The Reaction of Real Estate-Related Industries to the Monetary Policy Actions

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Abstract

We study the impact of changes in US monetary policy on the equity returns of real-estate-related industries. We find that over the 1989 to 2005 sample period covered in our study, a hypothetical unexpected rate cut of 25 basis points is associated with an increase of about 170 basis points in the value-weighted returns of real estate-related industries. We find that monetary policy impacts the stock prices in real estate-related industries through its impact on the future expected stock returns and not on real interest rates or expected future dividends.
There is also some evidence of asymmetry in the responses of the industry returns to the monetary policy actions. A strong stock price response to reversals in the direction of the Federal Reserve's monetary policy is reported.

JEL classification: E4, G1

Key Words: Real Estate-Related Industries, REIT, Monetary Policy, Surprise changes in Fed Funds Target Rate, Fed Funds Futures.

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Introduction

The market's reaction to the Federal Reserve's monetary policy has long been a topic of interest, with many prior studies examining the effect of Federal Reserve policies on different market sectors. Some studies have focused on measuring the impact of monetary policy on general equity markets and bond markets[3]. To our knowledge, none of these studies aimed to determine the impact of the Federal Reserve's monetary policy on real-estate-related industries. Rigobon and Sack (2002) estimate the response of asset prices and interest rates to changes in monetary policy, using the three-month Eurodollar rate as the measure of monetary policy.[4] Bernanke and Kuttner (2005), who we follow in our study, measure and analyze the stock market's response to monetary policy actions, attempting to explain the factors responsible for changes in the stock market. Patelis (1997) uses the same approach to estimate the role of monetary policy on the predictability of stock returns. Payne (2003) applies the vector-autoregressive approach to analyze the macroeconomic impact of changes in the Federal Funds Rate on the risk premiums for Real Estate Investment Trusts. Plazzi, Torous, and Valkanov (2007) show that the variation in commercial real estate prices is largely due to the movements in discount rates, and not to cash flows. Using the VAR method, Campbell et al. (2008) study the Rent-to-price ratios in US housing markets. They show that significant portion of the variability in that ratio can be

[3] Kuttner (2001) measures the impact of monetary policy on interest rates of different maturities, Cook and Hahn (1989) study the reaction of bond prices to monetary policy actions from 1974 to 1989, Rigobon and Sack (2002) estimate the response of asset prices and interest rates to the changes in the monetary policy. Bernanke and Kuttner (2005) measure and analyze the stock market's response to monetary policy actions, Thornton (1998) studies the reaction of interest rates of 3 month, 12 months, 10 yr and 30 yr maturities to the changes in the FFTR, Goukasian and Cialenco (2006) study the impact of the monetary policy on the term structure of interest rates.

[4] ED Futures are very liquid securities which gives them an advantage relative to the ED deposit rates. They use the prices on nearest month ED futures (These contracts have four expiration months a year).

explained by changes in the housing premia. They also show that covariances between house prices, rents and housing risk premia damp fluctuations in the rent-price ratios.

This paper studies the impact of monetary policy on real-estate-related industries. We also attempt to identify the channels through which the monetary policy impacts the equity returns in the real estate-related industries. Estimating this impact is not straightforward due to the fact that, under the efficient market hypothesis, any new information gets quickly reflected in market prices long before policy decisions are made and implemented. Because adjustments occur continuously, measuring the impact of policy changes on the asset prices is not readily apparent.

We estimate the impact of changes in the monetary policy on the real-estate-related industries by studying the industry returns on days when a decision was made and announced to the public. On an announcement date, the market should only react to the unexpected portion of the news, not the expected portion, as the expected portion is already reflected in prices. Thus, to measure the impact of the policy on the prices, we need to measure and use the unexpected part of the monetary policy action. To measure the unexpected portion of monetary policy or the "surprise" change, we employ the method proposed by Kuttner (2001) to construct a dataset of unexpected changes in the FFTR.[5]

In the second section we explain the details of the calculations. We then break the changes in the monetary policy actions down to two components – expected and unexpected - and study the impact of each on prices under different econometric specifications. The initial analysis of the

[5] Bernanke and Kuttner (2005) use the same method to analyze the impact on the broad equity markets and Goukasian and Cialenco (2006) use the same method to estimate the impact on the term structure of zero-rates.

data in the third Section indicates that real-estate-related industries react strongly and significantly to surprise changes in the FFTR. In the event of a hypothetical 25 basis point cut in the rate, the average industry reaction is approximately a 100 basis point increase if the entire sample period from 1989 to 2005 is used. After 1994, when the Federal Reserve changed its announcement policy, the reaction became stronger with a hypothetical 25 basis point cut in the FFTR yielding an approximate 170 basis point increase in the returns.[6] One reason for this difference in the reactions is that prior to 1994, the decision by the fed would not be announced to the market and thus the new information would be reflected in the prices not on the day the decision was made, but in the next few subsequent days. As a result, the reaction of the market prices prior to or post-1994 are a bit different. As expected, there is also a small and insignificant reaction to the portion of the rate change that was anticipated by the market.

Not only the impact of monetary policy is different for real-estate-related industries compared to other industries but we expect that within this sector, each industry react differently to monetary policy actions to the extent that the policy has differing impact on their future profitability. Consistent with our expectations, the strength of the reaction differs between industries. The industries that we study include: *Mortgage & Banking, Real Estate Investment Trusts (REITs), Real Estate Brokerage & Management, Real Estate Residential Construction, Commercial Construction Contractors, Building Material Supply* and *Water & Sewage Utilities.* The results indicate that the *Building Material Supply* and *Mortgage & Banking* industries demonstrate the strongest responses and *REITs* and *Water & Sewage Utilities* show the weakest reactions to changes in monetary policy. This is particularly consistent with the theory, that industries with

[6] Post-1994 is of particular interest because beginning January 1994 the Fed undertook the current policy of announcing any changes in the FFTR on the same day of the Federal Open Market Committee meetings.

higher returns have more volatility of returns and are expected to react stronger to surprise changes in the cost of money.

To better evaluate the strength of our results, we exclude outliers that might have an effect on our estimated coefficients for each regression, and find similar results with minor differences in the magnitude of the responses. Additionally, we investigate asymmetries in the results to observe if industry responses to policy changes are particularly sensitive to certain characteristics of monetary policy. These characteristics are direction of the policy (increases or decreases in the FFTR), whether there is an "inaction" in the policy, i.e. if the markets expects a rate change and the Fed does not change the rate, or if it is a reversal in rate change (from increasing to decreasing or vice versa). These are all possible sources for asymmetric responses of industry returns to the monetary policy actions.

The majority of our results confirm that among these characteristics only when there is a reversal in the policy the returns respond asymmetrically and the response is significantly and consistently stronger than usual. To clarify, a reversal in policy (from tightening to easing or vice versa) sparks a stronger reaction in the market than any other surprise policy change. This can be explained: when reversals happen, markets are not only surprised by the magnitude of policy change but also by the direction of the change. In other words, the reversals in monetary policy are usually turning points that change the course of the policy from one set of increases to a set of decreases or vice versa. On the other hand, if the markets expect a rate change and the Federal Reserve does not change the rate, (i.e. an "inaction" in the policy), then the market's reaction is

small or even positive in some cases, presumably because the markets expect that a rate cut is inevitable in the future.

The remainder of the paper is organized as follows: The second section describes the data and methods employed in extracting the unexpected changes in the FFTR and the data on real estate-related industry. In the thirds section we report the results of the initial regressions of industry returns on the expected and unexpected changes in the FFTR. The forth section discusses the robustness of our results, and Section five highlights asymmetries in the findings. In this section we analyze particular industries to detect any asymmetries. In the sixth section we attempt to disentangle the various effects and find the source of the impact of the monetary policy on real estate-related industries. Section seven concludes our findings.

The data

We constructed two datasets to conduct this study. The first is a dataset of prices for all the stocks in the real estate-related industries, obtained from the CRSP. We used the US Department of Labor SIC Division Structure to identify the real estate-related sub-industries by their SIC codes[7]. The complete list of SIC codes and their descriptions are reported in Table 1. Then we obtained pricing data on all companies that have the SIC codes in table 1 from CRSP database of WRDS. To form value-weighted indices, we used the market capitalizations of all the companies in the group (having the same SIC codes) to assign weights to each company, and thus form value-weighted portfolios of stocks of sub-industries.

[7] Please see the details of the SIC codes and their descriptions at http://www.osha.gov/pls/imis/sic_manual.html

The second source of data contains prices of front-month and a month-out futures on average effective federal funds rates for the month under consideration. These are referred to as 30-day Fed Funds Futures and are traded in the CBOT. We use these futures prices to estimate the unexpected changes in the FFTR. This data was obtained from Bloomberg.

Several methods have been utilized by researchers to measure unexpected changes in monetary policy. Kuttner (2001) and Faust, Swanson, and Wright (2001) used current-month federal funds futures contracts, Bomfim (2002) and Poole and Rasche (2000) used one-month out federal funds futures contracts, Cochrane and Piazzesi (2002) employed one-month Euro-Dollar deposit rates, Ellingsen and Soderstrom (1999) used the three-month Treasury bill, and Rigobon and Sack (2002) referenced the three-month Euro-Dollar futures rate. Results indicate that since 1994, federal funds futures rates serve as the best indicator for predicting future changes in the federal funds rate over horizons of several months.[8] We follow Kuttner (2001) and use current-month federal funds futures prices to measure the impact of expected and unexpected changes in the FFTR.

Denote by i^- and i^+ the fed funds rate before and after the meeting (the event day). If the meeting is on the *d*-th day of the month that has *m* days, then

$$FFTR^- = \frac{d}{m} i^- + \frac{m-d}{m} E_-(i^-) + \varepsilon^-,$$

[8] Krueger and Kuttner (1996) show that funds rate forecasts based on futures prices are efficient: that is, the forecast errors are uncorrelated with other variables. Sack (2003) shows that these risk premia vary over time and that the impact of these variations on prices of futures with short horizons is limited and the impact increases with maturity. Since we are using daily data on the fed funds futures and sometimes intraday data, the premium for such a small time interval will be negligible.

where $FFTR^{-}$ is the implied FFTR for the month and ε^{-} is the premium for the futures contract as of the day before the rate changes. On the day of the rate change (FOMC meetings), the rate for the rest of the month is known and the implied FFTR from the futures contract is

$$FFTR^{0} = \frac{d}{m} i^{-} + \frac{m-d}{m}(i^{-}) + \varepsilon^{0}.$$

Using the conventional way of measuring the surprise (unexpected) change in monetary policy as $\Delta i^{s} = i^{-} - E_{-}(i^{-})$ and using the two equations above, we get

$$\Delta i^{s} = \frac{m}{m-d}\left(FFTR^{0} - FFTR^{-}\right) + \frac{m}{m-d}\left(\varepsilon^{0} - \varepsilon^{-}\right).$$

Thus, assuming that the premium ε is not significant[9] to have an impact on the policy, we get an expression for finding the unexpected portion of the monetary policy action[10]:

$$\Delta i^{s} = \frac{m}{m-d}\left(FFTR^{0} - FFTR^{-}\right), \qquad (1)$$

in which $FFTR^{0}$ is the current-month futures rate on day d and $FFTR^{-}$ is the current-month futures rate on day $d-1$.[11] The expected portion of the rate change will be the difference between the actual change and the surprise, or

[9] Since we are using daily data on the fed funds futures and sometimes intraday data, the premium for such a small time interval will be negligible.

[10] When the event day is on the first days of month, we take the open and close prices of futures on the days to find the surprise change in rates. If the event day is on the last day of the month, we take the 1-month out futures prices on the last day of the previous month and the current-month prices on the first day of the month to find the surprise change in the fed funds target rate.

$$\Delta i^e = \Delta i - \Delta i^s \ , \tag{2}$$

One of the significant steps in gathering the observations on Fed funds rate changes is determining the correct dates when changes actually occurred or were released to the public. Currently, the Fed announces its decision concerning any changes in the FFTR on the same day of the Federal Open Market Committee (FOMC from now on) meeting when the decision is made. Resultantly, both futures markets and the stock market become aware of any changes in monetary policy on the day when changes are decided and announced. This announcement practice has been used since January 1994. Prior to 1994, markets were unaware of rate changes until the Open Market Desk implemented the new policy, which was generally the business day following the FOMC meeting. It is worth noting that in some instances the Desk implemented the policy before the rate was changed or the decision was finalized, causing the markets to react sooner in these cases. Therefore, the announcement timing is important in measuring the impact on the industries under consideration. We reference Rudebusch (1995) and Hilton (1994) to construct a database of Fed funds rate changes before 1994 according to Desk implementation. Additionally, Kuttner (2003) points out several anomalies for this period which we accounted for in our study. Six of the anomalies, identified by Kuttner (2003) are events in which the Desk reduced the rates before the FOMC decision.[12] The inaction of the Desk after the FOMC decision is meant to be an agreement between the FOMC's decision and implementation by the Desk. The

[11] The future contracts are traded on the Chicago Board of Trade (CBOT) and the futures rates that we use in this formula are simply 100 minus the contract prices on CBOT. When the Fed funds rate change occurs on the first day of the month, we use "next-month" futures rate on the last day of previous month for $FFTR^-$. Moreover, when d is some day at the end of the month, m-d becomes smaller and so the proxy becomes exponentially larger. Therefore, for events that fell on the last three days of the month we use the un-scaled change in one month futures rate instead of the spot month rate.

[12] We thank K. Kuttner for providing his calculations and the details of the timing of information releases and other specifics.

last exception is the rate cut on December 18, 1990 when the Fed uncommonly announced the rate cut after their meeting before Desk implementation causing the markets to react the same day.

Since 1994, the FOMC has generally announced changes in the target rate before the close of the futures market at 3:15 p.m. EST. Therefore, both closing futures prices and stock prices reflect the new monetary policy, responding to the new policy on the same announcement day. October 15, 1998 is the only date in our study when an announcement was made after the futures market closed. To accommodate for this singular occurrence we use the opening price on October 16th and the closing rate on the 15th to measure the expected and unexpected portion of the monetary policy. Table 2-A reports the descriptive statistics of the FFTR and Table 2-B reports the distribution of the FFTR for three different time periods. Out of all 155 event-days, no changes were made to the FFTR 86 times, the rate was cut by 50 basis points (bps) 12 times, and once it was raised by 75 basis points.

The majority of FFTR decisions were made on Federal Open Market Committee meeting days. Out of 155 decisions, 135 decisions occurred on FOMC meeting days, and the remainder occurred on non-FOMC days. Most decisions following January 1994 occurred on FOMC meeting days. Out of 98 event days after January 1994, the Fed did not change the FFTR for 55 of those event days. We study these days as well to interpret the reaction of the expected changes on the market. The distribution of the actual rate changes is shown in Table 2-A. Additionally, we include contracting and expanding policy environments in which the rates were raised or lowered. We divide the changes into two components (expected and unexpected) for the

analysis, but do not report the details here.[13] We conducted this study for the entire sample period and for the period after January 1994. As mentioned earlier, the Fed changed its announcement policy after January 1994, providing information to the market the same day as the decision. By creating two samples, the first containing all event days between 1989 and 2005, and the second containing only event days following the 1994 announcement policy change, we measure the impact of the new announcement policy compared to the entire sample.

We report the statistical average and the standard deviation of the FFTR. By comparing two time periods, it can be clearly seen that the surprise change in the FFTR is less volatile after 1994 than before when policy actions were less transparent and not generally made in the FOMC meeting. We also study the 86 days when there were no changes in FFTR. For 46 of these days the market was expecting an action by the Fed, meaning no change was considered an unexpected change that triggered a reaction in the stock market.

The Initial Results

The stock markets are forward looking in nature, continuously reacting to changes in expectations according to the expectations theory. Actual policy changes do not always coincide with market expectations. If there is a difference between the expected and actual changes in the FFTR, then the market should react to the unexpected portion of the news on the changes in the FFTR. Thus, to understand the effects of monetary policy decisions on certain market prices, we need to study the effects of the unexpected portion of the change in monetary policy on those prices.

[13] See Goukasian and Whitney (2006) for the details of the calculations of surprise changes in the FFTR, the breakdowns and the descriptions of the event days.

Our sample of observations consists of dates when monetary policy actions (decided by the Federal Reserve and measured in the FFTR) were released to the public. As this sample is a combination of event days, our analysis is an "event" study. The data range spans the period from June 1989 to January 2006 and includes 155 event days. The Federal Reserve changed its announcement policy regarding changes in the funds rate after 1994, and adopted the new practice of announcing new rates after the meeting. Prior to 1994, markets became aware of the new rates on the day after the meeting when Open Market Desk implemented it. Due to this difference, we study the whole sample and a sub sample that consists of post 1994 event days. The latter sample contains 100 event days.

While the market may anticipate a certain change in the FFTR, the Fed may surprise the market by changing the rate by more or less than market expectations. Accordingly, the market will react to these unexpected changes[14]. To estimate the reaction, we run the following regression:

$$R_t = \alpha + \beta^e \cdot \Delta i_t^e + \beta^s \cdot \Delta i_t^s + \varepsilon_t \ , \qquad (3)$$

in which the expected changes Δi_t^e and surprise change Δi_t^s are calculated as described in Section 2 and R_t is the value-weighted return of the industry under consideration. Table 3 shows the results of the regressions of the value-weighted returns of the real estate-related industries on the expected and unexpected changes in the FFTR. We also run and report the reaction of the global

[14] Theoretically, the market should not react to the expected changes in the rate since it already is reflected in the market prices, but only to the unexpected changes.

equity market to the changes in FFTR.[15] As discussed earlier and expected, the industry responses to the expected changes are insignificant. However, the industry responses to the surprise changes in the rate are significant for all industries, except for the *Water* & *Sewage Utilities*. The results in this case possess higher explanatory power than in the previous case, meaning, breaking down the rate changes into two components in the regressions increases the explanatory power of the regressions. Also, as expected, the overall market reaction to the monetary policy is smaller than the one of the overall real estate- related industries.

Taking the entire sample into consideration, for a 25 basis point surprise rate cut, the real estate industry will roughly yield a 109 basis point return. This is a strong reaction, considering the fact that these are daily returns. In the post-1994 sample, the response is even stronger and even more significant. For a hypothetical 25 bps rate increase, the industry loses approximately 180 basis points, as opposed to nearly 109 basis points for the entire period. Responses also vary among different industries, but are quite consistent to the results found in table 1 and reinforce our arguments for these differences. The Building Material Supply and Mortgage & Banking industries demonstrate the strongest reaction. REITs exhibit the smallest reaction of all the industries: for every hypothetical 25 basis point rate cut, REITs yield a 60 basis point return post-1994 and a 42 basis point return for the entire period. The R^2 of this regression increases dramatically in comparison to the one of the regression on the actual changes in the rate (not reported here). For the post-1994 sample, we can explain nearly 27% of the variation in equity prices of real-estate-related industries resulting from monetary policy actions.

[15] We use CRSP value-weighted index (data obtained from WRDS database) as a proxy for the overall equity market and measure the impact of the monetary policy on this index.

The scatter plot in figure 1 depicts the negative response of real estate equity market prices to surprise increases in the FFTR. In our sample there are some observations that demonstrate a dramatic response to small changes in the FFTR, and could exert a strong impact on our response estimation. To compensate for this factor, we calculate the Cook's D influence statistic to discover observations which exhibited an abnormally strong effect on the estimations.[16] Observations with influence statistics above 0.2 are considered influential and we label them as outliers.[17] Figures 2a through 2h illustrate the distributions of the influence statistics and report the influential observations for each real estate industry studied. Most outliers fall in the easing cycle which began in 2001. The 50 basis point rate reductions on January 3 and April 18 have an unusually strong impact on the real estate industries' returns. The reason for this is that many market participants expected the rate cuts to be of larger magnitude for these instances. On those dates the real estate industries lost on average more than 2 percent. Other unusual reactions occurred on October 15, 1998 and June 30, 1999. Table 4 reports the results of the regressions, illustrated in table 3, with the outliers removed. The impact of the surprise changes is still negative, strong and significant, although less in magnitude than the results shown in table 3. The most notable changes in the estimated responses occur for the Building Material Supply and Real-Estate Brokerage and Management industries which are now insignificant both for 1989 to 2005 and post 1994 samples. This shows that the results for these particular industries were

[16] Cook (1977) developed these statistics as the quadratic form $\Delta\hat{\beta}_t'\hat{\Sigma}^{-1}\Delta\hat{\beta}_t$ in which $\Delta\hat{\beta}_t$ is change in the estimated coefficients resulting from dropping observation t and $\hat{\Sigma}$ is the estimated variance-covariance matrix of the coefficients.

[17] The Cook's D influence statistic has distribution of $F(p, n-p)$ in which p is the rank of independent variable matrix and n is the number of observations. Observations with influence statistics between 10% and 50% of the distribution are considered influential and above 50% as highly influential. In our case, p = 3 and n =155, $F_{0.10}(3,152) \approx 0.2$ and $F_{0.50}(3,152) \approx 0.8$.

driven by few outliers. The modified regressions in Table 4 show lower R^2 due to the exclusion of those outliers.

One of the robust results that we get (using both the whole sample and sample without outliers) is that the impact of the surprise change in the rate on Residential REITs is consistently the lowest. As explained earlier, the rate increases have negative impact of the prices of these stocks through higher discount rates of future cash flows. On the other hand, however, the rate increases may help increase the potential cash flows of these firms as higher rates may imply higher mortgage rates, and therefore lower affordability of housing purchases, therefore more demand for rental properties, and therefore more cash flow for Residential REITs. Thus, we have two competing sources of impacts on the returns of the Residential REITs. At the end, it is an empirical question as to which of the two would have a dominating impact on the prices. In Table 5 we report the results of the regressions in which we estimate the reaction of each industry to the surprise changes in the fed funds rate, larger than 5 basis points[18]. For most industries, the coefficient of the surprise change is negative or statistically insignificant. For REITs, in general, the surprise effect is positive, but insignificant. But if we just consider the Residential REITs among all the REITs, the impact of the surprise change in the rate becomes positive and statistically significant (first column of Table 5). If the magnitude of the surprise rate change is larger than 10 basis points, the effect of the surprise rate increase becomes even more positive and significant. This type of response makes the Residential REITs unique in their response to the surprise rate hikes by the Fed. This finding may be used to suggest investments in

[18] We consider the events in which the market was surprised by more than +5 basis points to focus on the cases in which the affordability might be impacted.

Residential REITs as a hedging strategy against large positive surprises in the fed's monetary policy decisions.

Robustness of the results

The validity of the results in the previous sections generated through regressions depends on the assumptions that there is no contemporaneous correlation between error terms, as well as if the variables we used as proxies are good representations of what they proxy. Our results should only use changes in the monetary policy, and not be distorted by measurement errors or other sources of variation.

As mentioned earlier, there are several methods to measure the surprise components of monetary policy actions. Using futures-based computation of surprise changes in the FFTR is a reliable way of measuring monetary policy shocks. There is some error in this proxy yet recent studies show that this error has minor effect on regressions. In a study of Treasury Yield responses to monetary policy, Poole, Rasche and Thornton (2002) investigated the measurement error from ambient variations in the Federal Funds Futures Rate. They assume the error in the futures rate is independent of other factors influencing returns. This error should weaken estimations. By calculating the variance of the rate implied by futures prices, on days when the actual change in the funds rate coincided with the consensus market expectations reported by the *Wall Street Journal*, and estimating the parameters using the errors-in-variables method, Poole et al. found that their estimates were larger, contrary to expectation, suggesting that measurement error plays no role in affecting the results.

Another potential source of bias can occur when estimated surprises in the FFTR are correlated with other factors that affect stock returns. For example, if the funds rate surprise is correlated with the disturbance term in Equation 4, then the results would be biased. The first source would be a simultaneous response of the funds rate to equity prices. Employing daily data should minimize this source of error. If the Fed cut the rate and the stock market fell, this would reduce the size of the estimated response from equity returns to the funds rate surprise. D'Amico and Farka (2003) and Rigobon and Sack (2002) demonstrated that this is not the case through two different approaches.[19]

The joint response of monetary policy and the stock market to new information is a second source of possible contamination in our results. For example, the release of reports describing the overall condition of the economy could trigger a rally in the stock market, causing the Fed to cut the FFTR to maintain a sustainable growth rate in the economy. Similar to the discussion above, this may cause a downward bias in the size of the estimated responses.[20]

There are eight event days when the Fed decisions were announced along with employment reports. All of these events occurred before 1994.[21] We analyzed the simultaneity of responses by separating the reactions on these eight events using a dummy variable equal to one times the surprise change in the FFTR if employment reports were released and zero otherwise. The results

[19] D'Amico and Farka (2003) examined the equity response in a ten-minute interval after the announcement of policy. Their results are quite similar to those reported by Bernanke and Kuttner (2005). Rigobon and Sack (2002) propose an estimator based on the heteroskedasticity introduced by monetary policy actions. Their estimator provides slightly larger estimates of the total stock market's response to Fed funds surprises derived by Bernanke and Kuttner (2005): −3.7 to −4.0 (depending on the form of the estimator used), compared with −3.2 for the OLS event-study estimate.

[20] Romer and Romer (2000) argue that the surprises are the result of private information on economic conditions that the Fed possesses.

[21] After 1994, the changes of the FFTR were made and announced in pre-scheduled FOMC meeting days. Therefore, there is no simultaneous reaction of the Fed and stock markets to the economic news, except for September 17, 2001, when both react to the news. This day was removed from the study.

of this analysis are reported in Table 6. For the entire sample the results show that these events have insignificant differences from other events. When we exclude the outliers, the level of significance decreases and in the majority of cases there is almost no difference.

We also track the effects of fed announcements on stock prices of real estate–related industries at two time horizons: from thirty minutes before until thirty minutes after the announcements, and from market close of the day before until the market close on the day of the announcement.[22] The former is to capture the impact of the monetary policy more precisely in isolation of any other sources of news that could have impacted stock prices. The latter is the standard method used in the literature in measuring the impact of news on asset prices (yields). These two intervals are intended to capture, respectively, the immediate and full-day response of stock prices to the unexpected changes in the fed funds rate. One may argue that the actual responses to the announcements should be reflected in prices rather quickly – thus studying the impact of the fed announcements within 60 minutes of the announcements would estimate the impact more precisely. On the other hand, Evans and Lyons (2005**)** argue that the market needs more time to digest any news. The latter paper presents theoretical and empirical evidence showing that it does take time for news to be reflected in prices.

We estimate the responses of the stock prices of companies in real estate-related industries to a hypothetical 25 bps unexpected increase in the fed funds rate 60 min within the announcement (from 30 minutes before until 30 minutes after) and from market close of a day before until the market close of the announcement day. The results of the estimation and their standard errors (which are half-lengths of the 1-standard deviation confidence intervals) are reported in Table 7.

[22] We thank one of the referees for suggesting this robustness test.

We also report the differences in responses and the ratio of standard errors in Table 7. One important finding of our estimation is that the price responses can be measured with a higher precision in a short time period - 60 minutes within the announcements, than later, at the market close (4PM EST), as can be seen by comparing the standard errors of both estimation exercises. The responses are quantitatively and qualitatively quite similar in both cases; however, the standard errors are lower when the response is measured from 30 minutes before until 30 minutes after the announcement as reported in Table 7. This result is intuitive: as time passes after an announcement, other information will arrive and influence asset prices, increasing the uncertainty of the response. Thus, our results support the view that asset markets tend to absorb the impact of economic news rather quickly.

Asymmetries in the Results

Another set of interesting questions arises when one wants to see if the reaction of the real estate-related companies to monetary policy shocks are asymmetric when, for example the decision was to hike or cut the FFTR, or whether the decision was made during economic expansion or contraction, or the fed reverses its policy from expansion to contraction (or vice versa), or whether the unexpected portion of the change in the FFTR was positive or negative, and so on. In other words we study whether there are asymmetries in the responses to the monetary policy in different situations. In this section, we discuss the responses of various industries based on different assumptions on the timing of the event or the characteristics of the event.

The first possibility is that positive or negative surprises may cause different impacts on the market and result in different reactions by the market. We study the impact of signed surprises

by introducing a dummy variable that is one if the surprise is positive and zero otherwise. We multiply this dummy by the amount of surprise change and analyze the coefficient of this variable.

The regression results are reported in Table 8. Left panel contains the results for whole sample and the right panel displays the results excluding the outliers from the sample. The table portrays that the cases in which there was a positive surprise in the change in FFTR, the reaction is different from the ones with negative surprises (see regressions 1 and 5). If the surprises are positive, the equities may not react much while for negative surprises returns drop significantly. It is statistically significant even if we add other independent variables in the study. This may be explained by the fact that positive surprises in the change in FFTR may actually be good for some industries; such as Residential REITs, which may overweigh the negative impact on some other industries.

As expected and shown before, in all cases studied in Table 8 (10 regressions; 5 with and the other 5 without the outliers), the surprise positive change in the FFTR resulted in significantly negative returns in the whole industry. The reaction to the expected changes in the FFTR, on the other hand, is insignificant in all cases, as expected in the light of efficient market hypothesis.
Similarly, we analyzed other possibilities for asymmetries: positive rate changes; reversals in the fed policy (the first time increase/decrease in rate after a period of successive rate decreases/increases, i.e. tightening to easing or vice versa); and no rate changes. We included new dummy variables multiplied by the magnitude of the surprise change in the regressions. The "no rate change" dummy variable is used for event days when no change actually occurred in the

FFTR (regardless of whether the market expected the change or not) and the "positive rate change" is set to one for event days with actual positive rate changes. The coefficient of "no rate change" dummy is positive and statistically significant for all the cases. This dummy variable is important, meaning that on the days when the fed did not change the rate, the surprise change had little impact on the returns. It is not surprising, as for real estate industries, no change in the FFTR means that there would be relatively little change in the demand for real-estate, mortgage, and related services and products in the future and hence it has little effect on the stream of future cash flows or their present values. This is consistent with the results in Bernanke and Kuttner (2005), and, following them, we interpret it as a sign that markets might think that the Fed postponed the change in rate to the next meeting. On the other hand, positive or negative actual rate changes are not significantly different (See regressions 2 and 6). This means that the direction of actual monetary policy does not matter.

The impact of "reversals" is negative and statistically significant in all the cases. This finding indicates that a reversal in the direction of the monetary policy plays a significant role in explaining the real-estate-related industries' reaction to monetary policy action. This is also not surprising as markets may interpret reversals in the monetary policy as a long term change in Federal Reserve's policy. In other words, after a reversal, the markets may think that the Fed will not change the direction of its policy for a while and, therefore, successive rate changes will be in the same direction. Hence the reaction will be stronger in anticipation of the above expectation. The Adjusted R^2 is high in all regressions, indicating that we can explain over 32% of the variation in one-day return of the stocks in real-estate-related industries on the day when the Federal Reserve makes decisions on the FFTR.

In summary, there is a strong significant response of real estate-related industries to surprise changes in FFTR and this response is at least twice the magnitude of responses of the average daily returns in the equity markets, found by Bernanke and Kuttner (2005). As expected, real estate-related industries react strongly to any unexpected changes in the FFTR. The reaction is stronger than the response for a broad value-weighted CRSP index of the equity market, consistent with the view that real-estate-related industries are more sensitive to the "cost of money" (proxied by the FFTR and controlled by the Federal Reserve) than other average industries.[23] All observations in this analysis are post 1994 events, therefore, all are FOMC meetings and we do not need to be concerned about the endogeneity problem discussed in the earlier sections.

We employed the same method to explain the reaction of each of the industries to monetary policy actions. Table 9 summarizes the response of daily stock returns of the Mortgage & Banking industry to monetary policy actions. The results show that there is almost no asymmetry in the responses. The expected portion of the change in the FFTR has no impact on the returns, as expected, and the unexpected portion demonstrates a negative and statistically significant impact on the returns. Because companies in this industry are in the "business of interest rates", they hedge their future cash flows against future uncertainties in interest rates movements. This may be the reason for the symmetric responses to the monetary policy. Regardless of the direction of the surprise, or the actual change, the response is the same as the interaction coefficients are insignificant. When "no rate change" is considered, the response becomes

[23] The regressions in Table 8 show evidence that the strength of the response also depends on some specifics of the rate changes. As discussed above, in the case of "no actual rate change" or "reversal" the reactions are different from other cases.

smaller, although the coefficients in regressions (2), (5), (7) and (10) in the Table 9 are less significant than their counterparts in Table 8. In the event of reversals, the response becomes larger, yet the coefficients are less significant than those for the whole industry. Overall, the response of the Mortgage & Banking industry is nearly the same as the average for the other real estate-related industries.

Table 10 reports similar analysis for Real Estate Investment Trusts (REITs). Comparing the coefficients of "surprise" changes in the rate of this industry with other industries, we can see big differences. To some extent, this confirms our hypothesis that the impact of higher interest rates may be smaller (or even positive in some cases) on REITs. Regression (1) of Table 10 shows that positive surprises have no impact for this industry, yet when considering other variables in regression (5), this becomes more significant. Excluding outliers, in regression (10) the difference again becomes insignificant. Turning to regressions (2), (7), and (10), we can see that the response to "no rate change" is always positive. That is consistent across other industries. These regressions also show that the sign of the surprise is symmetric: there is no difference between the events with positive or negative rate changes. The response of REITs to "reversals" is greater in regressions (3) and (8), but when considering other variables it becomes insignificant and similar compared to the case when the policy does not change its direction.

The Real Estate Brokerage & Management industry has virtually no asymmetry in its response to reversals as seen in Table 11. The coefficient of interaction of a positive surprise dummy with the surprise in the rate in Table 11 is insignificant, even if other variables are included or outliers are excluded (regressions (1), (5), (6) and (10)). The same is true for positive rate changes. When there is "inaction" in the monetary policy, there is ambiguity in the direction of the response.

However, after including other variables and excluding the outliers, the regression coefficient becomes insignificant. For reversals, the response is greater and significant in the whole sample, but when outliers are excluded and other variables are included, the response becomes insignificant, particularly as one of the outliers corresponds to an event day with a reversal in policy. As expected, the coefficient of expected change is almost zero and insignificant in all regressions of Table 11.

Table 12 illustrates the regressions for the Residential Construction industry, reflecting the entire sample since there are no outliers. Regressions (1) and (5) show no difference between negative and positive surprises. The same is true for positive and negative rate changes from regressions (2) and (5). Regression (3) exhibits that the response to reversals is bigger, but the difference in the response becomes insignificant when all variables are considered. The only variable which stocks react differently to is the "no rate change" variable. Interestingly, if there is no change in the FFTR, then the response is positive.

Companies in the Commercial Construction Contractors industry have the same response pattern to the monetary policy as the Residential Construction industry. As can be seen in Table 13, the results are similar to ones in Table 12. The response is not sensitive to the direction of the surprise. The response to "reversals" is greater, but the difference becomes insignificant if all variable are considered. There is some evidence that the stocks in this industry also react positively when there is no rate change.

The situation is different for the Building Material Supply industry. Compared to other industries, this industry reacts differently to monetary policy changes and the reaction is asymmetric. This is partially explained by the fact that there are not many publicly traded firms in this industry, and that these firms are dependent on other industries like residential and commercial constructions. The changes in monetary policy affect these firms directly through the "cost of money" and indirectly, by impacting their future cash flows (that are dependent on other real estate-related industries that are customers of these firms). In Table 14, regression (1) shows a difference in positive and negative surprises, but it vanishes as we consider all variables or if we exclude the outliers. However, this industry is sensitive to the direction of monetary policy. If there is no rate change, or if there is a positive rate change, the response could be even positive and significant, as shown in regressions (2), (5), (7), and (10). There is a significant negative coefficient for the surprise change in the rate in the case of a reversal in the policy. However, excluding outliers with all variables in the regression, the difference is less significant (regression 10). The Adjusted R^2s are lower when outliers are excluded, indicating that those outliers could explain a considerable portion of the variance in the returns.

The final industry we studied, the Water & Sewage Utilities industry, is not always considered a real-estate-related industry, yet it is affected both by residential and commercial real estate development. Because the industry is a utility service with very low market beta, we anticipated that there would not be great variation in the returns and hence small responses to the rate changes and no asymmetry. Table 15 contains the regression results for this industry. The entire sample is represented since there is no outlier in the regression. Regressions (1) and (5) show no difference between positive and negative surprise responses. The response is also irresponsive to

changes in the direction of rate changes. Even if there is "inaction" in policy the results are still insignificant as seen in regressions (2) and (5). A reversal in monetary policy, which prompts a strong response in other industries, has no statistical significance in explaining the return on event days. As expected, the reactions on Fridays are not different from other event days. The coefficient of surprise change along with expected change is nearly zero for this industry and is insignificant, showing no sign of reaction to the Federal Reserve's monetary policies. Each calculated adjusted R^2 is almost zero showing that Federal Reserve Policy plays no role in explaining the returns of stocks in the Water & Sewage Utilities industry on the days when policy decisions are announced.

Fundamentals and industry returns

The main question that arises from the analysis of previous sections is why Real-Estate related stocks should react to the unexpected changes in the fed funds rate, i.e. what are the fundamental sources underlying the changes in the stock returns with respect to an unanticipated monetary policy changes? If equity prices reflect the discounted stream of future dividends, then three factors may contribute to the response of equity returns to the surprise monetary policy changes: 1) expected future dividends, 2) future expected real interest rates which are used to discount future dividends, or 3) the equity premium (or expected excess returns) [24].

Suppose the market faces an unexpected increase in the fed funds rate. As we saw in previous sections, this will lead to a decrease in stock prices. The latter response could be due to a decrease in expected future dividends, an increase in future expected real interest rates, or an

[24] See Campbell (1993) or Campbell and Ammer (1993) for the justification of this.

increase in equity premiums. In order to attribute the stock price responses to any one of the candidate sources, we will follow a method that was first developed by Campbell and Shiller (1988), the "dynamic Gordon" model, to analyze the determinants of variability of the dividend-price ratio in the aggregate stock market. This framework has been used in studying the fixed income markets by Campbell and Ammer (1993), equity returns by Vuolteenaho (2002) and Bernanke and Kuttner (2005), the Rent-to-price ratios in local and national housing markets by Campbell et al. (2008), and commercial real estate by Plazzi et al. (2007).

The main idea of the method[25] is to decompose excess equity returns of Real-Estate related industries into components that are attributable to the changes in the three above-mentioned factors, and utilize Vector Autoregressive (VAR) model[26] to estimate the relative expectations of each factor. We then use the method advanced by Bernanke and Kuttner (2005) to use the estimated expectations and estimate the impact of the surprise changes in the fed funds rate on the three factors described above.

Here, we explain the method used in our paper in more detail.

Start with the simple definition of a one period log-return, then take the first-order Taylor approximation; solve it forward and obtain the equation for excess returns below.

Let y_{t+1} be the log of the excess equity return in period t, in excess of risk free rate (that is, the excess return from the beginning of period t to the beginning of period $t+1$).

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[25] See also Bernanke and Kuttner (2005) for more details of and the use of the method. Campbell, Davis, Gallin, and Martin (2008) also have the details of the derivation of the method.

[26] Christiano, Eichenbaum, Evans (1999) discuss Vector Autoregression (VAR) in great details and its uses in measuring the monetary policy shocks.

Let e_{t+1}^{y} be the unexpected excess return during period t, given all the information up to time t:

$$e_{t+1}^{y} = y_{t+1} - E_t y_{t+1}$$

As described above, adopting the log-linearization method and following Campbell and Shiller (1988) or Campbell (1991) we can derive the following equation for unexpected equity excess returns:

$$y_{t+1} - E_t y_{t+1} =$$

$$-(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j y_{t+1+j} - (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j r_{t+1+j} + (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j}$$

Here E_t is the conditional expectation operator, given all the information up to time t. The details of the derivation can be found in papers Campbell and Shiller (1988), Campbell (1991), or Campbell and Ammer (1993). After making the following notations

$$\tilde{e}_{t+1}^{d} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j}$$

$$\tilde{e}_{t+1}^{r} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j r_{t+1+j}$$

$$\tilde{e}_{t+1}^{y} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j y_{t+1+j},$$

and using them in the equation for excess returns we obtain

$$e_{t+1}^{y} = \tilde{e}_{t+1}^{d} - \tilde{e}_{t+1}^{r} - \tilde{e}_{t+1}^{y} \qquad (4)$$

where $\tilde{e}_{t+1}^{d}$, $\tilde{e}_{t+1}^{r}$, $\tilde{e}_{t+1}^{y}$ are the revisions in expectations of discounted future dividends (d), the real interest rates (r) and future excess returns (y) respectively.

The discount factor, ρ, is set to 0.9962, following Campbell and Ammer (1993). Using the equation (4), we will try to understand the fundamental causes for unexpected changes in equity

returns. That is, our objective here is to use the equation (4) and estimate the relative importance of the revisions in expectations of future dividends, the real interest rates, or the future excess returns for the behavior of equity returns in the real estate-related industries.

For the decomposition in (4), we need empirical estimates of expectations, for which we will adopt the VAR method.

Suppose z_{t+1} is a $np \times 1$ vector of n variables and the p lagged values of those variables. Consider the following VAR model:

$$z_{t+1} = Az_t + w_{t+1} \tag{5}$$

Campbell and Ammer (1993) show that if z_{t+1} contains excess equity returns, real interest rate, and any other extra variable that might be helpful in predicting them, then the terms in the decomposition above (in the equation (4)), can be estimated using estimated parameters in the VAR model as follows:

$$\begin{aligned} e^{y}_{t+1} &= s_y w_{t+1} \\ \tilde{e}^{d}_{t+1} &= e^{y}_{t+1} - \tilde{e}^{r}_{t+1} + \tilde{e}^{y}_{t+1} \\ \tilde{e}^{r}_{t+1} &= s_r(1-\rho A)^{-1} w_{t+1} \\ \tilde{e}^{y}_{t+1} &= s_y \rho A(1-\rho A)^{-1} w_{t+1} \end{aligned} \tag{6}$$

where A and w_{t+1} are the vectors of parameters and error terms in the VAR model respectively (in equation (5)), and s_r, and s_y are appropriate selection vectors. To form the vector z and to estimate equation (5), we will use six variables and one of their lagged vales, that is we will take $n = 6$ and $p = 1$..The six variables are 1) excess equity returns, 2) real interest rates (one-month bill rate minus the log-difference in non-seasonally-adjusted CPI) , 3) relative bill rate (three-

month US TSY bill rate minus its 12-month lagged moving average), 4) the change in the bill rate, 5) the dividend-price ratio, and 6) the spread between the 10-year treasury note and 3-month treasury bill rates. . All the variables are de-meaned in the VAR equation (5) and it is estimated without a constant term. Estimating A and w_{t+1} in the VAR model and setting $s_y = [1\ 0\ 0\ 0\ 0\ 0]$ and $s_r = [0\ 1\ 0\ 0\ 0\ 0\ ]$, we can find each of the terms in equation (6)[27].

After forecasting the VAR model, we can calculate the variance decomposition of equation (4) simply by using the following equation

$$Var(e^y_{t+1}) = Var(\tilde{e}^d_{t+1}) + Var(\tilde{e}^r_{t+1}) + Var\left(\tilde{e}^y_{t+1}\right) \quad (7)$$
$$-2Cov\left(\tilde{e}^d_{t+1}, \tilde{e}^r_{t+1}\right) - 2Cov\left(\tilde{e}^d_{t+1}, \tilde{e}^y_{t+1}\right) + 2Cov(\tilde{e}^y_{t+1}, \tilde{e}^r_{t+1})$$

Table 16 reports the results for this variance decomposition. The column headed 'Total' has the value of each of the above terms and the column titled 'Share' has each value normalized by $Var(e^y_{t+1})$, i.e. the attribution of each term in explaining the variance of e^y_{t+1}. The variance of future excess return- $Var(\tilde{e}^d_{t+1})$, accounts for almost the entire variance of excess returns- $Var(e^y_{t+1})$[28]. The covariance terms of the future excess return with other terms are also large in absolute value, but insignificant. All the covariance terms are insignificant, consistent with other prior studies (e.g. Bernanke and Kuttner (2005)). The shares of the other variances are very small

[27] As noted in Bernanke and Kuttner (2005), there are two major issues about the above VAR model. One is that, we are essentially imposing a parametric model in forecasting the future expectations of stock returns. Since we do not have a long history of federal funds futures this is the best option. The second issue is that although we could forecast the revisions in expected future dividends directly from the VAR model but the complications in implementing this method practically impedes such a method.

[28] Campbell, Davis, Gallin, and Martin (2008) use VAR -to study how rent growth, real rates, and housing premia contribute to the volatility of rent-price ratios in housing markets in the US over the 1975-2007 period. They find that find that changes in expected future housing premia are an important source of volatility in rent-price ratios. They also find that the covariances between the three components reduce the total variation of rent-price ratios. Consistent with our findings, they show that house prices have not fully capitalized changes to expected future real rates.

(0.9%) and not statistically significant. It shows that forecastability of the future excess returns for real estate–related industries is quite strong[29]. The results also show that the real interest rate has insignificant contribution, consistent with the Campbell and Ammer (1993) and Bernanke and Kuttner (2005). The contribution of the dividends is relatively small (4.5%) compared to the 24.5% of Bernanke and Kuttner and 14% of Campbell and Ammer.

Next we attempt to assess the impact of the unexpected changes in the monetary policy on revisions in expectations regarding the fundamental factors under consideration. We extend the above analysis to incorporate surprises in federal funds rate by including them in the VAR model in equation (5) as an exogenous variable and by transforming it to the following equation

$$z_{t+1} = Az_t + \emptyset\overline{\Delta}\iota_{t+1}^{u} + w_{t+1}^{\perp} \tag{8}$$

in which, $\emptyset$ is a 6×1 vector containing the reaction of elements of z_{t+1} to unexpected federal funds rate changes $\overline{\Delta}\iota_{t+1}^{u}$ in period $t+1$. $w_{t+1}^{\perp}$ is the new error term which is orthogonal to the fed funds rate surprise. In addition, since $\overline{\Delta}\iota_{t+1}^{u}$ is part of an error from the predicted z_{t+1} from period t, it is orthogonal to z_t. Therefore, we can use the VAR model to find the dynamic response of each variable in z to this orthogonal component - $\overline{\Delta}\iota_{t+1}^{u}$. ; If $\overline{\Delta}\iota_{t+1}^{u}$ is measured in percentage points, the response of z, $q-$ months after one-percentage point unexpected rise in federal funds rate can be simply estimated as $A^q\emptyset$. Bernanke and Kuttner (2005) show that the

[29] Bernanke and Kuttner have 76 % of the total explained by the variance of the future excess returns. Our finding is close to the one of Campbell and Ammer's 101%.

fed funds rate surprises and other news are almost orthogonal after 1994, and there is little endogeneity problem in estimation of Ø.

Having gained some insight into the initial reactions to the changes in the policy actions, we now would like to further ask how the impact of these changes unfolds over time. Figure 3 contains the dynamic response functions of each of the six variables in the VAR model to a one-percentage point surprise increase in the fed funds rate, over 24 months after the announcements of the fed funds rate changes. As is shown, the excess equity returns drop in all 24 months after the announcements though the negative response gradually diminishes from -1.35% in the first month after the announcement to almost -0.1% 24 months later. That shows that monetary policy has a long-lasting effect on equity returns in the real estate –related industries, although the initial effect here is less than the one for the entire equity market, estimated to be -11.6% by Bernanke and Kuttner (2005). The response of the spread between the long and short-term treasury yields is negative and stays negative for the entire estimation period, although the size gets smaller over time. The real interest rate and dividend-price ratio responses are similar: positive and higher initially, then gradually decreasing, but at a slow rate. The change in the treasury bill rate and the relative bill rate responses are also similar: positive and higher initially, then gradually decreasing, and turning negative after about a year of the announcements.

Going back to our main question of the mechanism by which a surprise change in the fed funds rate can affect stock prices, we now investigate the effect of the surprises on the three fundamental factors mentioned earlier - the expected future dividends, expected real interest rate, and the equity premium. These three factors in the new VAR model can be written as:

$$e_{t+1}^{y} = s_y w_{t+1} = s_y(\emptyset\bar{\Delta}\iota_{t+1}^{u} + w_{t+1}^{\perp})$$

$$\tilde{e}_{t+1}^{d} = e_{t+1}^{y} - \tilde{e}_{t+1}^{r} + \tilde{e}_{t+1}^{y}$$

$$\tilde{e}_{t+1}^{r} = s_r(1-\rho A)^{-1} w_{t+1} = s_r(1-\rho A)^{-1}(\emptyset\bar{\Delta}\iota_{t+1}^{u} + w_{t+1}^{\perp})\tilde{e}_{t+1}^{y} \quad (9)$$

$$= s_y \rho A(1-\rho A)^{-1} w_{t+1} = s_y \rho A(1-\rho A)^{-1}(\emptyset\bar{\Delta}\iota_{t+1}^{u} + w_{t+1}^{\perp})$$

Hence, the response of expected real interest rate, expected future excess returns, and expected future dividends to the fed funds rate surprise changes would be

$s_r(1-\rho A)^{-1}\emptyset$,

$s_y \rho A(1-\rho A)^{-1}\emptyset$, and

$$s_y\emptyset + s_y\rho A(1-\rho A)^{-1}\emptyset + s_r(1-\rho A)^{-1}\emptyset \quad (10)$$

$$= \left(s_y + s_r\right)(1-\rho A)^{-1}\emptyset$$

respectively. Table 17 provides the values of each of these responses. The impact of monetary policy on current excess returns of real estate-related industries is negative and significant. It is, however, of a smaller magnitude than the impact of monetary policy on the entire equity market as estimated by Bernanke and Kuttner (2005): -3.94 vs. -11.01. This finding is consistent with our results for daily excess returns reported in Table 3. I In the results for the daily returns, the magnitude of the coefficient of the surprise change (-4.56), shows the effect of a one percentage point unexpected increase in fed funds rate on equity returns, while -3.94 is the impact of the surprise fed funds rate change on unexpected monthly excess returns, i.e., on $y_{t+1} - E_t y_{t+1}$. On the other hand, the impact on future excess returns is positive, although insignificant, implying that the persistent negative response of excess returns that we saw on figure 3 will turn into positive responses later, in the future, canceling out the initial negative impact. The impact on

dividends and real interest rates are also insignificant. The latter is consistent with the Bernanke and Kuttner findings, but the former is not. Our finding indicates that the surprise changes in the fed funds rate have no significant impact on the future dividends of the companies in the real estate-related industries. This may be explained by the fact that not all the sub-industries would be impacted by the unexpected changes in the monetary policy the same way. For example, higher rates are, on average, found to have negative impact on equity returns as they have negative impact on the future earnings. This is not the case for residential REITs as we show in this paper. Higher rates actually may increase the future dividends for these companies (through less affordability of mortgages and thus less affordability of housing, and thus, more demand for rental properties, and thus higher earnings for residential REITs). This may be the reason for non-significant impact of the surprise increases in the rates on the future dividends in the real estate-related industries.

Conclusion

This study reports that real-estate-related industries react strongly to monetary policy actions, measured by surprise changes in the Federal Funds Target Rate. A hypothetical surprise rate cut of 25 basis points results in an approximately 100 basis point increase in returns for the entire sample spanning 1989 to 2005, and around 170 basis points for the post-1994 period when the Fed began announcing policy actions on the same day of the FOMC meeting. By breaking down the rate changes into expected and unexpected changes, we are able to study the "real" impact of the monetary policy on the prices. As expected, there is a small and insignificant reaction to the portion of rate changes that were expected by the market. This is consistent with the efficient market hypothesis. The industries respond significantly to the unexpected changes in the policy

actions. We expected that within real estate-related industries the reaction would differ across sub-industries partially because each industry has a different market beta and may react differently to macroeconomic shocks to the market. On the other hand, we had a hypothesis that in some cases, like in the case of Residential REITs, the response should be smaller or even of opposite direction from all the others. We hypothesized that Residential REITs might respond to the unexpected rate increase differently (positively) than the other industries, which respond negatively. The reason for this contrarian reaction is that even though rate increases may imply higher discount factors, they may also result in higher future cash flows for some industries. If the positive impact of the latter outweighs the negative impact of the former, then the reaction of the industry to the announcement of the rate hikes would be positive.

This hypothesis is verified by detecting a positive and significant reaction of Residential REITs prices to unexpected rate increases by the fed. We show that Building Material Supply and Mortgage & Banking industry have the strongest responses to monetary policy actions, while REITs and Water & Sewage Utilities exhibit the weakest responses. The fact that REITs reaction is small compared to the ones for all the other industries proves the "positive reaction to rate hikes" hypothesis.

We study the impact of the unexpected changes in the fed funds rate on the potential sources that may explain stock price reactions – expected future excess returns, expected future dividends, and real interest rate. We show that the reaction of stock prices in real estate related industries to monetary policy changes is attributable to the expected future excess returns. This means that the surprise increase in the fed funds rate results in lower stock prices mainly and (economically significantly) only due to the higher expected future excess returns, or higher risk premiums.

We also demonstrate that the industries react stronger on the days in which the monetary policy reverses its course. If there is "inaction" in the policy, the market's reaction is small or even positive in some cases, presumably because markets expect a "guaranteed" rate cut in the near future. It would be interesting to study the impact of the monetary policy on the real estate-related industries, especially the Residential REITs, by analyzing its impact on the mortgage rates, proxied by 10-year US Treasury Note yield, and then studying the days, in which the mortgage rates actually increase as a result of the increases in the FFTR. We leave this for a future project.

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Table 1: Sub-industries and their SIC codes used in our analysis.

SIC code	Industry description
Mortgage Banks and Brokers	
6162	Mortgage Bankers and Loan Correspondents
REITs	
6798	Real Estate Investment Trusts
Real Estate Brokerage and Management	
6512	Operators of Nonresidential Buildings
6513	Operators of Apartment Buildings
6514	Operators of Dwellings Other Than Apartment Buildings
6515	Operators of Residential Mobile Home Sites
4225	General Warehousing and Storage
Residential Construction Contractors	
1521	General Contractors-Single-Family Houses
1522	General Contractors-Residential Buildings, Other Than Single-Family
1531	Operative Builders
6552	Land Subdividers and Developers, Except Cemeteries
Commercial Construction Contractors	
1522	General Contractors-Residential Buildings, Other Than Single-Family
1531	Operative Builders
1541	General Contractors-Industrial Buildings and Warehouses
1542	General Contractors-Nonresidential Buildings, Other than Industrial Buildings and Warehouses
1611	Highway and Street Construction, Except Elevated Highways
1622	Bridge, Tunnel, and Elevated Highway Construction
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction
1629	Heavy Construction, Not Elsewhere Classified
8741	Management Services
Material Supply	
5031	Lumber, Plywood, Millwork, and Wood Panels
5032	Brick, Stone, and Related Construction Materials
5033	Roofing, Siding, and Insulation Materials
5039	Construction Materials, Not Elsewhere Classified
5211	Lumber and Other Building Materials Dealers
Water and Sewage (Utilities)	
4941	Water Supply
4952	Sewerage Systems
4971	Irrigation Systems
These sub-industries were used in the whole sample only	
1741	Masonry, Stone Setting, and Other Stone Work
1771	Concrete Work
1791	Structural Steel Erection
1742	Plastering, Drywall, Acoustical, and Insulation Work
1761	Roofing, Siding, and Sheet Metal Work
1731	Electrical Work

Table 2-a: Descriptive Statistics of Fed funds rates

The full sample consists of 155 observations. We exclude September 17, 2001 from the sample. There are 135 FOMC days and 20 rate changes that did not occur on FOMC days. In 86 out of 155, days, there were no changes in the FFTR and in the other 69 days there were changes in the FFTR. There were 55 days before February, 1994 and 100 days after (and including) it.

	Number of FOMC days	**Number of NON-FOMC Days**	**Number of FFTR changes**	**Number of no changes in FFTR**	**St. Dev. Of unexpected changes**	**Average of FFTR**
05/1989-01/1994	37	18	24	31	10.23	576
02/1994-12/2005	98	2	45	55	9.34	408
05/1989-12/2005	135	20	69	86	9.88	468

Comments:
1. All numbers are in basis points.
2. September 17, 2001 is included in the sample, but not in the subsequent analysis.

Table 2-b: The distribution of changes in the Fed Funds target rates in basis points.

FFTR change	**05/1989- 02/2006**	**05/1989-02/1994**	**02/1994-02/2006**
-50	12	3	9
-25	31	21	10
0	86	31	55
25	21	0	21
50	4	0	4
75	1	0	1

Table 3: The response of the CRSP Value-Weighted Index and Real Estate Industries to expected and surprise components of the fed funds rate change

		CRSP VW Index	Whole RE Industry	Mortgage and Banking	REITs	Real Estate Brokerage & Management	Residential Real Estate Construction	Commercial Construction Contractors	Building Material Supply	Water & Sewer Utilities
Whole data	Intercept	7.15 (3.19)	19.61 (2.08)	13.65 (0.98)	8.67 (1.74)	2.11 (0.22)	20.80 (1.74)	17.74 (1.57)	39.32 (2.10)	12.50 (1.07)
	Surprise Change	-4.11 (-6.34)	-4.35 (-4.55)	-5.87 (-4.13)	-1.71 (-3.39)	-2.59 (-2.64)	-4.47 (-3.68)	-2.75 (-2.39)	-5.71 (-3.00)	-0.75 (-0.63)
	Expected Change	-0.94 (-1.49)	-0.57 (-1.14)	0.40 (0.54)	0.08 (0.31)	-0.005 (-0.01)	-0.46 (-0.73)	-0.06 (-0.09)	-1.29 (-1.31)	-0.07 (-0.11)
	Adjusted R-Squared	0.1815	0.1261	0.0891	0.0582	0.0323	0.0796	0.0250	0.0624	-0.0103
	Number of observations	155	155	155	155	155	155	155	155	155
Post 1994	Intercept	11.01 (4.92)	28.61 (2.66)	20.07 (1.08)	11.03 (1.66)	8.27 (1.00)	27.58 (1.79)	21.68 (1.59)	57.98 (2.59)	11.74 (0.93)
	Surprise Change	-4.36 (-3.88)	-7.18 (-5.90)	-7.95 (-3.79)	-2.39 (-3.19)	-4.30 (-4.57)	-5.58 (-3.21)	-4.28 (-2.77)	-12.51 (-4.95)	-0.68 (-0.48)
	Expected Change	1.03 (1.16)	-0.65 (-1.28)	0.50 (0.57)	0.08 (0.27)	-0.14 (-0.37)	-0.36 (-0.49)	-0.10 (0.15)	-1.60 (-1.52)	-0.03 (-0.05)
	Adjusted R-Squared	0.1921	0.2694	0.1114	0.0764	0.1658	0.0836	0.0563	0.2127	-0.0181
	Number of observations	100	100	100	100	100	100	100	100	100

Notes: The dependent variable is the daily value - weighted return of each industry, in percentages. The upper section reports the results for all events from June 1989 to December 2005 and the lower section only shows the results considering the events after 1994 (both exclude the September 17, 2001 event). The full sample contains 135 FOMC meetings. Parentheses contain *t*-statistics.

Table 4: The response of Real Estate Industries to expected and surprise parts of the fed funds rate change excluding outliers

		Whole Industry	Mortgage and Banking	REITs	Real Estate Brokerage & Management	Residential Real Estate Construction	Commercial Construction Contractors	Building Material Supply	Water & Sewer Utilities
Whole data	Intercept	20.06 (2.28)	19.71 (1.50)	6.88 (1.52)	2.44 (0.26)			37.63 (2.30)	
	Surprise Change	-3.03 (-3.24)	-4.05 (-2.89)	-1.61 (-3.50)	-1.59 (-1.61)			-0.87 (-0.46)	
	Expected Change	-0.56 (-1.20)	-0.32 (-0.44)	-0.11 (-0.46)	0.003 (0.01)			-0.81 (-0.89)	
	Adjusted R-Squared	0.0693	0.0456	0.0690	0.0041			-0.0051	
	Number of observations	154	153	154	154			152	
Post 1994	Intercept	26.55 (2.66)	28.04 (1.61)	8.76 (1.49)	6.64 (0.87)			42.42 (2.16)	
	Surprise Change	-5.01 (-4.04)	-5.01 (-2.33)	-2.18 (-3.30)	-2.58 (-2.70)			-4.80 (-1.61)	
	Expected Change	-0.60 (-1.27)	-0.34 (-0.40)	-0.12 (-0.43)	-0.10 (-0.28)			-0.70 (-0.72)	
	Adjusted R-Squared	0.1471	0.0383	0.0886	0.0538			0.0165	
	Number of observations	99	98	99	99			97	

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. The upper section reports the results for all events from June 1989 to December 2005 and the lower section only shows the results considering the events after 1994. Both exclude outliers and the September 17, 2001 event. The outliers for each industry have strong influences on the estimates of the coefficients. The full sample contains 135 FOMC meetings. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 5: The response of Real Estate Industries to expected and surprise parts of funds rate change
Using only events with surprise changes above +5 bps.

		Residential REITs	Whole Industry	Mortgage and Banking	REITs	Real Estate Brokerage & Management	Residential Real Estate Construction	Commercial Construction Contractors	Building Material Supply
Whole samples	Intercept	-197.7 (-2.03)	-159.01 (-0.63)	356.33 (1.15)	-59.37 (-0.68)	-32.48 (-0.42)	84.17 (1.72)	8.00 (0.03)	-563.49 (-1.09)
	Surprise Change	15.04 (1.99)	14.85 (0.76)	-25.93 (-1.08)	4.61 (0.68)	-1.33 (-0.22)	-4.34 (-3.32)	-3.81 (-0.16)	52.52 (1.31)
	Expected Change	0.07 (0.16)	-0.40 (-0.34)	-0.35 (-0.23)	0.09 (0.22)	0.34 (0.90)	-0.45 (-0.71)	-0.01 (-0.00)	-0.56 (-0.23)
	Adjusted R-Squared	0.2146	-0.1512	-0.1159	-0.2370	-0.1290	0.0739	-0.3369	0.0222

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. Each column reports the result for the same regressions as table 2 using only events with surprise rate changes above +5 basis points. There are 9 observations for each regression. The first column reports the results for Residential REITs which is part of REITs equities. Parentheses contain *t*-statistics.

Table 6: Endogeneity and Stability of the Results

		Whole Industry	Mortgage and Banking	REITs	Real Estate Brokerage & Management	Residential Real Estate Construction	Commercial Construction Contractors	Building Material Supply	Water & Sewer Utilities
Whole samples	Intercept	20.60 (2.19)	14.38 (1.03)	8.69 (1.74)	3.16 (0.33)	20.59 (1.72)	18.71 (1.65)	41.43 (2.21)	13.61 (1.16)
	Surprise Change	-4.94 (-4.82)	-6.31 (-4.12)	-1.72 (-3.15)	-3.21 (-3.06)	-4.34 (-3.32)	-3.33 (-2.69)	-6.96 (-3.42)	-1.41 (-1.10)
	Expected Change	-0.63 (-1.26)	0.35 (0.48)	0.08 (0.31)	-0.07 (-0.13)	-0.45 (-0.71)	-0.11 (-0.19)	-1.42 (1.44)	-0.13 (-0.22)
	Surprise change x employment report	3.71 (1.54)	2.76 (0.77)	0.06 (0.05)	3.94 (1.60)	-0.76 (-0.25)	3.64 (1.26)	7.90 (1.66)	4.15 (1.38)
	Adjusted R-Squared	0.1340	0.0867	0.0520	0.0422	0.0739	0.0287	0.0731	-0.0042
Excluding Outliers	Intercept	20.62 (2.34)	20.08 (1.52)	6.87 (1.51)	3.18 (0.34)			37.98 (2.31)	
	Surprise Change	-3.41 (-3.35)	-4.30 (-2.81)	-1.60 (-3.24)	-2.09 (-1.94)			-1.22 (-0.58)	
	Expected Change	-0.59 (-1.27)	-0.34 (-0.47)	-0.11 (-0.45)	-0.04 (-0.08)			-0.83 (-0.91)	
	Surprise change x employment report	2.16 (0.95)	1.40 (0.41)	-0.02 (-0.02)	2.80 (1.16)			1.66 (0.39)	
	Adjusted R-Squared	0.0686	0.0403	0.0628	0.0064			-0.0108	

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. The upper section reports the results for all events from June 1989 to December 2005 and the lower section only shows the results for the same sample excluding the outliers (both samples exclude the September 17, 2001 event). The full sample contains 135 FOMC meetings. The employment report is a dummy variable equal to 1 when the Feds funds rate change occurred the same day as the employment report release. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 7: The response of Real Estate Industries to hypothetical 25 bps unexpected increases in the fed funds rate at 2 different time intervals: from 30 minutes before until 30 min after the announcement, and from the market close of a day before until the market close of the day of the announcement.

	Whole Industry	Mortgage and Banking	REITs	Real Estate Brokerage & Management	Residential Real Estate Construction	Commercial Construction Contractors	Building Material Supply	Water & Sewer Utilities
From 30 min before to 30 min after	-178	-251	-66	-99	-167	-112	-211	-32
	(14.3)	(17.5)	(7.0)	(11.2)	(13.1)	(14.5)	(14.5)	(3.8)
A day before-to the close of the Announcement day	-172	-234	-68	-104	-178	-110	-228	-30
	(16.2)	(21.3)	(7.1)	(12.0)	(13.9)	(16.6)	(18.5)	(4.4)
Differences in the Responses (in bps)	6	17	-2	-5	-11	2	-17	2
	(3%)	(6%)	(-3%)	(-5%)	(-6%)	(2%)	(-8%)	(9%)
Ratio of Standard Deviations	1.13	1.22	1.01	1.07	1.06	1.14	1.28	1.16

Note: The numbers reported are the responses of industry returns (in basis points) to a hypothetical unexpected 25 basis point fed funds rate increases. In parenthesis, we report the half-lengths of one standard deviation confidence intervals around the responses.

Table 8: Asymmetries in the results for all real estate-related industries after 1994.

N = 100 / 99	Whole sample					Excluding Outliers				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	5.16 (0.41)	25.38 (2.46)	27.00 (2.79)	29.48 (2.74)	13.04 (1.13)	10.56 (0.87)	25.10 (2.54)	27.27 (2.81)	27.58 (2.78)	12.34 (1.10)
Expected Change	-0.53 (-1.08)	-0.63 (-1.25)	-0.61 (-1.34)	-0.64 (-1.26)	-0.41 (-0.83)	-0.52 (-0.12)	-0.56 (-1.16)	-0.62 (-1.35)	-0.57 (-1.23)	-0.69 (-1.39)
Surprise Change	-10.03 (-6.85)	-10.53 (-7.73)	-4.44 (-3.62)	-6.96 (-5.66)	-9.08 (-5.54)	-7.34 (-4.59)	-8.15 (-5.34)	-4.44 (-3.60)	-4.69 (-3.75)	-9.18 (-5.47)
Surprise Change ×										
Positive surprise	10.68 (3.20)				6.67 (1.62)	7.43 (2.25)				5.18 (1.27)
No rate change		11.48 (3.88)			8.72 (3.11)		9.15 (3.11)			8.81 (3.21)
Positive rate change		8.81 (2.45)			4.30 (0.93)		6.28 (1.77)			8.03 (1.67)
Reversals			-12.91 (-4.92)		-9.02 (-3.28)			-16.50 (-2.49)		-40.87 (-2.91)
Friday Surprise				-9.39 (-1.14)	-8.39 (-1.08)				-11.63 (-1.54)	21.90 (1.45)
Adjusted R-Squared	0.333	0.381	0.410	0.272	0.484	0.182	0.224	0.191	0.159	0.328

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. Regressions (1) to (5) are estimate coefficients using all events after 1994 and regressions (6) to (10) demonstrate the results excluding the January 3, 2001 outlier (both sets exclude the September 17, 2001 event). The full sample contains 100 observations; all FOMC meetings. The positive surprise dummy variable is set to 1 when the surprise change in funds rate is greater than zero. The *no rate change* and *positive rate change* dummy variables are 1 when there is no change in funds rate or increase in rate, respectively. The *reversal* dummy variable is 1 for rate changes that occurred when a series of successive increases or decreases in rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries. Also see notes for Table 1 and 3.

Table 9: Asymmetries in the results for Mortgage & Banking industry after 1994

N = 100 / 99	Whole sample					Excluding Outliers				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	-1.36 (-0.06)	17.89 (0.95)	18.51 (1.03)	20.90 (1.12)	6.81 (0.30)	11.55 (0.54)	26.23 (1.46)	28.96 (1.67)	29.12 (1.66)	12.89 (0.60)
Expected Change	0.61 (0.71)	0.61 (0.66)	0.54 (0.63)	0.51 (0.59)	0.80 (0.82)	-0.27 (-0.33)	-0.27 (-0.29)	-0.38 (-0.45)	-0.32 (-0.38)	-0.51 (-0.52)
Surprise Change	-10.56 (-4.03)	-11.48 (-4.61)	-5.32 (-2.32)	-7.74 (-3.64)	-10.10 (-3.11)	-7.43 (-2.65)	-8.19 (-2.97)	-4.36 (-2.00)	-4.69 (-2.14)	-9.19 (-3.02)
Surprise Change ×										
Positive surprise	9.76 (1.64)				5.96 (0.73)	7.75 (1.34)				5.15 (0.67)
No rate change		12.96 (2.40)			10.42 (1.87)		9.18 (1.73)			8.68 (1.66)
Positive rate change		8.07 (1.23)			4.10 (0.45)		6.25 (0.98)			8.80 (0.97)
Reversals			-12.44 (-2.54)		-8.34 (-1.53)			-18.51 (-1.59)		-51.04 (-1.91)
Friday Surprise				-8.95 (-0.63)	-8.01 (-0.52)				-11.70 (-0.89)	31.49 (1.10)
Adjusted R-Squared	0.127	0.153	0.159	0.106	0.168	0.046	0.054	0.053	0.036	0.087

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. Regressions (1) to (5) are estimate coefficients using all events after 1994 and regressions (6) to (10) demonstrate the results excluding the October 15, 1998, January 3, 2001 and March 20, 2001 outliers (both sets exclude September 17, 2001). The full sample contains 100 observations, all FOMC meetings. The positive surprise dummy variable is set to 1 when the surprise change in funds rate is greater than zero. The no rate change and positive rate change dummy variables are 1 when there is no change in the funds rate or increases in the rate, respectively. The reversal dummy variable is 1 for rate changes that occurred when a series of successive increases or decreases in the rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 10: Asymmetries in the results for REITs industry after 1994

N = 100 / 99	Whole Sample					Excluding Outliers				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	4.21 (0.52)	12.90 (1.89)	10.58 (1.62)	11.39 (1.71)	3.05 (0.37)	1.54 (0.22)	8.30 (1.37)	8.50 (1.46)	9.11 (1.55)	2.53 (0.35)
Expected Change	0.12 (0.38)	0.26 (0.80)	0.09 (0.31)	0.09 (0.28)	0.51 (1.44)	-0.08 (-0.30)	-0.08 (-0.27)	-0.10 (-0.38)	-0.11 (-0.41)	0.07 (0.20)
Surprise Change	-3.23 (-3.43)	-3.06 (-3.39)	-1.62 (-1.96)	-2.31 (-3.03)	-3.38 (-2.91)	-3.06 (-3.71)	-3.13 (-3.95)	-1.61 (-2.19)	-2.10 (-3.12)	-3.37 (-3.25)
Surprise Change ×										
Positive surprise	3.11 (1.45)				5.87 (2.01)	3.28 (1.75)				3.55 (1.34)
No rate change		4.09 (2.09)			3.16 (1.58)		3.61 (2.09)			3.15 (1.77)
Positive rate change		-0.72 (-0.30)			-5.08 (-1.55)		2.02 (0.93)			-0.23 (-0.07)
Reversals			-3.66 (-2.06)		-2.00 (-1.02)			-2.75 (-1.74)		-1.06 (-0.60)
Friday Surprise				-3.80 (-0.75)	-1.84 (-0.33)				-3.76 (-0.84)	-4.59 (-0.93)
Adjusted R-Squared	0.087	0.101	0.072	0.104	0.135	0.108	0.116	0.108	0.086	0.126

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. Regressions (1) to (5) are estimate coefficients using all events after 1994 and regressions (6) to (10) demonstrate the results excluding the January 3, 2001 outlier (both sets exclude September 17, 2001). The full sample contains 100 observations, all FOMC meetings. The positive surprise dummy variable is set to 1 when the surprise change in funds rate is greater than zero. The no rate change and positive rate change dummy variables are 1 when there is no change in the funds rate or increases in rate, respectively. The reversal dummy variable is 1 for rate changes that occurred when a series of successive increases or decreases in the rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 11: Asymmetries in the results for Real Estate Brokerage & Management industry after 1994

N = 100 / 99	Whole sample					Excluding Outliers				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	3.25 (0.32)	10.21 (1.20)	7.07 (0.94)	8.81 (1.06)	6.94 (0.72)	8.47 (0.89)	9.92 (1.26)	7.03 (0.93)	7.30 (0.95)	6.89 (0.71)
Expected Change	-0.12 (-0.30)	0.08 (0.18)	-0.11 (-0.32)	-0.14 (-0.35)	0.11 (0.27)	-0.11 (-0.30)	0.15 (0.39)	-0.11 (-0.32)	-0.09 (-0.24)	0.09 (0.21)
Surprise Change	-4.91 (-4.14)	-5.40 (-4.83)	-2.27 (-2.37)	-4.16 (-4.38)	-3.17 (-2.31)	-2.31 (-1.83)	-2.95 (-2.42)	-2.27 (-2.36)	-2.37 (-2.45)	-3.17 (-2.30)
Surprise Change ×										
Positive surprise	2.29 (0.85)				1.22 (0.35)	-0.85 (-0.33)				1.11 (0.32)
No rate change		5.98 (2.46)			3.51 (1.49)		3.58 (1.52)			3.52 (1.49)
Positive rate change		-0.05 (-0.02)			-1.97 (-0.51)		-2.66 (-0.94)			-1.70 (-0.41)
Reversals			-9.59 (-4.69)		-8.92 (-3.87)			-8.96 (-1.73)		-11.21 (-0.92)
Friday Surprise				-5.76 (-0.91)	2.16 (0.33)				-7.53 (-1.29)	4.34 (0.33)
Adjusted R-Squared	0.163	0.200	0.314	0.164	0.306	0.045	0.070	0.073	0.060	0.062

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. Regressions (1) to (5) are estimate coefficients using all events after 1994 and regressions (6) to (10) demonstrate the results excluding the June 30, 1999 outlier (both sets exclude September 17, 2001). The full sample contains 100 observations, all FOMC meetings. The positive surprise dummy variable is set to 1 when the surprise change in the funds rate is greater than zero. The no rate change and positive rate change dummy variables are 1 when there is no change in the funds rate or increase in rate, respectively. The reversal dummy variable is 1 for rate changes that occurred when a series of successive increases or decreases in the rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 12: Asymmetries in the results for
Residential Real Estate Construction industry after 1994

N = 100 / 99	Whole sample				
	(1)	(2)	(3)	(4)	(5)
Intercept	22.74 (1.20)	28.37 (1.80)	26.76 (1.75)	28.33 (1.83)	29.48 (1.52)
Expected Change	-0.33 (-0.46)	-0.12 (-0.16)	-0.34 (-0.47)	-0.35 (-0.48)	-0.22 (-0.27)
Surprise Change	-6.17 (-2.80)	-7.98 (-3.84)	-4.20 (-2.17)	-5.40 (-3.06)	-6.81 (-2.47)
Surprise Change ×					
Positive surprise	2.20 (0.44)				-1.13 (-0.16)
No rate change		10.47 (2.32)			9.66 (2.05)
Positive rate change		3.26 (0.59)			5.01 (0.64)
Reversals			-6.54 (-1.58)		-3.71 (-0.80)
Friday Surprise				-7.99 (-0.68)	-7.75 (-0.59)
Adjusted R-Squared	0.076	0.116	0.098	0.079	0.102

Table 13: Asymmetries in the results for
Commercial Construction Contractors industry after 1994

N = 100 / 99	Whole sample				
	(1)	(2)	(3)	(4)	(5)
Intercept	24.29 (1.44)	24.54 (1.75)	20.80 (1.54)	22.69 (1.66)	30.10 (1.75)
Expected Change	-0.11 (-0.17)	0.22 (0.32)	-0.08 (-0.12)	-0.08 (-0.13)	-0.01 (-0.01)
Surprise Change	-3.97 (-2.03)	-5.84 (-3.15)	-2.78 (-1.63)	-4.03 (-2.58)	-3.79 (-1.55)
Surprise Change ×					
Positive surprise	-1.19 (-0.27)				-4.01 (-0.65)
No rate change		8.48 (2.10)			7.44 (1.78)
Positive rate change		-0.20 (-0.04)			3.50 (0.51)
Reversals			-7.10 (-1.94)		-5.34 (-1.30)
Friday Surprise				-10.87 (-1.04)	-6. 80 (-0.59)
Adjusted R-Squared	0.047	0.080	0.083	0.057	0.080

Notes for both Tables 12 and 13: The dependent variable is the daily value-weighted return of each industry, in percentages. In regressions (1) to (5) we estimate the coefficients using all events after 1994 and there is no outlier in the sample (sample excludes September 17, 2001). The full sample contains 100 observations, all FOMC meetings. The positive surprise dummy variable is set to 1 when the surprise change in the funds rate is greater than zero. The no rate change and positive rate change dummy variables are 1 when there is no change in the funds rate or increase in rate, respectively. The reversal dummy variable is 1 for rate changes that occurred when a series of successive increases or decreases in the rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 14: Asymmetries in the results for Building Material Supply industry after 1994

N = 100 / 97	Whole sample					Excluding Outliers				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	8.71 (0.33)	45.99 (2.14)	54.79 (2.69)	59.65 (2.66)	28.92 (1.19)	36.86 (1.49)	34.86 (1.75)	43.78 (2.26)	44.91 (2.30)	44.42 (1.85)
Expected Change	-1.34 (-1.33)	-1.93 (-1.84)	-1.52 (-1.59)	-1.57 (-1.49)	-1.71 (-1.64)	-0.71 (-0.72)	-0.61 (-0.59)	-0.79 (-0.82)	-0.69 (-0.72)	-1.35 (-1.27)
Surprise Change	-18.52 (-6.09)	-19.51 (-6.87)	-7.10 (-2.75)	-12.10 (-4.73)	-15.76 (-4.56)	-5.92 (-1.39)	-14.26 (-3.14)	-3.45 (-1.14)	-3.70 (-1.23)	-11.90 (-2.38)
Surprise Change ×										
Positive surprise	22.44 (3.24)				8.56 (0.98)	2.86 (0.37)				-9.47 (-0.96)
No rate change		20.11 (3.26)			14.84 (2.50)		15.68 (2.31)			15.48 (2.35)
Positive rate change		23.53 (3.14)			18.58 (1.90)		15.95 (2.07)			30.34 (2.88)
Reversals			-25.55 (-4.63)		-18.52 (-3.19)			-25.31 (-1.93)		-41.51 (-1.43)
Friday Surprise				-17.96 (-1.05)	-19.73 (-1.21)				-26.43 (-1.80)	3.74 (0.12)
Adjusted R-Squared	0.283	0.329	0.350	0.214	0.426	0.007	0.069	0.044	0.039	0.122

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. In regressions (1) to (5) we use all the events after 1994, and regressions (6) to (10) demonstrate the results excluding the outliers - Jan. 3 2001, Jan. 31 2001 and Apr. 18 2001 (both sets exclude September 17, 2001). The full sample contains 100 observations, all FOMC meetings. The positive surprise dummy is set to 1 when the surprise change in funds rate is greater than zero. The no rate change and positive rate change dummies are 1 when there is no change in funds rate or increase in rate, respectively. The reversal dummy is 1 for rate changes that occurred when a series of successive increase or decrease in rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 15: Asymmetries in the results for Water & Sewage Utilities industry after 1994

N = 100 / 99	Whole sample				
	(1)	(2)	(3)	(4)	(5)
Intercept	19.47 (1.26)	16.14 (1.23)	11.34 (0.90)	12.88 (1.02)	21.09 (1.31)
Expected Change	-0.07 (-0.12)	0.32 (0.50)	-0.02 (-0.04)	-0.01 (-0.02)	0.12 (0.17)
Surprise Change	0.26 (0.15)	-1.18 (-0.68)	-0.00 (-0.00)	-0.40 (-0.28)	-0.24 (-0.10)
Surprise Change ×					
Positive surprise	-3.52 (-0.86)				-3.33 (-0.58)
No rate change		5.26 (1.40)			5.18 (1.32)
Positive rate change		-3.48 (-0.76)			0.36 (0.06)
Reversals			-3.21 (-0.94)		-1.65 (-0.43)
Friday Surprise				-12.18 (-1.27)	-9.38 (-0.86)
Adjusted R-Squared	-0.021	-0.010	-0.019	-0.012	-0.025

Notes: The dependent variable is the daily value-weighted return of each industry, in percentages. Regressions (1) to (5) use all events after 1994 and there is no outlier in the sample (sample excludes September 17, 2001). The full sample contains 100 observations, all FOMC meetings. The positive surprise dummy variable is set to 1 when the surprise change in the funds rate is greater than zero. The no rate change and positive rate change dummy variables are 1 when there is no change in the funds rate or increase in rate, respectively. The reversal dummy variable is 1 for rate changes that occurred when a series of successive increases or decreases in the rate is reversed. Parentheses contain *t*-statistics. There were no outliers for the Residential & Commercial Construction and Water & Sewage Utilities industries.

Table 16 : Variance Decomposition of Excess Equity return

	1989 – 2005	
	Total	Share (%)
Var(excess return)	20.32	
Var(future excess return)	20.33	100.05 (279.7)
Var(real rate)	0.91	4.48 (0.3)
Var(dividends)	0.91	4.50 (0.3)
-2Cov(dividends, real rate)	-1.82	-8.93 (-0.6)
-2Cov(dividends, future excess return)	-7.45	-36.64 (-0.8)
2Cov(future excess return, real rate)'	7.44	36.60 (0.4)

Note: This table shows the variance decomposition of excess equity returns as shown in equation 7. Excess equity return is the difference between value-weighted return and the 3-month treasury bill rate. A VAR(1) is constructed to estimate forecasts of future excess returns and real interest rates. The VAR model consists of 6 variables: excess equity return, the real interest rate, change in bill rate (3-month bill rate minus 12 month lagged moving average) , change in 3-month bill rate, spread between the 10 year and 3-month treasury yields, and the dividend price ratio. VAR is computed over the sample of January 1989 through December 2005. t-statistics are in parentheses, calculated using delta method.

Table 17: The Impact of Monetary Policy Surprises on Future Excess Return, Real Interest Rate, and Dividends

Current Excess Return	-3.94
	(-1.94)
Future Excess Return	1.77
	(0.94)
Real Interest Rate	-0.43
	(-0.70)
Dividends	0.19
	(0.12)

Note: Note: This table shows the impacts of monetary policy on the current excess equity return and the future excess return, current and future real interest rate, and current and future dividends. The impacts are estimated using equation 10. Excess equity return is the difference between value-weighted return and the 3-month treasury bill rate. A VAR(1) is constructed to estimate forecasts of future excess returns and real interest rates. The VAR model consists of 6 variables: excess equity return, the real interest rate, change in bill rate (3-month bill rate minus 12 month lagged moving average) , change in 3-month bill rate, spread between the 10 year and 3-month treasury yields, and the dividend price ratio. VAR is computed over the sample of January 1989 through December 2005. But the impact of monetary policy surprise is computed by regressing the predicted error terms of the VAR model on surprise rate on the sample of February 1994 through September 2005. t-statistics are in parentheses, calculated using delta method.

Figure 1: Scatter plot of real estate equity returns and fed funds surprises, daily data.

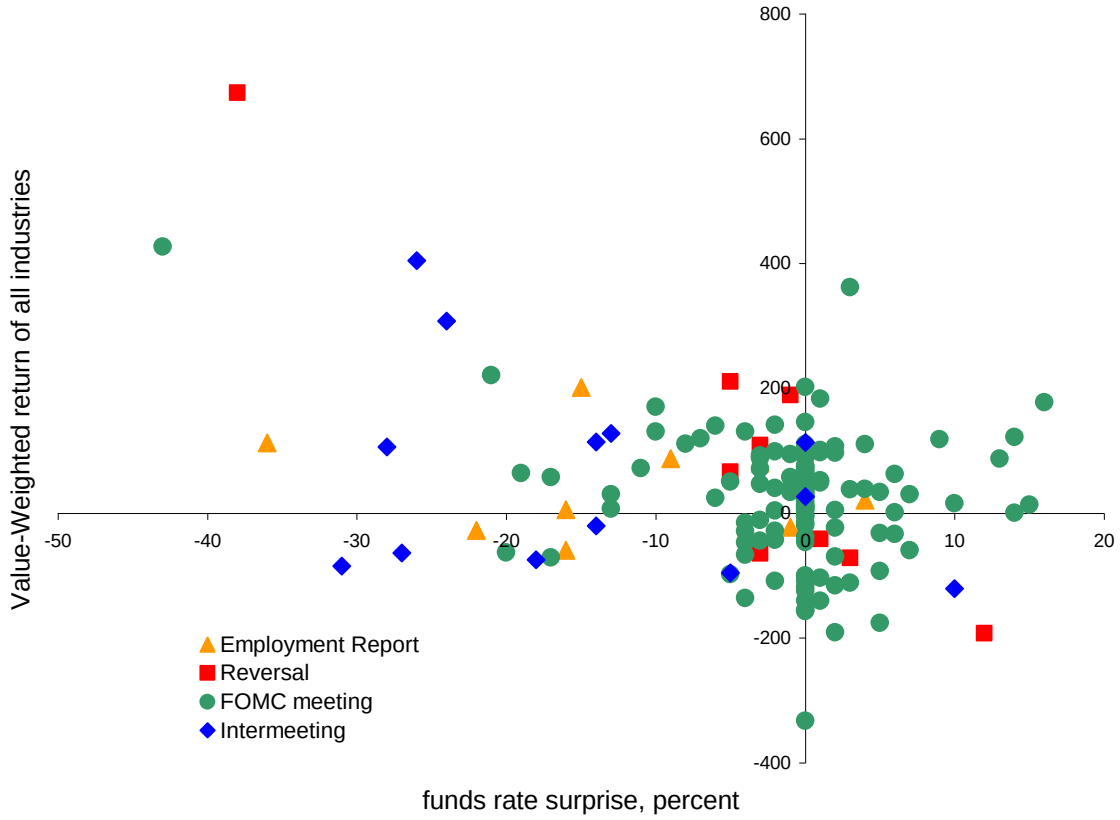
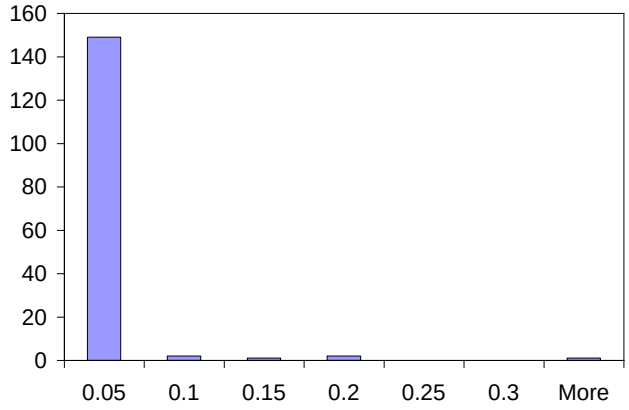


Figure 2: Histogram of Influence Statistics with tables of outliers

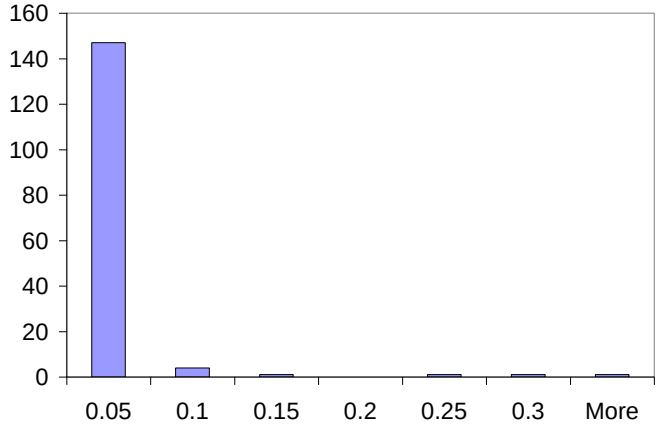
(a) Whole Industry

Date	Influence Statistic
Jan. 3, 2001	0.708



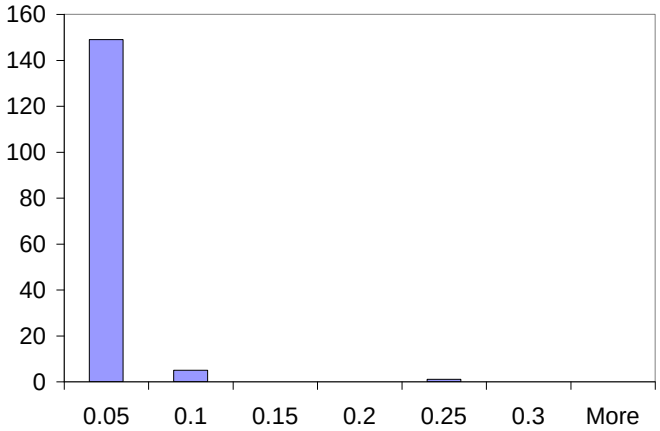
(b) Mortgage & Banking

Date	Influence Statistic
Oct. 15, 1998	0.214
Jan. 3, 2001	0.252
Mar. 20, 2001	0.370



(c) Whole REITs

Date	Influence Statistic
Jan. 3, 2001	0.38040



(d) Real Estate
Brokerage & Management

Date	Influence Statistic
Jun. 30, 1999	0.24336

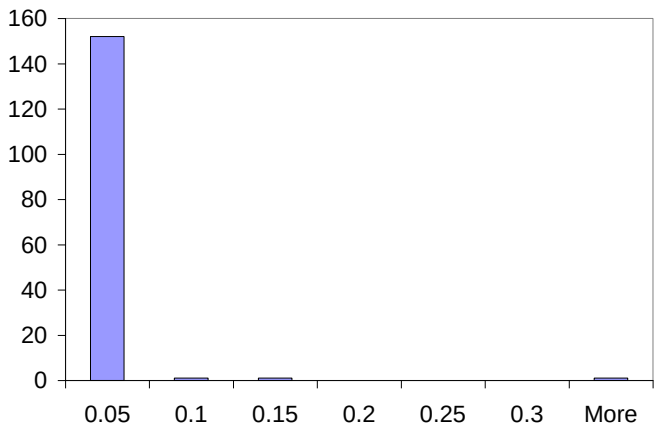
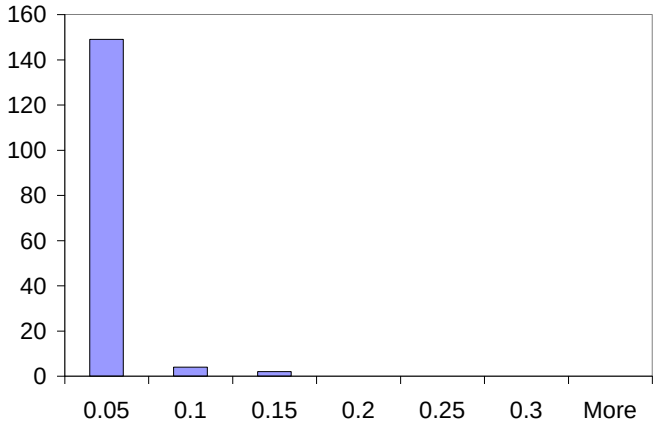


Figure 2 (continued): Histogram of Influence Statistics with tables of outliers.

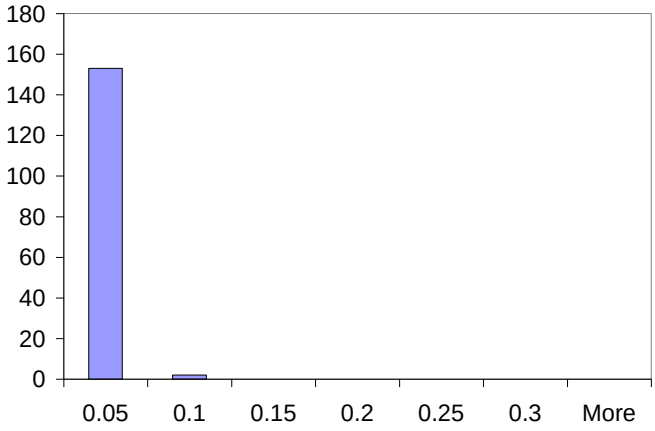
(e) Residential Real Estate Construction

No outliers in this industry.



(f) Commercial Construction Contractors

No outliers in this industry.



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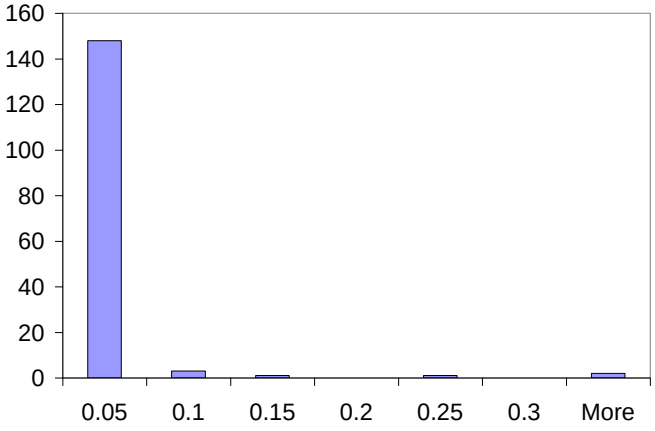
(g) Building Material Supply

Date	Influence Statistic
Jan. 3, 2001	0.87256
Jan. 31, 2001	0.22284
April 18, 2001	0.40588



(h) Water & Sewage Utilities

No outliers in this industry.

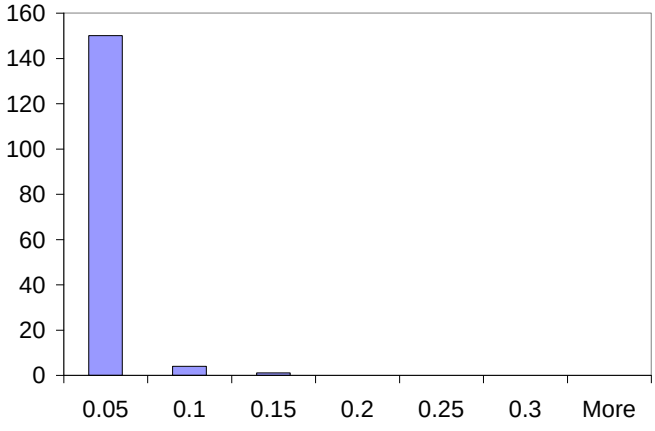
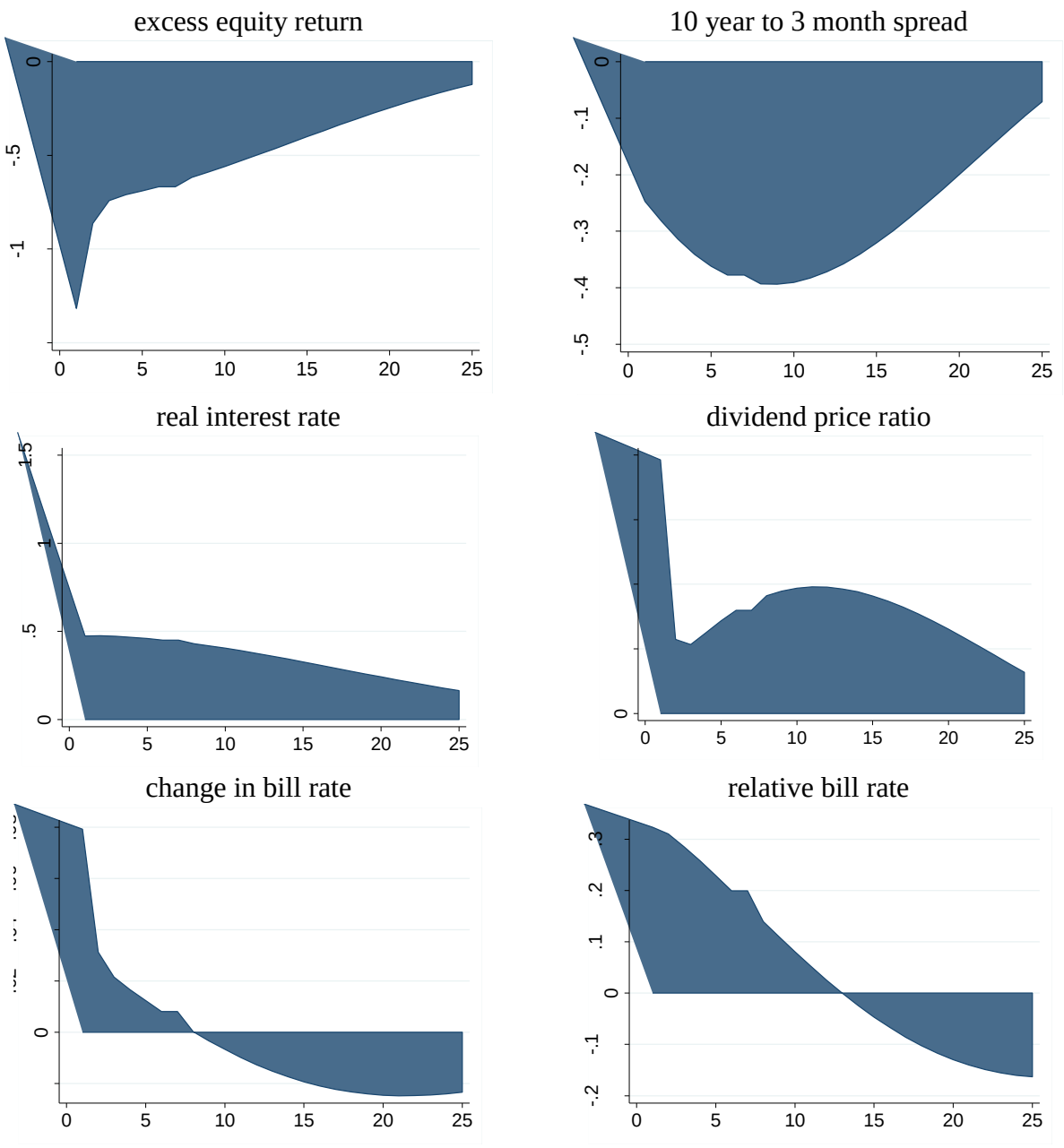


Figure 3: Dynamics Response to Surprise Rate



Note: The above figures show the response of the six mentioned variables to a 1 percent surprise change in the fed funds rate. A VAR(1) is constructed to estimate forecasts of future excess returns and real interest rates. The VAR model consists of 6 variables: excess equity return, the real interest rate, change in bill rate (3-month bill rate minus 12 month lagged moving average), change in 3-month bill rate, spread between the 10 year and 3-month treasury yields, and the dividend price ratio. VAR is estimated over the sample of January 1989 through December 2005. The impact of monetary policy is computed by regressing the predicted error terms of the VAR model on the unexpected changes in the rate.