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Investor sentiment and the stock market's reaction to monetary policy

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ABSTRACT

This paper shows that monetary policy decisions have a significant effect on investor sentiment. The effect of monetary news on sentiment depends on market conditions (bull versus bear market). We also find that monetary policy actions in bear market periods have a larger effect on stocks that are more sensitive to changes in investor sentiment and credit market conditions. Overall, the results show that investor sentiment plays a significant role in the effect of monetary policy on the stock market.

> It takes months for rate cuts to translate into economic growth ... What a Fed rate cut – or a series of cuts – could change quickly is investor psychology.
>
> The Wall Street Journal, September 17, 2007

1. Introduction

Monetary policy has two primary goals: price stability and sustainable economic growth. Policymakers recognize, however, that these goals can be achieved only through the effects of monetary policy on financial markets, including equity markets.[1] Bernanke and Kuttner (2005) examine the effect of the surprise policy actions on stock prices. They show that the stock market reaction to monetary policy is driven primarily by the effect of the unexpected changes in the fed funds target rate on the equity risk premium. Bernanke and Kuttner (2005) argue that the large effect of monetary shocks on expected excess returns may be related to the influence of monetary policy on the riskiness of stocks or on investor risk aversion. They note, however, that their results are also consistent with investor overreaction or excess sensitivity of stock prices to monetary shocks. In other words, investor psychology may play a significant role in the response of equity investors to monetary news.

Baker and Wurgler (2006, 2007), Brown and Cliff (2005) and Kumar and Lee (2006) show that investor sentiment predicts stock returns in the cross-section and in the aggregate. Their findings indicate that investor sentiment moves stock prices and, therefore, affects expected returns. This raises the question whether the effect of monetary news on stocks is driven, at least in part, by the influence of Fed policy on investor sentiment. The purpose of this paper is to address this question empirically.

Our empirical methodology accounts for possible asymmetries in the effects of Fed policy in different market regimes (bull versus bear market). We find that monetary policy changes in bear markets have similar directional effects on the aggregate stock returns, investor sentiment and expectations of credit market conditions. We also find that policy decisions have little effect on stock returns and sentiment in bull markets. The reaction of investor sentiment to monetary surprises in bear markets is consistent with the notion that investors believe in the Federal Reserve's ability to put a "floor" under stock prices in periods of market stress by easing monetary policy.

In further analysis, we examine the response of stock returns to monetary news in a cross-section of stocks. The results show that the response of stocks to monetary news depends on sensitivity of stock returns to changes in credit market conditions and sentiment

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[1] For example, consider this statement made by Alan Greenspan during an FOMC meeting: "The problem that we have here is that monetary policy works through its effects on overall financial markets. ... The only way to eliminate the wealth effect, which has to be eliminated, is for the discount rate – the market interest rate used by investors to calculate the present value of expected earnings – to rise. ... The question is how we can facilitate that rise." (Transcript of February 1–2, 2000 FOMC Meeting, pp. 124–125.)

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changes. These results lend further evidence that the effect of monetary shocks on investor sentiment plays an important role in the impact of Fed policy on stock returns.

Bernanke and Kuttner (2005) show that changes in timing of expected policy actions have no significant effect on stocks on average. Our results show, however, that unexpected changes in timing of target rate decisions have a large effect on stock returns in bear markets. The effect of such timing changes on the stock market can be traced to their impact on investor sentiment and expectations of credit market conditions.

According to traditional finance theory, economic news should affect security prices only to the extent that it influences the rational present value of expected future cash flows. This paper presents evidence that investor sentiment plays a significant role in the effect of monetary news on the stock market. Since the stock market is an important conduit of monetary policy, our findings contribute to better understanding of the monetary transmission mechanism.

2. Related literature

Our paper contributes to the literature on state dependence in the stock market's response to macroeconomic news. Studies that do not account for time variation in the stock market's response often find little reaction of stocks to macroeconomic fundamentals. For example, Pearce and Roley (1985) find little evidence that the equity market responds to news about inflation and real activity. McQueen and Roley (1993), however, find such evidence after incorporating business cycle variation in the estimation procedure. More recently, Boyd et al. (2005) show that the sign of the stock market's reaction to unemployment news depends on the state of the economy.

In a paper closely related to our study, Chen (2007) finds that monetary policy has a much larger effect on the aggregate stock returns in bear markets then in bull markets. He argues that this asymmetric reaction of stocks to monetary policy can be explained by cyclical fluctuations in the level of financial constraints faced by firms. Similarly, Basistha and Kurov (2008) find that the reaction of stocks to monetary news is much stronger in recessions and in tight credit market conditions than in good economic times. They provide evidence that the state dependence in the stock market's response to monetary news is consistent with the credit channel of monetary transmission.

Our paper adds to the literature in several ways. First, we examine both the effect of unexpected monetary policy actions and the effect of changes in timing of expected policy decisions in different market regimes. Second, we consider the role of investor sentiment in the stock market's reaction to monetary shocks. This analysis contributes to the debate on the effect of investor sentiment on asset prices. Furthermore, most studies looking at the reaction of stocks to macroeconomic news use aggregate returns. In addition to examining the effect of monetary shocks on the overall stock market, we perform a cross-sectional analysis of the response of stock returns. This analysis helps to explain the aggregate results and allows examining cross-sectional heterogeneity in the stock market's response to monetary policy.

3. Key variables and sample selection

3.1. Estimation of monetary surprises

Following Kuttner (2001) and Bernanke and Kuttner (2005), we compute the unexpected component of the federal funds target rate change using the prices of fed funds futures on the day of the meeting of the Federal Open Market Committee (FOMC):

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

where f_t^0 is the fed funds rate implied in the settlement price of the current-month fed funds futures contract, d is the day of the current FOMC meeting and D is the number of days in the month. The settlement price of the fed funds futures is based on the average daily fed funds rate during the contract's delivery month. The first term in Eq. (1) is a scaling factor that accounts for the timing of the announcement within a month.[2]

Bernanke and Kuttner (2005) note that a funds target rate surprise extracted from the current-month futures prices may be, at least in part, a "timing" surprise. In other words, this surprise may be caused by a change in the timing of an expected policy decision rather than by a totally unexpected Fed action. Gürkaynak (2005) and Gürkaynak et al. (2007) present a decomposition of the aggregate monetary surprises into two parts, the level (permanent) surprise and the timing (transitory) surprise. The timing surprise is defined as the component of the total surprise that does not affect the expected fed funds rates beyond the next FOMC meeting. In contrast, the level surprise is defined as the change in the expected interest rate beyond the next meeting. The level surprise is calculated as follows:

$$Level_t = \left[(f_t^1 - f_{t-1}^1) - \frac{d_1}{D_1}\Delta i_t^u\right]\frac{D_1}{D_1 - d_1}, \tag{2}$$

where f_t^1 is the fed funds rate implied in the settlement price of the fed funds futures contract expiring in the month of the next scheduled FOMC meeting, d_1 is the day of the next scheduled FOMC meeting and D_1 is the number of days in that month.[3] We compute the timing surprise as the difference between the total surprise Δi_t^u and the level surprise.[4] The timing and level surprises for our sample are shown in Fig. 1.

3.2. Investor sentiment measures

Investor sentiment is broadly defined as the propensity to speculate. We use two measures of investor sentiment changes to examine the role of investor sentiment in the stock market's reaction to monetary news. The first measure is the index of investor sentiment changes from Baker and Wurgler (2006, 2007). Baker and Wurgler (2006) note that there is no perfect sentiment measure and propose a composite measure that captures the common component of several sentiment proxies. Specifically, the index of sentiment changes is the first principal component of the changes in the following six variables: NYSE turnover, closed-end fund discount, number of IPOs, first-day return on IPOs, the equity share in the new issues and the dividend premium. The six variables are orthogonalized with respect to macroeconomic conditions to remove business cycle variation from the sentiment proxies.[5]

[2] As the scaling factor increases at the end of the month, it amplifies the noise induced by discreteness of the futures prices. To alleviate this problem, when the target rate decision occurs in the last 7 days of the month we use the change in the rate implied in the next-month's contract as the measure of the unexpected target change.

[3] When the date of the next scheduled FOMC meeting is in the last 7 days of the month, we measure the level surprise as the change in the rate implied in the following month's contract.

[4] Gürkaynak (2005) estimates the timing surprise as a residual from the regression of the total surprise on the level surprise. In our sample, this regression yields a coefficient of 0.93 with a standard error of 0.09. To avoid dealing with the generated regressor issue for the timing surprise, we assume that the true coefficient is equal to one and calculate the timing surprise as the difference between the total surprise and the level surprise.

[5] Monthly series of the index of investor sentiment changes is obtained from Jeffrey Wurgler's website (http://pages.stern.nyu.edu/~jwurgler).

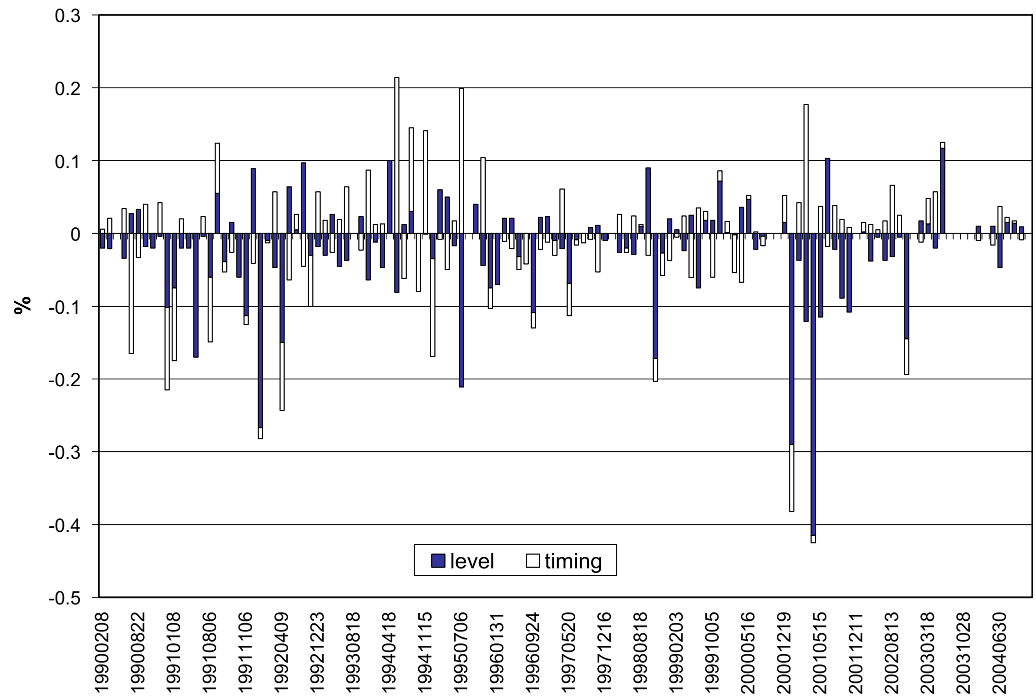

Fig. 1. Decomposition of fed funds surprises into level and timing components.

Our second investor sentiment proxy is the change in the investor sentiment index computed using Investor Intelligence survey. The survey represents the outlook of over 120 independent market newsletters. Investor Intelligence classifies newsletters as bullish, bearish or correction and releases the resulting percentages every Friday. Following Fisher and Statman (2006), we compute an investor sentiment index as a ratio of the percentage of bullish advisors to the sum of the percentages of bullish and bearish advisors. Therefore, in contrast to the Baker and Wurgler's sentiment index, the Investor Intelligence sentiment index is bounded between zero and one. High values of the Investor Intelligence sentiment index indicate increased investor confidence and greater propensity to speculate in stocks.

Panel A of Fig. 2 shows levels of the Investor Intelligence and Baker and Wurgler's sentiment indices. The two sentiment proxies exhibit only a limited degree of co-movement. Panel A of Table 1 presents the correlations of the measures of investor sentiment changes and the return on the S&P 500 index. The correlation between the two measures of investor sentiment is about 0.20. Both sentiment variables are also positively correlated with the stock returns.

Table 1 also includes correlations of our two proxies for sentiment changes with two other related measures: change in net stock mutual fund flows and change in the VIX index. Frazzini and Lamont (2008) use equity fund flows as a measure of investor sentiment. The VIX index is constructed from implied volatilities of S&P 500 index options. It is often referred to as an "investor fear gauge" (e.g., Whaley, 2000) and is used by traders as a sentiment indicator. Table 1 shows that, as expected, the change in the stock fund flows is positively correlated with the changes in both investor sentiment indices and with the aggregate stock returns.[6] Also as expected, the corresponding correlations for the change in the VIX index are negative.

3.3. Market regimes

Chen (2007) estimates the probabilities of bull and bear markets using a simple Markov-switching model of stock returns[7]:

$$R_t = \mu_{S_t} + \varepsilon_t, \quad \varepsilon_t \sim i.i.d.N(0, \sigma^2_{S_t}), \tag{3}$$

where R_t is the monthly return on the S&P 500 index and S_t is an unobserved dummy variable that indicates bull or bear market. Therefore, μ_{S_t} and $\sigma^2_{S_t}$ are the state-dependent mean and variance of returns, respectively. The transition from one state to the other is modeled as a Markov chain process and depends on probabilities of transition between the two regimes. The model is used to statistically identify a regime with a higher mean and lower variance of returns (bull market) and a regime with a lower mean and higher variance (bear market). The model parameters (means, variances and transitional probabilities) are estimated jointly with maximum likelihood. Once the parameter estimates are obtained, conditional probabilities of bull and bear market at each point in time are computed by using the data available at that time.[8] Panel B of Fig. 2 shows the smoothed bull market probabilities for our sample period estimated by assuming fixed transitional probabilities.[9]

According to a common rule of thumb, a 20% increase in the overall stock market from the last low constitutes a bull market, and a 20% decline from the last high marks a bear market. We use this simple rule to construct an alternative proxy for the market regime. Fig. 2 shows the bear market periods identified with this rule using values of the S&P 500 index. There is a close correspondence between the bear markets identified with the 20% threshold and the bear market probabilities from Chen (2007). The correlation between the bull market probability and the bull market dummy variable constructed using the 20% threshold is about 0.7.

6 We thank the Investment Company Institute for providing the mutual fund flow data.

7 Similar Markov-switching models are used in Chen (2009) and Henry (2009).

8 See Hamilton (1994, pp. 685–688) for details on parameter estimation and computation of regime probabilities.

9 We thank Shiu-Sheng Chen for providing the bull market probabilities.

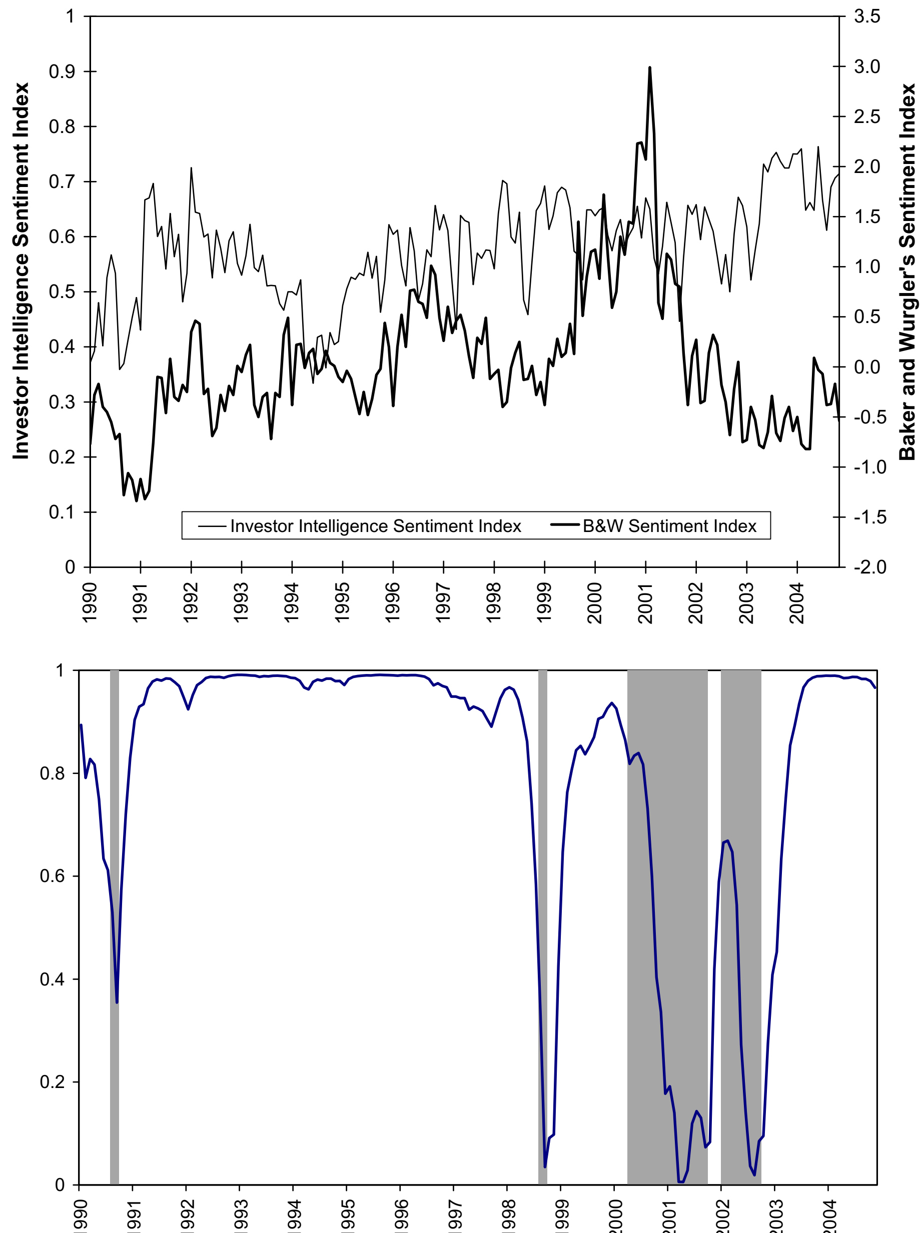

Fig. 2. Investor sentiment measures and market regimes. Shaded areas represent bear markets, defined as peak to though periods when the S&P 500 index declined by more than 20% from the last high. The first panel – investor sentiment measures. The second panel – smoothed probabilities of bull market from Chen (2007).

3.4. Sample selection

We use an event study approach by examining a sample period that extends over fifteen years from January 1990 to November 2004 and includes 129 decisions made by the FOMC regarding the Federal funds target rate.[10] Thirteen of these decisions were made at unscheduled FOMC meetings.[11] Following Basistha and Kurov (2008), we exclude eight FOMC announcements made on days with employment releases. These observations are excluded for two reasons. First, the target rate surprises on employment release days cannot be considered exogenous, as the Federal Reserve reacts to employment news released earlier in the day. Second, Boyd et al. (2005) show that the response of stocks to employment news is state dependent. Similar to Bernanke and Kuttner (2005), we also omit the target rate announcement made at the unscheduled FOMC meeting of September 17, 2001. Panel B of Table 1 shows descriptive statistics for the monetary surprises and investor sentiment measures in our sample. The target rate surprises tend to be larger in absolute value in bear markets.

4. Empirical results

4.1. Effect of monetary news on aggregate stock prices

We begin by looking at the effect of the Fed policy decisions on the stock market in bull and bear market regimes. Specifically, we estimate the following regression of the daily S&P 500 index return

[10] The sample period does not include the most recent bear market because the market regime probabilities and Baker and Wurgler sentiment measure are unavailable for the last few years.

[11] Three unscheduled meetings (October 15, 1998, January 3, 2001 and April 18, 2001) were held during bear market periods, i.e., when the bull market probability was below 0.5.

Table 1
Summary statistics.

	S&P 500 return	B&W index of sentiment changes	Changes in II sentiment index	Change in VIX
Panel A. Correlations of proxies for investor sentiment changes				
B&W index of sentiment changes	0.28***			
Changes in II sentiment index	0.52***	0.20***		
Change in VIX	−0.67***	−0.11	−0.34***	
Change in net stock mutual fund flow	0.54***	0.35***	0.35***	−0.45***

	Full sample (129 FOMC meetings)			Bull market (105 FOMC meetings)			Bear market (24 FOMC meetings)		
	Mean	Median	Standard deviation	Mean	Median	Standard deviation	Mean	Median	Standard deviation
Panel B. Descriptive statistics									
Total target rate surprises	−0.02	0	0.09	−0.01	0	0.07	−0.05	0	0.13
Level surprises	−0.02	0.00	0.07	−0.01	0.00	0.06	−0.06	−0.02	0.11
Timing surprises	0.00	0	0.05	0.00	0	0.05	0.01	0.00	0.05
B&W index of sentiment changes	0.01	0.04	1.06	0.04	0.06	0.98	−0.16	−0.27	1.43
Changes in II sentiment index	0.00	0.00	0.07	0.00	0.00	0.07	0.00	−0.02	0.07

The sample period is from January 1990 through November 2004. Panel A shows Pearson correlation coefficients of the index of investor sentiment changes from Baker and Wurgler (2006, 2007), changes in the Investor Intelligence (II) sentiment index, changes in the net stock mutual fund flows and changes in the VIX index. Monthly data are used for all variables. Panel B shows descriptive statistics for the monetary surprises and investor sentiment measures. Monthly data are used for the investor sentiment measures. Bull markets are defined as periods when the smoothed probability of the bull market regime is above 0.5.
*** Correlation is statistically significant at 1% level.

on the unexpected component of the change in the fed funds target rate:

$$R_t = \alpha + \gamma_1 \Delta i_t^u BP_t + \gamma_2 \Delta i_t^u (1 - BP_t) + \varepsilon_t, \quad (4)$$

where BP_t is the smoothed probability of the bull market regime from Chen (2007). The coefficients γ_1 and γ_2 measure the average stock market response to monetary news in bull and bear markets, respectively.

Eq. (4) is estimated using OLS and using the MM weighted least squares procedure introduced by Yohai (1987). This procedure maintains robustness in the presence of a large number of outliers. The regression results reported in Panel A of Table 2 are consistent with Chen (2007), showing that stocks tend to react significantly more strongly to monetary surprises in bear markets. For example, the OLS coefficient of the monetary surprise in bull markets is a statistically insignificant −0.68. This implies that a hypothetical unexpected 100-basis point cut of the fed funds target during bull market leads to a 0.68% increase in the overall stock prices. In contrast, the stock prices jump by about 11.85% in response to a similar monetary surprise in bear market. The difference between the regression coefficients representing the stock market response in bull and bear market is statistically significant.

The response of the stock returns to the timing and level components of the monetary surprise may not be symmetric and the presence of the timing component may bias the estimate of the response to level shocks when we use the total surprise. It is also possible that the stock market responds differently to timing and level surprises in different market regimes. To examine this empirically, we estimate the following regression for the returns on the S&P 500 index:

$$R_t = \alpha + \gamma_1 Level_t BP_t + \gamma_2 Timing_t BP_t + \gamma_3 Level_t (1 - BP_t) + \gamma_4 Timing_t (1 - BP_t) + \varepsilon_t, \quad (5)$$

where $Level_t$ and $Timing_t$ are the level and timing shocks estimated as discussed in Section 3.1.

The results reported in Panel B of Table 2 show that while level shocks affect the stock returns negatively in both bull and bear market, their effect is much larger in bear markets. However, stock prices tend to respond to timing surprises positively in bull markets and negatively in bear markets. Surprisingly, in bear markets the stock market responds to timing surprises much more strongly than to the level surprises. This result seems to suggest that a change in timing of expected policy actions conveys important information to the stock market in bear market periods. An alternative explanation is that equity investors tend to overreact to timing surprises in bear market conditions. This finding contradicts the conclusion of Bernanke and Kuttner (2005) and Gürkaynak (2005) that changes in timing of policy decisions have little effect on stock returns. The major difference in our approach is that we allow the stock market's response to level and timing shocks to depend on the market regime.

Table 2
Response of stock prices to target rate changes.

	OLS	Robust regression
Panel A. Total surprises		
Intercept	0.19** (0.08)	0.16** (0.08)
Bull market (γ_1)	−0.68 (1.35)	−1.50 (1.30)
Bear market (γ_2)	−11.85*** (2.15)	−11.81*** (1.49)
$\gamma_2 - \gamma_1$	−11.17***	−10.31***
R^2	0.323	0.102
Panel B. Timing and level surprises		
Intercept	0.21** (0.08)	0.18** (0.08)
Bull market		
Level (γ_1)	−2.89** (1.36)	−3.63** (1.52)
Timing (γ_2)	3.08** (1.52)	2.21 (1.64)
Bear market		
Level (γ_3)	−9.69*** (1.35)	−9.71*** (1.48)
Timing (γ_4)	−24.75*** (3.04)	−24.37*** (3.50)
R^2	0.424	0.205

The coefficients reported in Panel A are for the following regression: $R_t = \alpha + \gamma_1 \Delta i_t^u BP_t + \gamma_2 \Delta i_t^u (1 - BP_t) + \varepsilon_t$, where R_t is the one-day S&P 500 return, Δi_t^u is the unexpected change in the fed funds target rate, and BP_t is the smoothed probability of bull market from Chen (2007). The coefficients reported in Panel B are for the following regression: $R_t = \alpha + \gamma_1 Level_t BP_t + \gamma_2 Timing_t BP_t + \gamma_3 Level_t(1 - BP_t) + \gamma_4 Timing_t(1 - BP_t) + \varepsilon_t$, where $Level_t$ and $Timing_t$ are the level and timing surprises estimated as discussed in Section 3.1. The sample period is from January 1990 through November 2004. The sample contains 129 observations. The regressions are estimated using (1) OLS with the White (1980) heteroskedasticity consistent covariance matrix and (2) MM weighted least squares procedure introduced by Yohai (1987). Standard errors are shown in parentheses.
** Coefficient is statistically significant at 5% level.
*** Coefficient is statistically significant at 1% level.

Table 3
Effect of target rate changes on investor sentiment.

	Index of sentiment changes		Change in Investor Intelligence sentiment index	
	OLS	Robust Regression	OLS	Robust Regression
Panel A. Total surprises				
Intercept	−0.02 (0.09)	−0.09 (0.07)	−0.03 (0.09)	−0.03 (0.09)
Bull market (γ_1)	1.96 (1.52)	2.43** (1.15)	−0.21 (1.65)	−0.21 (1.44)
Bear market (γ_2)	−4.67** (1.99)	−7.10*** (1.32)	−3.10* (1.79)	−3.10* (1.68)
$\gamma_2 - \gamma_1$	−6.63**	−9.53***	−2.89	−2.89
R^2	0.069	0.108	0.027	0.019
N	122	122	129	129
Panel B. Timing and level surprises				
Intercept	0.00 (0.09)	−0.08 (0.07)	0.00 (0.09)	0.02 (0.09)
Bull market				
Level (γ_1)	2.30 (2.06)	2.27 (1.46)	−0.05 (2.08)	−0.14 (1.12)
Timing (γ_2)	2.13 (1.43)	2.92* (1.54)	0.58 (1.76)	0.59 (1.85)
Bear market				
Level (γ_3)	−3.95* (2.22)	−6.66*** (1.38)	−1.42 (1.38)	−0.67 (1.71)
Timing (γ_4)	−10.54*** (3.21)	−10.46*** (3.44)	−13.31*** (1.61)	−14.18*** (4.01)
R^2	0.085	0.121	0.080	0.089
N	122	122	129	129

The coefficients reported in Panel A are for the following regression: $\Delta IS_t = \alpha + \gamma_1 \Delta i_t^u BP_t + \gamma_2 \Delta i_t^u (1 - BP_t) + \varepsilon_t$, where Δi_t^u is the unexpected change in the fed funds target rate, BP_t is the smoothed probability of bull market from Chen (2007), and ΔIS_t is one of two proxies for investor sentiment changes: (1) index of sentiment changes from Baker and Wurgler (2006, 2007) and (2) change in the Investor Intelligence sentiment index. The coefficients reported in Panel B are for the following regression: $\Delta IS_t = \alpha + \gamma_1 Level_t BP_t + \gamma_2 Timing_t BP_t + \gamma_3 Level_t (1 - BP_t) + \gamma_4 Timing_t (1 - BP_t) + \varepsilon_t$, where $Level_t$ and $Timing_t$ are the level and timing surprises estimated as discussed in Section 3.1. The sample period is from January 1990 through November 2004. Monthly data are used for the index of sentiment changes and weekly data are used for changes in Investor Intelligence sentiment index. Both sentiment measures are normalized using their sample means and standard deviations. The regressions are estimated using (1) OLS with the White (1980) heteroskedasticity consistent covariance matrix and (2) MM weighted least squares procedure introduced by Yohai (1987). Standard errors are shown in parentheses.
* Coefficient is statistically significant at 10% level.
** Coefficient is statistically significant at 5% level.
*** Coefficient is statistically significant at 1% level.

4.2. Effect of monetary shocks on sentiment and yield spreads

Our first hypothesis is that monetary policy shocks affect investor sentiment. To test this hypothesis, we estimate a regression similar to the one in Eq. (4) using change in investor sentiment as the dependent variable. Baker and Wurgler's (2006) index of sentiment changes is available at monthly intervals. Similar to the stock return regression, we use daily target rate surprises to prevent possible endogeneity concerns with target rate surprises estimated at monthly frequency. On several occasions during our sample period, two target rate decisions were made in one month. In such instances, we sum up the daily target rate surprises on the policy decision days over the month to obtain a single observation for each month that contains a target rate decision. This aggregation of target rate surprises is unnecessary in regressions using changes in the Investor Intelligence sentiment index, because the underlying data are available at weekly intervals.

The regression results using the total target rate surprises are reported in Panel A of Table 3. For both sentiment proxies, there seems to be little effect of monetary news on investor sentiment in bull markets. However, in bear markets, similar policy surprises have a large effect on investor sentiment. For example, when the Baker and Wurgler sentiment measure is used, the robust estimate of the coefficient of the monetary surprise in bear market is about −7.10. That is, a 100 basis point cut in the fed funds target rate in bear market leads to a seven standard deviations increase in investor sentiment. This asymmetric effect of monetary shocks on sentiment is observed for both sentiment measures. The reaction of sentiment to monetary policy in bear market periods suggests that investor believe in the Fed's ability to ride to the rescue of financial markets in periods of market stress. The Fed's pattern of reacting to financial crises and market declines by lowering short-term rates has been labeled the "Greenspan put" or, more recently, the "Bernanke put."

A plausible explanation of the results in Table 3 relates to investor inattention. People have limited capacity to process information. As a result, economic information tends to diffuse gradually in financial markets. For example, DellaVigna and Pollet (2009) and Hirshleifer et al. (forthcoming) show that investor inattention and distraction by extraneous news events increase underreaction of prices to earnings announcements. Supporting the investor inattention hypothesis, Klibanoff et al. (1998) and Peress (2008) show that information is incorporated into the prices faster when it is covered more prominently in the news media. Kliger and Kudryavtsev (2008) find that attention-grabbing events affect formation of investors' mental reference levels assigned to stocks. Doms and Morin (2004) find that the tone and volume of media reporting on the economy affect consumer sentiment more than economic fundamentals would suggest. Investors are likely to pay more attention to Fed policy decisions in bear markets because of intense media coverage and due to the fact that the Fed is often viewed as the provider of the market-wide "put." The increased level of investor attention is likely to contribute to the effect of monetary shocks on sentiment and stock prices in bear markets.

Does investor sentiment respond differently to timing and level components of the monetary news? Panel B in Table 3 shows the results from regression of the two investor sentiment proxies on timing and level surprises in the two market regimes. Both level and timing surprises affect investor sentiment in bear markets, at least when the Baker and Wurgler index of sentiment changes is used. However, the coefficient estimates of timing shocks are larger in absolute value. When these coefficient estimates are averaged across the two sentiment measures and the two estimation methods, the effect of timing shocks on investor sentiment exceeds that of level shocks by a factor of more than three.[12]

[12] Monetary policy decisions may affect investor sentiment through their effects on stock prices. To test for this alternative explanation of the results, we estimated the regressions in Table 3 after including the S&P 500 index return on the FOMC announcement days as an additional explanatory variable. However, the index return coefficient was insignificant and the coefficients of primary interest were not significantly affected. The results of this robustness check are not tabulated to save space but are available upon request.

Table 4
Effect of target rate changes on yield spread factors.

	Default spread factor		Term spread factor	
	OLS	Robust regression	OLS	Robust regression
Panel A. Total surprises				
Intercept	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bull market (γ_1)	0.18*** (0.04)	0.18*** (0.04)	−0.48*** (0.06)	−0.45*** (0.05)
Bear market (γ_2)	−0.13 (0.14)	0.02 (0.06)	−0.35** (0.14)	−0.71*** (0.08)
$\gamma_2 - \gamma_1$	−0.31**	−0.16**	0.13	−0.26**
R^2	0.116	0.081	0.512	0.281
Panel B. Timing and level surprises				
Intercept	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bull market				
Level (γ_1)	0.31*** (0.04)	0.32*** (0.05)	−0.50*** (0.06)	−0.46*** (0.06)
Timing (γ_2)	0.06 (0.05)	0.05 (0.06)	−0.47*** (0.07)	−0.44*** (0.06)
Bear market				
Level (γ_3)	−0.07 (0.12)	0.06 (0.06)	−0.38*** (0.14)	−0.30*** (0.07)
Timing (γ_4)	−0.49** (0.23)	−0.24* (0.13)	−0.22 (0.25)	−0.05 (0.14)
R^2	0.248	0.186	0.516	0.316

The coefficients reported in Panel A are for the following regression: $YSF_t = \alpha + \gamma_1 \Delta i_t^u BP_t + \gamma_2 \Delta i_t^u (1 - BP_t) + \varepsilon_t$, where YSF_t is one of two yield spread factors (default spread factor or term spread factor), Δi_t^u is the unexpected change in the fed funds target rate, and BP_t is the smoothed probability of bull market from Chstoen (2007). The coefficients reported in Panel B are for the following regression: $YSF_t = \alpha + \gamma_1 Level_t BP_t + \gamma_2 Timing_t BP_t + \gamma_3 Level_t(1 - BP_t) + \gamma_4 Timing_t(1 - BP_t) + \varepsilon_t$, where $Level_t$ and $Timing_t$ are the level and timing surprises estimated as discussed in Section 3.1. The sample period is from January 1990 through November 2004. The sample contains 129 observations, including 116 scheduled meetings. Daily data are used in all regressions. The regressions are estimated using (1) OLS with the White (1980) heteroskedasticity consistent covariance matrix and (2) MM weighted least squares procedure introduced by Yohai (1987). Standard errors are shown in parentheses.
* Coefficient is statistically significant at 10% level.
** Coefficient is statistically significant at 5% level.
*** Coefficient is statistically significant at 1% level.

Investor sentiment changes are strongly positively correlated with the aggregate stock returns. Similarly, Brown and Cliff (2005) find that stock market valuation errors are positively correlated with investor sentiment. Therefore, the results in Table 3 provide evidence that the effect of monetary policy on investor sentiment contributes to the asymmetric reaction of aggregate stock returns to monetary news.

In the next sub-section we will examine the effect of sensitivity of stock returns to sentiment changes on the response of disaggregated stock returns to monetary news. In this analysis, it is important to control for key determinants of cross-sectional stock returns. Petkova (2006) and Hahn and Lee (2006) show that changes in default spread and term spread are important state variables that capture information contained in the Fama-French factors. The default spread contains information about the market's expectations of future credit market conditions. The term spread reflects expectations of future interest rates. Therefore, we examine the effect of monetary news on the default spread and term spread factors. The default spread is calculated as the difference between the yield of a corporate Baa bond and 10-year Treasury constant maturity rate. The term spread is defined as the difference between the 10-year and 1-year Treasury constant maturity rates. Following Hahn and Lee (2006), the default spread factor is defined as $\Delta DEF_t \equiv -(def_t - def_{t-1})$, where def_t is the default spread at time t. The term spread factor is defined as $\Delta TERM_t \equiv (term_t - term_{t-1})$, where $term_t$ is the term spread at time t.

The estimation results for the default spread and term spread factors using daily data are shown in Panel A of Table 4. The results for the default spread factor show an asymmetric reaction to monetary shocks in different market regimes. In bull markets, an unexpected increase in the fed funds target is followed by an increase in the default spread factor (i.e., by a decline in the default spread). The target surprise coefficient for the total surprise is insignificant in bear markets. When the total surprises are split into level and timing shocks, however, the coefficient of the timing surprise in bear markets is negative and statistically significant, showing that, for example, the default spread narrows when the FOMC cuts the target rate sooner than expected.

The results for the term spread factor show less asymmetry between the market regimes and between level and timing surprises. The expectations of future interest rates seem to respond somewhat stronger to timing and level surprises in bull markets. The term spread shows little response to timing shocks in bear markets. Overall, the results in Tables 3 and 4 suggest that the strong stock market response to timing shocks in bear markets documented in Table 2 may be related to the effect of these shocks on investor sentiment and the expectations of future credit market conditions.

4.3. Cross-sectional results

Our second hypothesis is that monetary news moves stock prices, in part, through its effect on investor sentiment. If investor sentiment plays a role in the effect of monetary news on stock returns, stocks that are more sensitive to sentiment changes should react more strongly to such news. To measure the sensitivity of firm-level stock returns to fluctuations in market sentiment, we estimate the following model for monthly excess returns on stock i:

Table 5
Summary statistics for factor loadings.

	β_i^{mkt}	β_i^{def}	β_i^{term}	β_i^{sent}
Panel A. Descriptive statistics				
Mean	1.06	−0.17	0.21	−0.66
Median	1.00	−0.78	0.22	−1.18
Standard deviation	0.50	8.87	4.05	1.98
Panel B. Correlations				
β_i^{mkt}	1.00			
β_i^{def}	0.21***	1.00		
β_i^{term}	0.22***	−0.15***	1.00	
β_i^{sent}	0.41***	0.18***	0.03	1.00

The table shows Pearson correlations of the coefficients of the regression in Eq. (6). The sample contains 465 firms.
*** Correlation is statistically significant at 1% level.

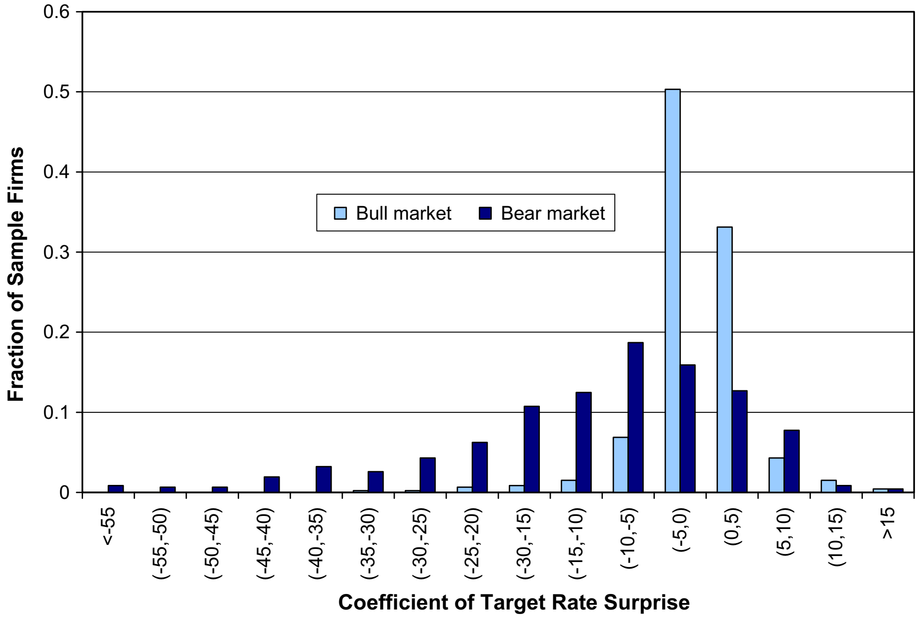

Fig. 3. Distribution of responses to target rate surprises across S&P 500 stocks.

$$R_{it} = \alpha_i + \beta_i^{mkt} R_{m,t} + \beta_i^{def} \Delta DEF_t + \beta_i^{term} \Delta TERM_t + \beta_i^{sent} \Delta SENT_t + \varepsilon_i, \quad (6)$$

where $R_{m,t}$ is the value-weighted excess return on all NYSE, AMEX and NASDAQ stocks from CRSP, ΔDEF_t and $\Delta TERM_t$ are the default spread and term spread factors defined in the previous sub-section, and $\Delta SENT_t$ is the index of sentiment changes from Baker and Wurgler (2006, 2007). The coefficients β_i^{def} and β_i^{sent} measure sensitivities of firm-level stock returns to changes in credit market conditions and investor sentiment, respectively. The model is estimated over our sample period for stocks included in the S&P 500 index as in December 2004. Stocks with fewer than 60 monthly return observations are removed, leaving a sample of 465 firms.

The summary statistics for the estimated beta coefficients are shown in Table 5. The default spread factor betas are positively correlated with the sentiment betas, showing that stocks sensitive to changes in credit market conditions are also more affected by changes in investor sentiment.

We proceed by estimating the basic regression in Eq. (4) with OLS using daily data for each stock separately. The distribution of the coefficient estimates is shown in Fig. 3. The coefficient estimates of the stock responses in bull market range from −31.96 to 28.85, with a mean of −0.83 and median of −0.66. Less than 13% of these coefficient estimates are statistically significant at the 10% level or better. For bear markets, the range of the coefficient estimates is from −59.14 to 17.82, with a mean of −10.84 and median of −8.13. Over 62% of these estimates are statistically significant at the 10% level or better, including 21 positive coefficient estimates. Seventeen of the 21 firms that show significant positive responses to monetary news in bear markets are non-durable goods firms, utilities or energy firms. The distribution of bear market responses is skewed to the left.

To explain the heterogeneity in the firm-level responses, we regress the estimated coefficients γ_1 and γ_2 on the factor betas. This allows examining whether stocks most sensitive to changes in credit market conditions, interest rate expectations and sentiment react more strongly to monetary news. Specifically, we estimate the following cross-sectional regression[13]:

$$\gamma_i = \alpha_0 + \alpha_1 \beta_i^{mkt} + \alpha_2 \beta_i^{def} + \alpha_3 \beta_i^{term} + \alpha_4 \beta_i^{sent} + \sum_{sectors} \alpha_{sectors} D_{sectors} + \varepsilon_i, \quad (7)$$

where γ_i is either γ_1 or γ_2 in Eq. (5) estimated separately for each firm i, and β_i^{mkt}, β_i^{def}, β_i^{term} and β_i^{sent} are the factor loadings (betas) for market, default spread, term spread and sentiment, respectively.[14] To simplify comparison and interpretation of the coefficients, all factor loadings (betas) are normalized using their sample means and standard deviations. The regression also includes industry dummies to account for sectoral heterogeneity in the effect of monetary shocks on stock returns. The energy sector is used as the base sector in the regression. The estimate of the intercept can be interpreted as the reaction of an energy stock with all factor betas equal to their sample means. The coefficients of the sectoral dummies signify the additional reaction of the respective industry relative to the energy sector. To make sure our results are not driven by a small number of outliers, we estimate the regression in (7) using OLS and the MM robust regression procedure.

The regression results are reported in Table 6. In bull markets, sensitivities to the term spread factor and sentiment have no statistically significant effect on the impact of target rate changes on stock returns. This finding is consistent with monetary shocks having little effect on stocks in good times. The bear market results are more interesting. The OLS regression R-squared is about 0.76, compared to only 0.03 for the bull market results. As expected, stocks with high market betas are more affected by Fed policy. According to the theories of the credit channel of monetary transmission, firms that are relatively financially constrained should be most affected by monetary shocks in bad economic times because such shocks affect their access to credit.[15] Consistent with the credit channel, we find that firms with higher betas of the default spread factor, i.e., those that are more sensitive to credit market conditions, are more affected by monetary shocks in bear markets.

[13] The regression in Eq. (7) uses generated regressors. The statistical significance of the results is unchanged when bootstrapped standard errors are used.

[14] Peersman and Smets (2005) use a similar two-step approach by first estimating the impact of monetary shocks on output growth in several industries and then regressing this impact on industry characteristics.

[15] See, for example, Bernanke et al. (1996) for a thorough discussion of the credit channel of monetary transmission.

Table 6
Effect of the market risk, sentiment and credit market conditions on the response of daily disaggregated stock returns to target rate changes.

	Bull market		Bear market	
	OLS	Robust regression	OLS	Robust regression
Intercept	0.45 (0.96)	1.16* (0.62)	−2.35** (1.07)	−2.16* (1.25)
Factor betas				
Market	−0.69 (0.45)	−0.85*** (0.19)	−5.90*** (0.56)	−6.14*** (0.40)
Default spread factor	−0.06 (0.51)	0.53*** (0.18)	−3.56*** (0.49)	−3.27*** (0.35)
Term spread factor	−0.19 (0.46)	−0.33** (0.17)	−1.00** (0.42)	−1.00*** (0.33)
Sentiment	0.22 (0.45)	0.23 (0.19)	−4.36*** (0.70)	−5.35*** (0.42)
Sector dummies				
Business equipment	0.28 (1.50)	−0.20 (0.81)	−11.05*** (1.50)	−11.10*** (1.58)
Telecom	−1.76 (2.24)	−2.60* (1.36)	−11.25*** (2.40)	−11.46*** (2.52)
Durable	−0.76 (1.32)	−1.89 (1.16)	−12.74*** (1.73)	−13.48*** (2.38)
Manufacturing	−1.57 (1.19)	−1.63** (0.77)	−7.36*** (1.59)	−8.52*** (1.59)
Non-durable	−2.76*** (1.00)	−3.42*** (0.79)	−5.33*** (1.41)	−5.97*** (1.61)
Finance	−1.31 (0.98)	−2.00*** (0.70)	−10.91*** (1.23)	−11.47*** (1.41)
Chemicals	−1.73 (1.16)	−2.55*** (0.95)	−4.88** (2.02)	−7.03*** (2.01)
Utilities	−2.84*** (1.04)	−3.78*** (0.84)	−4.33*** (1.52)	−6.07*** (1.72)
Retail	−1.43 (1.09)	−1.62** (0.78)	−11.98*** (1.64)	−12.17*** (1.58)
Health	−1.42 (1.12)	−1.31* (0.80)	−4.16*** (1.30)	−4.32*** (1.61)
Other	−1.76 (1.49	−2.19*** (0.83)	−11.44*** (1.53)	−11.37** (1.66)
R^2	0.033	0.080	0.766	0.553

The reported coefficients are for the following cross-sectional regression: $\gamma_i = \alpha_0 + \alpha_1 \beta_i^{mkt} + \alpha_2 \beta_i^{def} + \alpha_3 \beta_i^{term} + \alpha_4 \beta_i^{sent} + \sum_{sectors} \alpha_{sectors} D_{sectors} + \varepsilon_i$, where γ_i is either γ_1 or γ_2 in Eq. (4) estimated separately for each firm *i*, and β_i^{mkt}, β_i^{def}, β_i^{term} and β_i^{sent} are the factor loadings (betas) for market, default spread factor, term spread factor, and sentiment, respectively, estimated as discussed in Section 4.3. The sample contains 465 firms. All factor loadings (betas) are normalized using their sample means and standard deviations. The regressions are estimated using (1) OLS with the White (1980) heteroskedasticity consistent covariance matrix and (2) MM weighted least squares procedure introduced by Yohai (1987). Standard errors are shown in parentheses.
* Coefficient is statistically significant at 10%, level.
** Coefficient is statistically significant at 5% level.
*** Coefficient is statistically significant at 1% level.

Furthermore, the significant estimates of the coefficient of the sentiment beta show that the impact of target rate surprises in bear market periods is especially pronounced for stocks that are more sensitive to changes in investor sentiment. These findings support the conclusion that Fed policy affects stock returns, at least in part, through its effects on investor sentiment and expectations of credit market conditions. Changes in expectations of future interest rates appear to be less important in explaining the stock market's reaction to monetary news.

The results also show that, controlling for firm-specific factor sensitivities, some industries react to monetary news more strongly than others. Specifically, technology, telecommunications, durable goods, retail and finance industries are most strongly affected by target rate changes. The response of the energy sector, captured by the regression intercept, is relatively weak. These industry effects are consistent with Ehrmann and Fratzscher (2004).

Bernanke and Kuttner (2005) show that the observed cross-industry variation in stock responses to target rate shocks is explained reasonably well by the one-factor CAPM. We examine whether our model in Eq. (7) does a better job in explaining the variation in stock responses than the CAPM. To obtain the stock response implied by the CAPM, we multiply the stock's beta from a single-factor market model by the estimated response of the CRSP value-weighted excess return to target rate surprises. Panel A of Fig. 4 plots the estimated stock responses to monetary news in bear market against the fitted responses based on the CAPM. The plot shows that the CAPM tends to misestimate the responses of high and low beta stocks.

A significant number of stocks tend to respond positively to monetary news. Because these stocks have positive market betas, the CAPM is unable to explain such positive responses. Panel B reveals a much closer correspondence between the estimated responses of stock returns and the fitted responses from OLS estimation of Eq. (7).[16] Therefore, accounting for sensitivity of stock returns to the yield spread factors and investor sentiment, as well as for systematic variation across industries, gives a more accurate description of the reaction of stock returns to monetary shocks.

Table 7 reports the results of regressions in which the dependent variables are the stocks' responses to timing and level shocks.[17] When the dependent variable is the stock's reaction to timing shocks, the OLS coefficient of the sentiment beta is larger by a factor of about three compared to the similar coefficient in the level shocks regression. This result shows that stocks that are sensitive to sentiment moves are more strongly affected by timing surprises.

The results also show pronounced sectoral heterogeneity in the response to timing shocks. For example, the insignificant estimate of the intercept shows that energy stocks with average sensitivities to the four factors included in the model show no reaction to timing surprises. At the same time, prices of telecom stocks with average factor sensitivities increase by about 3.51% in response to a hypothetical negative 10-basis point timing surprise in bear markets ($-0.1(1.36 - 36.49) = 3.51\%$).

4.4. Robustness checks

Several additional robustness checks were conducted, including omitting unscheduled FOMC meetings, limiting the sample period to 1994–2004 when all target rate decisions were announced immediately after the meeting, using change in the new stock mutual fund flow and change in the VIX index as alternative investor

[16] The pseudo R-squared for the stock responses implied by the CAPM is about 0.58, significantly lower than the OLS R-squared of the model in Eq. (7).

[17] To save space, we tabulate only the regression results relating to stocks' reactions to timing and level shocks in bear markets.

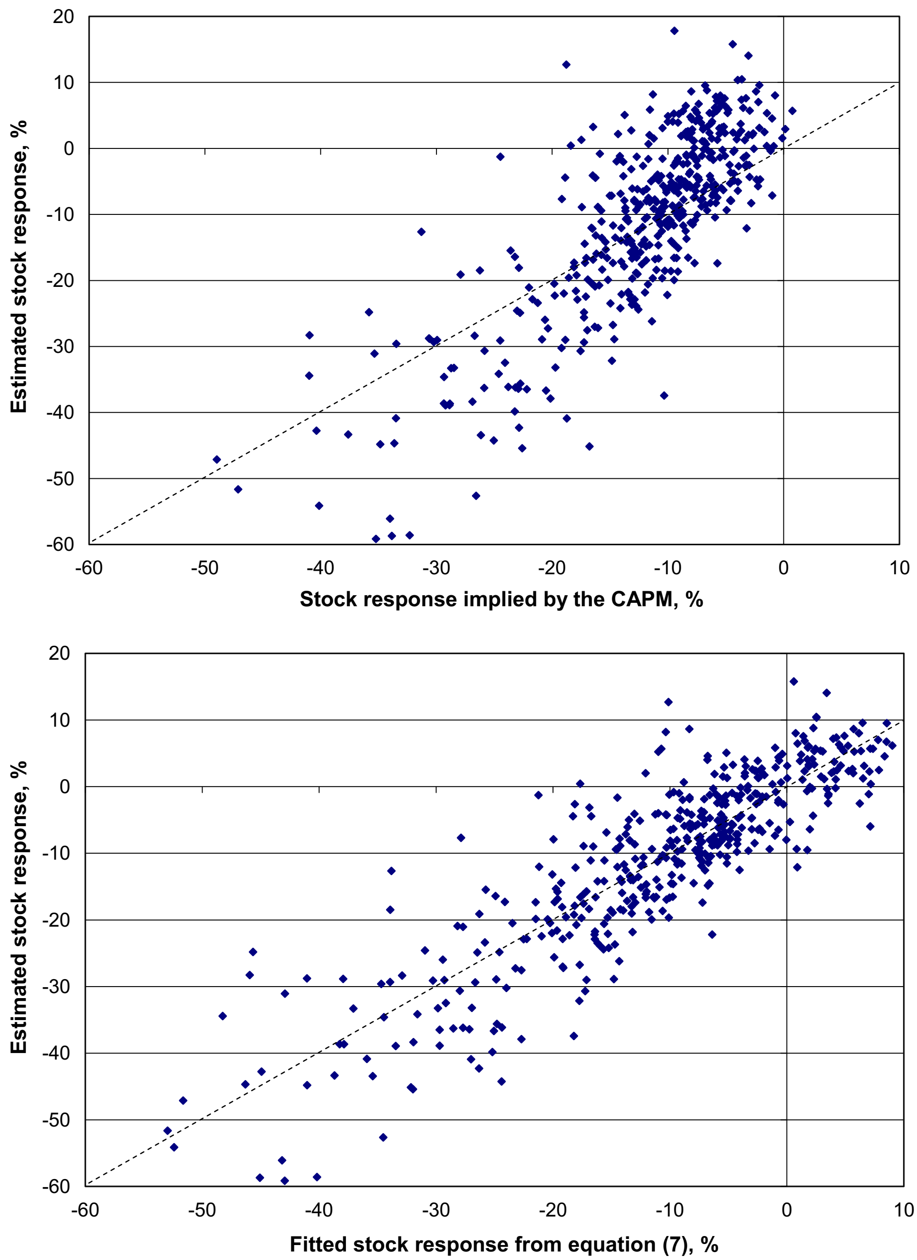

Fig. 4. Fitted and estimated stock responses to target rate surprises in bear market. The stock responses implied by the CAPM are calculated as a product of the stock's beta from a single-factor market model and the estimated response of the CRSP value-weighted excess return to target rate surprises. The first panel – fitted values based on CAPM implications. The second panel – fitted values based on OLS estimation of Eq. (7).

sentiment measures, and using a dummy variable based on the 20% bull/bear market threshold as a proxy for the market regime. The results were similar to those reported above. The results of the robustness checks are not tabulated to save space but are available upon request.

5. Summary and conclusion

This paper seeks to answer two interrelated questions. First, do monetary policy decisions affect the sentiment of stock market investors? Second, does the investor psychology influence the stock market's reaction to monetary news? We find that monetary policy shocks have a strong impact on investor sentiment in bear market periods. Furthermore, our analysis of stock returns on FOMC announcement days shows that stocks that are more sensitive to sentiment changes react much more strongly to monetary news.

We also find that changes in timing of otherwise expected policy actions have a large effect on investor sentiment and stock prices in bear markets. Prior research does not account for time variation in the stock market's response to timing surprises and concludes that such timing changes have no effect on stocks. Overall, our results are consistent with the conjecture of Bernanke and Kuttner (2005) that a market inefficiency driven by investor behavior may contribute to the strong effect of monetary news on stock returns.

Table 7
Effect of the market risk, sentiment and credit market conditions on the response of daily disaggregated stock returns to level and timing surprises.

	Bear market: level shocks		Bear market: timing shocks	
	OLS	Robust regression	OLS	Robust regression
Intercept	−2.97*** (1.04)	−2.59* (1.27)	1.36 (2.40)	1.03 (2.38)
Factor betas				
Market	−5.04*** (0.55)	−4.83*** (0.39)	−11.21*** (1.02)	−11.64*** (0.72)
Default spread factor	−3.46*** (0.48)	−3.10*** (0.35)	−4.45*** (0.91)	−4.70*** (0.65)
Term spread factor	−1.11*** (0.41)	−1.09*** (0.32)	−0.47 (0.92)	−0.53 (0.63)
Sentiment	−3.23*** (0.70)	−4.57*** (0.43)	−11.22*** (1.13)	−10.45*** (0.72)
Sector dummies				
Business equipment	−8.21*** (1.51)	−8.26*** (1.60)	−28.52*** (3.26)	−28.32*** (3.00)
Telecom	−7.06*** (2.70)	−7.61*** (2.55)	−36.49*** (3.65)	−35.97*** (4.79)
Durable	−10.76*** (1.78)	−11.80*** (2.40)	−24.37*** (4.70)	−23.63*** (4.51)
Manufacturing	−5.38*** (1.56)	−6.94*** (1.61)	−18.86*** (3.37)	−18.07*** (2.99)
Non-durable	−3.10** (1.39)	−3.68** (1.63)	−18.84*** (2.83)	−18.61*** (3.04)
Finance	−7.86*** (1.21)	−8.40*** (1.43)	−29.38*** (2.52)	−28.86*** (2.67)
Chemicals	−3.07 (1.97)	−5.45*** (2.03)	−15.63*** (3.51)	−14.98*** (3.69)
Utilities	−0.84 (1.46)	−1.77 (1.73)	−25.60*** (3.08)	−26.84*** (3.26)
Retail	−10.93*** (1.67)	−11.08*** (1.60)	−18.17*** (3.12)	−18.05*** (3.00)
Health	−1.53 (1.30)	−1.59 (1.63)	−20.19*** (2.76)	−20.20*** (3.07)
Other	−9.11*** (1.49)	−9.26*** (1.68)	−24.87*** (3.57)	−24.38*** (3.18)
R^2	0.711	0.535	0.755	0.460

The reported coefficients are for the following cross-sectional regression: $\gamma_i = \alpha_0 + \alpha_1\beta_i^{mkt} + \alpha_2\beta_i^{def} + \alpha_3\beta_i^{term} + \alpha_4\beta_i^{sent} + \sum_{sectors}\alpha_{sectors}D_{sectors} + \varepsilon_i$, where γ_i is either γ_3 or γ_4 in Eq. (5) estimated separately for each firm *i*, and β_i^{mkt}, β_i^{def}, β_i^{term} and β_i^{sent} are the factor loadings (betas) for market, default spread factor, term spread factor and sentiment, respectively, estimated as discussed in Section 4.3. The sample contains 465 firms. All factor loadings (betas) are normalized using their sample means and standard deviations. The regressions are estimated using (1) OLS with the White (1980) heteroskedasticity consistent covariance matrix and (2) MM weighted least squares procedure introduced by Yohai (1987). Standard errors are shown in parentheses.
* Coefficient is statistically significant at 10% level.
** Coefficient is statistically significant at 5% level.
*** Coefficient is statistically significant at and 1% level.

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