

# **Does the stock market under-react to the Federal Reserve Bank's monetary policy actions?\***

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**First draft: March 1, 2006**

## **Abstract**

This paper analyzes the reaction of the stock market to the monetary policy actions of the Federal Reserve (the Fed). Specifically, we examine the reaction of the stock market to the monetary policy announcements by the Federal Open Market Committee (FOMC) of the Fed. We show that the full information conveyed by the Fed is not immediately incorporated in asset prices and that there is a statistically significant abnormal return to a broad market index on the day after the announcement by the FOMC of its monetary policy actions. We use data from the federal funds futures market to measure the expected and unexpected changes in the federal funds rate. We demonstrate that the market reacts to the unexpected changes in monetary policy of the FOMC. We detect positive and statistically significant abnormal market returns on the day after the FOMC makes its monetary policy announcements. We reject the hypothesis that these returns are unpredictable by finding predictable returns the day following the day of the FOMC announcement of its monetary policy actions.

**JEL classification:** E4, G1

**Key Words:** Efficient Markets Hypothesis (EMH), Abnormal Returns, Underreaction, Monetary Policy, Fed Funds Futures.

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\* We would like to thank Daniel Grombacher of the CBOT and Ray Sasaki of Sempra Energy for providing data and valuable information on Federal Funds Futures. This research was possible only because of their generosity.

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## 1 Introduction

For a long time, academic researchers, securities market participants, and policy makers have been interested in how financial asset prices adjust to new information, including information related to the policy announcements of the Federal Open Market Committee (FOMC) of the Federal Reserve (Fed). In spite of the fact that various researchers have established a long list of anomalies,<sup>3</sup> which suggest some predictability in financial markets, most scholars and textbook authors in finance and economics are inclined to believe that financial asset prices are either very difficult or impossible to predict. Their faith in efficient markets (the Efficient Market Hypothesis or EMH)<sup>4</sup> remains strong despite this growing body of literature regarding irrational behavior by investors, anomalies in the markets, and predictability of returns—all of which would seem to merit a rejection of the EMH.

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<sup>3</sup> DeBondt and Thaler (1985) detect over-reaction in markets, while Michaely *et al.* (1995) and Bernard and Thomas (1989) detect market under-reactions. Many other anomalies, such as size effect and momentum effect, are now established in the literature. See Jegadeesh and Titman, (1993) and (2001), as well as Schwert (2001) for a more extensive description of these anomalies and their persistence. Additional studies that demonstrate market mis-reaction include (but are not limited to) the following: Mendenhall (1991) and Abarbanell and Bernard (1992) study market reaction to earnings announcements; Grinblatt, Masulis, and Sheridan (1984) and Desai and Prem (1997) study stock splits; Ikemberry and Stice (1996) evaluate tender offers; Akhigbe, Gosnell and Harikumar (1998), Atkins and Dyl (1990), Bremer and Sweeney (1991), Brown, Harlow, and Tinic (1988), Cox and Peterson (1994), Howe (1986), and Peterson (1995) examine post-event abnormal returns related to extreme, 1-day stock price changes for U. S. stocks; Lakonishok and Vermaelen (1990), Ikenberry, Lakonishok, and Varmaelen (1995) study market repurchases; Groth, Lewellen, Scharbaum, and Lease (1979), Bjerring, Lakonishok, and Vermaelen (1983), Elton, Gruber, and Gultekin (1984), and Womack (1996) study seasonal equity offerings; Lougran and Ritter (1995), Teoh, Welch, and Wong (1998) study revisions in analysts' recommendations; Seyhun (1986) and (1988) studies public announcements of insider trades; Gomper and Lerner (2005) study venture capital share distributions; Chan (2003) studies headline news. Perhaps the most helpful work is that of Schwert (2001), who has published a detailed list of market anomalies detected over the past few decades. He reviews the persistence of these anomalies and shows that most of the anomalies have disappeared over time. After they are detected and disclosed to market participants, market participants take actions that apparently eliminate the anomalies and end their ability to earn abnormal returns. This result is often termed "long-term efficiency of the markets."

<sup>4</sup> See Fama (1970) and Fama (1991) for a review of the forms of market efficiency.

The common understanding of market efficiency defines financial markets as efficient when prices react speedily and properly to newly available information (Fama 1970 and 1991). Eugene Fama's summary generally categorizes market efficiency hypotheses as weak form (efficient with regard to all past information), semi-strong form (efficient with regard to all currently available information as well as past information), and strong form (efficient with regard to insider information as well, the one hypothesis rejected even by the faithful). Thus, the general idea behind the EMH is that asset prices are determined by the underlying supply and demand for securities offered in a competitive market populated with rational investors who gather all relevant information very rapidly and act immediately upon the information by buying or selling the appropriate financial asset, which results in the right, though unpredictable price. If, in this efficient markets world, information is immediately incorporated into prices, then only new information (news) should cause changes in prices. Since news is unpredictable, price changes should also be unpredictable. This analysis led to the prevailing belief, especially among academics, that stock prices follow a so-called "random walk," and the best prediction of next year's stock price is today's price plus an unpredictable drift term.

In truth, substantial evidence exists to challenge the traditional (semi-strong) EMH that assets are priced to reflect all publicly available information. As noted by Schwert (2001), a number of anomalies have been detected over the past few decades, and new anomalies emerge rather frequently. Again, as Schwert notes, the empirical literature is replete with a variety of studies of corporate news events and disclosures (for example, studies of earnings announcements, stock splits, tender offers, insider transactions, and

R& D expenditures)<sup>5</sup> where investors appear to over- or under-react to the news or disclosures. In some cases, the event-date abnormal returns have the same sign as subsequent stock returns for the subsequent (days, weeks, or months) period. Such price movements are indicative of under-reaction. In other words, the studies of these situations have demonstrated that the market reacts slowly in adjusting to the newly available information; hence, prices of the affected stocks lag. Over-reaction occurs when the event-date abnormal returns have the opposite sign of the returns over the subsequent period. On the event-date, the market over-reacts to news and, only later, corrects the over-adjustment.

As indicated, in order to understand the process of price adjustment to newly available information, a rational expectations framework has been employed (Brown and Jennings, 1989, and Grundy and McNichols, 1989). However, actions of market participants that affect prices are dependent on additional factors that explain human behavior, including biased behaviors. Thus, behavioral models have been used to explain anomalies. Human psychology suggests that participants may be prone to actions that can affect stock prices, but that are not particularly rational (Barberis *et. al.*, 1998; Daniel *et. al.*, 1998; Hong and Stein, 1999; and Hirshleifer, 2001).

## **2 A brief review of other relevant studies**

We will examine in a little greater detail a few studies that are particularly relevant to the study at hand because they examine over- and under-reaction related to securities markets or market indices. First, Ajayi and Mehdian (1994) studies investor over-reaction to

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<sup>5</sup> *Ibid.* See footnote 3 herein.

unexpected news or events that affected major international stock markets. In fact, their objective was to test the hypothesis that the market indices for eight international stock markets over-reacted to newly disclosed and unexpected events (news). The results of their study were mixed in that they found support for over-reaction in some of these markets, under-reaction in others, and market efficiency in still others.

Ball and Brown (1968) first reported one of the most persistent anomalies, the so-called “post-earnings-announcement drift.”<sup>6</sup> While the EMH would suggest that the receipt of new information leads investors to instantaneously adjust their expectations regarding a firm’s future earnings and take action (buy or sell) that would likewise be instantaneously reflected in new, but appropriate stock prices. Beginning with Ball and Brown, researchers have been able to consistently find evidence that documents that stock prices continue to drift for a long period after new earnings announcements. In fact, Fama (1998) comments on this stream of research by boldly stating that the post-earnings-announcement drift is an anomaly that is above suspicion. While we do not deal with earnings announcements, we note that these various research studies have documented well that investors often react slowly in adjusting their expectations regarding the future earnings of the firms in which they have invested. In other words, we take note of this response, often termed a “delayed response hypothesis.” We also note that few studies have tested this hypothesis by focusing on the speed at which investors adjust their expectations after news releases or events.<sup>7</sup>

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<sup>6</sup> See also Bernard and Thomas (1989); Chan, Jegadeesh, and Lakonishok (1996); and Doyle, Lundholm, and Soliman (2003).

<sup>7</sup> Bernard and Thomas (1989) suggest that the “delayed response” hypothesis is a more likely explanation for the drift. Hong and Stein (1999) propose that the market under-reacts because private information diffuses gradually across investors. They suggest that, although the news itself is public, some other, private information may be needed in order to convert this news into a judgment related to value. They call this explanation a “gradual information diffusion” explanation. Barberis, Shleifer, and Vishny (1998)

The first published research that reported on the markets' reaction to monetary policy announcements is Cook and Hahn (1989), who studied the one-day response of bond rates to changes in the fed funds target rate (FFTR). Their study covered a period prior to 1994, when the FOMC began to announce of any changes in the target rate on the same day of the meetings. Their research procedure involved performing a regression of the change in Treasury Bill (T-Bill), Treasury Note (T-Note), and Treasury Bond (T-bond) rates on the change in the FFTR for a sample taken from the years 1974 through 1979 that consisted of the 75 days on which the Fed changed the FFTR. Thus, the actual changes in the FFTR were used to assess the impact of monetary policy announcements on bond rates.

Since this first study by Cook and Hahn, other studies have examined monetary policy surprises and interest rates. Kuttner (2001) examined the impact of monetary policy actions on T-Bill, T-Note, and T-Bond yield using data from the futures market for fed funds. He also separated changes in the target fed funds rate into anticipated and unanticipated components. He found the bond rates' response to anticipated changes to be essentially zero, but he found their response to unanticipated (surprise) changes in target rates to be large and highly significant.

Rigobon and Sack (2002) used an identification technique based on the heteroskedasticity of stock market returns to measure the reaction of monetary policy to the stock market.

In their study, they used the 3-month Eurodollar rate as an indicator of monetary policy.

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propose a model of investor sentiment to explain market under- and over-reaction. Their model is based on literature related to the psychology of decision-making. In particular, they suggest that market under-reaction is consistent with a phenomenon documented in psychology. What psychology refers to as "conservatism" in decision-making is defined as the slow updating of models in the presence of new information.

They found a significant policy response, with a 5 percent rise (fall) in the S&P 500 Index. Their study utilized various stock market indices (DJIA, S&P500, NASDAQ, and WILSHIRE 5000) and demonstrated that increases in the Eurodollar rates have a negative impact on asset prices and a positive impact on interest rates, with the largest impact on shorter-term rates. Their paper did not break down the changes in the FFTR to study the impact of the expected and unexpected changes in the FFTR on interest rates.

More recently, Poole, Rasche, and Thornton (2002) of The Federal Reserve Bank of St. Louis completed a similar investigation of the extent to which market participants (in the Treasury Bill, Note, and Bond markets) anticipate Fed policy actions. They also found that the 3-month rate responded to expected changes efficiently. Interestingly, they found that the Treasuries' market only responds to expected target changes when new information is simultaneously provided. The new information they note is the added information that the discount rate will also change. Significantly, their study also seems to suggest that market transparency following the 1994 FOMC policy of announcing changes in the target fed funds rate only in the FOMC meeting has meant that the market correctly anticipated even surprise events in seven of ten such situations post-1993. If they are correct, then FOMC transparency should facilitate an efficient market for stocks as well. They suggest that greater clarity enables the market to better predict how the Fed is likely to respond to incoming information about the economy.

Bernanke and Kuttner (2005) measured and analyzed (in some detail) the stock market's response to monetary policy actions, both in the aggregate and at the level of industry

portfolios. They also attempted to explain the reasons behind the stock market's response to changes in monetary policy. However, estimating the response of equity prices to monetary policy actions is not straightforward, as the market is unlikely to respond to policy actions that were already anticipated. Thus, researchers need a mechanism by which they can distinguish between expected and unexpected monetary policy actions. Bernanke and Kuttner use the technique proposed by Kuttner (2001), in which FFTR data is used to construct a measure of surprise rate changes that serve as a proxy for monetary policy actions. Using this methodology, they find that *unanticipated rate changes* are negatively related to changes in equity prices. Specifically, they suggest that a hypothetical, surprise rate cut of 25 basis points would typically lead to an increase in stock prices on the order of 100 basis points. In general, they believe that monetary policy actions affect stock prices through its impact on real interest rates, expected future dividends, or expected future stock returns. Of additional relevance to our study, they show that changes in equity prices as a response to changes in monetary policy are associated with expected future excess returns on the market.

Finally, Bomfim (2003) examined the effects of pre-announcement of monetary policy on the stock market. Results of his study suggest that the stock market is relatively quiet on days preceding the FOMC announcement of its monetary policy (FFTR). He also studied how the actual FOMC interest rate decisions affected stock market volatility. He reports in his paper that surprise elements related to monetary policy announcements increased stock market volatility in the short run and that positive surprises (defined as higher than expected target fed funds rates) tended to have a greater effect on volatility.



Bomfim (2003) concludes his paper with suggestions for further study, including analyzing the market's response to scheduled and unscheduled announcements. Another issue he suggested was whether "the corresponding impulse response functions for volatility are significantly different" (Bomfim, 2003; Li and Engle, 1998). Importantly, he suggests that the issue of the impact of pre-announcement on the stock market is ripe for study by the market microstructure researcher.

### **3 The Futures on the FFTR**

As indicated above, in order to measure the impact of monetary policy on asset prices, several approaches have been adopted by researchers. Kuttner (2001) and Faust, Swanson, and Wright (2001) use the current-month federal funds futures contract; however, Bomfim (2002) and Poole and Rasche (2000) use the 1-month-out federal funds futures contract, Cochrane and Piazzessi (2002) use the one-month Eurodollar deposit rate, Ellingsen and Soderstrom (1999) use the three-month Treasury bill, and Rigobon and Sack (2002) use the three-month Eurodollar futures rate. Our firm belief is that since 1994 the federal funds futures rates or FFTR Futures dominate all other market interest rates for predicting changes in the federal funds rate over horizons several months out. Gürkaynak, Sack and Swanson (2002) show that federal funds futures dominate other market-based measures of monetary policy expectations at horizons for time frames up to approximately five months out. (To be fair, they also show that for horizons longer than a few months, Eurodollar futures provide the best measure of monetary policy expectations. Eurodollar Futures are very liquid securities, which gives them relative

advantage over Eurodollar deposit rates.) In this study of the movement of the CRSP Value-Weighted Index on the days before and after the event (announcement of FOMC policy), we have chosen to follow Kuttner's approach and use the current-month fed funds futures prices to measure expected and unexpected changes in fed funds rate.

The Chicago Board of Trade (CBOT) began trading federal funds futures contracts in October of 1988. The federal funds futures contract is based on the arithmetic average of the daily effective federal funds rate during the month of the contract. The effective federal funds rate is a weighted average of all federal funds transactions for a group of federal funds brokers who report to the Federal Reserve Bank of New York each day. The CBOT offers contracts ranging from the current month to 24 months out. The settlement price in these contracts is equal to 100 minus the average of the effective federal funds rate for the month of the contract.

Since their inception in 1988, prices of fed funds futures contracts have been popular as a simple way of measuring market expectations about the monetary policy and for forecasting the FOMC's future policy moves. As indicated, these contracts are based on the monthly average of the effective fed funds rate, but it is the target fed funds rate or TFFR that is the main policy instrument of the Fed. However, the effective fed funds rate on average follows the target set by the Fed, so the rate implied from prices can be interpreted as the expected average of the FFTR for the remaining days of the month. Kuttner (2001) uses the prices of 30-Day Federal Funds Futures on the FFTR to extract the shocks in the FFTR. We follow Kuttner (2001)<sup>8</sup> to find the unanticipated changes in the FFTR as follows: assume that the FFTR is equal to the fed funds effective rate. Denote by  $r^{before}$  and  $r^{after}$  the FFTR before and after the FOMC meeting (the event day). If the meeting is on the  $i^{th}$  day of the month that has  $d$  days, then

$$FFTR^{before} = \frac{i}{d} r^{before} + \frac{d-i}{d} E_{-}(r^{after}) + \varepsilon^1$$

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<sup>8</sup> Goukasian and Cialenco (2006) use similar method to extract the unanticipated changes in the FFTR.

where  $FFTR^{before}$  is the implied FFTR rate for the month and  $\varepsilon^1$  is the premium for the futures contract as of a day before the event day.

On the day of the rate changes (event days), the rate for the rest of the month is known and the implied FFTR from the futures contract is

$$FFTR = \frac{i}{d} r^{before} + \frac{d-i}{d} E(r^{after}) + \varepsilon^0$$

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

$$\Delta^{surprise} = \frac{d}{d-i} (FFTR - FFTR^{before}) - \frac{d}{d-i} (\varepsilon^0 - \varepsilon^1)$$

Assuming that premium  $\varepsilon$  is not significant<sup>9</sup> to have an impact on the policy, we get an expression for finding the unexpected portion of the monetary policy action.<sup>10</sup>

$$\Delta^{surprise} = \frac{d}{d-i} (FFTR - FFTR^{before})$$

Thus, the above formula is used to extract the surprise changes in the FFTR for the subsequent study. This breakdown of the change in the FFTR between expected and unexpected changes will be used to assess the impact of the monetary policy on asset prices and their subsequent continuation.

#### 4 The data and our analysis

In Table 1 we report the FFTR levels, the expected and unexpected changes in the rate for all the days for which we study the stock market's reaction. This covers 156 event-days from June, 1989 to January, 2006, the period of our study. We also comment on the

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<sup>9</sup> Krueger and Kuttner (1996) show that funds rate forecast based on the 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.

<sup>10</sup> 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.

calculation of the surprise changes on the days that are at the beginning, at the end of months, or in some other unusual circumstances. Table 2 reports the descriptive statistics of the changes in FFTR and shows the distribution of the FFTR for three different time periods. Out of all the 156 event-days, there were no changes made to the FFTR 86 times, once the FFTR was raised by 75 basis points (bps), and 12 times it was cut by 50 bps. The vast majority of FOMC decisions were announced on FOMC meeting days: 135 out of 155.

We also report the statistical average and the standard deviation of the FFTR. By comparing two time periods, it is clear that the surprise change in the FFTR is less volatile in post-1994 period than pre-1994 (when policy actions were less transparent and not generally made in the FOMC meeting). We also study the 86 days on which there were no changes in FFTR. In 46 of those days the market was expecting an action by the Fed, so no change was considered an unexpected change that triggered a reaction by the stock market.

## **5 The market reaction around the Fed decisions**

Finally, in order to study any deviations from EMH's expected "unpredictable" market reaction to the changes in the monetary policy, we follow the standard event-study approach. Our event-days are the days on which the decisions were made on FFTR.<sup>11</sup> We test whether abnormal returns immediately before and after the event-days are zero, for example. We compute then abnormal and cumulative abnormal returns to see if the prices adjust to the announcements quickly and appropriately. If prices adjust to new information in efficient ways, there should not exist any predictable ways to trade for profit in the market. As noted before, in our study we use the broad market index, the CRSP Value-Weighted Index.<sup>12</sup> Under the no-predictability or efficient markets

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<sup>11</sup> There are some exceptions: in some days the decision of the rate change was announced after the market close. In those cases we will consider the next business day as the event day to capture the market reaction to announcements and subsequent behavior. We used the notes provided to us by Ken Kuttner, our investigation and Kuttner (2001) to resolve the timing issues of some of pre-1994 days, in which the news on the policy was out after the close of the futures market.

<sup>12</sup> We also studied the reaction of the CRSP Equally-weighted index and found similar results.

hypothesis (EMH), there is no predictable way of earning statistically significant returns. That is, we test the following hypothesis:

$$H_0 : \text{The abnormal returns after the event days are 0.}$$

$$H_a : \text{The abnormal returns are different from 0.}$$

We denote  $R_t^e = R_t^{act} - E(R_t)$ , where  $R_t^e$ ,  $R_t^{act}$  and  $E(R_t)$  are the abnormal, actual and expected returns of the CRSP VW index on date t. The event data is t=0 and similarly s days before and m days after the event are denoted by t=-s and t=m. We estimate the  $E(R_t)$  by taking the average returns of CRSP VW index in pre-event windows of 25 days. The reason for this selection is to avoid the overlap of the impact of subsequent events, as the Fed meetings (and thus the events) are sometimes only less than 30 days apart. After computing the abnormal returns on days before and after the event days, we can test the hypothesis. We use the model of Brown, Warner (1985) to conduct the event

study. Thus, we denote  $CAR_t^e = \sum_{ALL\ EVENT\ DAYS} R_t^e$  the cumulative abnormal return for day t.

The t-statistic is then computed as  $T_t = \frac{\overline{CAR_t}}{s(CAR_t)}$ , where the  $\overline{CAR_t}$  and  $s(CAR_t)$  are the

average and the standard deviation of the cumulative abnormal returns on t-days from the event days. We compute the abnormal return on CRSP VW index on all the days (from June, 1989 until December, 2005) during which there was a decision made on the FFTR.<sup>13</sup>

Next, we study the abnormal returns on the event days. In Panel B of Table 3 we note that the abnormal return is positive and statistically significant on the event-days. We study these returns and test the hypothesis of no-abnormal-returns for different cases. First, we break down the time interval between two periods: before and after January, 1994 when FOMC announcements of policy changed. The Federal Reserve began announcing the changes in the FFTR immediately after the decision was made beginning in February of

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<sup>13</sup> Tables 2, 3 and 4 describe the data and the changes in the FFTR and give descriptive statistics.

1994<sup>14</sup>. We were interested in determining whether that practice had any impact on the reaction of the market on the monetary policy. We find statistically significant, abnormal returns on the event-days during 1989-1994 and 1994-2005. The abnormal return on the day of the events before 1994 is less than the one after 1994. We posit that the reason for this difference could be the reporting manner before and after 1994. The information conveyed by the Fed seems to have taken longer to be reflected in prices before 1994, as compared to the period after 1994. This may also explain why the abnormal return on the days after the event continues for a few days after the pre-1994 event (see Panel A of Table 3). Thus, the abnormal return on the event-days can be attributed to the market's reaction to the changes in monetary policy.

We also detect 15 basis points abnormal return to the CRSP WV index on days in which there were no changes in the monetary policy (perhaps, in some instances at least, the market was expecting a change). On days during which there was a negative surprise related to the change in FFTR, the abnormal return was 46 basis points. On days during which change in the FFTR was negative (a result of policy tightening), the abnormal return was 44 basis points regardless of the market expectations. Recall that Bernanke and Kuttner (2005) argued that a hypothetical 25-bps cut in the FFTR would be associated with a 100 bps increase in stock indices. Here, we find that the average abnormal return on the days of changes in FFTR is about 20 bps, a finding that could be entirely attributable to the changes in monetary policy. However, it turns out that in addition to the abnormal returns on the days of the events, there are abnormal returns on the days after the events. We find statistically significant positive abnormal returns (about 20 bps) on the next day following the event-day itself.

Our findings are set forth in Panel A of Table 3 and show that there is a positive and statistically significant abnormal return on the day after the event-day. We then refine and study the problem for any asymmetries in order to determine whether the findings depend on the direction of the monetary policy, the unexpected changes in the monetary policy, or the days of the FOMC meetings. Panel A of Table 3 shows further that the returns on

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<sup>14</sup> Some of the event days in the study coincide with days in which employment reports were released. These days were before February, 1994. That is why studying the pre-1994 responses, and comparing these to the ones of after 1994 will prove the robustness of the findings.

the day after the event-days are positive and statistically significant for the periods 1989-1994 and the entire period of 1989 to 2005. That is, on the day following the event-day, the market continues to adjust to the new information conveyed by the Fed on the event-day.

To study the abnormal returns on the day after the event even further, we break all the event days into two additional groupings, whether the changes in FFTR was on those days when the FOMC met or on some other day. Our study determined that there is a 15 basis points abnormal return to the CRSP Value Weighted Index when FFTR changes are announced during the FOMC meetings. However, there was no abnormal return on the days when there were positive surprises in the changes in the federal funds rate. Also, there was no abnormal return a day after the days in which there was unexpected positive change in the FFTR.

We find abnormal returns on the days when there was negative surprise change in the FFTR. We also find a 32 basis point abnormal return to the CRSP VW index on the day after the days when there was a negative surprise in the change in FFTR. That is, if the actual changes in the FFTR were less than the anticipated ones, the market's reaction is positive and, in addition to that, this market reaction continues on the next day following the event.

We also find a 27 bps abnormal return to the index on days during which the change in the FFTR was negative, even if the change was expected. That is, the market under-reacts to the Fed monetary policy tightening. Or, the information diffuses in the asset prices gradually when the Fed tightens monetary policy.

We also study the abnormal returns several days before and after the event days. Figures 1 to 5 show (for different cases) the cumulative abnormal returns days before and after the event-days. We can observe abnormal returns on the first day after the event. On other days there is no clearly significant abnormal return to the CRSP VW Index. One observation is particularly important: Figure 2 shows the cumulative abnormal returns for the period 1989 to 1994. As discussed above, prior to 1994 the information about FFTR change is incorporated into securities prices slowly because the Fed ordinarily refused to comment about its monetary policy decisions during the pre-1994 period. Thus, it would

take longer for the market to reflect the new information regarding Fed monetary policy in securities' prices.<sup>15</sup>

## 6 Conclusion

We study the stock market's reaction to the Fed's monetary policy actions on the days after the policy announcements. We find statistically significant abnormal returns to the broad market index (CRSP VW Index) on the day following the day during which FOMC decisions were announced regarding its monetary policy and FFTR. The CRSP VW Index yields abnormal, positive returns on the day after the event-days (the day the FOMC announces its FFTR). This finding is robust. We find abnormal returns on the days of the events, which are attributed to the market's reaction to the changes in Fed monetary policy. However, we also detect positive abnormal return on the day after the event-day itself. If we assume that the stock market immediately incorporates all the available information in prices, then the phenomenon we find here could be labeled as an anomaly. This cannot be classified as market over-reaction or under-reaction, in general. We do not intend to use this as an argument against the EMH hypothesis or as a support for under- or over-reaction in the market. It may be a combination of both of these factors. There seems to be a convergence to efficiency that may be happening slowly, as a collective action of the market participants (as our Figures 1-5 would suggest). Maybe the uncertainty of the impact of the monetary policy on securities' prices can be explained by the time it takes for prices to adjust. We did not address the question here as to the speed at which the prices adjust to the new information conveyed by the monetary policy actions.<sup>16</sup> We intend to study this in the near future.

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<sup>15</sup> We also study the days that we call reversals: the days on which the monetary policy is reversed - a long sequence of rate hikes is followed by a rate cut or the other way around and did not find abnormal returns on those days.

<sup>16</sup> Chordia et al. (2002) study the speed at which the market converges to efficiency. Similar methods could be used to study the speed of convergence in this particular event.



## 7 References

- Ajayi, R. A., & Mehdian, S. (1994), "Rational investors' reaction to uncertainty: evidence from the world's major markets". *Journal of Business Finance and Accounting*, 21 (4), pages 533–545.
- Balduzzi, Pierluigi, Guiseppe Bertola, and Silverio Foresi, (1997), "A Model of Target Changes and the Term Structure of Interest Rates," *Journal of Monetary Economics*, 39 July, pages 223-249.
- Balduzzi, Pierluigi, Guiseppe Bertola, Silverio Foresi, and Leora Klapper, (1998), "Interest Rate Targeting and the Dynamics of Short-term Rates," *Journal of Money, Credit, and Banking*, 30, February, pages 26-50.
- Barberis, Nicholas, Andrei Shleifer, and Robert Vishny. (1998), "A model of investor sentiment", *Journal of Financial Economics*, Vol. 49, pages 307-343.
- Bernanke, Ben S., and Alan S. Blinder, (1992), "The Federal Funds Rate and the Channels of Monetary Transmission," *American Economic Review*, 82, September, pages 901-921.
- Bernanke, B.S., K.N. Kuttner, (2005), "What Explains the Stock Market's Reaction to Federal Reserve Policy?" *Journal of Finance*, LX (3), June.
- Bonser-Neal, Catherine, V. Vance Roley, and Gordon H. Sellon, Jr., (1998), "Monetary Policy Actions, Intervention, and Exchange Rates: A Re-examination of the Empirical Relationships Using Federal Funds Rate Target Data," *Journal of Business*, 71 (April), pages 147-177.
- Brown, S., and J. Warner (1985), "Using daily stock returns: The case of event studies", *Journal of Financial Economics* 14: pages 3-31.
- Carlson, John B., Jean McIntire, and James B. Thomson, (1995), "Federal Funds Futures as an Indicator of Future Monetary Policy: A Primer," *Federal Reserve Bank of Cleveland, Economic Review*, (First Quarter), pages 20-30.
- Chordia, T., Roll, R. Subrahmanyam, A. (2002). "Evidence on the speed of Convergence to Market Efficiency". Working paper, UCLA.
- Cochrane, J.H., M. Piazzesi, (2005), "The Fed and the Interest Rates –A High Frequency Identification". *American Economic Review*, 92, pages 90-101.
- Cook, T. and T. Hahn, (1989), "The effect of changes in the federal funds rate target on market interest rates in the 1970s", *Journal of Monetary Economics* 24, pages 331-351.

DeBondt, W. F. M., & Thaler, R. H. (1985). "Does the stock market overreact?" *Journal of Finance*, 40, pages 793–805.

Demiralp, S. and Jordà, O. (2004), "The Response of Term Rates to Fed Announcements". *Journal of Money, Credit and Banking*, 36, June, pages 387-405.

Fama, E.F., (1970). "Efficient Capital Markets: A review of theory and empirical work". *Journal of Finance* 25, pages 383-418.

Goukasian, L. and I. Cialenco (2006), "The Reaction of Term Structure of Interest Rates to the Monetary Policy Actions". *Journal of Fixed Income*. Sep., 2006.

Gürkaynak, R., B. Sack, and E. Swanson (2002). "Market-Based Measures of Monetary Policy Expectations," *Federal Reserve Board Finance and Economics Discussion Series* 2002-2040.

Jegadeesh, N., and S. Titman. (1993), "Returns to Buying Winners and Selling Losers: Implications For Stock Market Efficiency", *Journal of Finance*, Vol. 48, pages 65-91.

Krueger, J. & Kuttner, K. (1996), 'The fed funds rate as a predictor of federal reserve policy,' *Journal of Futures Markets* 16, pages 865–879.

Kuttner, K.N. (2001), "Monetary Policy surprises and interest rates: Evidence from the Fed funds futures market". *Journal of Monetary Economics*, 47(3), pages 523-544.

Poole, W., Rasche, R.H and D.L. Thornton, (2002), "Market Anticipations of Monetary Policy Actions". *The Federal Reserve Bank of St. Louis*, July/August, pages 65-94.

Reichenstein, William.(1987) "The Impact of Money on Short-term Interest Rates." *Economic Inquiry* XXV (January, pages 67-82.

Rigobon, Roberto and Brian Sack (2002), "The Impact of Monetary Policy on Asset Prices," *National Bureau of Economic Research Working Paper* No. 8794.

Robertson, John C. and Daniel L. Thornton, (1997), "Using federal funds futures rates to predict Federal Reserve actions", *Federal Reserve Bank of St. Louis Review* 79 (6), November/December, pages 45-53.

Rudebusch, Glenn D., (1995), "Federal Reserve Interest Rate Targeting, Rational Expectations and the Term structure". *Journal of Monetary Economics* 35, pages 245-74.

Sack, B. (2004), "Extracting the Expected Path of Monetary Policy From Futures Rates", *Journal of Futures Markets* 24(8), pages 733-754.

Soderstrom, Ulf (2001), "Predicting Monetary Policy with Federal Funds Futures Prices," *Journal of Futures Markets* 21, pages 377-391.

Schwert, G.W. (2001). “Anomalies and Market Efficiency”. Ch. 17 in G. Constantinides, M. Harris and R. Stulz eds., Handbook of the economics of Finance.

Zhang, Y. (2004), “Analysts’ Responsiveness and Market Underreaction to Earnings announcements”. Working paper, Columbia University.

**Table 1**

This table shows the FFTR levels on each of the 155 event days, the expected , actual and unexpected changes in the FFTR and whether I was on a FOMC day or not. The comments on the calculation of the surprises in the changes in FFTR that occurred on some non-standard cases are at the end.

Date	FFTR	SUR	ACT	EXP	FOMC	Cmts		Date	FFTR	SUR	ACT	EXP	FOMC	Cmts
6/6/1989	950	-1	-25	-24	NO FOMC			12/22/1992	300	0	0	0	FOMC	
7/7/1989	925	-3	-25	-22	FOMC			2/3/1993	300	0	0	0	FOMC	
7/27/1989	900	0	-25	-25	NO FOMC			3/23/1993	300	0	0	0	FOMC	
8/22/1989	900	3	0	-3	FOMC			5/18/1993	300	-2	0	2	FOMC	
10/3/1989	900	1	0	-1	FOMC			7/7/1993	300	0	0	0	FOMC	
10/18/1989	875	0	-25	-25	NO FOMC			8/17/1993	300	0	0	0	FOMC	
11/6/1989	850	4	-25	-29	NO FOMC			9/23/1993	300	0	0	0	FOMC	
11/14/1989	850	-2	0	2	FOMC			11/16/1993	300	-4	0	4	FOMC	
12/20/1989	825	-17	-25	-8	FOMC			12/21/1993	300	0	0	0	FOMC	
2/7/1990	825	0	0	0	FOMC			2/4/1994	325	12	25	13	FOMC	
3/27/1990	825	0	0	0	FOMC			3/22/1994	350	-3	25	28	FOMC	
5/15/1990	825	0	0	0	FOMC			4/18/1994	375	10	25	15	NO FOMC	
7/3/1990	825	1	0	-1	FOMC			5/17/1994	425	13	50	37	FOMC	
7/13/1990	800	-14	-25	-11	NO FOMC			7/6/1994	425	-5	0	5	FOMC	
8/21/1990	800	0	0	0	FOMC			8/16/1994	475	14	50	36	FOMC	
10/2/1990	800	1	0	-1	FOMC			9/27/1994	475	-20	0	20	FOMC	
10/29/1990	775	-31	-25	6	NO FOMC			11/15/1994	550	14	75	61	FOMC	
11/14/1990	750	4	-25	-29	FOMC			12/20/1994	550	-17	0	17	FOMC	
12/7/1990	725	-27	-25	2	NO FOMC			2/1/1995	600	6	50	44	FOMC	b
12/18/1990	700	-21	-25	-4	FOMC	a		3/28/1995	600	10	0	-10	FOMC	
1/8/1991	675	-18	-25	-7	NO FOMC			5/23/1995	600	0	0	0	FOMC	
2/1/1991	625	-16	-50	-34	NO FOMC	b		7/6/1995	575	-1	-25	-24	FOMC	
2/6/1991	625	-4	0	4	FOMC			8/22/1995	575	0	0	0	FOMC	
3/8/1991	600	-16	-25	-9	NO FOMC			9/26/1995	575	0	0	0	FOMC	
3/26/1991	600	0	0	0	FOMC			11/15/1995	575	6	0	-6	FOMC	
4/30/1991	575	-14	-25	-11	NO FOMC	c		12/19/1995	550	-10	-25	-15	FOMC	
5/14/1991	575	2	0	-2	FOMC			1/31/1996	525	-6	-25	-19	FOMC	c
7/3/1991	575	-3	0	3	FOMC			3/26/1996	525	-3	0	3	FOMC	
8/6/1991	550	-15	-25	-10	NO FOMC			5/21/1996	525	0	0	0	FOMC	
8/20/1991	550	3	0	-3	FOMC			7/3/1996	525	-5	0	5	FOMC	
9/13/1991	525	-5	-25	-20	NO FOMC			8/20/1996	525	-4	0	4	FOMC	
10/1/1991	525	1	0	-1	FOMC	b		9/24/1996	525	-13	0	13	FOMC	
10/31/1991	500	-13	-25	-12	NO FOMC	c		11/13/1996	525	0	0	0	FOMC	
11/6/1991	475	-13	-25	-12	FOMC			12/17/1996	525	1	0	-1	FOMC	
12/6/1991	450	-9	-25	-16	NO FOMC			2/5/1997	525	-3	0	3	FOMC	
12/17/1991	450	-2	0	2	FOMC			3/25/1997	550	3	25	22	FOMC	
12/20/1991	400	-28	-50	-22	NO FOMC			5/20/1997	550	-11	0	11	FOMC	
2/5/1992	400	0	0	0	FOMC			7/2/1997	550	-2	0	2	FOMC	
3/31/1992	400	0	0	0	FOMC	c		8/19/1997	550	-1	0	1	FOMC	
4/9/1992	375	-24	-25	-1	NO FOMC			9/30/1997	550	0	0	0	FOMC	c
5/19/1992	375	0	0	0	FOMC			11/12/1997	550	-4	0	4	FOMC	
7/2/1992	325	-36	-50	-14	FOMC			12/16/1997	550	-1	0	1	FOMC	
8/18/1992	325	0	0	0	FOMC			2/4/1998	550	0	0	0	FOMC	
9/4/1992	300	-22	-25	-3	NO FOMC			3/31/1998	550	-2	0	2	FOMC	c

10/6/1992	300	7	0	-7	FOMC		5/19/1998	550	-3	0	3	FOMC	
11/17/1992	300	0	0	0	FOMC		7/1/1998	550	-1	0	1	FOMC	b
Date	FFTR	SUR	ACT	EXP	FOMC	Cmts	Date	FFTR	SUR	ACT	EXP	FOMC	Cmts
8/18/1998	550	1	0	-1	FOMC		10/28/2003	100	0	0	0	FOMC	
9/29/1998	525	0	-25	-25	FOMC		12/9/2003	100	0	0	0	FOMC	
10/15/1998	500	-26	-25	1	NO FOMC	d	1/28/2004	100	0	0	0	FOMC	
11/17/1998	475	-6	-25	-19	FOMC		3/16/2004	100	0	0	0	FOMC	
12/22/1998	475	-2	0	2	FOMC		5/4/2004	100	-1	0	1	FOMC	
2/3/1999	475	0	0	0	FOMC		6/30/2004	125	-3	25	28	FOMC	c
3/30/1999	475	0	0	0	FOMC		8/10/2004	150	2	25	23	FOMC	
5/18/1999	475	-4	0	4	FOMC		9/21/2004	175	2	25	23	FOMC	
6/30/1999	500	-5	25	30	FOMC	c	11/10/2004	200	0	25	25	FOMC	
8/24/1999	525	2	25	23	FOMC		12/14/2004	225	0	25	25	FOMC	
10/5/1999	525	-4	0	4	FOMC		2/2/2005	250	0	25	25	FOMC	
11/16/1999	550	9	25	16	FOMC		3/22/2005	275	0	25	25	FOMC	
12/21/1999	550	2	0	-2	FOMC		5/3/2005	300	0	25	25	FOMC	
2/2/2000	575	-5	25	30	FOMC		6/30/2005	325	0	25	25	FOMC	c
3/21/2000	600	-3	25	28	FOMC		8/9/2005	350	0	25	25	FOMC	
5/16/2000	650	5	50	45	FOMC		9/20/2005	375	1	25	24	FOMC	
6/28/2000	650	7	0	-7	FOMC		11/1/2005	400	1	24	25	FOMC	b
8/22/2000	650	-2	0	2	FOMC		12/13/2005	425	1	24	25	FOMC	
10/3/2000	650	0	0	0	FOMC		1/31/2006	450	1	24	25	FOMC	c
11/15/2000	650	0	0	0	FOMC								
12/19/2000	650	5	0	-5	FOMC								
1/3/2001	600	-38	-50	-12	FOMC	e							
1/31/2001	550	16	-50	-66	FOMC	c							
3/20/2001	500	6	-50	-56	FOMC								
4/18/2001	450	-43	-50	-7	FOMC	e							
5/15/2001	400	-8	-50	-42	FOMC								
6/27/2001	375	5	-25	-30	FOMC								
8/21/2001	350	2	-25	-27	FOMC								
9/17/2001	300	-32	-50	-18	FOMC	e							
10/2/2001	250	-7	-50	-43	FOMC								
11/6/2001	200	-10	-50	-40	FOMC								
12/11/2001	175	0	-25	-25	FOMC								
1/30/2002	175	0	0	0	FOMC								
3/19/2002	175	-3	0	3	FOMC								
5/7/2002	175	0	0	0	FOMC								
6/26/2002	175	0	0	0	FOMC								
8/13/2002	175	3	0	-3	FOMC								
9/24/2002	175	2	0	-2	FOMC								
11/6/2002	125	-19	-50	-31	FOMC								
12/10/2002	125	0	0	0	FOMC								
1/29/2003	125	0	0	0	FOMC								
3/18/2003	125	5	0	-5	FOMC								
5/6/2003	125	4	0	-4	FOMC								
6/25/2003	100	15	-25	-40	FOMC								
8/12/2003	100	0	0	0	FOMC								
9/16/2003	100	0	0	0	FOMC								

### **Comments on Table 1:**

- a:** The Fed announced a 50bps cut in Discount rate after the FOMC meeting. The action was announced only after the futures market was closed: 3:30 PM. Here we use the prices on 18th(close) and 19th(open) of December, 1990
- b:** One these first days of month, we take the open and close prices of futures on the days to find the surprise change in rates.
- c:** One 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 to find the surprise change in the rate.
- d:** The Fed changed the rate in between the FOMC meetings.  
The action was announced only after the futures market in CBOT was closed: 3:15 PM. Here we use the prices on 15th(close) and 16th(open) of October, 1998.
- e:** These are unscheduled FOMC meetings.

**Table 2****Panel A****Descriptive Statistics of the FFTR**

The full sample consists of 155 observations. We exclude September 17, 2001 from the sample. There were 135 FOMC days and 20 rate changes that occurred not 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 made in the FFTR. There were 55 days before February, 1994 and 100 days after (and including) it.

	<b>Number of FOMC days</b>	<b>Number of NON-FOMC Days</b>	<b>Number of FFTR changes</b>	<b>Number of No changes in FFTR</b>	<b>St. Dev. Of the unexpected changes in bps</b>	<b>The average of the FFTR in bps</b>
<b>May 1989- Jan 1994</b>	37	18	24	31	10.23	576
<b>Feb 1994 – Dec-2005</b>	98	2	45	55	9.34	408
<b>May 1989- Dec-2005</b>	135	20	69	86	9.88	468
Comments: 1. All the numbers are in basis points. 2. September 17, 2001 is included in the sample, but not in the subsequent analysis.						

**Panel B**

The distribution of the changes in the fed funds target rates.

<b>FFTR change(in bp)</b>	<b>May 89-Feb 06</b>	<b>May 89-Jan 94</b>	<b>Feb 94-Feb 06</b>
<b>-50</b>	12	3	9
<b>-25</b>	31	21	10
<b>0</b>	86	31	55
<b>25</b>	21	0	21
<b>50</b>	4	0	4
<b>75</b>	1	0	1

**Table 3**

The full sample consists of 155 observations that cover the period of June 1989 to December 2005. There were 55 days before February, 1994 and 100 days after (and including) it. We exclude September 17, 2001 from the sample. Thus we have 155 observations for the study. FOMC are the days in which there was a FOMC meeting, Sur>0 (Sur<0) corresponds to the case in which the unexpected change in the FFTR was positive (negative). No Chg (Chg>0, Chg<0) corresponds to the case in which the FFTR was unchanged (increased, decreased). All the returns are in basis points. N is the number of observations.

**Panel A**

The test of hypothesis of no abnormal returns *on the next day* of the monetary policy actions announcement.

	<b>89-94</b>	<b>89-06</b>	<b>FOMC</b>	<b>Sur&gt;0</b>	<b>Sur&lt;0</b>	<b>No Chg</b>	<b>Chg&gt;0</b>	<b>Chg&lt;0</b>
$\overline{CAR}_1$	18	18	15	13	32	15	16	27
$T_1$	<b>1.66*</b>	<b>2.09**</b>	<b>1.69*</b>	0.66	<b>2.58**</b>	1.21	0.99	<b>1.68*</b>
$N$	55	155	135	41	64	86	27	42

**Panel B**

The test of hypothesis of no abnormal returns *on the day* of the announcement of the monetary policy actions.

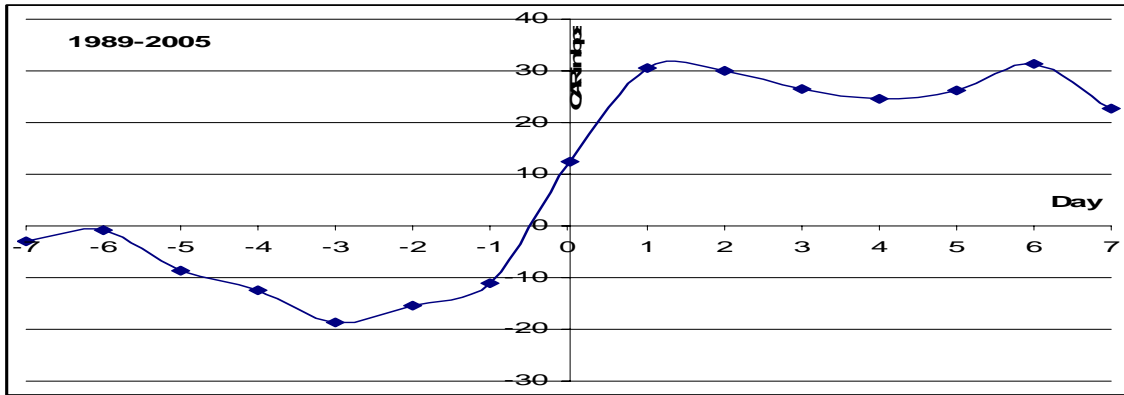
	<b>89-94</b>	<b>89-06</b>	<b>FOMC</b>	<b>Sur&gt;0</b>	<b>Sur&lt;0</b>	<b>No Chg</b>	<b>Chg&gt;0</b>	<b>Chg&lt;0</b>
$\overline{CAR}_0$	16	24	23	0	46	13	25	44
$T_0$	<b>1.71*</b>	<b>2.86**</b>	<b>2.67**</b>	-0.03	<b>1.79*</b>	<b>3.06**</b>	1.42	<b>1.94**</b>
$N$	55	155	135	41	64	86	27	42

\*, \*\* and \*\*\* indicate statistically significant findings at 10%, 5% and 1% level respectively.



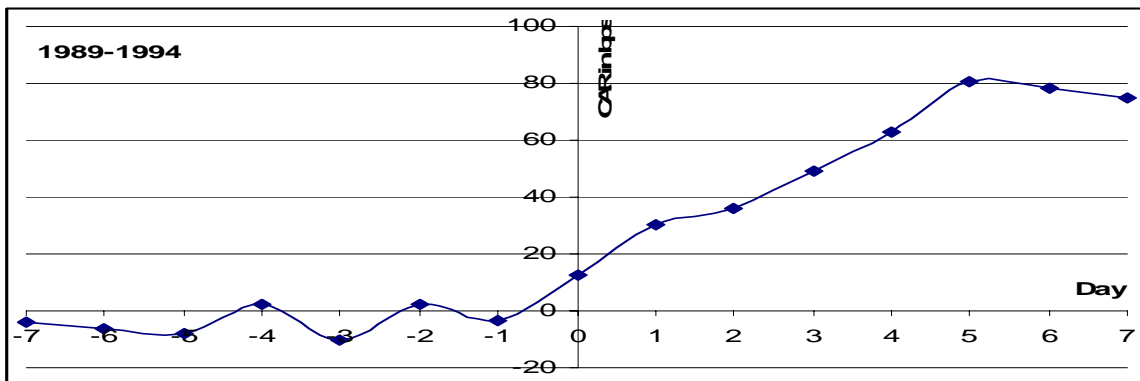
**Figure 1**

The following figure shows the cumulative abnormal returns of the CRSP VW index on the days before and after the event. Day-0 is the day of the event. All the numbers are in basis points. This table is for the time period from 1989 to 2005.



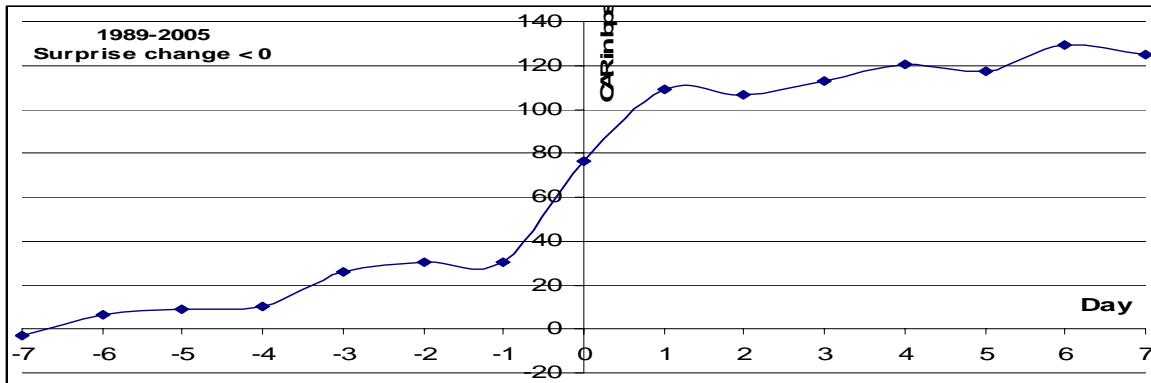
**Figure 2**

The following figure shows the cumulative abnormal returns of the CRSP VW index on the days before and after the event. Day-0 is the day of the event. All the numbers are in basis points. This table is for the time period from 1989 to 1994.



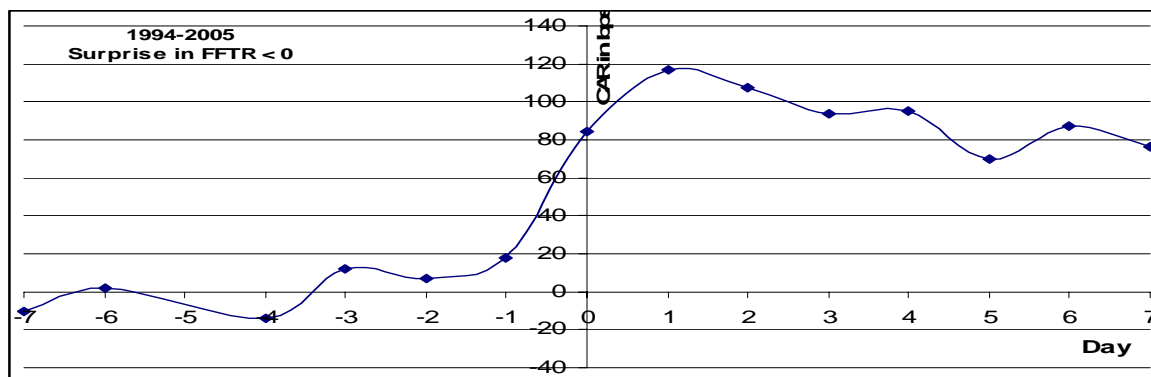
**Figure 3**

The following figure shows the cumulative abnormal returns of the CRSP VW index on the days before and after the event. Day-0 is the day of the event. All the numbers are in basis points. This table is for the time period from 1989 to 2005 and the cases in which the unexpected change in the FFTR was negative.



**Figure 4**

The following figure shows the cumulative abnormal returns of the CRSP VW index on the days before and after the event. Day-0 is the day of the event. All the numbers are in basis points. This table is for the time period from 1994 to 2005 and the cases in which the unexpected change in the FFTR was negative.



**Figure 5**

The following figure shows the cumulative abnormal returns of the CRSP VW index on the days before and after the event. Day-0 is the day of the event. All the numbers are in basis points. This table is for the time period from 1989 to 2005 and the cases in which the change in the FFTR was negative.

