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MONETARY MOMENTUM

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ABSTRACT

We document a large return drift around monetary policy announcements by the Federal Open Market Committee (FOMC). Stock returns start drifting up 25 days before expansionary monetary policy surprises, whereas they decrease before contractionary surprises. The cumulative return difference across expansionary and contractionary policy decisions amounts to 2.5% until the day of the policy decision and continues to increase to more than 4.5% 15 days after the meeting. Standard returns factors and time-series momentum do not span the return drift around FOMC policy decisions. The return drift is a market-wide phenomenon and holds for all industries and many international equity markets. A simple trading strategy exploiting the drift around FOMC meetings increases Sharpe ratios relative to a buy-and-hold investment by a factor of 4.

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I Introduction

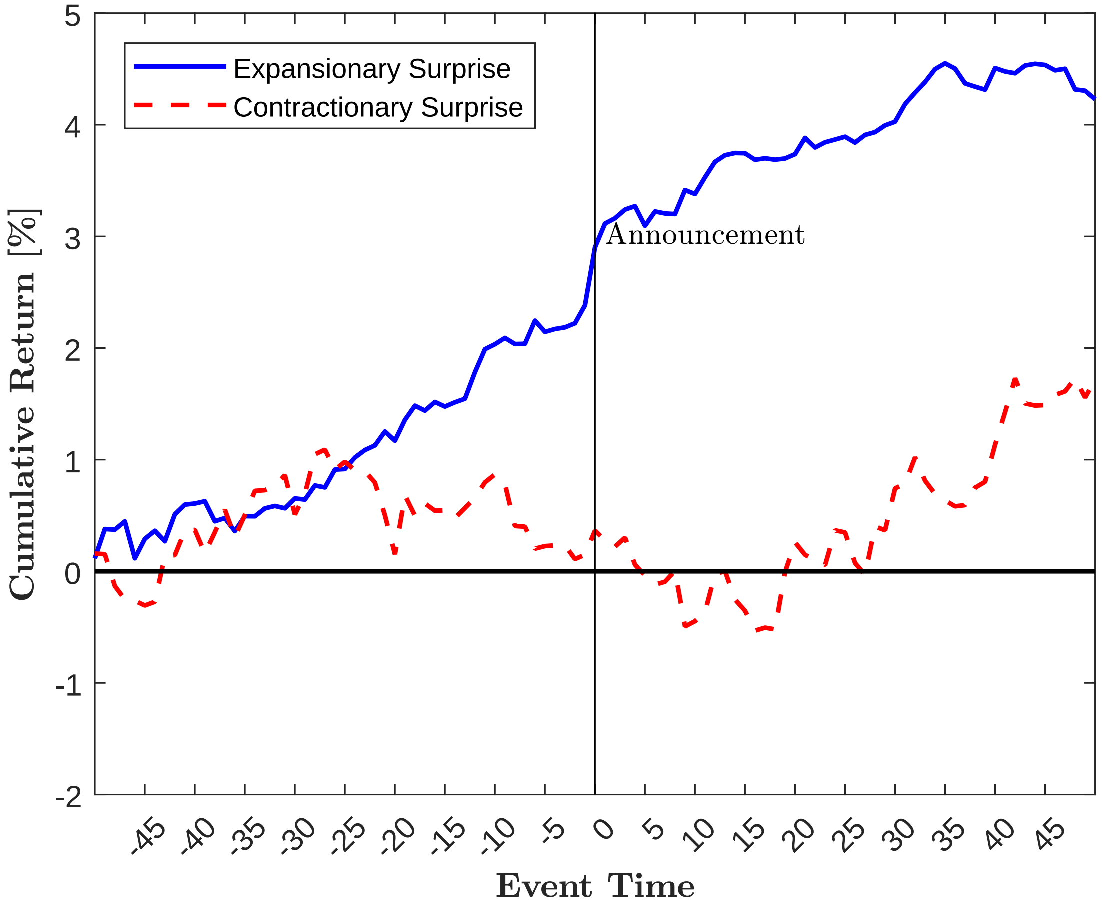
Figure 1 documents a novel fact for stock returns around monetary policy decisions by the Federal Open Market Committee (FOMC): starting around 25 days before the FOMC meeting, returns of the Center for Research in Security Prices (CRSP) value-weighted index drift upwards before expansionary monetary policy decisions (lower-than-expected federal funds target rates) and drift downwards before contractionary policy decisions. The difference in returns between expansionary and contractionary policy surprises amounts to 2.5% until the day before the announcement. On the day before the announcement, returns drift upwards independent of the direction of the monetary policy surprise, which is the pre-FOMC announcement drift of Lucca and Moench (2015). Around the announcement, contractionary monetary policy surprises result in negative returns, and expansionary surprises result in an increase in returns, consistent with a large literature, such as Bernanke and Kuttner (2005). Returns, however, continue to drift in the same direction for another 15 days, which – together with the long pre-drift – is the novel fact we document in this paper. The continuation in returns is surprising, because the trading signal it builds on is publicly observable. On average, the difference in the drift from before until after the announcement across contractionary and expansionary surprises amounts to around 4.5%, which is large relative to an annual equity premium of 6%. We label the return drift around monetary policy decisions *monetary momentum.*[1]

Our findings have important implications for policy and research. First, a recent literature studies the effect of monetary policy on asset prices, using narrow event windows of 30 or 60 minutes around FOMC policy decisions to obtain identification. The large drift before and after FOMC decisions suggests researchers might underestimate the effect of monetary policy on asset prices by restricting attention to narrow event windows. Second, the magnitude of the drift around FOMC decisions suggests asset-pricing theories that aim to understand the unconditionally large excess returns of stocks relative to bonds should focus on channels through which monetary policy and asset markets interact. Third, the pre-drift around FOMC decisions implies "surprise changes" in target rates

[1] We do not report standard-error bands in the figures but evaluate statistical significance in regressions later in the paper.

might partially be predictable, which has important implications for the large literature in macroeconomics and monetary economics that tries to understand the real effects of *exogenous* monetary policy *shocks* on real consumption, investment, and GDP.

Figure 1: **Cumulative Returns around FOMC Policy Decisions**



This figure plots cumulative returns in percent around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

The differential drift around contractionary and expansionary FOMC announcements is a robust feature of the data and holds for samples with or without intermeeting policy decisions (policy decisions on unscheduled FOMC meetings), with or without turning points in monetary policy (changes in the federal funds target rate in the direction opposite to the previous move), or how we treat zero-changes in the federal funds target rate (FOMC meetings on which the target rate does not change).

Our baseline sample runs from 1994, when the FOMC started issuing press releases after meetings and policy decisions, until 2009, the start of the binding zero-lower-bound (ZLB) period. Our results continue to hold when we stop our sample in 2004, as in Bernanke and Kuttner (2005).

We define expansionary and contractionary monetary policy shocks using federal funds futures (Kuttner (2001) surprises). Lower-than-expected federal funds target rates (expansionary monetary policy surprises) do not necessarily coincide with cuts in the target rate. The market might assign a probability of less than 100% to a cut in target rates, and we would measure expansionary surprises whenever the FOMC indeed lowers target rates. But we would also measure an expansionary monetary policy surprise if the market assigns a positive probability to a tightening in target rates that does not materialize. We do not find similar return drifts when we sort on raw changes in the target rate. Instead, the FOMC seems to increase rates following positive stock returns and cut rates after negative stock returns.

Market participants cannot observe whether target-rate changes are expansionary or contractionary according to our definition until after the actual change in target rates. We show that the differential drift following expansionary versus contractionary policy shocks is still economically large and statistically significant when we start the event window on the *day after* the FOMC policy decision.

The pre- and post-drifts are largely a market-wide phenomenon. We do not find similar returns drifts around FOMC announcements for cross-sectional return premia, such as size, value, profitability, or investment, because all portfolios tend to drift in the same direction. Momentum is an exception: momentum returns are flat around FOMC announcements for expansionary monetary policy surprises. For contractionary surprises, however, we find an upward drift in momentum returns starting 15 days before the FOMC meeting and continuing for another 15 days subsequent to the target-rate decision. Within this 30 day trading period, momentum earns an excess return of 4%. When we decompose momentum into winners and losers, we see a flat momentum return around expansionary monetary policy shocks, because both winners and losers appreciate in lock-step. Instead, for contractionary monetary policy shocks, past losers drop by 5% within days, whereas past winners appreciate slightly. This differential behavior around contractionary surprises holds for the full sample, but also for a sample ending in 2004, and hence, a momentum crash cannot explain this pattern (see Daniel and Moskowitz (2016)).

We find drift behavior similar to the drift for the overall market at the industry level when we study returns following the Fama & French 17-industry classification with a return-drift difference of around 4% around expansionary versus contractionary monetary policy surprises. *Machinery* is an exception, with a return drift of almost 8%, and *Mining*, with no differential return drift at all because mining stocks appreciate following contractionary monetary policy.

The return drift is not contained to the United States, but also occurs in international equity markets. We find a differential return drift for benchmark equity indexes around U.S. monetary policy decisions for Germany, Canada, French, Spain, Switzerland, and the U.K. with magnitudes that are comparable to the pattern in the United States. Japan is an exception, because returns are flat for both U.S. contractionary and expansionary monetary policy surprises similar to the non-existent pre-FOMC announcement drift for Japan in Lucca and Moench (2015).

We compare the Sharpe ratios of monetary momentum strategies with the Sharpe ratios of a buy-and-hold investor to gauge the economic significance of the return drift around FOMC meetings. We find increases in Sharpe ratios by a factor of four for a simple monetary momentum strategy that investors can implement in real time. We also find standard return factors cannot span our monetary momentum strategy with a large unexplained return of 9.6% per year. Recently, Moskowitz, Ooi, and Pedersen (2012) popularized time-series momentum strategies. We show time-series momentum and monetary momentum are economically two separate phenomena.

Predictability and persistence in the monetary policy shocks themselves might drive the return drift we uncover. We find expansionary surprises follow contractionary and expansionary surprises with equal probabilities, and the sign of past surprises cannot predict the sign of current surprises. These patterns in policy surprises mean persistent shocks and predictability in monetary policy decisions are unlikely to explain our results.

Another possible explanation might be state dependence of monetary policy shocks.

The FOMC might surprisingly cut rates in times of high risk or risk aversion, which could possibly explain the upward drift around events we associate with expansionary shocks. However, we also find equal probabilities of observing expansionary or contractionary surprises in times of high and low economic uncertainty as measured by the VIX.

Ultimately, and similarly to many important findings in empirical asset pricing, such as time-series momentum or the pre-FOMC announcement drift only to name few, what explains the patterns we document in the data remains an open question that we leave to future research.

A. Related Literature

A large literature at the intersection of macroeconomics and finance investigates the effect of monetary policy shocks on asset prices in an event-study framework. In a seminal study, Cook and Hahn (1989) use daily event windows to examine the effects of changes in the federal funds rate on bond rates using a daily event window. They show that changes in the federal funds target rate are associated with changes in interest rates in the same direction, with larger effects at the short end of the yield curve. Bernanke and Kuttner (2005)—also using a daily event window—focus on unexpected changes in the federal funds target rate. They find that an unexpected interest-rate cut of 25 basis points leads to an increase in the CRSP value-weighted market index of about 1 percentage point. Gürkaynak, Sack, and Swanson (2005) focus on intraday event windows and find effects of similar magnitudes for the S&P500. They argue that two factors, a target and path factor, are necessary to describe the reaction of notes with up to ten-year maturity to monetary policy shocks. Boyarchenko, Haddad, and Plosser (2017) extend the heteroskedasticity-based identification of Rigobon and Sack (2003) and also argue that two shocks best describe the reaction of financial instruments across a wide range of asset markets: a conventional monetary policy shock and a confidence shock. Leombroni, Vedolin, Venter, and Whelan (2016) decompose monetary policy shocks into a target and communication shock, and find the latter is the main driver of yields around policy decisions. Neuhierl and Weber (2017) show the whole future path of monetary policy matters for the association between stock returns and federal funds rate changes. Boguth, Grégoire, and Martineau

(2017) show that the market expects monetary policy actions in recent years only on FOMC meetings with subsequent press conferences. Ozdagli and Weber (2016) use spatial autoregressions to decompose the overall response of stock returns to monetary policy surprises into direct demand effects and higher-order network effects, and find that more than 50% of the overall market response comes from indirect effects. Fontaine (2016) estimates a dynamic term-structure model and finds that uncertainty about future rate changes is cyclical. Law, Song, and Yaron (2018) document cyclical variation in the sensitivity of stock returns to monetary policy shocks. Ozdagli and Velikov (2017) use observable firm characteristics to construct a monetary policy exposure index to measure a monetary policy risk premium from the cross section of stock returns. Drechsler, Savov, and Schnabl (2015) provide a framework to rationalize the effect of monetary policy on risk premia.

Besides the effect on the level of the stock market, researchers have recently also studied cross-sectional differences in the response of stocks to monetary policy and the response of other asset classes. Ehrmann and Fratzscher (2004) and Ippolito, Ozdagli, and Perez-Orive (2018), among others, show that firms with high bank debt, firms with low cash flows, small firms, firms with low credit ratings, firms with low financial constraints, firms with high price-earnings multiples, and firms with Tobin's q show a higher sensitivity to monetary policy shocks, which is in line with bank-lending, balance-sheet, and interest-rate channels of monetary policy. Gorodnichenko and Weber (2016) show that firms with stickier output prices have more volatile cash flows and high conditional volatility in narrow event windows around FOMC announcements. Weber (2015) studies how firm-level and portfolio returns vary with measured price stickiness, and shows that sticky-price firms have higher systematic risk and are more sensitive to monetary policy shocks. Brooks, Katz, and Lustig (2018) study the drift in Treasury markets after changes in fed fund target rates, Mueller, Tahbaz-Salehi, and Vedolin (2017) find a trading strategy short the US dollar and long other currencies earns substantially higher excess returns on FOMC announcement days, Wiriadinata (2018) shows unexpected cuts in fed funds target rates lead to larger currency appreciation of countries with larger US dollar denominated net external debt, and Karnaukh (2018) documents the U.S. dollar appreciates in the two-day window before contractionary monetary policy decisions and depreciates before expansionary policy decisions.

We also contribute to a recent literature studying stock return patterns around FOMC announcements. The most closely related paper is Lucca and Moench (2015), who show that 60% to 80% of the realized equity premium since 1994 is earned in the 24 hours *before* the actual FOMC meeting. Their pre-FOMC announcement drift is independent of the sign of monetary policy shocks and is contained in the 24 hours before the policy decision. Savor and Wilson (2013) show stock returns are substantially higher on macroeconomic announcement days such as FOMC days and Savor and Wilson (2014) find the CAPM tends to hold on these days. Ai and Bansal (2018) develop a theory to rationalize macroeconomic announcement premia and pre-drifts such as the pre-FOMC announcement drift. This line of research focuses on patterns in stock returns independent of the sign of the monetary policy shock. We build on this body of work and document an extended pre- and post-FOMC drift that has signs opposite to the surprises in line with the event-study literature we cite above: negative, that is, expansionary monetary policy shocks result in an upward drift in stock returns after as well as *before* the rate changes.

Moreover, the paper relates to the literature on the the post-earnings-announcement drift (PEAD). Ball and Brown (1968) first document PEAD, which describes the tendency of stock returns to drift in the direction of recent earnings' surprises. Fama (1998) points out that PEAD has undergone heavy scrutiny and holds up out of sample and is therefore "above suspicion." Livnat and Mendenhall (2006) show the robustness of PEAD to different ways of measuring surprises and also provide a nice overview of the literature. PEAD is, however, concentrated in smaller firms, which raises concerns of its exploitability (see, e.g., Chordia et al. (2009)). We document a drift in returns around FOMC decisions in the direction opposite of the monetary-policy surprises. The drift occurs for market-wide indices and industry portfolios and is therefore not subject to high transaction costs. In addition, FOMC decisions during our sample period are pre-scheduled and closely watched, which makes inattention unlikely to drive our findings.

Finally, our findings are reminiscent of, but distinct from, the time-series momentum strategy of Moskowitz, Ooi, and Pedersen (2012), who document that aggregate indices that did well over the previous 12 months positively predict future excess returns for up to 12 months. Hence, our results provide *out-of-sample* findings to test behavioral theories of momentum, such as Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998), and Hong and Stein (1999) against rational theories, such as Berk, Green, and Naik (1999), Ahn, Conrad, and Dittmar (2003), and Sagi and Seasholes (2007).[2]

II Data

A. Stock Returns

We sample daily returns for the CRSP value-weighted index directly from CRSP. The index is an average of all common stocks trading on NYSE, Amex, or Nasdaq. We also sample returns for international stock indices from Datastream. Industry and factor returns are from the Ken French data library.

B. Federal Funds Futures Data

Federal funds futures started trading on the Chicago Board of Trade in October 1988. These contracts have a face value of $5,000,000. Prices are quoted as 100 minus the average daily federal funds rate as reported by the Federal Reserve Bank of New York. Federal funds futures face limited counterparty risk due to daily marking to market and collateral requirements by the exchange. We use tick-by-tick data of the federal funds futures trading on the Chicago Mercantile Exchange (CME) Globex electronic trading platform (as opposed to the open outcry market) directly from the CME. Using Globex data has the advantage that trading in these contracts starts on the previous trading day at 6.30 pm ET (compared to 8.20am ET in the open outcry market). We are therefore able

[2]Of course a large literature also exists on cross-sectional momentum, that is, comparing the past performance of securities relative to the past performance of other securities. See, for example, Jegadeesh and Titman (1993) for U.S. equities, Moskowitz and Grinblatt (1999) for industries, Asness, Liew, and Stevens (1997) for equity indices, Shleifer and Summers (1990) for currencies, Gorton et al. (2013) for commodities, and Asness, Moskowitz, and Pedersen (2013) for evidence across asset classes and around the world.

to calculate the monetary policy surprises for all event days including the intermeeting policy decisions occuring outside of open outcry trading hours.

Our sample period starts in 1994 and ends in 2009. With the first meeting in 1994, the FOMC started to communicate its decision by issuing press releases after meetings and policy decisions. The liquidity trap and ZLB on nominal interest rates determine the end of our sample because little variation exists in federal funds futures-implied rates and no target rate change occurs for the following seven years. The FOMC has eight scheduled meetings per year and, starting with the first meeting in 1994, most press releases are issued around 2:15 pm ET.

We now define the measure of monetary policy shocks following Kuttner (2001), Bernanke and Kuttner (2005), and Gürkaynak, Sack, and Swanson (2005). Let $ff_{t,0}$ denote the rate implied by the current-month federal funds futures on date t and assume that one FOMC meeting takes place during that month. t is the day of the FOMC meeting and D is the number of days in the month. We can then write $ff_{t,0}$ as a weighted average of the prevailing federal funds target rate, r_0, and the expectation of the target rate after the meeting, r_1:

$$ff_{t,0} = \frac{t}{D} r_0 + \frac{D-t}{D} \mathbb{E}_t(r_1) + \mu_{t,0}, \tag{1}$$

where $\mu_{t,0}$ is a risk premium.[3] Gürkaynak et al. (2007) estimate risk premia of 1 to 3 basis points, and Piazzesi and Swanson (2008) show that they only vary at business-cycle frequencies. We focus on intraday changes to calculate monetary policy surprises and neglect risk premia in the following, as is common in the literature.

We can calculate the surprise component of the announced change in the federal funds rate, v_t, as:

$$v_t = \frac{D}{D-t}(ff_{t+\Delta t^+,0} - ff_{t-\Delta t^-,0}), \tag{2}$$

where t is the time when the FOMC issues an announcement, $ff_{t+\Delta t^+,0}$ is the fed funds

[3] We implicitly assume date t is after the previous FOMC meeting. Meetings are typically around six to eight weeks apart.

futures rate shortly after t, $ff_{t-\Delta t^-,0}$ is the fed funds futures rate just before t, and D is the number of days in the month.[4] The $D/(D-t)$ term adjusts for the fact that the federal funds futures settle on the average effective overnight federal funds rate.

We follow Gürkaynak et al. (2005) and use the unscaled change in the next-month futures contract if the event day occurs within the last seven days of the month. This approach ensures small targeting errors in the federal funds rate by the trading desk at the New York Fed, revisions in expectations of future targeting errors, changes in bid-ask spreads, or other noise, which have only a small effect on the current-month average, are not amplified through multiplication by a large scaling factor.

Following the convention in the literature, which we discuss in the introduction, we call monetary policy surprises expansionary when the new target rate is lower than predicted by fed funds futures before the FOMC meeting, that is, when v_t is negative and we call positive v_t contractionary. Table 1 reports descriptive statistics for surprises in monetary policy for all 137 event dates between 1994 and 2009, as well as separately for turning points in monetary policy and intermeeting policy decisions. Turning points (target-rate changes in the direction opposite to previous changes) signal changes in the current and future stance of monetary policy and thus convey larger news (Piazzesi 2005, Coibion and Gorodnichenko 2012). The average monetary policy shock is approximately 0. The most negative shock is more than -45 basis points—about three times larger in absolute value than the most positive shock. Policy surprises on intermeeting event dates and turning points are more volatile than surprises on scheduled meetings.

Table 2 reports the transition matrix for contractionary and expansionary shocks. We see contractionary shocks are about as likely to be followed by contractionary shocks as they are to be followed by expansionary shocks, and the same holds for expansionary shocks. In untabulated results, we also find little predictability in the sign of the shocks using the sign or level of past shocks, and aggregate uncertainty such as the VIX also has no predictive power for the sign of v_t.

[4] We implicitly assume in these calculations that the average effective rate within the month is equal to the federal funds target rate and that only one rate change occurs within the month. Due to changes in the policy target on unscheduled meetings, we have six observations with more than one change in a given month. Because these policy moves were not anticipated, they most likely have no major impact on our results. We nevertheless analyze intermeeting policy decisions separately in our empirical analyses.

III Empirical Results

A. Methodology

We follow a large event-study literature focusing on the conditional reaction of stock returns around contractionary and expansionary monetary policy shocks by the FOMC. Contrary to the recent literature studying intraday event windows of 30 to 60 minutes, we focus on drifts in returns several days up to a few weeks before and after the announcement. Specifically, the FOMC policy day constitutes event day 0, and we then study the reaction of returns in event time before and after the announcement, separating expansionary from contractionary monetary policy shocks.

B. Baseline

Figure 1 plots the return movements around FOMC announcements separately for expansionary and contractionary monetary policy surprises, which we calculate following equation (2). Expansionary monetary policy shocks are all surprises that are smaller than or equal to zero, whereas positive surprises are contractionary monetary policy shocks. In line with the recent literature, we focus on regular FOMC meetings and exclude FOMC policy decisions occurring on unscheduled meetings, so-called intermeeting policy decisions. Faust et al. (2004) argue that intermeeting policy decisions are likely to reflect new information about the state of the economy, and hence, the stock market might react to news about the economy rather than changes in monetary policy. In addition, intermeetings are not scheduled and we would not expect to find any pre-drift. We show robustness checks regarding the sample below.

We see in Figure 1 stock returns start drifting upwards around 25 days before expansionary monetary policy decisions (blue-solid line), whereas stock returns are flat or drift down slightly before contractionary monetary policy decisions (red-dashed line). For both types of events, we see a positive return on the day before the FOMC meeting, the pre-FOMC announcement drift of Lucca and Moench (2015). For expansionary monetary policy events, stock returns continue to increase. Following contractionary shocks, instead, we see flat or slightly decreasing returns for the next 20 days. The difference in cumulative return drifts around contractionary and expansionary monetary policy surprises amounts to 4.5%.

The sensitivity of stock returns to monetary policy shocks varies across types of events. Ozdagli and Weber (2016) find larger sensitivities of stock returns to monetary policy shocks on turning points in monetary policy compared to regular meetings. Figure 2 shows very similar drift patterns when we also exclude turning points in monetary policy in addition to intermeeting policy moves, both in sign and magnitude, and Figure 3 shows the same drift pattern in returns when we exclude neither of the two types of events.

So far, we assign meeting dates with zero monetary policy shock to the expansionary monetary policy shocks sample. Figure 4 shows this definition does not drive our findings. When we exclude all events with zero policy surprises, we confirm our baseline findings. Our baseline sample lasts until the start of the binding ZLB, whereas a large event-study literature stops in the early 2000s. Figure 5 shows results for a sample ending in 2004 that confirm our baseline finding.

Cieslak and Vissing-Jorgensen (2017) document a Fed Put; that is, the FOMC tends to lower federal funds target rates following weak stock returns. Figure 6 plots cumulative returns for the CRSP value-weighted index when we split events by actual changes in federal funds target rates. We find stock returns tend to be lower before the FOMC lowers its target rate and higher before increases in target rates. Returns tend to remain flat when we condition on either positive or negative changes in the actual target rates. These results for actual changes in target rates are consistent with Cieslak and Vissing-Jorgensen (2017), but a Fed Put is unlikely to explain our findings, because we show that stock returns drift *upwards* before *lower-than-expected* federal funds target rates, whereas returns tend to drift *downwards* before *cuts in actual* target rates.

So far, our analysis relies on graphs, eyeball econometrics, and cumulative returns from 50 days before until 50 days after the FOMC meeting. The choice of the window implies that in rare cases, part of the window might overlap with previous and subsequent FOMC meetings. Table 3 reports regression estimates for different event windows around FOMC policy decisions ranging from –15 until +15 days around the meetings ensuring no overlap across policy events occurs. Specifically, we regress cumulative returns of the

CRSP value-weighted index from $t^- = -15$ until $t^- + s$, with s running from 1 until +30 and $s = 15$ being the event day, r_{t^-,t^-+s}, on a constant and a dummy variable that equals 1 around expansionary monetary policy surprises, $\mathscr{D}^{exp}$:

$$r_{t^-,t^-+s} = \beta_0 + \beta_1 \times \mathscr{D}^{exp} + \varepsilon_{t^-,t^-+s}. \tag{3}$$

β_0 reports the average cumulative return around contractionary monetary policy surprises, whereas β_1 reports the average differential cumulative return around expansionary monetary policy surprises relative to cumulative returns on contractionary policy meetings. We report robust t-statistics in parentheses.

Panel A reports results for our baseline sample excluding intermeeting policy releases. We see returns drift upwards before expansionary surprises relative to contractionary surprises, but the differential drift is not statistically significant before the policy release. Including the day of the release, the differential drift is 1.5% and statistically significant at the 10% level. Returns continue to drift upwards differentially, resulting in a difference in cumulative returns of 2% five days after the meeting and doubling to 3% 15 days after the meeting. All post-meeting estimates of β_1 are significant at the 5% level.

In Panels B to D, we see economically and statistically similar results for samples with intermeetings, when we exclude both intermeetings and turning points, or when we exclude all events with zero monetary policy surprises: returns start drifting upwards before expansionary monetary policy surprises, and the cumulative return differential reaches around 1.5% on the day of the meeting, and increases to about 3% over the course of the next 15 days.

Table 4 adds control variables to the previous specifications. Specifically, we add dummies that equal 1 if a FOMC meeting corresponds to an intermeeting or turning point in monetary policy and the actual change in federal funds target rates. We see that cumulative returns tend to be negative around intermeeting policy decisions, consistent with findings in the literature with no differential drift around turning points in monetary policy and no effect of actual changes in the target rate on cumulative returns. Importantly, our baseline results continue to hold in a sample with these additional controls.

Table 5 also adds the level of the federal funds rate in addition to the previous controls, because stock markets might be differentially sensitive at different stages of the business cycle. Contrary to this hypothesis, we never find a statistically significant effect of the level of the federal funds rate on cumulative stock returns around FOMC meetings and no effect on the differential return drift around positive versus negative surprises.

C. Cross-Sectional Factors

So far, we have focused on the drift of a broad market index around expansionary and contractionary monetary policy surprises, but the reaction of the CRSP value-weighted index might camouflage large cross-sectional variation. We first study the reaction of the five Fama and French (2015) factors.

Figure 8 plots the drift around FOMC announcements for the size factor. Cumulative excess returns are close to zero around both expansionary and contractionary monetary policy surprises. The non-response of the size factor might reflect the insignificant unconditional size premium during our sample period.[5]

Figure 9 plots the drift for the value factor, Figure 10 plots the drift for the profitability factor, and Figure 11 plots the drift for the investment factor. Overall, little drift occurs either before or after the announcement for all three factors for expansionary monetary policy surprises. Before contractionary monetary policy surprises, we see an upward drift of value firms relative to growth firms, high-profitability relative to low-profitability firms, and low- relative to high-investment firms, but the drift levels off at the announcement and is smaller than the drift for the overall market.

Lastly, Figure 12 plots the drift for the momentum factor. We see little return drift for expansionary monetary policy surprises. Around contractionary monetary policy surprises, however, we see a large upward drift for the momentum factor: starting 20 days before the announcement, excess returns drift upwards, reaching 2% on the day of the

[5]Asness, Frazzini, Israel, Moskowitz, and Pedersen (2015) show that firm size is highly correlated with other firm characteristics, and once they condition on these, the size effect reappears. This result is consistent with evidence in Freyberger, Neuhierl, and Weber (2017), who find that the size effect conditional on other firm characteristics is strongest in the modern sample period.

announcement, but continue to drift for another 20 days, and a cumulative drift of 4% for the 40-day window centered around contractionary monetary policy surprises. The 4% cumulative return is large relative to an average annual excess return of the momentum factor of 6.12% between 1994 and 2009 and 10% when we end the sample in 2008 and exclude the momentum crash (see Daniel and Moskowitz (2016)).

An upward drift of past winners or a downward drift of past losers might drive the large upward drift of the momentum factor around contractionary monetary policy surprises. Figure 13 plots the cumulative excess returns around contractionary and expansionary monetary policy surprises separately for past winners and losers. We define past winners to be portfolio 10 in the 10 momentum-sorted portfolios of Fama & French and past losers to be portfolio 1. For expansionary monetary policy announcements, we see no large drift for the momentum factor, because both past winners and losers tend to drift upwards in parallel. Around contractionary surprises, however, we see a pronounced downward drift in returns: starting 10 days before the announcement, past losers start drifting downwards, reaching a cumulative return of -2% on the FOMC meeting day and continue drifting down for another 10 days, and a cumulative return of -5% within these 25 days. In Figure 14, we see a similar pattern in a sample until 2004, indicating a momentum crash is unlikely to explain these patterns.

D. Industry Returns

Industries might react differentially to monetary policy shocks, because of demand effects or different sensitivities to monetary policy. Durable-goods demand is particularly volatile over the business cycle, and consumers can easily shift the timing of their purchases, thus making monetary policy sensitivity especially high (see, e.g., D'Acunto, Hoang, and Weber (2017)). Figure 15 to Figure 18 plot the cumulative industry returns following the Fama & French 17-industry classification for expansionary monetary policy shocks in blue and for contractionary monetary policy shocks in red.

For all but one industry, we see a differential drift around expansionary versus contractionary monetary policy surprises that averages aroud 4%, consistent with the overall results for the CRSP value-weighted index. The mining industry is an exception, because returns also drift upwards around contractionary monetary policy shocks (see Figure 17). We observe the largest differential drift for the machinery industry, with a cumulative return difference of more than 7% (see Figure 16).

E. International Equity Returns

We now study international equity returns around FOMC meetings to see whether similar return patterns are present around the world. Lucca and Moench (2015) already document that their pre-FOMC announcement drift is a global phenomenom in that international stock indices appreciate in the 24 hours before the announcement of U.S. monetary policy decisions.

Figure A.1 in the Online Appendix plots the cumulative returns of the German DAX 30 index around expansionary and contractionary monetary policy decisions. Similar to the evidence for the United States, we see stock returns drifting differentially before expansionary versus contractionary surprises starting around 20 days before the U.S. monetary policy decision. The return gap between the two types of events increases to around 3.5% on the day of the FOMC meeting. Returns of the DAX index, however, continue to drift in the same direction, so that the return gap widens to 6% 15 days after the FOMC meeting.

We find similar evidence for the Canadian TSX Composite index in Figure A.2, for the French CAC40 in Figure A.3, the Spanish IBEX 35 index in Figure A.4, the Swiss SMI index in Figure A.5, and the British FTSE100 in Figure A.6, but to a lesser extent. The Japanese Nikkei 225 in Figure A.7 is an exception with almost zero return drift. The non-result for the Nikkei is consistent with Lucca and Moench (2015), who also do not find any pre-FOMC return drift for Japan.

F. Trading Strategy

We report daily mean returns, standard deviations, and Sharpe ratios in Table 7, to benchmark the economic significance of the differential drift of the CRSP value-weighted index around FOMC monetary policy decisions across expansionary and contractionary policy surprises. Specifically, we compare the Sharpe ratios of monetary momentum strategies to the ones for a passive buy-and-hold strategy for event windows around the FOMC meeting t of different lengths in trading days. The event window in columns (1) and (2) starts 15 days before the FOMC meeting and ends 15 days after the FOMC meeting. The monetary momentum strategy invests in the market when the monetary policy shock is expansionary, and shorts the market when the monetary policy shock is contractionary. We calculate the annualized Sharpe ratio as the ratio of the daily mean excess return and the daily standard deviation multiplied by the square root of 252.

We see in column (1) that holding the market in the 30 days around the FOMC meeting results in an annualized Sharpe ratio of 0.20. The baseline monetary momentum strategy, instead, has a Sharpe ratio of 0.61, which is more than three times larger than the Sharpe ratio of the passive long-only strategy.

Lucca and Moench (2015) document large returns in the 24 hours before the FOMC meeting. These large returns cannot explain the increase in Sharpe ratios by a factor of three, because the buy-and-hold strategy automatically harvests these returns. In columns (3) and (4), we nevertheless study event windows that exclude the day of and the day before the FOMC meeting.[6] We see that a passive buy-and-hold strategy earns a negative Sharpe ratio when we exclude the large returns before the FOMC meeting. The monetary momentum strategy instead still earns an economically meaningful Sharpe ratio of 0.43.

So far, we might not be able to implement the monetary momentum strategies we study, because we do not know the sign of the monetary policy surprise 15 days before the FOMC meeting.[7] We now study event windows that start only the day after the FOMC meeting in columns (5) and (6). The passive buy-and-hold strategy has a Sharpe ratio of 0.13 only. A strategy that starts investing in the market for 15 days whenever the monetary policy surprise was negative on the previous day instead earns an annualized Sharpe ratio of 0.52, which is larger by a factor of 4.

Columns (7) and (8) compare the Sharpe ratio of a strategy that holds the market

[6] We work with daily returns, and both days cover part of that pre-FOMC drift window.

[7] A recent literature argues that monetary policy shocks are predictable; see, for example, Miranda-Agrippino (2016). See also discussion below.

throughout the year with a *buy-and-hold strategy plus* that shorts the market for 15 days following any contractionary monetary policy surprise. We see that this simple timing strategy that is implementable in real time increases annualized Sharpe ratios by 65%.

For comparison, Panel B lists annualized Sharpe ratios for the five Fama & French factors and the time-series momentum strategy of Moskowitz et al. (2012). We see that the simple *monetary momentum* market-timing rules generate Sharpe ratios that are comparable to the Sharpe ratios of leading risk factors and do not require frequent rebalancing or the trading of a large number of stocks.

G. Predictability of Monetary Policy Shocks

We find returns start drifting upwards several days before expansionary monetary policy decisions. We now want to study whether the cumulative returns before FOMC meetings can actually predict monetary policy *shocks*.

When we run a regression of federal funds futures based monetary policy shocks on the stock returns in the 15 days before the FOMC press release, we find a point estimate of -0.0024, which is marginally statistically significant with a t-stat of -1.92. Figure 7 graphically shows the negative association between past 15-day returns and surprise changes in federal funds rates. In particular, in the top figure, we show a binned scatter plot of cumulative returns on the x-axis and monetary policy surprises on the y-axis using 25 bins. We see that positive returns in the period 15 days before the FOMC meeting tend to be associated with expansionary monetary policy surprises. The bottom figure instead shows a flat association between returns on the day before the FOMC meeting and policy surprises, consistent with findings of Lucca and Moench (2015) that returns drift upwards in the 24 hours before the rate decision independent of the sign of the shock.

This predictability does not seem to occur due to any autocorrelation in shocks. When we regress current shocks on a constant and shocks from the last meeting, we find a point estimate on the lagged shock of -0.09 with a p-value of 29%, making it unlikely that the predictability of monetary policy shocks by past market returns originates due to any persistence in the shocks themselves.

Transition matrices are another way to study possible persistence in monetary policy shocks. Table 2 shows contractionary shocks are followed 39 times by other contractionary shocks but also 34 times by expansionary shocks. On the other hand, contractionary shocks follow expansionary shocks 33 times, but other expansionary shocks follow 30 times. Hence, little persistence exists in the type of shocks, which makes it unlikely that the sign of the shocks is predictable by past shocks.

The predictability of fed funds futures based monetary policy shocks by past cumulative stock returns implies these shocks are not exogenous and researchers in macroecomics should possibly regress these shocks on past returns to orthognolize the shocks. The predictability might also expain some puzzling findings in the literature such as the "price puzzle", that is, the fact that consumer prices increase in the short run following contractionary monetary policy shocks.

H. Monetary Momentum versus Time-Series Momentum

In an influential paper, Moskowitz, Ooi, and Pedersen (2012) show large time-series momentum across asset classes such as equity indices, currency, commodities, and bond futures. They show the past 12-month returns of each instrument positively predicts future returns. Time-series momentum returns might partially explain the return drifts we document around FOMC meetings.

To study the associations between time-series momentum and monetary momentum, we adapt the Moskowitz, Ooi, and Pedersen (2012) time-series strategy to our context and start investing in the market index 15 days before the FOMC meeting whenever the return of the market excess return was positive over the previous 12 months, and short the market whenever the excess return was negative. Table 8 reports results from different spanning tests to see whether monetary momentum is economically different from time-series momentum and other well-known trading strategies.

We see in column (1) that monetary momentum and time-series momentum strategies are negatively correlated. But even after controlling for exposure to time-series momentum, we still find a positive, statistically significant alpha of 0.055% per day, which is almost 14% annualized. Column (2), instead, shows that monetary momentum does not subsume time-series momentum. Columns (3) and (4) regress monetary momentum strategies on time-series momentum and the Fama & French 3 and 5 factors. Column (4) implies monetary momentum expands the mean-variance frontier relative to the Fama & French 5 factors and time-series momentum and results in annualized excess returns of 9.6%.

IV Concluding Remarks

Momentum is a pervasive feature across asset classes, countries, and sample periods. We document novel time-series momentum strategies around monetary policy decisions in the United States. Starting 25 days before expansionary monetary policy announcements, stock returns start drifting upwards. Before contractionary monetary policy surprises returns drift downwards. The differential drift continues after the policy decision for another 15 days and amounts to 4% per year within 30 days of the monetary policy decision.

The differential drift we document is largely a market-wide phenomenon and holds for all industries, but we find little differential drift for cross-sectional asset-pricing factors. Momentum is an exception: around contractionary policy shocks, we find large momentum returns, because loser stocks tend to plummet. The drift we document is a global phenomenon, and major stock indices around the world exhibit the differential drift around U.S. contractionary and expansionary monetary policy decisions.

A simple market-timing strategy that exploits the monetary momentum strategy we document improves on the Sharpe ratio of a buy-and-hold investor by a factor of 4, and investors can implement the strategy in real time.

Our findings have important implications for policy and research. First, a recent literature studies the effect of monetary policy on asset prices using narrow event windows of 30 or 60 minutes around FOMC policy decisions to obtain identification. The large drift before and after FOMC decisions suggests researchers might underestimate the effect of monetary policy on asset prices by restricting attention to narrow event windows. Second, the magnitude of the drift around FOMC decisions suggests asset-pricing theories that aim to understand the unconditionally large excess returns of stocks relative to bonds should focus on channels through which monetary policy and asset markets interact. Third, the pre-drift around FOMC decisions implies "surprise changes" in target rates might partially be predictable, which has important implications for the large literature in macroeconomics and monetary economics that tries to understand the real effects of monetary policy shocks on real consumption, investment, and GDP and warrants future research.

References

Ahn, D.-H., J. Conrad, and R. F. Dittmar (2003). Risk adjustment and trading strategies. *The Review of Financial Studies 16*(2), 459–485.

Ai, H. and R. Bansal (2018). Risk preferences and the macro announcement premium. *Econometrica*.

Asness, C. S., A. Frazzini, R. Israel, T. J. Moskowitz, and L. H. Pedersen (2015). Size matters, if you control your junk. *Unpublished Manuscript, AQR*.

Asness, C. S., J. M. Liew, and R. L. Stevens (1997). Parallels between the cross-sectional predictability of stock and country returns. *The Journal of Portfolio Management 23*(3), 79–87.

Asness, C. S., T. J. Moskowitz, and L. H. Pedersen (2013). Value and momentum everywhere. *The Journal of Finance 68*(3), 929–985.

Ball, R. and P. Brown (1968). An empirical evaluation of accounting income numbers. *Journal of Accounting Research 6*, 159–178.

Barberis, N., A. Shleifer, and R. Vishny (1998). A model of investor sentiment. *Journal of Financial Economics 49*(3), 307–343.

Berk, J. B., R. C. Green, and V. Naik (1999). Optimal investment, growth options, and security returns. *The Journal of Finance 54*(5), 1553–1607.

Bernanke, B. S. and K. N. Kuttner (2005). What explains the stock market's reaction to Federal Reserve policy? *The Journal of Finance 60*(3), 1221–1257.

Boguth, O., V. Grégoire, and C. Martineau (2017). What are they meeting for? a tale of two FOMC announcements. *Unpublished Manuscript, Arizona State University*.

Boyarchenko, N., V. Haddad, and M. C. Plosser (2017). The Federal Reserve and market confidence. *Unpublished Manuscript, UCLA*.

Brooks, J., M. Katz, and H. Lustig (2018). Post-fomc announcement drift in us bond markets. *Unpublished manuscript, Stanford University*.

Chordia, T., A. Goyal, G. Sadka, R. Sadka, and L. Shivakumar (2009). Liquidity and the post-earnings-announcement drift. *Financial Analysts Journal 65*, 18–32.

Cieslak, A. and A. Vissing-Jorgensen (2017). The economics of the fed put. *Unpublished Manuscript, University of California at Berkeley*.

Coibion, O. and Y. Gorodnichenko (2012). Why are target interest rate changes so persistent? *American Economic Journal: Macroeconomics 4*(4), 126–162.

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*(3), 331–351.

D'Acunto, F., D. Hoang, and M. Weber (2017). The effect of unconventional fiscal policy on consumption expenditure. *Unpublished manuscript, University of Chicago*.

Daniel, K., D. Hirshleifer, and A. Subrahmanyam (1998). Investor psychology and security market under-and overreactions. *The Journal of Finance 53*(6), 1839–1885.

Daniel, K. and T. J. Moskowitz (2016). Momentum crashes. *Journal of Financial Economics 122*(2), 221–247.

Drechsler, I., A. Savov, and P. Schnabl (2015). A model of monetary policy and risk premia. *Journal of Finance (forthcoming)*.

Ehrmann, M. and M. Fratzscher (2004). Taking stock: Monetary policy transmission to equity markets. *Journal of Money, Credit, and Banking 36*(4), 719–737.

Fama, E. F. (1998). Market efficiency, long-term returns, and behavioral finance. *Journal of Financial Economics 49*, 283–306.

Fama, E. F. and K. R. French (2015). A five-factor asset pricing model. *Journal of Financial Economics 116*(1), 1–22.

Faust, J., E. T. Swanson, and J. H. Wright (2004). Do Federal Reserve policy surprises reveal superior information about the economy? *Contributions to Macroeconomics 4*(1), 1–29.

Fontaine, J.-S. (2016). What fed funds futures tell us about monetary policy uncertainty. *Unpublished Manuscript, Bank of Canada*.

Freyberger, J., A. Neuhierl, and M. Weber (2017). Dissecting characteristics nonparametrically. *Unpublished Manuscript, University of Chicago Booth School of Business*.

Gorodnichenko, Y. and M. Weber (2016). Are sticky prices costly? Evidence from the stock market. *American Economic Review 106*(1), 165–199.

Gorton, G. B., F. Hayashi, and K. G. Rouwenhorst (2013). The fundamentals of commodity futures returns. *Review of Finance 17*(1), 35–105.

Gürkaynak, R. S., B. P. Sack, and E. T. Swanson (2005). Do actions speak louder than words? The response of asset prices to monetary policy actions and statements. *International Journal of Central Banking 1*(1), 55–93.

Gürkaynak, R. S., B. P. Sack, and E. T. Swanson (2007). Market-based measures of monetary policy expectations. *Journal of Business & Economic Statistics 25*(2), 201–212.

Hong, H. and J. C. Stein (1999). A unified theory of underreaction, momentum trading, and overreaction in asset markets. *The Journal of Finance 54*(6), 2143–2184.

Ippolito, F., A. K. Ozdagli, and A. Perez-Orive (2018). The transmission of monetary policy through bank lending: The floating rate channel. *Journal of Monetary Economics 95*, 49 – 71.

Jegadeesh, N. and S. Titman (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of Finance 48*(1), 65–91.

Karnaukh, N. (2018). The dollar ahead of fomc target rate changes. *Unpublished Manuscript, Ohio State University*.

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

Law, T. H., D. Song, and A. Yaron (2018). Fearing the fed: How wall street reads main street. *Unpublished manuscript, University of Pennsylvania*.

Leombroni, M., A. Vedolin, G. Venter, and P. Whelan (2016). Central bank communication and the yield curve. *Unpublished Manuscript, Boston University*.

Livnat, J. and R. Mendenhall (2006). Comparing the post–earnings announcement drift for surprises calculated from analyst and time series forecasts. *Journal of Accounting Research 44*, 177–205.

Lucca, D. O. and E. Moench (2015). The pre-FOMC announcement drift. *The Journal* *of Finance 70*(1), 329–371.

Miranda-Agrippino, S. (2016). Unsurprising shocks: Information, premia, and the monetary transmission. *Unpublished Manuscript, Bank of England*.

Moskowitz, T. J. and M. Grinblatt (1999). Do industries explain momentum? *The Journal of Finance 54*(4), 1249–1290.

Moskowitz, T. J., Y. H. Ooi, and L. H. Pedersen (2012). Time series momentum. *Journal of Financial Economics 104*(2), 228–250.

Mueller, P., A. Tahbaz-Salehi, and A. Vedolin (2017). Exchange rates and monetary policy uncertainty. *The Journal of Finance 72*(3), 1213–1252.

Neuhierl, A. and M. Weber (2017). Monetary policy slope and the stock market. *Unpublished manuscript, University of Chicago Booth School of Business*.

Ozdagli, A. and M. Velikov (2017). Show me the money: the monetary policy risk premium. *Boston Fed Working Paper*.

Ozdagli, A. and M. Weber (2016). Monetary policy through production networks: Evidence from the stock market. *Unpublished Manuscript, University of Chicago*.

Piazzesi, M. (2005). Bond yields and the Federal Reserve. *Journal of Political Economy 113*(2), 311–344.

Piazzesi, M. and E. Swanson (2008). Futures prices as risk-adjusted forecasts of monetary policy. *Journal of Monetary Economics 55*(4), 677–691.

Rigobon, R. and B. Sack (2003). Measuring the reaction of monetary policy to the stock market. *Quarterly Journal of Economics 118*(2), 639–669.

Sagi, J. S. and M. S. Seasholes (2007). Firm-specific attributes and the cross-section of momentum. *Journal of Financial Economics 84*(2), 389–434.

Savor, P. and M. Wilson (2013). How much do investors care about macroeconomic risk? Evidence from scheduled economic announcements. *Journal of Financial and Quantitative Analysis 48*(2), 343–375.

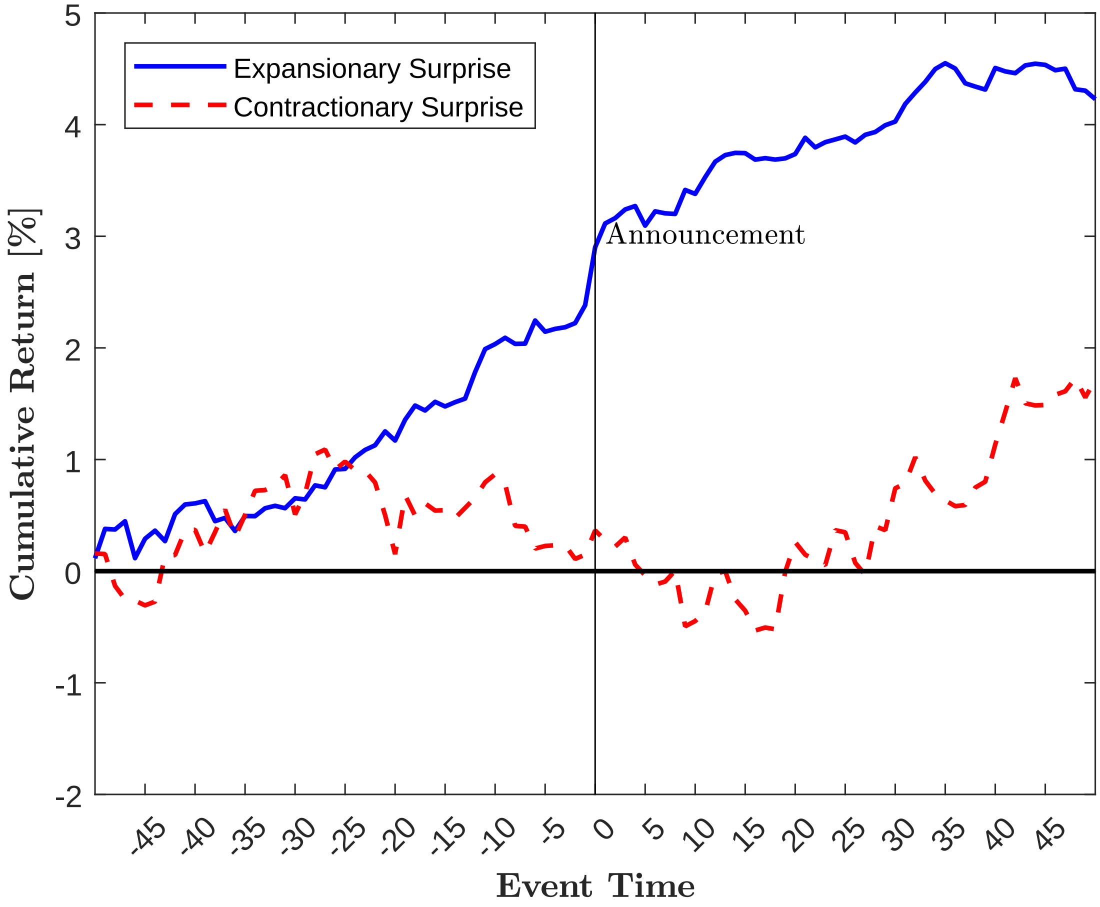
Savor, P. and M. Wilson (2014). Asset pricing: A tale of two days. *Journal of Financial Economics 113*(2), 171–201.

Shleifer, A. and L. H. Summers (1990). The noise trader approach to finance. *The Journal of Economic Perspectives 4*(2), 19–33.

Weber, M. (2015). Nominal rigidities and asset pricing. *Unpublished manuscript, University of Chicago Booth School of Business*.

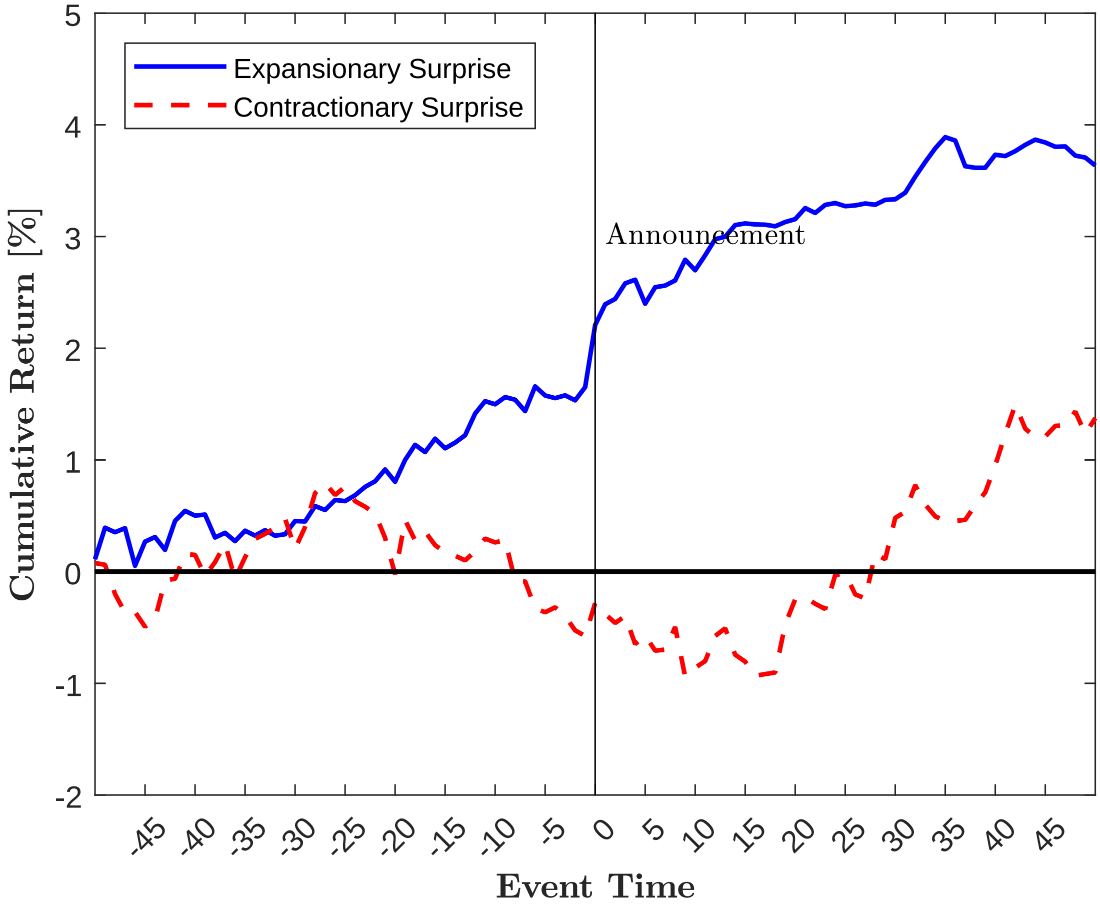
Wiriadinata, U. (2018). External debt, currency risk, and international monetary policy transmission. *Unpublished Manuscript, Chicago Booth*.

Figure 2: **Cumulative Returns around FOMC Policy Decisions: No Turning Points**



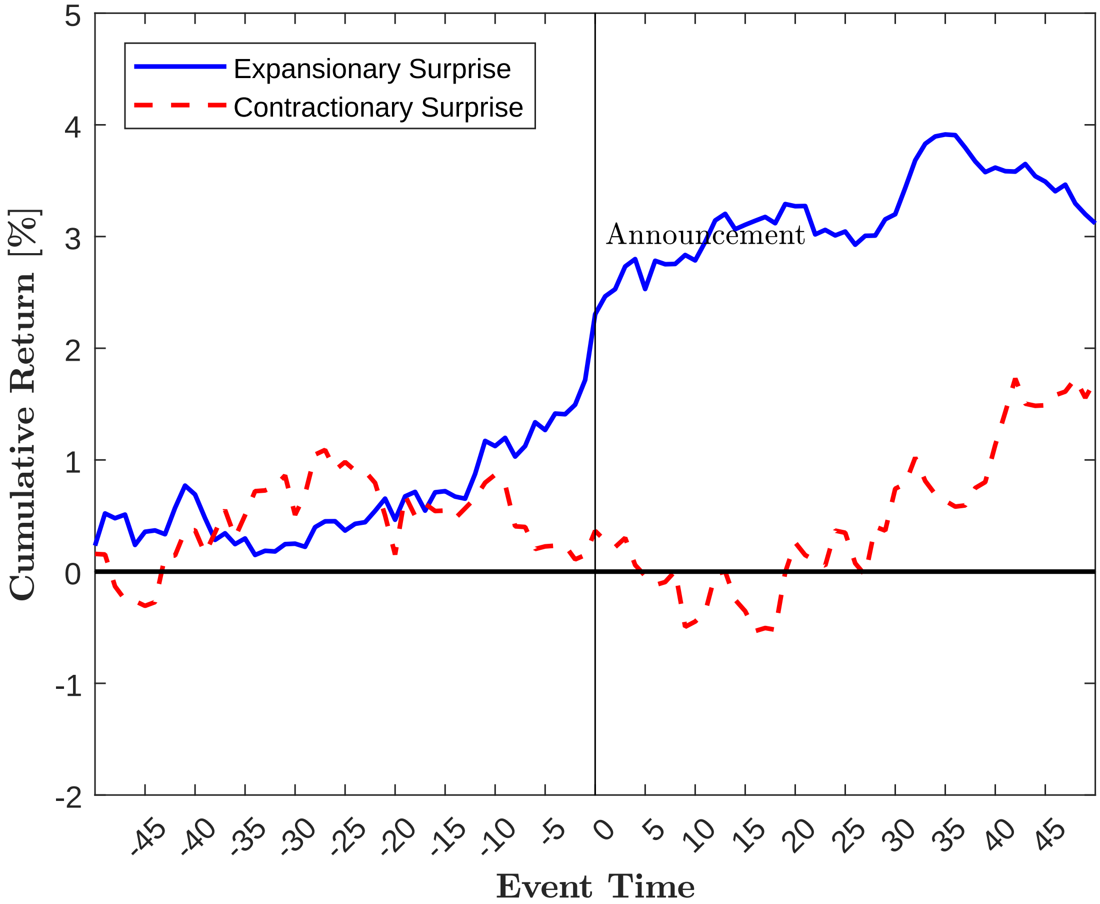
This figure plots cumulative returns in percent around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. We exclude turning points in federal funds target rates. The sample period is from 1994 to 2009.

Figure 3: **Cumulative Returns around FOMC Policy Decisions: Including Intermeeting Decisions**



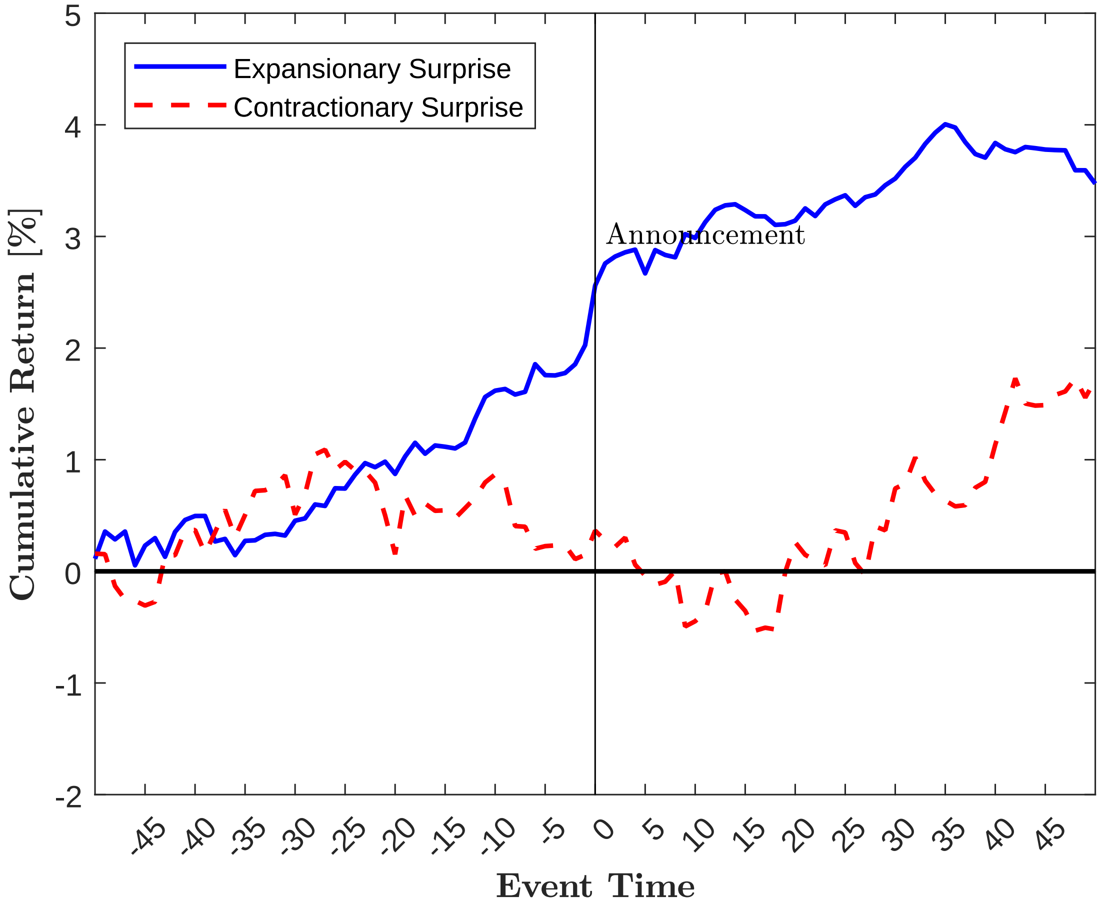
This figure plots cumulative returns in percent around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. We add intermeeting policy decisions to the sample. The sample period is from 1994 to 2009.

Figure 4: **Cumulative Returns around FOMC Policy Decisions: No Zero Surprises**



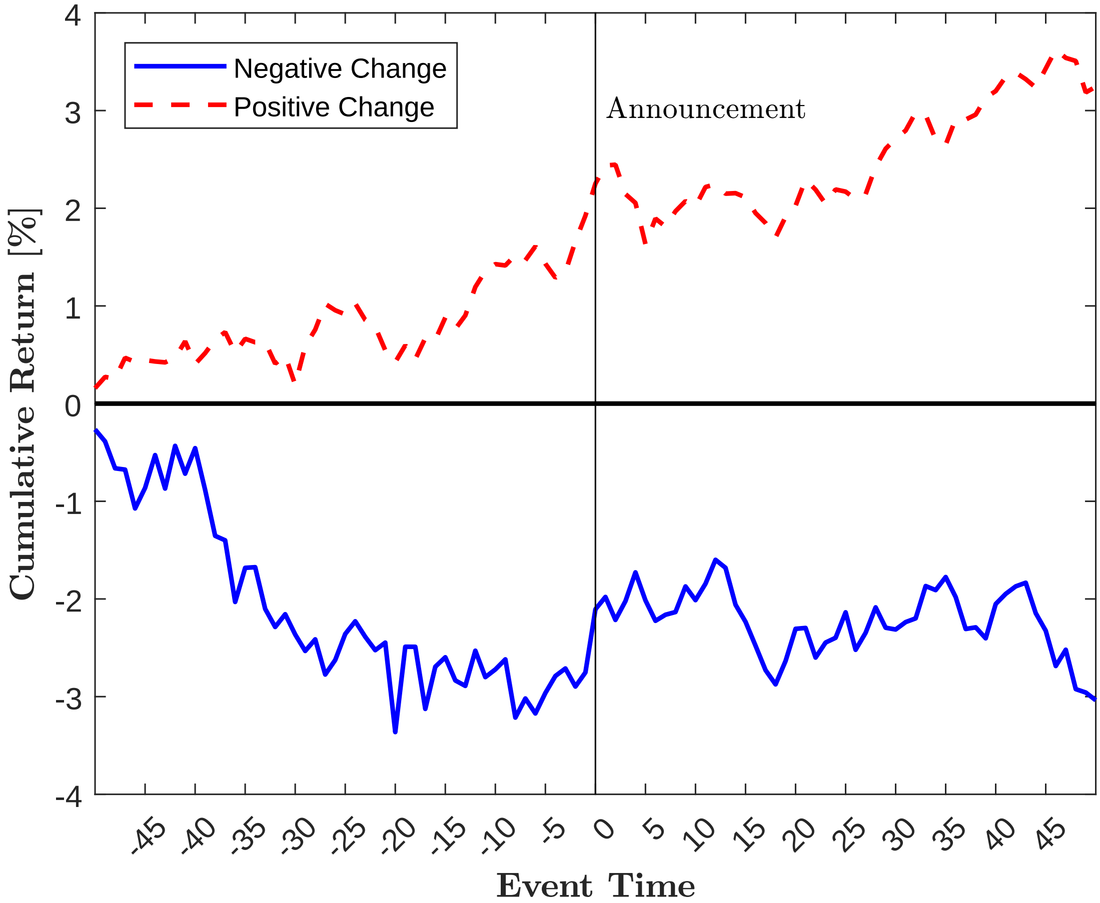
This figure plots cumulative returns in percent around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. We exclude zero monetary policy surprises. The sample period is from 1994 to 2009.

Figure 5: **Cumulative Returns around FOMC Policy Decisions: 1994–2004**



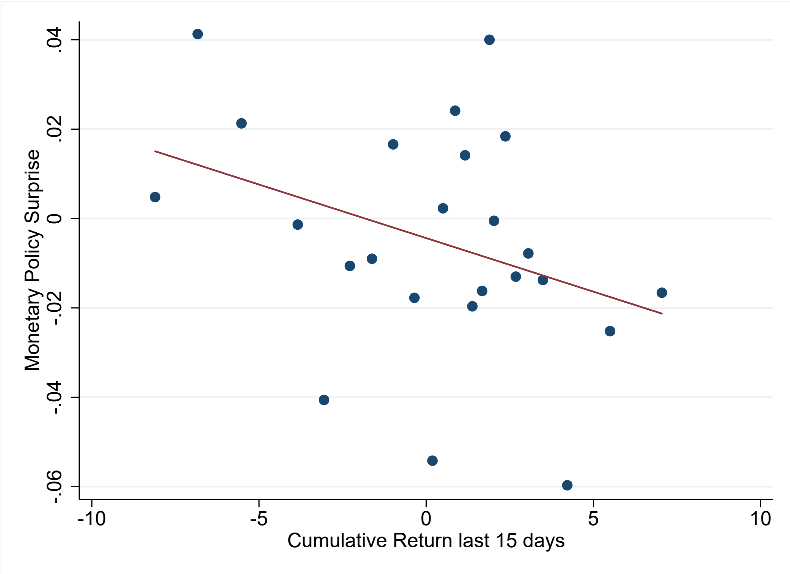
This figure plots cumulative returns in percent around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2004.

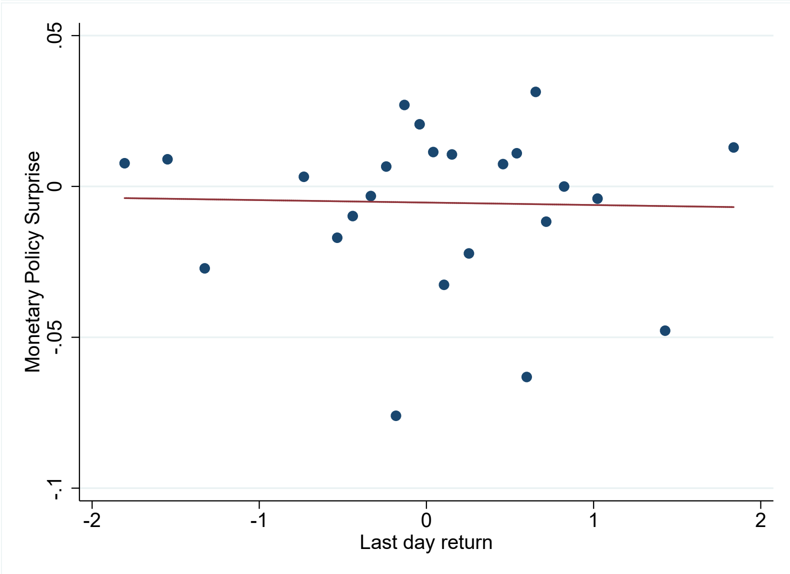
Figure 6: **Cumulative Returns around FOMC Policy Decisions: Actual Change**



This figure plots cumulative returns in percent around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) changes in actual federal funds target rates. The sample period is from 1994 to 2009.

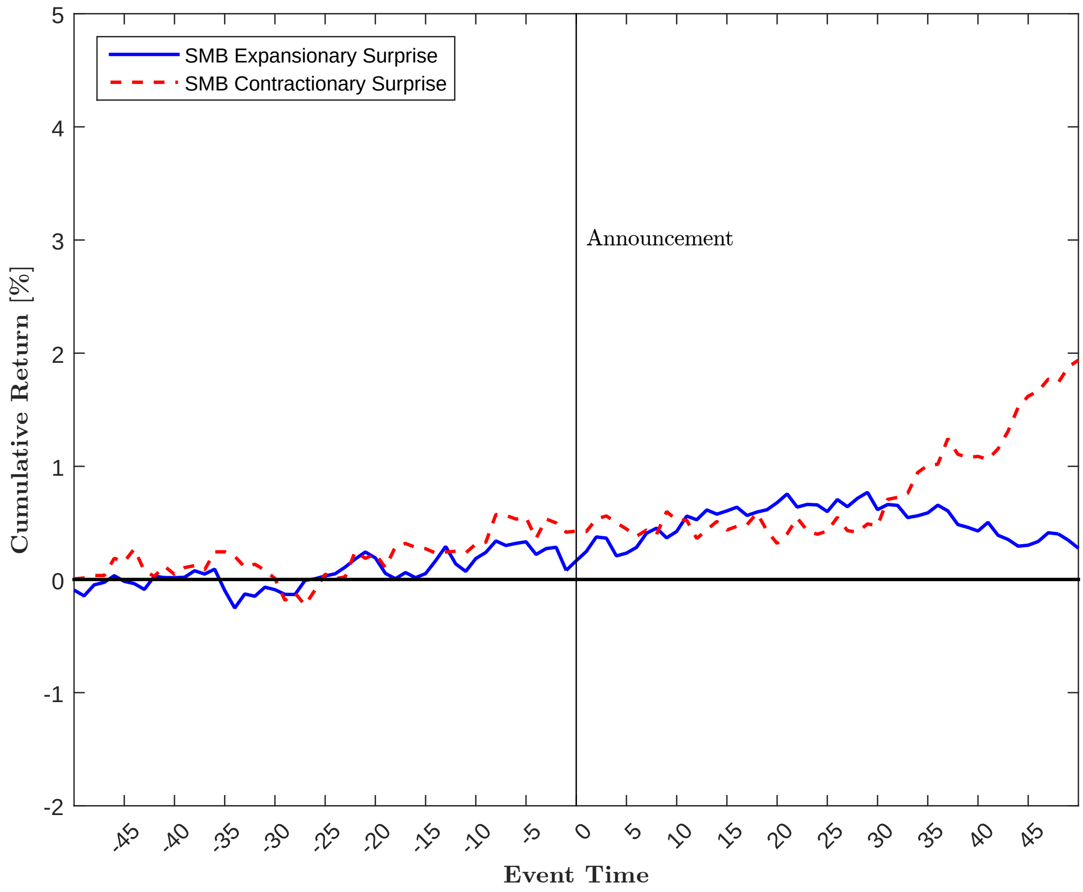
Figure 7: **Bin Scatter Plot of Previous Returns and Monetary Policy Surprises**





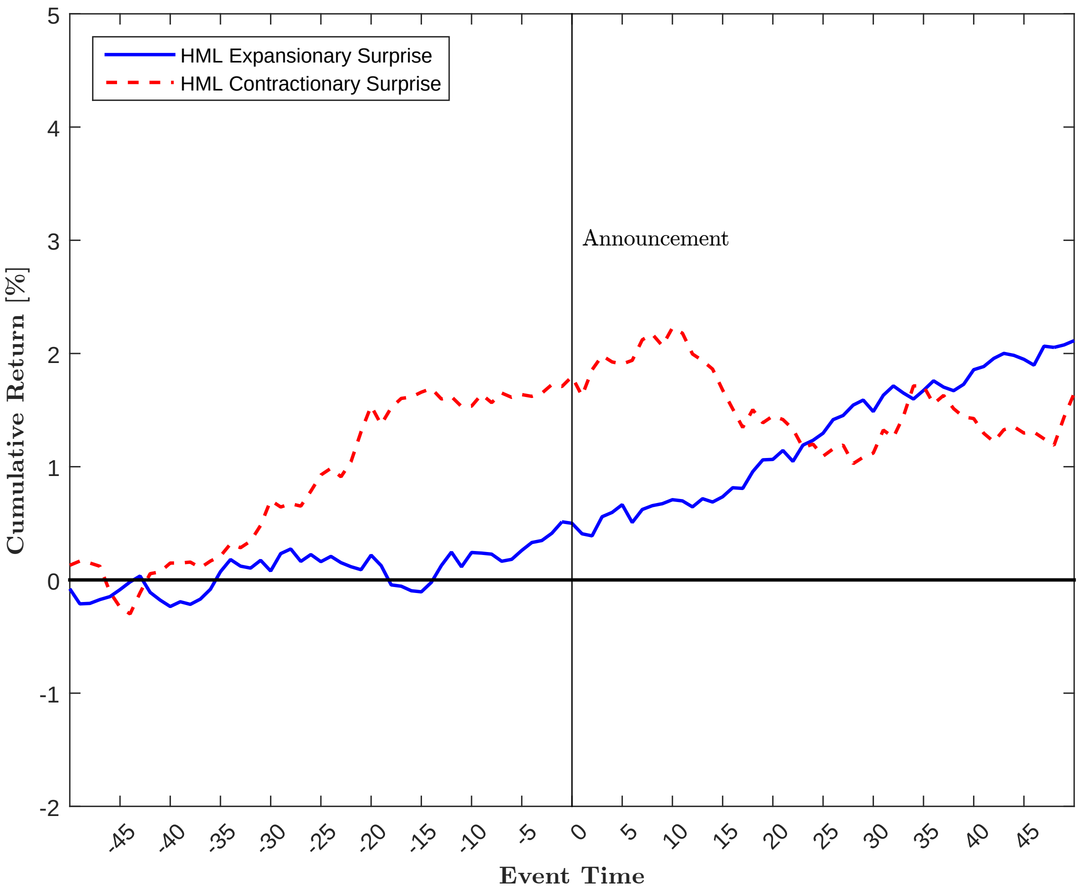
This figure plots cumulative excess returns in percent in the 15 days before the FOMC meeting and the federal-funds-futures-based monetary policy shocks in the top panel and the previous-day returns in the bottom panel. The sample period is from 1994 to 2009.

Figure 8: **Cumulative Returns around FOMC Policy Decisions: SMB**



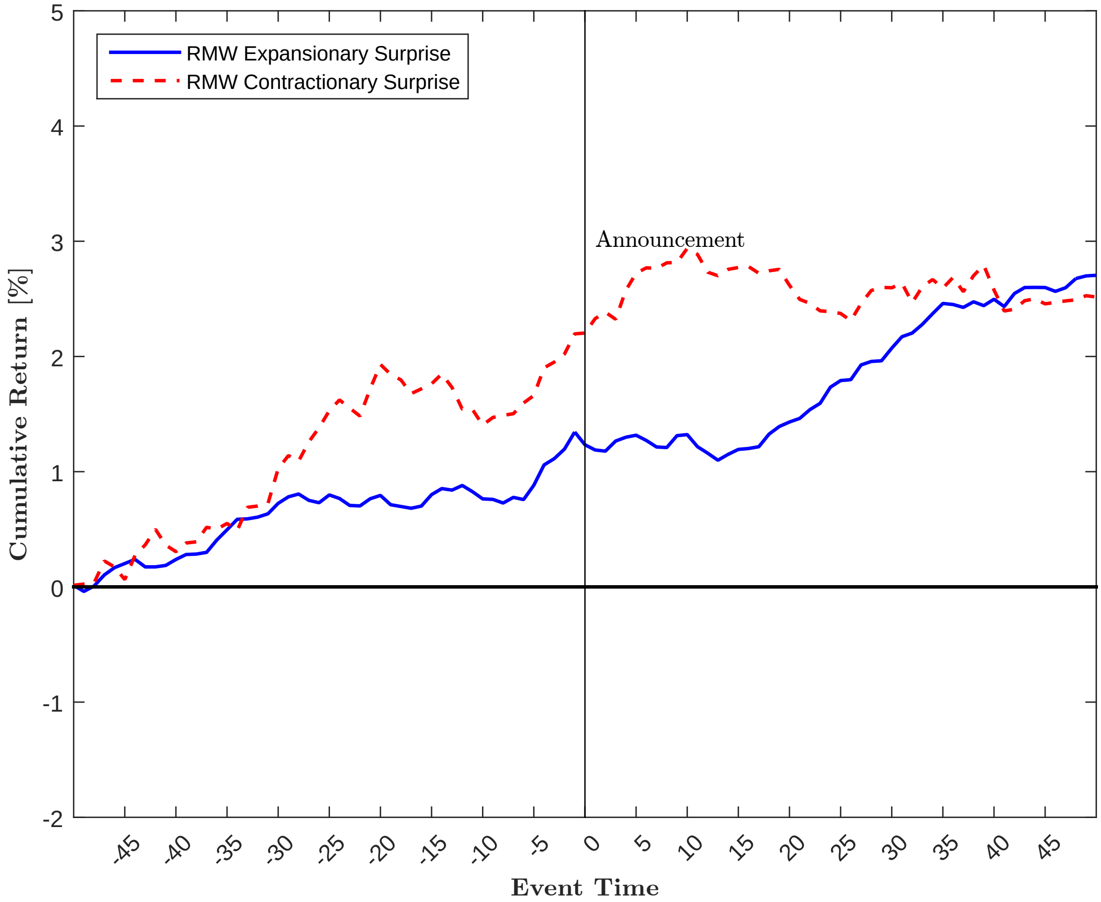
This figure plots cumulative returns in percent for the SMB factor around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 9: **Cumulative Returns around FOMC Policy Decisions: HML**



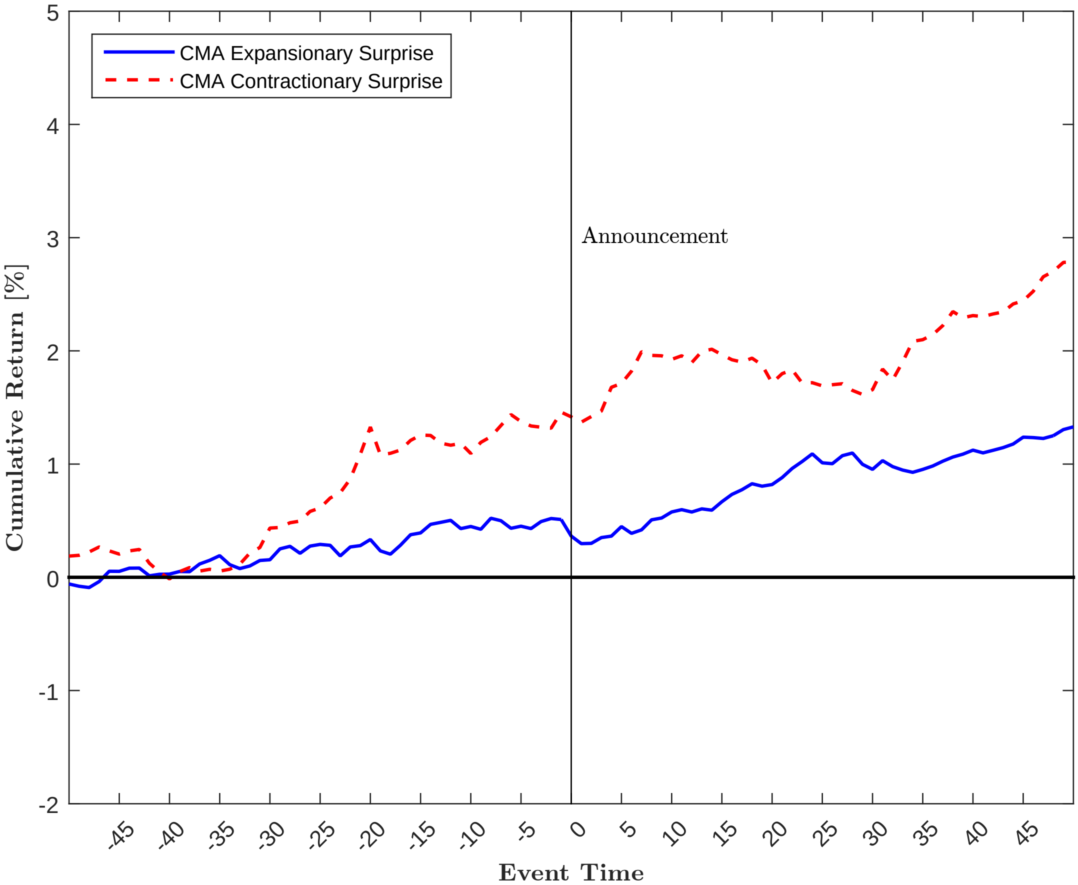
This figure plots cumulative returns in percent for the HML factor around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 10: **Cumulative Returns around FOMC Policy Decisions: RMW**



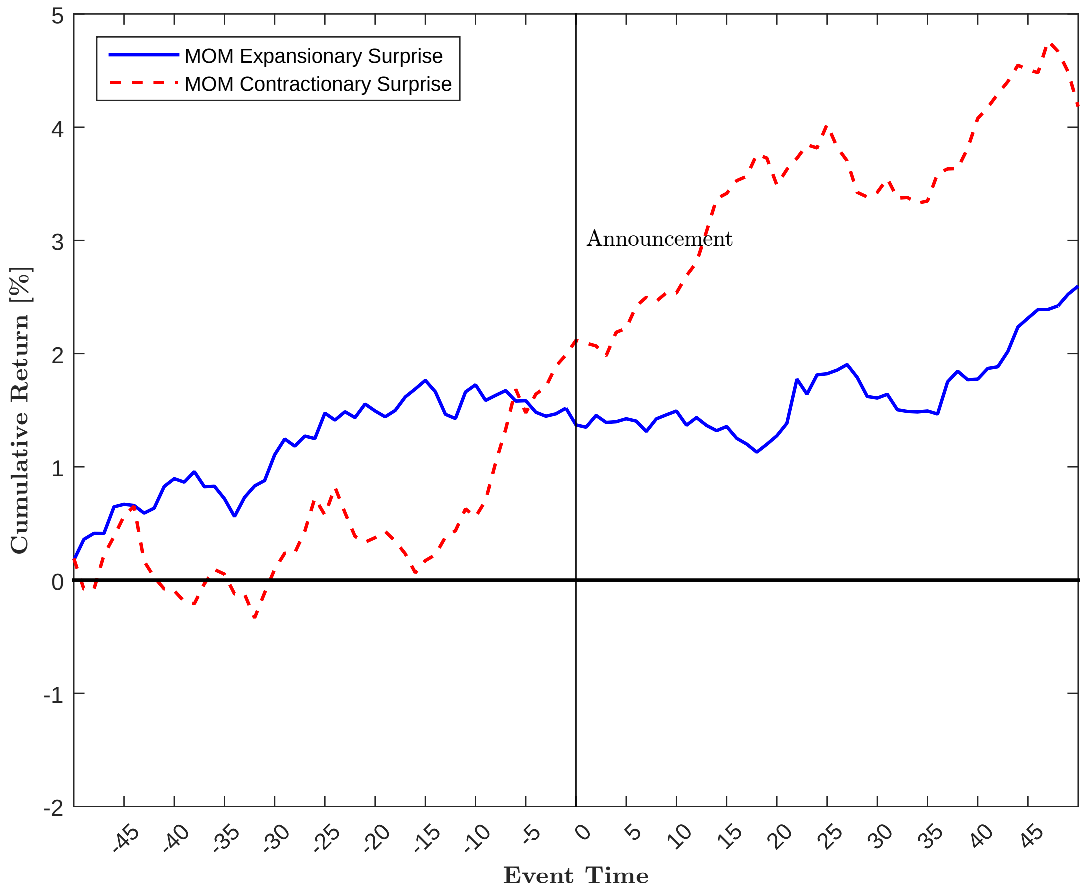
This figure plots cumulative returns in percent for the RMW factor around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 11: **Cumulative Returns around FOMC Policy Decisions: CMA**



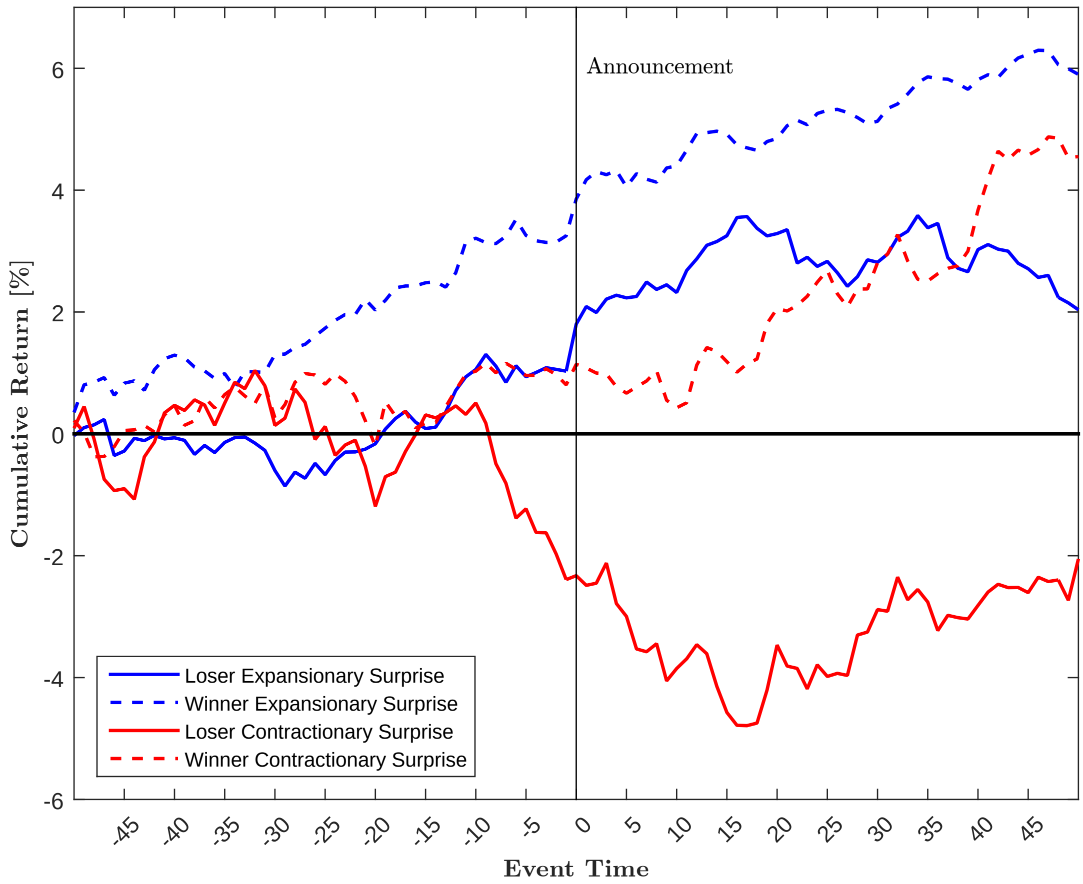
This figure plots cumulative returns in percent for the CMA factor around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 12: **Cumulative Returns around FOMC Policy Decisions: Momentum**



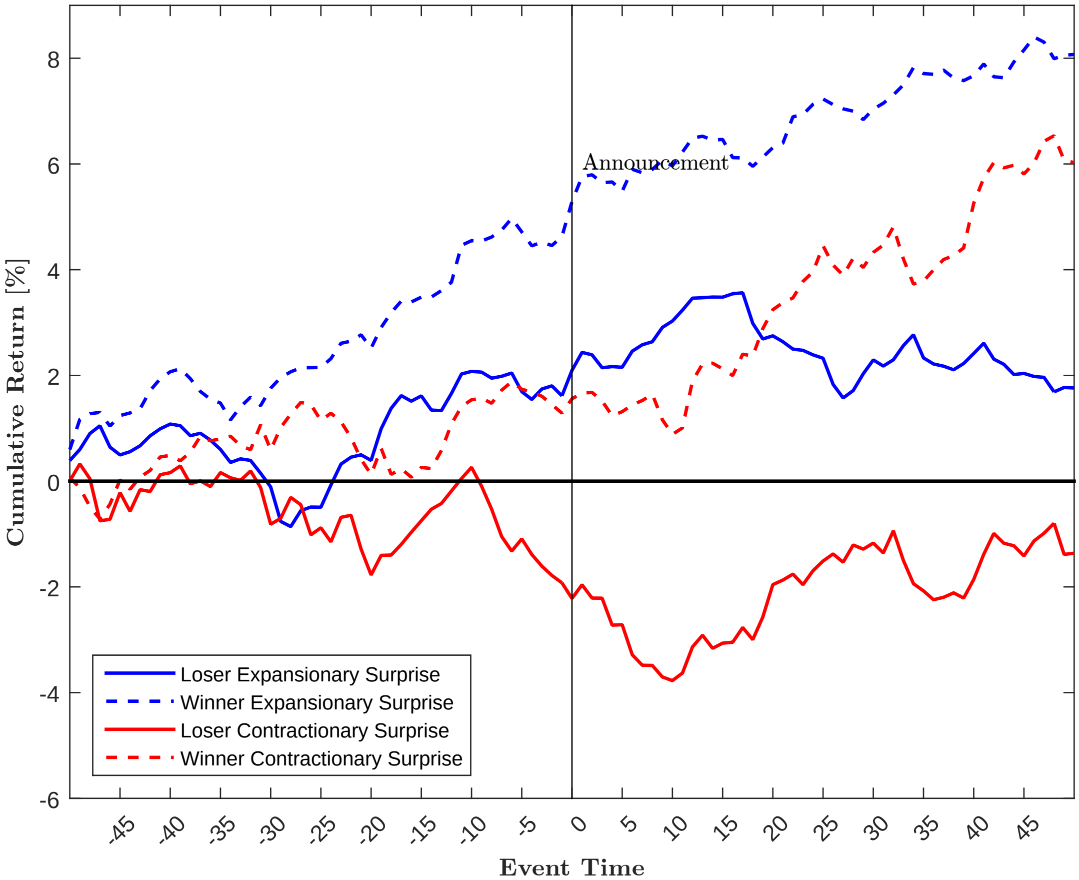
This figure plots cumulative returns in percent for the Momentum factor around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 13: **Cumulative Returns around FOMC Policy Decisions: Winners vs Losers**



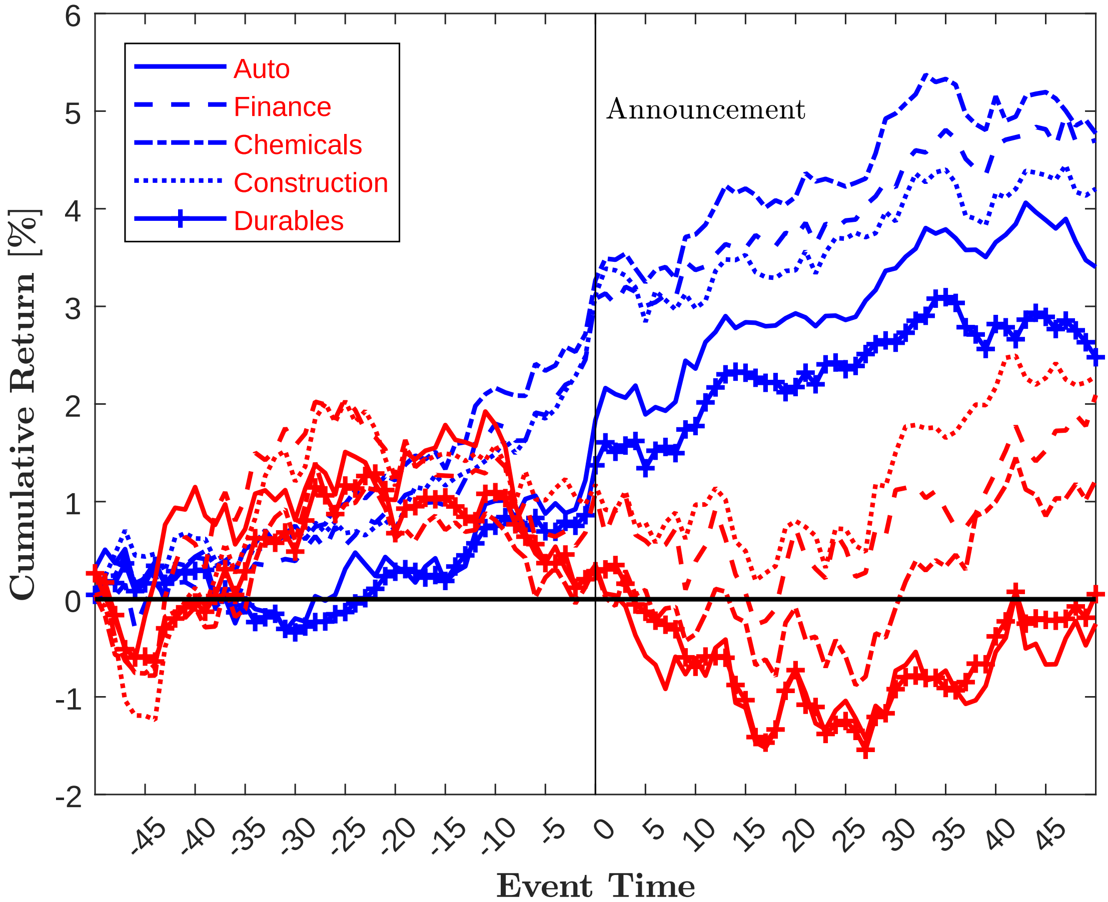
This figure plots cumulative returns in percent for past winners and losers around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 14: **Cumulative Returns around FOMC Policy Decisions: Winners vs Losers (1994–2004)**



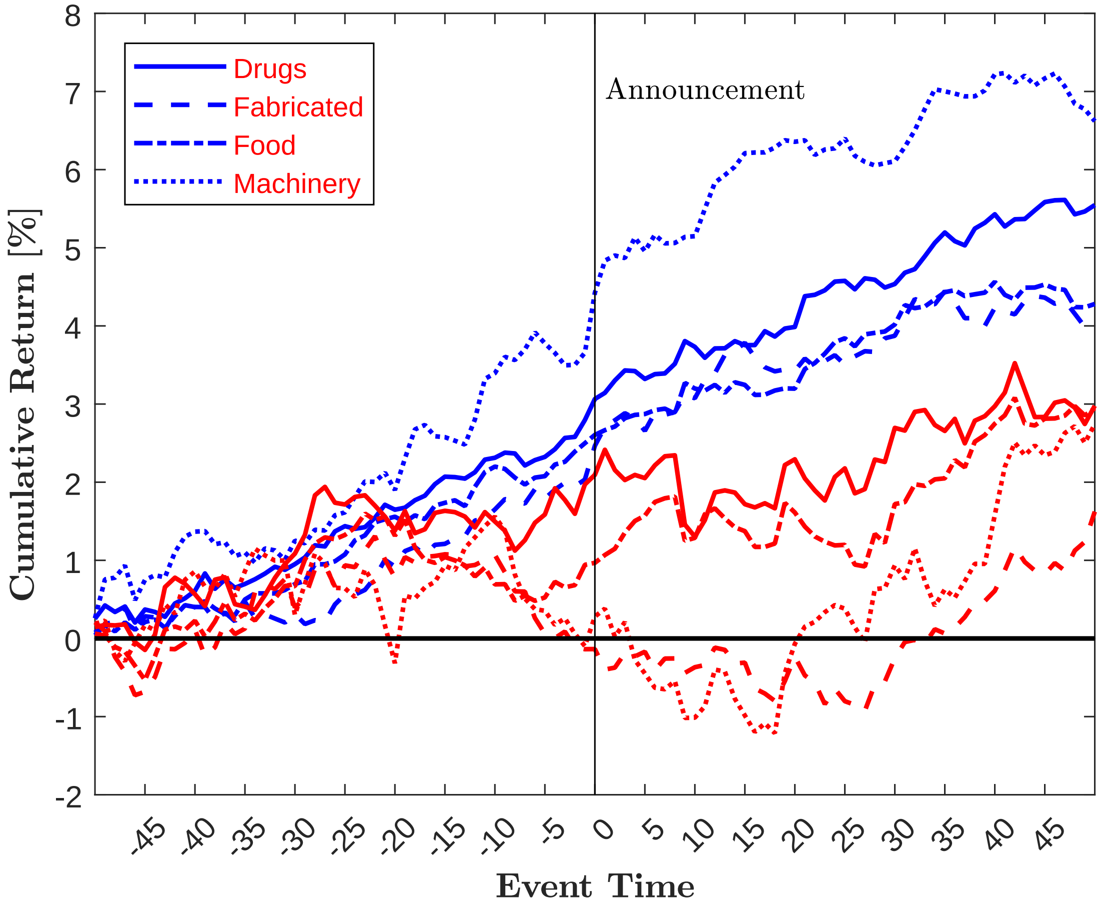
This figure plots cumulative returns in percent for past winners and losers around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2004.

Figure 15: **Cumulative Returns around FOMC Policy Decisions: Industry Returns I**



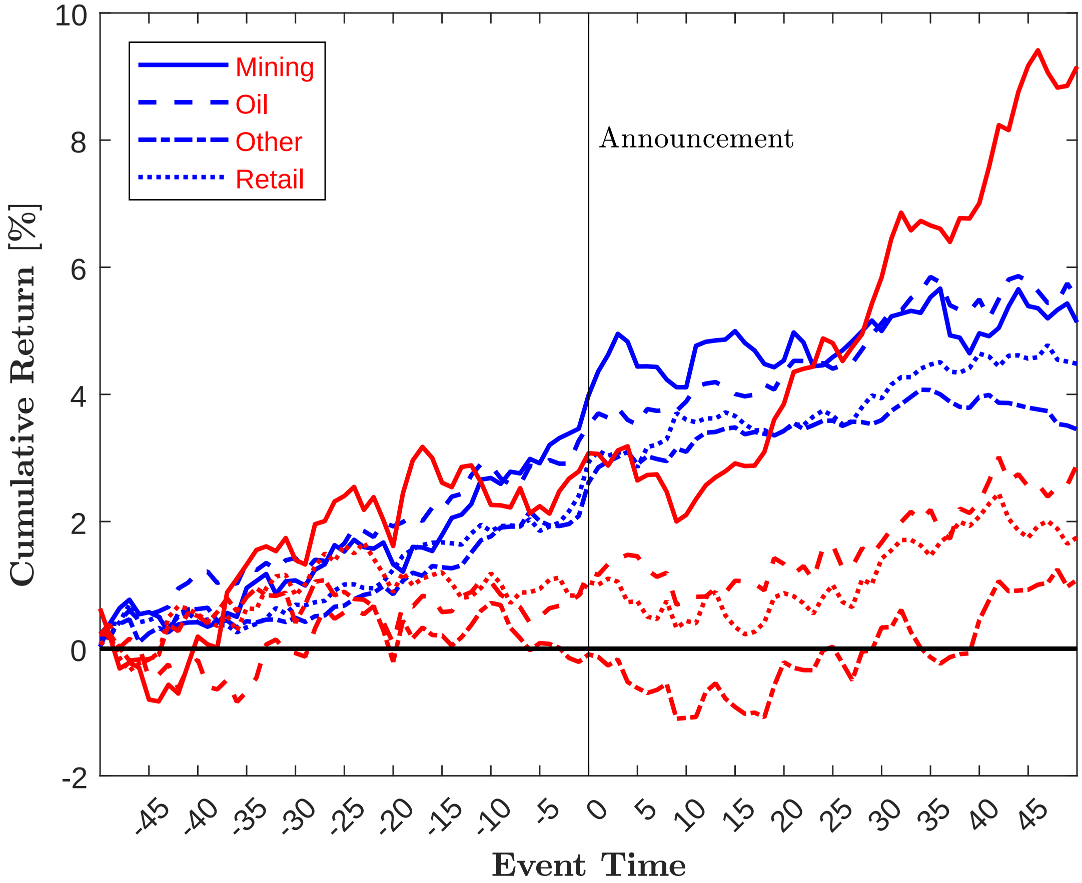
This figure plots cumulative returns in percent at the industry level around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 16: **Cumulative Returns around FOMC Policy Decisions: Industry Returns II**



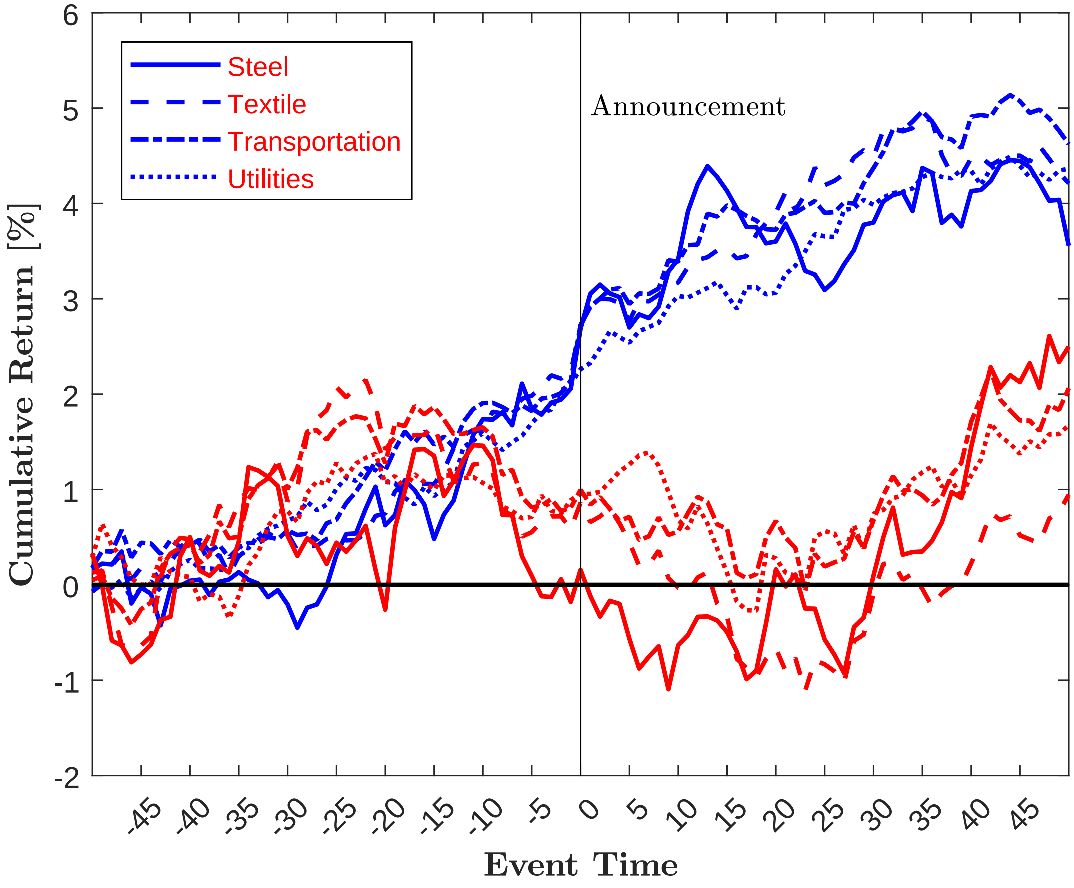
This figure plots cumulative returns in percent at the industry level around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 17: **Cumulative Returns around FOMC Policy Decisions: Industry Returns III**



This figure plots cumulative returns in percent at the industry level around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure 18: **Cumulative Returns around FOMC Policy Decisions: Industry Returns IV**



This figure plots cumulative returns in percent at the industry level around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Table 1: **Monetary Policy Shocks**

This table reports descriptive statistics for monetary policy shocks separately for all 137 event days between 1994 and 2009, turning points in monetary policy, and intermeeting policy decisions. The policy shock is calculated according to equation (1) as the scaled change in the current-month federal funds futures in a 30-minute window bracketing the FOMC press releases.

	All Event Days	Turning Points	Intermeeting Releases
Mean	−1.60	−6.09	−12.23
Median	0.00	−1.75	−5.73
Standard deviation	8.94	17.28	23.84
Min	−46.67	−39.30	−46.67
Max	16.30	16.30	15.00
Observations	137	8	8

Table 2: **Shock Transition Matrix**

The table reports the transition matrix of shocks from contractionary to expansionary. The sample period is from 1994 until 2009.

	Contractionary	Expansionary
Contractionary	39	34
Expansionary	33	30

Table 3: **Cumulative Returns around FOMC Decisions**

Panel A reports the cumulative return of the CRSP value-weighted index around FOMC policy decisions, excluding policy decisions on intermeetings. $\mathscr{D}^{exp}$ is a dummy that equals 1 if the monetary policy surprise is negative (expansionary). 0 is the day of the FOMC meeting. Panel B adds intermeeting policy dates, Panel C excludes intermeetings and turning points in monetary policy, and Panel D excludes events with zero monetary policy surprises. The sample period is from 1994 until 2009.

	-15	-10	-5	-1	0	1	2	3	4	5	10	15
						Panel A. No Intermeetings						
$\mathscr{D}^{exp}$	−0.05	0.06	0.83	1.11	1.46∗	1.75∗∗	1.85∗∗	1.83∗∗	2.10∗∗	2.02∗∗	2.68∗∗	2.92∗∗
	(−0.17)	(0.10)	(1.22)	(1.35)	(1.78)	(2.01)	(2.13)	(2.05)	(2.29)	(2.19)	(2.52)	(2.32)
Constant	0.02	0.43	−0.23	−0.26	−0.07	−0.15	−0.21	−0.11	−0.36	−0.46	−0.87	−0.76
	(0.07)	(0.96)	(−0.40)	(−0.35)	(−0.09)	(−0.19)	(−0.27)	(−0.15)	(−0.45)	(−0.60)	(−0.96)	(−0.69)
Nobs						129						
Adjusted R^2	-0.01	-0.01	0.00	0.01	0.02	0.03	0.03	0.03	0.04	0.03	0.04	0.04
						Panel B. With Intermeetings						
$\mathscr{D}^{exp}$	−0.02	0.14	0.88	1.14	1.45∗	1.73∗	1.84∗∗	1.91∗∗	2.19∗∗	1.89∗∗	2.45∗∗	2.79∗∗
	(−0.07)	(0.26)	(1.30)	(1.37)	(1.74)	(1.93)	(2.05)	(2.12)	(2.39)	(2.03)	(2.33)	(2.28)
Constant	−0.05	0.12	−0.52	−0.70	−0.42	−0.52	−0.60	−0.53	−0.78	−0.70	−0.99	−0.91
	(−0.24)	(0.26)	(−0.95)	(−1.00)	(−0.62)	(−0.70)	(−0.81)	(−0.70)	(−1.02)	(−0.96)	(−1.19)	(−0.90)
Nobs						137						
Adjusted R^2	-0.01	-0.01	0.01	0.01	0.01	0.0 2	0.02	0.03	0.04	0.02	0.03	0.03
						Panel C. No Intermeetings & Turningpoints						
$\mathscr{D}^{exp}$	0.06	0.28	1.03	1.36	1.59∗	1.84∗∗	1.85∗∗	1.82∗	2.04∗∗	1.91∗∗	2.58∗∗	3.03∗∗
	(0.22)	(0.51)	(1.47)	(1.63)	(1.89)	(2.04)	(2.04)	(1.98)	(2.15)	(2.00)	(2.33)	(2.33)
Constant	−0.10	0.26	−0.36	−0.43	−0.22	−0.25	−0.18	−0.06	−0.27	−0.35	−0.81	−0.88
	(−0.44)	(0.57)	(−0.62)	(−0.58)	(−0.30)	(−0.31)	(−0.23)	(−0.08)	(−0.33)	(−0.43)	(−0.86)	(−0.78)
Nobs						122						
Adjusted R^2	-0.01	-0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04
						Panel D. No Zero Surprises						
$\mathscr{D}^{exp}$	0.01	−0.05	0.75	1.25	1.69∗	1.94∗∗	2.04∗∗	2.15∗∗	2.46∗∗	2.28∗∗	2.91∗∗	3.12∗∗
	(0.03)	(−0.08)	(0.99)	(1.43)	(1.92)	(2.09)	(2.21)	(2.27)	(2.54)	(2.33)	(2.59)	(2.32)
Constant	0.02	0.43	−0.23	−0.26	−0.07	−0.15	−0.21	−0.11	−0.36	−0.46	−0.87	−0.76
	(0.07)	(0.96)	(−0.40)	(−0.35)	(−0.09)	(−0.19)	(−0.27)	(−0.15)	(−0.45)	(−0.60)	(−0.96)	(−0.69)
Nobs						103						
Adjusted R^2	-0.01	-0.01	0.00	0.01	0.03	0.04	0.04	0.04	0.05	0.04	0.06	0.04

Table 4: **Cumulative Returns around FOMC Decisions: Including Controls**

The table reports the cumulative return of the CRSP value-weighted index around FOMC policy decisions, excluding policy decisions on intermeetings. $\mathscr{D}^{exp}$ *is a dummy that equals 1 if the monetary policy surprise is negative (expansionary).* $Dummy^{inter}$ *indicates an intermeeting policy move,* $Dummy^{turn}$ *indicates a turning point in monetary policy, and* $\Delta FFTR$ *is the actual change in federal funds target rates. 0 is the day of the FOMC meeting. The sample period is from 1994 until 2009.*

	-15	-10	-5	-1	0	1	2	3	4	5	10	15
$\mathscr{D}^{exp}$	−0.09	0.08	0.83	1.09	1.34	1.63*	1.78*	1.80**	2.05**	1.79*	2.45**	2.82**
	(−0.34)	(0.15)	(1.23)	(1.30)	(1.60)	(1.76)	(1.94)	(1.99)	(2.22)	(1.88)	(2.23)	(2.25)
$\mathscr{D}^{inter}$	−0.91	−3.99***	−4.19***	−6.69***	−5.82**	−6.16*	−6.28*	−5.92**	−6.03**	−5.37	−4.21	−3.68
	(−1.30)	(−3.24)	(−2.72)	(−3.14)	(−2.17)	(−1.88)	(−1.89)	(−2.36)	(−2.45)	(−1.62)	(−1.14)	(−1.00)
$\mathscr{D}^{turn}$	0.80	0.58	0.13	0.30	1.41	0.88	−0.27	−0.72	−0.74	−0.71	0.35	1.21
	(1.19)	(0.53)	(0.10)	(0.18)	(1.03)	(0.67)	(−0.18)	(−0.42)	(−0.45)	(−0.43)	(0.22)	(0.56)
$\Delta FFTR$	−0.23	1.17	1.28	2.39	1.58	1.78	2.04	1.29	1.01	1.18	1.85	2.15
	(−0.27)	(0.87)	(0.65)	(1.21)	(0.66)	(0.74)	(0.95)	(0.63)	(0.54)	(0.61)	(0.70)	(0.74)
Constant	0.00	0.39	−0.23	−0.25	−0.05	−0.11	−0.14	−0.05	−0.28	−0.27	−0.72	−0.74
	(−0.00)	(0.85)	(−0.38)	(−0.33)	(−0.07)	(−0.13)	(−0.17)	(−0.06)	(−0.34)	(−0.33)	(−0.75)	(−0.66)
Nobs							137					
Adjusted R^2	0.01	0.10	0.07	0.15	0.11	0.11	0.11	0.10	0.10	0.06	0.05	0.04

Table 5: **Cumulative Returns around FOMC Decisions: Including Federal Funds Rate**

The table reports the cumulative return of the CRSP value-weighted index around FOMC policy decisions, excluding policy decisions on intermeetings. $\mathscr{D}^{exp}$ *is a dummy that equals 1 if the monetary policy surprise is negative (expansionary).* $\mathscr{D}^{inter}$ *indicates an intermeeting policy move,* $\mathscr{D}^{inter}$ *indicates a turning point in monetary policy,* $\Delta FFTR$ *is the actual change in federal funds target rates, and* FFR *is the actual federal funds rates. 0 is the day of the FOMC meeting. The sample period is from 1994 until 2009.*

	-15	-10	-5	-1	0	1	2	3	4	5	10	15
$\mathscr{D}^{expan}$	−0.09	0.08	0.82	1.07	1.32	1.61∗	1.76∗	1.79∗	2.03∗∗	1.78∗	2.43∗∗	2.80∗∗
	(−0.35)	(0.15)	(1.22)	(1.30)	(1.59)	(1.75)	(1.92)	(1.98)	(2.21)	(1.87)	(2.21)	(2.25)
$\mathscr{D}^{inter}$	−0.92	−4.03∗∗∗	−4.31∗∗∗	−6.87∗∗∗	−5.97∗∗	−6.32∗	−6.45∗	−6.04∗∗	−6.16∗∗	−5.48∗	−4.37	−3.86
	(−1.33)	(−3.23)	(−2.78)	(−3.29)	(−2.26)	(−1.94)	(−1.96)	(−2.43)	(−2.54)	(−1.66)	(−1.19)	(−1.06)
$\mathscr{D}^{turn}$	0.77	0.49	−0.16	−0.14	1.05	0.50	−0.69	−1.01	−1.06	−0.99	−0.05	0.77
	(1.15)	(0.45)	(−0.13)	(−0.08)	(0.79)	(0.39)	(−0.47)	(−0.60)	(−0.66)	(−0.60)	(−0.04)	(0.37)
$\Delta FFTR$	−0.26	1.09	1.03	2.02	1.27	1.45	1.68	1.05	0.73	0.94	1.51	1.77
	(−0.31)	(0.83)	(0.53)	(1.01)	(0.53)	(0.61)	(0.77)	(0.51)	(0.39)	(0.49)	(0.58)	(0.62)
FFR	2.81	7.15	21.90	32.80	26.90	28.70	31.10	21.10	24.00	21.00	30.20	33.30
	(0.42)	(0.51)	(1.19)	(1.64)	(1.28)	(1.29)	(1.41)	(0.91)	(1.05)	(0.85)	(1.05)	(1.02)
Constant	−0.10	0.12	−1.04	−1.47	−1.05	−1.17	−1.29	−0.83	−1.17	−1.05	−1.84	−1.98
	(−0.28)	(0.16)	(−1.04)	(−1.28)	(−0.92)	(−0.95)	(−1.07)	(−0.64)	(−0.90)	(−0.79)	(−1.22)	(−1.07)
Nobs						137						
Adjusted R^2	0.01	0.09	0.08	0.16	0.11	0.11	0.12	0.10	0.10	0.06	0.05	0.04

Table 6: **Cumulative Returns after FOMC Decisions: Post Announcement**

The table reports the cumulative return of the CRSP value-weighted index following FOMC policy decisions, excluding policy decisions on intermeetings. $\mathscr{D}^{exp}$ is a dummy that equals 1 if the monetary policy surprise is negative (expansionary). 0 is the day of the FOMC meeting. The sample period is from 1994 until 2009.

	1	2	3	4	5	10	15
$\mathscr{D}^{exp}$	0.31	0.40	0.37	0.64	0.53	1.21**	1.47**
	(1.26)	(1.25)	(0.99)	(1.50)	(1.13)	(2.18)	(1.98)
Constant	−0.09	−0.14	−0.05	−0.29	−0.38	−0.82*	−0.74
	(−0.46)	(−0.56)	(−0.15)	(−0.84)	(−0.99)	(−1.81)	(−1.22)
Nobs				129			
Adjusted R^2	0.00	0.00	0.00	0.01	0.00	0.03	0.02

Table 7: **Trading Strategies and Sharpe Ratios**

The table reports daily mean excess returns, standard deviations, and annualized Sharpe ratios of buy-and-hold strategies and monetary momentum strategies for different event windows in trading days around FOMC policy decisions, excluding policy decisions on intermeetings, in Panel A, and for the five Fama & French factors plus times-series momentum and cross-sectional momentum in Panel B. t indicates the FOMC meeting. The monetary momentum strategy is invested in the market when the monetary policy shock is expansionary and shorts the market for contractionary monetary policy surprises. The sample period is from 1994 until 2009.

Panel A. Market Returns and Monetary Momentum

	t-15 – t+15		t-15 – t+15, excl t-1 & t=0		t+1 – t+15		Annual	
	Buy and hold	Monetary Momentum	Buy and hold	Monetary Momentum	Buy and hold	Monetary Momentum	Buy and hold	Buy and hold +
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean	0.02	0.05	0.00	0.04	0.01	0.04	0.02	0.04
Std	(1.31)	(1.31)	(1.30)	(1.30)	(1.30)	(1.30)	(1.24)	(1.24)
$SR_{annualized}$	0.20	0.61	-0.02	0.43	0.13	0.52	0.31	0.46

Panel B. Factor Returns

	TS Mom	SMB	HML	Prof	Invest	Mom
	(1)	(2)	(3)	(4)	(5)	(6)
Mean	0.04	0.01	0.01	0.02	0.01	0.02
Std	(1.31)	(0.64)	(0.72)	(0.57)	(0.51)	(1.04)
$SR_{annualized}$	0.50	0.24	0.31	0.58	0.40	0.34

Table 8: **Spanning Tests**

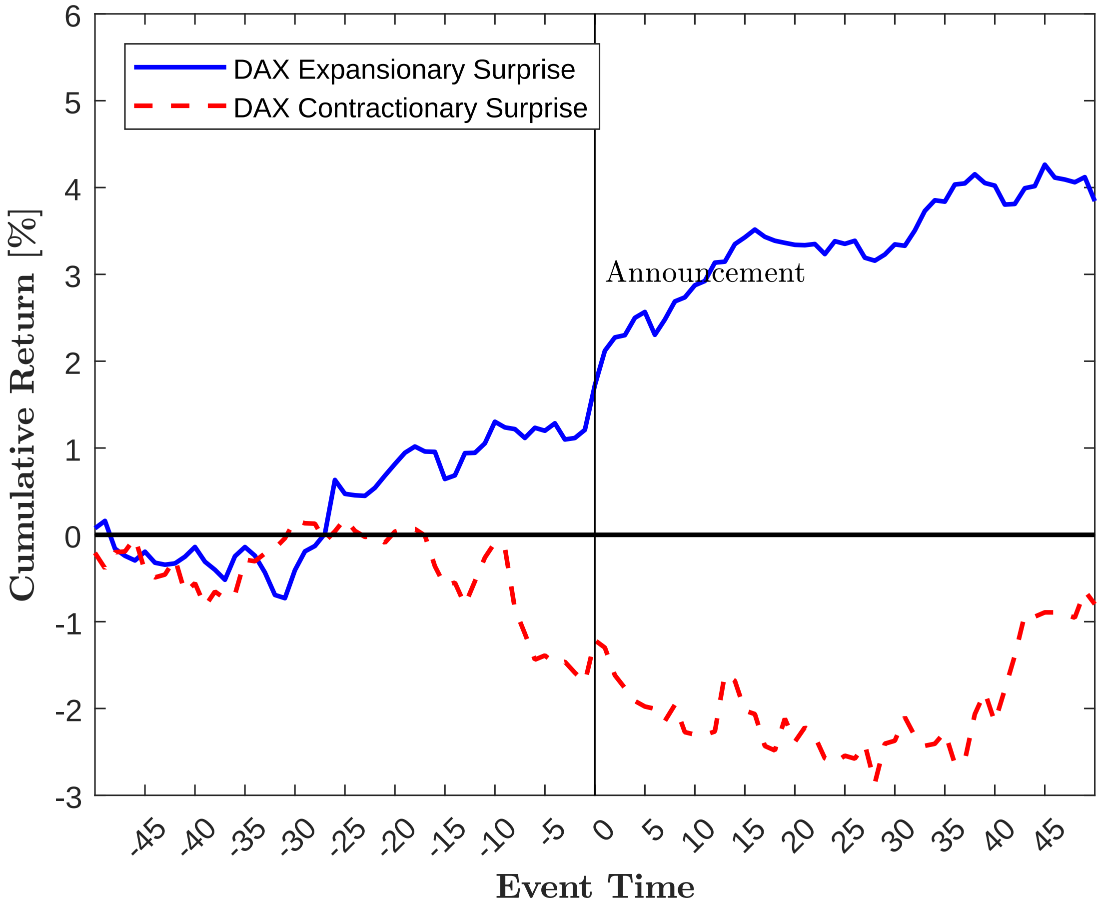
The table reports spanning tests of monetary momentum and times-series momentum strategies on the Fama & French three- and five-factor models. The sample period is from 1994 until 2009.

	Monetary Momentum (1)	Times-Series Momentum (2)	Monetary Momentum (3)	Monetary Momentum (4)
Time-series Momentum	−0.11***		−0.016	−0.022
	(−7.14)		(−1.03)	(−1.44)
Monetary Momentum		−0.11***		
		(−7.14)		
Market			0.33***	0.37***
			(21.91)	(21.48)
SMB			0.12***	0.17***
			(3.83)	(5.24)
HML			0.12***	0.077**
			(4.53)	(2.47)
Invest				0.069
				(1.45)
Prof				0.19***
				(4.65)
alpha	0.055***	0.047**	0.043**	0.038**
	(2.76)	(2.32)	(2.27)	(2.02)
Nobs	4,247			
Adjusted R^2	0.01	0.01	0.11	0.12

Online Appendix: Monetary Momentum

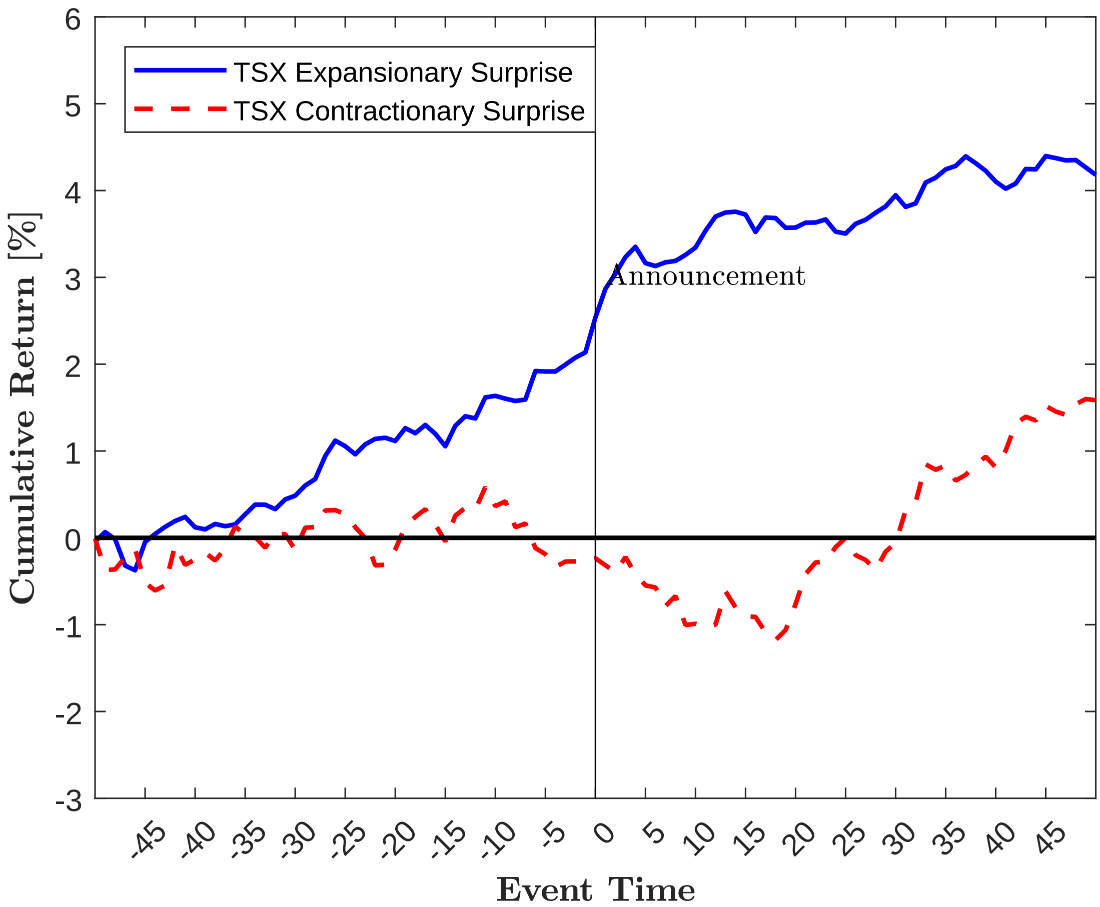
Not for Publication

Figure A.1: **Cumulative Returns around FOMC Policy Decisions: DAX 30**



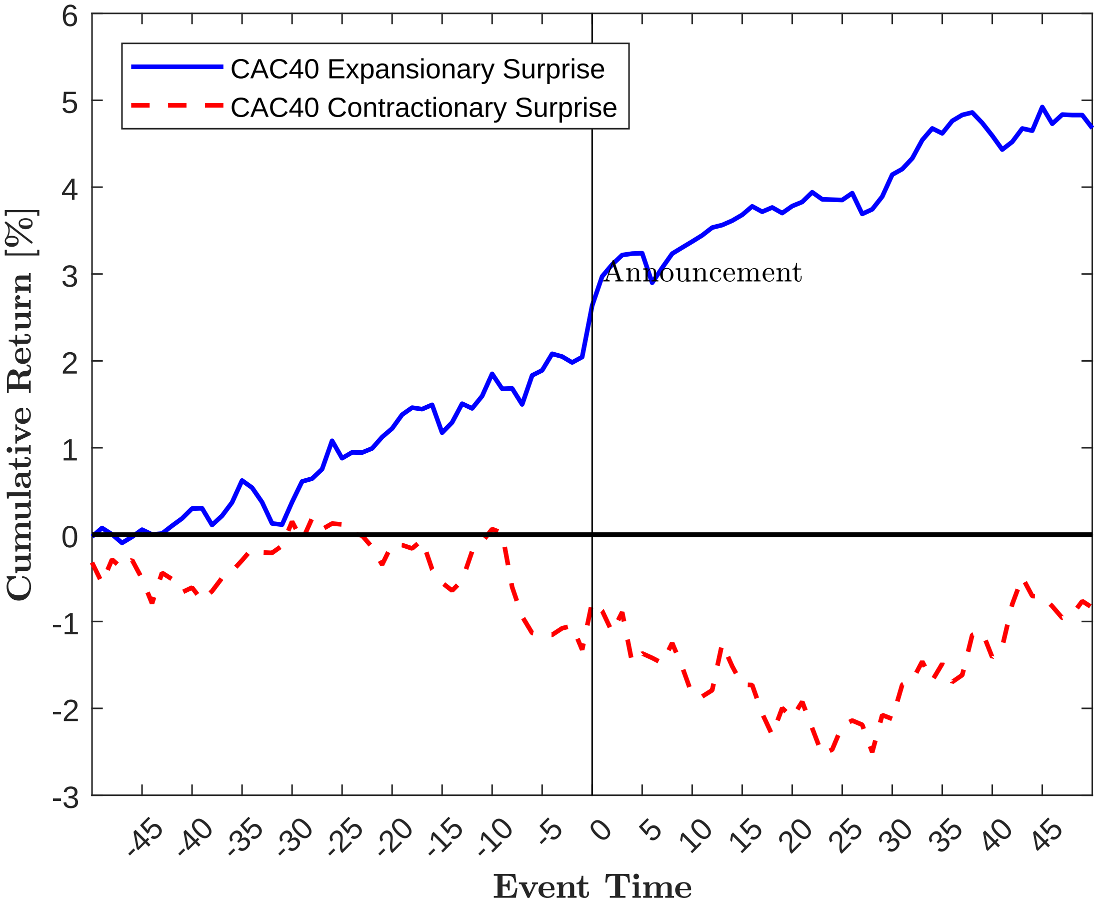
This figure plots cumulative returns in percent for the DAX 30 around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure A.2: **Cumulative Returns around FOMC Policy Decisions: TSX 300**



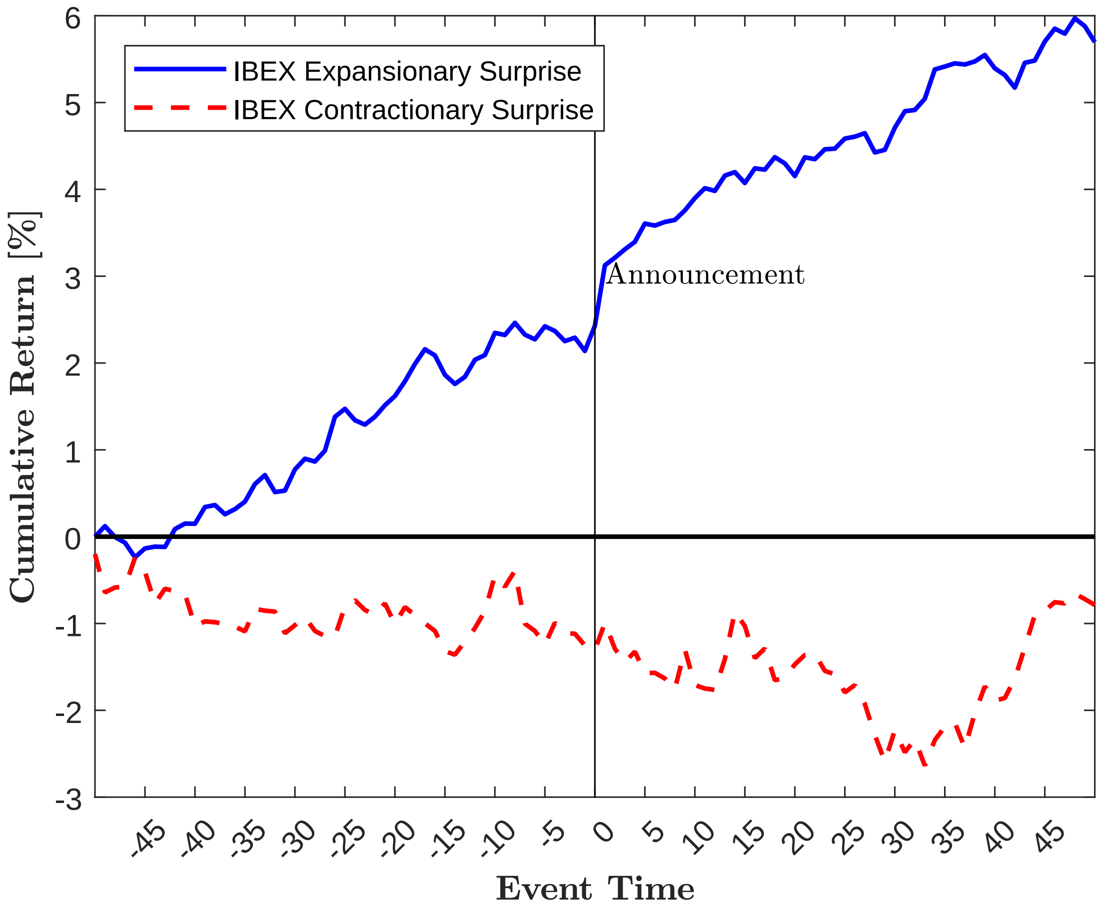
This figure plots cumulative returns in percent for the TSX 300 around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure A.3: **Cumulative Returns around FOMC Policy Decisions: CAC 40**



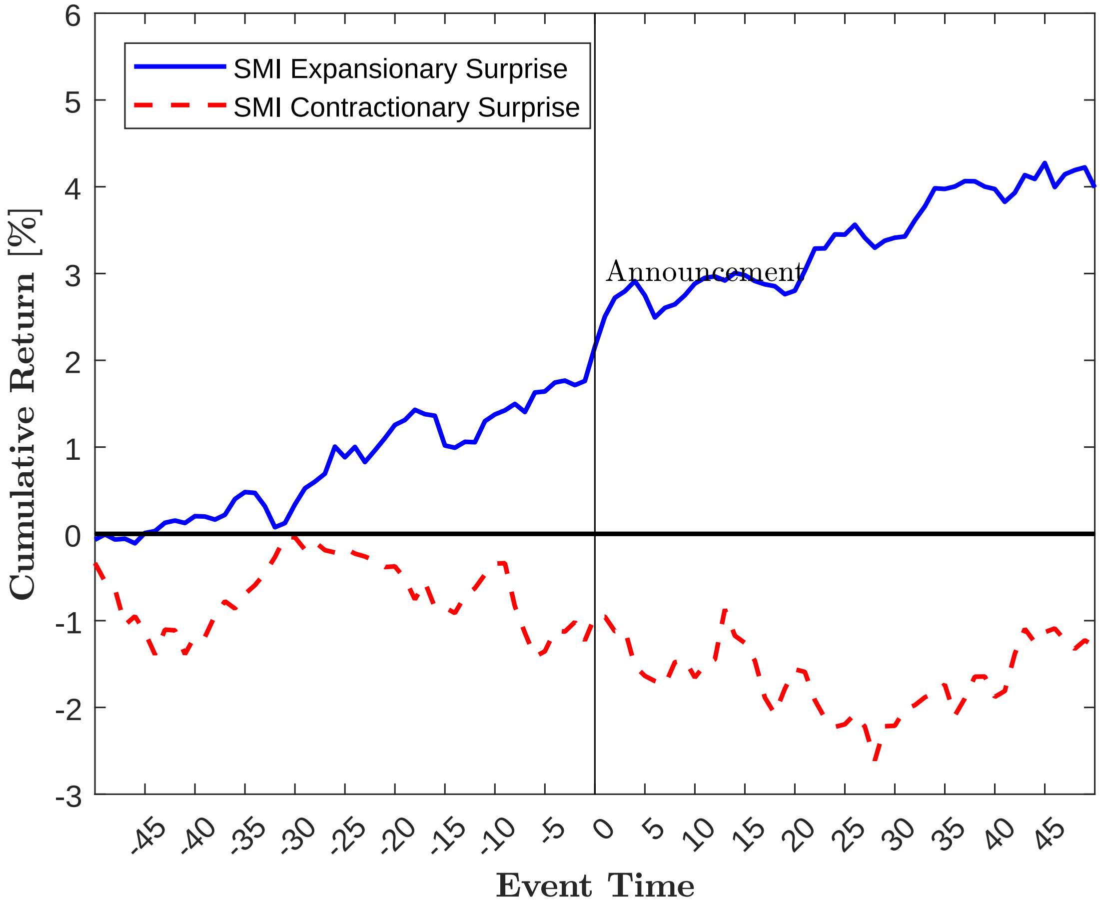
This figure plots cumulative returns in percent for the CAC 40 around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure A.4: **Cumulative Returns around FOMC Policy Decisions: IBEX 35**



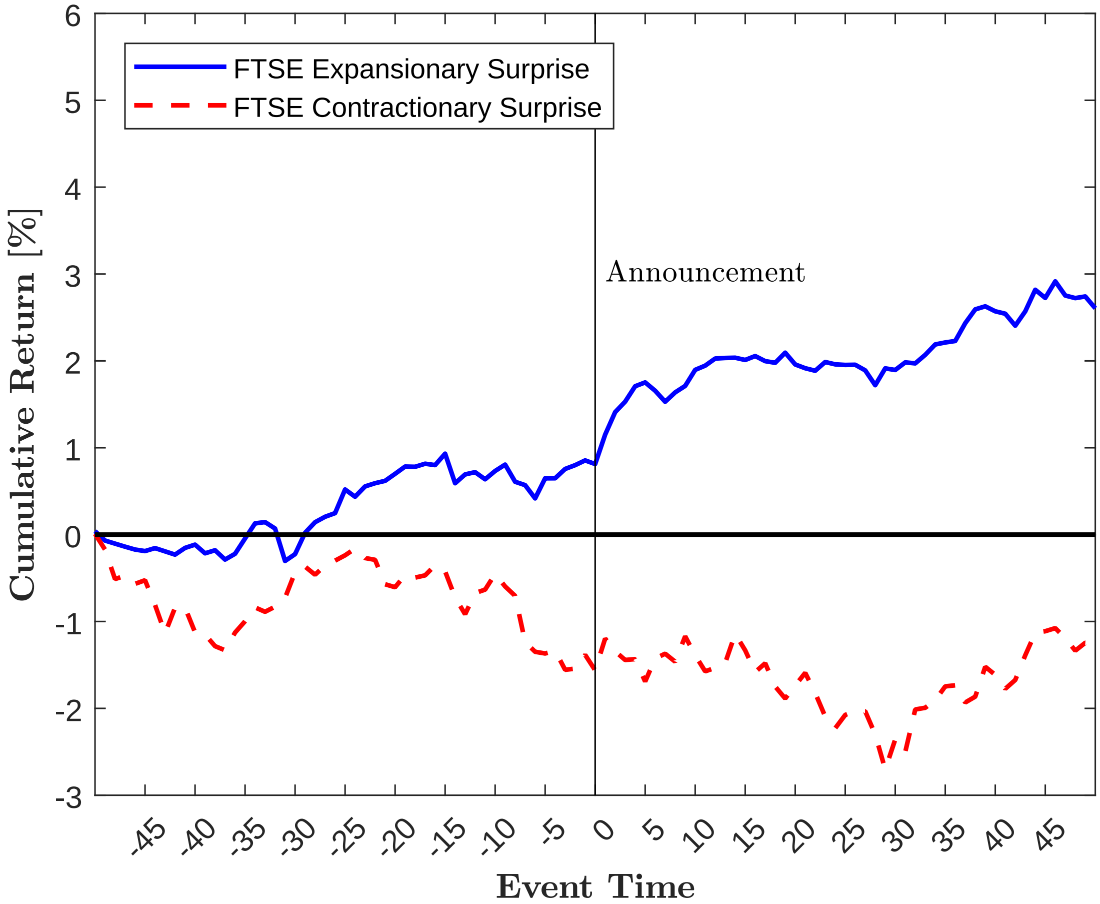
This figure plots cumulative returns in percent for the IBEX 35 around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure A.5: **Cumulative Returns around FOMC Policy Decisions: SMI**



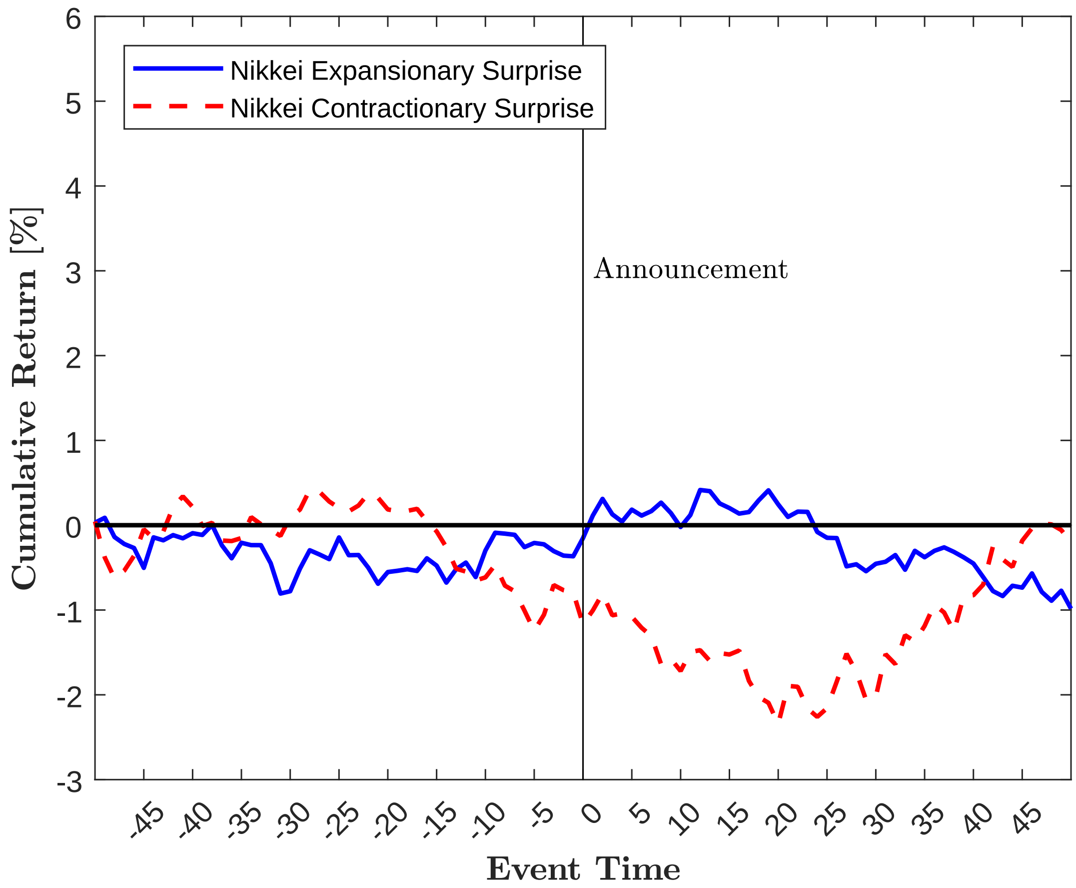
This figure plots cumulative returns in percent for the SMI around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure A.6: **Cumulative Returns around FOMC Policy Decisions: FTSE 100**



This figure plots cumulative returns in percent for the FTSE 100 around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.

Figure A.7: **Cumulative Returns around FOMC Policy Decisions: Nikkei 225**



This figure plots cumulative returns in percent for the Nikkei 225 around FOMC policy decisions separately for positive (contractionary; red-dashed line) and negative (expansionary; blue-solid line) monetary policy surprises. The sample period is from 1994 to 2009.