

The Effects of Federal Funds Target Rate Changes on S&P100 Stock Returns, Volatilities, and Correlations

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ABSTRACT AND KEYWORDS	
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Asymmetric Effects of Federal Funds Target Rate Changes on S&P100 Stock Returns, Volatilities, and Correlations*

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Abstract

We study the effects of FOMC announcements of Federal funds target rate decisions on individual stock returns, volatilities and correlations at the intraday level. For all three characteristics we find that the stock market responds differently to positive and negative surprises. First, the average response to negative surprises is larger. Second, in case of bad news the mere occurrence of a surprise matters most, whereas for good news its magnitude is more important. These new insights are possible due to the use of intraday data. Financials and IT stocks show the strongest reaction, whereas Utilities stocks respond the least.

Keywords: monetary policy announcements, interest rate surprises, high-frequency data, realized volatility

JEL Classification: E44, E52, G14

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1 Introduction

This paper documents the presence of asymmetric effects of announcements of Federal Open Market Committee (FOMC) decisions concerning the Federal funds target rate, on stock market returns, volatilities and correlations. For all three characteristics we find that in case of bad news the mere occurrence of a monetary policy surprise matters most, whereas in case of good news its magnitude is more important.

The effects of monetary policy news announcements on exchange rates, interest rates, and stock prices have been examined extensively. This has provided considerable insight into the link between monetary policy and asset prices and, thereby, has benefited our understanding of the monetary policy transmission mechanism. For example, an important common finding in the existing literature is that asset returns and volatilities only respond to the surprise component in monetary policy announcements. Our study makes three contributions. First, we focus on asymmetries in the effects of monetary policy surprises. Several such asymmetries have been suggested in the literature, including the possibility that the response of stock prices and volatility depends on the surprise being positive or negative, or on the direction of the actual target rate change (Lobo, 2000; Bernanke and Kuttner, 2005), or on the phase of the business cycle (Guo, 2004; Andersen et al., 2007). The empirical evidence for the presence of such asymmetric effects is, however, scarce. As discussed in more detail below, this may be due to the use of daily measures of returns and volatilities most previous literature has relied upon. Here we use intraday data so that we can obtain more precise and less noisy estimates of the effects of monetary

policy surprises, and any asymmetries therein.

This use of intraday data is in itself a second contribution. Most previous studies on the effects of monetary policy shocks on the stock market use daily data. As noted by Bomfim (2003), this may reduce the precision with which the impact of target rate announcements is estimated as other economic data could be released on the same day, see also Fair (2002).¹ In an extreme scenario, endogeneity may arise if the stock market and monetary policy both respond simultaneously to other new information, see Rigobon and Sack (2003, 2004) and Bernanke and Kuttner (2005) for discussion.

Third, we use data at the individual stock level, which enables us to examine the heterogeneity of the response across stocks and to explore the effects of monetary policy news on correlations between stocks. Most existing research for the stock market examines the effects of monetary policy surprises on the market as a whole, see Bomfim (2003), Bernanke and Kuttner (2005), Boyd et al. (2005), Gürkaynak et al. (2005), Hausman and Wongswan (2006), Andersen et al. (2007), Zebedee et al. (2008), Wongswan (2009), and Andersson (in press), among others. As a consequence, the extent of heterogeneity in the response to monetary policy announcements across individual stocks is not well understood, although Ehrmann and Fratzscher (2004) present evidence that this may be substantial.² In addition, due to the focus on the aggregate market reaction, the prior literature does not

¹Wongswan (2006) illustrates this point in the context of transmission of information contained in macroeconomic announcements across international equity markets. The effects of macroeconomic announcements on exchange rates and interest rates are more commonly analyzed with high-frequency intra-day data, see Andersen *et al.* (2003) and Faust *et al.* (2007), among others, for recent examples.

²Guo (2004) and Bernanke and Kuttner (2005) also document different effects of monetary policy surprises across size portfolios and across sectors, respectively.

consider the effects of news announcements on correlations between stocks (or other assets). A notable exception is Christiansen and Rinaldo (2007), who examine the behavior of the correlation between stocks and bonds around news announcements.

Although our paper is related to the broader literature on the effects of macroeconomic news announcements on stock prices, we specifically focus on Federal funds target rate announcements for two reasons. First, many other macroeconomic news announcements are made prior to or at the opening of the stock exchange trading day, which bars the use of high-frequency intraday data. Second, there is a natural link between the discount rate and stock prices. The dividend discount model states that the value of a stock is equal to the future cash flows expected to be generated by the firm discounted at an appropriate risk-adjusted rate. In its most standard setting the value of a stock is equal to the dividend per share divided by the difference between the discount rate and the dividend growth rate.³ Hence both an expected increase (decrease) in the future discount rate as well as an unexpected increase (decrease) in the current discount rate should lower (increase) stock prices. A further advantage is that surprises in target rate changes can be derived from the Federal funds futures rate, as first demonstrated by Kuttner (2001) and subsequently adopted by Bomfim (2003), Fleming and Piazzesi (2005), Gürkaynak et al. (2005), Zebede et al. (2008) and Wongswan (2009), among others.

In our empirical analysis we examine the effects of Federal funds target rate decisions made at scheduled FOMC meetings between May 1997 and October 2006 on intraday returns, volatilities and correlations of the constituents of the S&P100

³See Ehrmann and Fratzscher (2004) and Bernanke and Kuttner (2005) for an extensive analysis of the question why stock prices respond to monetary policy news announcements and to target rate surprises in particular, and also Campbell and Vuolteenaho (2004) on decomposing stock betas into news about future cash flows and future discount rates.

index. We measure the effects on returns during the five-minute interval immediately following the announcement, and volatilities and correlations during the 60-minute window starting 10 minutes before the target rate decision is made public. We perform an extensive analysis for the presence of various asymmetries in the effects of news announcements, by examining whether their effects are different for positive and negative surprises, for target rate increases and decreases, and during economic contractions and expansions.

Our main findings can be summarized as follows. First, we confirm existing results that for returns and volatilities consistent with previous studies, our results overwhelmingly show that indeed only surprises in target rate decisions matter, and that the actual (or expected) rate changes do not. The stock market's reaction to surprises is fairly strong though. An unexpected 10 basis points increase of the target rate leads to a 46 basis points negative return in the five minutes immediately following the announcement⁴ and to a 51 basis points increase in volatility during a 60-minute window around the announcement.

Second, we find considerable heterogeneity in the effects of target rate surprises on returns and volatilities across sectors. Financials and IT stocks show the strongest response, while Utilities stocks show the weakest response. Concerning the persistence of the effects of monetary policy surprises, they appear to trigger an immediate reaction in stock prices, in the sense that prices jump upon the public release of FOMC decisions, with large returns occurring only during the first five minutes after the announcement. The effects on volatility are much longer-lasting and are

⁴For a different sample period (1995-2002) and using a different methodology Zebedee et al. (2008) report a negative market return of 48 basis points after a 25 basis points positive surprise.

noticeable until at least an hour after the announcement, corroborating the results of Andersen et al (2003, 2007).

Third, intraday correlations also are affected by unexpected target rate changes only, with a surprise of 10 basis points doubling the average correlation between stocks from 0.20 to 0.40. The effects are relatively short-lived, with correlations returning to normal levels after around 15-30 minutes.

Fourth, we find that positive and negative target rate surprises have rather different effects on the stock market. In the former case (negative news for stocks), the mere *occurrence* of a surprise triggers a reaction in stock prices, volatilities and correlations, which is independent of the *magnitude* of the surprise. On the other hand, for negative surprises (positive news for stocks), the magnitude of the surprise clearly is important. As a result, the effects of negative news are larger than the effects of positive news for small magnitudes of the target rate surprise and vice versa for large surprises. For example, an unexpected target rate decrease with 5 (15) basis points provokes a positive return of 14 (73) basis points on average, compared to a 20 (36) basis points negative return following a positive surprise of the same magnitude. This is in contrast with Bernanke and Kuttner (2005), who find no evidence for asymmetric effects of positive and negative news in FOMC decisions using daily stock returns. This clearly demonstrates the advantage of using intraday data for measuring the response of stock prices to (monetary policy) news announcements.

Fifth, we find that positive target rate surprises result in larger changes in stock volatility than negative ones for realistic magnitudes of the surprise. A 5 (15) basis points unexpected target rate increase also increases volatility by 50 (82) basis points, whereas an unexpected decrease of the same magnitude increases volatility by 46

(103) basis points. This result is partly in agreement with Bomfim (2003), who finds that positive surprises in target rate changes tend to have a larger effect on daily S&P500 index volatility than negative surprises.

Sixth and finally, we find that correlations between stocks increase more after negative news. Correlations between stocks from the same sector increase by 0.27 (0.34) following a 5 (15) basis points unexpected target rate increase, and by 0.23 (0.45) following a negative surprise. This is intraday evidence of a well-documented asymmetric response of correlations to positive and negative news, see Longin and Solnik (2001), among others. Cappiello et al. (2006), for example, find that conditional correlations among financial markets in the same region increase dramatically when bad news hits the markets. Ang and Chen (2002) find that correlations between US stocks and the aggregate market are much higher for downside moves, especially for extreme downside moves, than for upside moves.

The remainder of the paper is organized as follows. Section 2 describes our data. Section 3 lays out the methodology we use to analyze the effects of FOMC announcements on returns, volatilities and correlations of the S&P100 constituent stocks and discusses the empirical results.⁵ Section 4 concludes.

2 Data

In this section we describe the available data set of FOMC announcements of Federal funds target rate changes and intraday stock prices.

⁵Additional empirical results are provided in a supplemental Appendix to this paper.

2.1 FOMC announcements and Federal funds target rate surprises

We examine the effects of Federal funds target rate decisions made at scheduled FOMC meetings between May 1997 and October 2006. The FOMC meets eight times a year (approximately every six weeks), such that our sample period contains 77 target rate decisions. In addition, four unscheduled meetings were held during our sample period, on October 15, 1998, January 3, 2001, April 18, 2001, and September 17, 2001. We omit these unscheduled meetings from our analysis, as they have rather different effects than target rate decisions made at regular, scheduled meetings, see Bernanke and Kuttner (2005) and Fleming and Piazzesi (2005).⁶

Given the forward-looking nature of financial markets, it is likely that anticipated target rate changes have already been incorporated in stock prices before the actual change is announced. At least we should allow for the possibility that investors respond differently to expected and unexpected FOMC decisions. We use the methodology proposed by Kuttner (2001) to obtain a measure of the surprise in the Federal funds target rate change from the change in the current-month Federal funds futures rate on the day of the FOMC announcement.⁷ As the futures contract's payoff depends on the monthly average Federal funds rate, the change in the futures rate is scaled up by a factor reflecting the number of remaining days in

⁶Appendix A shows that the target rate decisions made at these unscheduled meetings took the market almost completely by surprise with the unexpected target rate change being almost equal to the actual change, deviating substantially from scheduled announcements.

⁷Gürkaynak et al. (2005) provide evidence that the effects of FOMC announcements have multiple dimensions that can be adequately captured by two factors, which are obtained as rotated principal components of changes in Federal funds future rates for different maturities. The first 'target' factor closely corresponds with the surprise in the current-month Federal funds target rate, while the second 'path' factor reflects market expectations of future policy actions. Given that these two factors are orthogonal, the fact that we do not include the path factor in our regressions does not affect our results on the effects of the surprise change in the current target rate on stock prices. We leave a detailed investigation of the effects of the path factor for future research.

the month, which are affected by the change. In sum, we compute the unexpected target rate change or the “surprise” S as

$$S = \frac{D}{D-d} (f_d^0 - f_{d-1}^0), \quad (1)$$

where f_d^0 is the current-month futures rate at the end of the announcement day d , and D is the number of days in the month. In order to avoid disturbances from end-of-month effects in the effective funds rate, we use the change in the next month’s futures rate for announcements made within the last seven calendar days of the month, following Bernanke and Kuttner (2005) and Fleming and Piazzesi (2005). Throughout the empirical analysis below the surprise S is measured in basis points.

Appendix A shows the dates of the FOMC meetings and the changes in the Federal funds target rate together with the corresponding surprises. The mean (median) surprise for the 77 scheduled FOMC meetings is equal to -0.23 (0.00) basis points with a standard deviation of 4.35 basis points, suggesting that market expectations of these monetary policy actions are essentially unbiased. Interestingly, there is a substantial difference in variability of the surprises for the different types of FOMC decisions. The standard deviation of surprises in case of a target rate decrease is equal to 9.51 basis points, compared to only 2.73 and 2.56 basis points in case the FOMC decides to lower the target rate or to leave it unchanged, respectively. Admittedly these numbers are based on small samples (during our sample period, the target rate was increased (decreased) 23 (12) times), but they nevertheless suggest that uncertainty is considerably larger when monetary policy actions are tightening than when they are loosening.⁸

⁸We also observe a marked decline in the standard deviation of the target rate surprises from

2.2 Intra-day stock returns

The stock price data set consists of open, high, low, and close transaction prices at the one-minute sampling frequency for the June 2004 S&P100 index constituents for the period from April 16, 1997 until November 3, 2006. For some stocks the price series start at a later date, while for others they stop earlier. On average, prices are available for 94 stocks at the time of the 77 scheduled FOMC meetings.

From the one-minute closing prices we obtain intraday returns, volatilities and correlations as follows. First, we compute five-minute returns for a window surrounding the FOMC announcements, from 15 minutes before until 75 minutes after the announcement. In the return regressions discussed in Section 3 we use the stock returns during the five-minute interval immediately following the announcement as the dependent variable, following the evidence reported in the literature that the effects on price levels occur instantaneously and are short-lived, see Ederington and Lee (1995) and Andersen et al. (2007), among others. The use of precise announcement times is therefore essential for the accuracy of this analysis. Although the FOMC announcements are scheduled to be released at 14:15 EST, in practice the exact timing has varied by up to several minutes. We therefore make use of exact announcement times obtained from the Federal Reserve Board of Governors,⁹ which are shown in Appendix A. For volatilities, it has been found that announcement effects are more sluggish and last longer, see Ederington and Lee (1993) and Fleming and Remolona (1997), among others. For that reason we focus on the 60-minute

5.34 basis points before the August 2003 meeting to just 1.22 basis points thereafter. This may be related to changes in the Federal Reserve's communication policy during the Greenspan era, see Kohn and Sack (2004), Poole (2005), Swanson (2006), and Ehrmann and Fratzscher (2007a,b), among others.

⁹We are grateful to Jonathan Wright for providing these exact announcement times.

window between 10 minutes before the announcement until 50 minutes thereafter, following Fleming and Piazzesi (2005).¹⁰ In particular, we compute the realized volatility (RV) for stock i for the announcement on day t as

$$RV_{it} = \sqrt{\sum_{k=l}^u R_{it,k}^2}, \quad (2)$$

where $R_{it,k}$ is the five-minute return for stock i in interval k of day t , with the interval $k = 0$ corresponding to the first five minutes after the announcement, where we set $l = -2$ and $u = 9$ to capture the selected 60-minute window.¹¹ Similarly, the realized correlation (RC) between stocks i and j for the announcement on day t is computed as

$$RC_{ijt} = \frac{\sum_{k=l}^u R_{it,k} R_{jt,k}}{RV_{it} RV_{jt}}, \quad (3)$$

where RV_{it} and RV_{jt} are the realized volatilities for stocks i and j computed according to (2).

3 Methodology and empirical results

This section consists of three parts, analyzing the effects of FOMC target rate decisions on stock returns, on volatilities, and on correlations, respectively. In each case both the employed methodology and the results are presented. The regressions below are implemented at the individual stock level. To save space, we present results

¹⁰We examine the robustness of our results with respect to the length of this window, by repeating the complete analysis with volatilities and correlations over 30- and 90-minute windows (starting 5 and 15 minutes before the announcement, respectively) as well. In general we find that results and conclusions are robust to the choice of window length.

¹¹It may appear that realized volatility as defined in (2) is not suitable for properly measuring the effects of target rate decisions on volatility as it includes the possible jump in prices due to the FOMC announcements. To disentangle the continuous and jump parts of total variation, we use the concept of bipower variation (BPV) proposed by Barndorff-Nielsen and Shephard (2004), see also Andersen *et al.* (2007). Bipower variation, defined as the sum of cross-products of absolute returns in adjacent five-minute returns, that is, $BPV_{it} = \frac{\pi}{2} \sum_{k=l}^{u-1} |R_{it,k}| |R_{it,k+1}|$, is not affected by the presence of price jumps and delivers a consistent estimate of the continuous volatility part. Using this BPV measure instead of RV we obtain similar conclusions, see the supplemental Appendix.

aggregated to the market and sector levels, by taking averages of the coefficients for the relevant individual stocks.¹² This enables us to assess the average effects of target rate changes on the market as a whole and any differences therein across sectors. Results for the individual stocks are occasionally presented to further illustrate the pervasiveness and heterogeneity of the response of stock prices to monetary policy announcements.¹³

3.1 The effect of FOMC meetings on stock returns

Table 1 shows means and standard deviations of the returns of individual stocks aggregated to the market and sector levels during the five-minute interval immediately following the Federal funds target rate announcements. The first column shows averages taken over all 77 scheduled FOMC meetings. These overall average returns are negative and significantly different from zero at the 1% level for the market and for all sectors. In order to gain more insight in the cause for these negative returns, we split the sample into several subgroups defined by the nature of the target rate change and the surprise component.

- insert Table 1 about here -

The second and third columns of Table 1 show the average return for those meetings at which the FOMC decided to increase (23 times) or decrease (12 times)

¹²Throughout, the reported standard errors for these average coefficients allow for heteroskedasticity as well as correlation of residuals across stocks, see Petersen (2009).

¹³Detailed results for the individual stocks can be found in the supplemental Appendix. As a robustness check, we also implemented the regression analysis for sector and market returns, obtained as equally weighted returns of the individual stocks. This renders very similar estimates of the average effects of FOMC announcements. The main difference occurs in the fit of the regressions as measured by the R^2 , which is considerably higher for the market and sector returns than for the average individual stock. This can be attributed to the fact that the aggregate returns contain much less idiosyncratic noise.

the target rate. The average returns following target rate decreases and increases are small as expected, given that the average surprises therein are small as well, being equal to -0.80 and 0.32 basis points, respectively.

The final two columns show the results for positive and negative surprises separately. Now we do observe a substantial response in stock returns. Recall that a positive surprise means that the target rate was increased more or decreased less than the market anticipated. This represents bad news for stocks as in this case the market underestimated the future discount factor. Hence, we see that the announcement of the FOMC decision triggers a significantly negative reaction in stock prices. Similarly, a negative surprise implies that the target rate ended up lower than expected. This is good news for stocks, which duly show a significant positive return. Also note that the response to negative news for stocks is larger than to positive news. After positive target rate surprises the average five-minute return is -21.1 basis points compared to 12.2 basis points after negative surprises. We observe significantly negative and positive returns following positive and negative surprises for all sectors, although there is considerable heterogeneity in magnitude. Average returns are largest for IT, Financials, Consumer Discretionary, and Telecommunications, while they are smallest for Utilities, Energy and Health Care stocks.

We examine the speed at which the market responds to the FOMC announcements by computing the average returns in five-minute intervals around the time of the news release, as shown in Figure 1, where we distinguish between average returns following positive, negative and zero surprises. As expected the response to target rate changes occurs mostly during the first five minutes after the announcement. Interestingly, we observe that the average returns between 5 and 20 minutes after the

announcement are negative for both negative and positive target rate surprises. This suggests some sort of overreaction of stock prices to positive news and underreaction to negative news. The change in stock prices following target rate surprises appears to be permanent with bad news having a larger price impact, as the (unreported) cumulative returns up to 75 minutes after the announcement are equal to -30 and 20 basis points for positive and negative surprises, respectively.

- insert Figure 1 about here -

Combining the average five-minute returns of -21.1 and 12.2 basis points following positive and negative target rate surprises with the overall average return of -3.8 basis points in Table 1 implies that the average return following the 23 announcements for which the surprise was equal to zero is less than minus one basis point. This indicates that the stock market is efficient to the extent that expected target rate changes are already incorporated into stock prices prior to the FOMC meetings and that only surprises lead to a reaction of stock prices. We continue with running three regressions, intended to confirm this formally and to examine whether the magnitude of the surprise is important. The first regression relates the stock return to the actual target rate change,

$$R_{it} = \alpha_i + \beta_i \Delta FF_t + \varepsilon_{it}, \quad (4)$$

where R_{it} is the return for stock i in the five-minute interval following the news release on day t , and ΔFF_t is the actual change in the Federal funds target rate, both measured in basis points. The second regression decomposes the actual target rate change in the expected component and the surprise,

$$R_{it} = \alpha_i + \beta_i S_t + \gamma_i (\Delta FF_t - S_t) + \varepsilon_{it}, \quad (5)$$

where S_t is the surprise (in basis points) measured by means of the change in the Federal funds futures rate, as defined in (1). If indeed only the surprise component in the target change affects stock prices, we would expect γ_i to be equal to zero and β_i to be significantly negative, where the expected sign follows from the fact that positive surprises mean bad news for stocks. In the third regression we account for the fact that certain ‘special’ FOMC announcements may have different effects than ‘regular’ target rate decisions. Results based on daily returns in Bernanke and Kuttner (2005) suggest that in particular this applies to so-called ‘reversal decisions’ changing the direction of short-term interest rates, that is, the first target rate increase following a period of decreases or vice versa. Preliminary analysis¹⁴ indicates that this is relevant for the reversal decisions during our sample period, taken at the meetings on September 29, 1998, on June 30, 1999 and on June 30, 2004.¹⁵ To allow for different effects of these reversal decisions, we estimate the regression

$$R_{it} = \alpha_i + \beta_i S_t + \gamma_i (\Delta FF_t - S_t) + \delta_i S_t D(\text{REV}_t) + \varepsilon_{it}, \quad (6)$$

where $D(\text{REV}_t)$ is a 0-1 dummy indicating whether or not a reversal decision was taken in the meeting at time t . Estimation results for these three regressions for the individual stocks aggregated to the market level (all stocks) and sector level are presented in Table 2.

- insert Table 2 about here -

¹⁴Among others, this is based on the computation of influence statistics for each observation in the sample, see also Bernanke and Kuttner (2005). These indicate that especially announcements of reversal decisions have a large influence on the estimation results for the regression in (5).

¹⁵Recall that we omit the unscheduled meeting on January 3, 2001, which also involved a reversal decision.

The results overwhelmingly confirm that surprises matter while the actual target rate changes do not. Consider the regression of the five-minute post-announcement stock returns on the surprise and the expected target rate change as given in (5). The average coefficient estimates in the first row of Table 2 imply a five-minute return of -46 basis points following a surprise of 10 basis points in the target rate change, corresponding quite closely with estimates reported by Bernanke and Kuttner (2005) based on daily CRSP value-weighted index returns. The coefficient of the expected rate change is positive at 0.12 but not significantly different from zero. This is consistent with market efficiency in that stock prices fully reflect expected interest rate changes, and react to new information only. The estimation results averaged to the sector level reveal considerable differences in the effects of target rate surprises across sectors, where our findings are in partial agreement with Ehrmann and Fratzscher (2004). We confirm their conclusion that stocks in non-cyclical sectors such as Utilities, Consumer Staples, Health Care, and Energy are less responsive to target rate surprises than the aggregate market. On the other hand, we do not find that cyclical and capital-intensive sectors such as Telecommunications, Consumer Discretionary, and Industrials are more responsive than the market average. Note though that Consumer Discretionary is in the top 3 in terms of average returns when considering positive and negative surprises separately, see the final two columns in Table 1, suggesting that asymmetric effects may be relevant for this sector. Conversely, while Ehrmann and Fratzscher (2004) find the reaction of stocks in the Financials sector to be very close to the market average, our results suggest that these stocks are most sensitive to target rate surprises, with the average estimate of the surprise coefficient in (5) being almost one and a half times larger than the market average.

Finally, we find relatively strong effects of the target rate surprises on IT stocks, which can perhaps be explained by the fact that during our sample period IT firms are largely built on future earnings instead of current earnings. Hence the discount factor would have a larger effect on the value of IT stocks.

The four columns on the right of Table 2 demonstrate that allowing for different effects of reversals is warranted, as the average δ_i estimates are significantly different from zero at the 5% level or better for the market level and for all sectors except Materials. Including the reversal term also leads to a substantial improvement of the explanatory power of the regression, with the average R^2 increasing from 0.19 to 0.28. We observe that reversals have much larger effects than ‘regular’ target rate decisions, with the average coefficient for reversals being equal to -18.08 compared to -3.97 for regular surprises. The effects of reversals also varies across sectors, with by far the largest effects occurring for stocks in the Financials sector, where an unexpected 10 basis points increase of the target rate in a reversal decision leads to a return of no less than -3.36 percent. Finally, compared to (5) allowing for different effects of reversals leads to smaller coefficients (in absolute value) for regular surprises, but all conclusions drawn previously continue to hold, including those with respect to heterogeneity across sectors.

The pervasiveness and heterogeneity of the response of stock prices to target rate surprises can perhaps best be seen from the regression results for the 100 individual stocks. Based on (6), the estimate of the surprise coefficient is significantly negative at the 1%, 5% and 10% levels for 61, 26, and 3 stocks, respectively. The majority of the individual betas are between -2 and -5 , but some are even below -8 . We refer to Ehrmann and Fratzscher (2004) for a detailed analysis of the possible determinants

of the heterogeneity in response to target rate surprises across firms. In addition to the industry effects discussed above, Ehrmann and Fratzscher (2004) document that small firms and financially-constrained firms respond significantly more to monetary policy surprises than large and less constrained ones.¹⁶

Given the above results, we focus on the effects of surprises in the target rate decisions in more detail. In particular, we examine the presence of different types of asymmetries in their effects on stock prices. As discussed in the introduction, different types of asymmetries may be present, depending on the sign of the surprise (bad news vs. good news), the direction of the target rate decision (loosening vs. tightening monetary policy), and the macroeconomic environment (expansions vs. recessions).¹⁷ The average returns in Table 1 suggest that these asymmetric effects may also be relevant for the S&P100 constituents, for example for Consumer Discretionary stocks, as mentioned before. We assess the empirical evidence for these asymmetries more formally using an extension of the previous regressions. For example, we test whether the post-announcement return is different following positive and negative surprises, and whether only the occurrence of a surprise matters or also its magnitude by means of the regression

$$R_{it} = \alpha_{0i} + (\alpha_{1i} + \beta_{1i}S_t)D(S_t < 0) + (\alpha_{2i} + \beta_{2i}S_t)D(S_t > 0) + \delta_i S_t D(\text{REV}_t) + \varepsilon_{it}, \quad (7)$$

where $D(A)$ is a dummy variable taking the value 1 if the event A is true and 0 otherwise. Regression results are presented in Table 3, showing average coefficient estimates across all stocks and across stocks within a given sector, as before.

¹⁶Using decile portfolios, Guo (2004) finds that the size effect in the responsiveness to monetary policy only occurs during economic recessions but not during booms.

¹⁷Fleming and Piazzesi (2005) document an asymmetric response of Treasury note yields depending on the slope of the yield curve. We find no such asymmetry for the S&P100 stocks and hence do not consider this further.

- insert Table 3 about here -

We observe a marked difference between positive and negative surprises. The average estimate of β_{1i} is significant at the 1% level for both the market level and for all individual sectors, while the average α_{1i} is not significant except for the IT and Telecommunications sectors. This implies that for negative surprises, meaning good news for stocks, the magnitude of the surprise is much more important than the fact that the actual target rate decision is different from market expectations. In contrast, in the case of positive target rate surprises, or bad news for stocks, it is not possible to determine whether the fact that there is a surprise or its magnitude is more important, as the average estimates of α_{2i} and β_{2i} are not significant individually, with a few exceptions. Note that this should not be interpreted as saying that stocks do not respond to positive surprises at all. In fact a Wald test shows that jointly the averages of α_{2i} and β_{2i} are significant at the 10% level or better for the market and all sectors except Energy, Financials, Health Care and Materials. In addition, it is useful to point out that the coefficient estimates imply that the response to negative news is in fact larger than the effect of positive news for realistic magnitudes of the target rate surprise of less than eight basis points, which occurs for more than 90 percent of the observations in our sample. For example, an unexpected increase of the target rate with 3.6 basis points (which is the mean absolute surprise across the non-zero surprises) provokes a negative market return of -18.0 basis points, compared to a positive return of only 5.8 basis points following an unexpected decrease of the target rate of the same magnitude.

The asymmetric effect of the magnitude of positive and negative surprises is also visible when considering the individual stock returns. The estimate of β_{1i} in (7) is

negative in all 100 cases and significant at the 1%, 5% and 10% levels for 77, 7, and 6 stocks, respectively. The corresponding numbers for β_{2i} are 0, 3, and 11. The difference between β_{1i} and β_{2i} is negative for all stocks, with the average being equal to -4.27 . A Wald test rejects the null hypothesis that the average difference is equal to zero at the 1% level, see Table 3. Note also that the Wald tests in Table 3 indicate that the asymmetry of positive and negative surprises is due to different responses to the magnitude and not to the occurrence of a surprise, as the null hypothesis $\beta_{1i} = \beta_{2i}$ can be rejected at the market level and for most sectors, while the null $\alpha_{1i} = \alpha_{2i}$ cannot.

The above results differ markedly from the findings of Bernanke and Kuttner (2005), who document weak support at best for asymmetric effects of positive and negative surprises based on daily returns. This demonstrates the advantage of using intraday data.¹⁸ Repeating our regression analysis using daily returns, we find that also at the daily level stock prices respond to surprises but not to expected target rate changes. The regression R^2 s in (5) and (6), however, are substantially lower, that is, noise contaminates the analysis when using daily data. For example, using daily individual stock returns as dependent variable, the R^2 of (6) is 0.07 only. We also find some asymmetry, with the average estimates α_{2i} and β_{1i} in (7) across all stocks being significant (confirming that in case of negative news for stocks only the fact that there is a surprise matters, while for positive news the magnitude of the surprise is relevant), but at much lower significance levels. This indicates that using daily data makes it difficult to draw the same clearcut conclusions as we can do here

¹⁸A second difference in methodology is that Bernanke and Kuttner (2005) use market and sector index returns. We find that this difference is not important, as intraday market and sector returns render comparably strong evidence for asymmetry.

based on intraday data.

Our findings for the other two types of asymmetry are much less supportive. First, we do not find any significant asymmetry in the effects of surprises depending on whether the target rate is increased or decreased or left unchanged. Bernanke and Kuttner (2005) reach a similar conclusion with respect to the effects for rate increases and decreases, but do find that the market responds very little, if at all, to “policy inactions”. Second, we find no evidence for different effects of target rate surprises in business cycle recessions and expansions. This holds irrespective of whether we use the official NBER turning points (according to which the recession period is April 2001 through November 2001 with six FOMC meetings), or whether we follow Andersen et al. (2007) and define the start (end) of a recession when there are three consecutive monthly declines (increases) in nonfarm payroll employment (leading to a longer recession from March 2001 through December 2002 with 20 FOMC meetings). This is in contrast to Andersen et al. (2007), who find that equity markets only react according to expectations to target rate surprises during recessions, while during expansions the response is not significant.¹⁹ Possibly this is due to our use of a longer sample period, with the larger number of observations leading to more precise estimates of the effects of FOMC announcements.

3.2 The effect of FOMC meetings on stock volatilities

We now turn to the impact of FOMC target rate decisions on stock return volatility. As discussed in Section 2, we consider the realized volatility (RV) for the 60-minute window starting 10 minutes before the target rate decision is made public, see (2).

¹⁹Andersen et al. (2007) document even more pronounced business cycle effects in asset prices’ response to news concerning real activity, with bad news unexpectedly having a positive impact during expansions and the expected negative impact during recessions; see also Boyd et al. (2005).

We focus on the difference between RV_{it} on the announcement day and the day before given the ample empirical evidence that the level of volatility changes over time, which may obscure the effects of Federal funds target rate changes.²⁰

- insert Table 4 about here -

The summary statistics in Table 4 clearly demonstrate that FOMC news leads to a substantial volatility increase for the S&P100 constituents. Across all stocks and all FOMC meetings we observe an average increase in realized volatility of 34.8 basis points, with a standard deviation of 57.2. As expected, among the different sectors Financials experiences the largest volatility change at 50.4 basis points, closely followed by IT and Telecommunications. Again it seems that the impact of FOMC announcements is smallest for the Utilities, Energy and Health Care sectors. The second and third columns show that the average volatility change is considerably larger following target rate decreases than increases. For the market as a whole, on days with target rate decreases the change in volatility equals 66.7 basis points on average, compared to 33.6 on days with target rate increases. This difference may be due to several reasons. First, as mentioned in Section 2.1, the standard deviation of surprises in case of a target rate decrease is more than three times larger than in case of target rate increases. Second, below we also discuss that during recessions, obviously periods of rate decreases, markets react more strongly to surprises, which results in larger volatility increases.²¹

²⁰Bomfim (2003) documents the presence of a so-called ‘calm-before-the-storm’ effect, that is, volatility tends to be depressed on pre-announcement days. This does not affect the results of our analysis, as we obtain qualitatively and quantitatively similar results when using the difference between the realized volatility on announcement days and the average volatility during the previous five trading days excluding the day before the announcement.

²¹In addition, we note that all 12 target rate decreases happened prior to August 2003 when FOMC introduced more explicit forward-looking language into its press statement resulting in a

From the final two columns of Table 4 we observe that for FOMC decisions which surprised the market the change in volatility is larger than when considering all announcements. This holds at the market level as well as for all sectors. There does not appear to be a large difference between negative and positive surprises when looking at these average volatility changes. The average change in volatility considering all 77 FOMC meetings and all stocks is equal to 34.8 basis points, whereas it is higher at 45.7 after the 28 positive surprises and 42.5 after the 26 negative surprises. From these numbers it also follows that the average change in volatility in case the FOMC announcement does not contain a surprise is equal to 12.4 basis points only.

To gauge the persistence of the increase in volatility after FOMC announcements, we consider absolute stock returns in five-minute intervals between 15 minutes before and 75 minutes after the time of the release of the FOMC target rate decisions. We compute averages across all stocks of the change in absolute return relative to the pre-announcement day, again to account for time-varying volatility. These are shown in Figure 2 for announcements containing positive, negative and no surprises separately. We observe that the increase in volatility is persistent if the actual target rate does not correspond with the market expectations. Bad news appears to have larger and longer lasting effects on stock volatility than good news, except for the initial impact during the first five minutes after the announcement.²² The relevance of this asymmetry is analyzed more rigorously using regression analysis

substantial decline of the standard deviation of surprises from 5.34 basis points to 1.22 basis points. Related to this, the average change in realized volatility following the 17 target rate increases after August 2003 is substantially smaller (23.7 basis points) than following the six target rate increases before August 2003 (61.6).

²²The fact that the average absolute return immediately following the announcement is larger after negative surprises does not contradict Figure 1. The smaller average positive return following good news observed there is based on more extreme positive and negative returns for individual meetings than the larger negative return after bad news.

below. Finally, Figure 2 also shows that volatility does increase after announcements with no surprise element, but to a lesser extent and for a much shorter period of time, returning to normal levels around 30 minutes after the news release.

- insert **Figure 2** about here -

We examine the effects of target rate changes and surprises on stock volatility by means of regressions similar to the ones used for stock returns in the previous subsection, except that for obvious reasons we now use absolute target rate changes and surprises. Specifically, we regress the daily change in the 60-minute realized volatility on the absolute actual target rate change, and on the absolute surprise and the absolute expected target rate change with or without allowing for different effects of reversal decisions, that is

$$\Delta RV_{it} = \alpha_i + \beta_i |\Delta FF_t| + \varepsilon_{it}, \quad (8)$$

$$\Delta RV_{it} = \alpha_i + \beta_i |S_t| + \gamma_i |\Delta FF_t - S_t| + \varepsilon_{it}, \quad (9)$$

$$\Delta RV_{it} = \alpha_i + \beta_i |S_t| + \gamma_i |\Delta FF_t - S_t| + \delta_i |S_t| D(\text{REV}_t) + \varepsilon_{it}, \quad (10)$$

where ΔRV_{it} denotes the difference between realized volatility for stock i during the 60-minute window starting 10 minutes before the target rate decision is made public and during the same window on the day before.

The results in Table 5 show that the stock volatilities respond to the (absolute) surprise and not to the expected target rate change. We do find that the average estimates of the actual target rate change coefficient in (8) are significantly positive at the market and sector levels, but splitting this into the expected target rate change and the surprise as in (9) shows that this is due entirely to the latter component.

The estimates of the surprise coefficients are positive and highly significant, in both (9) and (10). The average estimate of β_i in (9) for the market RV implies that an unexpected target rate change of 3.6 basis points (the mean absolute surprise across the non-zero surprises) leads to an increase of volatility by 18.5 basis points during the 60-minute window around the announcement. Financials, as expected, shows the strongest response to surprises with the average estimated coefficient for S_t being equal to 7.8 in (9), considerably larger than the market average of 5.2. The Utilities sector forms the other extreme, with an average surprise coefficient of 2.5 only. For the individual stocks, the estimate of β_i in (9) is positive for all stocks and significantly different from zero at the 1% significance level for 66 stocks, with another 15 and 5 coefficients being significant at the 5% and 10% significance levels, respectively. The majority of the individual betas are between 3 and 9, showing that there is considerable heterogeneity in the effects of target rate surprises on individual stock volatility.

The results for the effects of reversals on volatility based on (10) also are interesting. Averaging across all stocks, we find a significant estimate of δ_i at 8.3, which is larger than the average effect of regular surprises at 5.1. Looking at individual sectors, we observe substantial heterogeneity, with significant estimates occurring only for Financials, Consumer Discretionary and Consumer Staples. For these sectors the effects of reversals do seem particularly strong though, being about three times as large as the effects of regular surprises.

- insert Table 5 about here -

In the remainder of this section we analyze the effects of surprises on volatility in more detail, again focusing on possible asymmetries. In particular, the volatility

literature strongly suggests that the response of volatility to negative news is stronger than the response to positive news. This can conveniently be examined by the regression

$$\Delta RV_{it} = \alpha_{0i} + (\alpha_{1i} + \beta_{1i}|S_t|)D(S_t < 0) + (\alpha_{2i} + \beta_{2i}|S_t|)D(S_t > 0) + \delta_i|S_t|D(\text{REV}_t) + \varepsilon_{it}. \quad (11)$$

The results presented in Table 6 reveal marked differences between positive and negative surprises. For negative surprises, representing good news for stocks, the magnitude of the surprise is far more important than the occurrence of a positive surprise, as the average β_{1i} estimate is significant at the 1% level for both the market level and for individual sectors, while the average α_{1i} estimates are not significant at all. In contrast, in the case of positive surprises, thus bad news for stocks, both the fact that there is a negative surprise and the magnitude of the surprise are relevant, as both the average α_{2i} and β_{2i} are significant for the market and for most sectors. The magnitude of the estimates of α_{2i} also suggest that negative news leads to a sizable jump in volatility, irrespective of the magnitude of the surprise. In fact the average taken over all stocks at 21.0 is more than 4 times larger than the average α_{1i} at 5.0, while this difference is significant at the 5% level according to the Wald test reported in Table 6. Whereas the average β_{1i} at 5.7 is clearly larger than the average β_{2i} at 3.3, this difference is not significant at the 10% level. We only find significant differences in these slope coefficients for Consumer Discretionary and Energy stocks. In sum, just like for returns, the occurrence of a surprise is more important for negative news while the magnitude of the surprise is more important for positive news. Finally, the average coefficient estimates in (11) imply that stock volatility

reacts more strongly to negative news than to positive news for surprises less than 6.6 basis points and vice versa for larger surprises. Hence for realistic magnitudes of the surprise, bad news has a larger impact than good news. An unexpected target rate increase with 3.6 basis points, for example, implies an average volatility increase of 45.3 basis points, compared to 38 basis points following an unexpected target rate decrease of the same magnitude.

- insert Table 6 about here -

For the other possible asymmetries that we examine, we do observe some differences in the response of volatility to FOMC surprises depending on the type of target rate change, but according to Wald tests these generally are not significant. This is in contrast to Lobo (2000), who (using daily data and a different methodology) documents moderate evidence for an increase in aggregate stock market volatility following target rate cuts but not following rate hikes. Allowing for different news effects over the business cycle, we find more pronounced asymmetries. In particular, the average volatility change following an FOMC announcement is larger during recessions, while the surprise coefficient is larger during expansions. The differences are significant at the market level and for several sectors. Hence, this suggests that FOMC announcements lead to a larger jump in volatility, independent of the magnitude of the target rate surprise during recessions, while the magnitude of the surprise is more important during expansions. We do hesitate to draw firm conclusions from this finding though, given the small number of recession observations in our sample period.

3.3 The effect of FOMC meetings on stock correlations

We next consider the impact of FOMC meetings on intraday realized correlations during the 60-minute window around target rate announcements, computed according to (3). In order to control for time-variation in correlations for reasons other than the FOMC announcements, we consider the difference between these realized correlations on the announcement day and on the day before.

We compute daily changes in the correlations between individual stocks, and average these to ‘within sectors’ (inter) and ‘between sectors’ (intra) levels. Table 7 (intra-sector) and 8 (inter-sector) both clearly demonstrate that FOMC news leads to a substantial increase in correlations between the S&P100 constituents, by 0.19 and 0.18, respectively. On days with actual rate changes the increase is even 0.25, which also is higher than the average correlation increase for surprises at around 0.21. The largest increase is found in the intra-sector correlations for Financials, which equals 0.33 after target rate increases. The correlations between Energy stocks increase the least, being just 0.10 higher than in the corresponding window the day before. Differences in increases in correlations between stocks from different sectors are less pronounced, ranging between 0.16 (averaged across all meetings for pairwise correlations that involve an Energy stock) and 0.29 (average changes following target rate increases for pairwise correlations that involve a Telecommunications stock).

- insert Tables 7 and 8 about here -

Figure 3 shows averages across all pairs of stocks i and j of the cross-product of five-minute returns from 15 minutes before until 75 minutes after the announcement time, normalized with their realized volatilities over the same window, that

is $(R_{it,k}R_{jt,k})/(RV_{it}RV_{jt})$, where RV_{it} and RV_{jt} are computed according to (2) with $l = -3$ and $u = 14$. Note that this quantity can be interpreted as the contribution of the k -th five-minute interval to the total realized correlation during the 90-minute window around the announcement time. As before we compute averages for announcements with positive, negative and no surprises separately, and control for time-variation in the level of correlations by computing changes relative to the pre-announcement day.

Figure 3 demonstrates that the effect of monetary policy surprises is large during the first minutes after the news release. The effects are relatively short-lived though, with correlations returning to normal levels after around 15-30 minutes. Negative surprises have a larger initial impact than positive surprises, but this is reversed during subsequent intervals, suggesting that also for correlations bad news may have more persistent effects than good news.

- insert Figure 3 about here -

Following Christiansen and Rinaldo (2007), in the regressions below that are used to examine the effects of target rate surprises on realized correlations we use the Fisher transformation,

$$F(RC_{ijt}) = \frac{1}{2} \log \left(\frac{1 + RC_{ijt}}{1 - RC_{ijt}} \right).$$

Again, to avoid that the effects of FOMC announcements are blurred by changes in the correlations due to other reasons, we consider the difference between $F(RC)$ on the announcement day and the day before. Specifically, we regress the daily change in transformed realized correlations on the absolute actual target rate change, and on

the absolute surprise and the absolute expected target rate change with or without allowing for different effects of reversal decisions, that is,

$$\Delta F(RC_{ijt}) = \alpha_{ij} + \beta_{ij}|\Delta FF_t| + \varepsilon_{ij,t}, \quad (12)$$

$$\Delta F(RC_{ijt}) = \alpha_{ij} + \beta_{ij}|S_t| + \gamma_{ij}|\Delta FF_t - S_t| + \varepsilon_{ij,t}, \quad (13)$$

$$\Delta F(RC_{ijt}) = \alpha_{ij} + \beta_{ij}|S_t| + \gamma_{ij}|\Delta FF_t - S_t| + \delta_{ij}|S_t|D(\text{REV}_t) + \varepsilon_{ij,t}, \quad (14)$$

compare the regressions for realized volatility in (8)-(10).

Regression results are provided in Tables 9 (intra-sector) and 10 (inter-sector). Just like for volatilities we find that the significance of the actual absolute target rate change in (12) is completely due to the surprise component, as shown by the estimation results for (13) and (14). Across all stock pairs within sectors, the average surprise coefficient is highly significant and equal to 2.1. Note that due to the Fisher transformation, the effect of surprises on the correlations is highly nonlinear and, in particular, depends on the level of the pre-announcement correlation. For the average pre-announcement correlation between stocks of 0.20, the models in (13) and (14) imply that a surprise of 10 basis points leads to an increase of 0.19 in the realized correlation. Correlations between Consumer Discretionary stocks, Financials, and Materials stocks increase most after surprises. Correlations between Utilities stocks and between Energy stocks respond the least, and not significantly. For the reversal decisions we find mixed results. The average effect is significantly positive for intra-sector correlations for Financials, Consumer Discretionary, Consumer Staples and IT, as before. For other sectors we do not find significant average δ_{ij} coefficients, while for Materials and Telecommunications the estimates even are significantly negative. Similar results are obtained for correlations between stocks from different

sectors, although in that case next to surprises also actual rate changes have some positive impact on correlations.

- insert Tables 9 and 10 about here -

We conclude this section by examining whether there is a different response in intra- and inter-sector correlations following positive and negative surprises, and whether only the size of the surprise matters or also the fact that there is a surprise. This is accomplished by estimating the regression

$$\Delta F(RC_{ijt}) = \alpha_{0ij} + (\alpha_{1ij} + \beta_{1ij}|S_t|)D(S_t < 0) + (\alpha_{2ij} + \beta_{2ij}|S_t|)D(S_t > 0) + \delta_{ij}|S_t|D(\text{REV}_t) + \varepsilon_{ij,t}, \quad (15)$$

compare (11), for all pairs of stocks i and j .

The results of this regression are presented in Tables 11 and 12 for intra-sector and inter-sector stock pairs, respectively. The most interesting results can be seen from comparing the average estimates of the alpha and beta coefficients. Similar to our findings for returns and volatilities, it appears that for correlations the fact that there is a surprise is more important for positive surprises, whereas the magnitude of the surprise is more important for negative surprises. Considering all correlations between stocks from the same sector (first row Table 11) the average β_{1ij} (measuring the effect of the magnitude of the positive news of correlations) is significant at 2.95, whereas β_{2ij} (negative news) is not. The Wald test rejects the null hypothesis that the two average betas are equal at the 5% significance level. On the other hand the average α_{2ij} (occurrence of negative news for stocks) at 10.1 is significant at the 10% level and more than 5 times larger than the insignificant average of α_{1ij} (positive news) at -1.9 . Translating these results into changes in correlations, we find

that intra-sector correlations increase by 0.27 (0.34) following a 5 (15) basis points unexpected target rate increase, and by 0.23 (0.45) following a negative surprise. For the individual sectors, despite having much less observations, these conclusions are strongly present for the sectors Consumer Discretionary, Materials and Telecommunications. The results for correlations between stocks from different sectors are somewhat less pronounced but point towards the same conclusion.

- insert Tables 11 and 12 about here -

We find a similar type of asymmetric response of correlations following announcements of target rate decreases and increases. In case the target rate is increased, intra- and inter-sector correlations appear to jump to a higher level independent of the magnitude of the surprise. By contrast, if the target rate is lowered, the magnitude of the surprise is an important determinant of the change in correlations. No significant asymmetries are found in the effects of announcements in different business cycle phases on correlations.

4 Conclusions

We use high-frequency intraday data for the S&P100 constituents to analyze the effects of FOMC announcements on the Federal funds target rate on stock returns, volatilities and correlations. Unique features of our analysis are the use of high-frequency data, our focus on individual stock returns, and with it also considering the impact of FOMC announcements on correlations. We first confirm in this setting the general finding that only surprises in the target rate change matter, whereas expected changes do not. This is consistent with market efficiency. The response in

stock prices, volatilities and correlations are substantial. For example, an unexpected 10 basis points increase of the target rate leads on average to a 46 basis points negative stock return within five minutes after the announcement. It also increases stock volatility during the 60-minute window around the announcement with 51 basis points, while correlations double from 0.20 to 0.40 on average.

Second, we find that positive surprises in the target rate (bad news for stocks) trigger a stronger reaction in stock prices than negative surprises (good news for stocks). This result differs markedly from that of Bernanke and Kuttner (2005), who document weak support at best for asymmetric effects of positive and negative monetary policy surprises based on daily stock returns. This demonstrates the advantage of using intraday data.

Third, we see an interesting pattern in the asymmetric response that has not been documented before. In particular we find that for positive surprises the fact that there is news is more important than the magnitude of the surprise. In contrast, for negative surprises, the magnitude of the surprise is more important. This result holds for returns, volatilities and correlations. This finding adds to the list of behavioral biases of investors, specifically when it comes to negative news.

Finally, we find considerable heterogeneity in the effects of target rate surprises across sectors. As expected, the Financials sector shows the strongest response to surprises. IT stocks also react strongly, whereas Utilities stocks respond the least.

Appendix A: Federal funds target rate changes and surprises

Date	Time	FF_t	ΔFF_t	Surprise	Date	Time	FF_t	ΔFF_t	Surprise
May 20, 1997	14:15	5.50	0	-9.9	Jan 30, 2002	14:16	1.75	0	2
Jul 2, 1997	14:15	5.50	0	-1.6	Mar 19, 2002	14:19	1.75	0	-2.6
Aug 19, 1997	14:15	5.50	0	0	May 7, 2002	14:14	1.75	0	0.6
Sep 30, 1997	14:13	5.50	0	0	Jun 26, 2002	14:13	1.75	0	0.5
Nov 12, 1997	14:12	5.50	0	-5	Aug 13, 2002	14:14	1.75	0	3.4
Dec 16, 1997	14:15	5.50	0	0	Sep 24, 2002	14:12	1.75	0	3
Feb 4, 1998	14:12	5.50	0	0.6	Nov 6, 2002	14:14	1.25	-50	-18.8
Mar 31, 1998	14:14	5.50	0	0	Dec 10, 2002	14:13	1.25	0	0
May 19, 1998	14:13	5.50	0	-2.6	Jan 20, 2003	14:16	1.25	0	0.5
Jul 1, 1998	14:14	5.50	0	0	Mar 18, 2003	14:15	1.25	0	2.4
Aug 18, 1998	14:12	5.50	0	0	May 6, 2003	14:13	1.25	0	3.1
Sep 29, 1998	14:17	5.25	-25	6	Jun 25, 2003	14:16	1.00	-25	12.5
Oct 15, 1998	15:14	5.00	-25	-26.2	Aug 12, 2003	14:15	1.00	0	0
Nov 17, 1998	14:19	4.75	-25	-6.9	Sep 16, 2003	14:19	1.00	0	0
Dec 22, 1998	14:13	4.75	0	0	Oct 28, 2003	14:14	1.00	0	-0.5
Feb 3, 1999	14:12	4.75	0	0	Dec 9, 2003	14:14	1.00	0	0
Mar 30, 1999	14:12	4.75	0	0	Jan 28, 2004	14:14	1.00	0	0.3
May 18, 1999	14:11	4.75	0	-1.2	Mar 16, 2004	14:15	1.00	0	0
Jun 30, 1999	14:15	5.00	25	-4	May 4, 2006	14:16	1.00	0	-1.1
Aug 24, 1999	14:14	5.25	25	3.5	Jun 30, 2004	14:18	1.25	25	-1
Oct 5, 1999	14:12	5.25	0	-4.8	Aug 10, 2004	14:15	1.50	25	1.5
Nov 16, 1999	14:16	5.50	25	7.5	Sep 21, 2004	14:15	1.75	25	0
Dec 21, 1999	14:13	5.50	0	0	Nov 10, 2004	14:15	2.00	25	0
Feb 2, 2000	14:14	5.75	25	-5.9	Dec 14, 2004	14:16	2.25	25	-0.9
Mar 21, 2000	14:15	6.00	25	-3.1	Feb 2, 2005	14:17	2.50	25	-0.5
May 16, 2000	14:13	6.50	50	4.1	Mar 22, 2005	14:17	2.75	25	1.7
Jun 28, 2000	14:15	6.50	0	-2.5	May 3, 2005	14:16	3.00	25	0
Aug 22, 2000	14:14	6.50	0	-1.7	Jun 30, 2005	14:15	3.25	25	0
Oct 3, 2000	14:12	6.50	0	-0.6	Aug 9, 2005	14:17	3.50	25	0
Nov 15, 2000	14:12	6.50	0	-1	Sep 20, 2005	14:17	3.75	25	3
Dec 19, 2000	14:16	6.50	0	6.5	Nov 1, 2005	14:18	4.00	25	0
Jan 3, 2001	13:13	6.00	-50	-36.5	Dec 13, 2005	14:13	4.25	25	0.9
Jan 31, 2001	14:15	5.50	-50	3.5	Jan 31, 2006	14:14	4.50	25	0.5
Mar 20, 2001	14:13	5.00	-50	5.6	Mar 28, 2006	14:17	4.75	25	1
Apr 18, 2001	10:54	4.50	-50	-42.5	May 10, 2006	14:17	5.00	25	0.7
May 15, 2001	14:15	4.00	-50	-7.8	Jun 29, 2006	14:16	5.25	25	-1.5
Jun 27, 2001	14:12	3.75	-25	11	Aug 8, 2006	14:14	5.25	0	-4
Aug 21, 2001	14:13	3.50	-25	1.6	Sep 20, 2006	14:14	5.25	0	0
Sep 17, 2001	08:20	3.00	-50	-28.9	Oct 25, 2006	14:13	5.25	0	0.5
Oct 2, 2001	14:15	2.50	-50	-3.2					
Nov 6, 2001	14:20	2.00	-50	-13.1					
Dec 11, 2001	14:14	1.75	-25	0					

Note: The table presents dates and exact times of the FOMC announcements on Federal funds target rate decisions. The column FF_t contains the post-announcement level of the target rate in percent. The columns ΔFF_t and Surprise show the announced change in the target rate and the surprise therein, respectively, in basis points.

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Table 1: Five-minute returns following FOMC announcements

	All (77 obs)	Rate increase (23 obs)	Rate decrease (12 obs)	Positive surprise (28 obs)	Negative surprise (26 obs)
All stocks (100 stocks)	-3.79*** (51.66)	1.68*** (43.08)	1.41*** (83.82)	-21.06*** (50.22)	12.19*** (62.30)
Consumer Discretionary (15)	-3.35*** (49.30)	1.33*** (46.58)	2.11*** (78.81)	-22.35*** (41.49)	14.15*** (62.86)
Consumer Staples (11)	-3.62*** (42.28)	-0.31 (31.35)	-2.73*** (70.38)	-18.39*** (42.91)	8.93*** (49.01)
Energy (6)	-2.17*** (45.78)	1.46*** (28.84)	-0.51 (75.39)	-14.63*** (49.66)	10.26*** (50.20)
Financials (14)	-3.08*** (70.54)	8.98*** (61.16)	7.93*** (121.39)	-23.78*** (65.22)	18.92*** (91.12)
Health Care (10)	-2.54*** (39.80)	-0.91** (33.68)	-0.78 (59.97)	-15.54*** (39.46)	10.07*** (45.16)
Industrials (14)	-5.05*** (43.41)	-3.06*** (38.50)	0.22 (66.47)	-20.36*** (40.42)	8.62*** (52.09)
IT (13)	-6.26*** (61.00)	3.50*** (45.08)	-1.07 (96.84)	-29.30*** (65.86)	13.77*** (67.37)
Materials (7)	-3.68*** (45.59)	1.86*** (43.38)	1.73* (71.64)	-19.76*** (42.44)	12.78*** (54.57)
Telecommunications (5)	-4.06*** (57.22)	2.04*** (38.43)	6.15*** (98.61)	-22.27*** (57.12)	9.39*** (69.42)
Utilities (5)	-1.37*** (35.00)	0.54 (34.45)	1.18 (47.62)	-14.52*** (34.58)	8.46*** (37.41)

Note: The table reports the average return in basis points during the five-minute interval following FOMC announcements for the 77 scheduled FOMC meetings from May 1997 to October 2006, with standard deviations given in parentheses. The table shows equally weighted averages across the individual constituents of the S&P100 index aggregated to the market level (all stocks) and sector level. Columns headed ‘Rate increase (decrease)’ show average returns following the announcement of an increase (decrease) of the Federal funds target rate. Columns headed ‘Positive (negative) surprise’ show average returns following a positive (negative) surprise in the target rate change, where the surprise is computed as the difference between the closing price of the nearby Fed funds futures contract one day before the announcement and on the announcement day itself, as given in (1). ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 2: Response of stock prices to actual target rate changes and surprises

	Rate Changes		Surprises & Expected			Surprise, Expected & Reversal			
	β	R^2	β	γ	R^2	β	γ	δ	R^2
All stocks (100)	-0.08 (0.31)	0.01	-4.58*** (1.04)	0.12 (0.23)	0.19	-3.97*** (0.96)	-0.06 (0.21)	-18.08*** (3.62)	0.28
Cons. Discr. (15)	-0.08 (0.30)	0.01	-4.53*** (0.99)	0.11 (0.24)	0.21	-3.89*** (0.88)	-0.08 (0.20)	-21.03*** (4.02)	0.31
Cons. Staples (11)	-0.01 (0.21)	0.01	-3.44*** (0.93)	0.13 (0.18)	0.15	-2.74*** (0.77)	-0.06 (0.14)	-18.93*** (2.00)	0.29
Energy (6)	-0.13 (0.41)	0.02	-3.91*** (1.23)	0.06 (0.25)	0.15	-3.33*** (1.13)	-0.10 (0.22)	-22.11** (10.42)	0.26
Financials (14)	-0.08 (0.44)	0.01	-6.42*** (1.79)	0.19 (0.37)	0.18	-5.22*** (1.62)	-0.15 (0.31)	-33.62*** (5.24)	0.33
Health Care (10)	-0.07 (0.21)	0.01	-3.42*** (0.71)	0.07 (0.17)	0.16	-3.02*** (0.68)	-0.04 (0.17)	-12.34*** (4.25)	0.24
Industrials (14)	-0.12 (0.22)	0.02	-3.74*** (0.79)	0.04 (0.15)	0.18	-3.37*** (0.76)	-0.06 (0.15)	-11.58*** (3.32)	0.24
IT (13)	-0.02 (0.39)	0.00	-6.63*** (1.39)	0.26 (0.27)	0.25	-5.98*** (1.37)	0.09 (0.27)	-17.56*** (5.50)	0.32
Materials (7)	-0.10 (0.30)	0.01	-4.42*** (0.82)	0.09 (0.22)	0.23	-4.09*** (0.83)	0.01 (0.22)	1.36 (8.64)	0.28
Telecomm. (5)	-0.20 (0.33)	0.02	-4.51*** (1.15)	-0.01 (0.28)	0.18	-3.90*** (1.08)	-0.19 (0.26)	-21.16** (8.40)	0.27
Utilities (5)	-0.05 (0.18)	0.02	-2.62*** (0.63)	0.06 (0.15)	0.13	-2.33*** (0.61)	-0.03 (0.15)	-14.25** (6.77)	0.18

Note: The table shows results from regressions of the stock returns (in basis points) during the five-minute interval following FOMC announcements on Federal funds rate changes (equation (4)), on surprises and expected rate changes (equation (5)), and on surprises and expected rate changes allowing for different effects of reversal decisions (equation (6)). The models are estimated for individual stock returns for the constituents of the S&P100 index following the 77 scheduled FOMC meetings between May 1997 and October 2006. Average coefficient estimates and R^2 values are shown for the market (all stocks) and sectors. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks.

Table 3: Asymmetric response of returns to positive and negative surprises

	α_0	α_1	β_1	α_2	β_2	δ	R^2	Wald tests		
								$\alpha_1 = \alpha_2$	$\beta_1 = \beta_2$	$\alpha_1 = \alpha_2$ $\beta_1 = \beta_2$
All stocks (100)	-0.44 (4.45)	-14.88 (9.47)	-5.86*** (0.96)	-11.84* (6.99)	-1.59 (1.45)	-18.82*** (4.21)	0.31	0.76	0.01	0.05
Cons. Discr. (15)	0.02 (4.72)	-12.17 (9.81)	-5.46*** (0.99)	-15.61** (7.26)	-0.98 (1.34)	-20.90*** (4.18)	0.33	0.74	0.01	0.03
Cons. Staples (11)	0.02 (3.95)	-10.47 (8.01)	-3.83*** (1.08)	-10.73* (6.42)	-1.08 (0.98)	-19.22*** (1.81)	0.32	0.98	0.06	0.17
Energy (6)	0.96 (5.08)	-11.87 (9.88)	-5.10*** (1.17)	-10.61 (8.11)	-0.73 (1.24)	-22.36** (10.87)	0.29	0.91	0.01	0.04
Financials (14)	-2.36 (6.26)	-22.66 (14.39)	-9.07*** (1.77)	-8.83 (10.04)	-1.63 (2.59)	-35.10*** (4.71)	0.36	0.36	0.02	0.04
Health Care (10)	-0.70 (4.60)	-8.30 (7.74)	-4.11*** (0.72)	-7.55 (6.88)	-1.50 (1.11)	-12.52*** (4.09)	0.27	0.93	0.05	0.15
Industrials (14)	-1.36 (4.39)	-11.07 (9.07)	-4.65*** (0.93)	-13.96** (7.06)	-0.99 (1.02)	-11.68*** (3.96)	0.27	0.77	0.01	0.03
IT (13)	-0.86 (5.41)	-23.13** (11.11)	-8.36*** (1.08)	-9.96 (8.86)	-4.55 (2.96)	-19.49*** (5.63)	0.34	0.27	0.23	0.25
Materials (7)	-2.60 (5.29)	-11.24 (9.78)	-5.81*** (0.92)	-8.20 (8.81)	-1.96 (1.91)	1.67 (9.25)	0.30	0.78	0.07	0.16
Telecomm. (5)	3.13 (6.44)	-26.26** (12.02)	-6.86*** (1.13)	-21.66** (10.70)	-0.13 (1.71)	-25.46*** (9.14)	0.31	0.73	0.00	0.00
Utilities (5)	4.48 (4.67)	-10.60 (8.83)	-2.98*** (0.92)	-15.73** (7.75)	-0.53 (1.20)	-14.85* (7.76)	0.20	0.60	0.10	0.23

Note: The table shows the results from the regression of stock returns (in basis points) during the five-minute interval following FOMC announcements on surprises in Federal funds rate changes allowing for different effects of positive and negative surprises, and for different effects of 'reversal' decisions (equation (7)). The model is estimated for individual stock returns for the constituents of the S&P100 index following the 77 scheduled FOMC meetings between May 1997 and October 2006. Average coefficient estimates and R^2 values are shown for the market (all stocks) and sectors. Negative and positive surprises occur in 26 and 28 cases, respectively. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks. Columns headed 'Wald tests' contain p -values of Wald statistics for testing the indicated restrictions for the average coefficients (allowing for heteroskedasticity as well as correlation of residuals across stocks).

Table 4: Mean change of realized volatility following FOMC announcements

	All (77 obs)	Rate increase (23 obs)	Rate decrease (12 obs)	Positive surprise (28 obs)	Negative surprise (26 obs)
All stocks (100 stocks)	34.77*** (57.16)	33.56*** (45.20)	66.69*** (68.84)	45.72*** (62.17)	42.48*** (60.74)
Consumer Discretionary (15)	31.12*** (53.97)	31.69*** (51.82)	61.67*** (65.51)	41.27*** (52.15)	37.07*** (64.10)
Consumer Staples (11)	28.68*** (42.32)	26.55*** (36.93)	52.22*** (53.37)	40.64*** (42.41)	31.30*** (44.86)
Energy (6)	24.14*** (92.05)	17.68*** (35.74)	45.50*** (66.53)	29.41*** (135.37)	31.15*** (56.24)
Financials (14)	50.44*** (65.12)	54.18*** (63.24)	96.61*** (84.72)	61.24*** (56.61)	66.36*** (83.01)
Health Care (10)	25.73*** (45.71)	28.24*** (30.48)	51.69*** (52.42)	36.01*** (45.34)	30.85*** (48.85)
Industrials (14)	33.50*** (46.40)	30.89*** (38.44)	57.41*** (56.49)	43.45*** (46.59)	38.96*** (49.79)
IT (13)	42.92*** (63.03)	38.75*** (44.26)	88.77*** (80.35)	58.49*** (69.77)	54.14*** (62.53)
Materials (7)	33.37*** (43.92)	32.21*** (34.79)	60.15*** (54.51)	42.50*** (45.82)	38.25*** (45.53)
Telecommunications (5)	42.09*** (66.55)	31.72*** (41.79)	87.35*** (82.54)	57.36*** (75.94)	51.24*** (67.69)
Utilities (5)	21.40*** (44.64)	23.72*** (30.08)	36.73*** (39.82)	30.46*** (40.66)	26.55*** (38.13)

Note: The table reports the average daily change of realized volatility in basis points during 60-minute windows (from 10 minutes before until 50 minutes after) around FOMC announcements on days of the 77 scheduled FOMC meetings from May 1997 to October 2006, with standard deviations given in parentheses. The table shows equally weighted averages across the individual constituents of the S&P100 index aggregated to the market level (all stocks) and sector level. Columns headed ‘Rate increase (decrease)’ show average volatilities following the announcement of an increase (decrease) of the Federal funds target rate. Columns headed ‘Positive (negative) surprise’ show average volatilities following a positive (negative) surprise in the target rate change, where the surprise is computed as the difference between the closing price of the nearby Fed funds futures contract one day before the announcement and on the announcement day itself, as given in (1). ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 5: Response of realized volatilities to actual target rate changes and surprises

	Rate Changes		Surprises & Expected			Surprise, Expected & Reversal			
	β	R^2	β	γ	R^2	β	γ	δ	R^2
All stocks (100)	0.78*** (0.10)	0.07	5.15*** (0.91)	0.26 (0.18)	0.19	5.10*** (0.90)	0.19 (0.18)	8.32** (3.71)	0.23
Cons. Discr. (15)	0.81*** (0.09)	0.08	4.23*** (0.88)	0.38** (0.17)	0.17	4.21*** (0.86)	0.29* (0.16)	11.16*** (2.95)	0.21
Cons. Staples (11)	0.47*** (0.09)	0.04	3.92*** (0.78)	0.12 (0.18)	0.14	3.80*** (0.68)	0.00 (0.18)	13.85*** (1.51)	0.24
Energy (6)	0.62** (0.26)	0.01	4.77* (2.57)	-0.06 (0.65)	0.12	4.71* (2.60)	-0.10 (0.66)	0.14 (41.08)	0.13
Financials (14)	1.20*** (0.10)	0.10	7.79*** (1.72)	0.41 (0.31)	0.26	7.70*** (1.65)	0.21 (0.29)	21.98*** (7.99)	0.34
Health Care (10)	0.74*** (0.13)	0.10	4.66*** (0.71)	0.32** (0.13)	0.24	4.63*** (0.71)	0.29** (0.13)	2.85 (3.00)	0.25
Industrials (14)	0.48*** (0.14)	0.04	4.98*** (0.57)	-0.06 (0.15)	0.18	4.96*** (0.57)	-0.08 (0.15)	2.78 (2.39)	0.19
IT (13)	1.10*** (0.16)	0.10	6.74*** (1.35)	0.49 (0.31)	0.22	6.68*** (1.33)	0.44 (0.32)	6.28 (5.37)	0.25
Materials (7)	0.67*** (0.16)	0.10	3.49*** (0.74)	0.30* (0.18)	0.19	3.48*** (0.80)	0.30 (0.20)	1.44 (7.86)	0.19
Telecomm. (5)	0.94*** (0.20)	0.07	5.93*** (1.21)	0.35 (0.36)	0.23	5.91*** (1.19)	0.28 (0.37)	12.23 (9.67)	0.25
Utilities (5)	0.47*** (0.17)	0.07	2.52*** (0.76)	0.25 (0.19)	0.12	2.55*** (0.76)	0.27 (0.19)	-3.27 (5.28)	0.14

Note: The table shows the results from regressions of the daily change in 60-minute realized volatilities on absolute Federal funds rate changes (equation (8)), on absolute surprises and absolute expected rate changes (equation (9)), and on absolute surprises and absolute expected rate changes allowing for different effects of ‘reversal’ decisions (equation (10)). The models are estimated for the realized volatilities of the individual constituents of the S&P100 index following the 77 scheduled FOMC meetings between May 1997 and October 2006. Average coefficient estimates and R^2 values are shown for the market (all stocks) and sectors. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks.

Table 6: Asymmetric response of realized volatilities to positive and negative surprises

	α_0	α_1	β_1	α_2	β_2	δ	R^2	Wald tests		
								$\alpha_1 = \alpha_2$	$\beta_1 = \beta_2$	$\alpha_1 = \alpha_2$ $\beta_1 = \beta_2$
All stocks (100)	12.52*** (2.98)	5.03 (6.11)	5.68*** (0.89)	21.00*** (6.06)	3.26** (1.29)	8.82** (4.07)	0.26	0.03	0.12	0.10
Cons. Discr. (15)	11.63*** (3.91)	3.39 (7.99)	5.14*** (1.03)	20.08*** (7.54)	2.66** (1.07)	11.27*** (3.36)	0.24	0.08	0.09	0.17
Cons. Staples (11)	11.27*** (3.48)	2.30 (6.01)	3.70*** (0.68)	18.14*** (5.65)	2.69** (1.29)	13.57*** (1.39)	0.28	0.02	0.49	0.04
Energy (6)	9.55 (12.25)	-6.20 (21.56)	6.97*** (2.57)	19.92 (19.25)	-1.78 (2.49)	4.27 (42.45)	0.19	0.26	0.01	0.05
Financials (14)	19.29*** (4.74)	6.56 (10.89)	8.81*** (1.84)	23.16** (9.52)	4.54* (2.41)	23.20*** (7.59)	0.37	0.20	0.16	0.31
Health Care (10)	7.76** (3.11)	-1.22 (5.73)	5.62*** (0.74)	16.15*** (5.56)	3.52*** (1.20)	5.47* (3.05)	0.27	0.01	0.14	0.03
Industrials (14)	14.48*** (3.24)	4.07 (5.76)	4.77*** (0.77)	17.56*** (5.89)	3.43*** (1.13)	2.19 (2.24)	0.24	0.05	0.33	0.13
IT (13)	11.27** (5.23)	13.97 (8.51)	6.79*** (1.13)	27.72*** (10.00)	5.75* (3.08)	6.73 (5.92)	0.28	0.21	0.75	0.38
Materials (7)	16.96*** (4.75)	2.24 (7.64)	4.49*** (0.69)	18.46** (8.06)	2.15 (1.34)	0.99 (8.52)	0.22	0.07	0.12	0.16
Telecomm. (5)	11.56** (5.69)	13.42 (9.28)	6.09*** (0.85)	31.31** (12.40)	4.14 (2.64)	8.84 (9.38)	0.29	0.18	0.48	0.40
Utilities (5)	4.59 (5.28)	12.67 (7.89)	2.33*** (0.78)	20.50*** (7.91)	1.91 (1.59)	-2.06 (5.43)	0.17	0.35	0.81	0.55

Note: The table shows the results from the regression of the daily change in 60-minute realized volatilities on absolute surprises in Federal funds rate changes allowing for different effects of positive and negative surprises, and for different effects of ‘reversal’ decisions (equation (11)). The model is estimated for the realized volatilities of the individual constituents of the S&P100 index following the 77 scheduled FOMC meetings between May 1997 and October 2006. Average coefficient estimates and R^2 values are shown for the market (all stocks) and sectors. Negative and positive surprises occur in 26 and 28 cases, respectively. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks. Columns headed ‘Wald tests’ contain p -values of Wald statistics for testing the indicated restrictions for the average coefficients (allowing for heteroskedasticity as well as correlation of residuals across stocks).

Table 7: Mean change of intra-sector realized correlations following FOMC announcements

	All (77 obs)	Rate increase (23 obs)	Rate decrease (12 obs)	Positive surprise (28 obs)	Negative surprise (26 obs)
All stocks (100 stocks)	0.19*** (0.39)	0.25*** (0.38)	0.25*** (0.40)	0.22*** (0.37)	0.21*** (0.41)
Consumer Discretionary (15)	0.18*** (0.42)	0.25*** (0.41)	0.27*** (0.41)	0.22*** (0.39)	0.21*** (0.43)
Consumer Staples (11)	0.18*** (0.40)	0.24*** (0.39)	0.26*** (0.38)	0.22*** (0.37)	0.17*** (0.44)
Energy (6)	0.10*** (0.36)	0.10*** (0.33)	0.14** (0.39)	0.13*** (0.37)	0.07*** (0.34)
Financials (14)	0.23*** (0.37)	0.33*** (0.35)	0.27*** (0.38)	0.26*** (0.34)	0.26*** (0.39)
Health Care (10)	0.19*** (0.39)	0.25*** (0.37)	0.25*** (0.40)	0.24*** (0.37)	0.18*** (0.41)
Industrials (14)	0.17*** (0.39)	0.21*** (0.37)	0.23*** (0.40)	0.19*** (0.39)	0.23*** (0.39)
IT (13)	0.19*** (0.39)	0.27*** (0.37)	0.19*** (0.38)	0.23*** (0.36)	0.20*** (0.40)
Materials (7)	0.14*** (0.42)	0.22*** (0.41)	0.28*** (0.41)	0.18*** (0.38)	0.17*** (0.46)
Telecommunications (5)	0.22*** (0.38)	0.27*** (0.35)	0.32*** (0.33)	0.29*** (0.35)	0.18*** (0.40)
Utilities (5)	0.18*** (0.43)	0.25*** (0.39)	0.18*** (0.49)	0.25*** (0.41)	0.16*** (0.43)

Note: The table reports the average daily change of intra-sector realized correlations in basis points during 60-minute windows (from 10 minutes before until 50 minutes after) around FOMC announcements on days of the 77 scheduled FOMC meetings from May 1997 to October 2006, with standard deviations given in parentheses. Columns headed ‘Rate increase (decrease)’ show average correlations following the announcement of an increase (decrease) of the Federal funds target rate. Columns headed ‘Positive (negative) surprise’ show average correlations following a positive (negative) surprise in the target rate change, where the surprise is computed as the difference between the closing price of the nearby Fed funds futures contract one day before the announcement and on the announcement day itself, as given in (1). ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 8: Mean change of inter-sector realized correlations following FOMC announcements

	All (77 obs)	Rate increase (23 obs)	Rate decrease (12 obs)	Positive surprise (28 obs)	Negative surprise (26 obs)
All stocks (100 stocks)	0.18*** (0.40)	0.25*** (0.39)	0.25*** (0.39)	0.22*** (0.39)	0.20*** (0.41)
Consumer Discretionary (15)	0.18*** (0.41)	0.24*** (0.40)	0.26*** (0.40)	0.22*** (0.39)	0.19*** (0.42)
Consumer Staples (11)	0.18*** (0.40)	0.24*** (0.40)	0.26*** (0.40)	0.22*** (0.38)	0.19*** (0.43)
Energy (6)	0.16*** (0.39)	0.19*** (0.39)	0.25*** (0.39)	0.20*** (0.39)	0.17*** (0.40)
Financials (14)	0.20*** (0.39)	0.27*** (0.38)	0.26*** (0.39)	0.24*** (0.37)	0.22*** (0.41)
Health Care (10)	0.18*** (0.40)	0.26*** (0.39)	0.24*** (0.39)	0.23*** (0.39)	0.19*** (0.41)
Industrials (14)	0.18*** (0.40)	0.23*** (0.39)	0.25*** (0.40)	0.21*** (0.39)	0.21*** (0.41)
IT (13)	0.19*** (0.40)	0.26*** (0.39)	0.24*** (0.39)	0.23*** (0.38)	0.20*** (0.41)
Materials (7)	0.17*** (0.41)	0.23*** (0.41)	0.27*** (0.39)	0.21*** (0.39)	0.19*** (0.43)
Telecommunications (5)	0.20*** (0.40)	0.29*** (0.39)	0.29*** (0.37)	0.25*** (0.38)	0.20*** (0.42)
Utilities (5)	0.19*** (0.42)	0.24*** (0.39)	0.26*** (0.41)	0.23*** (0.41)	0.18*** (0.42)

Note: The table reports the average daily change of inter-sector realized correlations in basis points during 60-minute windows (from 10 minutes before until 50 minutes after) around FOMC announcements on days of the 77 scheduled FOMC meetings from May 1997 to October 2006, with standard deviations given in parentheses. Columns headed ‘Rate increase (decrease)’ show average correlations following the announcement of an increase (decrease) of the Federal funds target rate. Columns headed ‘Positive (negative) surprise’ show average correlations following a positive (negative) surprise in the target rate change, where the surprise is computed as the difference between the closing price of the nearby Fed funds futures contract one day before the announcement and on the announcement day itself, as given in (1). ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 9: Response of intra-sector realized correlations to actual target rate changes and surprises

	Rate Changes		Surprises & Expected			Surprise, Expected & Reversal			
	β	R^2	β	γ	R^2	β	γ	δ	R^2
All stocks (100)	0.45*** (0.14)	0.04	2.07*** (0.58)	0.21 (0.15)	0.07	2.05*** (0.58)	0.18 (0.15)	2.23 (2.16)	0.08
Cons. Discr. (15)	0.52*** (0.15)	0.04	2.61*** (0.55)	0.21 (0.15)	0.08	2.62*** (0.58)	0.18 (0.14)	4.82** (2.46)	0.10
Cons. Staples (11)	0.44*** (0.16)	0.03	1.57** (0.76)	0.26 (0.20)	0.05	1.53** (0.78)	0.22 (0.20)	4.62** (2.03)	0.06
Energy (6)	0.07 (0.16)	0.01	0.78 (0.49)	-0.01 (0.20)	0.04	0.74 (0.49)	-0.06 (0.20)	9.79 (9.44)	0.07
Financials (14)	0.57*** (0.17)	0.05	2.55*** (0.79)	0.25 (0.19)	0.08	2.54*** (0.79)	0.20 (0.18)	5.90*** (1.13)	0.10
Health Care (10)	0.41*** (0.16)	0.03	1.97*** (0.74)	0.23 (0.17)	0.06	1.93** (0.75)	0.21 (0.17)	-1.51 (4.34)	0.08
Industrials (14)	0.39** (0.18)	0.03	2.13*** (0.75)	0.14 (0.21)	0.07	2.11*** (0.76)	0.12 (0.21)	2.48 (3.65)	0.08
IT (13)	0.34** (0.16)	0.02	1.37* (0.83)	0.18 (0.20)	0.04	1.34 (0.82)	0.16 (0.20)	3.28** (1.53)	0.05
Materials (7)	0.68*** (0.22)	0.06	3.04*** (0.96)	0.28 (0.21)	0.10	2.91*** (0.76)	0.30* (0.17)	-21.16*** (6.24)	0.12
Telecomm. (5)	0.56*** (0.18)	0.05	1.38 (0.85)	0.36 (0.22)	0.06	1.28 (0.84)	0.39* (0.22)	-24.77*** (9.06)	0.09
Utilities (5)	0.32 (0.27)	0.02	0.77 (1.65)	0.35 (0.34)	0.05	0.71 (1.63)	0.31 (0.34)	-0.47 (11.99)	0.06

Note: The table shows the results from regressions of the daily change in 60-minute realized correlations on absolute Federal funds rate changes (equation (12)), on absolute surprises and absolute expected rate changes (equation (13)), and on absolute surprises and absolute expected rate changes allowing for different effects of ‘reversal’ decisions (equation (14)). The models are estimated using the realized correlations between individual stocks belonging to the same sector following the 77 scheduled FOMC meetings between May 1997 and October 2006, and are aggregated to the sector level by taking averages. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks.

Table 10: Response of inter-sector realized correlations to actual target rate changes and surprises

	Rate Changes		Surprises & Expected			Surprise, Expected & Reversal			
	β	R^2	β	γ	R^2	β	γ	δ	R^2
All stocks (100)	0.46*** (0.13)	0.04	1.83*** (0.54)	0.25* (0.15)	0.06	1.80*** (0.54)	0.22 (0.14)	0.04 (2.20)	0.08
Cons. Discr. (15)	0.49*** (0.14)	0.04	2.17*** (0.53)	0.24* (0.14)	0.07	2.14*** (0.54)	0.21 (0.14)	0.86 (2.19)	0.09
Cons. Staples (11)	0.45*** (0.14)	0.04	1.86*** (0.58)	0.24 (0.16)	0.06	1.83*** (0.59)	0.21 (0.16)	2.30 (2.09)	0.08
Energy (6)	0.34*** (0.13)	0.03	1.57*** (0.24)	0.15 (0.14)	0.06	1.54*** (0.26)	0.11 (0.13)	0.02 (2.20)	0.08
Financials (14)	0.47*** (0.13)	0.04	2.06*** (0.57)	0.22 (0.14)	0.07	2.04*** (0.57)	0.18 (0.13)	2.62* (1.57)	0.08
Health Care (10)	0.43*** (0.13)	0.03	1.69*** (0.63)	0.26* (0.15)	0.06	1.65*** (0.63)	0.24 (0.15)	0.31 (2.67)	0.08
Industrials (14)	0.45*** (0.14)	0.04	1.92*** (0.62)	0.23 (0.16)	0.06	1.88*** (0.62)	0.21 (0.16)	0.18 (2.31)	0.08
IT (13)	0.44*** (0.12)	0.04	1.47** (0.60)	0.28* (0.16)	0.06	1.43** (0.59)	0.25* (0.15)	2.13 (2.46)	0.07
Materials (7)	0.53*** (0.15)	0.05	2.34*** (0.60)	0.25 (0.17)	0.08	2.28*** (0.55)	0.24* (0.13)	-8.25*** (2.58)	0.10
Telecomm. (5)	0.57*** (0.14)	0.05	1.56** (0.71)	0.37** (0.16)	0.07	1.53** (0.72)	0.36** (0.16)	-2.85 (3.42)	0.09
Utilities (5)	0.38** (0.15)	0.03	1.13* (0.67)	0.31* (0.18)	0.05	1.07* (0.65)	0.29 (0.18)	-4.96* (2.93)	0.07

Note: The table shows the results from regressions of the daily change in 60-minute realized correlations on absolute Federal funds rate changes (equation (12)), on absolute surprises and absolute expected rate changes (equation (13)), and on absolute surprises and absolute expected rate changes allowing for different effects of ‘reversal’ decisions (equation (14)). The models are estimated using the realized correlations between individual stocks belonging to different sectors following the 77 scheduled FOMC meetings between May 1997 and October 2006, and are aggregated to the sector level by taking averages. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks.

Table 11: Asymmetric response of intra-sector realized correlations to positive and negative surprises

	α_0	α_1	β_1	α_2	β_2	δ	R^2	Wald tests		
								$\alpha_1 = \alpha_2$	$\beta_1 = \beta_2$	$\alpha_1 = \alpha_2$ $\beta_1 = \beta_2$
All stocks (100)	15.66*** (4.27)	-1.90 (6.72)	2.95*** (0.47)	10.08* (5.68)	0.90 (0.71)	4.01 (2.82)	0.11	0.06	0.02	0.06
Cons. Discr. (15)	11.32** (5.17)	-1.66 (7.31)	3.52*** (0.48)	11.13* (6.34)	1.33* (0.70)	7.21** (2.98)	0.13	0.04	0.01	0.04
Cons. Staples (11)	18.78*** (4.67)	-9.60 (9.05)	2.83*** (0.81)	4.53 (6.75)	1.15 (1.00)	5.55** (2.45)	0.09	0.12	0.20	0.30
Energy (6)	11.67** (5.82)	-4.00 (7.27)	0.51 (0.70)	-1.08 (7.92)	1.27 (1.12)	13.43 (9.40)	0.10	0.67	0.57	0.49
Financials (14)	21.97*** (4.50)	-2.32 (7.27)	3.68*** (0.50)	10.17 (6.89)	1.14 (1.35)	6.80*** (1.24)	0.13	0.11	0.08	0.18
Health Care (10)	16.43*** (5.17)	-4.81 (7.51)	2.67*** (0.91)	8.78 (8.09)	1.66* (0.92)	1.97 (4.87)	0.11	0.10	0.44	0.18
Industrials (14)	12.78** (4.98)	4.51 (8.17)	2.69*** (0.60)	10.51 (7.48)	0.43 (0.86)	2.91 (4.51)	0.10	0.48	0.03	0.03
IT (13)	15.66*** (5.00)	2.27 (7.55)	2.06*** (0.80)	15.89** (6.66)	-0.36 (1.18)	3.87** (1.55)	0.09	0.06	0.09	0.13
Materials (7)	11.36** (5.12)	-11.77 (8.01)	4.85*** (0.70)	3.94 (8.24)	1.95* (1.08)	-16.40** (6.46)	0.15	0.08	0.02	0.08
Telecomm. (5)	25.84*** (6.40)	-17.80** (8.78)	3.83*** (0.61)	12.73 (8.75)	-0.49 (1.02)	-15.46* (9.30)	0.14	0.00	0.00	0.00
Utilities (5)	14.21* (8.59)	3.52 (15.07)	0.27 (1.89)	12.62 (12.57)	2.00 (1.64)	4.98 (14.50)	0.10	0.55	0.49	0.26

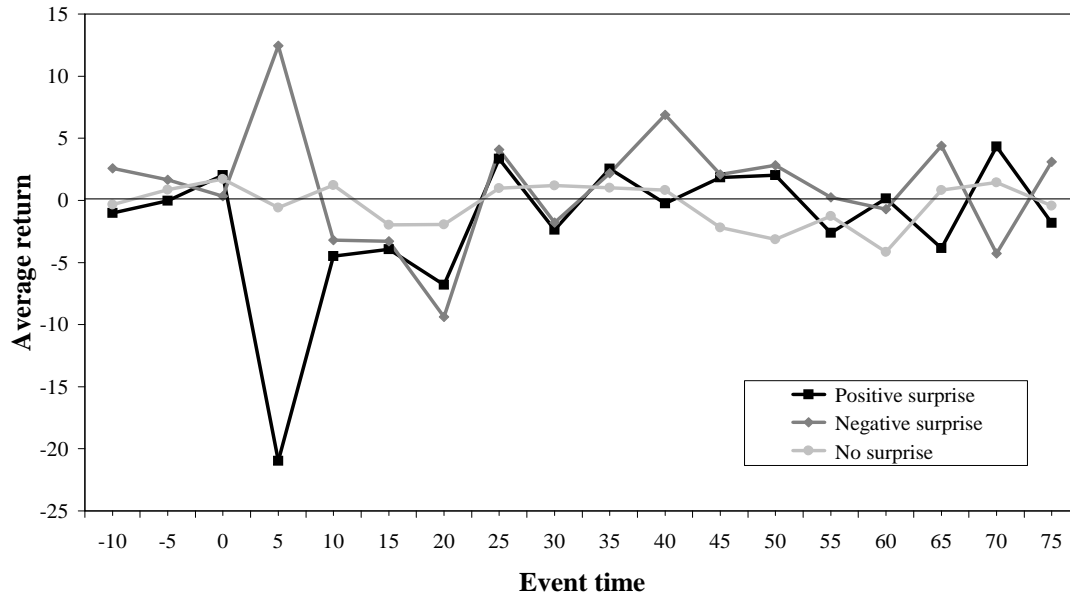
Note: The table shows the results from the regression of the daily change in 60-minute realized correlations on absolute surprises in Federal funds rate changes allowing for different effects of positive and negative surprises, and for different effects of 'reversal' decisions (equation (15)). The model is estimated using the realized correlations between individual stocks belonging to the same sector for the 77 FOMC meetings between May 1997 and October 2006, and are aggregated to the sector level by taking averages. Negative and positive surprises occur in 26 and 28 cases, respectively. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks. Columns headed 'Wald tests' contain p -values of Wald statistics for testing the indicated restrictions for the average coefficients (allowing for heteroskedasticity as well as correlation of residuals across stocks).

Table 12: Asymmetric response of inter-sector realized correlations to positive and negative surprises

	α_0	α_1	β_1	α_2	β_2	δ	R^2	Wald tests		
								$\alpha_1 = \alpha_2$	$\beta_1 = \beta_2$	$\alpha_1 = \alpha_2$ $\beta_1 = \beta_2$
All stocks (100)	15.60*** (4.36)	-2.42 (6.86)	2.69*** (0.46)	8.06 (5.93)	1.09 (0.70)	1.92 (3.49)	0.11	0.11	0.06	0.16
Cons. Discr. (15)	13.28*** (4.66)	-2.32 (7.06)	3.05*** (0.46)	9.26 (5.95)	1.27* (0.70)	2.99 (3.32)	0.12	0.07	0.03	0.10
Cons. Staples (11)	16.68*** (4.47)	-5.00 (7.58)	2.72*** (0.56)	5.25 (6.11)	1.50* (0.77)	3.81 (3.43)	0.10	0.17	0.20	0.36
Energy (6)	13.83*** (4.19)	-0.55 (6.48)	1.91*** (0.43)	5.42 (6.17)	1.05 (0.91)	2.82 (4.14)	0.11	0.37	0.39	0.64
Financials (14)	17.08*** (4.29)	-1.09 (6.87)	2.89*** (0.46)	8.88 (5.92)	1.03 (0.82)	3.73 (3.07)	0.11	0.14	0.05	0.14
Health Care (10)	16.00*** (4.62)	-2.73 (7.02)	2.45*** (0.63)	7.86 (6.89)	1.23 (0.81)	2.22 (3.63)	0.10	0.15	0.24	0.35
Industrials (14)	14.90*** (4.36)	-0.40 (6.95)	2.74*** (0.49)	8.39 (6.22)	0.85 (0.76)	1.62 (3.08)	0.10	0.21	0.04	0.10
IT (13)	15.79*** (4.50)	-1.47 (6.68)	2.41*** (0.49)	10.90* (6.00)	0.44 (0.79)	3.76 (3.03)	0.10	0.05	0.04	0.09
Materials (7)	13.27*** (4.71)	-4.14 (7.31)	3.46*** (0.49)	7.23 (6.53)	1.44** (0.63)	-5.37 (3.85)	0.13	0.11	0.01	0.04
Telecomm. (5)	18.79*** (5.38)	-6.70 (7.77)	3.11*** (0.54)	10.14 (7.06)	0.62 (0.60)	0.62 (4.48)	0.12	0.02	0.00	0.01
Utilities (5)	18.50*** (5.11)	-3.05 (9.01)	1.54* (0.80)	3.56 (7.78)	1.86* (1.04)	-3.40 (6.00)	0.09	0.48	0.81	0.43

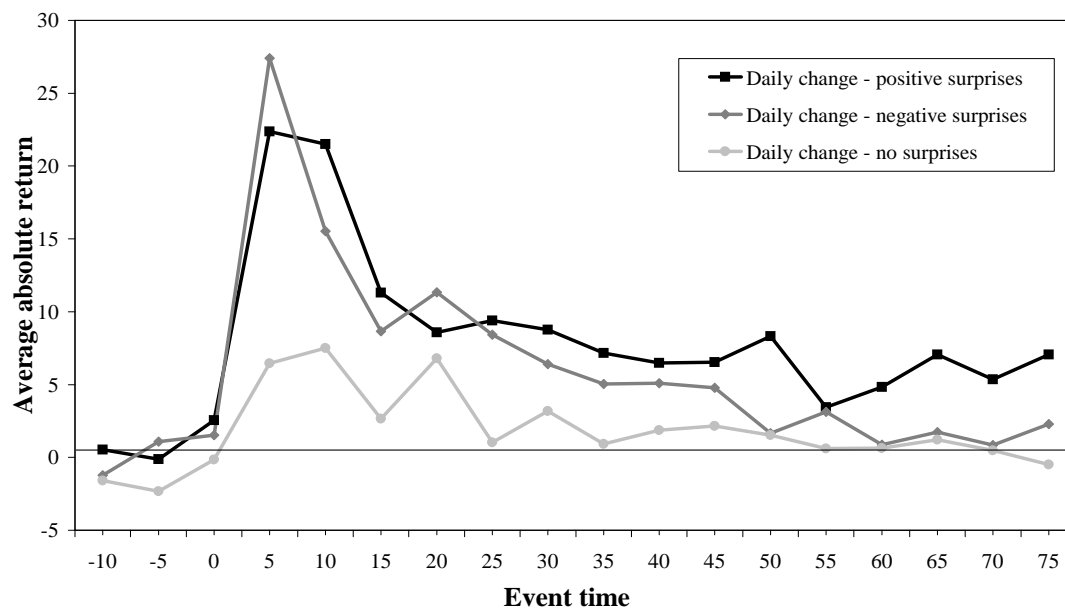
Note: The table shows the results from the regression of the daily change in 60-minute realized correlations on absolute surprises in Federal funds rate changes allowing for different effects of positive and negative surprises, and for different effects of ‘reversal’ decisions (equation (15)). The model is estimated using the realized correlations between individual stocks belonging to different sectors for the 77 FOMC meetings between May 1997 and October 2006, and are aggregated to the sector level by taking averages. Negative and positive surprises occur in 26 and 28 cases, respectively. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively, based on the standard errors given in parentheses, which allow for heteroskedasticity as well as correlation of residuals across stocks. Columns headed ‘Wald tests’ contain p -values of Wald statistics for testing the indicated restrictions for the average coefficients (allowing for heteroskedasticity as well as correlation of residuals across stocks).

Figure 1: Stock returns around FOMC announcements



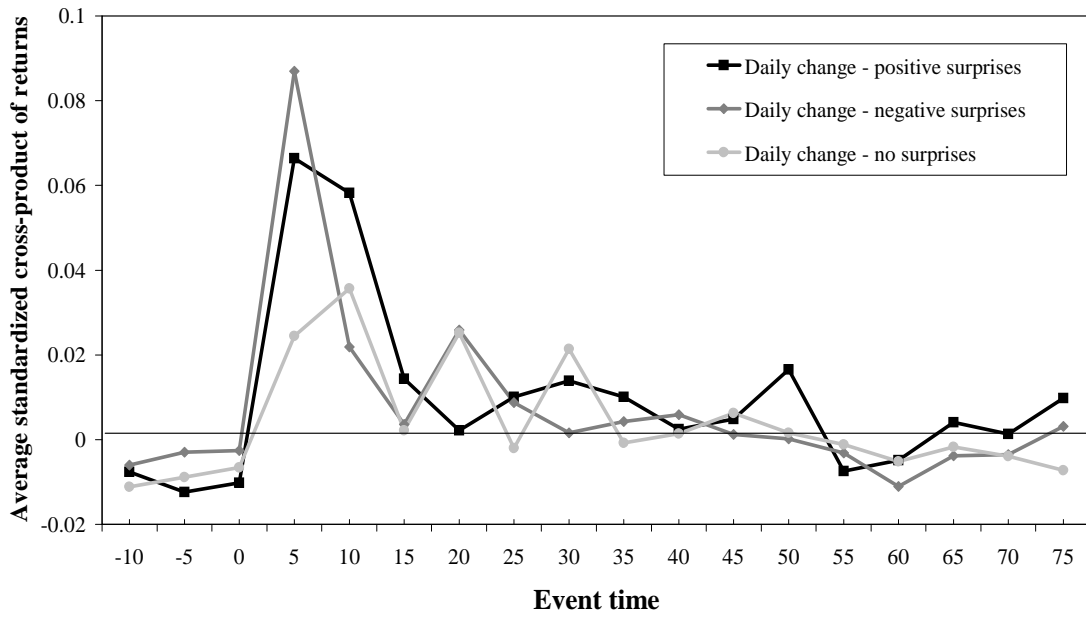
Note: The figure shows the average returns for the S&P100 constituents in five-minute intervals around the announcement of the Federal funds target rate decision. The label '5' on the horizontal axis indicates the average return in the first 5 minutes after the announcement. The graph is based on the 77 scheduled FOMC meetings between May 1997 and October 2006, which are split into 23 'No surprise', 28 'Positive surprise' and 26 'Negative surprise' cases.

Figure 2: Volatility changes around FOMC announcements



Note: The figure shows the average change in absolute return for the S&P100 constituents in five-minute intervals around the announcements of the Federal funds target rate decision, relative to the pre-announcement day. The label '5' on the horizontal axis indicates the average return in the first 5 minutes after the announcement. The graph is based on the 77 scheduled FOMC meetings between May 1997 and October 2006, which are split into 23 'No surprise', 28 'Positive surprise' and 26 'Negative surprise' cases.

Figure 3: Correlation changes around FOMC announcements



Note: The figure shows the average change in cross-products of returns taken over all possible pairs of S&P100 constituents in five-minute intervals around the announcement of the Federal funds target rate decision, relative to the pre-announcement day. The cross-product of returns of stocks i and j during the k -th interval is normalized with their realized volatilities over the window from 15 minutes before until 75 minutes after the announcement time, that is $(R_{it,k}R_{jt,k})/(RV_{it}RV_{jt})$, where RV_{it} and RV_{jt} are computed according to (2) with $l = -3$ and $u = 14$. The label '5' on the horizontal axis indicates the average return in the first 5 minutes after the announcement. The graph is based on the 77 scheduled FOMC meetings between May 1997 and October 2006, which are split into 23 'No surprise', 28 'Positive surprise' and 26 'Negative surprise' cases.

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* A complete overview of the ERIM Report Series Research in Management:

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MKT Marketing

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