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Monetary Policy and the Equity Term Structure

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Abstract

We study the impact of monetary policy on the term structure of equity prices. We find that short-term and long-term equity prices respond in opposite ways to changes in monetary policy. Following an unanticipated cut in the target federal funds rate, short-term equity prices fall while long-term equity prices rise on average. This pattern could arise if policy decisions signal information about economic conditions. We examine this mechanism and find that the price change of the short-term equity asset in the 30-minute window around an FOMC announcement significantly predicts both macroeconomic growth and professional forecast errors over subsequent quarters.

JEL Classification: E50, G10

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1 Introduction

Asset prices provide an important way to study the impact of monetary policy. Unlike economic outcomes, which are often realized far into the future, the market prices of claims to real assets quickly adjust to incorporate the expected impact of monetary policy news on the future path of the economy. Consequently, researchers have extensively studied the link between the monetary policy and the overall stock market. Among key work in this area, Bernanke and Kuttner (2005) find that unexpected cuts to the target federal funds rate are associated with increases in stock market prices and document evidence that this response is primarily driven by discount rates. In our paper we contribute to this literature by estimating the term structure of equity prices in order to measure the differential effects of Fed policy announcements over the short- and long-term horizons. The empirical facts we document help shed light on a debate in the recent literature that Fed policy announcements reveal information about the current economic conditions (Nakamura and Steinsson 2018).[1]

We estimate the term structure of market prices using information embedded in the price of European put and call options on the S&P 500 index. An investor who holds a replicating portfolio of the S&P 500 index will receive dividend payments from its constituent firms while an investor who uses options to create synthetic exposure to the S&P 500 index will not be entitled to dividends. This difference allows us to estimate the implied prices of short-term dividends from the S&P 500 index based on the difference between option-implied prices and the value of the underlying index. We innovate on the methodology used in Van Binsbergen, Brandt, and Koijen (2012) and employ the linear regression approach of Golez and Jackwerth (2020) to simultaneously estimate intra-daily dividend prices and risk-free rates from the put-call parity restriction. We implement this procedure using options of different maturities to obtain the implied prices of short-term assets which pay the dividends of the S&P 500 over near-term horizons ranging from 180 days to 720 days.

[1] C. D. Romer and D. H. Romer (2000), Faust, Swanson, and Wright (2004), Campbell et al. (2012), Lunsford (2020), Bundick and Smith (2020), and Bauer and Swanson (2020).

We study the price response of these short-horizon assets to each FOMC announcement. We construct a measure of monetary policy shocks using tick-by-tick data on the 30 Day Federal Funds Futures contract from the CME group. We follow the procedure implemented in Nakamura and Steinsson (2018) by measuring unexpected changes in interest rates around the 30-minute window surrounding scheduled Federal Reserve announcements. We similarly estimate the change in price of the equity dividend strips over the same 30-minute window: from 10 minutes before the FOMC decision is released to 20 minutes after.

Unlike the market, the short-maturity assets only provide claims to cash flows over the immediate horizon and not over longer horizons which allows us to isolate investor beliefs about the short-horizon impacts of Fed announcements. Our identification comes from the fact that all public information at start of the 30-minute announcement window is already embedded into the initial Fed Funds futures and options prices. We also estimate the response of the long-term equity asset, the S&P 500 index return, over this same interval for comparison.

We examine returns around each FOMC announcement and find that prices of the short-term equity asset and the price of the long-term equity asset (the market) respond to changes in monetary policy in the exact opposite way. First, we replicate the findings in the prior literature by regressing the market return over the 30-minute window around the FOMC announcement on the monetary policy surprise. Consistent with the findings in Bernanke and Kuttner (2005), we estimate a negative and significant coefficient on the monetary policy shock in the market regression. We then run separate regressions of the 30-minute FOMC announcement window returns for dividend strips at maturities ranging from 180-days to 720-days on the monetary policy surprise. The coefficient estimates on the monetary policy shock are positive at all maturities up to 720-days and significant at the 5 percent level at the 180 day horizon. A one standard deviation increase (decrease) in the monetary policy shock corresponds to a 0.78 percent increase (decrease) in the price of the short-term asset and a 0.18 percent decrease (increase) in the market price.

In a simple non-parametric test, we categorize each FOMC announcement as positive, negative or zero based on the sign of the monetary policy shock at each meeting date and then estimate the average response of each dividend strip and

the market within each category. The results presented in Figure 1 are consistent with our baseline findings: following positive (negative) monetary policy shocks, the price of the 180-day dividend strip increases (decreases) while the price of the long-term asset falls (increases) on average. The average response of dividend strip prices to monetary shocks attenuates as the maturity of dividend strips increases.

The opposite response of the short-term assets and the long-term asset to monetary policy news cannot be explained by channels which produce persistent shocks purely to discount rates (or purely to expected cash flows). Furthermore, we find that the response of risk-free rates to monetary policy shocks cannot explain the short-term asset returns.

One channel that could generate our empirical findings is the idea that central bank policy announcements reveal information about the current state of the economy (referred to as "Fed Information effects" in the literature). For example, a larger than expected cut to the target Federal Funds rate may be good news for the aggregate stock market given the impact of lower rates on spending and investment in the long run. But this decision may signal to investors that economic conditions are worse than previously assumed, causing investors to revise down forecasts for near-term future cash flows and economic conditions and lowering the short-term asset price.

The existence of the Fed Information channel is debated in the literature with mixed empirical evidence. Some of the strongest evidence of a Fed Information effect is provided by Nakamura and Steinsson (2018), who document that unexpected changes to interest rates over the 30-minute window surrounding Federal Reserve announcements predict private sector forecast revisions for output growth with a positive sign (the opposite sign expected under the conventional interpretation of monetary policy shocks).[2] However, a number of studies have questioned the existence of information effects (Faust, Swanson, and Wright (2004), Bundick and Smith (2020), and Bauer and Swanson (2020)). Bauer and Swanson (2020) argue that the results in Nakamura and Steinsson (2018) could be driven by macroeconomic news released between the time the private sector forecasts are measured

[2]See also C. D. Romer and D. H. Romer (2000) and Campbell et al. (2012) for some of the earliest evidence for this channel.

and the FOMC meeting date.

The short-term asset announcement response provides a way to test the Fed Information channel while addressing the concerns raised by Bauer and Swanson (2020) and others. Since these equity strip prices incorporate shocks to short-horizon aggregate cash flow expectations, we design a set of tests of the Fed Information channel based on the joint hypothesis that: Fed Information effects exist; and these effects drive a component of the variation in short-term asset prices around the FOMC announcement. In this case, the short-term asset return around each FOMC announcement should forecast measures of near-term economic conditions. We consider two leading indicators of macroeconomic conditions: real GDP growth and real consumption growth. We run predictive regressions of $k-quarter$ ahead quarterly real GDP (real consumption) growth on price changes in the 180-day dividend strip in the 30-minute window around each FOMC announcement. In the GDP forecasting regressions, the coefficients on the short-term asset announcement return are positive at the 1 quarter to 5 quarters out horizons and significant at the 5 percent level at the 3 quarter horizon and at the 10 percent level at the 2 quarter horizon. The magnitudes of the coefficients tend towards zero as the horizon increases and are negative at the 6 and 7 quarter horizons. Based on the estimated coefficients, a one standard deviation decrease in short-term asset price corresponds to a 0.45 percent decline in real GDP growth over the next three quarters. The $k-quarter$ ahead quarterly real consumption growth predictive regression results are similar.

In prior studies, the sign of the monetary policy shock is used to infer the average type of Fed Information released about economic conditions: unexpected cuts (increases) to the target rate are a negative (positive) signal about economic conditions on average. In our setting, the short-term asset return provides a measure of Fed Information that does not require an assumption about the average type of Fed Information (positive or negative) based on the sign of the monetary policy shock. This flexibility allows us to account for other types of guidance or information released in the FOMC announcements as well as unobserved factors that may alter private sector perceptions of monetary policy surprises.

Furthermore, measuring Fed Information using the short-term asset announce-

ment return can help address an issue discussed by Nakamura and Steinsson (2018) who note that the standard deviation of the high-frequency monetary policy shock is only 5 basis points which creates a "power problem" that precludes the most direct test of the Fed Information channel: directly predicting future output growth. The short-term asset announcement returns exhibit substantially greater variation across FOMC meetings with a standard deviation of 3.0 percent. We run our real GDP growth and real consumption growth predictive regressions on all FOMC meetings, including meetings with no monetary policy surprise, and find a similar pattern of results.

Tests of economic growth predictability are not subject to concerns about forecaster incentives or frictions that may affect the reliability of macroeconomic forecasts: for example, individuals whose business depends on the perception of superior forecasting ability may be incentivized to maintain their prior stance and refrain from revising their forecasts to closely follow statements or forecasts from the Federal Reserve. Empirically, researchers have documented stickiness in macroeconomic growth forecasts (e.g. Coibion and Gorodnichenko (2015) show that forecast revisions predict subsequent forecast errors with a positive sign). This stickiness, whether driven by reputational concerns or other factors, may attenuate the response of forecasters to Fed announcements and limit evidence in favor of the Fed Information channel, potentially lead to the conflicting empirical findings in the literature regarding the existence of Fed Information effects.

Despite these issues, survey data can provide an important measure of private sector beliefs about economic conditions. Our next set of tests incorporates these private sector beliefs using macroeconomic forecast data from the Survey of Professional Forecasters. Given the concerns with forecast revisions discussed above, we focus our study on the predictability of forecast errors. Specifically, we consider professional forecasts for annual real GDP growth and real consumption growth made before each FOMC meeting and test whether the short-term dividend return predicts errors in these forecasts with a positive sign. If the short-term dividend price response to the monetary policy news released at the corresponding FOMC meeting does not contain new information about macroeconomic conditions, then forecast errors should not correlated with these price movements. On the other

hand, predictability in forecast errors suggests that Fed announcements embed relevant information about macroeconomic conditions. We find that forecast errors are predictable by the short-term dividend price response in the 30-minute window around the FOMC announcement with a positive sign: positive short-term dividend returns predict a larger gap between future realized real GDP growth (and real consumption growth) and the latest private sector forecasts made prior to the FOMC announcement.

In our last set of tests, we characterize the type of information contained in Fed announcements that drives variation in the short-term asset announcement returns. We examine two sources of information: the advance release of the Summary of Economic Projections (SEP) and the FOMC meeting minutes. We extract the FOMC participant forecasts for key economic variables from the advance release of the SEP and compare these projections to private sector forecasts. We find that the forecast gap, the difference between the SEP forecasts and private sector forecasts, is positively related to the short-term asset announcement return on meeting dates when the advance SEP is released. Finally, we parse the FOMC meeting minutes into sections based on content type and assign a numerical score to each section based on the tone of the Fed discussion using the sentiment text classification developed in Loughran and McDonald (2011). We show that the tone of Fed discussion around topics related to economic conditions forecasts future economic growth and also explains a portion of the short-term asset announcement returns.[3]

Our work relates to a large body of literature which studies the impact of monetary surprises on asset prices and macroeconomy.[4] We contribute to this literature by documenting the novel fact that short- and long-term asset prices react to monetary policy shocks in opposite ways. While this opposite response is consistent with the idea that Fed announcements signal information to investors about the current state of the economy, the existence of Fed Information effects is debated in

[3]The meeting minutes are typically released several weeks after the FOMC announcement. Our results indicate that the FOMC discussions contain information valuable to private sector beliefs about economic conditions. However, the minutes themselves are not the transmission mechanism into short-term asset prices.

[4]Papers include: Kuttner (2001); Bernanke and Kuttner (2005); Gürkaynak, Sack, and Swanson (2004); Campbell et al. (2012); Nakamura and Steinsson (2018); Cieslak and Schrimpf (2019); Jarocinski and Karadi (2020); Swanson (2021).

the literature (C. D. Romer and D. H. Romer (2000), Faust, Swanson, and Wright (2004), Campbell et al. (2012), Nakamura and Steinsson (2018), Lunsford (2020), Bundick and Smith (2020), and Bauer and Swanson (2020)). By studying changes in the equity term structure around FOMC announcements, we overcome many of the challenges faced by existing tests in the literature and provide strong evidence in favor of the Fed Information channel through a set of macroeconomic predictability results. Overall, our results indicate that the Fed Information channel is an additional transmission mechanism for monetary policy and would play a key role in central bank communications and policy decisions.

We also contribute to a fast-growing body of work analyzing the term structure of equity returns (Van Binsbergen, Brandt, and Koijen (2012); Van Binsbergen and Koijen (2017); Weber (2018); Li and Wang (2018); Bansal et al. (2019); Gormsen (2018); Golez and Jackwerth (2020)). While this literature focuses on the level and the time-series variation in the term structure of equity returns at monthly or lower frequencies, we analyze the high frequency response of the term structure to key macroeconomic shocks to understand precisely how this news transmits into the market and the economy.

The rest of the paper is organized as follows. In Section 2, we describe the construction of the monetary policy shock and the estimation of the short-term equity prices. Section 3 presents our main empirical results. Section 4 presents a set of predictability tests of the Fed Information channel. Section 5 examines the information content of Fed announcements which drive variation in the short-term asset return. Section 6 concludes the paper.

2 Measure Construction

In this section, we discuss the construction of the high-frequency monetary policy shock and describe the methodology to obtain the price of the short-term equity assets. We discuss the timing and procedure for measuring the response of short-term equity prices to monetary policy shocks.

2.1 Monetary Policy Shock

We use tick-by-tick data on the 30 Day Federal Funds Futures contract from the CME group to measure changes in expectations of the current month Federal Funds rate around each FOMC announcement. We follow the approach used in Nakamura and Steinsson (2018), by measuring unexpected changes in interest rates around the 30-minute window surrounding scheduled Federal Reserve announcements. This high-frequency approach provides stronger identification than monetary policy shocks constructed using daily futures data.

We obtain FOMC meeting dates and the timestamp when the meeting decision was made public from January 2004 to December 2019. The dates and times of FOMC meetings until June 2013 are provided in the Appendix of Lucca and Moench (2015) and from Bernile, Hu, and Tang (2016). We extend the data to December 2019 by obtaining FOMC meeting dates from the Federal Reserve website. We obtain the time of each announcement following a similar procedure from Fleming and Piazzesi (2005). Specifically, we record the timestamp of the earliest Dow Jones newswires on the day of each announcement with "Federal Reserve", or "Fed", or "Federal Open Market Committee", or "FOMC" in the headline. We verify that this procedure generates the same times as in Bernile, Hu, and Tang (2016) in the latter portion of their sample and then populate the meetings from June 2013 to December 2019.

A federal funds futures contract pays off $100 - \bar{r}$ where $\bar{r}$ is the average effective federal funds rate over the month. For an FOMC announcement occurring on date t, we define f_{t-} as the price of the current month federal funds futures contract immediately before the FOMC announcement time and f_{t+} as the price of this contract immediately following the announcement. Specifically, f_{t-} is the price of the last trade which occurred at least 10 minutes before the FOMC announcement and f_{t+} is the price of the first trade that occurred at least 20 minutes after the FOMC announcement. We construct the FOMC shock variable, Δi_t^u as:

$$\Delta i_t^u = E_{t-} r - E_{t+} r = -\frac{m}{m-d} \left(f_{t-} - f_{t+} \right) \tag{1}$$

where d be the day in the month of the FOMC announcement, m is the number of

days in the month, and r is the average federal funds rate for the remainder of the month. We scale the price change by $\frac{m}{m-d}$ to account for the fact that the contract's settlement is based on the average federal funds rate over the entire month. We use the current month futures except when the FOMC meeting occurs in the last 7 days in the month, in which case we use the change in price of the next month's contract. We flip the sign so that increases (decreases) in Δi_t^u correspond to increases (decreases) in expected Federal Funds rates. Figure A.1 in the Appendix plots our measure, Δi_t^u, against the measure constructed in Nakamura and Steinsson (2018) from January 2004 to March 2014. The correlation between the two measures is 0.993.

Panel A of Table 1 presents summary statistics of our monetary policy shock. The monetary policy shock runs from January 2004 to December 2019 and covers 128 scheduled FOMC meetings. The monetary policy shock is positive for 31 meetings and negative for 53 meetings.

2.2 Term Structure of Equity Prices

We estimate the term structure of market prices from the put-call parity relationship spanning prices of European put and call options on the S&P 500 index. The put-call parity restriction dictates that at any given moment s:

$$c_s^h(X) - p_s^h(X) = \left(S_s - P_s^h\right) - Xe^{-rf_s^h \times h} \tag{2}$$

where h is the time-to-expiration (horizon) of the options, c is the price of a European call option, p is the price of a European put option, S is the value of the underlying index, P is the price of dividends on the underlying index during the life of the options, X is the strike price and rf^h is the annualized required risk-free rate of return over the corresponding period of options maturity. Assuming an exogenous risk-free rate, we can invert the put-call parity relationship and estimate prices of short-term dividend P directly from the observed options prices (Van Binsbergen, Brandt, and Koijen (2012)). Recent work has argued that even small deviations in interest rates can have an important impact on estimated dividend prices (Boguth et al. (2019)). This is particularly important in our setting as FOMC announcements

have a direct effect on interest rates. Golez and Jackwerth (2020) advocate an interest rate invariant approach by first using a regression-based approach to estimate risk-free rates implied in the option prices (similar to Van Binsbergen, Diamond, and Grotteria (2019)), and then using these implied interest rates in the put-call parity relation to estimate dividend prices. This procedure ensures that dividend prices are internally consistent with the estimated risk-free rates. In this paper, we use the approach used in Golez and Jackwerth (2020) to simultaneously estimate dividend prices and risk-free rates from the put-call parity restriction using ordinary least squares. We document this procedure below.

We obtain minute-by-minute data for S&P 500 options (henceforth SPX options) from 2004 to 2019 from the CBOE. The data includes quotes on all the SPX options along with implied volatilities. We only keep standard monthly options that expire on the third Friday each month. We use the bid-ask midpoint and we eliminate all options with bid or ask prices lower than 3 dollars. We also eliminate options with moneyness levels below 0.5 or above 1.5.

We estimate prices of dividend strips and risk-free rates from these option prices immediately before each FOMC announcement and immediately after. For each FOMC announcement day, we define two 30 minute periods: the pre-announcement window and the post-announcement window. The pre-announcement window runs from 40 minutes before to 10 minutes before the FOMC announcement time. The post-announcement window runs from 20 after to 50 minutes after the announcement time.[5] We use all option prices within each 30 minute window to estimate our option-implied variables pre- and post- each announcement. For each estimation window, we run the following regression based on all put-call pairs within that interval:

$$S_s - c_s^h(X) + p_s^h(X) = \alpha + \beta X + \epsilon \tag{3}$$

where c is the price of a European call option, p is the price of a European put option with the same strike price X and maturity h, S is the value of the underlying index. All prices are measured at the same minute s. Identification comes from

[5] Results are robust to using 60-minute windows.

variation in the strike price X across put-call pairs with the same time-to-expiration h. From Equation 2, the implied price of dividends over horizon h is $P_s^h = \hat{\alpha}$. The implied risk-free rate is $rf^h = -\frac{1}{h} log\left(\hat{\beta}\right)$. We estimate the implied dividend prices and risk-free rates for 180 day to 720 day maturities in the 30 minute windows corresponding to the pre-announcement and post-announcement periods around each FOMC announcement.

We obtain the price of the S&P 500 dividend strip with maturity h, P_{t-}^h, estimated in the 30 minute window before the FOMC announcement on date t and the risk-free rate over horizon h, rf_{t-}^h, estimated in the 30 minute window before the FOMC announcement on date t. P_{t+}^h and rf_{t+}^h correspond to the same quantities estimated in the 30 minute window after the FOMC announcement on date t.

The horizons h depend on the maturities of the option contracts used in the estimation and the date t of the given FOMC announcement. We estimate the dividend strip prices at a set of standardized maturities by linearly interpolating between the option-implied prices for horizons slightly above and below each standardized maturity to obtain the dividend prices in the pre-announcement and post-announcement window around the FOMC announcement at each date t corresponding to maturities $h \in \{180, 360, 540, 720\}$ (in days). On FOMC dates where the standardized longer horizon maturities do not fall between the option-maturities, we linearly extrapolate based on the slope of the interior maturity and the next closest interior maturity. We follow a similar procedure to obtain option-implied risk-free rates at the same standardized horizons in the pre-announcement and post-announcement windows around each FOMC announcement date.

We measure the response of dividend prices, risk-free rates, and implied volatility at each horizon to monetary policy shocks by computing the change in each variable from immediately before to immediately after each FOMC announcement. We define: $\Delta P_t^h = log\left(\frac{P_{t+}^h}{P_{t-}^h}\right)$ and $\Delta rf_t^h = rf_{t+}^h - rf_{t-}^h$, where t is the FOMC announcement date and $h \in \{180, 360, 540, 720\}$ is the horizon in days. We estimate the market response to the FOMC announcement as, $\Delta P_t^\infty = log\left(\frac{P_{t+}^\infty}{P_{t-}^\infty}\right)$, where P_{t-}^∞ and P_{t+}^∞ respectively correspond to the average value of the S&P 500 index over the same 30-minute intervals used for calculating dividend price before and after the FOMC announcement time on date t.

3 Term Structure Response to Monetary Policy

In this section, we study the impact of monetary policy on the term structure of equity prices. We estimate the response of short-horizon and the long-horizon assets to unexpected changes in the Federal Funds rate around FOMC announcements. We start with the regression evidence, followed by a simple non-parametric test.

3.1 Baseline Results

We estimate the response of short-term dividend strip prices and the long-term asset to the monetary policy shock constructed in Section 2.1. We estimate the model:

$$\Delta x_t = \alpha + \beta \Delta i_t^u + \epsilon \tag{4}$$

where Δi_t^u is the monetary policy surprise estimated in the 30-minute window around the FOMC announcement at date t and Δx_t is the change in an outcome variable of interest estimated over the same window. We first estimate the return response of the short-term assets and report the results in Panel A of Table 2. We run separate regressions for dividend strips of each maturity with maturities ranging from 180 days to 720 days and report the results of each specification in separate columns. The last column with the heading "∞" reports the results using the S&P 500 index return as the dependent variable. We report standard errors in parentheses below each coefficient estimates and t-statistics in brackets. Consistent with prior literature, for the aggregate market, we find a negative and significant coefficient on the monetary policy shock. The response of the short-term dividend strips is opposite of the response of the market: the β estimates are positive at all maturities up to 720 days and significant at the 5 percent level at the 180 day horizon. The estimate for β is 0.260 in the 180-day strip specification and –0.059 in the long-term asset specification. The standard deviation of the monetary policy shock is 0.030 so a one standard deviation increase in the shock corresponds to a 0.78 percent increase in the return of the short-term asset and a 0.18 percent decrease in the market return.

Additionally, we test the difference in response of the short-term assets and the long-term asset to monetary policy news. For a given maturity, we take the

difference between the return of the short-term dividend strip and the return of the S&P 500 index and regress this difference on the monetary policy shock. We report the results in Panel B of Table 2. Consistent with the findings reported in Panel A, we find that the coefficient on the monetary policy shock is positive at all horizons and significant at the 1 percent level at the 180 day horizon.[6]

Overall, the short-term 180-day dividend asset response to monetary policy shocks is opposite of the documented long-term asset response. Following a decrease (increase) in expectations of the Federal Funds rate, the market increases (decreases) in value on average while the price of the short-term asset falls (increases) on average. We explore this result using a simple non-parametric test in the next section.

3.2 Average Response by Announcement Type

We estimate the average response of dividend strip prices, the market, and risk-free rates based on the sign of the monetary policy shock. We categorize each FOMC announcement as positive, negative or zero based on the sign of the monetary policy shock at each meeting date, t: Positive: $t_{pos} : \{t \ where \ \Delta i_t^u > 0\}$, Negative: $t_{neg} : \{t \ where \ \Delta i_t^u < 0\}$, Zero: $t_{zero} : \{t \ where \ \Delta i_t^u = 0\}$. We estimate the average response of each variable within each monetary policy shock group as:

$$\Delta x_{pos} = \frac{1}{N_{t_{pos}}} \sum_{t \in \{t \ where \ \Delta i_t^u > 0\}} \Delta x_t \tag{5}$$

where Δx is the outcome variable of interest and $N_{t_{pos}}$ is the number of positive monetary policy shock dates. We similarly compute Δx_{neg} and Δx_{zero}. The outcome variables Δx are the returns of the dividend strips with maturities from 180 days to 720 days, the change in implied risk-free rates at the same horizons, and the return of the market.

[6] We also verify that these results are not driven by outliers by winsorizing the dividend returns at the 5 percent level. Table A.1 in the Appendix presents the results. The coefficient estimates are positive at all horizons and significant at the 5 percent level for the 180-day strip. The β estimate in the 180-day strip specification is 0.215 with a t-statistic of 3.165 compared to the estimate and t-statistic of 0.260 and 2.408 respectively in the baseline specification.

Figure 1 presents the average return of the short-term dividend assets with maturities from 180 days to 720 days for positive (plotted in blue squares) and negative (plotted in red dots) monetary policy shocks. The x-axis denotes the horizon of each dividend strip and the y-axis is the average log return. We plot the average return of the long-term asset (the S&P 500 index return) following positive and negative monetary policy shocks on the right-hand graph for comparison. Following a positive monetary policy shock, the price of the 180-day strip increases while the price of the long-term asset falls on average. Following a negative monetary policy shock, the price of the 180-day dividend strip decreases, while the price of the long-term asset increases on average. The average returns of the 360 day horizon and beyond dividend strips tend towards 0 in response to both positive and negative monetary policy shocks.

These results indicate that the opposite response of the short-term asset and long-term asset to monetary policy shocks occurs following both positive and negative monetary policy shocks. The magnitude of the short-term asset response is largest at the 180-day horizon. In the next section, we explore potential mechanisms behind the pattern of opposite responses of the short-term and long-term assets to monetary policy shocks. We use the 180-day dividend strip as the short-term asset in the following section given that we find the strongest response at this horizon.

3.3 Discussion

Our results show that the short-term assets and the long-term asset respond in opposite ways to monetary policy news. To characterize the types of channels that could drive our results, we express the price of the long-term asset, P_t^{∞}, and short-term asset, P_t^1, as:

$$P_t^{\infty} = \frac{E_t\left(D_{t+1}\right)}{1 + RP_{t\to t+1} + RF_{t\to t+1}} + \frac{E_t\left(D_{t+2}\right)}{1 + RP_{t\to t+2} + RF_{t\to t+2}} + \ldots \tag{6}$$

$$P_t^1 = \frac{E_t\left(D_{t+1}\right)}{1 + RP_{t\to t+1} + RF_{t\to t+1}} \tag{7}$$

where D_t are the dividends at time t, $RP_{t\to t+h}$ is the risk premia from t to $t+h$, and $RF_{t\to t+h}$ is the risk-free rate from t to $t+h$. Price changes in the long-term assets in response to monetary policy news are driven by changes in expected future cash flows, changes in discount rates, or changes in risk-free rates at any horizon. Price changes in the short-term asset are driven by changes in these quantities at the near-term horizon.

Risk-free Rates We can rule out that the pattern of short-term and long-term asset responses to monetary policy is driven by fluctuations in risk-free rates. We obtain direct estimates of the risk-free rates at each horizon through our estimation based on the put-call parity restriction. Figure A.2 in the Appendix plots the average response of implied risk-free rates at different horizons following positive and negative monetary policy shocks. Following an unexpected increase (decrease) in the Federal Funds rate, implied risk-free rates increase (decrease) across all horizons from 180 days to 720 days out. These changes in implied risk-free rates will not generate the price response of the short-term asset since following a positive (negative) monetary policy surprise, the increase (decrease) in risk-free rates implies that the price of the short-term asset should fall (increase) which is opposite of the pattern we find in the data.

Discount Rates and Expected Cash Flows The opposite response of the short-term and long-term asset to monetary policy news also rules out channels which produce persistent shocks purely to discount rates (or purely to expected cash flows). Bernanke and Kuttner (2005) find evidence that the reaction of the stock market to unexpected changes in the target federal funds rate is due to monetary shocks affecting discount rates. However, as long as the dynamics of the discount rate can be described by a persistent AR(1) process, both short- and long-term asset should respond in the same direction. Prior work has estimated an AR(1) coefficient close to 0.9 for annual expected returns (Van Binsbergen and Koijen 2010). Thus, conventional discount rate channels are unlikely to produce the differential effect of short- and long-term assets. For the same reason, our results cannot be explained by pure persistent cash flow effects.

Fed Information Channel One channel that could generate our empirical findings is the idea that central bank policy announcements reveal information about the state of the economy to market participants.[7] For example, if the FOMC announces a larger than expected cut to the target Federal Funds rate during an economic downturn, this is good news for the market given the positive impact of lower rates on spending and investment in the long run. However, the unexpected cut may also signal to investors that economic conditions are worse than previously assumed in which case, investors may revise down forecasts of near-term future cash flows and economic conditions causing the price of the short-term asset to fall. To differentiate Fed Information effects from other potential explanations, we explore additional predictions of the Fed Information channel. We discuss these tests and the results in the next section.

4 Tests of Fed Information Effects

If information about economic conditions drives some of the variation in short-term asset prices around the FOMC announcement, the short-term asset announcement return should forecast measures of near-term economic conditions. This suggests we can test for Fed Information effects by implementing a more stringent joint hypothesis: first, that Fed announcements affect private sector beliefs about economic conditions and, second, that these beliefs are incorporated into prices of short-term assets in the 30-minute window around the FOMC announcements. In this case, the short-term asset announcement returns should predict short-horizon economic growth with a positive sign. We first test whether the short-term asset announcement return predicts the two leading indicators of macroeconomic growth: real GDP growth and real consumption growth.

In our next set of tests, we incorporate macroeconomic forecast data from the Survey of Profesional Forecasters, a measure of private sector beliefs. We consider professional forecasts for annual real GDP growth and real consumption growth

[7] This idea has been termed the "Fed Information channel." The existence of Fed Information effects is debated in the literature C. D. Romer and D. H. Romer (2000), Faust, Swanson, and Wright (2004), Campbell et al. (2012), Nakamura and Steinsson (2018), Lunsford (2020), Bundick and Smith (2020), and Bauer and Swanson (2020).

made before each FOMC meeting and test whether the short-term dividend return predicts errors in these forecasts with a positive sign. If the short-term dividend price response to the monetary policy news released at the corresponding FOMC meeting does not contain new information about macroeconomic conditions, then forecast errors should not correlated with these price movements. On the other hand, predictability in forecast errors suggests that Fed announcements embed relevant information about macroeconomic conditions.

4.1 Macroeconomic Predictability

We test the predictive power of short-term asset announcement returns for real GDP growth and real consumption growth over different horizons. Our predictive regressions are given by Equation (8):

$$\Delta x_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1,2,...,8\} \tag{8}$$

where $\Delta x_{t+k-1\to t+k} = \frac{x_{t+k}}{x_{t+k-1}} - 1$ is real the macroeconomic growth (real GDP or real consumption) from quarter $t+k-1$ to $t+k$ and ΔP_t^{180} is the return on the 180-day dividend strip in the 30-minute window around the FOMC announcement in quarter t.[8]

The top panel of Table 3 presents the results of the predictive regressions for real GDP growth. In our baseline specification, we restrict our test to FOMC days where the monetary policy shock is non-zero. Each column corresponds to the regression specification for a different k-quarter ahead horizon of future consumption

[8] One difference between the real GDP growth and real consumption growth regressions is based on the timing of the macroeconomic data. GDP growth is at the quarterly horizon which introduces mechanical autocorrelation in the dependent variable given the frequency of FOMC meetings (eight per year). We use monthly consumption growth data and aggregate to the quarterly level which allows us to construct quarterly consumption growth starting from the month of each FOMC announcement (i.e. for a January FOMC meeting, we construct 1-quarter ahead consumption growth using monthly consumption data from February to April, and for a March FOMC meeting, we construct 1-quarter ahead consumption growth using monthly consumption data from April to June). This procedure generates the usual mechanical autocorrelation in the dependent variable present in rolling predictive regressions. All t-statistics are calculated under Newey-West standard errors. For the real GDP growth regressions, we run an additional robustness specification in which we retain only the latest FOMC meeting each quarter. The results are similar to those of our baseline test. We discuss this test and the results further in the robustness discussion at the end of this section.

growth. Newey-West adjusted standard errors are presented in parentheses below each coefficient estimate and t-statistics are presented in brackets. The coefficients are positive at the 1 quarter to 5 quarters out horizons and significant at the 5 percent level at the 3 quarter horizon and at the 10 percent level at the 2 quarter horizon. The coefficients are negative at the 6 and 7 quarter horizons. Figure A.3 plots the coefficient estimates, δ_k, from the predictive regressions at each horizon, k, to provide a visual representation of these results. The y-axis is the coefficient estimate δ_k and the x-axis is the horizon. Newey-West adjusted t-statistics are in parentheses next to each point estimate. Short-term dividend prices forecast future real GDP growth at horizons up to 3 quarters out but do not significantly forecast future real GDP growth at longer horizons. The coefficients on the next quarter, two-quarter out, and three quarter out predictability regressions are 0.020, 0.077, and 0.052 respectively. The standard deviation of the 180-day dividend strip return is 0.030 so a one standard deviation decrease in short-term asset price corresponds to a 0.45 percent decline in real GDP growth over the next three quarters.

We present results from similar tests forecasting $k - quarter$ ahead quarterly real consumption growth using price changes in the 180-day dividend strip in the 30-minute window around each FOMC announcement. The lower panel of Table 3 presents the results of these predictive regressions. Each column corresponds to the forecasting regression for a different quarter-ahead horizon of quarterly real consumption growth. Figure A.4 similarly plots the coefficient estimates on the short-term dividend return from the predictive regressions at each horizon, k. The y-axis is the coefficient estimate and the x-axis is the horizon. Newey-West adjusted t-statistics are provided in parentheses next to each point estimate. The overall pattern of results is similar to the real GDP growth forecasting regressions. The coefficients are positive in magnitude at the 1 quarter to 7 quarter horizons negative at the 8 quarter horizon. The coefficient at the 2 quarter out horizon is significant at the 5 percent level. The magnitudes of the coefficients tend towards zero at the longer horizons.

We run a number of robustness tests of the predictability results: robustness tests for real GDP growth and real consumption growth are reported respectively in Panel A and Panel B of Table A.2 in the Appendix. Results from each robustness

specification are grouped under common column headings. Each row in the table is a separate regression for each quarterly horizon k. Within each robustness column heading, the coefficient estimates for the short-term asset announcement return are presented in the first column, the Newey-West adjusted standard errors are presented in parentheses in the second column, and t-statistics are presented in brackets in the third column. The results presented under the "60-Minute Window" header document the results from the predictive regression from Equation 8 using the prices of the dividend strip estimated over the 60-minute pre- and post-announcement windows. The results are stronger than our baseline specification with the two-quarter and three-quarter out coefficients positive and significant at the 5 percent level. Additionally, we run the predictive regression discarding the first FOMC meeting each quarter and using the short-term asset return only from the latest FOMC meeting each quarter. This eliminates the mechanical correlation in the dependent variable in the baseline regression by ensuring each quarterly real GDP value is mapped to one FOMC meeting. The results are presented under the column header "Non-zero Dates, Latest." The columns under the "All FOMC Dates" header report the results for the regression run using all FOMC meeting dates including days where the monetary policy shock is zero. The final columns under the header "All FOMC Dates, Latest" report the results from the specifications which take the latest FOMC meeting each quarter from the set of all FOMC meetings including ones which have a zero monetary policy surprise. The results in each of the three specifications are broadly similar. The coefficients on the short-term asset return in the one-quarter ahead regressions are positive in the "Non-zero Dates, Latest" and the "All FOMC Dates, Latest" specifications and negative in the "All FOMC dates" specification but not significantly different from zero. The coefficients are positive in all three specifications for the two-quarters out and three quarters out horizons. The coefficients are statistically significant at the 5 percent level for the two quarters out horizon in the "Latest" specifications for both Non-zero and for All FOMC dates. The three quarters out horizon coefficients are statistically significant at the 5 percent level for both the All FOMC dates specifications. Panel B of Table A.2 reports the results for real consumption growth using all FOMC meeting dates including meetings where the monetary policy shock is zero. The coefficients on the short-term asset return

are positive for all horizons except the eight-quarters out horizon.

4.2 Fed Announcements and Professional Forecasts

Our next set of tests incorporates measures of private sector beliefs using macroeconomic forecast data from the Survey of Professional Forecasters (SPF), a survey of professional forecasters trained in economics and statistics conducted by the Federal Reserve Bank of Philadelphia.[9] We test whether private sector forecast errors are predictable by the short-term asset announcement return.

For each quarter, we obtain the average quarterly growth forecasts across all analysts in the SPF survey for two macroeconomic variables: real GDP growth (Δgdp) and real consumption growth (Δc). We obtain actual realizations of these variables from the Philadelphia Federal Reserve's Real-Time Data Set for Macroeconomists which records historical vintages of the data from the National Income and Product Accounts (NIPA). We obtain the SPF forecast deadline from the Federal Reserve Bank of Philadelphia website. We match each forecast deadline with the nearest FOMC meeting which occurs after the deadline. We denote actual real GDP growth over the next year by $\Delta x_{t+1\to t+4}$ and the average SPF growth rate forecast for annual real GDP growth made in quarter t by $F_{t-}(\Delta x_{t+1\to t+4})$. We calculate the forecast error as the difference between realized real GDP growth and the average forecast, $\Delta x_{t+1\to t+4} - F_{t-}(\Delta x_{t+1\to t+4})$.[10] We calculate the 180-day dividend return in the 30-minute window around the FOMC announcement for the nearest FOMC meeting at date $t+$ after the SPF forecast deadline. This meeting falls within the same quarter as the SPF deadline or in the first 30 days of the next quarter in all cases. We also include the change in nonfarm payroll employment, ΔNFP_t, re-

[9] The SPF is a quarterly survey in which participants are asked to provide forecasts for a number of U.S. macroeconomic variables at quarterly horizons from the current quarter to four quarters out. The survey timing is based on the Bureau of Economic Analysis' (BEA)' advance report of the national income and product accounts which is released at the end of the first month of each quarter and contains the initial estimates of GDP and its components for the previous quarter. The survey is sent after this report is released to the public and includes the recent historical values of variables from the BEA's advance report and the most recent reports of other government statistical agencies. The response deadlines are set at late in the second to third week of the middle month of each quarter.

[10] Our specifications using real consumption growth are identical.

leased in the monthly Bureau of Labor Statistics' employment report between the SPF forecast date, $t-$, and the subsequent FOMC meeting date, $t+$.[11] We use $t-$, t, and $t+$ subscripts with the SPF forecasts, change in nonfarm payroll employment, and short-term dividend return respectively to indicate the timing of each variable within the same quarter. Figure A.5 in the Appendix documents the timing of each variable.

We regress forecast errors for annual macroeconomic growth on the price response of the short-term dividend strip around the nearest FOMC meeting after the SPF forecasts are made and the change in nonfarm payroll employment. Equation 9 presents the regression specification:

$$\Delta x_{t+1\to t+4} - F_{t-}\left(\Delta x_{t+1\to t+4}\right) = \alpha + \beta \Delta P^{180}_{t+} + \delta \Delta NFP_t + \epsilon_{t+1\to t+4} \tag{9}$$

where, as described above, $\Delta x_{t+1\to t+4}$ is the actual annual growth rate of the given macroeconomic variable $x \in \{RGDP,\ RCONS\}$, $F_{t-}\left(\Delta x_{t+1\to t+4}\right)$ is the average forecast from the Survey of Professional Forecasters made in quarter t, ΔP^{180}_{t+} is the return of the 180-day dividend strip in the 30-minute window around the FOMC announcement at date $t+$, and ΔNFP_t is the monthly change in non-farm payroll employment based on the Bureau of Labor Statistics' employment report released between the SPF forecast deadline and the FOMC meeting.

Table 4 presents the results of this regression. The specifications run using annual real GDP growth forecast errors are in the left-hand columns labeled, RGDP, and the specifications run using annual real consumption growth forecast errors are in the right-hand side columns labeled, RCONS. In our baseline specification, Column 1 for the RGDP specification and Column 4 for the RCONS specification, the coefficient β on the short-term dividend return is positive and significant at the 5 percent level using Newey-West adjusted standard errors. The positive sign is consistent with the Fed Information channel: positive (negative) news from the Fed announcement about economic conditions is incorporated into the short-term asset price generating a positive (negative) announcement return; this positive (negative)

[11] Bauer and Swanson (2020) use this variable as a measure of economic news that may be relevant for macroeconomic forecasts. While this type of news should not affect our specification based on our discussion above, we include this variable as a robustness test of our baseline result.

short-term asset announcement return positively predicts forecast errors (future realized economic growth minus existing forecasts). The coefficient δ on the change in non-farm payroll employment is not significantly different from zero. The adjusted R-squared of the regression is 6 percent for the real GDP specification and 9 percent for the real consumption specification respectively.

Column 2 and 5 of Table 4 present regressions of real GDP growth forecast errors and real consumption growth forecast errors on the monetary policy shock. In both cases the coefficient is not significantly different from zero. The short-term dividend return provides a cleaner measure of news about economic conditions since this news may not be perfectly correlated with the monetary policy surprise. Columns 3 and 6 show a full specification run using the short-term dividend return, the change in non-farm payrolls, and the monetary policy shock. The coefficient on the short-term dividend return remains positive and is significant at the 5 percent level in the consumption growth forecast error specification. The coefficient on the monetary policy shock is negative in both specifications but not significant in either specification. The coefficient on changes in non-farm payrolls is not significant in either specification.

5 Information Content of Fed Announcements

Our predictability results from the last section suggest that Fed announcements contain important information about economic conditions: short-term asset prices respond to Fed announcements and this response predicts future macroeconomic growth over short-horizons but not longer horizons. The response of short-term assets to Fed surprises also predicts private sector forecast errors. In this section, we attempt to characterize the type of information contained in Fed announcements which drives the variation in the short-term asset announcement returns. We examine two sources of information: the advance release of the summary of economic projections and the FOMC meeting minutes.

We extract the FOMC participant forecasts for key economic variables from the advance release of the Summary of Economic Projections (SEP) and compare these projections to private sector forecasts. We test whether the forecast gap, the differ-

ence between the SEP forecasts and private sector forecasts, is positively related to the short-term asset announcement return on meeting dates when the advance SEP is released. Next, we parse the FOMC meeting minutes into sections based on content type and assign a numerical score to each section based on the tone of the Fed discussion.[12] We then test whether the tone of Fed discussion around topics related to economic conditions forecasts future economic growth and whether it also helps to explain the short-term asset announcement returns.

There are limitations to both tests: the FOMC minutes are not made public until about three weeks after the FOMC meeting which means that investors are not responding to the Fed communications within the text directly; and while the advance release of the SEP is released contemporaneously with the Fed announcement, it is provided for only four of the eight scheduled meetings per year starting in 2011 which significantly reduces the sample. Despite these limitations, these tests may be useful in examining the Fed Information channel by testing whether the tone of Fed discussion of economic conditions forecasts future economic growth and also whether variables such as this tone or the gap between SEP and private sector forecasts are related to the short-term asset announcement returns.

5.1 Summary of Economic Projections

We measure the difference between the Fed's economic growth forecasts released following an FOMC meeting and existing private sector forecasts. We examine the relationship between the short-term dividend price response to the FOMC announcement and this forecast gap. Our measure of the Fed's economic growth forecasts comes from the advance release of the Summary of Economic Projections (SEP) and our measure of private sector growth forecasts comes from the latest Survey of Professional Forecasters report released prior to each FOMC meeting. We describe the SEP data below.

[12]The meeting minutes are typically released several weeks after the FOMC announcement.

5.1.1 Data Description

Meeting participants, the 7 members of the Board of Governors and the 12 presidents of the Federal Reserve Banks submit individual projections for key economic variables including: annual change in real GDP from the fourth quarter of the previous year to the fourth quarter of the year indicated; the average civilian Unemployment rate in the fourth quarter of each year; the change in personal consumption expenditures (PCE) price index from the fourth quarter of the previous year to the fourth quarter of the year indicated; and projections for the appropriate level of the target federal funds rate.[13] For the FOMC meeting on date t, each individual i, makes forecasts $F_t^i\left(x_{year(k)}\right)$, for variable x at horizon $k \in \{0, 1, 2, 3, LongRun\}$. For example, if we take x to be real GDP growth and $k = 0$, then $\left\{F_t^i\left(\Delta rgdp_{year(0)}\right)\right\}_{i,t}$ is the set of forecasts for current year real GDP growth. On meeting date t^* there are 19 forecasts, $F_{t^*}^i\left(\Delta rgdp_{year(0)}\right)$, corresponding to each individual i for the annual real GDP growth in the year of the meeting.

The Federal Reserve began to provide an advance version of these economic projections in conjunction with the Chairman's the post-meeting press conference beginning in 2011. While the advance version of the SEP does not provide individual level forecasts, the report provides the ranges and central tendencies of the participants' projections. Specifically, for a given economic variable x and horizon k, the advance version of the SEP provides: the highest forecast among the i participants at meeting t, which we denote "range upper" $F_t^{ru}(x_k)$; the lowest forecast among the i participants at meeting t, which we denote "range lower" $F_t^{rl}(x_k)$; the highest forecast among the i participants at meeting t after removing the three highest forecasts, which we denote "central tendency upper" $F_t^{cu}(x_k)$; and the lowest forecast among the i participants at meeting t after removing the lowest three forecasts, which we denote "central tendency lower" $F_t^{cl}(x_k)$. We parse the advance version of the economic projections for the 36 meetings where the data was

[13] These projections are collected four times year, typically in the March, June, September, and December meetings. The horizon of the March and June meeting annual projections are for the current year, the subsequent two years, and the longer run. The projections made in the September and December meetings are for the current year, the subsequent three years, and the longer run. The longer run projections reflect the rates to which the forecaster expects the economy to converge to over time in the absence of further shocks.

released between April 2011 to December 2019 to obtain measures of the central tendency and range for annual real GDP growth, annual percent change in PCE inflation, fourth quarter Unemployment rate, and projections of the appropriate level of the Federal Funds rate at each horizon at each meeting.[14]

5.1.2 Forecast Gap Between Fed and Private Sector Projections

We focus on advance projections for current year real GDP growth. For each FOMC meeting where advance projections are available, we take the midpoint of the lower and upper values of the central tendency and denote this forecast as $F_t^{FED}\left(\Delta rgdp_{year(0)}\right)$, the Fed forecast for current year real GDP growth made at meeting date t. Private sector forecasts for annual real GDP growth are constructed using data from the Survey of Professional Forecasters. For each quarter, SPF quarterly growth forecasts for the remaining quarters in the year are combined with the actual quarterly real GDP growth in the prior quarters of the calendar year from the National Income and Product Accounts (NIPA) using the latest vintage available at the time the SPF forecasts were made. We denote these forecasts $F_{t-}^{SPF}\left(\Delta rgdp_{year(0)}\right)$, the latest SPF forecast for the current year real GDP growth made prior to the FOMC meeting at date t. We calculate the difference between the Fed forecasts and the SPF forecasts as: $ForecastGapUnadj_t = F_t^{FED}\left(\Delta rgdp_{year(0)}\right) - F_{t-}^{SPF}\left(\Delta rgdp_{year(0)}\right)$. The date of the FOMC meeting determines how many quarters of the current year GDP are known at the time of each forecast. When the meeting falls in the first quarter of the year, the forecast gap reflects differences in forecasts real GDP growth over the next four quarters. When

[14]Table A.4 in the Appendix presents the summary statistics of the central tendency measures for each variable. We calculate the average, standard deviation, minimum and maximum for each measure separately (central tendency: upper and lower). For instance, for current year real GDP growth ($x = \Delta rgdp$ and $k = 0$), we have $F_t^{cl}\left(\Delta rgdp_{year(0)}\right)$ and $F_t^{cu}\left(\Delta rgdp_{year(0)}\right)$ the 36 central lower and 36 central upper forecasts for this variable at the 36 meetings in our sample. We calculate the average of each measure across the 36 meetings as: $F_{avg}^{cl}(x_k) = \frac{1}{T}\sum_t F_t^{cl}(x_k)$ and $F_{avg}^{cu}(x_k) = \frac{1}{T}\sum_t F_t^{cu}(x_k)$. The table contains statistics for the central tendency measures presented in the format F^{cl}, F^{cu}, the lower central tendency statistic followed by the upper central tendency statistic separated by a comma. For example, the top left entry: Change in real GDP, Current Year, Average provides the average of the lower central tendency and upper central tendency for current year real GDP growth forecasts, $F_{avg}^{cl}\left(\Delta rgdp_{year(0)}\right)$ and $F_{avg}^{cl}\left(\Delta rgdp_{year(0)}\right)$ as 2.197 and 2.428 respectively.

the meeting falls in the fourth quarter, the forecast gap reflects differences in forecasts of current quarter only. We standardize the different horizons by scaling the forecast gap based on the number of quarters remaining in the year at the time of the forecasts: $ForecastGap_t = (1 + ForecastGapUnadj_t)^{\frac{4}{k}} - 1$. Where k denotes the number of quarters remaining in the year. We run the following regression:

$$\Delta P_t^{180} = \alpha + \beta ForecastGap_t + \epsilon_t$$

where ΔP_t^{180} is the return of the 180-day dividend strip in the 30-minute window around the FOMC meeting announcement at date t and $ForecastGap_t$ is the standardized difference in Fed SEP and private sector SPF real GDP forecasts defined above.

Table 5 presents the results from this regression. Newey-West adjusted standard errors are presented in parentheses below the coefficiente estimates and t-statistics are presented in brackets. The coefficient on the ForecastGap is positive and significant at the 1 percent level. Based on the coefficient estimate of 5.820, a 1 percent increase in the gap between the SEP and the SPF annual real GDP forecasts corresponds to an increase in the price of the short-term asset of about 6 percent in the 30-minute window around the FOMC announcement. The forecast gap explains 8 percent of the variation in the 180-day dividend strip announcement returns.

5.2 FOMC Minutes

In our last set of tests, we obtain the full text minutes from each FOMC meeting from January 2004 to December 2019 from the Federal Reserve Board website. We parse the minutes from each meeting into the following sections: Developments in Financial Markets (DFM); Staff Review of the Economic Situation (SRES); Staff Review of the Financial Situation (SRFS); Economic Outlook (EO); Participants' Views on Current Conditions (PVCC); and Committee Policy Action (CPA). Table A.5 in the Appendix provides a brief summary of each section. We further decompose the Staff Review of the Economic Situation section into 8 constituent components: Employment (SRES:E); Industrial Production (SRES:IP); Consumer Spending (SRES:CS); Residential Investment (SRES:RI); Firm Invest-

ment (SRES:NI); International Trade (SRES:IT); Foreign Economies (SRES::FE); and Inflation (SRES:I).

We assign a numerical score to each Section (and each subsection of SRES) using the sentiment text classification dictionary developed in Loughran and McDonald (2011). This dictionary classifies sets of words as "positive" or "negative" in tone based on their use in financial contexts and provides an improvement over standard sentiment dictionaries which are not constructed based on financial or economic discussion. For each Section of the FOMC minutes we define PositiveMinusNegative, PMN_t^j, as the count of positive words minus the count of negative words in a section:

$$PMN_t^j = Positive_t^j - Negative_t^j \tag{10}$$

where t is the FOMC meeting date, j is the Section (or subsection of SRES), $Positive_t^j$ is the number of positive words in section j of the minutes for FOMC meeting at date t, and $Negative_t^j$ is the number of negative words. Table A.6 in the Appendix presents the top fifteen most commonly occurring positive and negative words in the Staff Review of the Economic Situation (SRES) section of the FOMC minutes. The most frequently occurring positive word is "gains" with 384 occurrences. The most frequently occurring negative word is "declined" with 482 occurrences. The rest of the commonly occuring words determining the tone of Fed discussion are also intuitive. Positive words include: gains, strong, boosted, improved, despite, stable, rebounded, and improvement. Negative words include: declined, unemployment, slowed, sharply, deficit, weak, slower, and force.

5.2.1 Relationship with Future Economic Conditions

We first test whether the sentiment measure of each section contains information about the future state of the economy. We test the predictive power of PMN_t^j for quarterly real GDP growth and for quarterly real consumption growth k quarters ahead. We run the following regression:

$$\Delta x_{t+k-1 \to t+k} = \alpha_k^j + \beta_k PMN_t^j + \epsilon_{t+k-1 \to t+k}^j, k \in \{1, 2, ..., 8\}$$

where $\Delta x_{t+k-1 \to t+k}$ is the k quarter-ahead quarterly growth of variable x (real GDP or real consumption) and $PMN_t^j = Positive_t^j - Negative_t^j$ is the count of positive words minus the count of negative words in section j of the FOMC minutes for meeting at date t.

Panel A of Table 6 reports the coefficient estimates, Newey-West standard errors in parentheses below, and t-statistics in brackets for β as well as the adjusted R-squared for the real GDP regressions. Each column is a different regression corresponding to a different quarterly horizon. The first section of the table presents the results using the sentiment measure applied to the Staff Review of the Economic Situation (SRES) section. The coefficients on β are positive at the short-horizons (one-quarter, two-quarters, three-quarters, four-quarters, and five-quarters out) and significant at the 5 percent level at the 1-quarter out horizon. The coefficients become negative at the six-quarters out to eight-quarters out horizons and are significant at the six-quarters out horizon at the 1 percent level. The second section of the table presents the results using the sentiment measure applied to the Participants' Views on Current Conditions (PVCC) section. The coefficent estimates are positive at the one-quarter out to five-quarter out horizon and negative at longer horizons. The coefficient is statistically significant at the 1 percent level at the eight-quarters out horizon.[15] Panel B of Table 6 presents the real consumption growth predictability results following the same format described above. The results are broadly similar to the real GDP results for the Staff Review of the Economic Situation (SRES) section and the Participants' Views on Current Conditions (PVCC) section. The final section of the table presents the results restricted to consumer focused variables within the SRES section: Consumer spending and residential investment. The coefficient estimates are positive at all horizons except the six-quarter out horizon and the eight-quarter out horizon and statistically significant at the 5 percent level at the one-quarter out and two-quarters out horizons.[16]

[15] These GDP growth results are based on FOMC meeting dates where the monetary policy shock is non-zero. Table A.7 presents results based on all FOMC meeting dates. Results are broadly similar.

[16] These consumption growth results are based on FOMC meeting dates where the monetary policy shock is non-zero. Table A.8 presents results based on all FOMC meeting dates. Results are broadly similar.

5.2.2 Relationship with Short-term Equity Response

We examine the relationship between the short-term asset announcement return and tone of FOMC discussion in the minutes. If the response of the short-term dividend strip is driven by changes in investor beliefs about the state of the economy due to the Fed policy decisions, then we would expect to see a positive relationship between the asset return and the tone of discussion around economic conditions. We regress the 180-day dividend strip return on the tone of the FOMC minutes:

$$\Delta P_t^{180} = \alpha_j + \delta_j PMN_t^j + \epsilon_{j,t} \tag{11}$$

Table 7 presents the results of this regression. Each row is a different specification based on the number of positive minus negative words in a different section j. The first column presents the estimate for δ_j, the second column presents the standard errors in parentheses, and the third column presents the t-statistics in brackets. The final column presents the adjusted R-squared. The coefficient δ_j is positive for the Developments in Financial Markets, Staff Review of the Economic Situation, Consumer, Staff Review of the Financial Situation, and Economic Outlook sections. The coefficients are statistically significant at the 1 percent level in the Consumer specification and significant at the 10 percent level in the Staff Review of the Economic Situation specification. The adjusted R-squareds of the SRES and Consumer specifications are 3 percent and 12 percent respectively.[17] Overall, these results suggest that the Fed has information about future macroeconomic conditions and indicate a link between this information and the short-term equity response to the Fed announcement.

6 Conclusion

In this paper, we document evidence that the prices of short-term and long-term equity respond to monetary policy news in opposite ways. Following an unexpected

[17] These results are based on FOMC meeting dates where the monetary policy shock is non-zero. Table A.9 in the Appendix presents the results based on all FOMC meetings. The results are broadly similar.

decrease (increase) in the Federal Funds rate, market prices rise (fall) while short-term dividend prices fall (rise) on average. We explore possible channels which could drive this result and find evidence most consistent with the idea that policy decisions signal information about the state of the economy to investors. Consistent with this channel, we find that the price response of the short-term dividend asset in the 30-minute window around FOMC announcements predicts short-term macroeconomic growth and private sector macroeconomic forecast errors. We also find that short-term dividend announcement return is positively related to the tone of Fed discussion about economic conditions during the meeting and to the gap between Fed economic projections compared to those of the private sector. Overall, our results support the existence of Fed Information effects which would represent an additional transmission channel for monetary policy.

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7 Tables & Figures

Table 1: **Monetary Policy Shock Summary Statistics**

(a) Monetary Policy Shock

	MP Shock	Positive	Negative
Start Date	January 28, 2004		
End Date	December 11, 2019		
N	128	31	53
Mean	-0.003	0.020	-0.020
Std. Dev.	0.030	0.024	0.036

(b) Short-term Asset Announcement Return

	ΔP^{180}	ΔP^{360}	ΔP^{540}	ΔP^{720}	ΔP^{∞}
Mean	0.0028	-0.0003	-0.0004	-0.0009	0.0009
Std. Dev.	0.0373	0.0158	0.0106	0.0109	0.0056
$corr(\cdot, \Delta P^{\infty})$	-0.18	-0.21	-0.13	-0.06	1.00

Panel A of Table 1 presents the summary statistics of the monetary policy shock. Panel B presents summary statistics for the short-term asset returns around each FOMC announcement. Statistics are calculated separately for announcement returns of assets of different maturities, ΔP^h, where $h \in \{180, 360, 540, 720\}$ days. The last row, $corr(\cdot, \Delta P^{\infty})$, reports the correlation of the asset's FOMC announcement window return with the market return.

Table 2: **Dividend Strip Return on Monetary Policy Shock**

(a) Short-term asset return

	ΔP^{180}	ΔP^{360}	ΔP^{540}	ΔP^{720}	ΔP^{∞}
Δi_t^u	0.260	0.036	0.021	0.010	-0.059
	(0.108)	(0.047)	(0.031)	(0.032)	(0.016)
	[2.408]	[0.777]	[0.682]	[0.322]	[-3.789]
Intercept	0.004	0.000	0.000	-0.001	0.001
	(0.003)	(0.001)	(0.001)	(0.001)	(0.000)
	[1.132]	[-0.101]	[-0.398]	[-0.89]	[1.483]
Adj. R^2	0.036	-0.003	-0.004	-0.007	0.095
Obs.	128	128	128	128	128

(b) Short-term minus long-term asset return

Maturity	180	360	540	720
Δi_t^u	0.319	0.096	0.081	0.07
	(0.111)	(0.052)	(0.037)	(0.037)
	[2.88]	[1.833]	[2.199]	[1.907]
Intercept	0.003	-0.001	-0.001	-0.002
	(0.003)	(0.002)	(0.001)	(0.001)
	[0.892]	[-0.536]	[-0.972]	[-1.419]
Adj. R^2	0.05	0.02	0.03	0.02
Obs.	128	128	128	128

Panel A of Table 2 presents the results from the regression of dividend strip return on the monetary policy shock:

$$\Delta P_t^h = \alpha + \beta \Delta i_t^u + \epsilon$$

where ΔP_t^h is the return on the dividend strip with maturity $h \in \{180, 360, 540, 720\}$ and Δi_t^u is the unexpected change in target Federal Funds rate around the FOMC announcement. Each column presents the results from the regression specification based on dividend strips with maturities indicated in the column header. Standard errors are reported in parentheses below the coefficient estimates. T-statistics are reported in brackets. Panel B of Table 2 presents the results from the regression of dividend strip return minus the long-term asset return on the monetary policy shock:

$$\Delta P_t^h - \Delta P_t^{\infty} = \alpha + \beta \Delta i_t^u + \epsilon$$

Table 3: **Real GDP Forecasting**

Real GDP Growth								
Horizon	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
ΔP^{180}	0.020	0.077	0.052	0.003	0.012	-0.010	-0.025	0.003
	(0.031)	(0.039)	(0.024)	(0.015)	(0.015)	(0.018)	(0.017)	(0.022)
	[0.643]	[1.950]	[2.222]	[0.185]	[0.775]	[-0.571]	[-1.409]	[0.151]
Intercept	0.004	0.004	0.004	0.003	0.004	0.005	0.005	0.005
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
	[2.781]	[3.257]	[2.539]	[1.937]	[3.141]	[4.924]	[5.779]	[3.520]
Adj. R^2	-0.002	0.152	0.068	-0.013	-0.009	-0.009	0.01	-0.014
Obs.	83	81	79	79	77	75	73	72
Real Consumption Growth								
Horizon	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
ΔP^{180}	0.025	0.025	0.012	0.011	0.017	0.002	0.009	-0.006
	(0.018)	(0.012)	(0.015)	(0.012)	(0.010)	(0.008)	(0.010)	(0.012)
	[1.374]	[2.050]	[0.822]	[0.902]	[1.727]	[0.300]	[0.982]	[-0.507]
Intercept	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	[6.294]	[4.732]	[4.709]	[4.427]	[6.621]	[5.697]	[4.985]	[5.241]
Adj. R^2	0.033	0.031	0.000	-0.004	0.013	-0.013	-0.006	-0.011
Obs.	83	81	79	79	77	75	73	72

The top panel of Table 3 under the "Real GDP Growth" heading present the results from the regression of future k quarter ahead, quarterly real GDP growth on the 180-day dividend strip return in the 30 minute window around the FOMC announcement occurring on date t for FOMC announcements where the monetary policy shock is non-zero:

$$\Delta rgdp_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1, 2, ..., 8\}$$

Each column presents a different regression specification based on forecasting the k-quarter ahead macroeconomic growth indicated in the column header. Newey-West adjusted standard errors are in parentheses below the coefficient estimates. T-statistics are reported in brackets. The bottom panel of Table 3 under the "Real Consumption Growth" heading present the results from the same regression for predicting real consumption growth:

$$\Delta rcons_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1, 2, ..., 8\}$$

Table 4: **Predicting SPF Forecast Errors**

	RGDP			RCONS		
	(1)	(2)	(3)	(4)	(5)	(6)
ΔP^{180}	0.081		0.095	0.063		0.067
	(0.041)		(0.056)	(0.031)		(0.034)
	[1.990]		[1.709]	[2.023]		[2.008]
nfp	0.000		0.000	0.000		0.000
	(0.000)		(0.000)	(0.000)		(0.000)
	[0.300]		[0.387]	[0.730]		[0.818]
MP Shock		-0.065	-0.096		-0.006	-0.031
		(0.077)	(0.061)		(0.056)	(0.036)
		[-0.838]	[-1.555]		[-0.098]	[-0.858]
Intercept	-0.009	-0.008	-0.009	-0.006	-0.004	-0.006
	(0.007)	(0.007)	(0.006)	(0.006)	(0.008)	(0.005)
	[-1.339]	[-1.121]	[-1.493]	[-0.978]	[-0.527]	[-1.126]
Adj. R^2	0.06	0.01	0.11	0.09	-0.02	0.09
Obs	60	60	60	60	60	60

Table 4 presents the results from the regression specification of forecast errors on the short-term dividend return and the change in nonfarm payroll employment. For each quarter, t, we obtain the average SPF growth rate forecast for annual real GDP growth (real consumption growth), $F_{t-}(\Delta x_{t+1\to t+4})$, and calculate the forecast error as the difference between realized real GDP growth (real consumption growth) and the average forecast, $\Delta x_{t+1\to t+4} - F_{t-}(\Delta x_{t+1\to t+4})$. We calculate the 180-day dividend return in the 30-minute window around the FOMC announcement for the nearest FOMC meeting at date $t+$ after the SPF forecast deadline. We also include the change in nonfarm payroll employment, ΔNFP_t, released in the monthly Bureau of Labor Statistics' employment report between the SPF forecast date, $t-$, and the subsequent FOMC meeting date, $t+$. We use $t-$, t, and $t+$ subscripts with the SPF forecasts, change in nonfarm payroll employment, and short-term dividend return respectively to indicate the timing of each variable within the same quarter. We also include the monetary policy shock from the meeting at date $t+$, MP Shock, in some specifications. The full regression specification is:

$$\Delta x_{t+1\to t+4} - F_{t-}(\Delta x_{t+1\to t+4}) = \alpha + \beta \Delta P^{180}_{t+} + \delta \Delta NFP_t + \eta MPShock_{t+} + \epsilon_{t+1\to t+4}$$

Regressions based on real GDP growth forecast errors are presented in the left-hand side of the table and regressions based on real consumption growth forecast errors are presented on the right-hand side of the table. Each column presents a different specification. Newey-West adjusted standard errors are in parentheses below the coefficient estimates. T-statistics are reported in brackets.

Table 5: **Dividend Strip Return and Forecast Gap**

	ΔP^{180}
ForecastGap	5.820
	(2.864)
	[2.032]
Intercept	0.010
	(0.008)
	[1.369]
Adjusted R^2	0.08
Obs	36

Table 5 presents the results from the regression of the 180-day dividend strip return around the FOMC announcement occurring on date t and the forecast gap between the Fed Guidance and the latest SPF forecasts for the balance of year real GDP Growth. The regression specification is:

$$\Delta P_t^{180} = \alpha + \beta ForecastGap_t + \epsilon_t$$

where ΔP_t^{180} is the return of the 180-day dividend strip in the 30-minute window around the FOMC meeting announcement at date t, and the forecast gap, $ForecastGap_t = \left(F_t^{FED}\left(\Delta rgdp_{year(0)}\right) - F_{t-}^{SPF}\left(\Delta rgdp_{year(0)}\right)\right)^{\frac{k}{4}}$, is the standardized difference in Fed and SPF real GDP growth forecasts where k denotes the number of quarters remaining in the year. To obtain $F_t^{FED}\left(\Delta rgdp_{year(0)}\right)$, we take the midpoint of the lower and upper values of the central tendency for the Fed forecast for current year real GDP growth made at meeting date t. $F_{t-}^{SPF}\left(\Delta rgdp_{year(0)}\right)$ is the latest SPF forecast for the current year real GDP growth made prior to the FOMC meeting at date t combined with the actual quarterly real GDP growth in the prior quarters of the year from the National Income and Product Accounts (NIPA) using the latest vintage available at the time the SPF forecasts were made. Newey-West adjusted standard errors are presented in parentheses below the coefficient estimates. T-statistics are presented in brackets.

Table 6: **Fed Discussion and Macroeconomic Growth**

(a) Real GDP Growth

	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
Staff Review of the Economic Situation (SRES)								
PMN	0.021	0.020	0.014	0.003	0.004	-0.010	-0.003	-0.007
	(0.009)	(0.014)	(0.019)	(0.010)	(0.005)	(0.003)	(0.003)	(0.008)
	[2.298]	[1.472]	[0.727]	[0.311]	[0.905]	[-3.177]	[-1.384]	[-0.865]
Adj. R^2	0.179	0.167	0.077	-0.009	-0.006	0.052	-0.007	0.010
Participants' Views on Current Conditions (PVCC)								
PMN	0.013	0.011	0.016	0.010	0.007	-0.004	-0.004	-0.011
	(0.008)	(0.008)	(0.010)	(0.010)	(0.005)	(0.004)	(0.003)	(0.003)
	[1.722]	[1.339]	[1.567]	[1.009]	[1.502]	[-1.116]	[-1.169]	[-3.387]
Adj. R^2	0.102	0.072	0.159	0.055	0.021	0.004	-0.001	0.081

(b) Real Consumption Growth

	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
Staff Review of the Economic Situation (SRES)								
PMN	0.015	0.015	0.008	0.008	0.007	-0.001	-0.001	-0.001
	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.003)	(0.003)	(0.003)
	[5.596]	[3.285]	[1.639]	[1.249]	[1.550]	[-0.464]	[-0.265]	[-0.447]
Adj. R^2	0.291	0.250	0.094	0.074	0.061	-0.012	-0.014	-0.012
Participants' Views on Current Conditions (PVCC)								
PMN	0.010	0.011	0.010	0.009	0.006	0.002	0.000	-0.007
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)	(0.002)
	[3.192]	[2.746]	[3.127]	[2.538]	[1.447]	[0.795]	[0.103]	[-2.828]
Adj. R^2	0.181	0.182	0.204	0.142	0.057	-0.002	-0.015	0.076
SRES: Consumer Spending (CS) + Residential Investment (RI)								
PMN	0.052	0.065	0.031	0.022	0.028	-0.021	0.008	-0.003
	(0.025)	(0.025)	(0.026)	(0.029)	(0.018)	(0.015)	(0.012)	(0.016)
	[2.023]	[2.612]	[1.216]	[0.751]	[1.582]	[-1.463]	[0.688]	[-0.197]
Adj. R^2	0.107	0.146	0.036	0.007	0.025	0.007	-0.011	-0.014

Panel A of Table 6 presents the results from the regression of future k quarter ahead, quarterly real GDP growth on the positive minus negative word count, $PMN_t^j = Positive_t^j - Negative_t^j$, in section j of the FOMC minutes following meeting at date t (restricted to FOMC meetings where the monetary policy shock is non-zero):

$$\Delta rgdp_{t+k-1\to t+k} = \alpha_k^j + \beta_k PMN_t^j + \epsilon_{t+k-1\to t+k}^j, k \in \{1,2,...,8\}$$

The table is divided into sections based on the section of the FOMC minutes that we use to construct the PMN variable. Each column presents a different regression specification based on forecasting the k-quarter ahead macroeconomic growth indicated in the column header. Newey-West adjusted standard errors are in parentheses below the coefficient estimates. T-statistics are reported in brackets. Coefficients and standard errors are multiplied by 100 for readability. Panel B of Table 6 presents the results from predictive regressions for real consumption growth following the same structure as Panel A.

Table 7: **Text Measures and Short-term Equity Return**

PMN^j		ΔP^{180}		$Adj\ R^2$
Developments in Financial Markets (DFM)	0.003	(0.105)	[0.027]	-0.014
Staff Review of the Economic Situation (SRES)	0.049	(0.025)	[1.923]	0.032
SRES: Consumer Spending (CS)	0.475	(0.139)	[3.424]	0.117
+ Residential Investment (RI)				
Staff Review of the Financial Situation (SRFS)	0.032	(0.030)	[1.069]	0.002
Economic Outlook (EO)	0.142	(0.083)	[1.709]	0.023
Participants' Views on Current Conditions (PVCC)	-0.001	(0.022)	[-0.024]	-0.012
Committee Policy Action (CPA)	-0.052	(0.065)	[-0.802]	-0.005

Table 7 presents the results from the regression of the 180-day dividend strip return in the 30-minute window around the FOMC announcement at date t on the number of positive minus negative words, $PMN_t^j = Positive_t^j - Negative_t^j$, in section j of the FOMC minutes following meeting at date t (restricted to FOMC meetings where the monetary policy shock is non-zero):

$$\Delta P_t^{180} = \alpha_j + \delta_j PMN_t^j + \epsilon_j$$

Standard errors are presented in parentheses to the right of the coefficient estimates. T-statistics are in brackets. Coefficients and standard errors are multiplied by 100 for readability.

Figure 1: **Average Dividend Return by Monetary Policy Shock**

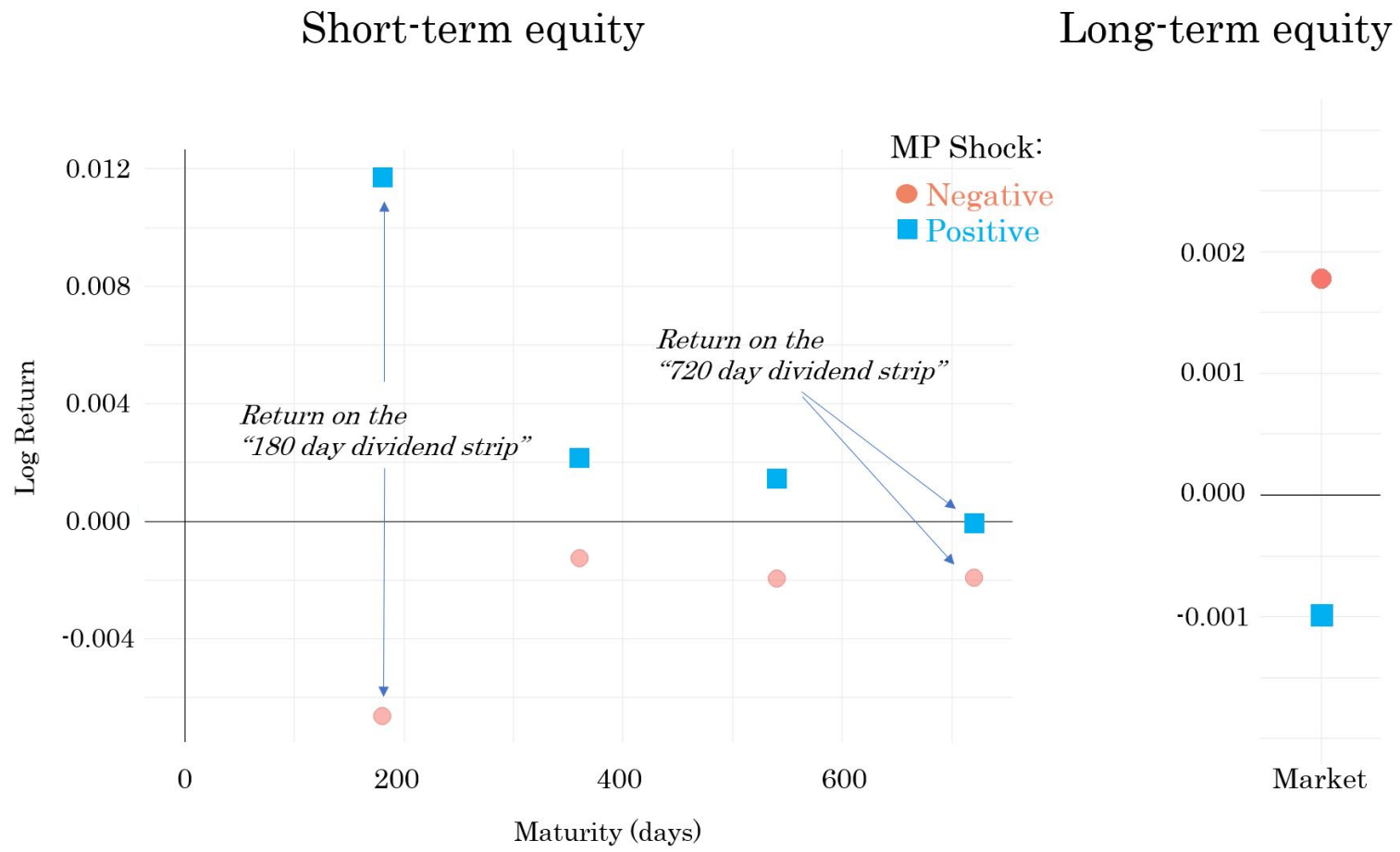

Figure 1 plots the average return of dividend strips by maturity grouped by the sign of the monetary policy shock. The return of the long-term asset is plotted on the right-hand side.

8 Appendix: For Online Publication

8.1 Tables & Figures

Table A.1: **Dividend Strip Return on Monetary Policy Shock (Winsorized Specification)**

Maturity	ΔP^{180}	ΔP^{360}	ΔP^{540}	ΔP^{720}
Δi_t^u	0.215	0.036	0.021	0.007
	(0.068)	(0.032)	(0.025)	(0.029)
	[3.165]	[1.141]	[0.847]	[0.244]
Intercept	0.004	0.000	0.000	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)
	[1.755]	[0.324]	[-0.036]	[-0.968]
Adj. R^2	0.066	0.002	-0.002	-0.007
Obs.	128	128	128	128

Table A.1 presents the results from the regression of the dividend strip return winsorized at the 5 percent level on the monetary policy shock.

$$\Delta P_t^h = \alpha + \beta \Delta i_t^u + \epsilon$$

where ΔP_t^h is the winsorized return on the dividend strip with maturity $h \in \{180, 360, 540, 720\}$ and Δi_t^u is the unexpected change in target Federal Funds rate around the FOMC announcement. Each column presents the results from the regression specification based on dividend strips with maturities indicated in the column header. Standard errors are reported in parentheses below the coefficient estimates. T-statistics are reported in brackets.

Table A.2: **Real GDP Growth predictability - Robustness**

Horizon	60-Minute Window			Non-zero Dates, Latest		
1Q	0.058	(0.054)	[1.084]	0.028	(0.026)	[1.088]
2Q	0.071	(0.033)	[2.143]	0.082	(0.035)	[2.355]
3Q	0.043	(0.019)	[2.307]	0.046	(0.026)	[1.776]
4Q	-0.01	(0.021)	[-0.468]	0.001	(0.014)	[0.104]
5Q	-0.001	(0.014)	[-0.083]	0.009	(0.011)	[0.879]
6Q	-0.008	(0.015)	[-0.539]	-0.019	(0.017)	[-1.121]
7Q	-0.023	(0.014)	[-1.656]	-0.024	(0.017)	[-1.381]
8Q	-0.001	(0.019)	[-0.075]	-0.006	(0.020)	[-0.298]

Horizon	All FOMC Dates			All FOMC Dates, Latest		
1Q	-0.002	(0.024)	[-0.087]	0.006	(0.025)	[0.225]
2Q	0.055	(0.029)	[1.919]	0.06	(0.025)	[2.440]
3Q	0.032	(0.015)	[2.106]	0.035	(0.015)	[2.334]
4Q	0.007	(0.009)	[0.788]	0.008	(0.007)	[1.103]
5Q	0.007	(0.011)	[0.646]	0.014	(0.008)	[1.642]
6Q	-0.001	(0.012)	[-0.097]	-0.002	(0.012)	[-0.125]
7Q	-0.016	(0.010)	[-1.531]	-0.015	(0.008)	[-1.923]
8Q	0.002	(0.012)	[0.157]	-0.001	(0.011)	[-0.047]

Table A.2 presents the results from four robustness specifications for the predictive regression of future k quarter ahead, quarterly real GDP growth on the 180-day dividend strip return in the 30-minute window around the FOMC announcement occurring on date t:

$$\Delta rgdp_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1, 2, ..., 8\}$$

The first robustness specification runs the predictive regression using dividend returns estimated over 60-minute windows. The latter three specifications use the dividend returns estimated in the baseline 30-minute windows. The columns under the "Non-zero Dates, Latest" header report the results for the regression run using the short-term asset return from the latest FOMC meeting each quarter. The columns under the "All FOMC Dates" header report the results for the regression run using all FOMC meeting dates including days where the monetary policy shock is zero. The final columns under the header "All FOMC Dates, Latest" report the results from the specifications which take the latest FOMC meeting each quarter from the set of all FOMC meetings including ones which have a zero monetary policy surprise. In each robustness specification, the coefficients on the short-term asset return are reported in the first column, Newey-West adjusted standard errors are reported in parentheses in the second column, and the t-statistics are reported in brackets in the third column. Each row is a separate regression for each quarterly horizon k.

Table A.3: **Real Consumption Growth Predictability - Robustness**

Horizon	60-Minute Window			All FOMC Dates		
1Q	0.025	(0.022)	[1.142]	0.009	(0.014)	[0.627]
2Q	0.028	(0.017)	[1.641]	0.016	(0.009)	[1.681]
3Q	0.019	(0.014)	[1.389]	0.011	(0.011)	[0.999]
4Q	0.004	(0.010)	[0.445]	0.012	(0.010)	[1.225]
5Q	0.009	(0.009)	[0.991]	0.007	(0.007)	[0.923]
6Q	0.004	(0.009)	[0.426]	0.011	(0.006)	[1.782]
7Q	0.002	(0.011)	[0.177]	0.015	(0.006)	[2.658]
8Q	-0.009	(0.010)	[-0.838]	-0.002	(0.007)	[-0.326]

Table A.3 presents the results from two robustness specifications for the predictive regression of future k quarter ahead, quarterly real consumption growth on the 180-day dividend strip return in the 30-minute window around the FOMC announcement occurring on date t:

$$\Delta realconsumption_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1,2,...,8\}$$

The first robustness specification runs the predictive regression using dividend returns estimated over 60-minute windows. The columns under the "All FOMC Dates" header report the results for the regression run using all FOMC meeting dates including days where the monetary policy shock is zero. In each robustness specification, the coefficients on the short-term asset return are reported in the first column, Newey-West adjusted standard errors are reported in parentheses in the second column, and the t-statistics are reported in brackets in the third column. Each row is a separate regression for each quarterly horizon k.

Table A.4: **Macroeconomic Forecast Summary Statistics**

	Central Tendency				
	Current Year	One year out	Two years out	Three years out	Longer run
$\Delta RGDP$					
Mean	2.197, 2.428	2.383, 2.758	2.336, 2.756	2.094, 2.488	2.014, 2.253
SD	0.385, 0.418	0.459, 0.503	0.604, 0.764	0.532, 0.661	0.25, 0.267
Min	1.6, 1.7	1.8, 2	1.7, 2	1.5, 2	1.7, 1.9
Max	3.1, 3.3	3.5, 4.2	3.5, 4.3	3, 3.9	2.5, 2.8
$\Delta PCEI$					
Mean	1.442, 1.639	1.611, 1.961	1.794, 2.033	1.876, 2.059	1.975, 2
SD	0.516, 0.534	0.248, 0.132	0.21, 0.063	0.152, 0.08	0.084, 0
Min	0.3, 0.4	1, 1.6	1.4, 2	1.5, 2	1.7, 2
Max	2.7, 2.9	2, 2.2	2.1, 2.2	2, 2.2	2, 2
Q4 U					
Mean	5.636, 5.772	5.267, 5.539	5.003, 5.403	4.659, 5.153	4.803, 5.242
SD	1.776, 1.818	1.58, 1.641	1.286, 1.367	0.992, 1.104	0.438, 0.574
Min	3.5, 3.6	3.4, 3.5	3.4, 3.7	3.5, 3.9	3.9, 4.3
Max	9, 9.1	8.5, 8.7	7.8, 8.2	6.8, 7.7	5.2, 6
FFR					
Mean	0.951	1.529	2.249	2.695	3.384
SD	0.79	0.85	0.799	0.639	0.554
Min	0.125	0.303	0.605	1.355	2.539
Max	2.493	3.016	3.325	3.544	4.206

Table A.4 presents the summary statistics of the central tendency measures of the advance Summary of Economic Projections released by the Fed for: $\Delta RGDP$ the change in real GDP, $\Delta PCEI$ the change in PCE Inflation, $Q4\ U$ Q4 Unemployment rate, and FFR the target federal funds rate. We parse the advance version of the economic projections for the 36 meetings where the data was released from April 2011 to December 2019 to obtain measures of central tendency for each meeting for each of these four measures at different horizons. The central tendency measures are aggregated from individual forecasts. For the FOMC meeting on date t, each individual i, makes forecasts $F_t^i\left(x_{year(k)}\right)$, for variable x at horizon $k \in \{0,1,2,3,LongRun\}$. We calculate the average, standard deviation, minimum and maximum for each measure separately (central tendency: upper and lower).We calculate the average of each measure across the 36 meetings as: $F_{avg}^{cl}(x_k) = \frac{1}{T}\sum_t F_t^{cl}(x_k)$ and $F_{avg}^{cu}(x_k) = \frac{1}{T}\sum_t F_t^{cu}(x_k)$. The table contain statistics for the central tendency measures presented in the format F^{cl}, F^{cu}, the lower central tendency statistic followed by the upper central tendency statistic separated by a comma. For example, the top left entry: $\Delta RGDP$, Current Year, Average provides the average of the lower central tendency and upper central tendency for current year real GDP growth forecasts, $F_{avg}^{cl}\left(\Delta rgdp_{year(0)}\right)$ and $F_{avg}^{cl}\left(\Delta rgdp_{year(0)}\right)$ as 2.197 and 2.428 respectively.

Table A.5: **FOMC Structure**

Section	Abbreviation	Description
Developments in Financial Markets	DFM	Short discussion at the beginning of the FOMC minutes about new financial markets developments.
Staff Review of the Economic Situation	SRES	Comprehensive review of the economic situation. Discussion of different aspects of the economy.
SRES: Employment	SRES:E	Employment, private nonfarm payroll, labor market conditions
SRES: Industrial Production	SRES:IP	Industrial production and output growth
SRES: Consumer Spending	SRES:CS	Consumer spending and personal consumption
SRES: Residential Investment	SRES:RI	Residential investment, housing and real estate
SRES: Nonresidential Investment	SRES:NI	Firm investment, software and business investments, inventories
SRES: International Trade	SRES:IT	International trade
SRES: Foreign Economies	SRES:FE	Growth and inflation prospects in other countries including China
SRES: Inflation	SRES:I	Consumer prices and inflation
Staff Review of the Financial Situation	SRFS	Discussion of the health and stability of the banking and financial sector
Economic Outlook	EO	Discussion of future economic prospects
Participants' Views on Current Conditions	PVCC	Meeting participants' (non-voting members) discussion and views on the state of the economy and future prospects
Committee Policy Action	CPA	Brief statement on the current policy of the Fed

Table A.5 presents the structure of the FOMC minutes.

Table A.6: **Measuring Sentiment of FOMC Minutes**

Positive	N	Negative	N
gains	384	declined	482
strong	191	unemployment	353
boosted	102	decline	260
gain	99	declines	228
improved	87	slowed	191
despite	74	sharply	158
stable	67	deficit	155
rebounded	62	weak	111
improvement	57	slower	109
rebound	47	force	102
positive	38	dropped	90
strength	37	claims	87
favorable	36	late	85
improve	27	slowing	75
strengthened	25	declining	73

Table A.6 presents the most commonly occurring positive and negative words in the "Employment", "Consumer Spending", and "Residential Investment" discussions within the Staff Review of the Economic Situation category of the FOMC minutes.

Table A.7: **Text Measures and GDP Growth All Dates**

	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
Staff Review of the Economic Situation (SRES)								
PMN	0.017	0.015	0.012	0.006	0.003	-0.002	-0.003	-0.003
	(0.008)	(0.012)	(0.013)	(0.008)	(0.004)	(0.005)	(0.004)	(0.004)
	[2.005]	[1.206]	[0.962]	[0.662]	[0.719]	[-0.473]	[-0.837]	[-0.832]
$Adj.R^2$	0.138	0.103	0.069	0.007	-0.005	-0.006	-0.004	-0.004
Participants' Views on Current Conditions (PVCC)								
PMN	0.010	0.008	0.012	0.010	0.006	-0.003	-0.003	-0.009
	(0.006)	(0.007)	(0.008)	(0.008)	(0.004)	(0.003)	(0.005)	(0.003)
	[1.760]	[1.114]	[1.502]	[1.230]	[1.340]	[-0.985]	[-0.653]	[-2.941]
$Adj.R^2$	0.068	0.036	0.106	0.058	0.014	-0.003	-0.001	0.048
Economic Outlook (EO)								
PMN	0.018	-0.001	0.004	0.001	-0.001	-0.003	-0.012	-0.006
	(0.018)	(0.018)	(0.014)	(0.016)	(0.011)	(0.019)	(0.014)	(0.008)
	[0.997]	[-0.038]	[0.293]	[0.040]	[-0.117]	[-0.154]	[-0.869]	[-0.738]
$Adj.R^2$	0.011	-0.009	-0.008	-0.009	-0.009	-0.009	-0.003	-0.008

Table A.7 presents the results from the regression of future k quarter ahead, quarterly real GDP growth on the positive minus negative word count, $PMN_t^j = Positive_t^j - Negative_t^j$, in section j of the FOMC minutes following meeting at date t (including all FOMC meetings):

$$\Delta rgdp_{t+k-1\to t+k} = \alpha_k^j + \beta_k PMN_t^j + \epsilon_{t+k-1\to t+k}^j, k \in \{1,2,...,8\}$$

The table is divided into sections based on the section of the FOMC minutes that we use to construct the PMN variable. Each column presents a different regression specification based on forecasting the k-quarter ahead macroeconomic growth indicated in the column header. Newey-West adjusted standard errors are in parentheses below the coefficient estimates. T-statistics are reported in brackets. Coefficients and standard errors are multiplied by 100 for readability.

Table A.8: **Text Measures and Consumption Growth All Dates**

	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q
Staff Review of the Economic Situation (SRES)								
PMN	0.014	0.014	0.010	0.008	0.008	0.000	0.001	0.001
	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.002)	(0.003)	(0.003)
	[5.511]	[3.887]	[2.564]	[1.585]	[1.820]	[0.126]	[0.301]	[0.232]
$Adj.R^2$	0.252	0.202	0.133	0.069	0.065	-0.009	-0.008	-0.009
Participants' Views on Current Conditions (PVCC)								
PMN	0.008	0.009	0.008	0.009	0.005	0.002	0.001	-0.005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
	[2.775]	[2.805]	[2.837]	[2.860]	[1.467]	[0.643]	[0.223]	[-2.014]
$Adj.R^2$	0.111	0.120	0.127	0.129	0.030	-0.003	-0.009	0.033
SRES: Consumer Spending (CS) + Residential Investment (RI)								
PMN	0.049	0.065	0.036	0.026	0.031	-0.010	0.010	0.004
	(0.021)	(0.022)	(0.022)	(0.021)	(0.014)	(0.012)	(0.011)	(0.011)
	[2.291]	[2.954]	[1.631]	[1.238]	[2.200]	[-0.866]	[0.927]	[0.332]
$Adj.R^2$	0.102	0.161	0.050	0.021	0.031	-0.005	-0.004	-0.009
Economic Outlook (EO)								
PMN	0.006	0.001	0.000	-0.003	-0.004	-0.001	-0.013	-0.017
	(0.015)	(0.015)	(0.011)	(0.015)	(0.012)	(0.011)	(0.012)	(0.006)
	[0.401]	[0.094]	[-0.047]	[-0.204]	[-0.381]	[-0.121]	[-1.092]	[-2.662]
$Adj.R^2$	-0.003	-0.008	-0.009	-0.008	-0.007	-0.009	0.013	0.028

Table A.8 presents the results from the regression of future k quarter ahead, quarterly real consumption growth on the positive minus negative word count, $PMN_t^j = Positive_t^j - Negative_t^j$, in section j of the FOMC minutes following meeting at date t (including all FOMC meetings):

$$\Delta rcons_{t+k-1\to t+k} = \alpha_k^j + \beta_k PMN_t^j + \epsilon_{t+k-1\to t+k}^j, k \in \{1,2,...,8\}$$

The table is divided into sections based on the section of the FOMC minutes that we use to construct the PMN variable. Each column presents a different regression specification based on forecasting the k-quarter ahead macroeconomic growth indicated in the column header. Newey-West adjusted standard errors are in parentheses below the coefficient estimates. T-statistics are reported in brackets. Coefficients and standard errors are multiplied by 100 for readability.

Table A.9: **Text Measures and Short-term Equity Return All Dates**

PMN^j		ΔP^{180}		$Adj\ R^2$
Developments in Financial Markets (DFM)	-0.058	(0.098)	[-0.596]	-0.006
Staff Review of the Economic Situation (SRES)	0.032	(0.025)	[1.261]	0.005
SRES: Consumer Spending (CS)	0.349	(0.138)	[2.527]	0.042
+ Residential Investment (RI)				
Staff Review of the Financial Situation (SRFS)	0.032	(0.029)	[1.093]	0.002
Economic Outlook (EO)	0.007	(0.076)	[0.091]	-0.008
Participants' Views on Current Conditions (PVCC)	0.002	(0.022)	[0.085]	-0.008
Committee Policy Action (CPA)	-0.135	(0.063)	[-2.147]	0.029

Table A.9 presents the results from the regression of the 180-day dividend strip return in the 30-minute window around the FOMC announcement at date t on the number of positive minus negative words, $PMN_t^j = Positive_t^j - Negative_t^j$, in section j of the FOMC minutes following meeting at date t (including all FOMC meetings):

$$\Delta P_t^{180} = \alpha_j + \delta_j PMN_t^j + \epsilon_j$$

The standard errors in parentheses are presented in the column to the right of the coefficient estimates. T-statistics are presented in brackets. Coefficients and standard errors are multiplied by 100 for readability.

Figure A.1: **Comparison of Monetary Policy Shock with Nakamura and Steinsson Measure**

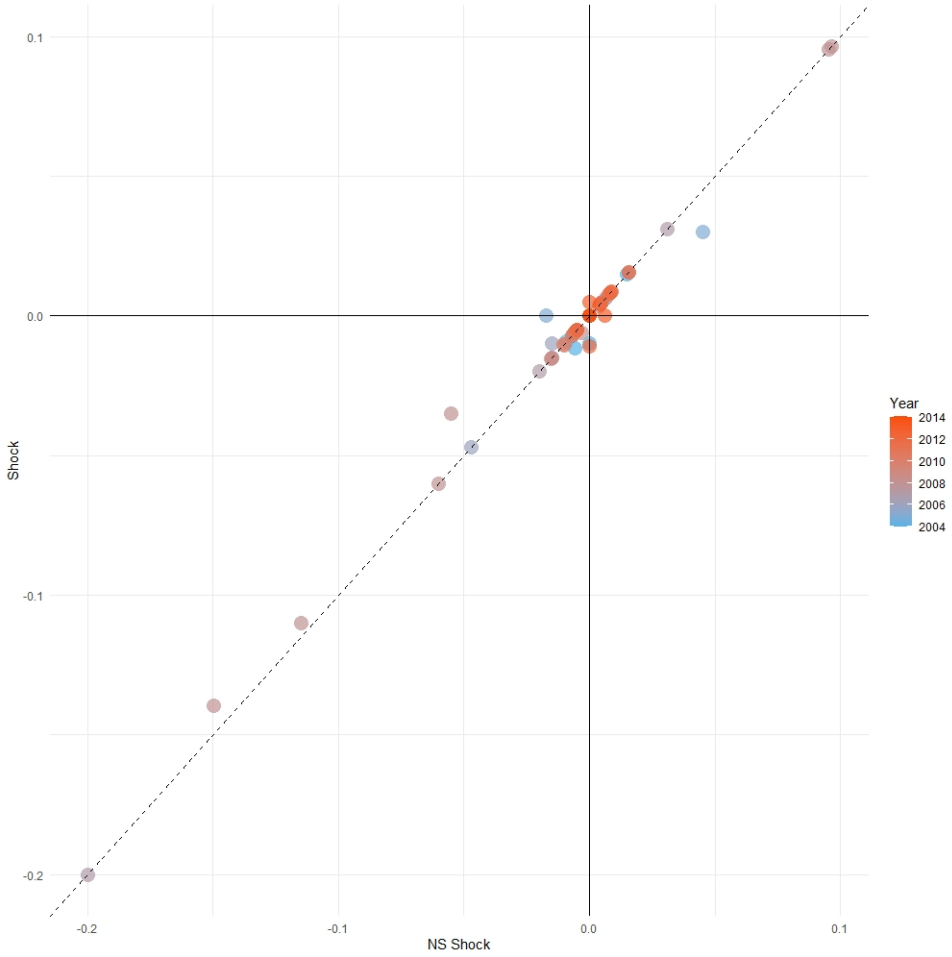

Figure A.1 plots our monetary policy shock on the y-axis against the shock constructed in Nakamura and Steinsson (2018) on the x-axis. The dashed $y = x$ line is plotted for comparison.

Figure A.2: **Implied Risk-free Rates by Horizon**

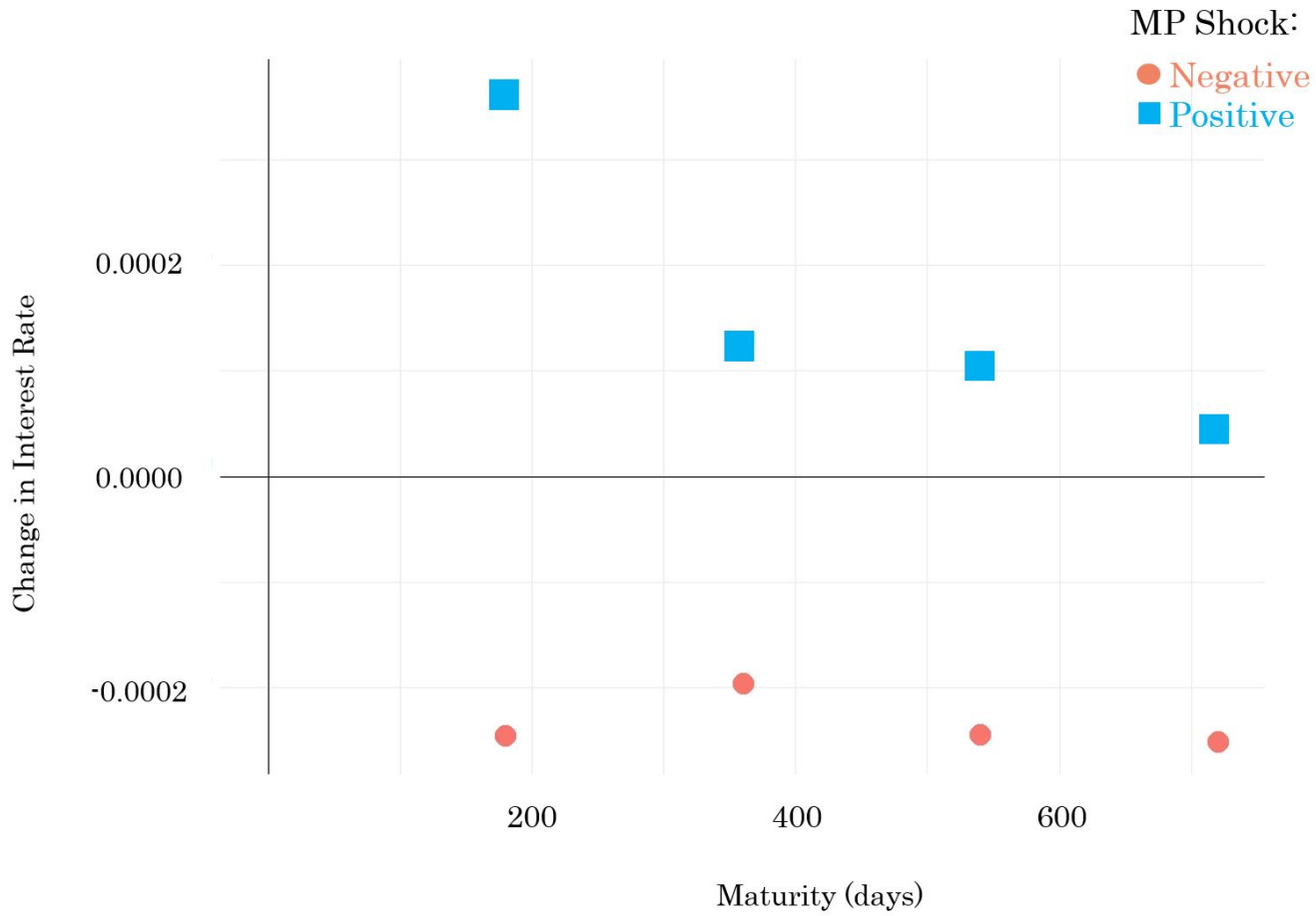

Figure A.2 plots the average change in risk-free rates by maturity grouped by the sign of the monetary policy shock.

Figure A.3: **Real GDP Growth Predictability**

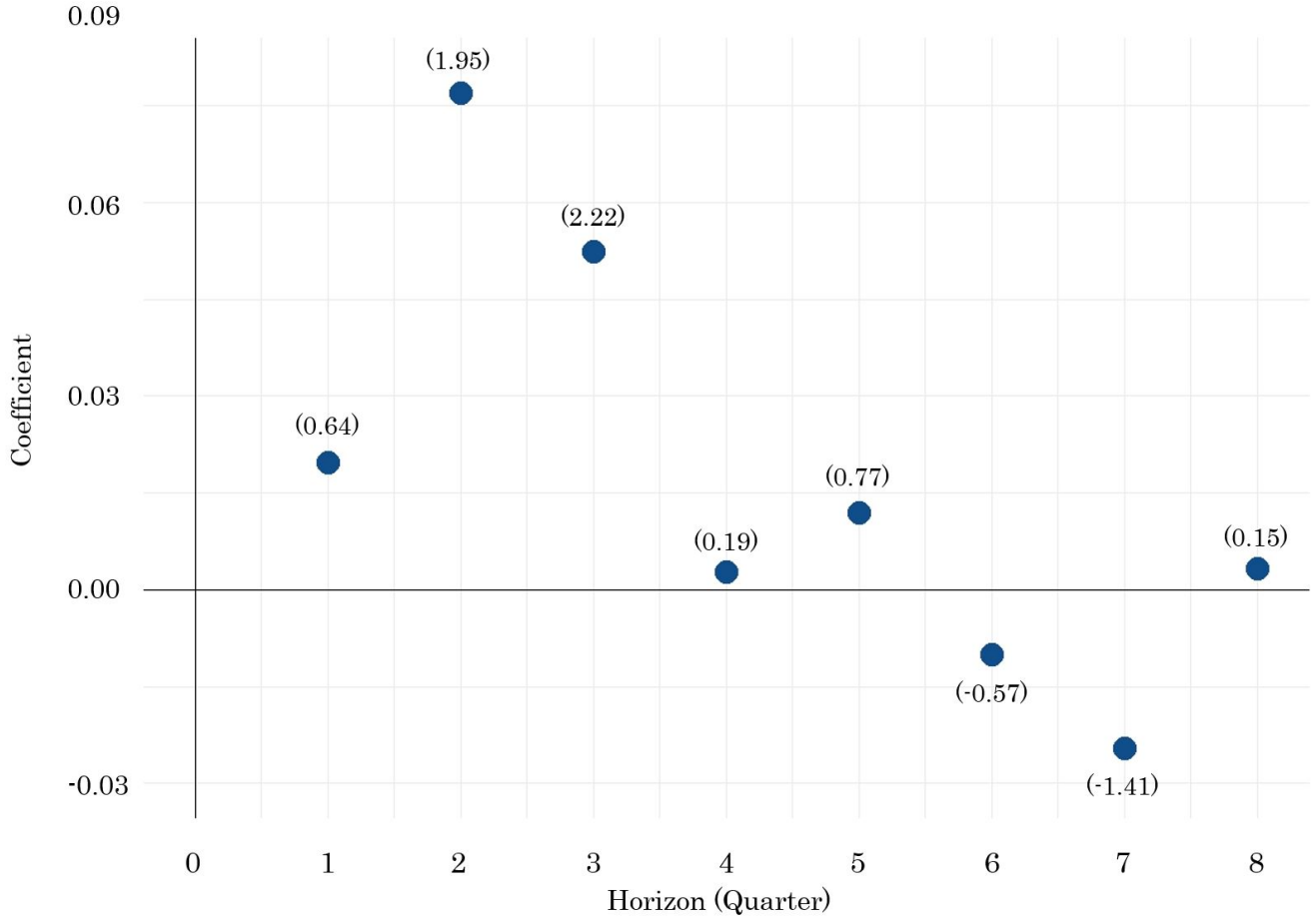

Figure A.3 plots coefficients from the predictive regressions of $k-quarter$ ahead quarterly real GDP growth on the return of the 180-day dividend strip in the 30-minute window around each FOMC announcement at date t:

$$\Delta rgdp_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1,2,\ldots,8\}$$

The y-axis is the coefficient estimate δ_k and the x-axis is the horizon. Newey-West adjusted t-statistics around the δ_k estimate are in parentheses next to each point estimate.

Figure A.4: **Real Consumption Growth Predictability**

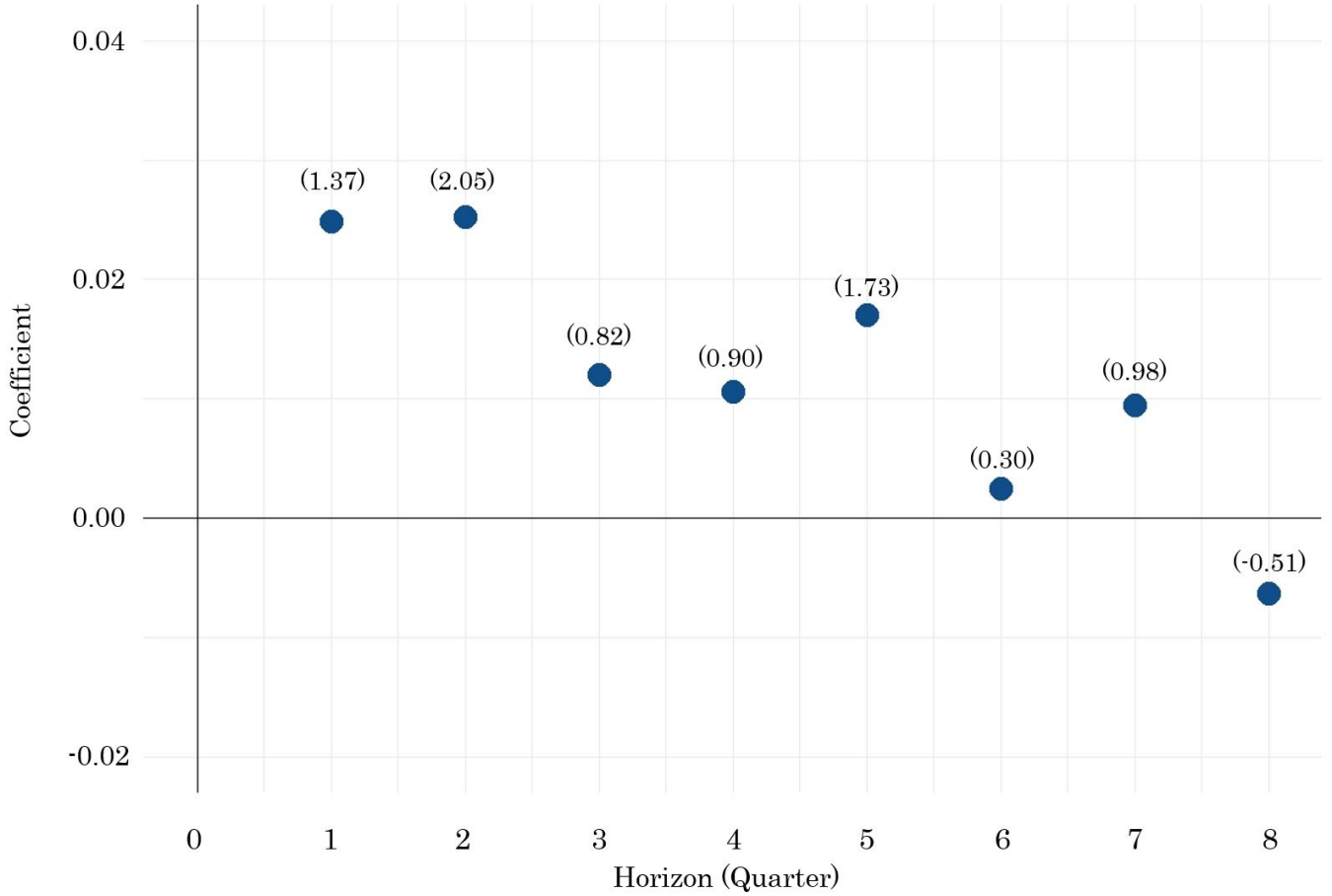

Figure A.4 plots coefficients from the predictive regressions of $k-quarter$ ahead quarterly real consumption growth on the return of the 180-day dividend strip in the 30-minute window around each FOMC announcement at date t:

$$\Delta rcons_{t+k-1\to t+k} = \alpha_k + \delta_k \Delta P_t^{180} + \epsilon_{t+k-1\to t+k}, k \in \{1,2,...,8\}$$

The y-axis is the coefficient estimate δ_k and the x-axis is the horizon. Newey-West adjusted t-statistics around the δ_k estimate are in parentheses next to each point estimate.

Figure A.5: **Timing of SPF Forecasts and FOMC announcements**

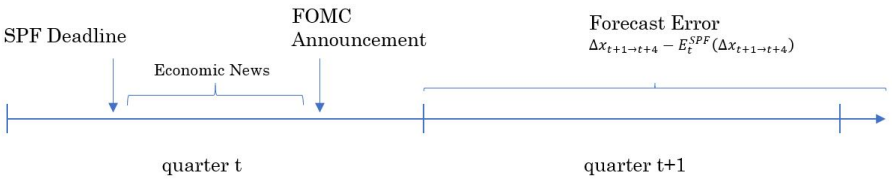

Figure A.5 shows the timing of the Survey of Professional Forecasts, economic news, and the subsequent FOMC announcement. The Survey of Professional Forecasters response deadlines are set at late in the second to third week of the middle month of each quarter. We obtain the date of the next FOMC meeting following the SPF deadline. This meeting falls within the same quarter as the SPF deadline in all cases. We calculate the SPF forecast errors for subsequent annual growth rates (growth over quarters $t+1$ to $t+4$).