



Institut canadien des dérivés
Canadian Derivatives Institute

L'Institut bénéficie du soutien financier de l'Autorité des marchés financiers ainsi que du ministère des Finances du Québec

Document de recherche

DR 23-01

Post-FOMC Announcement Reversal

Publié mai 2023

Ce document de recherche a été rédigée par :

Oleg Bondarenko, University of Illinois
Dmitriy Muravyev, Michigan State University

Post-FOMC Announcement Reversal[☆]

Oleg Bondarenko^a and Dmitriy Muravyev^{b,c}

This version: May 3, 2023

Abstract

Asset price behavior around monetary policy announcements, such as FOMC, provides important insights for macroeconomics and finance. The pre-FOMC announcement drift in the equity market is a prominent puzzle. We shed light on its mechanism by documenting the post-FOMC reversal – market returns have been particularly negative during the post-FOMC day in the last fifteen years. The pre-FOMC drift and the post-FOMC reversal add up to a zero total return. The zero average returns around FOMC are hard to reconcile with the risk premium and informed trading theories of the pre-FOMC drift but are consistent with the uninformed price pressure hypothesis.

JEL Classification: G12, G13, G14

Keywords: FOMC announcement, market risk premium, intraday data, pre-FOMC drift

[☆]We gratefully appreciate the financial support from the Canadian Derivatives Institute (CDI) research grant. We are responsible for all remaining errors.

^a Department of Finance, University of Illinois at Chicago, 601 S. Morgan St., Chicago, IL 60607. Tel.: +1 (312) 996-2362. E-mail: olegb@uic.edu

^b Department of Finance, Michigan State University, Eppley Center, 667 North Shaw Lane, East Lansing, MI 48824. E-mail: muravyev@msu.edu

^c Associate Fellow, Canadian Derivatives Institute

1. Introduction

The Federal Open Market Committee (FOMC) is responsible for setting monetary policy in the United States. The FOMC meets eight times a year to discuss economic conditions and determine the appropriate stance of monetary policy. Markets routinely forecast the content of FOMC announcements, which reveal the Fed's new target interest rates, and usually react when the Fed does not act as expected. Market reaction to FOMC announcements identifies the effect of monetary policy shocks on market prices and beliefs about the economy (e.g., Bernanke and Kuttner (2005), Nakamura and Steinsson (2018a, 2018b)). Indeed, stock market volatility and volume spike on FOMC announcements and remain high until the close on that day while investors process the released information.

The equity market behavior before FOMC announcements is particularly puzzling. Lucca and Moench (2015) document the pre-FOMC drift — market returns are large (0.49% per event) in the 24-hour window before the FOMC announcement, which makes up “about 80% of annual realized excess stock returns.” Two other empirical regularities deepen the puzzle. First, the market is less active and less volatile before the announcement, which implies that investors are not getting much new information or facing much realized risk pre-FOMC. Second, the pre-FOMC market return does not predict the Fed's surprises.

Multiple theories have been suggested to explain the pre-FOMC drift. Ai and Bansal (2018) argue that macro news should carry a sizable risk premium under certain risk preferences. Hu, Pan, Wang, and Zhu (2022) argue that information uncertainty is being resolved before FOMC, hence positive returns. Han, Ai, and Bansal (2021) and Ying (2020) argue that asymmetric information and informed trading pre-FOMC explain the drift. While these theories propose distinct mechanisms, they all agree that the returns from the pre-FOMC drift should be permanent and not reverse post-FOMC.

We document a novel empirical fact about market returns around FOMC announcements that is hard to reconcile with these theories. Specifically, returns for E-mini S&P 500 futures are abnormally negative on average, -0.31% per event, during the post-FOMC day in our sample period from September 2005 to June 2022. This negative return, which we call the post-FOMC reversal, is economically and statistically significant. The pre-FOMC drift is 0.30% during our sample, which almost exactly matches the post-FOMC reversal but with the opposite sign. Thus,

the pre-FOMC drift and post-FOMC reversal returns add up to zero around FOMC. Also, the pre- and post-FOMC returns are negatively correlated at the annual level.

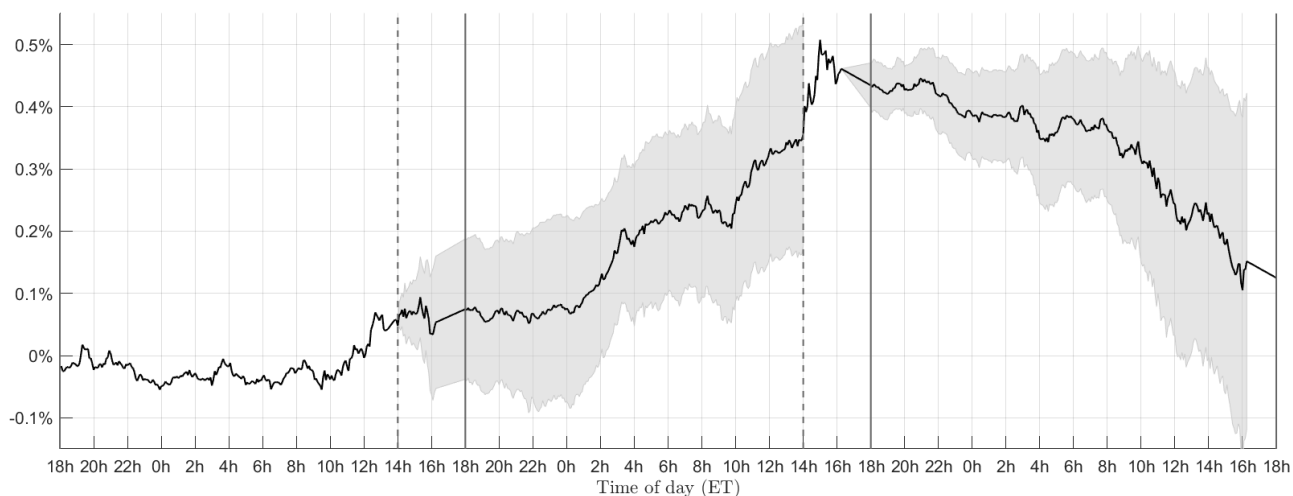


Figure 1. Cumulative returns for S&P 500 index E-mini futures over the three days around the FOMC announcement. FOMC news is released at 2:00 pm in the middle day. The pre-FOMC drift is measured in the 24-hours preceding the announcement, which are marked with dashed lines. The post-FOMC reversal is measured in the 24-hours starting from market close on the FOMC day. Grey areas denote the 95% confidence intervals for the pre-FOMC drift and post-FOMC reversal cumulative returns.

We confirm the strong relationship between the pre-FOMC drift and post-FOMC reversal in other major futures markets besides S&P 500 futures. We discover that markets that do not experience the pre-FOMC drift, such as interest rate futures, also do not show the post-FOMC reversal. On the other hand, the markets that witness the pre-FOMC drift, such as commodity and international index futures, display the post-FOMC reversal. The correlation between pre- and post-FOMC returns across futures markets is -0.91. In general, the pre-FOMC drift goes hand in hand with the post-FOMC reversal.

The pre-FOMC drift and the post-FOMC reversal cancel out resulting in the zero overall return around FOMC announcements. This finding is hard to reconcile with the common theories of the pre-FOMC drift because these theories expect that price appreciation from the pre-FOMC drift should last. Information risk premium (Ai and Bansal (2018) and Cocoma (2022)), uncertainty resolution (Hu et al. (2022)), and informed trading (Han, Ai, and Bansal (2021) and Ying (2020)) imply that the positive pre-FOMC returns should not go away the next day, but they do revert in the data. Our findings are more in line with the price pressure hypothesis. Once Lucca and Moench (2015) made the pre-FOMC drift strategy famous, it drew uninformed investors, who buy the index before the FOMC announcement creating the positive pre-FOMC drift, and then this

uninformed price pressure goes back the next day causing the post-FOMC reversal. Consistent with this explanation, the positive pre-FOMC returns and negative post-FOMC returns match particularly well after the end sample in Lucca and Moench (2015). Our results are also consistent with Dor and Rosa (2019) and Kurov, Wolfe, and Gilbert (2021), who find that the pre-FOMC drift became much weaker recently. Boguth, Grégoire, and Martineau (2019) show that the pre-FOMC drift is concentrated on the FOMC announcements that are accompanied by a press conference. This regularity does not affect our results because almost all FOMC announcements are accompanied by a press conference during our sample.

The paper is organized as follows. Section 2 describes the data. Section 3 explores returns around FOMC announcements. Section 4 concludes.

2. Data

The data for FOMC announcement dates and times are exported from Bloomberg, we then confirm them with the FOMC calendar on the Federal Reserve website. We only study preschedule announcements (the Fed had to make several unscheduled rate decisions during the 2008 crisis).

Our main analysis is based on E-mini S&P 500 futures (ticker ES) traded on CME. The data include one-minute price bars obtained from FirstRate Data, a provider that specializes in intraday futures data. Price bars are standard and include open, high, low, and close prices inferred from futures trades as well as the number of futures contracts traded. The data span the period from September 2005 to June 2022. We use data for the front-month contract until it reaches two days to expiration and then switch to the next available contract. We exclude days when the market is closed or when the trading session is cut short due to a US holiday.

We compute five-minute log returns, using the last price for every five-minute interval. Log returns can easily be aggregated to any required horizon. For robustness, we confirm that our results are similar if we use simple returns instead of log returns. Futures returns are already in excess of the risk-free rate, and they already account for the dividends paid by S&P 500 index.

The notional value of E-mini S&P 500 futures contract is \$50 times the value of the S&P 500 stock index or about \$90,000 exposure per contract during our sample. The E-mini S&P is the most important contract linked to the S&P 500 index due to its high liquidity and embedded leverage. Other S&P 500 alternatives are less popular. The SPDR S&P 500 ETF, or SPY, was launched in 1993 and currently boasts \$260 billion AUM. In 2012, the E-mini S&P traded \$142

billion per day versus \$18.5 billion for SPY. Regular, or “big,” S&P 500 futures (ticker SP) were popular until the early 2000s but rarely trade now. Other popular index futures contracts, such as E-mini Nasdaq 100 and E-mini DJIA are less liquid.

Currently, the E-mini contract trades 22:45 hours a day, 5 days a week. CME comes online on Sunday at 6:00 pm and closes on Friday at 5:00 pm ET. The continuous trading session spans from 6:00 pm to 4:15 pm the following day, followed by a 15-minute trading halt from 4:15 to 4:30 pm and a 30-minute trading session from 4:30 to 5:00 pm. Our empirical analysis covers the entire 24-hour day.

We extend our main analysis to other futures including on VIX (ticker VX), Euro STOXX 50 (FX), gold (GC), silver (SI), crude oil (CL), Brent oil (BZ), soybean (ZS), Euro (E6), US dollar index, (DX) yen (J1), Eurodollar (ED), 2-year Treasury note (ZT), 10-year Treasury note (ZN). These futures all trade on CME over the same continuous trading session as E-mini futures. Some of these futures were launched by CME more recently and, for each contract, we use all available history.

3. Results

FOMC announcements are typically made eight times per year on Wednesdays right after 14:00 EST. Following the literature, we only consider pre-scheduled FOMC announcements for which the date is known in advance. Due to the availability of intraday data from the data provider our sample starts in September 2005 and ends in May 2022. This period includes 132 FOMC events after we exclude a clear outlier on 2008/10/29.¹

We begin with a brief analysis of trading activity and volatility around the FOMC announcements. Figure 2 shows trading activity in the number of futures contracts traded per minute in the top panel and annualized realized volatility in the bottom panel. The patterns are similar for volatility and volume as the two variables are highly correlated. Volatility and especially volume are low outside of regular trading hours. The pre- and post-FOMC days show a regular U-shaped pattern where volatility and volume spike at the open at 9:30 am then slowly

¹ S&P 500 increased by 14% in the last two hours on 2008/10/28, which is the pre-FOMC day. This jump had nothing to do with FOMC announcement the next day, but we would have to include it as part of the pre-FOMC drift that is computed over 24-hour pre-FOMC window that includes the last two trading hours on the pre-FOMC day. After excluding this outlier, the maximum pre-FOMC return is 4.8% and the minimum is -2.6%.

decreases reaching a local low around mid-day and then start increasing peaking at 16:00, end of regular trading in the underlying equity market.

Trading activity on FOMC days is special in several ways. Volatility and volume are lower than usual before the announcement. They then expectedly jump on the announcement at or shortly after 14:00. Volume and volatility remain elevated until the close. Investors are trying to figure out the future monetary policy paths by studying the press release, listening to the post-announcement press conference, and observing trading by others. The post-FOMC day looks normal in terms of trading activity, so most of the FOMC-related information is reflected before the close on the FOMC day.

We split two days around FOMC announcements into four intraday subperiods: 24-hour pre-FOMC, initial reaction, subsequent reaction, and post-FOMC day periods. These four periods are motivated by the trading activity analysis. We mainly focus on the 24-hour pre- and post-FOMC periods, but the average returns in a short announcement window are important for understanding FOMC risk premium. Following the literature, we define the pre-FOMC period as 24-hours from 14:00 on the pre-FOMC day to 13:50 on the FOMC day. We leave ten minutes out to allow for the uncertainty of announcement timing. The market reacts instantly to the announcement, and we measure this initial reaction from 13:50 to 14:10. After the initial reaction, trading activity remains elevated until the end of regular trading at 16:15. Finally, the post-FOMC period runs from the close of regular trading at 16:15 until the close at 16:15 on the post-FOMC day.

Table 1 reports average S&P 500 excess returns during these intraday periods and compares returns on FOMC days with all other days. We first confirm the pre-FOMC drift in our sample. The pre-FOMC drift return is 0.30% in our sample with a t -statistic of 3.20. The pre-FOMC drift is lower in our sample than the 0.49% that Lucca and Moench (2015) found. Their sample ends in March 2011, so most of our results are out-of-sample relative to the original paper. Average returns over the same 14:00-to-13:50 window on non-FOMC days are only 0.02%, much lower than on FOMC days and the difference is highly significant with t -statistics of 2.91.

The initial and subsequent reactions to FOMC are positive with 0.055% and 0.06% average returns and t -statistics of 2.55 and 0.62, respectively. The time window covers the intraday period from right before the announcement (13:50) until the market close (16:15) when trading activity

and volatility revert to normal indicating that the announcement information was processed. A 0.11% cumulative average return can be thought of as monetary announcement risk premium.

The post-FOMC day returns are -0.31% on average with *t*-statistics of -2.26. The returns on the post-FOMC days are also significantly lower than on an average day (-0.35% with a *t*-statistic of -2.53). This post-FOMC reversal matches the pre-FOMC as they add up to -0.006%. Thus, excluding an intraday window around the announcement, the cumulative return is zero.

We further explore the relationship between the pre-FOMC drift and the post-FOMC reversal. Table 2 compares returns for pre-FOMC, FOMC, and post-FOMC periods by year. The pre-FOMC and FOMC returns are positive in 12 and 13 years out of 18, respectively, while the post-FOMC return is negative in 13 years. The pre- and post- returns have the opposite signs in 13 years. The correlation between annual pre- and post-FOMC returns is -0.39. These results suggest that the pre-FOMC drift and the post-FOMC reversal are consistent and negatively related. The correlation is much stronger (-0.83) post-2011 right after the end of the sample in Lucca and Moench (2015). Interestingly, the correlation between the pre-FOMC return and the announcement return is negative (-0.47), which is consistent with the hypothesis that the pre-drift doesn't positively predict announcement surprise.

Figure 3 provides further details by documenting the time series of individual returns. The top panel shows post-FOMC returns accompanied by their two-year moving average. The bottom panel shows the pre-FOMC returns, which are especially positive during the 2008 financial crisis. The individual returns are quite volatile, but their moving averages show that the pre- and post-FOMC returns move similarly.

The analysis of returns from other major futures markets besides E-mini S&P 500 futures further supports the relationship between the pre-FOMC drift and the post-FOMC reversal. For this analysis, we use data from the same data provider that includes futures on VIX (ticker VX), Euro STOXX 50 (FX), gold (GC), silver (SI), crude oil (CL), Brent oil (BZ), soybean (ZS), Euro (E6), US dollar index, (DX) yen (J1), Eurodollar (ED), 2-year Treasury note (ZT), 10-year Treasury note (ZN). These contracts cover equity, commodity, currency, and interest rate asset class.

Table 3 reports pre-FOMC, FOMC, and post-FOMC for each market. For VIX futures the effect is flipped due to the leverage effect as volatility increases when the market declines. For

crude oil, the pre-drift and the reversal are 0.24% and -0.32% respectively. There is no pre-FOMC drift and the reversal for interest rate futures, which is consistent with the prior literature.

Figure 4 shows the scatter plot of pre- and post-returns across markets with each observation being a separate market. Evidence from other major futures markets confirms that the post-FOMC reversal matches the pre-FOMC drift. Figure 4 shows the slope of -1.01 (almost exactly -1) and cross-market R^2 is 84%. There is no pre-drift and post-reversal in fixed-income futures, but both are present in the other futures markets.

What do these results mean? Multiple theories have been suggested to explain the pre-FOMC drift puzzle. Ai and Bansal (2018) argue that macro news should carry a sizable risk premium under certain risk preferences. Hu, Pan, Wang, and Zhu (2022) argue that information uncertainty is being resolved before FOMC, hence positive returns. Han, Ai, and Bansal (2021) and Ying (2020) argue that asymmetric information and informed trading pre-FOMC explain the drift. While these theories propose distinct mechanisms, they all agree that the returns from the pre-FOMC drift should be permanent and not reverse post-FOMC.

In contrast to the key prediction of these theories, we find that the pre-FOMC drift is transitory, and the positive returns are reversed on average the next day. Thus, our results make the pre-FOMC drift even more puzzling by rejecting the existing theories. We suggest a price pressure explanation for the drift that is potentially consistent with the empirical regularities. The transitory nature of the price runup can suggest that the buying pressure before FOMC meetings is uninformed. Interestingly, Lucca and Moench (2015) find no reversal in their sample period that ends in 2011, while we find a strong reversal especially post-2011. This observation could suggest that once Lucca and Moench (2015) made the pre-FOMC drift strategy, it drew uninformed investors, who buy the index before the FOMC announcement creating the positive pre-FOMC drift, and then this uninformed price pressure goes back the next day causing the post-FOMC reversal. While the price pressure hypothesis seems more successful than the conventional theories at explaining the price dynamics around the FOMC announcements, it does not explain the facts perfectly. More research is needed to solve the FOMC price puzzle. We add an important empirical fact for future theories to consider.

4. Conclusion

In this paper, we document a novel empirical fact about market returns around the FOMC announcements. The pre-FOMC drift is positive while the post-FOMC reversal is equally negative so that the total return around FOMC is a noisy zero. This result is hard to reconcile with the conventional theories of the pre-FOMC drift, including information risk premium, uncertainty resolution, and informed trading. These theories argue that the pre-FOMC returns must be permanent. Our results are most consistent with price pressure from uninformed investors before the announcements, which subsequently gets reversed causing the post-FOMC reversal. Overall, our results contribute to the debate on the effect of macroeconomic and monetary policy announcements on financial markets.

References

- Ai, H. and Bansal, R., 2018. Risk preferences and the macroeconomic announcement premium. *Econometrica*, 86(4), pp.1383-1430.
- Bernanke, B.S. and Kuttner, K.N., 2005. What explains the stock market's reaction to Federal Reserve policy? *The Journal of Finance*, 60(3), pp.1221-1257.
- Cocoma, P., 2018. Explaining the pre-announcement drift. Available at SSRN 3014299.
- Dor, A.B. and Rosa, C., 2019. The pre-FOMC announcement drift: an empirical analysis. *The Journal of Fixed Income*, 28(4), pp.60-72.
- Gu, C., Kurov, A. and Wolfe, M.H., 2018. Relief rallies after FOMC announcements as a resolution of uncertainty. *Journal of Empirical Finance*, 49, pp.1-18.
- Han, L.J., Ai, H. and Bansal, R., 2021. Information acquisition and the pre-announcement drift. Available at SSRN 3964349.
- Hu, G.X., Pan, J., Wang, J. and Zhu, H., 2022. Premium for heightened uncertainty: Explaining pre-announcement market returns. *Journal of Financial Economics*, 145(3), pp.909-936.
- Kurov, A., 2010. Investor sentiment and the stock market's reaction to monetary policy. *Journal of Banking & Finance*, 34(1), pp.139-149.
- Laarits, T., 2019. Pre-announcement risk. NYU Stern School of Business.
- Lucca, D.O. and Moench, E., 2015. The pre-FOMC announcement drift. *The Journal of Finance*, 70(1), pp.329-371.
- Nakamura, E. and Steinsson, J., 2018. Identification in macroeconomics. *Journal of Economic Perspectives*, 32(3), pp.59-86.
- Nakamura, E. and Steinsson, J., 2018. High-frequency identification of monetary non-neutrality: the information effect. *The Quarterly Journal of Economics*, 133(3), pp.1283-1330.
- Ying, C., 2020. The Pre-FOMC Announcement Drift and Private Information: Kyle Meets Macro-Finance. Available at SSRN 3644386.

Table 1**Average returns around FOMC days versus non-FOMC days**

This table reports average E-mini S&P futures returns for four periods around FOMC: the 24-hour pre-FOMC window corresponding to the pre-FOMC drift from 14:00 to 13:50, the 20-minute announcement window from 13:50 to 14:10, the post-announcement window before the close from 14:10 to 16:15, and the next-day 24-hour reversal from 16:15 till 16:15 the next day. We report returns for the same four periods on non-FOMC (all other) days, and the last two columns formally compare average returns on FOMC and non-FOMC days. Returns are in percentage (e.g., 0.298 is 0.298%). The table reports regular regressions of return on the intercept with robust standard errors.

Label	Return period	FOMC (132 obs.)		non-FOMC (4,190 obs.)		FOMC - non-FOMC	
		Average	T-stat	Average	T-stat	Difference	T-stat
Pre-FOMC drift	14:00(-1)-13:50	0.298	3.20	0.021	0.96	0.277	2.91
Announcement	13:50-14:10	0.055	2.55	-0.007	-2.30	0.062	2.84
Announ. reaction	14:10-16:15	0.060	0.62	0.025	2.10	0.035	0.36
Post-FOMC reversal	16:15-16:15(+1)	-0.310	-2.26	0.040	1.75	-0.350	-2.53

Table 2**Average returns on FOMC days by year**

We compute average returns for all FOMC announcements in a year (typically eight per year).

The bottom of the table reports correlations across returns for the three intraday periods.

Returns are in percentage (e.g., 0.174 is 0.174%).

	Pre-FOMC 14:00 (-1)- 13:50 (1)	FOMC 13:50- 14:10 (2)	Post-FOMC 16:15- 16:15(+1) (3)
2005	0.086	0.008	0.174
2006	0.240	0.056	-0.081
2007	0.862	0.000	-0.036
2008	1.009	-0.015	-1.314
2009	2.094	-0.082	-0.552
2010	-0.676	0.040	-0.511
2011	-0.035	-0.014	-1.229
2012	0.649	-0.069	-0.396
2013	-0.013	0.170	-0.254
2014	-0.202	0.139	0.405
2015	0.066	0.218	-0.258
2016	0.098	0.130	0.154
2017	0.067	0.084	-0.103
2018	0.236	-0.075	-0.474
2019	-0.092	0.135	0.284
2020	0.555	0.049	-1.052
2021	-0.133	0.095	0.240
2022	0.948	0.144	-0.778
	(1)-(2)	(2)-(3)	(1)-(3)
Correlation	-0.470	0.398	-0.386

Table 3**Average returns on FOMC days by year**

We compute average returns for the three intraday subperiods around FOMC announcements across major futures markets. The three intervals include 24 hours before the announcement, 20 minutes around it, and 24 hours after the market closes on the announcement day. We use the same intervals for all markets in Eastern Standard Time. Returns are in percentage (e.g., 0.298 is 0.298%).

Futures Market	Ticker	pre-FOMC		FOMC	post-FOMC
		14:00(-1)	-13:50	13:50-14:10	16:15-16:15(+1)
S&P 500	ES		0.298	0.055	-0.310
VIX	VX		-0.416	-0.128	0.278
Euro STOXX 50	FX		0.410	0.074	-0.556
Gold	GC		0.049	0.037	-0.166
Silver	SI		0.156	0.079	-0.468
Crude Oil	CL		0.237	0.032	-0.324
Brent Oil	BZ		0.313	0.104	-0.321
Soybean	ZS		0.056	0.039	-0.125
Euro	E6		0.127	-0.003	-0.073
US Dollar Index	DX		-0.115	0.002	0.093
Yen	J1		-0.085	-0.012	0.024
Eurodollar	ED		0.003	0.001	0.001
2-Year Treasury Note	ZT		-0.007	0.000	0.007
10-Year Treasury Note	ZN		-0.021	-0.001	0.044

Figure 2

Trading volume and volatility around FOMC announcements

The figure shows trading activity and volatility on the pre-FOMC, FOMC, and post-FOMC days. The top panel shows trading volume in contracts per minute. The bottom panel shows annualized realized volatility. Trading activity is elevated during regular trading hours from 9:30 to 16:15 EST. E-mini futures are open for trading for almost 24 hours but have a technical break between 16:15 and 18:00. Activity spikes at the second dashed line that denotes FOMC announcement time at 14:00. Occasionally, the news is released a few minutes after the official time, which is why volatility reaches a maximum after 14:00.

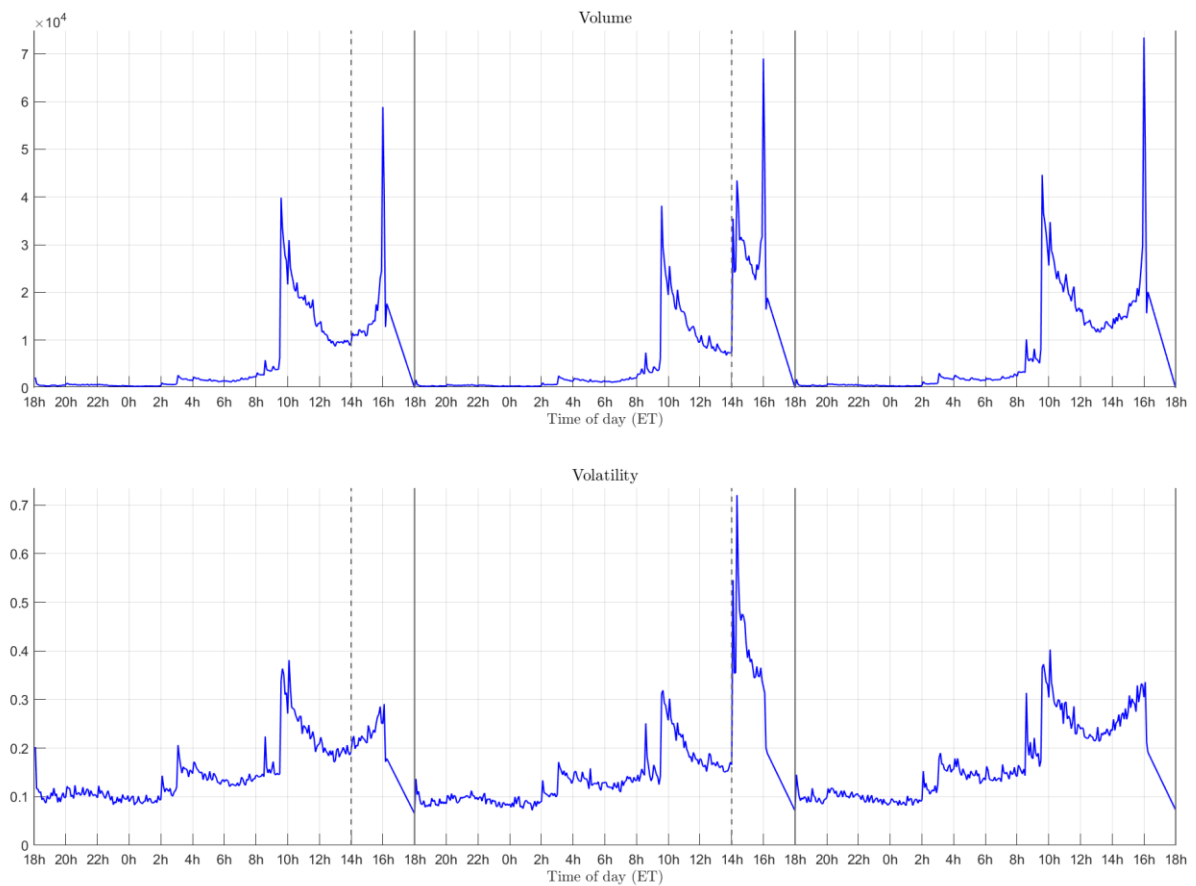


Figure 3
Pre- and post-FOMC returns over time.

The figure shows how the pre-FOMC drift matches the post-FOMC reversal over time. The bottom panel reports returns for the pre-FOMC period from 14:00 the previous day to 13:50 on the announcement day. The top panel reports returns for the post-FOMC period from 16:15 on the announcement day until 16:15 the next day. Blue bars report returns for individual announcements (typically eight per year), while the green line reports a two-year moving average.

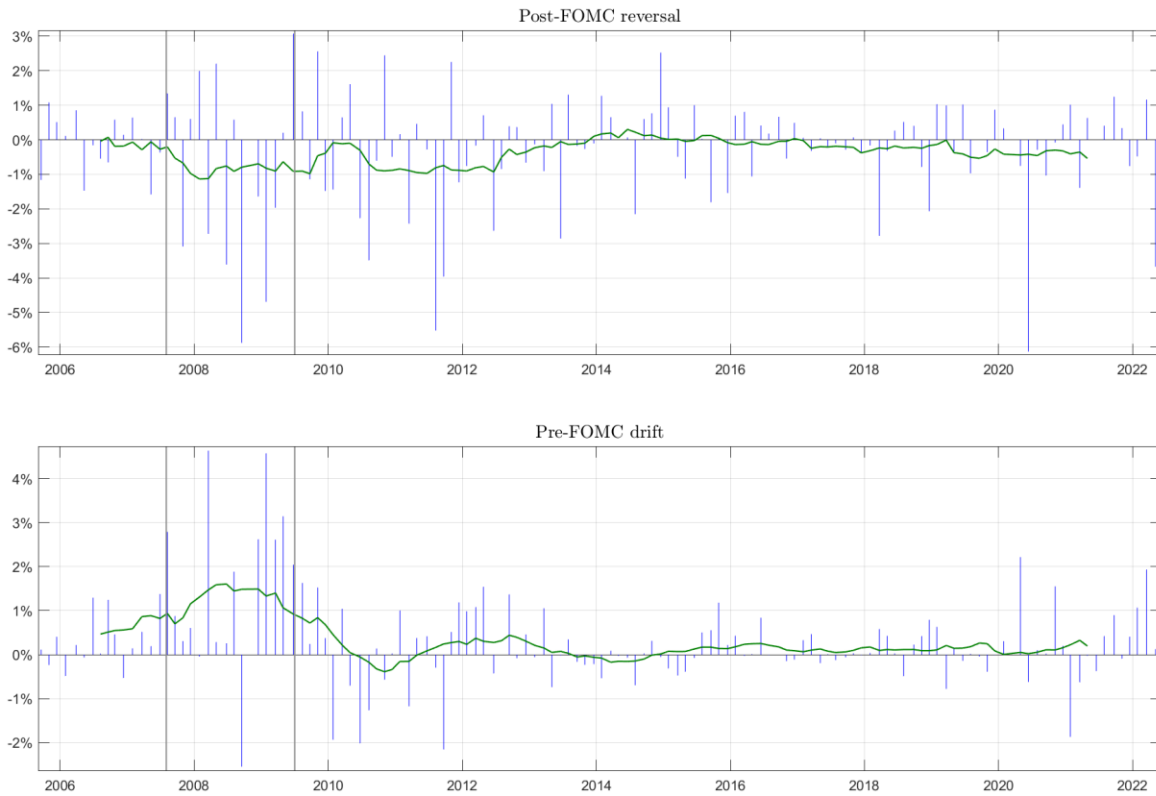


Figure 4

Average returns pre and post FOMC announcements across different futures markets.

The figure shows a negative relationship between the pre-FOMC drift and the post-FOMC reversal across major futures markets. Pre-FOMC return is for the 24-hour window preceding the announcement (14:00 to 13:50). Post-FOMC return is from the close of the announcement day until the close the next day (16:15 to 16:15). Returns are in percentage (e.g., 0.3 is 0.3%). We also report the regression line with the estimated equation and R-squared. The futures include S&P 500 (ES), VIX (VX), Euro STOXX 50 (FX), gold (GC), silver (SI), crude oil (CL), Brent oil (BZ), soybean (ZS), Euro (E6), US dollar index, (DX) yen (J1), Eurodollar (ED), 2-year Treasury note (ZT), 10-year Treasury note (ZN).

