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The Fed and the stock market: A tale of sentiment states ☆

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ABSTRACT

We analyze the period before the zero lower bound and show that the state of investor sentiment strongly affects the transmission of monetary policy to the stock market. The impact of Federal funds rate (FFR) surprises is mostly potent when sentiment-driven overvaluation is followed by a correction, whereby the stock market increases by 0.8% in response to an unexpected FFR cut of 10 basis points. Our findings suggest that monetary easing surprises during sentiment-waning phases boost the stock market by alleviating investors' fear. The ability of sentiment to drive the observed state dependence is hard to reconcile with rational pricing.

1. Introduction

"*Animal spirits, sentiment, psychology, whatever you want to call it, was central to the economic and financial story*…" (B. Bernanke, 2015).

In this paper we document that the transmission of monetary policy news to the U.S. stock market depends on the state of investor sentiment. We show that the stock market reacts strongly to monetary policy surprises only during sentiment-waning phases, which are largely distinct from recessions and bear market episodes. Classical finance theory and standard models of the monetary policy transmission mechanism can not explain this effect since they leave no role for investor sentiment (Bernanke and Kuttner, 2005; Baker and Wurgler, 2006). Hence, they would predict no difference in the stock market return response to policy shocks across different states of investor sentiment. The capacity of sentiment to drive the observed JEL classification:state dependence is hard to reconcile with rational pricing.

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Investor sentiment can be defined as investors' beliefs about asset valuation that are not justified by the existing facts. This is consistent with extensive work in the literature (Shleifer and Summers, 1990; Kumar and Lee, 2006; Baker and Wurgler, 2007).[1] Investors may assign excessively optimistic valuations, by overestimating the size of future cash flows and/or by underestimating risk (Mian and Sankaraguruswamy, 2012), and in the presence of limits to arbitrage, stocks are overpriced (De Long et al., 1990; Shleifer and Vishny, 1997; Baker and Wurgler, 2007). The mispricing tends to be corrected during sentiment-waning phases (Huang et al., 2015), with varying degrees of pricing correction across different categories of stocks (Baker and Wurgler, 2006; Baker and Wurgler, 2007; Stambaugh et al., 2012). The correction generates investment losses, and uncertainty about exposure to future losses, making investors anxious and fearful. We hypothesize that monetary policy easing news during sentiment-waning phases boost the stock market by alleviating investors' fear.

Prior research has documented a strong link between stock returns and monetary policy shifts (Bernanke and Kuttner, 2005; Kontonikas et al., 2013; Maio, 2014; Ozdagli, 2017). This literature suggests that the positive stock market response to expansionary policy surprises can be interpreted within the dividend discount model or more advanced macroeconomic-based models that highlight the importance of a risk factor related to the stance of monetary policy (Balvers and Huang, 2009; Lioui and Maio, 2014).[2] These studies, however, do not consider the role of investor sentiment. In this paper we pay close attention to capturing the state of sentiment and ensuring that it is not confounded by the state of the economy.

For our baseline analysis, we measure sentiment using the U.S. Conference Board's Confidence Index. Moreover, we show that our results are robust to the use of two, also widely used, alternative measures: Baker and Wurgler's (2006) Sentiment Index and the University of Michigan Consumer Sentiment Index. In order to capture optimism or pessimism that is not justified by economic fundamentals, we remove business cycle variation by orthogonalizing each of the sentiment measures to a set of macroeconomic variables. We then construct sentiment states using two alternative approaches based on the orthogonalized indexes. The first approach follows the existing literature and uses a classification based on the *level* of sentiment at the start of the year (Baker and Wurgler, 2006; Yu and Yuan, 2011; Chung et al., 2012). The second approach is novel. Motivated by the mean-reverting nature of sentiment (Baker and Wurgler, 2006; Yu and Yuan, 2011), it interacts the *level* of sentiment with *changes* in sentiment over the year. Essentially, it captures sentiment-waning phases, when sentiment starts at high level but then declines. For example, the build-up of optimism during the "dot-com" boom of the late 1990s was followed by a prolonged correction phase.

We use an event study methodology to estimate the stock market reaction to monetary policy surprises conditional on investor sentiment states. Events are identified using meetings of the Federal Open Market Committee (FOMC), the monetary policy-making body of the Federal Reserve (Fed). Our sample covers the period from June 1989 to December 2008, hence including the pre-crisis period and the financial crisis of 2007–2008. We analyze the stock market impact of monetary policy surprises, measured by unexpected changes in the Federal funds rate (FFR) using the methodology of Kuttner (2001). At the end-point of our sample, following several rate cuts during the financial crisis, the FFR reached the zero lower bound (ZLB).

We find that the state of investor sentiment strongly affects the transmission of monetary policy news to the stock market. The effect of FFR surprises is mostly potent during sentiment-waning episodes, that is when sentiment starts high at the beginning of the year but then falls. Our findings are robust to the choice of windows (daily vs. intraday) for measuring the stock market's response and a host of other sensitivity checks, including the use of alternative econometric specifications. The estimates imply that during sentiment-waning phases the stock market rises by about 0.8% in response to an unexpected cut of 10 basis points in the FFR. In contrast, during other sentiment states, such as phases of exuberance (pessimism) when sentiment is already high (low) and keeps increasing (decreasing), the effect of FFR surprises is statistically insignificant. Importantly, we show that the relationship is asymmetric with the stock market responding only to looser-than-expected, as opposed to tighter-than-expected, monetary policy.

Our proposed explanation for the positive impact of monetary policy easing news on stock market returns during sentiment-waning phases is related to the alleviation of investors' fear. Using the variance risk premium component of the VIX, which to a large extent reflects "crash-o-phobia" (Bollerslev and Todorov, 2011; p.2191), our findings align with this conjecture. Extending previous work by Bekaert et al. (2013), we show that the variance risk premium declines in response to expansionary policy surprises only during sentiment-waning phases. Our evidence highlights the ability of sentiment to drive state dependence in the link between monetary policy shocks and investors' fear, which is difficult to reconcile with the notion of rational pricing (Yu and Yuan, 2011). Further, we consider various alternative explanations and potential confounding factors and show that our main findings hold.

This paper contributes to several strands of the literature. First, there is a nascent line of work that draws insights from behavioural finance to improve our understanding on the stock market's reaction to news. Mian and Sankaraguruswamy (2012) show that market-wide sentiment affects how firm-specific earnings surprises are impounded into firms' stock prices. Unlike Mian and Sankaraguruswamy (2012), we analyze the impact of market-wide news, stemming from shifts in monetary policy, on the aggregate market price response conditional on sentiment states.

[1] For example, Shleifer and Summers (1990) define investor sentiment as beliefs that are not justified by fundamental news. In a similar fashion, Kumar and Lee (2006) describe sentiment as the common directional component in investors' trading beyond that attributable to fundamental news.

[2] According to the dividend discount model, shifts in monetary policy can affect stock prices through changes in the rates that market participants use to discount future cash flows, and through changes in the expected cash flows. Using a return variance decomposition framework, Bernanke and Kuttner (2005) demonstrate the importance of revisions in expected returns, that is, discount rate news, in explaining the impact of monetary policy surprises on the stock market.

Second, our work is related to the broader literature on state dependence in the relationship between stock returns and monetary policy surprises. Previous studies highlight the role of recessions and bear markets as drivers of the state dependence. Perez-Quiros and Timmermann (2000) and Basistha and Kurov (2008) show that the stock market effect of policy surprises is stronger during recessions, while Chen (2007),Jansen and Tsai (2010), Kurov (2010),Li (2015) find that it is stronger during bear markets.[3] Importantly, we show that the effect of sentiment is not driven by recessions, casting doubt on potential explanations that are related to the state of the economy.[4]

Importantly, the mechanism that we propose, and empirically support, generates state dependence that is distinct to what Kurov (2010) and the other related studies identify. Our interest, both from a conceptual and methodological viewpoint, is *not* on bull/bear markets per se, but on the correction phases that follow bullish periods of overvaluation and high sentiment. While these periods play a key role in the well-established literature on the links between sentiment and stock market predictability (Baker and Wurgler, 2006; Baker and Wurgler, 2007; Stambaugh et al., 2012; Chung et al., 2012), they have been largely ignored by studies on the relationship between monetary policy and the stock market. As Greenspan (2009) remarks, discussing the links between monetary policy and financial markets,"We have never successfully modelled the transition from euphoria to fear". By construction, our sentiment-waning phases measure is designed to capture the notion of transition from overvaluation inherent in our conceptual framework, as described in Section 2.

To better understand the link between bull/bear markets and sentiment-waning phases, and highlight our contribution, we should point out the well-established view that sentiment is high during bull markets and low during bear markets (Baker and Wurgler, 2006; Mian and Sankaraguruswamy, 2012). Crucially, however, correction phases and bear market episodes are unlikely to exhibit a perfect association. For instance. sentiment can decline from a high level but not necessarily to the low point of a bear market. In support of this argument, the correlation between frequently used bear market indicators and sentiment-waning phases is low. Moreover, we use two alternative empirical approaches, including a new orthogonization scheme that disentangles the effect of bear markets from sentiment-waning phases, and show that our evidence on the distinct role of sentiment-waning phases is robust. Thus, overall, there are important conceptual and methodological differences with previous studies on state dependence in the stock market reaction to monetary policy shocks. Our empirical findings are novel and shed new light on the links between monetary policy, sentiment and the stock market.

Third, the use of intraday data allows us to demonstrate that our results are not confounded by the pre-FOMC announcement drift (Lucca and Moench, 2015) or by the leakage of news during the embargo period (Bernile et al., 2016; Kurov et al., 2019). Removing unscheduled FOMC meetings that are typically associated with the Fed responding to emergencies (Ozdagli, 2017; Cieslak and Vissing-Jorgensen, 2017) does not alter our key findings regarding the importance of sentiment-waning phases. In addition, our evidence is robust to removing FOMC meetings that strongly reflect the Fed information effect (Nakamura and Steinsson, 2018; Lunsford, 2020; Jarociński and Karadi, 2020; Miranda-Agrippino and Ricco, 2021; Bauer and Swanson, 2021).

Finally, our findings relate to work on the risk-taking channel of monetary policy. In theoretical models of the risk-taking channel, a reduction in the policy rate causes higher risk-taking by financial institutions, resulting in lower risk premia and amplifying the magnitude of the interest rate cut. These models highlight the role of leverage (Adrian and Shin, 2010), funding conditions (Drechsler et al., 2018), and institutional frictions (Acharya and Naqvi, 2019). Supporting the risk-taking channel, previous empirical studies show that there is a greater propensity for risky investments by banks, mutual funds, pension funds and other financial institutions when monetary policy is expansive (Dell'Ariccia et al., 2017; Di Maggio and Kacperczyk, 2017). Besides, empirical evidence demonstrates that expansionary surprises reduce risk aversion (Bekaert et al., 2013) and the equity premium (Bernanke and Kuttner, 2005).[5] These studies tend to ignore behavioural factors, while we demonstrate the importance of the state of investor sentiment.

The rest of the paper proceeds as follows. Section 2 presents the framework that links sentiment with the reaction of stocks to monetary policy news. Section 3 describes the measurement of monetary policy news and investor sentiment states. Section 4 presents evidence related to the role of investor sentiment in the transmission of monetary policy news to the stock market and discusses potential explanations. Section 5 presents the results from various robustness checks. Finally, Section 6 concludes.

2. Conceptual framework

Our conceptual framework hinges on the idea of mispricing, which is subsequently corrected, and the links between policy, fear alleviation and stock market returns during such periods when sentiment wanes. To develop it, we start by defining investor sentiment as non-fundamental beliefs, that is beliefs held by investors about future cash flows and discount rates

[3] There is also empirical evidence suggesting that monetary policy surprises influence investor sentiment (Lutz, 2015), especially during bear markets (Kurov, 2010).

[4] Two other related studies are those by Garcia (2013) and Cenesizoglu (2014), who also argue that investors' sensitivity to news is state dependent. In Garcia's (2013) analysis, however, this is related to the state of the business cycle, with the sensitivity being stronger during recessions. Similarly, in Cenesizoglu (2014) it is the underlying state of the economy that matters.

[5] Bernanke and Kuttner (2005) attribute a large part of the positive stock market effect of monetary stimulus to a lower equity premium. They point out that a lower premium could reflect a reduction in the riskiness of stocks, e.g., through improvements in firms' balance sheets, and an increase in the willingness of stock market investors to bear risk. The latter mechanism may operate through expected consumption, as in Campbell and Cochrane (1999).

that are not justified by existing facts (Shleifer and Summers, 1990; Kumar and Lee, 2006; Baker and Wurgler, 2007). In contrast to classical finance theory, where investors are rational and stock prices reflect fundamentals, i.e. the rationally discounted present value of expected cash flows, in behavioural finance mispricing can occur. When sentiment is high, optimistic valuations combine with limits to arbitrage leading to episodes of overpricing (De Long et al., 1990; Shleifer and Vishny, 1997; Baker and Wurgler, 2007; Shiller, 2016). During such periods, there is greater participation of sentiment-driven traders in the markets, moving prices away from levels that would otherwise be consistent with a positive mean–variance tradeoff (Yu and Yuan, 2011).

The extant literature also widely documents that sentiment-induced mispricing tends to be corrected during sentiment-waning phases (Huang et al., 2015), with the extent of pricing correction varying across different categories of stocks (Baker and Wurgler, 2006; Baker and Wurgler, 2007; Stambaugh et al., 2012). We argue that since most investors have long positions (Gervais and Odean, 2001), they become anxious and fearful during the pricing correction as they face losses and uncertainty about exposure to future losses. The links between anxiety, fear and uncertainty are well-established in the psychology literature (Ortony et al., 1990; Gino et al., 2012; Garcia, 2013).[6] The central hypothesis we propose is that through expansionary monetary policy shocks the Fed can boost the stock market during sentiment-waning phases by alleviating investors' fear.

3. Data and methodology

3.1. Monetary policy news

Before the recent financial crisis, Open Market Operations (OMOs) were the key policy tool that the Fed used to achieve its operating target for the FFR, the interest rate on overnight loans of reserves between banks (Bernanke and Mihov, 1998).[7] Our sample commences on June 1989. Before 1994, there were no press releases regarding FOMC decisions and market participants had to infer whether the FOMC had taken a policy action from the signals provided by the size and type of OMOs that followed each meeting. We use the dates provided by Kuttner (2003) to identify event dates prior to February 1994, while for the rest of the sample we use the FOMC meeting dates, obtained from: http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm. In a development that enhanced transparency, on February 1994 the Fed commenced the practice of issuing a statement on the day that the FOMC meeting is concluded to inform market participants about an interest rate change.

Some of the FOMC meetings in our sample are unscheduled, taking place between the 8 regular meetings each year. In total, 18 out of the 26 unscheduled meetings occurred before 1994, while the remaining ones are typically associated with episodes of financial turmoil in the post-1994 period.[8] In line with Bernanke and Kuttner, 2005 and several other related studies, we exclude from the baseline estimation sample the unscheduled FOMC meeting that occurred in the first day of trading (17 September 2001) following the 11 September 2001 terrorist attacks. Moreover, we remove the most prominent outlier, as identified by the difference in the fits statistic of Welsch and Kuh (1977), that corresponds to the unscheduled FOMC meeting on 22 January 2008.[9]

Using the methodology proposed by Kuttner (2001), we isolate the unexpected component of changes in the FFR (Δi_t^u) on day t when the FOMC meeting takes place:

$$\Delta i_t^u = \frac{D}{D-t}(f_{m,t}^0 - f_{m,t-1}^0) \tag{1}$$

where $f_{m,t}^0$ is the current-month implied futures rate (100 minus the FFR futures contract price), and D is the number of days in the month.[10]

This measure of monetary policy surprises captures revisions in expectations about the FFR using the price change in the 30-day Federal funds futures contract relative to the day preceding the policy action. FFR expectations embedded in futures

[6] Furthermore, narrative evidence in Table A2 of the Online Appendix indicates that during such sentiment-waning phases worries about negative market psychology featured prominently in the deliberations of the Fed. For example, discussing developments that followed the burst of the "dot-com" bubble, Greenspan (2008) explicitly links the correction with increased fear.

[7] OMOs involve buying or selling U.S. government securities (primarily short-term Treasuries) either outright, with the aim of altering monetary policy (dynamic OMOs), or through daily repurchase and sale-repurchase agreements, targeted towards smoothing temporary fluctuations in the monetary base. Monetary policy decisions are taken by the FOMC and implemented by the Open Market Trading Desk of the New York Fed. For example, to reduce the FFR, the Fed buys securities, thereby adding to the stock of bank reserves and reducing the need of banks to borrow reserves from each other.

[8] Table A1 in the Online Appendix lists unscheduled FOMC meetings, while Table A2 provides examples of financial turmoil periods around unscheduled meetings.

[9] On 22 January 2008 the market declined by almost 1%, in spite of a massive FFR cut of 75 basis points, almost all of which was unexpected. In a similar fashion, on 17 September 2001 the market plummeted despite a large FFR cut. In the robustness checks, we show in Table A9 that using an estimation method which is robust to the presence of outliers, the main results hold when the two aforementioned events are included in the estimation sample. In Section 4.3.3 we further analyze the role of unscheduled meetings.

[10] Following Kuttner (2001), when the FOMC meeting falls on one of the last three days of the month, the unscaled change in the one-month futures rate ($f_{m,t}^1 - f_{m,t-1}^1$) is used to calculate the FFR surprise. Also, when the FOMC meeting occurs on the first day of the month, $f_{m-1,D}^1$, instead of $f_{m,t-1}^0$, is used to measure the surprise. These contracts are cash settled against the average daily effective FFR for the delivery month. Hence, the implied surprise is adjusted by a factor related to the number of days in the month affected by the policy change. The source of the futures data is Bloomberg, while the FFR data is obtained from the Federal Reserve Economic Database (FRED) maintained by the St. Louis Fed.

contracts have some key advantages over alternative proxies, such as immunity to model selection issues (Kuttner, 2001). They tend to outperform forecasts based on sophisticated time-series models, monetary policy rules and forecasts obtained using other financial market instruments (Evans, 1998; Gürkaynak et al., 2007). Moreover, focusing on one-day changes in near-dated Fed funds futures on the day of a monetary policy announcement is important to "difference out" predictable risk premia (Piazzesi and Swanson, 2008). The emphasis on monetary policy surprises is in line with the idea that the market is not likely to react to anticipated actions since these should already be incorporated in stock prices prior to the FOMC announcement (Ozdagli, 2017). The futures market-based proxy of policy surprises has been extensively used in previous event studies that analyze the response of stock prices to monetary policy shifts (Bernanke and Kuttner, 2005; Kontonikas et al., 2013; Ozdagli, 2017).[11]

Fig. 1 plots actual and unexpected changes in the target FFR on FOMC meeting dates. It shows that large expansionary monetary policy surprises, as reflected in unexpected declines in the FFR, typically occur during, or near, periods of economic slowdown. In October 2008, in the aftermath of the Lehman Brother's collapse, the Fed reduced the target FFR from 2% to 1%. This was followed by another major cut in the FFR at the FOMC meeting on 16 December 2008, from 1% to the range of 0%–0.25%. Since then and until the end of the sample period, there are no further rate changes and the volatility of FFR surprises dies out. Therefore, our estimation for the impact of FFR surprises on the stock market focuses on the period before the ZLB (June 1989 - December 2008). Table 1 reports that the average FFR change in the pre-ZLB period is -0.05%, ranging from a minimum of -0.75% to a maximum of 0.75%. There are 82 FOMC meetings that are associated with FFR changes, 51 of which are of expansionary nature ($\Delta i < 0$), while 31 are contractionary ($\Delta i > 0$). On average, target rate surprises are expansionary, with 30 cases of unexpected FFR decline of 10 basis points, or more.

3.2. Investor sentiment states

For our baseline analysis, we use the U.S. Conference Board's Confidence Index (CCI), obtained from the OECD database, to proxy for investor sentiment. The CCI is a consumer survey-based sentiment index, measured outside the financial markets. It relies on surveys conducted by the Conference Board in which 5,000 randomly selected U.S. households are asked questions about their outlook on the economy.[12] It has been used by Lemmon and Portniaguina (2006),Ho and Hung (2009) and Antoniou et al. (2013), among others, to measure investor sentiment. Fisher and Statman (2003) report positive correlations between consumer confidence and measures of bullishness of individual investors about the stock market. In the robustness analysis, we employ two alternative measures, Baker and Wurgler's (2006, 2007) Sentiment Index (BWI), and the the University of Michigan's Consumer Sentiment Index (CSI). Our findings remain robust to the use of different measures of sentiment.

To distinguish between behavioral and rational explanations for the relationship between monetary policy and stock returns, the effects of business cycle variation should be removed from the sentiment proxy. To achieve this, we follow Baker and Wurgler (2006) who orthogonalize each of the constituent variables of their sentiment index with respect to a set of macroeconomic variables.[13] Specifically, we orthogonalize the CCI by regressing it on the same set of macroeconomic variables that BW used. The residuals from this regression capture sentiment (optimism or pessimism) that is not justified by economic fundamentals (Lemmon and Portniaguina, 2006). The orthogonalized CCI is standardized so that it has zero mean and unit variance.

The time-series plot of the orthogonalized CCI sentiment index in Fig. 2 (left-hand panel) is consistent with mean-reverting behaviour. Following episodes of exuberance, a correction phase ensues, during which sentiment declines (Baker and Wurgler, 2006; Yu and Yuan, 2011; Chung et al., 2012). Having reached a low point, sentiment tends to recover. The late 1990s - early 2000s boom-bust cycle provides an illustrative example. Specifically, the ebullience of the late 1990s is related to the "dot-com" boom and cannot be fully accounted by economic developments. As Shiller (2016) characteristically points out, "Greenspan's irrational exuberance speech in 1996 came near to the beginning of what may be called the biggest historical example to date of a speculative upsurge in the stock market. The stock market increase from 1994 to 2000 could not obviously be justified in any reasonable terms. Basic economic indicators did not come close to tripling" (p.2).[14]

Following the culmination of the "dot-com" boom, the CCI sentiment index starts to decline by around year 2001, with further declines in 2002. By construction, this fall in orthogonalized sentiment was above and beyond what was warranted by the brief recession of 2001. Crucially, the speed of mean reversion in sentiment is rather low. Visual inspection of the CCI

[11] Fed funds futures are also commonly employed by both market participants and policymakers to gauge FFR expectations. See, for example, the 2005 Federal Reserve Monetary Policy Report to Congress (https://www.federalreserve.gov/boarddocs/hh/2005/July/fullreport.htm) and Bernanke (2015).

[12] For each question, scores are calculated as the ratio of the number of favorable replies, divided by the sum of favorable and unfavorable replies. The CCI is then generated by aggregating the scores on the different questions.

[13] The set of macro-variables include the growth in industrial production, the real growth in durable, nondurable and services consumption, the growth in employment, and a dummy variable that indicates recessions as classified by NBER business cycle dates. This approach is also used by other studies to remove business cycle information from sentiment indicators (Yu and Yuan, 2011; McLean and Zhao, 2014)

[14] Shiller (2016) defines irrational exuberance as a recurrent social phenomenon whereby prices are bid up to unusually high and unsustainable levels under the influence of market psychology. Alan Greenspan, Fed Chairman at that time, was concerned about the high valuations. In his autobiography, Greenspan dates the birth of the "dot-com" boom to August 1995, when Netscape, "a tiny, two-year old software maker in Silicon Valley that had almost no revenues and not a penny of profits", was floated on the Nasdaq, with its price more than doubling on the first day of trading (Greenspan, 2008, p.164). The boom intensified in the late 1990s and Greenspan argues that even rising productivity could not explain the very high valuations. Other academic work in support of a "dot-com" bubble includes, for instance, Brunnermeier and Nagel (2004).

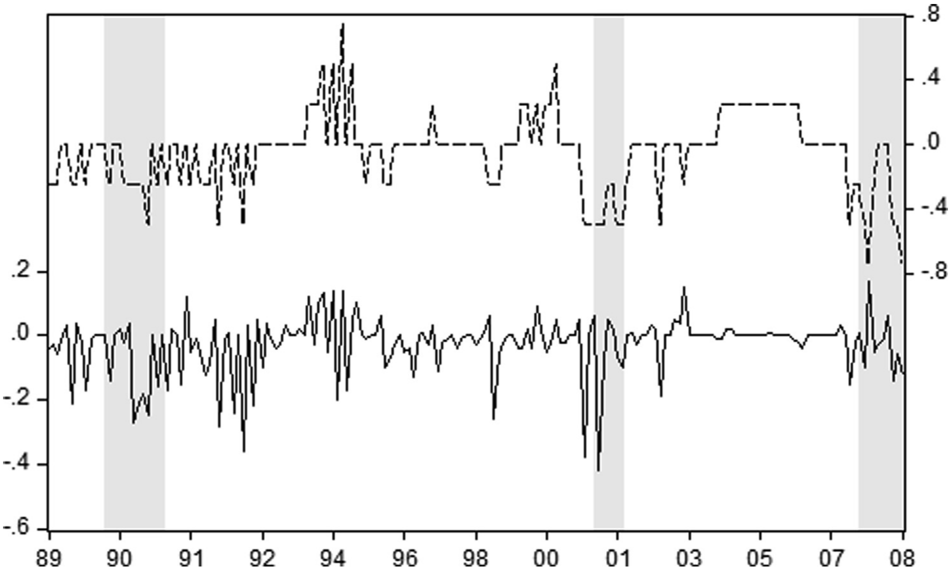

Fig. 1. Conventional monetary policy surprises This figure plots actual (dotted line) and unexpected FFR changes (solid line) on scheduled and unscheduled FOMC meetings over June 1989 - December 2008. Shaded areas denote U.S recessions as classified by NBER business cycle dates.

Table 1
Descriptive statistics for monetary policy surprises Δi_t and Δi_t^u denote FFR target rate changes and unexpected changes, respectively, on scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings.

	Obs	Min	Max	Mean	St.Dev.
			Panel A: All meetings		
Δi_t	181	−0.75	0.75	−0.05	0.23
Δi_t^u	181	−0.42	0.17	−0.03	0.09
			Panel B: Contractionary		
$\Delta i_t > 0$	31	0.25	0.75	0.30	0.12
$\Delta i_t^u > 0$	46	0.01	0.17	0.05	0.04
			Panel C: Expansionary		
$\Delta i_t < 0$	51	−0.75	−0.25	−0.34	0.14
$\Delta i_t^u < 0$	80	−0.42	−0.01	−0.09	0.09
			Panel D: No change		
Δi_t=0	99	0.00	0.00	0.00	0.00
$\Delta i_t^u = 0$	55	0.00	0.00	0.00	0.00

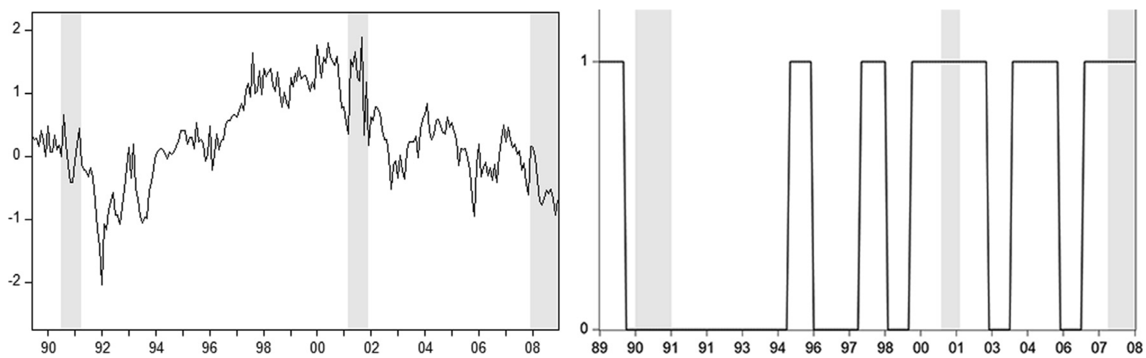

Fig. 2. Orthogonalized sentiment index and sentiment-waning phases The left-hand panel of this figure plots the U.S. Consumer Confidence index (CCI) using monthly data over the period June 1989 - December 2008. The right-hand panel plots the associated changes-based sentiment states, as captured by S_t^{HD}, on scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. S_t^{HD} is a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. Shaded areas denote the U.S recessions as classified by NBER business cycle dates.

series in Fig. 2 suggests that it is highly persistent. Quantitatively, the estimated AR(1) coefficient from a regression of monthly CCI on a constant and its first lag over January 1989 - December 2008 is 0.9. The implied half-life estimate is 7 months.[15] Consequently, it takes considerable time to move from peaks to troughs in sentiment. Narrative evidence by Baker and Wurgler (2006, 2007), stretching back to the 1960s, suggests the presence of long-lasting boom-bust cycles in sentiment.

In order to examine whether the effect of monetary policy shifts on stock market price is conditional on the state of investor sentiment, we construct two alternative classifications of sentiment states. With both methods, we keep the state of sentiment fixed throughout the year.[16] The choice of whole-year classification is a common approach, widely adopted in the previous literature. For example, Baker and Wurgler (2006) and Baker et al. (2012) classify the twelve months within each sample year as being in the high (start-of-year) sentiment regime when evaluating the stock market patterns following high sentiment periods. In a similar fashion, Yu and Yuan (2011) classify each year based on the end of prior year's sentiment, before they analyse the impact of sentiment regimes on the mean–variance relationship.

Starting from the first classification, we use a dummy variable which is calculated using the level of the orthogonalized sentiment indexes. The dummy variable, S_t^H, is equal to 1 (0) if the FOMC meeting occurs during those years that start with high (low) sentiment level. In line with Baker and Wurgler (2006), we define a year as starting with high (low) sentiment if the sentiment indicator in December of the previous year is above (below) the full sample mean value (see also, Yu and Yuan, 2011; and Chung et al., 2012). In our empirical analysis, this dummy captures the effects of monetary policy surprises *following* periods of high sentiment.

The mean-reverting nature of sentiment motivates the construction of a variable that captures the optimism waning phases following periods of exuberance. This second measure of sentiment states, S_t^{HD}, is novel and accounts for the joint effect of the sentiment's level *and* changes on the reaction of the stock market price to FFR surprises. It is a dummy variable that is equal to 1 if the FOMC meeting occurs during a year when sentiment starts at a high level but then declines, and 0 otherwise. Specifically, a year is defined as starting with high sentiment which subsequently declines if the sentiment proxy in December of the previous year exceeds the full sample mean value and the sentiment proxy in December of that year is lower than in December of the previous year.

There are ten years associated with sentiment-waning phases ($S_t^{HD} = 1$). Fig. 2 (right-hand panel) plots the changes-based states (see also Table A2 in the Online Appendix). With the exception of 2001 and 2007–2008, sentiment-waning years do not encompass recessionary episodes, highlighting the rather distinct nature of sentiment-waning episodes. The correlation coefficient between sentiment-waning phases and recessions is close to zero (0.08) and statistically insignificant. Finally, the correlation between the level and changes-based states is high (0.76) but not perfect, reflecting the fact that there are periods of exuberance, when sentiment is already high and keeps increasing, e.g. 1996–1997. Thus, by construction, S_t^{HD} is better suited to capture the notion of mean-reversion inherent in our conceptual framework as well as in previous studies, such as Baker and Wurgler (2006), that nevertheless use level-type measures of sentiment states. For completion, we use both approaches throughout the paper.

4. Econometric models and results

This section contains event study estimates of the stock market response to monetary policy actions. Section 4.1 analyzes the impact of monetary policy surprises over the sample period June 1989 - December 2008, while Section 4.2 considers our proposed explanation, and Section 4.3 discusses alternative explanations.

4.1. The impact of monetary policy surprises

We begin our empirical investigation by examining the response of stock market returns to target FFR surprises on FOMC announcement days conditional on the start-of-the-year level of sentiment. To this end, we introduce an interaction term of the FFR surprise with the previously defined level-based sentiment dummy, S_t^H, in the following regression model:

$$R_t = \beta_0 + \beta_1(1 - S_t^H)\Delta i_t^u + \beta_2 S_t^H \Delta i_t^u + \varepsilon_t \quad (2)$$

where R_t denotes the daily CRSP value-weighted return in the event space between the end of the FOMC announcement day, t, and the end of the previous trading day, $t-1$. We also use CRSP equally-weighted returns.

Panel A of Table 2 reports OLS estimates of Eq. 2 with Huber–White heteroscedasticity consistent standard errors. The stock market reaction to unexpected FFR changes when sentiment is high at the beginning of the year ($S_t^H = 1$), as captured by β_2, is significant, both economically and statistically. The negative sign of β_2 indicates that the stock market responds positively (negatively) to monetary easing (tightening) surprises. The results imply an about 0.7% one-day stock market return in response to an unexpected cut of 10 basis points in the FFR, following periods of high sentiment. On the other hand, when

[15] Given an AR(1) model, $y_t = \alpha + \phi y_{t-1} + u_t$, the half-life is calculated as: $\ln(0.5)/\ln(|\phi|)$. The half-life reflects the time horizon that the process takes, on average, to halve its distance from the mean. Similar pattern of slow mean-reversion is observed in the alternative sentiment measures (see Figure A1 in the Online Appendix). The implied half-life estimates for the other measures fall between 4 months (CSI) and 1.5 years (BWI).

[16] Our results are robust to using a shorter horizon of 6 months to classify the sentiment states (results available upon request).

Table 2

Response of stock market returns to FFR surprises conditional upon the state of investor sentiment Panel A of this table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: R_t=β_0+$\beta_1(1-S_t^H)\Delta i_t^u$+$\beta_2 S_t^H \Delta i_t^u$+$\varepsilon_t$, where R_t and Δi_t^u denote CRSP market returns and unexpected FFR changes, respectively. S_t^H is a dummy variable that is equal to 1 (0) if the FOMC meeting occurred during a year that starts with high (low) sentiment level. A year is defined as starting with high (low) sentiment if the sentiment proxy at the end (December) of the previous year is above (below) the full sample mean value. Panel B of this table replaces S_t^H in the above equation with S_t^{HD}, a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. The 1989-start sample period includes scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. The 1994-start sample period includes scheduled and unscheduled FOMC meetings over February 1994 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. Standard errors are reported in parentheses. $*$, $**$, and $***$ indicate statistical significance at the 10%, 5% and 1% level, respectively.

1989 start					1994 start				
Obs	β_0	β_1	β_2	$Adj.R^2$	Obs	β_0	β_1	β_2	$Adj.R^2$
Panel A: S_t^H									
181	0.22**	−0.55	−7.38***	0.15	126	0.28**	−2.01	−7.52***	0.16
	(0.09)	(0.95)	(2.29)			(0.12)	(2.08)	(2.50)	
Panel B: S_t^{HD}									
181	0.23**	−0.27	−8.21***	0.17	126	0.29**	−0.62	−8.55***	0.19
	(0.09)	(0.94)	(2.28)			(0.11)	(1.84)	(2.48)	

sentiment is low at the start of the year the market response to FFR surprises, as captured by β_1, is statistically insignificant. To formally examine whether the impact of FFR surprises on stock returns is equal across sentiment states, we conduct a Wald test for equality of the relevant coefficients (β_1=β_2). The test rejects the null hypothesis at the 1% level of significance (p-value = 0). Thus, our findings highlight that the impact of monetary policy news is stronger following periods of high sentiment.[17]

As discussed earlier, sentiment exhibits a mean-reverting property, whereby exuberance tends to be followed by a correction phase, generating negative changes in sentiment. This prompts us to examine whether sentiment-waning phases affect the stock price response to FFR surprises. Therefore, we replace the sentiment level-based dummy variable with the changes-based dummy, S_t^{HD}, and then re-estimate Eq. 2. The results, presented in Panel B of Table 2, reveal that the stock market responds significantly to FFR surprises during years when sentiment starts at high level but then subsequently declines ($S_t^{HD}=1$), as captured by β_2. Estimates of β_2, are somewhat larger in magnitude than those reported in Panel A. Specifically, the stock market responds to an unexpected FFR cut of 10 basis points by 0.8% one-day return during sentiment-waning phases. In contrast, β_1 estimates reveal that the impact of monetary policy news on the stock market is insignificant during other periods. Again, the Wald test for equality of coefficients (β_1=β_2) strongly rejects the null hypothesis. All in all, replacing the level-based with the changes-based measure of sentiment states we provides further evidence on the important role of sentiment in the transmission of monetary policy surprises to the stock market.

We also employ an alternative starting point for the sample period. We use February 1994, that is, the time when the Fed started to announce its policy actions, representing a shift that enhanced transparency in monetary policy making. The results in Table 2 are similar to those from using the sample that begins in June 1989. During sentiment correction phases, the estimate of β_2 is -8.21 for June 1989 start and -8.55 for February 1994 start. We further consider a full 4-way decomposition in which we use related dummy variables to classify periods of "high & increasing", "high & decreasing", "low & increasing", and "low & decreasing" sentiment. The findings (available upon request) are consistent with those reported in Table 2, and show that the response of the stock market price to FFR surprises is statistically significant only when sentiment is high at the start of the year but then falls, as in the 2000–2002 period, for instance. On the other hand, during phases of exuberance (pessimism) when sentiment is already high (low) and keeps increasing (decreasing), for example during 1996–1997 (1990–1991), the effect of monetary policy news on the stock market is statistically insignificant. The same holds for periods of recovery, when sentiment is low at the start of the year but then rises. In sum, our findings highlight the limited effect of expansionary FFR surprises on the stock market when pessimism prevails.[18]

Overall, our evidence points to a behavioral perspective. This is because a rational pricing explanation would predict no difference in the stock market return response to policy shocks between different states of investor sentiment. In a similar vein, Yu and Yuan (2011) show that greater participation of sentiment traders in high sentiment period results in the disappearance of return-risk relation, and argue that it is hard to explain their results with the traditional asset pricing theories.

[17] Using equally-weighted market returns, the magnitude of the effect of FFR surprises following periods of high sentiment, declines by about a third as compared with the case of value-weighed returns. Nevertheless, the effect remains sizeable and statistically significant. Thus, the market response to target rate surprises is not exclusively driven by the reaction of large stocks. Finally, using a pre-crisis sample (June 1989 - August 2007), we obtain similar results for value- and equally-weighted returns (available upon request).

[18] Our evidence is also consistent with the notion that the Fed is not able to rein in bubbles with incremental tightening in times of exuberance. As Greenspan (2008) points out, a massive interest rate hike, say by 10%, would be a different story but would generate large collateral damage and therefore is not typically considered as an option by the Fed.

4.1.1. Alternative econometric specifications

We consider several alternative econometric specifications to Eq. 2. We start with a permutation of the baseline model which uses "raw" data on lagged sentiment, as opposed to dummy variables capturing sentiment states (see also Mian and Sankaraguruswamy, 2012). Moreover, it accounts for the possibility that returns at the event frequency are affected by past (start of the year) sentiment:

$$R_t = \beta_0 + \beta_1 S_{t-1} + \beta_2 \Delta i_t^u + \beta_3 S_{t-1} \Delta i_t^u + \varepsilon_t \tag{3}$$

where S_{t-1} denotes the sentiment value at the end (December) of the previous year and all other variables are as previously defined.

Panel A in Table 3 reports estimates of Eq. 3. The coefficient of interest, β_3, indicates that when past sentiment is higher, the stock market reaction to unexpected FFR changes is stronger. Hence, the evidence is consistent with our baseline findings. Lagged sentiment on its own, as captured by β_1, is typically statistically insignificant. We also use another specification which replaces S_{t-1} with S_t^{HD}. The resulting model is similar to Eq. 2, apart from that the sentiment-related variable is also included as an intercept dummy. The results in Panel B of Table 3 are consistent with those in Panel A since β_3 is highly significant, highlighting the importance of sentiment states for the reaction of the stock market to policy surprises, while the "intercept effect" of sentiment, reflected by β_1, is insignificant.

Moreover, we consider an alternative definition of the sentiment states indicator that does not utilize information on future developments. Specifically, for the alternative S_t^H, when evaluating whether sentiment is high (or low) at the start of a given year we compare it with the average sentiment calculated using data up to the end of the previous year, as opposed to the full sample mean; e.g., using data up to 2004 for the case of 2005. In other words, we use an expanding window for the calculation of mean sentiment. The start of the window is set to January 1984. Panel C in Table 3 reports estimates of Eq. 2 using the alternative sentiment states measure. The results are consistent with the baseline findings in Table 2. Thus, overall, the main findings regarding the role of sentiment in the relationship between monetary policy shocks and stock returns are robust to the use of alternative econometric specifications.

4.1.2. Policy asymmetry

Eq. 2 assumes a symmetric stock market reaction to monetary policy surprises with no distinction between expansionary and contractionary surprises. It is plausible that the stock market response may depend on the type of news, as classified by the sign of the monetary policy shock. Previous evidence by Bernanke and Kuttner (2005) provides only weak support for this type of asymmetry. Ozdagli and Weber (2017), on the other hand, provide evidence in line with a more important role of expansionary surprises. However, these studies do not consider sentiment states. To gain more insight on potential policy asymmetries, we augment Eq. 2 and estimate the following regression model that allows for both sentiment dependence and sign asymmetry:

$$R_t = \beta_0 + \beta_1 (1 - S_t^H) \Delta i_t^{un} + \beta_2 (1 - S_t^H) \Delta i_t^{up} + \beta_3 S_t^H \Delta i_t^{un} + \beta_4 S_t^H \Delta i_t^{up} + \varepsilon_t \tag{4}$$

where Δi_t^{un} and Δi_t^{up} denote negative and positive unexpected FFR target rate changes, respectively. The negative FFR surprise is defined as: $\Delta i_t^{un} = \Delta i_t^u D_t^n$, where D_t^n is a dummy variable equal to 1 if $\Delta i_t^u < 0$, and 0 otherwise. Likewise, the positive FFR surprise is: $\Delta i_t^{up} = \Delta i_t^u D_t^p$, where D_t^p is a dummy variable equal to 1 if $\Delta i_t^u > 0$, and 0 otherwise.

Panel A of Table 4 reports estimates of Eq. 4. We find that looser-than-expected monetary policy has a strong effect on stock market returns. Crucially, this effect appears only following periods of high sentiment as captured by β_3 , which is negative and significant at the 1% level. On the other hand, the effect of tighter-than-expected policy is always statistically insignificant, irrespectively of the state of investor sentiment. Hence, the stock market response to monetary policy news is highly asymmetric, driven by expansionary surprises, and at the same time conditional on investor sentiment. Moving on to the changes-based sentiment indicator, the results in Panel B of Table 4 imply that the effect of monetary stimulus is mostly potent when sentiment goes through a correction phase. Importantly, our findings are not reflecting the concentration of policy surprises in a particular sentiment state as expansionary and tightening surprises occur across both sentiment states (see Table A3 in the Online Appendix).

4.2. Sentiment, monetary policy and fear alleviation

Monetary policy easing news may affect the stock market by alleviating investors' fear. Following Bekaert et al. (2013), we use a decomposition of the option-implied expected volatility on the S&P500 index (VIX) to capture investors' fear. The VIX index, commonly interpreted as a "fear gauge" by financial market participants, reflects both stock market uncertainty (the "physical" expected volatility) and the variance risk premium (VRP). The VRP, obtained as the difference between the squared VIX index and expected realized market volatility, is a strong predictor of stock returns (Bollerslev et al., 2009; Bekaert and Hoerova, 2014).[19] As Bollerslev and Todorov (2011) show, fears of disasters account for a large fraction of the VRP. They highlight that about three-quarters of the VRP may be attributed to "crash-o-phobia" (see p.2191) as opposed rational

[19] In line with Bekaert et al. (2013), we obtain an estimate of the expected future realized volatility using daily data. The squared VIX and the past realized variance are used as predictors. We thank Nikos Vlastakis for providing us with the data.

Table 3

Response of stock market returns to FFR shocks conditional upon the state of investor sentiment - alternative econometric specifications Panel A of this table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: R_t=β_0+$\beta_1 S_{t-1}$+$\beta_2 \Delta i_t^u$+$\beta_3 S_{t-1}\Delta i_t^u$+ ε_t, where R_t and Δi_t^u denote CRSP value-weighted market returns and unexpected FFR changes, respectively. S_{t-1} denotes the raw sentiment value at the end (December) of the previous year. Panel B of this table replaces S_{t-1} with S_t^{HD}, a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. Panel C of this Table reports OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: R_t=β_0+$\beta_1(1-S_t^{Ha})\Delta i_t^u$+$\beta_2 S_t^{Ha}\Delta i_t^u$+$\varepsilon_t$, where S_t^{Ha} is the alternative level-based sentiment dummy variable, defined in Section 4.1.1 of the paper. The sentiment proxy is the U.S. Consumer Confidence index. The sample period includes scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. Standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Obs	β_0	β_1	β_2	β_3	$Adj.R^2$
		Panel A: Lagged sentiment			
181	0.21**	0.10	−3.95***	−4.47***	0.15
	(0.09)	(1.13)	(1.24)	(1.48)	
		Panel B: Adding S_t^{HD} intercept dummy			
181	0.16	0.14	-0.47	−7.52***	0.17
	(0.10)	(0.19)	(1.00)	(2.58)	
		Panel C: Alternative S_t^H			
181	0.20**	-0.25	−9.16***		0.20
	(0.09)	(1.26)	(1.56)		

Table 4

Response of stock market returns to FFR surprises conditional upon the state of investor sentiment - accounting for policy asymmetry This table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: R_t=β_0+$\beta_1(1-S_t^H)\Delta i_t^{un}$ + $\beta_2(1-S_t^H)\Delta i_t^{up}$+$\beta_3 S_t^H \Delta i_t^{un}$+$\beta_4 S_t^H \Delta i_t^{up}$+$\varepsilon_t$, where $R_t, \Delta i_t^{un}$ and Δi_t^{up} denote CRSP value-weighted market returns, negative unexpected FFR changes and positive unexpected FFR changes, respectively. Negative FFR surprises are calculated as $\Delta i_t^{un} = \Delta i_t^u D_t^n$, where D_t^n is a dummy variable that is equal to 1 if $\Delta i_t^u < 0$, and 0 otherwise. Positive FFR surprises are calculated as $\Delta i_t^{up} = \Delta i_t^u D_t^p$, where D_t^p is a dummy variable that is equal to 1 if $\Delta i_t^u > 0$, and 0 otherwise. S_t^H is a dummy variable that is equal to 1 (0) if the FOMC meeting occurred during a year that starts with high (low) sentiment level. A year is defined as starting with high (low) sentiment if the sentiment proxy at the end (December) of the previous year is above (below) the full sample mean value. In Panel B we replace S_t^H in the above equation with S_t^{HD}, a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. The sample period includes scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. Standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Obs	β_0	β_1	β_2	β_3	β_4	$Adj.R^2$
			Panel A: S_t^H			
181	0.03	−1.31	0.35	−10.11***	9.44	0.23
	(0.09)	(0.94)	(3.78)	(1.67)	(6.82)	
			Panel B: S_t^{HD}			
181	0.07	−1.13	1.28	−10.50***	7.37	0.23
	(0.09)	(0.93)	(3.74)	(1.68)	(8.22)	

asset pricing arguments. Our analysis in Table A2 of the Online Appendix highlights two important facts. First, there appears to be a link between VRP and investors' fear, since the former tends to peak during sentiment-waning phases. Second, during such periods the financial press makes numerous references to fear and panic in the markets.

We re-estimate Eq. 2, using changes in the VRP as the dependent variable. The positive sign and statistical significance of β_2 in Panel B of Table 5, along with the insignificance of β_1, indicate that the VRP declines in response to monetary easing surprises only during sentiment-waning phases. The effect is driven by looser-than-expected monetary policy.[20] Thus, we show that the link between fear alleviation and monetary stimulus that Bekaert et al. (2013) identify, is conditional upon the state of investor sentiment. Our results also suggest a limited effect of monetary policy surprises on the stock market via fear alleviation when pessimism prevails, that is, when sentiment declines from a level that is already low.[21]

Taken together, the results in Tables 2 and 5, along with the substantial correlation of VRP changes and stock market returns (correlation coefficient is −0.57), suggest that fear alleviation by monetary stimulus during sentiment-waning periods can help to explain the stock market response to monetary policy surprises. Crucially, the capacity of sentiment to drive the state dependence in both in Tables 2 and 5, suggests that it is hard to explain our findings using a rational story (Yu and Yuan, 2011).

[20] See Table A4 in the Online Appendix for estimates of Eq. 4, which allows for sign asymmetry in the effect of FFR surprises, replacing stock market returns with VRP changes. The results reveal that VRP changes react to expansionary surprises, but not to tightening ones.

[21] Unreported findings (available upon request) from a 4-way decomposition that considers "high & increasing", "high & decreasing", "low & increasing", and "low & decreasing" sentiment reveal that VRP changes react to FFR surprises only during periods when sentiment falls from a high level.

Table 5
Response of variance risk premium changes to FFR surprises conditional upon the state of investor sentiment This table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: $\Delta VRP_t = \beta_0 + \beta_1(1 - S_t^H)\Delta i_t^u + \beta_2 S_t^H \Delta i_t^u + \varepsilon_t$, where ΔVRP_t denotes the daily change in the S&P 500 Variance Risk Premium (VRP). Δi_t^u denotes the unexpected FFR changes. S_t^H is a dummy variable that is equal to 1 (0) if the FOMC meeting occurred during a year that starts with high (low) sentiment level. A year is defined as starting with high (low) sentiment if the sentiment proxy at the end (December) of the previous year is above (below) the full sample mean value. Panel B of this table replaces S_t^H in the above equation with S_t^{HD}, a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. The sample period includes scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. Standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Obs	β_0	β_1	β_2	$Adj.R^2$
		Panel A: S_t^H		
172	−0.12***	0.03	1.04**	0.01
	(0.04)	(0.43)	(0.51)	
		Panel B: S_t^{HD}		
172	−0.12***	−0.07	1.28**	0.02
	(0.04)	(0.42)	(0.54)	

4.3. Addressing alternative explanations

In this section, we consider alternative explanations and potential confounding factors for our main findings.

4.3.1. Business cycle effects

Rational explanations for the relationship between stock returns and monetary policy put emphasis on the state of the economy. Theoretical work and previous empirical evidence suggest that the impact of policy shifts on the stock market varies over the business cycle, being stronger during recessions (Perez-Quiros and Timmermann, 2000; Basistha and Kurov, 2008). Our results regarding the importance of sentiment-waning phases could then be explained by the effect of recessions, as long as sentiment co-moves with the economy. The use of orthogonalized sentiment, however, safeguards against this possibility by removing business cycle variation from the raw sentiment measures. As we have highlighted earlier, there is no correlation between recessions and corrections in sentiment.

Nevertheless, to formally account for business cycle effects within our framework, we interact the sentiment-waning phases with business cycle indicators. Essentially, we conduct a 4-way decomposition of the monetary policy impact by estimating Eq. 5:

$$\begin{aligned} R_t &= \beta_0 + \beta_1(1 - S_t^{HD})(1 - Rec_t)\Delta i_t^u + \beta_2(1 - S_t^{HD})Rec_t\Delta i_t^u \\ &+ \beta_3 S_t^{HD}(1 - Rec_t)\Delta i_t^u + \beta_4 S_t^{HD} Rec_t \Delta i_t^u + \varepsilon_t \end{aligned} \quad (5)$$

where Rec_t is a variable that captures the state of the economy, which we measure by the NBER business cycle chronology ($NBER_t$) and the real time probability of recession ($Recprob_t$). $NBER_t$ is a dummy variable that is equal to 1 if the FOMC meeting occurred during a month that U.S. economy is in recession, as classified by the NBER business cycle dates. $Recprob_t$ is equal to the real time recession probability provided by the FRED database for the month when the FOMC meeting takes place, obtained from the dynamic-factor Markov-Switching model of Chauvet and Piger (2008). The source for both proxies of economic states is the FRED database. There is a close correspondence between the two business cycle indicators, with the correlation coefficient being equal to 0.9.

The estimation results in the left-hand of Table 6 are based on the NBER recession indicator. They reveal that during sentiment-waning phases the stock market responds significantly to FFR surprises only outside recessions, as captured by β_3. The corresponding effect during recessions, as captured by β_4, is statistically insignificant. Similar insights are obtained using the recession probability indicator (right-hand of Table 6). Hence, the main challenge for explanations based on bad economic states is the disconnection between recessions and the stock market response to policy surprises, once the role of sentiment has been accounted for. Our findings highlight the importance of sentiment states, along with their distinct nature, that previous studies do not consider when analyzing the effect of monetary policy on the stock market over the business cycle.

4.3.2. Bear market effects

Previous studies show that the effect of monetary policy shocks on the stock market is stronger during bear markets (Chen, 2007; Jansen and Tsai, 2010; Kurov, 2010; Li, 2015). At the same time, it is well-established that sentiment is low (high) during bear (bull) markets (Baker and Wurgler, 2006; Mian and Sankaraguruswamy, 2012). A priori, it is unlikely that a perfect association will arise between sentiment-waning phases (captured by S_t^{HD}) and bear market episodes. For instance, sentiment can decline from a high level but not necessarily to the low point of a bear market. Nevertheless, sentiment-

Table 6

Response of stock market returns to FFR surprises conditional upon the state of investor sentiment - role of recessions This table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: $R_t = \beta_0 + \beta_1(1 - S_t^{HD})(1 - Rec_t)\Delta i_t^u + \beta_2(1 - S_t^{HD})Rec_t\Delta i_t^u + \beta_3 S_t^{HD}(1 - Rec_t)\Delta i_t^u + \beta_4 S_t^{HD} Rec_t \Delta i_t^u + \varepsilon_t$, where R_t and Δi_t^u denote CRSP value-weighted market returns and unexpected FFR changes, respectively. S_t^{HD} is a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. Rec_t is a variable that captures the state of the economy, measured by the NBER business cycle chronology and the real time probability of recession. Specifically, $NBER_t$ is a dummy variable that is equal to 1 if the FOMC meeting occurred during a U.S. recession as classified by NBER business cycle dates and 0 otherwise. $Recprob_t$ is equal to the real time recession probability when the FOMC meeting takes place, obtained from the dynamic-factor Markov-Switching model of Chauvet and Piger (2008). The sample period includes scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. Standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Obs	β_0	β_1	β_2	β_3	β_4	$Adj.R^2$	Obs	β_0	β_1	β_2	β_3	β_4	$Adj.R^2$
			$NBER_t$							$Recprob_t$			
181	0.23**	−0.62	0.62	−10.38***	−5.19	0.18	181	0.23**	−0.63	1.51	−10.22***	−4.24	0.17
	(0.09)	(1.15)	(1.17)	(1.92)	(4.37)			(0.09)	(1.17)	(2.26)	(2.84)	(7.99)	

waning phases may encompass bear market episodes, prompting us to analyze the impact of the latter within our framework.

While there is no commonly accepted definition for bear markets, we use two proxies that have been used in previous studies and are consistent with the standard notion of significant and sustained stock price declines. $Bear2y_t$ is a dummy variable that is equal to 1 if the FOMC meeting occurred during a month when the S&P 500 stock market index is lower than its 2-year moving average, and 0 otherwise (Kontonikas et al., 2013). $Bearprob_t$ is equal to the bear market probability for the month when the FOMC meeting takes place, obtained from the Markov-Switching model of Chen (2007).[22] Fig. 3 plots the changes-based sentiment states along with two alternative bear market indicators and shows that while some sentiment-waning years overlap with bear markets episodes (e.g. 2001 and 2008), there are also instances of sentiment-waning outside bear markets (e.g. 1995 and 2004–5). The correlation coefficient between S_t^{HD} and $Bear_t$ is low, equal to 0.16 for the case of $Bear2y_t$ and 0.20 for $Bearprob_t$.[23] Following the preliminary analysis, which suggests that our findings are not likely to be driven by bear markets, we proceed to formally investigate their role by estimating Eq. 6:

$$\begin{aligned} R_t &= \beta_0 + \beta_1(1 - S_t^{HD})(1 - Bear_t)\Delta i_t^u + \beta_2(1 - S_t^{HD})Bear_t\Delta i_t^u \\ &+\beta_3 S_t^{HD}(1 - Bear_t)\Delta i_t^u + \beta_4 S_t^{HD} Bear_t \Delta i_t^u + \varepsilon_t \end{aligned} \tag{6}$$

where $Bear_t$ is an indicator of bear markets.

The results in Panel A of Table 7 show that during sentiment-waning phases the stock market response to FFR surprises is significant during both bear markets, as captured by β_4, and outside them, as captured by β_3. Outside sentiment-waning periods, the impact of policy shocks is indistinguishable from zero, regardless of whether the market is in bear state. This evidence is robust to the use of two proxies of bear markets. Since the null hypothesis $\beta_2 = 0$ cannot be rejected, our findings do not support an alternative explanation that would require the state dependence to be solely function of bear markets.

In Panel B of Table 7 we conduct an additional analysis to account for the potential link between market states and sentiment-waning phases. In particular, we start by orthogonalizing the raw sentiment index data using the bear market indicator of Chen (2007) as an additional control in the set of macroeconomic variables that we used previously, as described in Section 3.2. Having done do, we reconstruct the sentiment-waning phases dummy variable, based upon the newly orthogonalized sentiment index, We then re-estimate the baseline model using the new sentiment-waning dummy (S_t^{HDB}) up to December 2007, to match the sample to the bear market measure endpoint. The results show that accounting for the role of bear markets, through the new orthogonalization scheme, does not affect our main conclusions. The estimates are very close to those from the baseline analysis, and the relationship between stock market returns and FFR shocks is statistically significant only during sentiment-waning phases. Hence, overall, our findings point out the distinct and important role of sentiment-waning phases, which is not subsumed by controlling for bear markets.

4.3.3. Pre-announcement effect, information leakage and the role of unscheduled meetings

Lucca and Moench (2015) document large average returns in the U.S. stock market in anticipation of monetary policy decisions made at scheduled FOMC meetings. FOMC statements are typically scheduled to be released in the afternoon. Thus, the daily returns on FOMC meeting days incorporate a pre-announcement window, implying that our results may be confounded by the pre-FOMC announcement drift. To rule out such effects, we turn to intraday data and calculate the stock market return, proxied by the S&P500 index, over a short period surrounding the FOMC announcement. Specifically, we start by considering a 30-min window, commencing 10 min before the FOMC announcement and ending 20 min after it: (-10, 20).

[22] We thank S. Chen for sharing with us the bear market probability data. The data is available up to December 2007.

[23] The correlation coefficient between the two bear market proxies is 0.7.

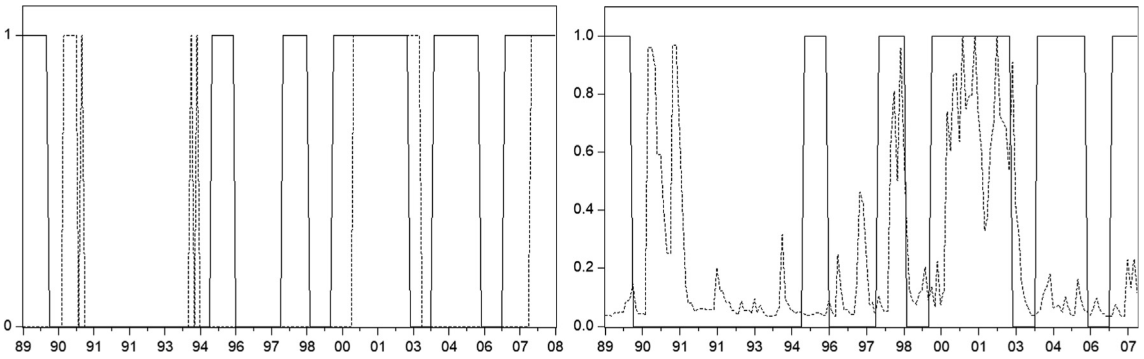

Fig. 3. Sentiment-waning phases and bear markets This figure plots the changes-based sentiment states (solid line), as captured by S_t^{HD}, along with two alternative bear market indicators (dotted line) on scheduled and unscheduled FOMC meetings over June 1989 - December 2008 (left-hand panel) and June 1989 - December 2007 (right-hand panel), with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. S_t^{HD} is a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. The bear market indicator in the left-hand panel (solid line) is a dummy variable that is equal to 1 if the FOMC meeting occurred during a month when the S&P 500 stock market index is lower than its 2-year moving average, and 0 otherwise (Kontonikas et al., 2013). The bear market indicator in the right-hand panel (dotted line) is equal to the bear market probability for the month when the FOMC meeting takes place, obtained from the Markov-Switching model of Chen (2007).

Table 7

Response of stock market returns to FFR surprises conditional upon the state of investor sentiment - role of bear markets Panel A of this table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: $R_t=\beta_0+\beta_1(1-S_t^{HD})(1-Bear_t)\Delta i_t^u+\beta_2(1-S_t^{HD})Bear_t\Delta i_t^u+\beta_3 S_t^{HD}(1-Bear_t)\Delta i_t^u+\beta_4 S_t^{HD}Bear_t\Delta i_t^u+\varepsilon_t$, where R_t and Δi_t^u denote CRSP value-weighted market returns and unexpected FFR changes, respectively. S_t^{HD} is a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. $Bear_t$ is an indicator of bear markets. Specifically, $Bear2y_t$ is a dummy variable that is equal to 1 if the FOMC meeting occurred during a month when the S&P 500 stock market index is lower than its 2-year moving average, and 0 otherwise (Kontonikas et al., 2013). $Bearprob_t$ is equal to the bear market probability for the month when the FOMC meeting takes place, obtained from the Markov-Switching model of Chen (2007). Panel B of this table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: $R_t=\beta_0+\beta_1(1-S_t^H)\Delta i_t^u+\beta_2 S_t^H\Delta i_t^u+\varepsilon_t$, In the right-hand of Panel B, S_t^{HD} is replaced by S_t^{HDB}, a dummy variable generated in the same way with S_t^{HD} but using a newly orthogonalized sentiment index that accounts for the role of bear markets. In Panel A, for $Bear2y_t$ the sample period includes scheduled and unscheduled FOMC meetings over June 1989 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. For $Bearprob_t$, as well as for the Panel B estimations, the sample period ends in December 2007. Standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

Obs	β_0	β_1	β_2	β_3	β_4	$Adj.R^2$	Obs	β_0	β_1	β_2	β_3	β_4	$Adj.R^2$
						Panel A							
			$Bear2y_t$							$Bearprob_t$			
181	0.23**	−0.45	0.6	−8.73***	−7.99**	0.18	172	0.17**	−0.78	0.81	−6.15**	−13.20***	0.31
	(0.09)	(0.09)	(1.06)	(1.57)	(3.07)			(0.08)	(1.29)	(2.19)	(2.68)	(1.89)	
						Panel B							
			S_t^{HD}							S_t^{HDB}			
172	0.14*	−0.47	−10.33***			0.31	172	0.15*	−1.13	−10.21***			0.27
	(0.08)	(0.93)	(1.39)					(0.08)	(0.99)	(1.45)			

Bernile et al. (2016) and Kurov et al. (2019) also focus on the pre-announcement effect and provide evidence consistent with information leakage during the FOMC news embargo period. To ensure that our results are not driven by news leakage during the embargo period, we further employ a tighter window, which commences 1 min before the announcement: (-1, 20). Likewise, FFR surprises are calculated using intraday data and the same windows with stock returns. This helps isolate the impact of news about monetary policy more effectively and mitigate endogeneity concerns (Gürkaynak et al., 2005; Gertler and Karadi, 2015). The sources of intraday data are TickData and CME Group for the S&P500 index and FFR futures prices, respectively. The latter is available only since January 1995, and hence our intraday estimations have a later start date relative to the baseline daily analysis.

Panel A of Table 8 reports intraday estimates of Eq. 2.[24] Starting with the wider window of (-10, 20), we find that the effect of sentiment on the transmission of FFR surprises to the stock market is robust to the use of intraday data for the identification of policy surprises and the stock market reaction. Policy shifts affect the stock market only following high sentiment periods, as

[24] See Table A5 in the Online Appendix for information on the FOMC announcement time that we use in the intraday analysis.

Table 8

Intraday response of stock market returns to FFR surprises conditional upon the state of investor sentiment - role of pre-announcement effect, information leakage, unscheduled meetings and Fed information. Panel A of this table presents OLS estimates with Huber–White heteroscedasticity-consistent standard errors, over FOMC announcement days, of the following model: $R_t = \beta_0 + \beta_1(1 - S_t^H)\Delta i_t^u + \beta_2 S_t^H \Delta i_t^u + \varepsilon_t$, where R_t and Δi_t^u denote log returns on the S&P500 index and unexpected FFR changes, respectively. Both aforementioned variables are measured using intraday data and windows surrounding FOMC announcements. When the embargo period is included, the relevant windows is: 30-min (-10,20). When the embargo period is excluded, the relevant windows is 21-min (-1,20). S_t^H is a dummy variable that is equal to 1 (0) if the FOMC meeting occurred during a year that starts with high (low) sentiment level. A year is defined as starting with high (low) sentiment if the sentiment proxy at the end (December) of the previous year is above (below) the full sample mean value. Panel B of this table replaces S_t^H in the above equation with S_t^{HD}, a dummy variable that is equal to 1 if the FOMC meeting occurred during a year when sentiment starts at high level but then declines, and 0 otherwise. A year is defined as of high at the start but then decreasing sentiment if the sentiment proxy at the end (December) of the previous year exceeds the full sample mean value and the sentiment proxy at the end of that year is lower than at the end of the previous year. The sentiment proxy is the U.S. Consumer Confidence index. Panels C and D of this table repeat the analysis of Panels A and B, respectively, but exclude meetings associated with Fed information effects, as documented by Bauer and Swanson (2021). The sample period includes scheduled and unscheduled FOMC meetings over February 1995 - December 2008, with the exception of the 17 September 2001 and 22 January 2008 unscheduled meetings. Standard errors are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

All meetings									Scheduled meetings only								
(-10, 20)					(-1, 20)				(-10, 20)					(-1, 20)			
Obs	β_0	β_1	β_2	$Adj.R^2$	β_0	β_1	β_2	$Adj.R^2$	Obs	β_0	β_1	β_2	$Adj.R^2$	β_0	β_1	β_2	$Adj.R^2$
Panel A: S_t^H																	
117	-0.16^{***}	-0.01	-7.06^{***}	0.51	-0.14^{***}	-1.38	-7.14^{***}	0.44	112	-0.16^{***}	-0.01	-4.46^{***}	0.20	-0.16^{***}	-1.26	-4.83^{***}	0.19
	(0.04)	(0.88)	(1.26)		(0.05)	(1.12)	(1.45)			(0.04)	(0.87)	(1.33)		(0.04)	(1.10)	(1.47)	
Panel B: S_t^{HD}																	
117	-0.14^{***}	-1.64	-7.34^{***}	0.52	-0.13^{***}	-2.93^{*}	-7.21^{***}	0.44	112	-0.15^{***}	-1.65	-4.80^{***}	0.20	-0.15^{***}	-2.97^{*}	-4.80^{***}	0.19
	(0.04)	(1.29)	(1.28)		(0.05)	(1.70)	(1.50)			(0.04)	(1.30)	(1.55)		(0.04)	(1.73)	(1.61)	
Panel C: S_t^H excluding Fed information effects																	
108	-0.14^{***}	1.32	-7.06^{***}	0.50	-0.13^{**}	0.06	-7.27^{***}	0.44	103	-0.13^{***}	1.32	-3.85^{**}	0.14	-0.15^{***}	0.16	-4.47^{**}	0.15
	(0.05)	(3.13)	(1.34)		(0.05)	(4.08)	(1.61)			(0.04)	(3.14)	(1.59)		(0.04)	(4.04)	(1.88)	
Panel D: S_t^{HD} excluding Fed information effects																	
108	-0.12^{**}	-1.66	-7.32^{***}	0.52	-0.11^{**}	-3.66	-7.31^{***}	0.44	103	-0.13^{***}	-1.75	-4.15^{**}	0.14	-0.14^{***}	-4.02	-4.33^{**}	0.14
	(0.05)	(-1.95)	(1.39)		(0.05)	(3.15)	(1.65)			(0.04)	(1.95)	(1.89)		(0.04)	(3.13)	(2.04)	

indicated by the highly significant estimates of β_2. Using all FOMC meetings (scheduled and unscheduled), intraday estimates are slightly smaller in terms of magnitude but still remarkably close to the daily estimates in Panel A of Table 2; for example, note the β_2 estimates of -7.14 (intraday) and -7.38 (daily). Replacing S_t^H with S_t^{HD} in Panel B, we obtain similar insights to those from the daily estimates, since the effect of policy surprises concentrates on years when sentiment starts at high level and subsequently declines. Outside of sentiment-waning phases, the effect of policy shocks, as captured by β_1, is statistically insignificant at the 5% level. The findings from using the 30-min window implies that new information is quickly impounded in asset prices. Using a tighter window (-1, 20) for the intraday analysis yields similar findings.

Table 8 also reports results from only using scheduled FOMC meetings. The approach of removing unscheduled meetings is consistent with Lucca and Moench (2015) and other related studies. Unscheduled meetings are interesting since they may be linked with the Fed put story, in which, monetary policy is eased in times of financial turmoil, but not tightened accordingly when financial conditions are good (Ozdagli, 2017; Cieslak and Vissing-Jorgensen, 2017). Bernanke (2015) highlights that a rate move outside regularly scheduled FOMC meetings is usually taken in responding to emergencies. These interventions aim to restore confidence by positively surprising investors. It is likely that the urgency nature conveyed by the FOMC will increase the magnitude of the stock market response (Bernanke and Kuttner, 2005).

Indeed, unscheduled meetings are typically associated with fairly large expansionary policy surprises and on several occasions, though not always, the stock market reacted euphorically to the news. For example, there was a strong positive response to the intermeeting rate cut on 15 October 1998, which occurred during a period of market turmoil associated with the Long-Term Capital Management (LTCM) crisis. When unscheduled meetings are removed, the magnitude of the impact of FFR surprises during sentiment-waning phases declines somewhat. For instance, with the wider window, removing unscheduled meetings reduces the magnitude of β_2 from -7.34 to -4.80 in Panel B. Nevertheless, the effect remains highly significant.

Overall, intraday evidence suggests that our results are not driven by the pre-announcement effect or information leakage during the FOMC news embargo period. Moreover, our conclusions concerning the importance of sentiment states are robust to the incorporation (removal) of unscheduled FOMC meetings to (from) the sample.

4.3.4. Fed information effect

According to the Fed information effect, FOMC announcements simultaneously reveal information about monetary policy and the Fed's assessment of the economic outlook. This literature extends back to the work of Romer and Romer (2000), which demonstrates that the Fed has considerable information about future inflation beyond what is known to private sector forecasters. More recent contributions include, among others, Nakamura and Steinsson (2018),Lunsford (2020), Jarociński and Karadi (2020),Miranda-Agrippino and Ricco (2021), and Bauer and Swanson (2021). The evidence concerning the importance of the information effect is rather mixed. For example, Bauer and Swanson (2021) find that there is little if any role for the Fed information effect, while Lunsford (2020) shows that the Fed information effect is present in the period from February 2000 to August 2003, but not afterwards. At the same time, Nakamura and Steinsson (2018) conclude that the Fed information effect exists, since monetary policy tightenings are associated with a significant upward revision in Blue Chip GDP forecasts.

To account for the Fed information effect, we follow Bauer and Swanson (2021) and analyse intraday data, removing from the sample of FOMC meetings a number of observations for which the information effect is strongest. The latter are identified using the approach of Nakamura and Steinsson (2018).[25] The intraday results from estimating Eq. 2 using the level and changes-based sentiment states are reported, respectively, in Panels C and D of Table 8. In line with Bauer and Swanson (2021), we show that removing the FOMC meetings with the strongest information effect, our main conclusions remain unchanged. The impact of monetary policy shocks on stock returns depends on the state of investor sentiment, manifesting itself only during sentiment-waning phases. Comparing the magnitude of the relevant coefficient, β_2, in Panel B, where the meetings with the strongest information effect are included, with Panel D, where they are excluded, we note that it is remarkably similar. Therefore, our evidence on the important role of investor sentiment is not affected by the Fed information effect.

5. Robustness checks

We conduct a host of robustness checks and our findings remain unchanged. The results are presented and discussed in the Online Appendix. The first check involves using alternative measures of investor sentiment, in particular the BWI and the CSI (Table A6). In the second check, we estimate the impact of FFR surprises having removed the FOMC meetings that coincide with employment data releases (Table A7). In the third check, we consider an estimation method that is robust to the presence of outliers (Table A8). The fourth check examines whether the impact of monetary policy shocks persists over the days that follow the FOMC meeting (Table A9). We are mindful of the possibility of endogeneity due to the simultaneous reaction of stocks and the market-based measure of monetary policy to new information. To mitigate this concern, in the fifth check we employ the approach proposed by Thornton (2014) to address the joint-response bias (Table A10).

[25] These are the most influential observations for regression model (3) in Nakamura and Steinsson (2018). That is, they provide the strongest evidence of an information effect for GDP. For a list, see Table 6 in Bauer and Swanson (2021).

6. Conclusions

This study brings together two broad streams of the existing literature by seeking to incorporate insights from behavioural finance to research about the impact of monetary policy on financial markets. We use an event study framework and show that the state of investor sentiment affects the transmission of monetary policy news to the stock market. We construct sentiment states using two alternative approaches based on the level of sentiment at the start of the year, and changes in sentiment over the year. Our approach is motivated by the (slowly) mean-reverting nature of sentiment, whereby episodes of exuberance tend to be followed by a correction phase. Our evidence reveals that the impact of monetary policy news, proxied by unexpected changes in the FFR, is mostly potent during the sentiment-waning phases that follow overvaluation. In particular, when sentiment is high at the start of the year but then declines, as e.g. in 2001, following the culmination of the "dot-com" boom. Importantly, we show that only expansionary news matter, leading to a positive stock market reaction.

We propose an explanation that is related to the alleviation of investors' fear. During sentiment-waning phases, overpricing tends to be corrected, which generates investment losses and uncertainty about exposure to future losses, hence making investors anxious and fearful. Easing surprises during such periods should boost the stock market by alleviating investors' fear. Empirical analysis, using the variance risk premium component of the VIX, which to a large extent reflects "crash-ophobia", supports this idea. Overall, the capacity of sentiment to determine the state dependence that we observe in the link between stock returns and monetary policy news, make rational pricing hard to reconcile with our evidence.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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