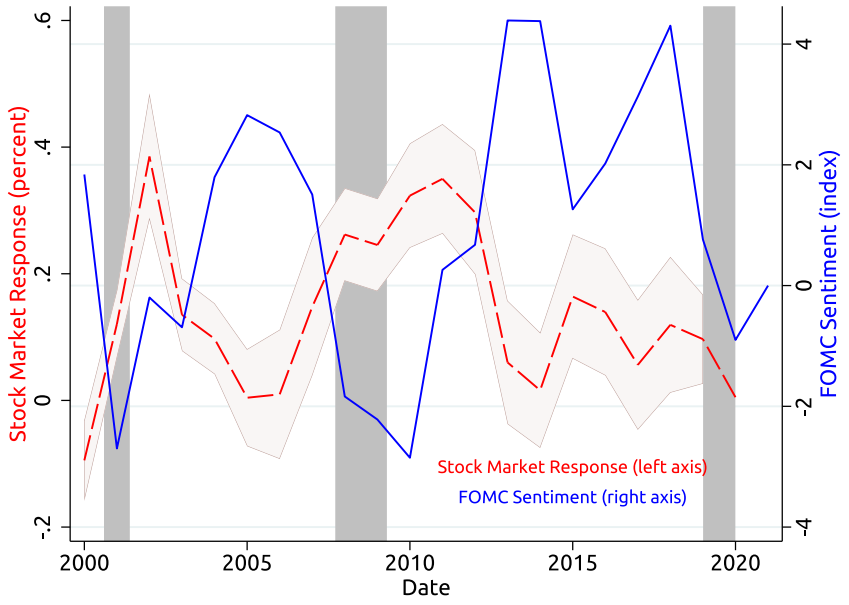


**Fig. 3.** FOMC sentiment index and time variation in the response of the stock market to macroeconomic news. Notes: The figure shows the overall FOMC sentiment index (blue solid line) and the response of the equity market to macroeconomic news announcements (red dashed line), along with 95% confidence bands (light-gray shaded area), over time. The response is the coefficient on macroeconomic news surprises when regressing the 30-min equity return on macroeconomic news surprises from 2000 to 2020. We allow the coefficient to vary over time and across announcements by estimating the non-linear Eq. (3) in the paper. Similar to Bauer and Swanson (2020), we constrain the effect across years to be 1, so year 2020 is equal to $1 - \sum_{i=2000}^{2019} Year_i$. The FOMC sentiment index is extracted using the textual analysis technique described in the paper, and it takes values that range from $-1$ to 1 for each meeting. We graph the sum of the FOMC sentiment index over the year. The shaded areas denote NBER recession periods.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Thomson Reuters Tick History and FOMC statements from www.federalreserve.gov.

Table 2 shows the results of the horse race when we include all of the interaction terms from Table 1 in the same regression. Column (2) includes the FOMC sentiment and a subset of other explanatory variables, and column (3) includes all of the variables. Even in the latter case, the FOMC sentiment remains significant, consistent with the view that it contains information above and beyond what is contained in the other variables.[23]

## 4. Properties of the FOMC sentiment index

This section focuses on a few exercises to help us understand better the information carried by the FOMC sentiment score. Specifically, we estimate the response of interest rates to the FOMC sentiment, and we test the ability of our index to forecast future monetary policy decisions and investors' beliefs about future economic activity. The results suggest that the FOMC sentiment index is a good predictor of upcoming FOMC decisions, and that it contains information beyond the short term. In fact, regressing a variety of interest rates on the FOMC sentiment index, we find that the index complements asset price information and affects the mid-section of the curve, as well as the fourth Eurodollar contract, suggesting that it may contain information about future economic activity and monetary policy stance. Testing for the so-called Fed information effect, we find that the FOMC sentiment index affects future Blue Chip forecast revisions even when controlling for monetary policy surprises (target and path surprises) and for omitted news variables as in Bauer and Swanson (2020).[24] Overall, these results indicate that the FOMC sentiment index contains important information about the state of the economy and therefore about the potential future monetary policy stance.

### *4.1. Can the FOMC sentiment forecast upcoming FOMC decisions?*

FFR changes are naturally ordered in 0.25 percent increments over the range of ±0.75 percent, prompting the use of an ordered probit model to forecast the size of the FFR change, consistent with Hamilton and Jordá (2002), Scotti

[23] Of course, there is a tradeoff from including too many variables (collinearity in Table 2) or too few (omitted variable bias in Table 1). In Table 2, some of the variables have the opposite sign than in Table 1. However, the FOMC sentiment variable has the same sign and similar magnitude in both tables, suggesting that FOMC sentiment contains information that complements the information in all the other variables.

[24] However, because such forecasts incorporate information from the FOMC statement, our FOMC index does not contribute to forecasting future economic activity above and beyond the Blue Chip forecasts for GDP, the GDP price deflator, and the unemployment rate. Section D in the Appendix presents these results.

**Table 1**
Response of equity markets to macroeconomic news.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Thomson Reuters Tick History, Center for Research in Security Prices (CRSP), the Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists, the Aruoba-Diebold-Scotti Business Conditions Index, the Favara et al. (2016) EBP update, the Congressional Budget Office, and FOMC statements from www.federalreserve.gov.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Panel A: Monetary policy and the state of the economy | | | | | | | | |
| Surprise | 0.492*** (122.29) | 0.553*** (156.74) | 0.591*** (166.39) | 0.547*** (148.73) | 0.544*** (149.11) | 0.564*** (160.23) | 0.554*** (151.25) | 0.556*** (154.37) |
| Surprise × FOMC sentiment | −0.325*** (53.12) | | | | | | | |
| Surprise × FFF expectations | | −0.158*** (16.52) | | | | | | |
| Surprise × Eurodollar expectations | | | −0.125*** (7.80) | | | | | |
| Surprise × BC expectations | | | | −0.080** (5.90) | | | | |
| Surprise × Δ UR Gap | | | | | 0.142*** (7.99) | | | |
| Surprise × inflation rate | | | | | | −0.143*** (9.26) | | |
| Surprise × ADS index | | | | | | | −0.015 (0.13) | |
| Surprise × EBP | | | | | | | | −0.011 (0.13) |
| Observations | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 |
| Adjusted $R^2$ | 0.146 | 0.127 | 0.122 | 0.125 | 0.122 | 0.122 | 0.121 | 0.13 |
| Panel B: Monetary policy, the state of the economy, and uncertainty | | | | | | | | |
| Surprise | 0.574*** (152.81) | 0.502*** (107.96) | 0.591*** (179.77) | 0.543*** (150.67) | 0.646*** (205.59) | 0.511*** (131.45) | 0.583*** (170.44) | 0.531*** (140.04) |
| Surprise × Inv. yield curve | −0.211 (1.77) | | | | | | | |
| Surprise × Recession | | 0.316*** (6.78) | | | | | | |
| Surprise × FFR | | | −0.303*** (52.69) | | | | | |
| Surprise × Δ monetary policy | | | | −0.214*** (29.49) | | | | |
| Surprise × 5-year yield | | | | | −0.326*** (62.02) | | | |
| Surprise × Δ 5-year yield | | | | | | −0.234*** (36.02) | | |
| Surprise × PD ratio | | | | | | | −0.168*** (18.11) | |
| Surprise × VIX | | | | | | | | 0.132*** (12.46) |
| Observations | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 | 1750 |
| Adjusted $R^2$ | 0.117 | 0.124 | 0.144 | 0.13 | 0.15 | 0.137 | 0.125 | 0.143 |

Notes: We estimate the response of E-mini S&P 500 futures to macroeconomic news announcements using data from 2000 to 2019. The dependent variable is the 30-min E-mini S&P500 futures returns using the prevailing futures price as of 1 min before the announcement to 29 min after the announcement. The estimation also includes main effects, but we do not report these coefficients. The independent variables are divided by their standard deviation, so that the magnitude of the coefficients can be interpreted more easily. We report the average coefficient across four macroeconomic surprises: nonfarm payroll, initial jobless claims, ISM manufacturing and the Conference Board consumer confidence index. F-statistics are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

(2011), and Angrist et al. (2018). However, because the period we analyze is characterized by both conventional and unconventional policies, we develop a policy stance indicator that takes the value $s = -1,\ 0,\ or\ 1$, as explained in Section 2.5.

In terms of explanatory variables, our specification is similar to that used by Angrist et al. (2018), who, consistent with Kuttner (2001), find that federal funds futures are one of the best predictors of the change in the FFR. We also include Blue Chip professional forecasts of the change in the FFR and the change in fed funds futures one year hence implied by Eurodollar futures. In addition to these variables measuring market expectations regarding target and forward-guidance (path) monetary policy changes, we also include Taylor rule-type variables—namely, inflation and the unemployment rate gap. According to the Taylor rule, the *change* in the federal funds target rate is a function of the inflation rate (minus a 2 percent long-run objective) and the change in the GDP gap (see, for example, Orphanides, 2005; Board of Governors,

**Table 2**
Response of equity markets to macroeconomic news: Horse race.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Thomson Reuters Tick History, Center for Research in Security Prices (CRSP), the Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists, the Aruoba-Diebold-Scotti Business Conditions Index, the Favara et al. (2016) EBP update, the Congressional Budget Office, and FOMC statements from www.federalreserve.gov.

| | (1) | (2) | (3) |
|---|---|---|---|
| Surprise | 0.556*** | 0.649*** | 0.605*** |
| | (157.13) | (194.2) | (102.77) |
| Surprise × FOMC sentiment | | −0.427*** | −0.375*** |
| | | (46.03) | (30.7) |
| Surprise × FFF expectations | | 0.370*** | 0.378*** |
| | | (15.71) | (11.28) |
| Surprise × Eurodollar expectations | | −0.369*** | −0.142 |
| | | (29.72) | (1.43) |
| Surprise × BC expectations | | 0.179*** | 0.157*** |
| | | (16.23) | (7.26) |
| Surprise × Δ UR Gap | | | 0.088 |
| | | | (2.31) |
| Surprise × inflation rate | | | 0.062 |
| | | | (0.96) |
| Surprise × ADS Index | | | 0.465*** |
| | | | (22.76) |
| Surprise × EBP | | | −0.022 |
| | | | (0.09) |
| Surprise × Inv. yield curve | | | 0.162 |
| | | | (0.72) |
| Surprise × Recession | | | 0.402** |
| | | | (4.15) |
| Surprise × FFR | | −0.331*** | 0.102 |
| | | (63.07) | (0.30) |
| Surprise × Δ monetary policy | | −0.347*** | −0.457*** |
| | | (18.79) | (23.24) |
| Surprise × 5-year yield | | | −0.398** |
| | | | (5.39) |
| Surprise × Δ 5-year yield | | | −0.042 |
| | | | (0.38) |
| Surprise × PD ratio | | | −0.071 |
| | | | (1.34) |
| Surprise × VIX | | | 0.269*** |
| | | | (10.46) |
| Observations | 1750 | 1750 | 1750 |
| Adjusted $R^2$ | 0.117 | 0.211 | 0.264 |

Notes: We estimate the response of E-mini S&P 500 futures to macroeconomic news announcements using data from 2000 to 2019. The dependent variable is the 30-min E-mini S&P500 futures returns using the prevailing futures price as of 1 min before the announcement to 29 min after the announcement. The estimation also includes main effects, but we do not report these coefficients. The independent variables are divided by their standard deviation, so that the magnitude of the coefficients can be interpreted more easily. We report the average coefficient across four macroeconomic surprises: nonfarm payroll, initial jobless claims, ISM manufacturing and the Conference Board consumer confidence index. F-statistics are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

2018)[25] In the literature, the monthly CPI index (or quarterly GDP deflator) and the change in the unemployment rate gap are generally used in place of inflation and the output gap change. We use real-time measures of inflation and the unemployment rate gap as suggested by Orphanides (2001) and as explained in the Data section. We also include the financial variables (Law et al., 2020) show to be good predictors of future monetary policy, such as the 5-year bond yield level and changes, the price-to-dividend ratio, and the VIX.[26] And, of course, we include our FOMC sentiment index, which is meant to capture the likelihood of a change in the federal funds target rate due to a change in economic conditions since the previous FOMC meeting.

[25] See the box "Monetary Policy Rules and Their Role in the Federal Reserve's Policy Process" in Board of Governors (2018).

[26] Our right-hand variable is the change in monetary policy; however, previous literature shows that both the level and the change in interest rates have predictive power, so we include both.

Specifically, we estimate the following probit specification at a daily frequency using observations only when there is an FOMC meeting:

$$Pr(MPD_t = s|X_{t-1}) = \Phi(X_{t-1}\mathrm{B} + \epsilon_t), \tag{4}$$

where $MPD_t$ is the monetary policy decision on day $t$ when there is an FOMC announcement, measured as the policy stance variable just described, and $X_{t-1}$ is the matrix of predictors of monetary policy decisions available as of the day before the FOMC meeting. For most variables, this means that we use their value as of $t-1$, but for the FOMC sentiment, the latest value is that corresponding to the previous FOMC meeting. In addition, $\Phi$ is the normal probability distribution.[27]

We first consider each variable's predictive power in isolation in a univariate specification. All of the variables, except for the indicator variables (recession and inverted yield curve), are standardized so that the marginal effects can be interpreted as the effects of a one-standard-deviation shock to the variable. In Table 3, we show that the expected rate change implied by federal funds futures—computed as described in Section 2.5 and in the Appendix—is the best predictor of future monetary policy, with a pseudo $R^2$ of 0.34, followed by the previous change in the monetary policy stance, with a pseudo $R^2$ of 0.30, and our FOMC sentiment index, with a pseudo $R^2$ of 0.26. These results are consistent with the intuitive notion that interest rate derivatives provide a very good policy forecast (Piazzesi, 2005), and that the texts of FOMC statements, as well as past FOMC actions, are good predictors of future monetary policy decisions. The VIX, the ADS index, and a recession indicator variable also turn out to be good predictors of future monetary policy stance. For ease of interpretation, we standardized all continuous variables, and the table reports the marginal effects on the probability of the FOMC making a tightening announcement for a one-standard-deviation increase in continuous variables, or for a change from 0 to 1 in discrete variables.[28] In column (1), we observe that a one-standard-deviation increase in the FOMC sentiment (corresponding to a 0.3 increase in the index) increases the probability of a tightening announcement by 0.21, which is a sizeable number. For comparison, a one-standard-deviation increase in the expected FFR change implied by fed funds futures (corresponding to about 25 basis points) would increase the probability of a tightening announcement by 0.24. Conversely, the probability of tightening decreases by 0.24 when the economy moves into recession.

In column (1) of Table 4, we show results from a horse race exercise where we include in the probit regression all of the variables at once. Not all variables are statistically significant in this specification: the fact that the FOMC sentiment maintains its significance in this regression is indicative of the fact that its information is not subsumed by other variables. Importantly, the marginal effect of the FOMC sentiment index is still sizeable. A one-standard-deviation increase in the FOMC sentiment increases the probability of tightening announcement by 0.13. Variables like the VIX or the ADS index, instead, lose significance in this exercise. In columns (2)–(4), we show that our conclusion is robust to excluding the ELB period and to forecasting federal funds target rate changes rather than using the monetary policy stance variable (more details in Section 6.3).[29]

### 4.2. Do interest rates respond to the FOMC sentiment?

In order to disentangle the information contained in the FOMC sentiment index, we look into its performance in affecting interest rates across maturities. While prior literature has shown that monetary policy surprises affect short- and long-term interest rates, we are particularly interested in the value of textual information as summarized by our index. Following Lucca and Trebbi (2009), we therefore investigate whether the FOMC sentiment index contains information relevant for interest rates beyond the target rate surprise. To this end, we regress interest rate movements in a narrow window around the FOMC announcement on the monetary policy target rate surprise and our FOMC sentiment index:

$$\Delta y^m_{\tau,t} = \alpha + \beta_S \text{Target Surprise}_t + \beta_{MPS} \text{FOMC Sentiment}_t + \epsilon_t, \tag{5}$$

where $y^m_{\tau,t}$ is the yield on day $t$ at time $\tau$ of U.S. Treasury bills with maturity $m = 3$ and 6 months, U.S. Treasury notes with maturity $m = 2$, 5, and 10 years, or the fourth Eurodollar futures contract. We define the 30-min yield change around the FOMC announcement as $\Delta y^m_{\tau,t} = 100 \times (y^m_{\tau+20,t} - y^m_{\tau-10,t})$. While the FOMC announcement time varies across our sample period, FOMC statements for scheduled meetings have been released at 2:00 p.m. ET since 2013, so $\tau - 10$ is 1:50 p.m. ET and $\tau + 20$ is 2:20 p.m. ET.[30] The *target surprise* and the FOMC sentiment are defined in Section 2.

Consistent with previous studies, the results in panel A of Table 5 document a statistically significant effect of target rate surprises on short-term yields and a substantial drop in the fraction of the variance explained for longer-dated yields.[31]

[27] Results are qualitatively similar when we estimate Eq. (4) with $MPD_t$ being the actual FFR change $s = -0.75, -0.5, -0.25, 0, 0.25, 0.50$ or 0.75 or when we exclude the ELB period—see Table 4, columns (3)–(4) and Section 6.3.

[28] To be clear, the table shows the marginal effect not in terms of slope, but in terms of impact on the probability.

[29] An alternative to a probit specification would be to use the shadow rate of Wu and Xia (2016) and follow the approach used by Hansen and McMahon (2016).

[30] Throughout our sample period, FOMC announcement times vary and we use the statement release times published on this website: https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.

[31] A related though separate issue is whether macroeconomic news can predict asset prices. Existing literature documents a positive interest rate response to macroeconomic news (e.g., Gilbert et al., 2017) and the ability of macroeconomic news to predict future monetary policy changes (e.g., Table VII in Bernanke and Kuttner, 2005; Bauer and Swanson, 2020).

**Table 3**
Forecast of FOMC monetary policy stance.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Blue Chip Financial Forecasts, Center for Research in Security Prices (CRSP), the Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists, the Aruoba-Diebold-Scotti Business Conditions Index, the Favara et al. (2016) EBP update, the Congressional Budget Office, and FOMC statements from www.federalreserve.gov.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Panel A: Monetary policy, expectations and the state of the economy | | | | | | | |
| FOMC sentiment | 0.213*** | | | | | | | |
| | (0.023) | | | | | | | |
| FFF expectations | | 0.243*** | | | | | | |
| | | (0.023) | | | | | | |
| Eurodollar expectations | | | 0.157*** | | | | | |
| | | | (0.024) | | | | | |
| BC expectations | | | | 0.176*** | | | | |
| | | | | (0.026) | | | | |
| $\Delta$ UR Gap | | | | | −0.101*** | | | |
| | | | | | (0.025) | | | |
| Inflation rate | | | | | | 0.101*** | | |
| | | | | | | (0.025) | | |
| ADS index | | | | | | | 0.197*** | |
| | | | | | | | (0.033) | |
| EBP | | | | | | | | −0.168*** |
| | | | | | | | | (0.057) |
| Observations | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| Pseudo $R^2$ | 0.258 | 0.339 | 0.133 | 0.147 | 0.051 | 0.052 | 0.151 | 0.052 |
| | Panel B: Monetary policy, the state of the economy, financial variables and uncertainty | | | | | | | |
| Inv. yield curve | −0.174** | | | | | | | |
| | (0.078) | | | | | | | |
| Recession | | −0.243*** | | | | | | |
| | | (0.035) | | | | | | |
| FFR | | | −0.029 | | | | | |
| | | | (0.025) | | | | | |
| $\Delta$ monetary policy | | | | 0.319*** | | | | |
| | | | | (0.027) | | | | |
| 5-year yield | | | | | 0.027 | | | |
| | | | | | (0.025) | | | |
| $\Delta$ 5-year yield | | | | | | 0.052** | | |
| | | | | | | (0.025) | | |
| PD ratio | | | | | | | −0.025 | |
| | | | | | | | (0.025) | |
| VIX | | | | | | | | −0.204*** |
| | | | | | | | | (0.033) |
| Observations | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 |
| Pseudo $R^2$ | 0.004 | 0.152 | 0.004 | 0.296 | 0.003 | 0.013 | 0.003 | 0.160 |

Notes: We estimate an ordered probit to forecast monetary policy decisions from 2000 to 2019. The dependent variable is an indicator variable equal to −1, 0, or 1 according to whether the FOMC decreased, left unchanged or increased the federal funds rate or announced other unconventional policies that were easing, neutral, or tightening. The table reports marginal effects on the probability of tightening for a one-standard-deviation increase in the independent variable, if the variable is continuous, and for an increase from 0 to 1, if the variable is an indicator variable. All of the independent variables are lagged as of the day before the FOMC meeting, except for the FOMC sentiment index, federal funds rate, and change in monetary policy stance, which are based on the most recent FOMC statement. For a detailed definition of the independent variables refer to Section 2 of the paper and Table A4. ELB denotes the effective lower bound period. Standard errors are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel B shows that the FOMC sentiment affects yields across the curve up to 5 years out, with larger coefficients in the middle part of the curve and for the fourth Eurodollar futures, possibly suggesting that the FOMC statement conveys more than information about current monetary policy decisions. When we make the FOMC sentiment compete against the target rate surprise, we find that the FOMC sentiment complements target rate information, as shown in panel C.[32] Interestingly, the FOMC sentiment is highly correlated with information related to the future path of monetary policy,

[32] It is worth emphasizing that Lucca and Trebbi (2009) take the difference in their FOMC index to measure the surprise component of FOMC communication. The level of our index conveys mainly information about changes in monetary policy and macroeconomic conditions, as explained in Section 2.1.

**Table 4**
Forecast of FOMC monetary policy stance: Horse race.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Blue Chip Financial Forecasts, Center for Research in Security Prices (CRSP), the Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists, the Aruoba-Diebold-Scotti Business Conditions Index, the Favara et al. (2016) EBP update, the Congressional Budget Office, and FOMC statements from www.federalreserve.gov.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Monetary policy stance | | Target rate change | |
| | 2000–19 | No ELB period | 2000–19 | No ELB period |
| FOMC sentiment | 0.128*** | 0.092*** | 0.046*** | 0.075*** |
| | (0.023) | (0.033) | (0.016) | (0.022) |
| FFF expectations | 0.134*** | 0.144*** | 0.032* | 0.06** |
| | (0.042) | (0.05) | (0.02) | (0.028) |
| Eurodollar expectations | 0.014 | 0.169*** | 0.162*** | 0.153*** |
| | (0.052) | (0.062) | (0.038) | (0.047) |
| BC expectations | −0.017 | 0.012 | 0.005 | −0.016 |
| | (0.024) | (0.031) | (0.012) | (0.016) |
| Δ UR Gap | −0.029 | −0.084*** | −0.023* | −0.058*** |
| | (0.02) | (0.031) | (0.012) | (0.021) |
| Inflation rate | 0.017 | 0.032 | −0.005 | 0.01 |
| | (0.018) | (0.023) | (0.012) | (0.017) |
| ADS index | 0.035 | −0.046 | 0.02 | 0.017 |
| | (0.033) | (0.049) | (0.016) | (0.023) |
| EBP | −0.085 | −0.098* | 0.001 | −0.002 |
| | (0.064) | (0.055) | (0.014) | (0.019) |
| Inv. yield curve | 0.408 | 0.371 | 0.022 | 0.071 |
| | (0.426) | (1.598) | (0.147) | (0.188) |
| Recession | −0.068 | −0.264*** | −0.08** | −0.156*** |
| | (0.081) | (0.037) | (0.036) | (0.058) |
| FFR | −0.142* | 0.158 | 0.156*** | 0.125* |
| | (0.081) | (0.108) | (0.052) | (0.07) |
| Δ monetary policy | 0.044 | −0.005 | 0.017 | −0.01 |
| | (0.035) | (0.053) | (0.012) | (0.017) |
| 5-year yield | 0.202** | −0.044 | −0.096* | −0.053 |
| | (0.08) | (0.099) | (0.049) | (0.066) |
| Δ 5-year yield | −0.021 | −0.034* | −0.008 | −0.037*** |
| | (0.02) | (0.02) | (0.01) | (0.014) |
| PD ratio | −0.069*** | −0.105*** | −0.037*** | −0.037** |
| | (0.022) | (0.031) | (0.013) | (0.015) |
| VIX | −0.005 | 0.002 | −0.033** | −0.032 |
| | (0.027) | (0.03) | (0.015) | (0.02) |
| Observations | 165 | 109 | 165 | 109 |
| Pseudo $R^2$ | 0.668 | 0.799 | 0.656 | 0.700 |

Notes: We estimate an ordered probit to forecast monetary policy decisions from 2000 to 2019. The dependent variable in columns (1) and (2) is an indicator variable equal to −1, 0, or 1 according to whether the FOMC decreased, left unchanged or increased the federal funds rate or announced other unconventional policies that were easing, neutral, or tightening. The dependent variable in columns (3) and (4) is the federal funds rate change. The table reports marginal effects on the probability of tightening (columns 1–2) or of a 25 basis point increase (columns 3–4) for a one-standard-deviation increase in the independent variable, if it is continuous, and for a change from 0 to 1, if it is an indicator variable. All of the independent variables are lagged as of the day before the FOMC meeting, except for the FOMC sentiment index, FFR, and change in monetary policy stance, which are based on the most recent FOMC statement. For a detailed definition of the independent variables, refer to Section 2 of the paper and Table A4. The change in monetary policy is either the monetary policy stance variable as of the most recent FOMC meeting in columns (1) and (2) or the change in the federal funds target rate in columns (3) and (4). ELB denotes the effective lower bound period. Standard errors are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

as shown by its relationship with the yield on the fourth Eurodollar futures contract.[33] These results also suggest that the FOMC sentiment index contains information that was unexpected by the market. In the next section, we further investigate this issue.

[33] The change in yield for the fourth Eurodollar futures contract from 10 min before the time of the announcement to 20 min afterward captures the effect of FOMC announcements on investors' revision in beliefs about future interest rates because the fourth Eurodollar futures contract is a bet on the level of 3-month interest rates about one year hence. The residuals of the regression of this change on the path surprise is labeled as the forward-guidance surprise.

**Table 5**
Response of interest rates to target rate surprise and FOMC sentiment.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses) and FOMC information from www.federalreserve.gov.

| | (1) 3-Month | (2) 6-Month | (3) Eurodollar | (4) 2-Year | (5) 5-Year | (6) 10-Year |
|---|---|---|---|---|---|---|
| | Panel A: Target rate surprise | | | | | |
| Target rate surprise | 2.239*** | 2.305*** | 1.729*** | 1.613*** | 0.420 | −0.232 |
| | (0.199) | (0.219) | (0.553) | (0.381) | (0.419) | (0.407) |
| Constant | −0.614*** | −0.824*** | −1.271** | −0.869** | −0.458 | −0.299 |
| | (0.198) | (0.218) | (0.551) | (0.380) | (0.418) | (0.406) |
| Observations | 166 | 166 | 166 | 166 | 166 | 166 |
| Adjusted $R^2$ | 0.436 | 0.403 | 0.056 | 0.099 | 0.006 | 0.002 |
| | Panel B: FOMC sentiment | | | | | |
| FOMC sentiment | 0.507* | 0.886*** | 1.644*** | 1.255*** | 0.979** | 0.605 |
| | (0.262) | (0.275) | (0.554) | (0.389) | (0.413) | (0.405) |
| Constant | −0.614** | −0.824*** | −1.271** | −0.869** | −0.458 | −0.299 |
| | (0.261) | (0.274) | (0.553) | (0.388) | (0.412) | (0.404) |
| Observations | 166 | 166 | 166 | 166 | 166 | 166 |
| Adjusted $R^2$ | 0.022 | 0.060 | 0.051 | 0.060 | 0.033 | 0.013 |
| | Panel C: Target rate surprise and FOMC sentiment | | | | | |
| Target rate surprise | 2.236*** | 2.218*** | 1.437** | 1.404*** | 0.215 | −0.384 |
| | (0.205) | (0.223) | (0.559) | (0.384) | (0.425) | (0.415) |
| FOMC sentiment | 0.0149 | 0.398* | 1.328** | 0.946** | 0.932** | 0.690* |
| | (0.205) | (0.223) | (0.559) | (0.384) | (0.425) | (0.415) |
| Constant | −0.614*** | −0.824*** | −1.271** | −0.869** | −0.458 | −0.299 |
| | (0.199) | (0.217) | (0.543) | (0.374) | (0.413) | (0.404) |
| Observations | 166 | 166 | 166 | 166 | 166 | 166 |
| Adjusted $R^2$ | 0.436 | 0.415 | 0.088 | 0.131 | 0.035 | 0.019 |

Notes: We estimate the response of interest rate changes to the target rate surprise and FOMC sentiment index using data from 2000 to 2019. The dependent variable is the 30-min yield change around the FOMC announcement using different maturities and different securities: U.S. Treasury bills, eurodollar interest rates, and U.S. Treasury notes. Standard errors are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

### 4.3. Do investors revise their beliefs about future economic activity after reading FOMC statements?

In the previous sections, we documented that the FOMC sentiment is a good predictor of future changes in monetary policy rates and that it affects interest rates across maturities. However, when the Federal Reserve surprises markets with a monetary policy decision, this shock is not only an exogenous interest rate shock, as in the monetary policy VAR literature (e.g., Christiano et al., 1996; Cochrane and Piazzesi, 2002; Faust et al., 2004b), but it can also convey either information about the state of the economy, as argued by "Fed information effect" studies (e.g., Romer and Romer, 2000; Faust et al., 2004a; Campbell et al., 2012; Nakamura and Steinsson, 2018; Cieslak and Schrimpf, 2019; Hoesch et al., 2020), or information about the Fed's response to news, as argued by Bauer and Swanson (2020). In this section, we formally test whether our FOMC sentiment index has forecasting powers for investors' beliefs about future macroeconomic activity.

The traditional Fed information effect hinges on the results that positive target rate surprises are associated with a positive (negative) revision to GDP (unemployment rate) forecasts—that is, the opposite signs to those predicted by a standard New Keynesian model—suggesting that the Fed has superior information about the state of the economy. Recently, however, Hoesch et al. (2020) show that such information advantage mostly disappeared after 2000, and Bauer and Swanson (2020) show that, controlling for macroeconomic news, the effects of Federal Reserve monetary policy announcements on Blue Chip forecasts looks very standard, consistent with a "Fed response to news" channel rather than a "Fed information effect" channel. We revisit the empirical evidence by making an important point of departure from the previous literature; namely, we consider the FOMC sentiment as a measure of text-based monetary policy surprise, in addition to the interest-rate-based surprises previous literature considers—the target and path surprises.[34] To do so, we use the same specification of Bauer and Swanson (2020) and other "Fed information effect" papers:

$$\text{BCrev}_{t+1} = \alpha + \beta_{TS}\text{Target Surprise}_t + \beta_{PS}\text{Path Surprise}_t + \beta_{FS}\text{FOMC Sentiment}_t + \beta_N\text{News}_t + \epsilon_t, \quad (6)$$

where $t$ indexes FOMC announcements, *Target Surprise* and *Path Surprise* are the monetary policy surprises as defined in Section 2.5, FOMC sentiment is defined in Section 2.1, *News* are three variables (Bauer and Swanson, 2020) consider—nonfarm payroll (NFP) surprises, quarterly S&P500 returns and a real-time macroeconomic index—and *BCrev* denotes

[34] Adding LSAP (large-scale asset purchases) surprises yields qualitatively similar results.

**Table 6**
Response of blue chip forecast revisions to FOMC information.
*Source:* SOURCE: Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Blue Chip Economic Indicators, the Aruoba-Diebold-Scotti Business Conditions Index, and FOMC statements from www.federalreserve.gov.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GDP | | | | UR | | | | GDP deflator | | | |
| | Panel A: Keep monthly revisions when there is an FOMC meeting in between forecasts | | | | | | | | | | | |
| FOMC sentiment | 0.337*** | | 0.328*** | 0.141** | −0.384*** | | −0.386*** | −0.147** | 0.278*** | | 0.312*** | 0.197** |
| | (0.0751) | | (0.0790) | (0.0690) | (0.0737) | | (0.0775) | (0.0692) | (0.0767) | | (0.0799) | (0.0834) |
| Target surprise | | 0.0345 | −0.00815 | −0.0248 | | −0.0139 | 0.0363 | 0.0901 | | −0.0702 | −0.111 | −0.100 |
| | | (0.0805) | (0.0773) | (0.0631) | | (0.0807) | (0.0758) | (0.0633) | | (0.0810) | (0.0782) | (0.0763) |
| Forward guidance | | 0.118 | 0.0390 | −0.0295 | | −0.109 | −0.0167 | 0.0441 | | 0.0156 | −0.0593 | −0.110 |
| | | (0.0805) | (0.0789) | (0.0636) | | (0.0807) | (0.0774) | (0.0638) | | (0.0810) | (0.0798) | (0.0768) |
| NFP surprise | | | | −0.0615 | | | | −0.109* | | | | −0.121 |
| | | | | (0.0623) | | | | (0.0625) | | | | (0.0753) |
| S&P 500 returns | | | | 0.434*** | | | | −0.211*** | | | | 0.136 |
| | | | | (0.0695) | | | | (0.0697) | | | | (0.0839) |
| ADS index | | | | 0.279*** | | | | −0.458*** | | | | 0.252*** |
| | | | | (0.0768) | | | | (0.0770) | | | | (0.0928) |
| Constant | −0.323*** | −0.323*** | −0.323*** | −0.323*** | 0.0997 | 0.0997 | 0.0997 | 0.0997* | −0.165** | −0.165** | −0.165** | −0.165** |
| | (0.0749) | (0.0792) | (0.0753) | (0.0599) | (0.0735) | (0.0793) | (0.0739) | (0.0601) | (0.0764) | (0.0796) | (0.0762) | (0.0724) |
| Observations | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 159 |
| Adjusted $R^2$ | 0.113 | 0.016 | 0.115 | 0.451 | 0.147 | 0.013 | 0.149 | 0.448 | 0.077 | 0.005 | 0.094 | 0.199 |
| | Panel B: Drop FOMC meetings that occur within the first 7 days of the month | | | | | | | | | | | |
| FOMC sentiment | 0.341*** | | 0.341*** | 0.0928 | −0.402*** | | −0.448*** | −0.143** | 0.283*** | | 0.332*** | 0.190** |
| | (0.0803) | | (0.0834) | (0.0719) | (0.0782) | | (0.0786) | (0.0679) | (0.0820) | | (0.0841) | (0.0898) |
| Target surprise | | 0.133 | 0.0830 | 0.0443 | | −0.129 | −0.0638 | 0.0122 | | −0.0354 | −0.0836 | −0.0851 |
| | | (0.0850) | (0.0814) | (0.0643) | | (0.0841) | (0.0766) | (0.0607) | | (0.0853) | (0.0820) | (0.0803) |
| Forward guidance | | 0.0240 | −0.0528 | −0.123* | | 0.147* | 0.247*** | 0.318*** | | −0.0960 | −0.171** | −0.217*** |
| | | (0.0850) | (0.0826) | (0.0635) | | (0.0841) | (0.0778) | (0.0600) | | (0.0853) | (0.0832) | (0.0794) |
| NFP surprise | | | | −0.0956 | | | | −0.0609 | | | | −0.129 |
| | | | | (0.0643) | | | | (0.0607) | | | | (0.0803) |
| S&P 500 returns | | | | 0.447*** | | | | −0.190*** | | | | 0.169* |
| | | | | (0.0718) | | | | (0.0677) | | | | (0.0896) |
| ADS index | | | | 0.330*** | | | | −0.544*** | | | | 0.251** |
| | | | | (0.0810) | | | | (0.0764) | | | | (0.101) |
| Constant | −0.326*** | −0.326*** | −0.326*** | −0.326*** | 0.0938 | 0.0938 | 0.0938 | 0.0938 | −0.155* | −0.155* | −0.155* | −0.155** |
| | (0.0800) | (0.0847) | (0.0802) | (0.0610) | (0.0779) | (0.0838) | (0.0755) | (0.0576) | (0.0817) | (0.0850) | (0.0808) | (0.0762) |
| Observations | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 | 139 |
| Adjusted $R^2$ | 0.116 | 0.018 | 0.126 | 0.505 | 0.162 | 0.039 | 0.226 | 0.559 | 0.080 | 0.010 | 0.113 | 0.228 |

Notes: We estimate the response of Blue Chip Economic Indicators forecast revisions for GDP, the unemployment rate (UR), and the GDP price deflator to FOMC information using data from 2000 to 2019. We keep a forecast revision only if there is an FOMC meeting between forecasts, and if there are two FOMC meetings, we keep only the information from the most recent meeting. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

the one-month revision in the Blue Chip consensus forecast of a given variable averaged over the one-, two-, and three-quarter-ahead horizons.[35]

During our sample period, the Blue Chip Economic Indicator surveys were conducted over the first three business days of each month until December 2000, and over the first two business day of each month after December 2000. The consensus (mean) forecast is released to the public on the 10th of each month. To make sure that the FOMC information is available to forecasters, Bauer and Swanson (2020) use forecast revisions if there was an FOMC announcement in between Blue Chip Economic Indicator surveys, and they drop forecast revisions if the FOMC announcement occurs in the first 7 days of the month. In panel A of Table 6, we show estimates of Eq. (6) for all of the dates when there is an FOMC meeting in between forecasts, and in panel B we show estimates when we drop forecast revisions if the FOMC announcement occurs in the first 7 days of the month.

The results in Table 6 show, consistent with recent literature, that the target rate surprise and forward guidance have limited impact on professional forecasts during the 2000–19 period. Interestingly, professional forecasters do appear to revise their forecasts based on the text of the FOMC statement. In other words, the FOMC sentiment index is statistically significant in most of the specifications even after controlling for news.

35 Our results are qualitatively similar when we replace the ADS index with the "big data" business cycle indicator of Brave et al. (2019)'s index as in Bauer and Swanson (2020).

## 5. What is the FOMC sentiment index capturing?

The previous results highlight that interest rates respond to the FOMC sentiment index and the FOMC sentiment index is a good predictor of changes in future FOMC decisions. Perhaps it is surprising that the information in the FOMC sentiment index is not subsumed by the information in the federal funds futures expectations and other financial variables that we control for. However, other authors have found that federal funds futures (FFF) forecasts are not fully efficient. For example, Karnaukh (2020) shows that FFF and other interest-rate-based FOMC expectations do not incorporate the information in the year-ahead Blue Chip GDP forecasts. Our interpretation is that the narrative that accompanies FOMC decisions complements point forecasts that are provided by asset prices such as federal funds futures expectations. This interpretation is consistent with the findings in Sharpe et al. (2017), who find that the narrative that accompanies the Fed's GDP point forecasts contains information above and beyond that contained in the point forecast.

Following the intuition of the "Fed information effect" literature, we show that the FOMC sentiment index contains relevant information that the FOMC releases with its statement—that is, information that affects market participants' expectations about the future state of the economy. In other words, the positive relationship between GDP forecast revisions and the FOMC sentiment index means that there is a Fed information effect driven by our index: the FOMC statement index offers a reading of the current and future macroeconomic conditions that will affect future FOMC monetary policy decisions. The bullish (bearish) read of the economy implied by a high (low) FOMC sentiment index suggests that in the immediate future, the Fed will raise (lower) rates, while the contractionary (expansionary) effect will take place in the more distant future. With the Fed raising rates in the immediate future when the FOMC sentiment index is high, we obtain our result that the response of asset prices to positive macro news decreases, because of the cash flow effect being offset by the discount rate effect.

Our results are linked to the inherent asymmetry in the Fed's reaction function due to conducting monetary policy in a low $r^*$ environment with an ELB constraint that binds in economic downturns, as highlighted in Caldara et al. (2020) and discussed in the online Appendix. More generally, other papers in the literature analyze the asymmetric/time-varying response of equity prices to news. For example, Law et al. (2020) show that the time variation is not due to good or bad announcements in terms of whether they are better or worse than expected, and it is not due to the announcement used (i.e., labor versus non-labor market announcement). They find evidence that periods of peak stock return sensitivity coincide with periods during which interest rates are expected to fall and the output gap is large and negative. We contribute to this literature by showing that these periods correspond to periods in which our FOMC index is low, which is indeed a period in which, as described by the FOMC statements, output is still suboptimal and the FOMC is still not talking about raising rates.

Importantly, in our analysis, we use our index in levels because the monetary policy subcomponent is specifically designed to capture information regarding future changes and when we tabulate the modifiers used to sign our four topics (inflation, labor, output, and financial conditions), the most common modifiers describe changes, e.g., the modifiers "increasing" and "decreasing" are more common than the modifiers "high" and "low". In contrast, Lucca and Trebbi (2009) use the change in their index as the unexpected component of the FOMC statement.

## 6. Robustness

This section presents some alternative specifications ranging from using the subcomponents of our FOMC sentiment index to using a different dictionary—namely, the Loughran and McDonald (2011) dictionary—or using a different measure of policy stance, like the more traditional FFR.

### 6.1. Subcomponents of the FOMC sentiment index

As discussed in Section 2.1, we construct the overall FOMC sentiment index as an aggregation of its subcomponents constructed on the subset of information related to output, labor, inflation, financial conditions and monetary policy, respectively. There are advantages and drawbacks to using these components separately. For example, information about labor conditions, as shown in Fig. 1, is primarily contained in FOMC statements in the second part of our sample, and, as such, the corresponding FOMC labor sentiment index might be inferior to its output counterpart in the first part of the sample. To shed light on where most of the information content of the overall FOMC sentiment index comes from, we present results similar to those shown for the overall FOMC sentiment for each of its subcomponents.

Table 7 shows results for the equity response, where Eq. (3) is estimated using each of the individual components of the FOMC sentiment index as an explanatory variable. As before, a positive macro surprise lifts equity prices, and the effect is damped when the subcomponent of the FOMC sentiment index increases. The inflation subcomponent of the FOMC sentiment index is not significant when it competes against all of the other explanatory variables, potentially highlighting the importance of aggregating the information from the subcomponents into an overall index, like the one that we use in the first part of the paper.[36]

[36] Additional results can be found in Tables A16 and A17 of the online Appendix. Table A16 shows results similar to those of Table 4, and Table A17 shows results similar to those of Table 6. To save space, each of the components of the FOMC sentiment index is used as an explanatory variable

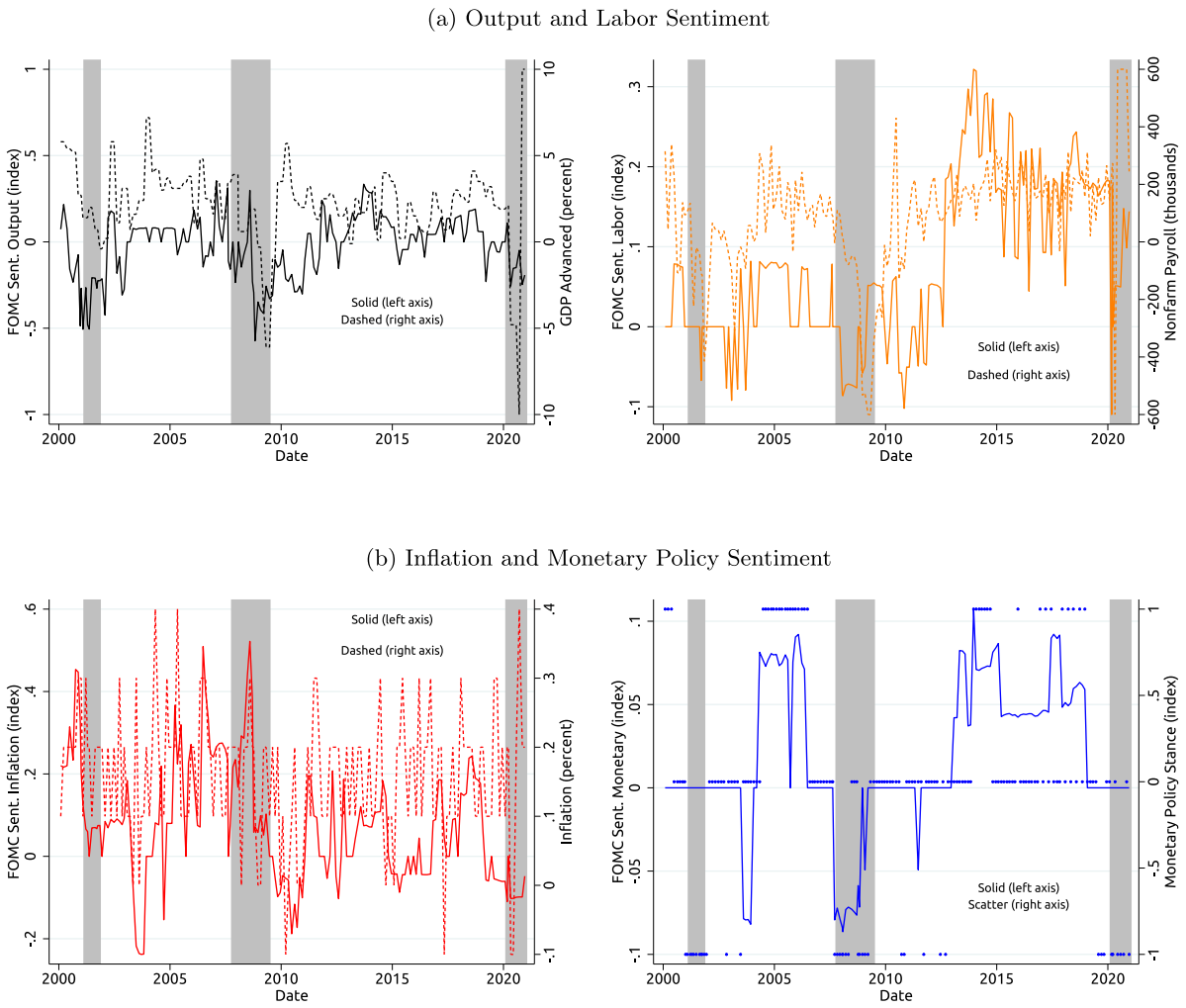


**Fig. 4.** FOMC sentiment index subcomponents and selected macroeconomic variables. Notes: The figure shows in each panel one of the FOMC sentiment index subcomponents (solid line) and the macroeconomic announcement most related over the 2000–20 period. The top-left panel shows the output FOMC sentiment (left axis) and GDP Advanced (right axis). The top-right panel shows the labor FOMC sentiment (left axis) and nonfarm payroll employment (right axis). The bottom-left panel shows the inflation FOMC sentiment (left axis) and CPI inflation (right axis). The bottom-right panel shows the monetary policy FOMC sentiment (left axis) and our monetary policy stance dummy (right axis). The shaded areas denote NBER recession periods. For graphing purposes, we truncated GDP Advance to −10% and 10% and nonfarm payroll changes to −600 thousands and 600 thousands. During the pandemic period, GDP Advance was as low as −32% and as high as 33%; nonfarm payroll changes were as low as −20,537 thousands and as high as 4800 thousands.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses) and FOMC statements from www.federalreserve.gov.

### 6.2. Alternative dictionaries and aggregation of subcomponents

Table 8 shows the results of our sentiment index competing against an alternative index generated using the Loughran and McDonald (2011) dictionary.[37] Consistent with prior research, we find that using a keyword list specific to the text in question is better than using a dictionary specific to broader texts such as companies' financial disclosures. The sentiment produced using the Loughran and McDonald (2011) dictionary (not shown) tracks our FOMC sentiment index for the majority of the sample; however, there is one key divergence. In the period from 2009 to 2010, the FOMC makes frequent

to help predict only the macroeconomic variables it is most related to. That is, for example, the output FOMC sentiment index is used to forecast GDP Advanced. Fig. 4 displays the components of the FOMC sentiment index and the macroeconomic outcomes that they forecast in this exercise. Results in Table A17 show that, generally, each subcomponents of the FOMC sentiment index helps forecast the macroeconomic announcement that it relates to.

37 The Loughran and McDonald (2011) dictionary is used as an input to a readily available polarity function found in the R package, qdap.

**Table 7**
Response of equity markets to macroeconomic news — subcomponents.
*Source:* SOURCE: Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Thomson Reuters Tick History, Center for Research in Security Prices (CRSP), the Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists, the Aruoba-Diebold-Scotti Business Conditions Index, the Favara et al. (2016) EBP update, the Congressional Budget Office, and FOMC statements from www.federalreserve.gov.

| | (1) Output | (2) Labor | (3) Inflation | (4) Financial | (5) Monetary |
|---|---|---|---|---|---|
| Surprise | 0.601*** | 0.633*** | 0.591*** | 0.637*** | 0.615*** |
| | (100.43) | (109.48) | (95.09) | (112.34) | (105.4) |
| Surprise × FOMC sentiment | −0.236*** | −0.288*** | −0.091 | −0.344*** | −0.274*** |
| | (12.04) | (16.8) | (2.08) | (27.15) | (23.45) |
| Surprise × FFF expectations | 0.278** | 0.220** | 0.281** | 0.368*** | 0.314*** |
| | (6.27) | (4.01) | (6.06) | (10.63) | (8.08) |
| Surprise × Eurodollar expectations | −0.139 | −0.029 | −0.122 | −0.222* | −0.078 |
| | (1.34) | (0.06) | (1.03) | (3.42) | (0.43) |
| Surprise × BC expectations | 0.148** | 0.162*** | 0.146** | 0.109* | 0.154*** |
| | (6.38) | (7.51) | (6.15) | (3.44) | (6.92) |
| Surprise × Δ UR Gap | 0.094 | 0.143** | 0.153*** | 0.130** | 0.155*** |
| | (2.51) | (6.36) | (7.28) | (5.34) | (7.61) |
| Surprise × inflation rate | 0.095 | 0.062 | 0.118* | 0.076 | .109* |
| | (2.29) | (.93) | (3.56) | (1.47) | (3.08) |
| Surprise × ADS index | 0.459*** | 0.463*** | 0.460*** | 0.533*** | 0.477*** |
| | (21.91) | (22.34) | (21.76) | (29.26) | (23.91) |
| Surprise × EBP | −0.067 | 0.018 | 0.004 | −0.026 | −0.002 |
| | (0.82) | (0.06) | (0.01) | (0.13) | (0.01) |
| Surprise × Inv. yield curve | 0.106 | 0.126 | 0.165 | 0.206 | 0.094 |
| | (0.30) | (0.43) | (0.73) | (1.15) | (0.24) |
| Surprise × Recession | 0.410** | 0.470** | 0.459** | 0.358* | 0.500** |
| | (4.26) | (5.68) | (5.28) | (3.29) | (6.41) |
| Surprise × FFR | −0.01 | 0.218 | 0.025 | −0.276 | 0.067 |
| | (0.01) | (1.27) | (0.02) | (2.08) | (0.13) |
| Surprise × Δ monetary policy | −0.404*** | −0.524*** | −0.446*** | −0.479*** | −0.466*** |
| | (17.62) | (28.49) | (21.78) | (25.18) | (24.06) |
| Surprise × 5-year yield | −0.341** | −0.629*** | −0.317* | −0.024 | −0.415** |
| | (3.92) | (11.51) | (3.37) | (.02) | (5.83) |
| Surprise × Δ 5-year yield | −0.052 | 0.047 | −0.106 | −0.138** | −0.088 |
| | (0.560) | (0.39) | (2.31) | (3.96) | (1.65) |
| Surprise × PD ratio | −0.073 | −0.076 | −0.073 | −0.013 | −0.078 |
| | (1.39) | (1.51) | (1.37) | (0.04) | (1.60) |
| Surprise × VIX | 0.351*** | 0.257*** | 0.363*** | 0.317*** | 0.263*** |
| | (18.22) | (8.82) | (19.44) | (14.93) | (9.63) |
| Observations | 1750 | 1750 | 1750 | 1750 | 1750 |
| Adjusted $R^2$ | 0.255 | 0.259 | 0.25 | 0.263 | 0.261 |

Notes: We estimate the response of E-mini S&P 500 futures to macroeconomic news announcements using data from 2000 to 2019. The dependent variable is the 30-min E-mini S&P 500 futures returns using the prevailing futures price as of 1 min before the announcement to 29 min after the announcement. The estimation also includes main effects, but we do not report these coefficients. The independent variables are divided by their standard deviation so that the magnitude of the coefficients can be interpreted more easily. We report the average coefficient across four macroeconomic surprises—nonfarm payroll, initial jobless claims, ISM manufacturing, and the Conference Board consumer confidence index. F-statistics are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

references to policies that are stabilizing and strengthening for the economy. The alternative sentiment heavily emphasizes these positive words without capturing the nuance communicated in these statements: "Although the economic outlook has improved modestly since the March meeting, partly reflecting some easing of financial market conditions, economic activity is likely to remain weak for a time. Nonetheless, the Committee continues to anticipate that policy actions to stabilize financial markets and institutions, fiscal and monetary stimulus, and market forces will contribute to a gradual resumption of sustainable economic growth in a context of price stability."[38] It appears that this alternative scoring method takes the FOMC at face value when it attempts to reassure investors.

To assess the robustness of our FOMC sentiment index, we also estimate an alternative FOMC overall index computed as the first factor in the principal component decomposition of the five subcomponents, rather than the sum of the five subcomponents. This alternative FOMC index is also statistically significant and highly correlated with our preferred FOMC sentiment index (0.75 correlation). However, as shown in Table 8, the results are qualitatively similar but when we make them compete against each other, the sum, rather than the principal component factor, remains statistically significant.

[38] See the April 29, 2009 FOMC statement at https://www.federalreserve.gov/newsevents/pressreleases/monetary20090429a.htm

**Table 8**
Response of equity markets to macroeconomic news—horse race with principal components analysis and Loughran and McDonald (2011) dictionary.
*Source:* Authors' calculations based on Bloomberg Finance LP, Bloomberg Terminals (Open, Anywhere, and Disaster Recovery Licenses), Thomson Reuters Tick History, Center for Research in Security Prices (CRSP), the Federal Reserve Bank of Philadelphia Real-Time Data Set for Macroeconomists, the Aruoba-Diebold-Scotti Business Conditions Index, the Favara et al. (2016) EBP update, the Congressional Budget Office, and FOMC statements from www.federalreserve.gov.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Surprise | 0.492*** | 0.519*** | 0.543*** | 0.492*** | 0.487*** |
| | (122.29) | (136.06) | (150.35) | (122.01) | (119.73) |
| Surprise × FOMC sentiment | −0.325*** | | | −0.411*** | −0.387*** |
| | (53.12) | | | (27.19) | (46.65) |
| Surprise × FOMC sentiment PCA | | −0.252*** | | 0.113 | |
| | | (27.63) | | (1.78) | |
| Surprise × FOMC sentiment LM | | | −0.139*** | | 0.105* |
| | | | (9.10) | | (3.29) |
| Observations | 1750 | 1750 | 1750 | 1750 | 1750 |
| Adjusted $R^2$ | 0.146 | 0.137 | 0.126 | 0.151 | 0.15 |

Notes: We estimate the response of E-mini S&P 500 futures to macroeconomic news announcements using data from 2000 to 2019. The dependent variable is the 30-min E-mini S&P 500 futures returns using the prevailing futures price as of 1 min before the announcement to 29 min after the announcement. PCA sentiment is constructed by taking the first principal component of the five subcomponents of the FOMC sentiment: output, labor, inflation, financial conditions, and monetary policy. LM sentiment is constructed using the Loughran and McDonald (2011) dictionary. The estimation also includes main effects, but we do not report these coefficients. The independent variables are divided by their standard deviation so that the magnitude of the coefficients can be interpreted more easily. We report the average coefficient across four macroeconomic surprises—nonfarm payroll, initial jobless claims, ISM manufacturing, and the Conference Board consumer confidence index. F-statistics are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

### 6.3. Predicting monetary policy decisions: Alternative specification

As explained in Section 4.1, in our tests regarding the ability of FOMC sentiment to predict future monetary policy, we use as our dependent variable a monetary policy stance dummy variable equal to 1, −1, or 0 depending on whether the FOMC announced a target rate decision or an asset purchase decision. This dummy variable takes into account easing monetary policy decisions during the ELB period and is shown in column (3) of Table A12. Alternatively, we can evaluate whether the FOMC sentiment index predicts the *target rate change* decisions shown in column (2) of the same table. In Table 4, we show in column (3) the estimates of the ordered probit in Eq. (4) where $MPD_t$ is the change in the FFR, using the full sample period. In column (4) we show the estimates when we exclude the ELB period from December 2008 to December 2015. For completeness, column (2) shows the estimate using the monetary policy stance dummy excluding the ELB period.[39] Results are robust to the different specifications.

### 6.4. COVID-19 sample

We extend our sample to include the year 2020 and show the results in Tables A18–A20 in Appendix.[40] While this is not the focus of the paper because we have too few observations, we find that when we include the COVID-19 recession period, our FOMC sentiment index and other variables are still significant, but perform less well in explaining the reaction of equity prices to macroeconomic news, suggesting that different dynamics might affect this reaction during the pandemic. This is illustrated in Fig. 3, as the equity price reaction to macroeconomic news during the pandemic is lower than during the previous two recessions.

Our interpretation of the results is that the "FOMC effect" described in the Introduction and in Appendix C is confirmed by the data in the 2000–19 sample period. However, this result does not completely disqualify (Veronesi, 1999)'s theory. It is possible that the FOMC effect dominates the uncertainty effect during more normal times. That is, while the FOMC effect is prevalent when analyzing the 2000–19 sample, it might not hold in periods of extremely elevated uncertainty, like the recent COVID-19 pandemic. Of course, another possibility is that the pandemic was a one-of-a-kind event, as highlighted by Borio (2020), and therefore different from previous recessions in ways that are not related to the uncertainty theory. This could be because, for example, some market participants expected the pandemic to be short lived and thus equity

[39] The federal funds target rate was essentially zero from August 2011 to December 2015. However, we use the same ELB period definition as in Benamar et al. (2021), which starts in August 2011 and ends in December 2012. The ELB starts in August 2011, when Swanson and Williams (2014) find that 2-year U.S. Treasury yields started being constrained. We end the ELB period in December 2012 because this is when the FOMC ends the "qualitative" and "calendar-based" forward-guidance period and starts a data-dependent or "threshold-based" forward-guidance period based on particular unemployment and inflation thresholds (Femia et al., 2013).

[40] During the year 2020 there were a few extremely large macroeconomic news surprises. For example, in April, May, and June 2020, the magnitude of the nonfarm payroll surprises were 19 times, 132 times, and 20 times the standard deviation estimated from 2000 to 2019, respectively. In order to avoid these surprises to have an unduly effect, we continue to standardize surprises using the standard deviation estimated from 2000 to 2019. We also confirm that dropping the April, May, and June 2020 macroeconomic surprises yield similar results to those reported in the online supplementary material.

prices not to react to the predominantly negative news during the pandemic period. Alternatively, it could be because the pandemic was mainly affecting small businesses rather than large, public firms (e.g., Amazon), and equity prices of large firms (the S&P500 we use in the paper) would not be directly and immediately affected by negative news predominantly coming from the small business side. Finally, some have also highlighted the fact that the pandemic was a mix of demand and supply shocks, unlike previous recessions that were primarily driven by demand shocks, potentially prompting different policy actions and outcomes.

## 7. Conclusion

In this paper, we study the effect that macroeconomic news has on equity prices with a particular attention to the role played by the description of the state of the economy as painted by FOMC statements. To this purpose, we construct an overall FOMC sentiment index over the 2000–20 period as an aggregation of its five components: the labor, output, inflation, financial conditions, and monetary policy FOMC sentiment indices.

We find that news has a bigger impact on equity prices during bad times as described by the FOMC. This finding is consistent with previous literature that finds that the stock market's reaction depends on the state of the economy, except that the FOMC's description of the state of the economy, more so than the state of the economy itself as measured by real-time indices, is the variable that better explains the variation in the response. We also find that the FOMC sentiment index is an important predictor of FOMC decisions, along with the federal funds futures and other variables; that it complements target rate surprises; and that it is highly correlated with news related to the future path of monetary policy. In addition, we find that professional forecasters revise their beliefs about future economic activity after reading FOMC statements. Overall, these results indicate that the FOMC sentiment index contains relevant information about the probability of an increase in rates through its description of the state of the economy. The index represents text-based information, which complements the more traditional interest-based information, like the target and forward-guidance (path) variables prior literature has investigated.

These results shed further light on two opposite predictions regarding the time variation in the effect of macro news on stock prices: an FOMC effect and an uncertainty effect. Our findings suggest that the FOMC effect dominates the uncertainty effect described in Veronesi (1999) during the 2000–19 sample period, while the uncertainty effect may dominate the FOMC effect during extremely elevated uncertainty periods, like the recent COVID-19 pandemic.

## Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jeconom.2021.07.014.

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