VIX Changes and Derivative Returns on FOMC Meeting Days

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Abstract

We examine the link between scheduled FOMC meetings and the VIX measure. Our results indicate that VIX declines significantly on scheduled meeting dates. Unlike prior studies suggesting that the drop in VIX is mechanical, we attribute the decline to the resolution of uncertainty regarding future interest rates provided by the meetings. We examine returns to investable positions on VIX. Though a decline in the VIX level commonly occurs on FOMC meeting dates, we find that significant returns may still be garnered from taking short-VIX positions in derivative markets, even after accounting for the bid-ask spread.

1. INTRODUCTION

The Federal Funds rate target is one of the essential monetary tools of the Federal Reserve Bank. Rate target movement causes stock markets to fluctuate as numerous interest rates throughout the economy rely on the target as a basis, and thus the prospects of many firms are affected by shifting costs of capital or the potential for interest income. We document that VIX, the market volatility or fear index, generally declines on scheduled FOMC (Federal Open Market Committee) meeting dates, regardless of the content of the meeting. One of our major contributions relates to the interpretation of this result. Unlike prior literature that suggests the drop is mechanical, we hold that this decline in VIX is related to a reduction in uncertainty. Consistent with this conclusion, we find the VIX reduction is greater when overall uncertainty is higher. We reconcile the result with previous studies (which find, e.g., an *increase* in market volatility around announcements) by noting that such studies find increased volatility only in the case of *surprise* announcements. Furthermore, typical volatility measures serve as *information* proxies, while VIX serves as an *uncertainty* proxy. Our other major contribution is the demonstration that the observed, predictable reduction in VIX leads to a profitable trading strategy using VIX options and VIX futures, suggesting that VIX derivatives are not efficiently priced around scheduled FOMC meetings.

Monetary policy actions generally affect market interest rates, and thus stock returns; however, anticipated and unanticipated policy actions have been shown to have different impacts. Kuttner (2001) documents that while there is a strong and robust relation between surprise monetary policy actions and market interest rates, the response to anticipated actions is generally small. Kuttner also finds that surprise changes in the

target rate have a minimal effect on expectations of future Fed actions, helping to explain the failure of the expectations hypothesis on the short end of the yield curve. Following these initial results, Bernanke and Kuttner (2005) document that, on average, a hypothetical unanticipated 25-basis-point cut in the Federal Funds rate target is associated with about a 1% increase in broad stock indices. Kurov (2010) finds that investor sentiment is linked to FOMC meetings and that the link depends on the state of the market.[1] Specifically, he notes that surprises have a strong impact on investor sentiment in bear markets. He notes that VIX is often used as a sentiment proxy and shows that VIX is correlated with other sentiment measures. We alter this interpretation slightly, and we suggest that VIX proxies for uncertainty rather than sentiment.

Lobo (2002) detects increased stock market volatility on the date of unexpected rate increases.[2] More generally, Bomfim (2003) examines the impact of monetary policy on stock market volatility and finds a significant increase on the days of monetary policy announcements. Andersson (2010) and Chuliá (2010) et al. examine similar hypotheses by using intraday data to examine volatility dynamics around monetary policy meetings, and their studies report that the announcement of monetary policy decisions can immediately cause large increases in stock market volatility, but volatility often subsequently declines greatly by the end of the announcement date. Ahn and Melvin (2007) find increased volatility on FOMC dates in foreign currency markets. Economic conditions have an impact on the degree of volatility changes. Chuliá (2010) et al. show that intraday increases in stock market volatility are substantially larger during business recessions and expansive

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[1]A similar finding (Hess et al., 2008) links macroeconomic state and commodity indices in the United States.
[2]Our focus is on scheduled FOMC meetings as we seek to demonstrate predictable effects. Fed actions may be interpreted differently by markets in the case of unscheduled meetings (see, e.g, Sakar, 2009).

monetary policy cycles than during periods of contractive monetary policy. One interpretation of increased volatility on a meeting date is that the volatility increase is reflecting an increase in information. For the information to be impounded in prices, trading must take place. This leads to increased volatility. Consistent with this interpretation is prior literature finding that increased volatility is typically observed only *when there is a surprise* in the announcement.

Nikkinen and Sahlström (2004) and Chen and Clements (2007) examine the behavior of implied volatility indices around FOMC meetings. Counter to the aforementioned market volatility studies, they document systematic decreases in implied volatility on the FOMC meeting dates. Most closely related to our work, Vähämaa and Äijö (2010) examine the effects of the Federal Reserve's monetary policy decisions on the implied volatility of the S&P 500 index (VIX). They find the unexpected portions of Federal Funds target rate movements are significantly linked to movements in VIX, while the expected portions of rate movements are immaterial to VIX. Their regression results show that stock market volatility generally decreases after FOMC meetings.

Nikkinen and Sahlstrom (2004) and Savor and Wilson (2010) theorize that the VIX drop on FOMC meeting days is mechanical. Specifically, they note that VIX can be viewed as a portfolio of one-day conditional volatilities. Thus, when a high volatility day, such as an announcement day, is removed from the portfolio of volatilities, a drop in VIX is to be expected. However, neither paper explicitly examines realized volatility on FOMC meeting dates. Our results indicate that average announcement dates (including positive, negative, and no surprise dates) do not have higher volatilities than normal dates. In this paper, we reconsider the impact of scheduled FOMC meetings on the VIX using updated data. Prior

work holds the importance of nonsurprise rate changes to be negligible to equity markets,[3] but our results suggest that VIX decreases, regardless of the nature of the meeting. This implies that uncertainty is generally reduced following FOMC meetings, regardless of the content of the meeting. We find that VIX serves as an uncertainty proxy, as opposed to a sentiment or information proxy, as previous work has hypothesized.[4] Thus, the behavior of VIX around FOMC meetings contains unique information. We additionally hypothesize that if VIX is capturing uncertainty, and FOMC meetings reduce this uncertainty, then VIX will increase as more time elapses since the previous meeting. Our results support this conjecture. Consistent with this hypothesis, Ehrmann and Fratzscher (2009) find that financial markets are more sensitive to Federal Reserve communication in periods before FOMC meetings than at other times.

Our results for VIX initially seem to contradict the literature, which finds that actual market volatility is higher on FOMC announcement dates.[5] We reconcile this fact by suggesting that usual volatility measures capture information. This is consistent with results showing that the volatility increase around meeting dates is only present when there is a surprise announcement. The absence of a change in other volatility measures on nonsurprise announcement dates indicates that these events do not contain new information. Our results show that VIX decreases on FOMC meeting dates, and the decrease does not depend on the presence of a surprise. Both the difference in the direction of the result, and the difference in the role of surprises, suggest that VIX is a different type of

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[3]An asymmetric effect in which negative surprises are met with a larger reaction than positive surprises has also been documented by Lobo et al. (2003), among others.

[4]Bekaert et al. (2010) decompose VIX into uncertainty and risk-aversion components and conclude that lax FOMC meeting policy is related to risk aversion in the medium term and not uncertainty. Our paper differs from theirs in that we focus on the short-term reaction of VIX to scheduled meeting announcements.

[5]See, for example, Lobo (2002), Bomfim (2003), Andersson (2010), and Chuliá (2010) et al.

proxy, capturing something other than information. We hold that VIX captures uncertainty, and FOMC meetings resolve uncertainty.

Our results also seem to contradict some of the literature suggesting that VIX serves as an investor-sentiment proxy. Kurov (2010) finds the link between sentiment and FOMC meeting dates is present only in bear markets. We find that VIX decreases on FOMC meeting dates are present for the full sample and are not conditional on the nature of the announcement. We reconcile these differences by suggesting that investor sentiment depends on the content of the meeting (e.g., good news will improve sentiment), while *uncertainty*, the degree to which information is unknown, will decrease regardless of the content of the meeting.

VIX cannot be invested indirectly. However, traders can attempt to hedge or speculate on VIX movements via the futures and options markets. Most work on VIX derivatives thus far has considered the role of VIX as a hedging instrument. Dennis et al. (2006) document the asymmetric relationship between VIX and the S&P 500 and specifically show that VIX increases and S&P 500 declines are more strongly correlated than VIX decreases and S&P 500 increases. Whaley (2009) describes the asymmetric nature of VIX, namely, that it increases more significantly during a stock market decline and it moves less substantially during a stock market boom. As a contrast to the longer-term protection of equity positions with long-VIX holdings, we seek to analyze the profitability of short-VIX positions surrounding scheduled events (FOMC meetings) as a potential strategy for profiting from a market inefficiency.

We find significant profitability to ex-ante positions in derivative markets that do not depend on the surprise element of rate announcements or the type of rate change

announced. We offer a new contribution to the literature by demonstrating the profitability of short-VIX option strategies surrounding scheduled FOMC dates. Results after incorporating conservatively high trading costs are still impressive. We also find that short positions in VIX futures contracts result in profitable one-day returns on FOMC meeting dates, even after trading costs are implemented.

Significant one-day mean returns of 8.4% (9.5%) to positions that buy VIX puts (sell VIX calls) preceding FOMC meeting dates are found, even after incorporation of the bid-ask spread. While data are limited, the positive returns to such strategies appear to be persisting, even as VIX options become more commonplace and open interest in such derivatives grows.[6] The returns to the option positions exist regardless of the ex-post surprise of the FOMC rate announcement. The one-day short-VIX futures positions result in highly significant mean returns of 2.5% (1.7%) even after the inclusion of 0.1% (0.5%) trading costs for both the opening and closing of the position.

The paper proceeds as follows. Section 2 discusses the data used to create the analyses and details the procedure for determining the amount of unexpected and expected Fed Funds target rate movements on FOMC dates. It also outlines the methodology. Section 3 discusses our results. Section 4 concludes.

2. DATA and METHODOLOGY

Fed Funds futures are an important risk management tool for investors who want to hedge against or speculate on changes in Federal Reserve monetary policy. Kuttner (2001)

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[6]While open interest in VIX options has increased since the initiation of the instruments in 2006, the dollar value of VIX option positions is still relatively limited (typically tens of millions of dollars of contracts on FOMC dates). We suspect that further prevalence of VIX options may close trading inefficiencies, but the effect has remained rather consistent to this time.

derives the surprise element of changes in the Federal Funds rate target from the change in the futures contract's price relative to the price the prior day. This approach is utilized by the subsequent research analyzing the surprise component of FOMC meetings. For an event taking place on day d of month m, the unexpected Fed Funds rate target can be calculated from the change in the rate implied by the current-month futures contract as:

$$\Delta i^u = \frac{D}{D - d}\left(f_{m,d}^0 - f_{m,d-1}^0\right), (1)$$

where Δi^u is the unexpected target rate change, D is the number of days in the month, and $f_{m,d}^0$ is the current-month futures rate. The expected component of the rate change is calculated as the actual change minus the surprise target funds rate change,

$$\Delta i^e = \Delta i - \Delta i^u \ (2)$$

Kuttner (2001) then examines how market interest rates are correlated with anticipated and unanticipated changes in market interest rates via:

$$\Delta R_t^i = a^i + \beta_1^i \Delta r_t^e + \beta_2^i \Delta r_t^u + \varepsilon_t^i \ (3)$$

where ΔR_t^i represents the market interest rate, Δr_t^e is the expected change in the funds rate target, and Δr_t^u is the surprise change in the funds rate target.

The 30-day federal funds futures data we use are from 1996 to 2010. For each scheduled FOMC meeting date we calculate the expected and unexpected component of the Fed Funds target rate movement (or nonmovement in the case of no change). These data are utilized in our paper to determine whether the degree of unexpected change from a scheduled FOMC meeting affects the movement of VIX or the CFTC sentiment level, or determines the profitability of short-VIX positions taken prior to that meeting. The data are

extracted from the futures prices of *The Wall Street Journal* archives. The sample includes 116 scheduled FOMC meetings, though for VIX derivative returns we further focus on the 35 (49) scheduled FOMC meetings since the beginning of the trading of VIX options (futures).

We take historical VIX data from the website of the Chicago Board Options Exchange (CBOE).[7] We obtain option price data for VIX options from Optionmetrics, beginning with their initial trading in 2006. For liquidity reasons, we consider herein only the options closest to at-the-money status. Historical VIX futures prices are taken from the CBOE website, beginning with their initial trading in 2004. We consider the performance of the next expiring and penultimate expiring VIX option contracts on FOMC meeting dates, requiring at least one week between the current date and the expiration date. The same approach is utilized for VIX futures. We find the FOMC meeting dates on the Federal Reserve Bank's website.[8]

We compare changes in VIX to changes in investor sentiment. Our investor sentiment proxy is from Han (2008) and is based on the Commodity Futures Trading Commission (CFTC) *Commitments of Traders Report*, which contains details on S&P 500 futures. The report is weekly, and our sentiment proxy is constructed by taking the number of long, noncommercial S&P 500 futures contracts minus the number of short noncommercial S&P 500 futures contracts, divided by the total open interest in S&P 500 futures.

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[7]http://www.cboe.com/micro/vix/historical.aspx
[8]http://www.federalreserve.gov/monetarypolicy/fomccalendars.html

3. METHODOLOGY and RESULTS

We first record the changes of the VIX index, the CFTC sentiment proxy, and the realized volatility, VOL, on the days of scheduled FOMC meetings. Table 1 presents statistics regarding the mean and median VIX, CFTC, and VOL changes on scheduled meeting days and tests the two-tailed hypothesis that each measure's change on meeting dates = 0. Panel A presents results for the full sample, dating back to 1996. Panel B considers the separate results for the subsample of observations beginning at the point VIX calls and puts were available for trade in March 2006 through the end of our data in June 2010.

[Insert Table 1]

The results suggest VIX significantly declines on the dates of scheduled FOMC meetings over both the full sample period and the subsample period. The average absolute (percentage) VIX decline is -0.66 (-2.74%) on FOMC meeting dates for the full sample. The median absolute (percentage) VIX decline is -0.55 (-3.06%) on FOMC meeting dates for the full sample. These declines are all statistically significant at the 1% level. The VIX declines in the recent subsample (seen in Panel B of Table 1) are of even greater magnitude than those seen in the full sample. These results confirm the results of Nikkinen and Sahlström (2004), Chen and Clements (2007), and Vähämaa and Äijö (2010), which find substantial decreases in VIX on FOMC meeting dates. They may also be viewed as initial confirmation of our hypothesis that the uncertainty regarding future interest rates is notably resolved by rate declarations made during FOMC meetings.

There is some limited evidence that sentiment increases on meeting dates as CFTC changes are generally positive, but the results are insignificant. This is consistent with

Kurov (2010), who finds that the impact of FOMC meetings on sentiment depends on market conditions, suggesting that VIX is capturing something different than traditional sentiment proxies. We posit that VIX is capturing uncertainty, which will decrease regardless of the content of the meeting. Finally, we find evidence inconsistent with the suggestion of Savor and Wilson (2010) and Nikkinen and Sahlstrom (2004) that the drop in VIX is mechanical. Specifically, we find that VOL changes on all scheduled FOMC dates are not higher than on other dates. Thus, the drop in VIX does not appear to be related to high volatility days dropping from the VIX portfolio of volatilities.

If VIX is indeed a proxy for uncertainty, then we would expect to see a larger drop in VIX when uncertainty is high.

[Insert Table 2]

In Table 2 we sort meeting dates based on the prevailing VIX levels. A higher VIX level means greater uncertainty. Consistent with our hypothesis of VIX as an uncertainty proxy, we find that VIX decreases are greater when VIX levels are higher. Specifically, the mean drop in VIX is -0.167 when VIX is at its lowest and the drop steadily shifts to -1.326 at the highest VIX levels. While this is not surprising, to our knowledge, we are the first to note that VIX decreases are more pronounced during times of higher uncertainty.

If FOMC meetings resolve uncertainty, then the time elapsed since the last FOMC meeting may be positively related to uncertainty. Indeed, Lobo (2000) notes that the incorporation of information in prices is slower just prior to rate announcements as compared to just after rate announcements. We test the relation between the number of days since the previous FOMC meeting and VIX or investor sentiment (CFTC). Specifically, we use OLS to estimate the following regression:

$$VIX(CFTC) = \propto + \beta1\ DaysSinceMeeting + \beta2\ LagVIX(LagCFTC) + \beta3\ SPReturn +$$
$$\beta4\ Month1Mom + \beta5\ Month2to6Mom + \beta6\ Month7to12Mom +$$
$$\beta7\ MeetScheduled + \beta8\ Crisis + e \qquad\qquad (4)$$

where $VIX(CFTC)$ is the level of VIX (CFTC) depending on the specification used.
DaysSinceMeeting is the number of elapsed days since the previous scheduled FOMC
meeting. *LagVIX* (*LagCFTC*) is the previous period's VIX (CFTC) and is included because of
the autoregressive nature of these indices. *SPReturn* is the day's S&P 500 return. We
include this control, which is the market reaction to the announcement, as a proxy for
whether or not the announcement was considered "good" news. [9] *Month1Mom,*
Month2to6Mom, and *Month7to12Mom* are the buy-and-hold returns to the S&P 500 in the
past month, from month -6 through month -2 and from month -12 through month -7,
respectively, and are also included as control measures. Two additional control measures
are included in order to isolate the impact of time since the latest FOMC meeting.
MeetScheduled is a dummy equal to 1 if the day is an FOMC meeting day and 0 otherwise.
We define *Crisis* as the period beginning December 2007 and ending June 2009, according
to NBER's classification of the recession period.

[Insert Table 3]

In the first column of Table 3, we estimate Equation (4) over the full sample. The
coefficient on *DaysSinceMeeting* is positive and significant when VIX is the dependent
variable. This result is consistent with our conjecture that VIX proxies for uncertainty and
FOMC meetings resolve uncertainty regardless of whether there is a surprise. The R^2 of
these regressions is very high because VIX is highly autocorrelated and we include the
lagged VIX value in our regressions.

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[9] We thank an anonymous referee for this suggestion.

The coefficient on *DaysSinceMeeting* is not significant in the full sample using CFTC as the dependent variable. This further suggests that VIX is capturing uncertainty rather than investor sentiment. For the dummy variable, *MeetScheduled,* we find that when VIX is the dependent variable, the coefficient in the full sample is negative and significant. This is consistent with VIX reduction on FOMC meeting days. The coefficient on *MeetScheduled* when CFTC is the dependent variable is insignificant. This is further evidence that VIX and investor sentiment (CFTC) are different proxies.

Two possible limitations of our interpretation of VIX as an uncertainty proxy are that the measure used for surprises may be noisy and that it is unclear in all cases whether or not a given rate announcement is "good" news. We include *SPReturn* in all specifications to proxy for the market reaction to the announcement. Additionally, we split the sample into positive market reactions (S&P Up) and negative reactions (S&P Down).[10] We find that the coefficient for *SPReturn* is negative and significant in all specifications for which VIX is the dependent variable. This is consistent with VIX dropping when the market views the FOMC announcement favorably. However, when we split the sample based on the market reaction, we find that the coefficient for *MeetScheduled* is negative and significant for the subsample of a negative market reaction. Thus, VIX drops even in the event of "bad" news, which is consistent with VIX serving as an uncertainty proxy.

The average drop in VIX that we observe on FOMC meeting days does not appear to be due only to rate decreases or the "good news" resulting from meetings with a surprisingly negative interest rate change. In Panel A of Table 4 we show that VIX declines are more likely than VIX increases, regardless of whether the announced rate change is

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[10]We thank an anonymous referee for this suggestion and for noting the importance of the market reaction.

negative, positive, or zero. Additionally, we illustrate in Panel B of Table 4 that while those meetings that see a negative Kuttner (2001) surprise are typically accompanied by VIX declines, even in the cases of no negative interest rate surprise, VIX declines are still more than twice as likely as VIX increases. This is true of both the overall measurement period, beginning in 1996, as well as the VIX option subperiod. In both panels, the mean and median VIX decline for the full sample is statistically significant, regardless of the nature of the rate announcement.

[Insert Table 4]

While the drop in VIX on FOMC meeting dates might be foreseeable given the information component of interest rate announcements (which have widespread impact throughout financial markets), efficient market theory requires that the pricing of assets should take into account all relevant information. This demands the pricing of predictable movements into securities. We next consider whether derivatives tied to the VIX index are priced in a manner that reflects the likely decline in VIX on scheduled FOMC meeting dates.

Beginning in March 2006, calls and puts on the VIX index were made available for trade on the CBOE. Anticipating a decline in VIX on scheduled FOMC meeting dates, we consider the returns made by buying VIX puts and selling VIX calls on the day preceding FOMC meetings. We utilize both those options expiring on the next option expiration date (if there is more than one week before that expiration date) and those options expiring on the penultimate valid expiration date. We calculate the returns to such option positions based on both a midpoint-to-midpoint strategy, which assumes all option transactions may be entered into at the midpoint between the best bid and best ask price, and on a basis that fully incorporates the bid-ask spread by buying (selling) puts (calls) at the best-ask (best-

bid) price available the day before scheduled FOMC meetings and selling (buying) puts (calls) at the best-bid (best-ask) price at the end of the FOMC meeting day. Results are available in Table 5.

[Insert Table 5]

Results based on the next option expiration date are given in Panel A of Table 5. We find strong and positively significant mean (median) returns of 22.0% (15.0%) from buying puts the day before scheduled FOMC meetings and holding the puts for one day. These results weaken to a still significant 8.4% mean return after a full bid-ask spread is incorporated (the median return is, however, insignificant). In Panel B, we give results based on the following option expiration date. Results decline in magnitude and, in many cases, in significance when using penultimate expiration date long puts. While the returns to midpoint based holdings are still highly significant, returns to full bid-ask spread positions no longer remain so.

Similar to the long-put results, we find positive and strongly significant abnormal returns to short-call positions entered into directly preceding scheduled FOMC meeting days. The mean (median) short-call return is 17.2% (15.4%) when midpoint prices are utilized for transactions. These results lessen to mean (median) returns of 9.5% (7.7%) if the bid-ask spread is fully implemented, but the results remain significant at the 1% level for the mean (median) return.

In Table 4, the results imply that VIX declines are not merely a result of those FOMC meeting dates that see declines or surprisingly negative changes in interest rates. Even on meeting dates with no surprises or positive surprises in interest rates, VIX tends to decline.

[Insert Table 6]

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In Table 6, we examine the impact of rate changes and surprises on the returns of the option trading strategies first shown in Table 5. In Panel A of Table 6 we find that positive rate changes are most strongly related to positive returns when focusing on puts, as the return is 20.7% for this group, compared to 8.2% for negative rate changes, and 6.9% for zero rate change, all when accounting for the bid-ask spread. The results are more consistent across negative, zero, and positive rate changes when considering a short-call position (returns of 10.3%, 11.2%, and 7.0%, respectively, when considering the bid-ask spread).[11]

In Panel B of Table 6, as might be expected, we find a negative rate surprise is most strongly linked to high returns from taking short-VIX positions in options. Holding VIX puts (writing VIX calls) results in an average 17.3% (9.4%) return on the 10 instances with negative interest rate surprises, even after accounting for the bid-ask spread. When no surprise is present on an FOMC meeting date, which occurs in 24 of the 35 observed instances, average returns are still positive from taking short-VIX, one-day option strategies, even after accounting for the bid-ask spread. The returns to short-VIX positions in the four instances that saw positive interest rate surprises on FOMC dates are smaller, but were not particularly poor.

In Table 7 we consider the results of positions that go short a VIX futures contract the day before an FOMC meeting day and close these positions at the end of the FOMC meeting day.

[Insert Table 7]

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[11]Given the small sample sizes, we no longer test for the statistical significance when considering these classifications.

The average one-day return with no trading costs, based on the next expiring futures contract, is 2.7%, significant at the 1% level. Median returns are also highly significant. This high significance persists when transaction costs of 0.1% and 0.5% are assumed for both opening and closing the positions. These costs are typically seen in the literature (e.g., Allen and Karjalainen, 1999; Wang, 2000); however, trading costs may now be substantially lower than in these earlier studies, and thus the significance reported for our findings on shorting VIX futures may actually be conservative. Results are not as strong when shorting the penultimate expiration futures contracts, similar to the effect we see for options, but positive and strongly significant returns are present unless trading costs of 0.5% are assumed.

Though statistically significant, the magnitude of the returns to shorting futures is considerably smaller than those seen for taking short-VIX positions through options. Part of this discrepancy may be due to the additional observations available to track returns in futures positions. VIX futures were available for trade two years prior to VIX options, commencing in 2004. However, further study reveals that the return level to such positions has not changed much over time (we also do not detect any time trend in VIX option returns). The most likely explanation for the lower magnitude of futures returns is the difference in the distribution structure of returns for options and futures. Given the relatively small cost per trading unit size of VIX options, considerably more extreme returns are realized for options than for VIX futures, particularly over one-day horizons. Larger return magnitudes for options, combined with the tendency we have shown for VIX to decline on FOMC meeting dates, may thus yield return results that are significant for each instrument but larger in degree for options.

We finally consider whether the type of interest rate announcement on scheduled FOMC meeting days is linked to the returns realized in short-VIX futures positions (similar to our investigation for VIX options). In Table 8, we examine the impact of rate changes and surprises on the returns of the VIX futures trading strategy. In Panel A of Table 8 we find that negative rate changes are most strongly associated with positive trading returns, though positive returns are found for all three groups of rate announcements. In Panel B of Table 8 we find that negative surprises are most strongly associated with positive trading returns but, again, positive returns are found for all three groups of surprises.

[Insert Table 8]

4. CONCLUSIONS

We investigate the relationship between the movement of the Federal Funds rate target and the volatility index (VIX). Specifically, we consider the impact of scheduled Federal Open Market Committee (FOMC) meetings that occurred from 1996 to 2010. We hypothesize that VIX proxies for uncertainty and that FOMC meetings resolve uncertainty regardless of whether the content of the meeting was anticipated. We confirm a significant decline in the VIX following scheduled FOMC meetings and note this result does not depend on surprise announcements. Further, the reduction is deepened during periods of high uncertainty, and uncertainty begins to increase following FOMC meeting dates.

Widespread VIX declines on FOMC meeting dates allow for analysis of simple, ex-ante strategies in the derivative market designed to profit from the impact of events whose timing is known. In conjunction with our trading hypothesis, we seek to determine the profitability of various strategies intended to trade on the foreseeable VIX decline, namely,

taking long (short) positions in VIX puts (calls). We also investigate the returns to short

positions in VIX futures. Contrary to basic market efficiency theory, we detect statistically

significant returns based on such derivative trading. The potential to realize such returns is

not enormous, given the limited number of contracts available for trade; however, their

statistical significance has thus far persisted even as VIX derivative markets have become

broader and deeper. Whether, or for how long, this relationship persists will be a subject

for future research.

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TABLE 1

VIX, CFTC, and VOL Changes on Scheduled FOMC Meeting Days

Panel A: 116 Scheduled FOMC meetings from January 1996–June 2010

	Mean Change	Mean % Change	Median Change	Median % Change
VIX	-0.656***	-2.741***	-0.550***	-3.064***
t-stat	(-5.24)	(-5.58)		
CFTC	0.001	0.354	0.001	-0.013
t-stat	(0.49)	(1.11)		
VOL	-0.0001	-0.007		
	VIX Increases:	29	CFTC Increases:	59
	VIX Decreases:	87	CFTC Decreases:	57

Panel B: 35 Scheduled FOMC meetings from March 2006–June 2010

	Mean Change	Mean % Change	Median Change	Median % Change
VIX	-0.989***	-3.962***	-0.740***	-4.416***
t-stat	(-2.95)	(-3.30)		
CFTC	0.002	0.995	0.002	-0.035
t-stat	(0.40)	(0.95)		
VOL	-0.0001	-0.007		
	VIX Increases:	8	CFTC Increases:	20
	VIX Decreases:	27	CFTC Decreases:	15

Notes: This table presents statistics regarding the changes in the VIX, CFTC, and volatility (VOL) levels on the day of scheduled FOMC meetings. Changes in the absolute level in VIX, CFTC, and VOL, as well as the percentage changes from the previous day are considered. Panel A gives results for the entire sample period; Panel B gives results beginning at the time that VIX options became available for trade in March 2006. T-test results for the hypothesis of zero mean change and sign-rank test results for the hypothesis of zero median change are given. *** denotes statistical significance at the 1% level.

TABLE 2

Mean VIX Changes by Pre-Meeting Level

Panel A: VIX changes from January 1996–June 2010

| | Pre FOMC Meeting VIX Level | | | | |
	Sub 15	15-20	20-25	25-30	Over 30
n	20	23	40	14	19
VIX Change	-0.167	-0.439	-0.661	-0.786	-1.326
VIX % Change	-1.313	-2.482	-2.912	-3.035	-4.048

Panel B: VIX changes from March 2006–June 2010

| | Pre FOMC Meeting VIX Level | | | | |
	Sub 15	15–20	20–25	25–30	Over 30
n	8	4	11	4	8
VIX Change	-0.351	-0.765	-0.485	-1.865	-1.996
VIX % Change	-2.872	-4.822	-2.096	-6.710	-5.692

Notes: This table presents statistics regarding the changes in mean VIX levels on the day of scheduled FOMC meetings. The meetings are sorted based on the VIX level on the day prior to the meeting. Panel A shows results for the entire sample period. Panel B gives results from the time that VIX options became available for trade on the CBOE in March 2006.

TABLE 3

Regression of VIX and CFTC Levels

	VIX Level			CFTC Level		
	All	S&P 500 Up	S&P 500 Down	All	S&P 500 Up	S&P 500 Down
Intercept	0.228***	0.285***	0.193**	-0.001	0.000	-0.003***
DaysSinceMeeting	0.004**	0.003	0.004	0.000	-0.0001*	0.0002***
LagVIX	0.988***	0.986***	0.990***			
LagCFTC				0.930***	0.922***	0.983***
SPReturn	-102.359***	-104.09***	-100.09***	-0.026	-0.041	-0.017
Month1Mom	0.574	0.087	1.320**	-0.007	-0.019	0.010
Month2to6Mom	0.059	0.189	-0.191	-0.018	-0.027***	0.003
Month7to12Mom	-0.043	-0.026	-0.089	-0.005	-0.005	-0.004
MeetScheduled	-0.226**	-0.123	-0.351**	0.001	0.002	-0.001
Crisis	0.049	0.139	-0.067	-0.001	0.000	-0.001
n	3629	2254	1375	3629	2254	1375
R^2	0.988	0.985	0.992	0.864	0.856	0.911

Notes: This table presents results from regressions using either the VIX or investor-sentiment (CFTC) level as the dependent variable. *DaysSinceMeeting* is the number of elapsed days since the previous scheduled FOMC meeting. *LagVIX* (*LagCFTC*) is the previous period's VIX (CFTC), which is the previous day for VIX and the previous week for CFTC. *SPReturn* is the day's S&P 500 return. *Month1Mom*, *Month2to6Mom*, and *Month7to12Mom* are the buy-and-hold returns to the S&P 500 in the past month, from month -6 through -2, and from month -12 through month -7, respectively. *MeetScheduled* is a dummy equal to 1 if the day is a scheduled FOMC meeting day and 0 otherwise. *Crisis* is a dummy variable equal to 1 if the economy is classified by the NBER as the recession period from the recent housing crisis (from December 2007 through June 2009) and 0 otherwise. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 4

Frequency of VIX Movement Relative to Rate Movement and Surprise

Panel A: VIX movements by interest rate movement

116 Scheduled FOMC meetings from January 1996–June 2010

	Rate Change < 0	Rate Change = 0	Rate Change > 0
VIX Fall Count	16	53	18
VIX Rise Count	10	13	6
Mean VIX Change	-0.722**	-0.666***	-0.567***
Median VIX Change	-0.320*	-0.670***	-0.495***

35 Scheduled FOMC meetings from March 2006–June 2010

	Rate Change < 0	Rate Change = 0	Rate Change > 0
VIX Fall Count	7	18	2
VIX Rise Count	5	2	1
Mean VIX Change	-1.601	-0.790	-0.573
Median VIX Change	-1.120	-0.850	-0.045

Panel B: VIX movements by interest rate surprise

116 Scheduled FOMC meetings from January 1996–June 2010

	Surprise < 0	Surprise = 0	Surprise > 0
VIX Fall Count	34	35	18
VIX Rise Count	8	14	7
Mean VIX Change	-0.851***	-0.463***	-0.705*
Median VIX Change	-0.935***	-0.470***	-0.770**

35 Scheduled FOMC meetings from March 2006–June 2010

	Surprise < 0	Surprise = 0	Surprise > 0
VIX Fall	12	13	2
VIX Rise	2	4	2
Mean VIX Change	-1.224	-0.714	-1.023
Median VIX Change	-1.120	-0.435	-0.245

Notes: This table presents frequencies of the occurrences of VIX declines and increases, relative to the type of interest rate movements, on scheduled FOMC meeting dates in Panel A. In Panel B, the frequencies of VIX declines and increases are segmented based on the type of Kuttner (2001) FOMC announcement surprise accompanying scheduled FOMC meetings, derived via Fed Funds futures prices. Mean and median VIX changes are reported for each category as well. The sample period ends in June 2010. Results are presented for the full sample, which begins with data availability in 1996, and the subsample, which begins with the start of tradable VIX options in March 2006. T-test results for the hypothesis of zero mean change and sign-rank test results for the hypothesis of zero median change are given for the full sample (but not the subperiod, for lack of statistical power). *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 5

VIX Option Returns on Scheduled FOMC Meeting Days

Panel A: Next Expiring Options	Long-put, MP	Long-put, BA	Short-call, MP	Short-call, BA
> 0 Return Frequency	24	16	30	22
= 0 Return Frequency	2	4	1	5
< 0 Return Frequency	9	15	4	8
Mean Return	0.220***	0.084*	0.172***	0.095***
t-stat	(3.95)	(1.71)	(6.23)	(2.74)
Median Return	0.150***	0.000	0.154***	0.077***
Panel B: 2nd Expiring Options	Long-put, MP	Long-put, BA	Short-call, MP	Short-call, BA
> 0 Return Frequency	23	14	26	19
= 0 Return Frequency	3	7	3	5
< 0 Return Frequency	9	14	6	11
Mean Return	0.123***	0.013	0.107***	0.040
t-stat	(3.09)	(0.35)	(4.74)	(1.66)
Median Return	0.097***	0.000	0.087***	0.023

Notes: This table presents results demonstrating the returns to VIX option holdings for the day of scheduled FOMC meetings beginning with the trading of VIX options in March 2006. The sample continues through June 2010. Panel A utilizes VIX options that are currently closest to expiration, with a minimum of one week remaining until that date. If less than one week remains until the next VIX option expires, the penultimate expiring option is used for the calculations of Panel A. The options expiring after the contract used for the calculation of Panel A are considered in Panel B. Options closest to at-the-money status on the day prior to the FOMC meeting are utilized. MP denotes option positions that are bought (sold) at the midpoint of the best-bid and best-ask price at the end of the day preceding the FOMC meeting (the day of each FOMC meeting). BA denotes positions executed while paying the bid-ask spread, i.e., puts (calls) are bought (sold) at the best-ask (best-bid) price at the end of the day preceding the FOMC meeting and sold (bought) at the best-bid (best-ask) price at the end of the day of the FOMC meeting. T-test results for the hypothesis of zero mean returns and sign-rank test results for the hypothesis of zero median returns are given. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 6

VIX Option Returns by Rate Changes and Surprises

Panel A: By Rate Change	Negative	Zero	Positive	
Long-put MP	0.209	0.210	0.331	
Long-put BA	0.082	0.069	0.207	
Short-call MP	0.153	0.178	0.179	
Short-call BA	0.103	0.112	0.070	
Number of Events	13	18	4	
Panel B: By Surprise	Negative	Zero	Positive	
Long-put MP	0.285	0.199	0.085	
Long-put BA	0.173	0.041	-0.047	
Short-call MP	0.193	0.159	0.158	
Short-call BA	0.094	0.091	0.112	
Number of Events	8	24	3	

Notes: This table presents results demonstrating the returns to VIX option holdings for the day of scheduled FOMC meetings beginning with the trading of VIX options in March 2006 and ending in June 2010 (this represents 35 meetings). Panel A presents results based on the type of interest rate change announced at the FOMC meeting. Panel B presents results based on the type of Kuttner (2001) interest rate change surprise accompanying scheduled FOMC meetings, derived via Fed Funds futures prices. Options closest to at-the-money status and nearest to expiration (with at least one week before expiration) are utilized. MP denotes option positions that are bought (sold) at the midpoint of the best-bid and best-ask price at the end of the day preceding the FOMC meeting (the day of the FOMC meeting). BA denotes positions executed while paying the bid-ask spread, i.e., puts (calls) are bought (sold) at the best-ask (best-bid) price at the end of the day preceding the FOMC meeting and sold (bought) at the best-bid (best-ask) price at the end of the day of the FOMC meeting.

TABLE 7

Returns of Shorting VIX Futures on Scheduled FOMC Meeting Days

Panel A: Next Expiring Futures	No TC	0.1% TC Per Transaction	0.5% TC Per Transaction
> 0 Return Frequency	36	36	30
≤ 0 Return Frequency	13	13	19
Mean Return	0.027***	0.025***	0.017**
t-stat	(4.05)	(3.75)	(2.55)
Median Return	0.023***	0.021***	0.014**

Panel B: 2nd Expiring Futures	No TC	0.1% TC Per Transaction	0.5% TC Per Transaction
> 0 Return Frequency	35	34	25
≤ 0 Return Frequency	14	15	24
Mean Return	0.018***	0.016***	0.008*
t-stat	(4.16)	(3.70)	(1.88)
Median Return	0.011***	0.009***	0.001

Notes: This table presents results demonstrating the returns to VIX futures shorting for the day of scheduled FOMC meetings, beginning with the trading of VIX futures in 2004. The sample continues through June 2010 (this represents 49 meetings). Panel A utilizes VIX futures that are currently closest to expiration, with a minimum of one week remaining until that date. If less than one week remains until the next VIX futures contract expires, the penultimate expiring future is used for the calculations of Panel A. The futures contract expiring after the contract used for the calculation of Panel A is utilized in Panel B. Raw return levels are presented, which implement no trading costs (TC) to the purchasing (selling) of VIX futures on the day preceding (of) a scheduled FOMC meeting. Alternatively, 0.1% and 0.5% trading costs are implemented on both the purchase and sale of VIX futures in order to calculate the one-day return of the futures positions. T-test results for the hypothesis of zero mean returns and sign-rank test results for the hypothesis of zero median returns are given. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 8

Short VIX Futures Returns by Rate Changes and Surprises

Panel A: By Rate Change	Negative	Zero	Positive	
Raw	0.044	0.029	0.018	
0.1% TC Per Transaction	0.042	0.027	0.016	
0.5% TC Per Transaction	0.034	0.019	0.008	
Number of Events	13	19	17	

Panel B: By Surprise	Negative	Zero	Positive	
Raw	0.046	0.021	0.025	
0.1% TC Per Transaction	0.044	0.019	0.023	
0.5% TC Per Transaction	0.036	0.011	0.015	
Number of Events	11	34	4	

Notes: This table presents results demonstrating the returns to short positions in VIX futures for the day of scheduled FOMC meetings, beginning with the trading of VIX futures in 2004. The sample continues through June 2010 (this represents 49 meetings). Panel A presents results based on the type of interest rate change announced at the FOMC meeting. Panel B presents results based on the type of Kuttner (2001) interest rate change surprise accompanying scheduled FOMC meetings, derived via Fed Funds futures prices. Futures nearest to expiration, with at least one week before expiration, are utilized. Results are presented based on no transaction costs (TC), a 0.1% transaction cost for both buying and selling futures, and a 0.5% transaction cost for both buying and selling futures.