Equity Premium Events*

Ben Knox Juan M. Londono
Mehrdad Samadi Annette Vissing-Jorgensen†

Federal Reserve Board

First Draft: February 2024
This Draft: July 2024

ABSTRACT: We develop a methodology to determine which days are "equity premium events": events with significantly elevated equity premia relative to the daily equity term structure. To do so, we use recently available daily S&P 500 option expirations and forward analogs of the Martin (2017) and Tetlock (2023) ex ante measures of the equity premium. We use a data-driven approach to identify events that are significantly priced by equity markets without taking a stance on what those events are. A wide variety of events are associated with significantly elevated equity premia. In the cross-section of macroeconomic releases, FOMC, CPI, and nonfarm payrolls have the largest abnormal equity premia, which increase substantially between June 2022 and June 2023. However, the elevated equity premia on macroeconomic release days account for a significantly smaller share of total expected returns compared to previous estimates using realized excess returns, suggesting a role for unexpectedly good news. To provide intuition for the variation in equity premia across announcement types and time, we propose an asset pricing framework that decomposes the equity premium for a given macroeconomic

*The authors thank Nick Bloom, Mike Chernov, Steven Davis, Ian Dew-becker, Mohammad Jahan-Parvar, Yuriy Kitsul, Dmitriy Muravyev, Yoshio Nozawa, Neil Pearson, Matt Ringgenberg, Ivan Shaliastovich, Taisiya Sikorskaya, Mungo Wilson, Emre Yoldas, conference participants at the CIREQ meeting in Honor of Eric Ghysels, FEBS, IRMC, U.Chicago BFI Firms' Cost of Capital, Discount Rates, and Investment Conference, and seminar participants at Arrowstreet Capital and Wake Forest University. Bill Lang provided excellent research assistance. The views expressed in this paper are those of the authors and do not represent the views of the Federal Reserve Board, Federal Reserve System or their staff.

†E-mails: ben.knox@frb.gov, juan.m.londono@frb.gov, mehrdad.samadi@frb.gov, and annette.vissing-jorgensen@frb.gov.

release into components due to news variance and the sensitivities of the stock market and the SDF to the news released.

JEL classification: E44, G12, G13
Keywords: Risk Premium, Macroeconomic Releases, FOMC, Daily Expiration Options

A fundamental question in finance is what drives the equity risk premium. Recent work has highlighted the importance of prescheduled economic releases containing information about cash flows and discount rates for which investors may demand risk compensation (Savor and Wilson (2013) and Lucca and Moench (2015)). Most existing evidence is based on realized returns around these events. However, analysis using realized returns to measure risk premia of prescheduled events is potentially subject to small-sample problems given that realized average returns are a noisy estimate of expected returns (Cieslak, Morse, and Vissing-Jorgensen (2019) and Ernst, Gilbert, and Hrdlicka (2019)).

In this paper, we exploit the rich forward term structure of S&P 500 option prices observed each trading day along with option-implied models of the equity premium to estimate the equity premium over daily (or, in some periods, 2-day) forward periods up to one month in the future. Since end-of-week S&P option expirations became available in 2009 (Andersen, Fusari, and Todorov (2017)), Cboe added Monday and Wednesday expirations on the S&P 500 in 2016 and added Tuesday and Thursday expirations in 2022, resulting in an option expiration at the end of each trading day. Because these options trade for one month prior to expiration, we can estimate expected returns for each upcoming day (forward period) using adjacent option expirations available on a given trade date. We estimate a panel of forward daily expected returns for trade dates from October 2016 through December 2023.

To estimate expected returns, we construct forward analogs of the Martin (2017) SVIX and Tetlock (2023) Implied Equity Premium (IEP) ex ante measures of the equity premium implied by option prices (Gandhi, Gormsen, and Lazarus (2022) and Londono and Samadi (2023)). We develop a new methodology to determine which days have an abnormally high equity premium relative to surrounding days based on the forward curve for the equity premium (abnormal premium). Because outliers on the equity term structure are of particular economic interest in our setting, we use quantile regressions

(QR) with first expiration of the calendar week, term, and term squared variables to fit the equity term structure each day, as traditional yield curve fitting methods (Nelson and Siegel (1987) and Svensson (1994)) would fit outliers if they are not removed prior to estimation (often in ad-hoc ways, see Fama and Bliss (1987) and Gürkaynak, Sack, and Wright (2007), among others).

We start our analysis by assessing the extent to which there are "equity premium events". We decompose the variation of our trade date-forward period panel of expected returns to assess the relative role of time-series variation versus variation across forward periods on a given trade date. We find that variation in the equity term structure across trade dates accounts for most of the variation in the panel. The time series standard deviation of trade date-level median forward premia is 1.31 basis points (bp) using the forward SVIX. However, there is also significant variation in forward equity premia within trade date. The average of within trade date standard deviation is 0.35 bp, with a significant share of this variation coming from outliers on the equity term structure, serving as preliminary evidence that there are events with significantly elevated risk pricing in our sample.

We then let the data speak regarding which forward periods are associated with significant abnormal premia. While a large literature has examined the drivers of large realized moves in equity markets (Niederhoffer (1971); Cutler, Poterba, and Summers (1988); Kapadia and Zekhnini (2019); and Baker, Bloom, Davis, and Sammon (2021)), our data-driven analysis provides an ex ante counterpart to these papers. The forward periods identified by our data-driven approach that are associated with abnormally high U.S. equity risk premia include types of events extensively studied in the literature on realized returns. The 38 most significant events in our sample include 9 U.S. CPI releases, 7 nonfarm payrolls (NFP) releases, 13 Federal Open Markets Committee (FOMC) meetings (Savor and Wilson (2013) and Lucca and Moench (2015), among others), and the

2016 and 2020 U.S. presidential elections (Niederhoffer, Gibbs, and Bullock (1970); Li and Born (2006); and Kelly, Pástor, and Veronesi (2016); among others). Our approach also identifies other events less explored in the literature, such as the 2018 and 2022 U.S. Midterm elections, the 2017 French Presidential election and runoff, the January 6, 2021, the Electoral College Count and Georgia Congressional runoff, and the 2019 Trump-Xi G-20 Bilateral meeting. Of the recurring events with significant abnormal risk pricing, presidential elections containing fiscal news are associated with the largest average abnormal premia, though elections comprise a small proportion of total expected returns in our sample as these events occur much less frequently than macroeconomic release and monetary policy announcement days.

To understand the role of macroeconomic releases more broadly, we extend the analysis to the full cross-section of U.S. economic releases tracked by the Bloomberg Economic Calendar. We find that FOMC, CPI, and NFP releases are associated with the largest abnormal macroeconomic release equity premia in our sample—average equity premia of 7.56 bp per forward period using the IEP measure. Yet, the expected returns of FOMC, CPI, and NFP release days account for a much smaller proportion of total expected returns compared to previous results examining realized excess stock market returns (Savor and Wilson (2013) and Lucca and Moench (2015)). Our estimates are potentially consistent with the notion that large excess realized returns associated with these releases could also partly reflect unexpectedly good news, with the news on FOMC announcement days potentially stemming from conditional policy promises (Cieslak et al. (2019) and Haddad, Moreira, and Muir (2023)). We also study the time-series evolution of abnormal equity premia for macroeconomic releases, and we find that equity premia for FOMC and CPI releases became particularly elevated during 2022 and 2023.

To understand the drivers of equity premium events and, in particular, the variation in CPI premia in 2022 and 2023, we derive an asset pricing framework that decomposes the equity premium for a given economic release into components due to (i) the variance of the news in the upcoming release, (ii) the beta of the stock market with respect to the news, and (iii) the beta of the stochastic discount factor (SDF) with respect to the news. We find a role for both increased risk with respect to release news and time-varying betas when explaining the elevated CPI release premia during 2022 and 2023.

Because our estimates of forward equity premia can be obtained in real time using end of day option prices, the empirical framework that we propose in this paper can be used to examine equity premia for upcoming events on the economic and political calendar. Given the significant variation in forward premia across release types and through time, our approach can identify which upcoming events equity markets perceive to be important on any given day. We provide an example of how to price the upcoming economic calendar as well as the 2024 presidential election. Forward premia for the upcoming month of daily forward periods are available at www.pricingthecalendar.com.

While our focus is on equity premia, our work is related to papers examining option prices around specific types of events, including the implied volatility, volatility slope, and variance risk premia of international presidential elections and political summits (Kelly et al. (2016)), the implied volatility of earnings releases (Dubinsky, Johannes, Kaeck, and Seeger (2019)), and variance risk premia of U.S. FOMC and NFP releases (Wright (2020)). We also build upon prior work estimating equity premia for FOMC meetings by imposing specific forms of investor preferences (Liu, Tang, and Zhou (2022)) and work estimating forward equity premia for CPI, GDP, FOMC, and NFP releases (Londono and Samadi (2023)).

The novelty of our work relative to this literature is as follows. Using the forward term structure of equity premia, we develop a methodology for estimating the abnormal equity premium for a given forward period relative to other forward periods observed on the same calendar date. By examining expected returns across all daily forward periods from October 2016 through December 2023, we use a data-driven approach to identify all events that are significantly priced by equity markets without taking a stance on what those events are. Furthermore, we quantify the role of equity premium events for the overall variation in our trade date-forward period panel the share of total expected returns that CPI, FOMC, and NFP releases account for (Savor and Wilson (2013); Lucca and Moench (2015)). Finally, to better understand the variation in event premia across events and time, we introduce a novel asset pricing methodology for decomposing the equity premium for a given event.

This paper proceeds as follows: Section I describes the data; Section II describes the estimation of forward daily equity premia, explains our methodology to identify abnormal forward daily equity premia, and decomposes the variance of our trade date-forward period equity premium panel; Section III presents results for a data-driven analysis that examines which forward periods are associated with significant abnormal forward premia; Section IV extends the analysis to the full cross-section of U.S. macroeconomic releases; Section V develops an asset pricing framework for macroeconomic release premia; Section VI provides an example of how the empirical framework can be used to price the economic and political calendar; and Section VII concludes.

I. Data

Our sample consists of prices of daily option expirations over trade dates from October 2016 through December 2023. For this time period, we construct forward periods generally one or two trading days long based on data availability. Cboe added Monday and Tuesday expirations to Friday expirations in October 2016, then added Tuesday and Thursday expirations in May 2022 resulting in a full set of Monday-Friday daily expirations. Otherwise known as SPX "Weeklys," these are cash settled European options that settle to the market closing price. Daily option expirations trade for one month prior to expiration.[1]

Data for option prices and interest rates are obtained from Optionmetrics. We use out of the money options with product code "SPXW". We remove options with missing implied volatility, which occurs when the option midquote is below the intrinsic value or when the Optionmetrics implied volatility calculation fails to converge. We use option expirations with at least 10 distinct strike prices and a minimum moneyness range of 95% to 105% (moneyness is defined as K/P_t, where K is the option's strike price and P_t is the close price of the S&P 500 on trading day t). For each trade date, we use a common moneyness range, which is calculated as the minimum moneyness range across forward periods.

We remove option expirations with more than 28 calendar days to expiration. We also remove a small subset of trade dates with negative expected returns over a given forward period. These initial filters result in 24,527 trade date-forward period observations and forward premia for 1,319 unique forward periods. Expiration-level descriptive statistics for the daily option expirations in our sample are reported in Appendix Table A1. These statistics indicate a large number of strikes, large moneyness range, and suggest that these options are actively traded, making them conducive to estimating option-implied measures. After estimating raw and abnormal forward premia, for our main tests, we further require that options have at least one week to expiration following the prior

[1]SPX Weeklys end of week expirations are not available on the same days as SPX monthly expirations with a.m. settlement (last trade day of the third week of the month) until May 2017. Results are qualitatively similar when we add SPX Monthly options to the sample for which SPX Weeklys are unavailable. SPX Tuesday and Thursday expirations initially traded for two weeks prior to expiration following their introduction until October 2022.

literature (Beber and Brandt (2006) and Kelly et al. (2016)).[2] This filter results in 19,574 trade date-forward period observations covering 1,317 unique expirations.

Table 1 summarizes option expiration dates by year and expiration day of the week. Panel A reports the number of unique option expiration dates, e, while Panel B reports the number of trade date-expiration, (t, e), observations. From October 2016 through 2021, nearly all option expiration dates fall on Mondays, Wednesdays, and Fridays. The limited number of Tuesday and Thursday expirations during this period are the result of exchange holidays for which the Cboe shifts the option expiration date to an adjacent trading day. From June 2022, there are option expirations on every trading day. Accordingly, the bottom rows of Table 1 show that expirations are approximately equally distributed across Mondays through Fridays in 2023.

[Insert Table 1 here]

We also collect all 124 U.S. macroeconomic variables for which releases are tracked in the Bloomberg Economic Calendar. Because a given release may contain information about several macroeconomic variables, we group variables released together, and we examine equity premia at the release level. For example, information about the Unemployment Rate is contained in the same release as NFP, so any abnormal equity premium on the release date is the combined compensation for both variables' releases. Our procedure to group 124 macroeconomic variables into 50 releases is detailed in Appendix A.

For reference, we also examine realized excess stock returns over an extended sample

[2]During the onset of Covid-19 in the U.S., options with less than one week to expiration became significantly more expensive in the absence of key prescheduled economic releases. Furthermore, there have been accounts that retail trading activity is concentrated in options within 24 hours to expiration (see Bloomberg's article "Retail Traders are Driving Up 40% of Zero-Day Options Boom"). We present statistics on retail trading activity using the proxy of Bryzgalova, Pavlova, and Sikorskaya (2023) in Appendix Table A2. Results are qualitatively similar when including options with less than one week to expiration.

period from October 1996 through December 2023. Excess realized stock returns are from Ken French's data library.

II. Abnormal Forward Equity Premia

In this section, we first discuss approaches to calculate raw forward equity premia using S&P 500 options and introduce a methodology to estimate abnormal equity premia with respect to the daily forward term structure, and we use a variance decomposition approach for both forward equity premia and abnormal equity premia.

II.A. Forward Equity Premia

We construct a panel of trade date-forward period-level expected returns using two approaches. The first approach uses a forward analog of the Martin (2017) SVIX. The SVIX provides a lower bound on expected returns under a relative negative correlation condition (NCC). The second approach uses a forward analog of the Tetlock (2023) implied equity premium (IEP), which provides a point estimate of expected returns subject to the main assumptions that markets for the S&P 500 and its options are frictionless and complete.

In the first approach, for each trade date t, the forward rate of expected returns ($F^{SVIX}_{t,T_{n:m}}$) over forward period $T_{n:m}$ is calculated using SVIX estimates obtained from option prices of adjacent daily option expirations (S_{t,T_n} and $S_{t,T_{n+m}}$):

$$
\begin{aligned}
F^{SVIX}_{t,T_{n:m}} &\approx \frac{(1+S_{T_{n+m}})}{(1+S_{T_n})} - 1 \\
S_{t,T_n} &= \frac{2}{P_t^2}\left[\int_0^{F_{t,T_n}} p_{t,T_n}(K)\,dK + \int_{F_{t,T_n}}^{\infty} c_{t,T_n}(K)\,dK\right],
\end{aligned}
\tag{1}
$$

where P_t is the price of the S&P 500 index on trade date t, F_{t,T_n} is the forward price on trade date t for horizon T_n, and $p_{t,T_n}(K)$ ($c_{t,T_n}(K)$) are the midquote prices of out-of-the-money put (call) options with strike price K and expiration date T_n, resulting in one observation per trade date-forward period. We numerically integrate across option strike prices using the approach of Martin (2017), among others. In the case of an unconstrained investor with log utility over terminal wealth who is fully invested in the stock market, the SVIX reflects expected future excess returns exactly. Without log utility, the forward SVIX provides a lower bound on expected future excess returns under a relative NCC: $\text{cov}_t(M_{t,T_{n+m}} R_{t,T_{n+m}}, R_{t,T_{n+m}}) \leq \text{cov}_t(M_{t,T_n} R_{t,T_n}, R_{t,T_n})$, for all stochastic discount factors M_t, where R_{t,T_n} is the return on the market portfolio from time t to time T_n.[3]

In our second approach, for each trade date t and forward period $T_{n:m}$, forward expected excess returns ($F^{IEP}_{t,T_{n:m}}$) over forward period $T_{n:m}$, are approximated using implied equity premium (IEP) estimates obtained from option prices of adjacent daily option expirations, ($E_t(\tilde{R}_{T_{n+m}})$ and $E_t(\tilde{R}_{T_n})$):

$$
\begin{aligned}
F^{IEP}_{t,T_{n:m}} &\approx \frac{(1 + E_t(\tilde{R}_{T_{n+m}}))}{(1 + E_t(\tilde{R}_{T_n}))} - 1 \\
E_t(\tilde{R}_{T_n}) &= R^{-1}_{f,t,T_n} \sum_{k=1}^{4} w_{k,t} E^*_t(\tilde{R}^{k+1}_{T_n}),
\end{aligned}
\tag{2}
$$

where $w_{k,t}$ are estimates of growth optimal (GO) portfolio weights on trade date t obtained using regressions of the variance premium on higher order risk neutral moments and $E^*_t(\tilde{R}^{k+1}_{T_n})$ are risk neutral expected excess market returns raised to the $k+1$ power. The SVIX ($F^{SVIX}_{t,T_{n:m}}$) is nested in the IEP framework, setting $w_1 = 1$ and $w_k = 0$ for $k >= 2$,

$$
E_t(\tilde{R}_{T_n}) = R^{-1}_{f,t,T_n} E^*_t(\tilde{R}^2_{T_n}). \tag{3}
$$

[3]We elaborate on the relative NCC underlying the forward SVIX in Appendix B.

Risk neutral moments of expected excess returns are estimated using the following expression (Bakshi and Madan (2000) and Carr and Madan (2001)):

$$R_{f,t,T_n}^{-1} E_t^*(\tilde{R}_{T_n}^{k+1}) = \\ \frac{j!}{P_t^j} \left[\int_0^{F_{t,T_n}} (K - F_{t,T_n})^{j-2} p_{t,T_n}(K) dK + \int_{F_{t,T_n}}^{\infty} (K - F_{t,T_n})^{j-2} c_{t,T_n}(K) dK \right], \tag{4}$$

For comparability with Tetlock (2023)'s estimates of expected returns, we use a similar approach to estimate GO portfolio weights. The details of our estimation can be found in Appendix D. While the IEP requires additional estimates of physical variance, higher order option-implied moments, and GO portfolio weights relative to the SVIX, the IEP provides a point estimate of the equity premium rather than a lower bound and requires weaker assumptions.

Our approximations of forward expected returns can differ from investors' expected forward return on the market portfolio if investors perceive there to be autocorrelation in daily market returns between horizons T_n and T_{n+m}. We elaborate on this approximation in Appendix C, where we provide empirical evidence that the approximation error is likely very small in practice. Results are qualitatively similar when we construct a forward expected log return analog using the Gao and Martin (2021) LVIX as in Gandhi et al. (2022) and Londono and Samadi (2023).

Panel A of Table 2 reports summary statistics of forward risk premium per day under the SVIX and IEP measures. The average forward risk premium is 1.48 bp per day under the SVIX measure with a standard deviation of 1.47. The mean and standard deviations are higher under the IEP measure at 4.16 and 4.11, respectively. A larger average forward risk premium under the IEP measure is consistent with the SVIX representing a lower bound of equity risk premia and the IEP representing a point estimate. There is significant variation in forward expected returns across the trade date-forward period-level observations in our sample, with IEP forward premia ranging from 1.12 bp for the 5th percentile to 10.14 bp for the 95th percentile. In subsequent tests for estimating abnormal equity premia for events we adjust for the number of trading days per forward interval.

[Insert Table 2 here]

Figure 1 reports the distribution of forward premia (blue points) and the median forward premia (orange series) each trade day. There is significant variation in the level of the daily forward equity term structure, as evidenced by the variation in the daily median, with median forward premia increasing notably during the onset of the Covid-19 pandemic. There is also significant variation in forward premia across forward periods within each trade date, as evidenced by the dispersion of blue points around the daily median. While some of this dispersion is due to the slope and curvature of the forward term structure, we will show that there are also many events with abnormally high forward equity premia relative to the equity premium term structure on the particular trading day. We develop the methodology in Section II.B and decompose the variance of our trade date-forward period panel in Section II.C.

[Insert Figure 1 here]

II.B. Abnormal Forward Equity Premia

We define the abnormal forward equity premium as the deviation from the fitted forward term structure. On each trade date t, we observe a term structure of forward expected daily returns across forward periods indexed by $e = 1, 2, \ldots, E$ up to one month in the future, where $F_{t,e}$ denotes the expected return per trade day over forward period e. From this term-structure of forward expected returns, we estimate a quantile regression

(QR) on each trade date t:

$$Q_{F_{t,e}|x_{t,e}}(\mathcal{T}) = x_{t,e}\beta_{t,\mathcal{T}}, \tag{5}$$

where $Q_{F_{t,e}|x_{t,e}}(\mathcal{T})$ is the $\mathcal{T}$'th quantile of forward expected returns on date t and $x_{t,e}$ is a vector containing the conditioning variables. The QR slope $\beta_{t,\mathcal{T}}$ is chosen to minimize the quantile weighted absolute value of errors across E forward periods:

$$\hat{\beta}_{t,\mathcal{T}} = \underset{\beta_{t,\mathcal{T}} \in R^k}{\arg\min} \sum_{e=1}^{E} \left(\mathcal{T} \cdot I_{(F_{t,e} > x_{t,e}\beta_t)} |F_{t,e} - x_{t,e}\beta_{t,\mathcal{T}}| + (1 - \mathcal{T}) \cdot I_{(F_{t,e} < x_{t,e}\beta_t)} |F_{t,e} - x_{t,e}\beta_{t,\mathcal{T}}| \right), \tag{6}$$

where $I_{(.)}$ denotes the indicator function.

The abnormal forward expected returns $(A_{t,e})$ on trade date t for forward period e are then defined as the residual from the QR estimation:

$$A_{t,e} = F_{t,e} - \hat{Q}_{F_{t,e}|x_{t,e}}(\mathcal{T}), \tag{7}$$

where $\hat{Q}_{F_{t,e}|x_{t,e}}(\mathcal{T})$ is the predicted quantile value of the forward expected return conditional on $x_{t,e}$.

In our baseline estimation, we implement a QR on each trade date using the median quantile ($\mathcal{T} = 0.5$) and condition on the vector $x_{t,e} = \left(a_t, I_{e=fow}, T_{t,e}, T^2_{t,e}\right)$, where a is a constant, $I_{e=fow}$ is an indicator variable equal to one if the option expiration e is the first expiration of the calendar week and equal to zero otherwise, $T_{t,e}$ is the time to expiration of the further dated option expiration for forward period e, and $T^2_{t,e}$ is the time to expiration squared. The first expiration of the week indicator variable accounts for the first forward period of the week also spanning weekends, the time to expiration variable absorbs variation that may come from a slope in the term structure of forward expected returns (Gormsen (2021)), and the time to expiration squared variable also absorbs curvature in the term structure.

Appendix Table A5 reports goodness of fit statistics for alternative QR specifications estimated on each trade date. We use the pseudo-R^2 as the goodness of fit measure, which is estimated as 1 minus the ratio between the sum of absolute deviations in the fully parameterized models and the sum of absolute deviations in the null (non-conditional) quantile model. In our baseline specification, the average pseudo-R^2 across all trade dates is 48 percent, indicating that about half of the variation in the term-structure of forward premia is attributable to the conditioning variables in our approach for the average trade date. The conditioning variables are particularly important for fitting the forward term structure during the onset of the Covid-19 pandemic in the U.S., when the forward equity term structure exhibited steep negative slopes and pronounced curvature.[4]

The QR estimation approach differs from traditional yield curve fitting methods (Nelson and Siegel (1987); and Svensson (1994)) in that these traditional methods would fit outliers if they are not removed prior to estimation. Outliers are often removed in ad-hoc ways, see Fama and Bliss (1987); and Gürkaynak et al. (2007).

Figure 2 illustrates the data and our approach on two example trade dates using the forward SVIX. In all panels, weekend days are excluded when constructing the timeline on the x-axis. The first forward periods of the week are marked with white circles. The left and right panels in the top row of the figure show the cumulative equity risk premium through each expiration date observed on October 19, 2020, and January 18, 2023, respectively. The panels in the middle row show the raw forward equity risk premium per calendar day over each forward period. According to these middle-row panels, forward equity risk premia are approximately 2 bp per day on October 19,

[4]The QR approach is robust when estimated using the median quantile so long as no more than half of the forward periods on a given trade date are abnormally priced. However, one can allow for a greater fraction of forward periods to have abnormal equity risk premium by estimating the QR at a lower percentile, e.g., with $\mathcal{T} < 0.3$. Results are qualitatively similar using this alternative approach.

2020 (middle-left panel) and approximately 1 bp per day on January 18, 2023 (middle-right panel). However, forward risk premia are significantly larger over certain forward periods (marked with vertical lines); in particular, the forward period spanning the 2020 presidential election in the left panel and those spanning the FOMC, NFP, and CPI releases in the right panel. The bottom row of Figure 2 reports abnormal forward expected returns per day over each forward period. Most forward periods have an abnormal equity risk premium close to zero, while the abnormal equity risk premium each forward period is measured as the deviation from the fitted forward term structure. The QR specification identifies forward periods that are outliers, and these outliers reflect significantly priced events in our empirical setting. We use forward premia per trade day to fit the forward term structure to account for forward periods of unequal length on a given day. In particular, during the period from October 2016 to May 2022 where only Monday, Wednesday and Friday expirations are available, the forward periods ending on Wednesdays and Fridays are two trading days long while those ending on Mondays are one trading day long. Following Section II, we re-scale abnormal forward premia per day by the length of the forward period (red series in bottom-left panel), capturing the full abnormal equity premium for any event that takes place during the interval.[5]

[Insert Figure 2 here]

Panel B of Table 2 reports summary statistics of abnormal risk premium estimated using the baseline QR specification. As in Panel A of the same table, we report risk premium estimates under both the SVIX and IEP models of expected returns. Median abnormal risk premia are, by design, zero across measures of equity premia. However, mean abnormal risk premia are positive, reflecting that some forward periods consistently

[5]Lucca and Moench (2015) find that most of the excess returns earned leading up to FOMC releases are earned after the previous days' market close. Similarly, in our subsample of daily option expirations, we do not find statistically significant abnormal forward premia for days preceding FOMC releases.

exhibit positive abnormal risk pricing across trade dates.

Panel C of Table 2 presents summary statistics of abnormal risk premium estimated using alternative QR specifications for the forward SVIX. Irrespective of the specification, median abnormal forward premia are consistently zero, while mean abnormal premia are positive. Moving down the rows, we see that the standard deviation of the abnormal risk premium falls as we include additional conditioning variables in the QR model. Comparing the last two rows, we see that the abnormal risk premium display similar distributional statistics whether estimating the QR model at the 50th or 30th percentile.

Panel A of Figure 3 shows the full time series of average abnormal forward risk premia for each forward period in our sample, averaged across available trade dates. While most forward periods have near-zero abnormal forward premia, many events appear in the data, with the frequency of these events significantly increasing since 2022. We identify several forward periods with negative abnormal premia in our sample, some of which correspond to periods spanning exchange holidays with lower risk pricing and some correspond to periods during the onset of the Covid-19 pandemic, where the negative abnormal forward premia could be due to data quality.

[Insert Figure 3 here]

To better understand the sources of variation in our trade date-forward period-level panel of expected returns, in Section II.C, we decompose the variation in our panel of forward premia.

II.C. Variance Decomposition of Forward Equity Premia

We explore the sources of variation in the trade date-forward period panel of expected returns. Table 3 reports results for a variance decomposition. We report the standard deviation of the time series of trade date-level median forward premia over our sample period and the time series average of trade date-level standard deviations of forward premia. The latter measures the typical amount of dispersion of forward premia on a given trade day. Variation in median forward premia accounts for the majority of the variation in our panel using both the SVIX model of expected returns (standard deviation of 1.31 bp) and the IEP (standard deviation of 3.67 bp). However, there is also significant variation within trade date, with the average of daily standard deviations being 0.35 bp for the SVIX and 0.99 bp for the IEP.

Some of the within trade date variation is due to the slope and curvature of the forward equity term structure each day. Consequently, we also report results for abnormal forward premia, which measures the deviation from a fitted forward term structure each day using QR. The time series average of daily standard deviations of abnormal forward premia is 0.25 bp for the SVIX and 0.69 bp for the IEP. By design, this variation captures events in the forward equity term structure, or forward periods with significant abnormal premia. In Section III, we employ a data-driven approach to identify forward periods with statistically significant abnormal premia.

[Insert Table 3 here]

III. Which Forward Periods are Significantly Priced?

We employ a data-driven approach to identify forward periods with significant abnormal premia.[6] While a large literature has examined the drivers of large realized moves in equity markets ((Niederhoffer (1971); Cutler et al. (1988); Kapadia and Zekhnini (2019); Baker et al. (2021); among others), we provide an ex ante analog to these papers,

[6]Data-driven approaches have been employed in cross-sectional asset pricing, where researchers look for variables that explain stock returns (Chordia, Goyal, and Saretto (2020)) and in corporate finance, where researchers search for outcome variables that are impacted by a given right-hand side variable (Heath, Ringgenberg, Samadi, and Werner (2023)).

identifying forward periods which require significant abnormal risk compensation. To do so, we first average abnormal premia for each forward period e across available trade dates. With this time series of average abnormal forward premia, A_e^{SVIX}, we estimate a series of separate regressions with an indicator variable that is equal to one for one forward period, and equal to zero for all other forward periods in the time series, I_e. In each regression, we vary the forward period for which the indicator variable is equal to one:

$$A_e^{SVIX} \times H_e = \alpha + \beta I_e + \epsilon_e, \tag{8}$$

where H_e is the length of the forward period in trade days.[7]

Since the regressions are estimated using average abnormal forward premia, this empirical approach identifies forward periods with consistently significant abnormal risk pricing across available trade days relative to the rest of the sample. Results are reported in Table 4. Statistically significant forward periods are sorted in descending order of economic significance measured by $\hat{\beta}$ in column (4), which represents the difference between the abnormal forward premia of a given forward period and other forward periods. For statistically significant forward periods which do not span CPI, FOMC, and NFP releases, we search the online archives of the Wall Street Journal for scheduled events.

[Insert Table 4 here]

We also report the average total forward premium over each forward period for both the forward SVIX and IEP measures. These are larger than $\hat{\beta}$ which is the estimated abnormal component of the total forward premium for the forward period.

Forward periods associated with statistically significant abnormal risk pricing span a wide variety of events, including those extensively studied in the literature, such as

[7] Results are qualitatively similar when we estimate these regressions using the abnormal forward IEP.

CPI releases, NFP releases, FOMC policy rate announcements, and U.S. presidential elections.

Abnormal forward premia over these forward periods are a significant proportion of corresponding raw forward premia. The forward period with the largest regression estimate in magnitude spans the 2020 presidential election, with an estimate of 7.90 bp, relative to the corresponding SVIX forward premia of 13.43 bp and IEP premium of 36.48 bp. The estimate for the forward period spanning the January 12, 2023, CPI release is proportionally the largest, with a regression estimate of 4.98 bp relative to the corresponding SVIX forward premia of 6.60 bp.

Forward periods spanning 9 CPI releases, all during the 2022-2023 inflationary period and monetary tightening cycle, are significantly priced in our sample. The CPI release with the largest abnormal and raw risk pricing in our sample is the January 12, 2023, release.

7 NFP releases taking place during 2020 and 2023 are abnormally priced in our sample. The release taking place in April 2020 had the largest abnormal and raw risk premium (regression estimate of 2.93 bp, SVIX premium of 20.68 bp, and IEP premium of 59.41 bp).

13 FOMC meetings are associated with statistically significant abnormal forward premia, making FOMC meetings the most frequently priced event type in our sample. The March 2023 FOMC meeting exhibits the largest abnormal premium (regression estimate of 3.23 bp, SVIX premium of 4.64 bp, and IEP premium of 12.40), while the March 2022 meeting exhibits the largest premium (SVIX premium of 8.01 bp and IEP premium of 22.35 bp).

Of the recurring events with statistically significant abnormal risk pricing, presidential elections containing fiscal news are associated with the largest average abnormal premia in our sample, with risk pricing multiple times larger than the average forward premium in our sample. In particular, the forward period spanning the 2016 presidential election has a regression estimate of 3.34 bp, SVIX premium of 4.95 bp, and IEP premium of 14.32 bp. However, presidential election still comprise a small portion of the total expected returns in our sample, as these events occur much less frequently than macroeconomic release and monetary policy announcement days.

Our data-driven approach also detects several less studied events in the literature as having abnormal U.S. equity risk pricing. These events include U.S. Midterm elections (1.34 bp regression estimate, 4.52 bp SVIX premium, and 13.41 bp IEP premium for the 2018 Midterms), the January 6, 2021, Electoral College Count and Georgia Congressional runoff (2.49 bp regression estimate, 6.39 bp SVIX premium, and 17.68 bp IEP premium), the July 2019 Trump-Xi G-20 Bilateral (regression estimate of 1.52 bp, SVIX premium of 2.65 bp, and IEP premium of 7.87 bp), and the 2017 French presidential election first round and subsequent runoff (1.61 bp regression estimate, 2.31 bp SVIX premium, and 6.77 bp IEP premium).

Two additional forward periods ending on April 1, 2020, and April 8, 2020, during the onset of the Covid-19 pandemic in the U.S. are also associated with statistically significant abnormal risk premia. These dates, however, do not seem to be explained by events that could have been anticipated by markets sufficiently in advance.

While market participants may not want to miss potentially important events we also account for multiple testing concerns (Harvey, Liu, and Zhu (2016); and Heath et al. (2023)) in light of our data-driven approach, by reporting multiple testing adjusted p-values in Appendix Table A6. We control both the Family-wise Error Rate (FWER), defined as the probability of making one or more false rejections given all tests considered, and the False Discovery Rate (FDR), which controls for the expected value of the ratio of false rejections to total rejections across all tests considered. We use the Holm (1979) correction for the FWER and the Benjamini and Hochberg (1995) correction for the

FDR.[8] Since the number of tests under consideration in our data is large (> 1000), the FWER is relatively conservative as it controls the probability of even one false positive. We find that the 17 (21) forward horizons with the largest regression estimates in our sample are statistically significant after controlling the FWER (FDR).

Panel B of Figure 3 reports average abnormal forward premia for different event types using the SVIX across all forward periods. Forward periods spanning CPI (red dots), FOMC (green dots), NFP (yellow dots), and U.S. Elections (purple dots) are marked separately. This figure indicates that CPI, FOMC, and NFP releases do not comprise all releases with significant abnormal forward premia. Furthermore, not all CPI, FOMC, and NFP are significantly abnormally priced, with substantial variation in macroeconomic release premia across release dates. We examine the full cross-section of macroeconomic releases in Section IV and introduce a conceptual framework further exploring the determinants of risk premia across macroeconomic release dates in Section V.

IV. Realized Excess Returns and Equity Premia on U.S. Macroeconomic Release Dates

We examine realized excess returns and option-implied equity premia for the full cross-section of U.S. macroeconomic variables tracked by the Bloomberg Economic Calendar. Since several variables are released at the same time as part of a given release, we group the 124 U.S. variables tracked in the Bloomberg Economic Calendar into the 50 underlying releases and perform our analysis at the release level. Our grouping methodology is detailed in Appendix A.

We first summarize prior research by reexamining daily realized excess returns asso-

[8]Since the indicator variables across regressions are uncorrelated, bootstrap-based methods (Romano and Wolf (2005) and Romano and Wolf (2016)) do not improve power.

ciated with U.S. macroeconomic releases over an extended sample period from October 1996 to December 2023 (with the sample period determined by the availability of the Bloomberg Economic Calendar). We estimate the following regression using the extended time series of daily excess returns:

$$r_t^{mkt} - r_t^f = \alpha + \Sigma_{m=1}^{M} \left(\gamma_m I_{m,t} \right) + \delta I_t^{election} + \epsilon_t, \tag{9}$$

where $r_t^{mkt} - r_t^f$ is the excess return of the market on date t, $I_{m,t}$ for $m = 1, ..., M$ are separate indicator variables for all 50 macroeconomic releases in our sample, and $I_t^{election}$ is an additional indicator variable for Presidential and Midterm Elections.

Regression estimates for all 50 macroeconomic release indicators are reported in Figure 4. Statistically significant releases are labelled by name, while statistically insignificant releases are labelled by number indexed in Appendix Table A3. Panel A reports the additional excess returns per release, $\widehat{\gamma_m}$, and Panel B reports additional excess returns per year ($\widehat{\gamma_m}$ times the number of releases per year for release m).

[Insert Figure 4 here]

Consistent with the previous literature, FOMC releases are associated with the largest excess returns per day over the extended sample (additional excess return of 28 bp per release). The ISM Manufacturing PMI (21 bp per release), NFP (16 bp per release), and Pending Home Sales (20 bp per release) are also associated with statistically significant additional excess returns over the extended sample. Additional excess returns for CPI and PPI releases are statistically insignificant during this sample period. Market returns have been shown to be negative in response to inflation surprises (Schwert (1981)) and were particularly large in magnitude during the 2022-2023 inflationary period (Gil de Rubio Cruz, Osambela, Palazzo, Palomino, and Suarez (2023)).

If the substantial excess returns earned on these release days reflect risk compensations, then equity premia should also be higher on days with these types of releases. We examine abnormal expected returns associated with these releases using our option-implied measures of equity premia. After averaging abnormal equity premia for each forward period across available trade dates, we estimate a similar regression to that in Equation (9), but instead using the time series of average abnormal forward equity premia over each forward period as the dependent variable instead of excess returns:

$$A_e^{EP} \times H_e = \alpha + \Sigma_{m=1}^{M} \left(\gamma_m I_{m,e} \right) + \delta I_e^{election} + \epsilon_e, \tag{10}$$

where A_e^{EP} is the average abnormal forward premia for either the SVIX or IEP measure of expected returns for forward period e, H_e is the length of the forward period in trade days (one day or two days), and, as before, $I_{m,t}$ for $m = 1, ..., M$ correspond to separate indicator variables for all 50 macroeconomic releases in our sample and $I_e^{election}$ is an additional indicator variable for Presidential and Midterm Elections. Results are presented in Figure 5 and tabular results are also presented in Appendix Table A7.

[Insert Figure 5 here]

Figure 5 reports regression estimates for all 50 macroeconomic release indicators for the regression using abnormal equity premia as the dependent variable. Statistically significant releases are labeled by name while statistically insignificant releases are labeled by number indexed in Appendix Table A3. FOMC, CPI, and NFP releases are statistically significant in our sample, indicating that these releases have elevated equity premia relative to the daily equity term structure. The regression coefficient for FOMC releases is 0.62 bp using the forward SVIX and highly statistically significant (t-statistic of 10.14), in contrast to out of sample examinations using realized returns (Cieslak et al. (2019)) which raise small sample issues. The corresponding regression coefficients for NFP and CPI releases are 0.29 bp and 0.46 bp (t-statistics of 3.90 and 6.93), respectively. The regression estimate for the ADP Employment Change release is also marginally statistically significant as are a few releases with negative abnormal equity premia. Multiplying the estimated coefficients with the number of announcements per year (Panel B), the abnormal equity premium per year associated with a given release is relatively modest, even for FOMC and CPI announcements, with total annual effects around 5-6 bp using SVIX and 14-15 bp using IEP. The abnormal equity premia for both FOMC, NFP are significnatly smaller compared to our estimates of realized excess returns for these events over the longer sample period.

Table 5 further elaborates on the quantitative magnitudes of the risk pricing for FOMC, CPI, and NFP releases in our sample. Prior research has found that a small number of economic release days have accounted for a large proportion of the total realized excess return (Savor and Wilson (2013); and Lucca and Moench (2015), Ai and Bansal (2018)). We examine what proportion of total forward equity premia is due to forward periods spanning CPI, FOMC, and NFP releases. We average forward equity premia across available trade dates separately for each forward period. We then calculate the proportion of total equity premia in our sample that forward periods spanning CPI, FOMC, and NFP releases account for. We also show the average total forward equity premium per period for each release type and for all release types pooled together. These results are presented in Panel A for the SVIX and Panel B for the IEP of Table 5.

[Insert Table 5 here]

The average forward SVIX and IEP premia for CPI, FOMC, and NFP releases in our sample are 2.68 and 7.56 bp per day relative to the corresponding full sample averages of 2.04 and 5.74 bp, respectively. Of these releases, FOMC releases are associated with the largest average forward premia (8.16 basis points per forward period, 65 bp per year for the IEP).

We find that for the SVIX and IEP models for forward equity premia, expected returns for forward periods spanning CPI, FOMC, and NFP releases comprise 23% of total expected daily returns across all forward periods in our sample. These proportions are larger than the 17% of all forward periods which span these releases. However, both the average magnitude of expected returns for these releases and the share of total expected returns in our sample accounted for by these releases are quantitatively far from fully explaining previous results using realized returns (Savor and Wilson (2013) and Lucca and Moench (2015), and the results reported in Figure 4.[9]

Our estimates in this section are consistent with the notion that large excess realized returns for some release types aren't fully explained by risk pricing, but could also reflect unexpectedly good news, potentially stemming from conditional policy promises in the case of FOMC announcements (Cieslak et al. (2019) and Haddad et al. (2023)). In an international panel, Baker et al. (2021) find that policy news is associated with a greater share of upward realized price jumps than downward jumps in the countries that they study.

V. Understanding Macroeconomic Release Premia

In this section, we propose an asset-pricing framework to understand the drivers of abnormal expected returns on macroeconomic release days. We apply this framework to gain intuition on the CPI-release risk premia and, in particular, on the period of elevated CPI risk premia between June 2022 and June 2023.

[9]Results are qualitatively similar for the sub sample following the introduction of option expirations for every trading day. Our results are also robust to adding neighboring forward periods which precede and follow releases and to measuring premia on the day prior to releases using the most short-dated option expirations available.

V.A. Conceptual framework

We start from the basic asset-pricing equation with a representative investor, $E_t\left(R_{t+1}\, M_{t+1}\right) = 1$, where R_{t+1} is the realized stock market return on day $t+1$ and M_{t+1} is the stochastic discount factor (SDF). The expected stock market excess return $\mu_t = E_t\left(R_{t+1}\right) - R^F_{t+1}$ can then be expressed as:

$$\mu_t = -R^F_{t+1} Cov_t\left(R_{t+1}\, M_{t+1}\right), \tag{11}$$

where R^F_{t+1} is the (gross) risk-free rate on day $t+1$.

Consider a macroeconomic data release day m where news η_{t+1} is released. The realized return on the release day can be expressed as follows:

$$R^m_{t+1} - R^F_{t+1} = \mu^m_t + \beta^R_t \eta_{t+1} + \epsilon^R_{t+1}, \tag{12}$$

where μ^m_t is the macroeconomic release day equity premium, β^R_t is the sensitivity of the market return to the news released, and ϵ^R_{t+1} is the residual return; i.e., the portion of the return that is uncorrelated with the macroeconomic news.

From equations (11) and (12), the equity premium for the macroeconomic data release day m is:

$$\begin{aligned}
\mu^m_t &= -R^F_{t+1} Cov_t\left(R^m_{t+1}, M_{t+1}\right) \\
&= -R^F_{t+1} Cov_t\left(\mu^m_t + \beta^R_t \eta_{t+1} + \epsilon^R_{t+1}, M_{t+1}\right) \\
&= -R^F_{t+1} \beta^R_t Cov_t\left(\eta_{t+1}, M_{t+1}\right) - R^F_{t+1} Cov_t\left(\epsilon^R_{t+1}, M_{t+1}\right).
\end{aligned}$$

Assuming the residual return ϵ^R_{t+1} on a release day has the same covariance with the SDF as returns on surrounding non-release days, i.e., $Cov_t\left(\epsilon^R_{t+1}, M_{t+1}\right) = Cov_t\left(R_{t+1}, M_{t+1}\right)$, and noting that $\mu_t = -R^F_{t+1} Cov_t\left(R_{t+1}, M_{t+1}\right)$, then, the abnormal equity premium on a macroeconomic release day is:

$$\mu_t^m - \mu_t = -R_{t+1}^F \beta_t^R Cov_t\left(\eta_{t+1}, M_{t+1}\right). \tag{13}$$

Defining the sensitivity of the SDF to the release news as $\beta_t^M = \frac{Cov_t(\eta_{t+1},M_{t+1})}{Var_t(\eta_{t+1})}$, we have the following result for abnormal release day risk premia:

Result 1 (Abnormal release day equity premia) *Assuming arbitrage-free markets (equation (11)) and a linear sensitivity of returns to announcement news (equation (12)), then the abnormal expected return on a macroeconomic data release day m is the product of four terms:*

$$\mu_t^m - \mu_t = -R_{t+1}^F \beta_t^R \beta_t^M \sigma_t^2(\eta_{t+1}), \tag{14}$$

where $R_{t+1}^F \approx 1$ is the risk-free rate on day $t+1$, β_t^R is the return sensitivity to the macroeconomic news released, β_t^M is the stochastic discount factor sensitivity to the macroeconomic news released, and $\sigma_t^2(\eta_{t+1})$ is the conditional variance of released news.

Result 1 implies that the drivers of abnormal risk premia can be grouped into the following two key determining factors:

1. the quantity of news released on the day: $\sigma_t^2(\eta_{t+1})$
2. the sensitivities to news released on the day: $-\beta_t^R \beta_t^M$.

Thus, variation in macroeconomic release risk premia, whether it is the variation over time for a given macroeconomic release type or variation across different macroeconomic release types within a given period of time, must fundamentally be due to variation in the amount of news released or to a change in the sensitivity of returns (or the SDF) for a given unit of released news.

V.B. Application to CPI Releases

We apply our conceptual framework to shed light on the CPI release abnormal equity premium during our sample period. The top panel of Figure 6 reports the time series of the abnormal equity premia for all CPI releases, with the shaded area highlighting the period of highly elevated CPI release premia between June 2022 and June 2023. Abnormal CPI release premia reached a peak of 4.98 bp midway through this period for the January 12, 2023, CPI release.

To understand this variation in CPI release premia, we first consider the role of the quantity of CPI news released on CPI days. The estimated time series of $\sigma_t^2(\eta_{t+1})$ is plotted on the left-hand-side of Figure 6 Panel B, where we estimate the conditional variance of CPI release day news using a GARCH(1,4) model on the release surprises.[10] The GARCH model specification is selected using the BIC for the optimal number of lags. Interestingly, the conditional variance of CPI release news peaks in the Summer of 2021, before the period of elevated abnormal release premia that begins in the Summer of 2022. The rise in CPI-release news variance in the Summer of 2021 reflects a period where the largest CPI release surprises occurred. The two largest CPI release shocks occur at the May 12, 2021, and July 13, 2021, releases, with month on month CPI being 60 bp and 40 bp above forecaster consensus at these releases, respectively.[11] Given that the elevated CPI risk premia in the June 2022 to June 2023 period do not line up well with the time-series of CPI-release news variance, there is also a role for elevated $-\beta_t^R\beta_t^M$ during the June 2022 to June 2023 period. To show this, on the right-hand-side of Figure 6 Panel B, we rearrange equation (14) and compute the implied product of

[10]Release surprises are defined as the difference between the actual data release and the median Bloomberg forecast for CPI. We use month-on-month CPI releases and compute a surprise for both headline and core releases, taking an equal-weighted average of the two.

[11]To get a sense of the timeline of CPI surprises and monetary policy reactions, headline year-on-year CPI in the U.S. first passed 3 percent at the April 2021 CPI release and reached its peak of 8.9 percent at the June 2022 CPI release. The Federal Reserve began its tightening cycle at the March 2022 meeting.

betas from the observed abnormal risk premia and the estimated news variance.

While the SDF M, and thus β_t^M, is not observable, we do observe the stock market responses to CPI release surprises and, therefore, we can compute β_t^R empirically. Specifically, for a given CPI release, we compute the return of near-month E-mini S&P 500 Futures from 8:20 am (10 minutes before the CPI data release) to 8:50 am (20 minutes after the CPI data release) and divide the high frequency data-release return by the release surprise. This method is conceptually close to estimating rolling regressions (without a constant) of returns on surprises to extract conditional betas. However, our approach yields a measure of the sensitivity of the stock market for each individual release, which should map closely to ex-ante risk premia for that specific release day. The cost to this approach is that when the CPI surprise on a particular release day is close to zero, the return sensitivity is not identified. In these cases, we use the lagged return sensitivity as measured at the previous CPI-release date.

The pink line in the left hand side of Figure 6 Panel C plots the measured betas of the stock market response to CPI news at the release day frequency. In the period of elevated abnormal risk premia, there were very large stock market responses to CPI release surprises. The largest CPI release beta was observed at the October 13, 2022, CPI release where, following an 18 bp higher CPI print than forecast, the stock market declined 324 bp over the following 20 minutes. The measured sensitivity was $\beta_t^R = -18$. Figure 6 Panel C also plots the implied β_t^M, which, as expected, is negatively correlated with β_t^R.

Our analysis indicates that CPI release abnormal risk premia reached elevated levels in 2022 and 2023 amid elevated variation in news shocks, but also amid a significant increase in the sensitivity of stock returns and the SDF to the releases of inflation news. The right hand side of Figure 6 Panel C explores one potential driver of this increase in sensitivity, which is an increase in long-term inflation uncertainty. The Federal Reserve's

Survey of Primary Dealers collects survey participants' probability density function for long-term inflation (divided into buckets) and presents the average distribution across participants in the public survey release. From this forecast distribution, we compute the variance of the average forecasts PDF of long-term inflation, and we plot this variance against CPI release-day return sensitivities. As can be seen, announcement risk premia and return sensitivities all peak at the same time as long-term inflation uncertainty, which is consistent with models where resolution of uncertainty can be a key driver of release-day premia (Ai and Bansal (2018)).

VI. Pricing the Calendar

Since end of day option prices can be obtained in real time, the methodology to estimate abnormal premia developed in this paper can be used to estimate risk pricing of upcoming events on the economic and political calendar. Forward premia for the upcoming month of daily forward periods are available at www.pricingthecalendar.com.

Pricing the economic calendar. In Table 6, we provide an example of how our empirical framework can be applied to the economic calendar for the upcoming month of forward periods as of June 10, 2024.

[Insert Table 6 here]

The table and figure present forward raw and abnormal premia using the SVIX, which only requires end of day option prices as opposed to the IEP. We report select economic releases occurring during each forward period. Abnormal forward equity premia falling above the top 80th percentile with respect to a historical distribution starting in August 2022, following the introduction of daily option expirations on the S&P 500, are highlighted with red shading corresponding to larger abnormal risk premium. In this example, the forward period ending on Jun 12th (CPI and FOMC) and July 5 (the employment report) have elevated abnormal forward premia (0.95 bp and 0.46 bp for June 12 and July 5, respectively, with corresponding raw forward premia of 1.37 bp and 0.98 bp, respectively), while the Jun 28 forward period is associated with modestly elevated risk pricing.

Given the significant variation documented with regard to which releases matter at a given point in time, this empirical framework can help us identify which upcoming events are perceived by markets to be more important on any given day.

Presidential election tracker. Since our approach is based on the forward equity term structure, it can in principle also be used monitor the importance of an upcoming event over longer time horizons depending on data availability. To illustrate, Figure 7 Panel A reports the forward equity term structure up to one year out using available option expirations on March 14, 2024. Marker labels denote the time to expiration for each option expiration. The forward interval spanning the upcoming November 2024 presidential election is a clear outlier on the longer-term equity term structure.

[Insert Figure 7 here]

Using the November 3, 2020, election as an example, Figure 7 Panel B shows the evolution of our estimate of the abnormal equity premium associated with this event. We calculate this abnormal premium using the same methodology as in Figure 2, restricting the time series shown to be based on a forward period of no longer than 20 trade days.

Panel B indicates that there is some variation in the estimated premium over this longer time period. Conceptually, variation in abnormal premia could reflect both (i) the market's changing perception about the uncertainty of who will win and (ii) the impact of the resolution of this uncertainty on the stock market and the stochastic discount factor. In that context, a decline in this abnormal equity premium during the fall of 2020 suggests either that there was less perceived remaining uncertainty about the outcome of the election (unlikely, given the close election result), or that the perceived policy differences between the two candidates diminished over time. One could potentially separate these channels using estimates of election probabilities (from polls, prediction markets, or statistical models).

Figure 7 Panel C shows the available estimates for the abnormal equity premium associated with the upcoming November 5, 2024, election with data as of February 2023. This estimate has fluctuated around 10 bps since we began tracking it on November 16, 2023, similar to the values observed just before the November 2020 election. Given that the forward term structure is now richer than it was in 2020, we can track the 2024 election earlier than was possible for the 2020 election.

VII. Conclusion

We exploit the recent introduction of daily option expirations on the S&P 500 and use option-implied models of the equity risk premium to estimate forward one-or-two day equity premia from October 2016 through December 2023. We develop a new methodology for identifying equity premium events, which are defined as days with abnormally high equity premia relative to surrounding dates. Using a data-driven approach, we find that a wide variety of events are important to equity investors, as they have forward risk premia that are significantly elevated relative to the forward equity term structure. These events well-studied macroeconomic releases, monetary policy releases, and presidential elections, as well as several less studied economic and political events.

Although the key economic announcements—FOMC, CPI, and NFP—have significantly higher risk pricing relative to the daily equity term structure and these release premia were particularly elevated between June 2022 and June 2023, equity premia on these release days are quantitatively far from from fully explaining the large share of realized excess stock returns accounted for by these days previously documented in the literature.

The asset pricing framework we introduce provides intution for the variation in release risk premia for a given announcement type over time, including the elevated levels of CPI equity premia between June 2022 and June 2023. Intuitively, event risk premia are driven by both the quantity of news, and the sensitivity of the stock market return and the stochastic discount factor (SDF) to the news.

Importantly, since forward premia can be estimated in real time, our approach can be applied to the upcoming economic and political calendar to assess which upcoming events the market perceives to be important at a given point in time. This calendar can be a useful tool for market participants, researchers, and policymakers.

References

Ai, H., & Bansal, R. (2018). Risk preferences and the macroeconomic announcement premium. *Econometrica*, *86*(4), 1383–1430.

Andersen, T. G., Fusari, N., & Todorov, V. (2017). Short-term market risks implied by weekly options. *The Journal of Finance*, *72*(3), 1335–1386.

Baker, S. R., Bloom, N., Davis, S. J., & Sammon, M. C. (2021). What triggers stock market jumps? *Working paper*.

Bakshi, G., & Madan, D. (2000). Spanning and derivative-security valuation. *Journal of financial economics*, *55*(2), 205–238.

Barndorff-Nielsen, O. E., Hansen, P. R., Lunde, A., & Shephard, N. (2009). *Realized kernels in practice: Trades and quotes.* Oxford University Press Oxford, UK.

Beber, A., & Brandt, M. W. (2006). The effect of macroeconomic news on beliefs and preferences: Evidence from the options market. *Journal of Monetary Economics*, *53*(8), 1997–2039.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal statistical society: series B (Methodological)*, *57*(1), 289–300.

Bryzgalova, S., Pavlova, A., & Sikorskaya, T. (2023). Retail trading in options and the rise of the big three wholesalers. *The Journal of Finance*, *78*(6), 3465–3514.

Campbell, J. Y., & Kyle, A. S. (1993). Smart money, noise trading and stock price behaviour. *The Review of Economic Studies*, *60*(1), 1–34.

Carr, P., & Madan, D. (2001). Optimal positioning in derivative securities. *Working paper*.

Chordia, T., Goyal, A., & Saretto, A. (2020). Anomalies and false rejections. *The*

Review of Financial Studies, *33*(5), 2134–2179.

Cieslak, A., Morse, A., & Vissing-Jorgensen, A. (2019). Stock returns over the fomc cycle. *The Journal of Finance*, *74*(5), 2201–2248.

Cutler, D. M., Poterba, J. M., & Summers, L. H. (1988). What moves stock prices? *Working paper*.

Dubinsky, A., Johannes, M., Kaeck, A., & Seeger, N. J. (2019). Option pricing of earnings announcement risks. *The Review of Financial Studies*, *32*(2), 646–687.

Ernst, R., Gilbert, T., & Hrdlicka, C. M. (2019). More than 100% of the equity premium: How much is really earned on macroeconomic announcement days? *Working paper*.

Fama, E. F., & Bliss, R. R. (1987). The information in long-maturity forward rates. *The American Economic Review*, 680–692.

Gandhi, M., Gormsen, N. J., & Lazarus, E. (2022). Does the market understand time variation in the equity premium? *Working paper*.

Gao, C., & Martin, I. W. (2021). Volatility, valuation ratios, and bubbles: An empirical measure of market sentiment. *The Journal of Finance*, *76*(6), 3211–3254.

Gil de Rubio Cruz, A., Osambela, E., Palazzo, B., Palomino, F., & Suarez, G. (2023). Inflation surprises and equity returns. *Working paper*.

Gormsen, N. J. (2021). Time variation of the equity term structure. *The Journal of Finance*, *76*(4), 1959–1999.

Gürkaynak, R. S., Sack, B., & Wright, J. H. (2007). The us treasury yield curve: 1961 to the present. *Journal of monetary Economics*, *54*(8), 2291–2304.

Haddad, V., Moreira, A., & Muir, T. (2023). *Whatever it takes? the impact of conditional policy promises* (Tech. Rep.). National Bureau of Economic Research.

Harvey, C. R., Liu, Y., & Zhu, H. (2016). … and the cross-section of expected returns.

The Review of Financial Studies, *29*(1), 5–68.

Heath, D., Ringgenberg, M. C., Samadi, M., & Werner, I. M. (2023). Reusing natural experiments. *The Journal of Finance*, *78*(4), 2329–2364.

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian journal of statistics*, 65–70.

Kapadia, N., & Zekhnini, M. (2019). Do idiosyncratic jumps matter? *Journal of Financial Economics*, *131*(3), 666–692.

Kelly, B., Pástor, L., & Veronesi, P. (2016). The price of political uncertainty: Theory and evidence from the option market. *The Journal of Finance*, *71*(5), 2417–2480.

Lewellen, J. (2019). Autocorrelation of stock and bond returns, 1960–2019.

Li, J., & Born, J. A. (2006). Presidential election uncertainty and common stock returns in the united states. *Journal of Financial Research*, *29*(4), 609–622.

Liu, Tang, X., & Zhou, G. (2022). Recovering the fomc risk premium. *Journal of Financial Economics*, *145*(1), 45–68.

Londono, J. M., & Samadi, M. (2023). The price of macroeconomic uncertainty: Evidence from daily option expirations. *International Finance Discussion Paper*.

Lucca, D. O., & Moench, E. (2015). The pre-fomc announcement drift. *The Journal of finance*, *70*(1), 329–371.

Martin, I. (2017). What is the expected return on the market? *The Quarterly Journal of Economics*, *132*(1), 367–433.

Nelson, C. R., & Siegel, A. F. (1987). Parsimonious modeling of yield curves. *Journal of business*, 473–489.

Niederhoffer, V. (1971). The analysis of world events and stock prices. *The Journal of Business*, *44*(2), 193–219.

Niederhoffer, V., Gibbs, S., & Bullock, J. (1970). Presidential elections and the stock market. *Financial Analysts Journal*, 111–113.

Patton, A. J., & Sheppard, K. (2015). Good volatility, bad volatility: Signed jumps and the persistence of volatility. *Review of Economics and Statistics*, *97*(3), 683–697.

Romano, J. P., & Wolf, M. (2005). Stepwise multiple testing as formalized data snooping. *Econometrica*, *73*(4), 1237–1282.

Romano, J. P., & Wolf, M. (2016). Efficient computation of adjusted p-values for resampling-based stepdown multiple testing. *Statistics and Probability Letters*, *113*, 38–40.

Savor, P., & Wilson, M. (2013). How Much Do Investors Care About Macroeconomic Risk? Evidence from Scheduled Economic Announcements. *The Journal of Financial and Quantitative Analysis*, *48*(2), 343–375.

Schwert, G. W. (1981). The adjustment of stock prices to information about inflation. *the Journal of Finance*, *36*(1), 15–29.

Shiller, R. J., Fischer, S., & Friedman, B. M. (1984). Stock prices and social dynamics. *Brookings papers on economic activity*, *1984*(2), 457–510.

Svensson, L. E. (1994). *Estimating and interpreting forward interest rates: Sweden 1992-1994.* National bureau of economic research Cambridge, Mass., USA.

Tetlock, P. C. (2023). The implied equity premium. *Working paper*.

Wright, J. (2020). Event-day options. *Working Paper*.

Figure 1: Forward Equity Premia

This figure shows the full panel data set of forward equity premia $F_{t,e}^{SVIX}$ for trade date t and forward period ending on date e using the $SVIX$-measure of equity premia. The figure reports the distribution of forward premia (blue points) and the median forward premia (orange series) each trade day. Forward equity premia are reported in bp per trade day. For readability of the figure, 47 data points with forward equity premia above 15 bp are reported at 15 bp (actual values range from 15.5 bp to 63.4 bps). These data points pertain to 13 calendar dates in Spring 2020.

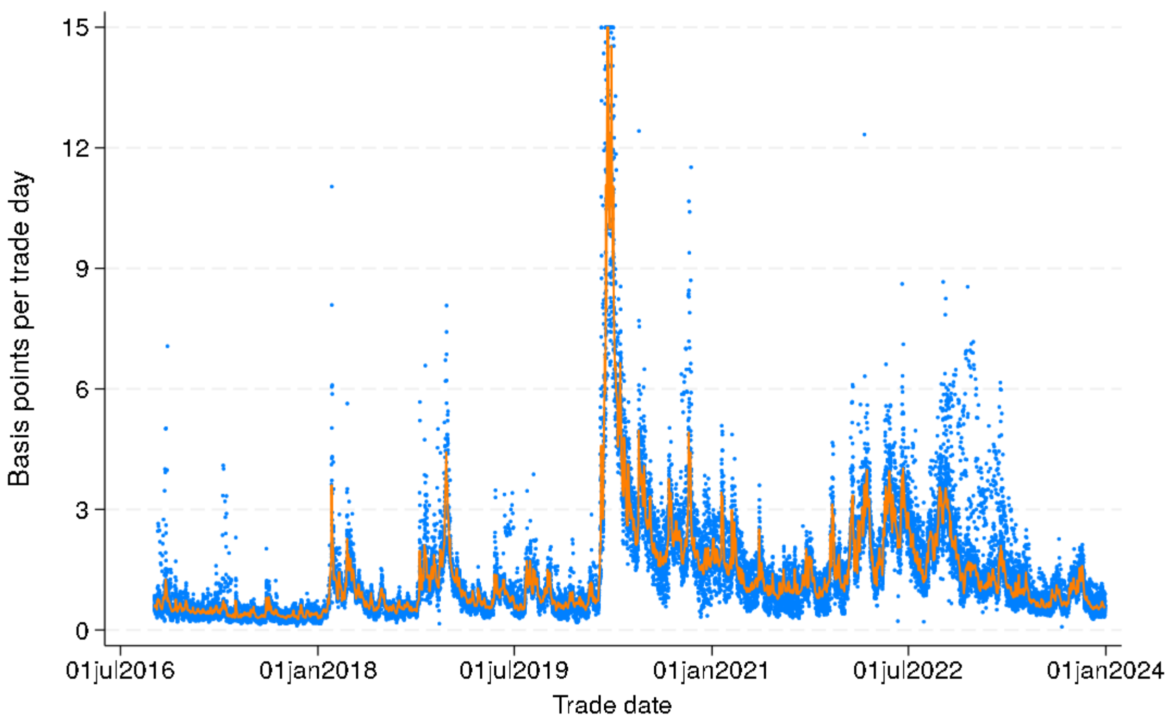


Figure 2: Forward Equity Premia on Example Trade Dates

This figure illustrates the data and our methodology on two example trade dates. Panel A reports risk premia observed on October 19, 2020, and Panel B reports risk premia observed on January 18, 2023. In all panels, first expiration dates of the week are differentiated from other days as white dots. The top row figures show the cumulative equity risk premium for each option expiration date, the middle row figures show the forward equity risk premium per trade day over each forward period, and the bottom row figures show the abnormal forward equity premium per trade day. The vertical lines highlight the forward periods with elevated abnormal forward premia. After fitting the daily equity term structure, we re-scale abnormal premia by the length of the forward period in trade days (bottom left panel, red series). The abnormal forward period observed on October 19, 2020, spans the 2020 presidential election. The three highlighted forward periods observed on January 18, 2023, span the February 1 FOMC announcement, the February 3 nonfarm payrolls release, and the February 14 CPI release.

Panel A. October 19, 2020 | Panel B. January 18, 2023

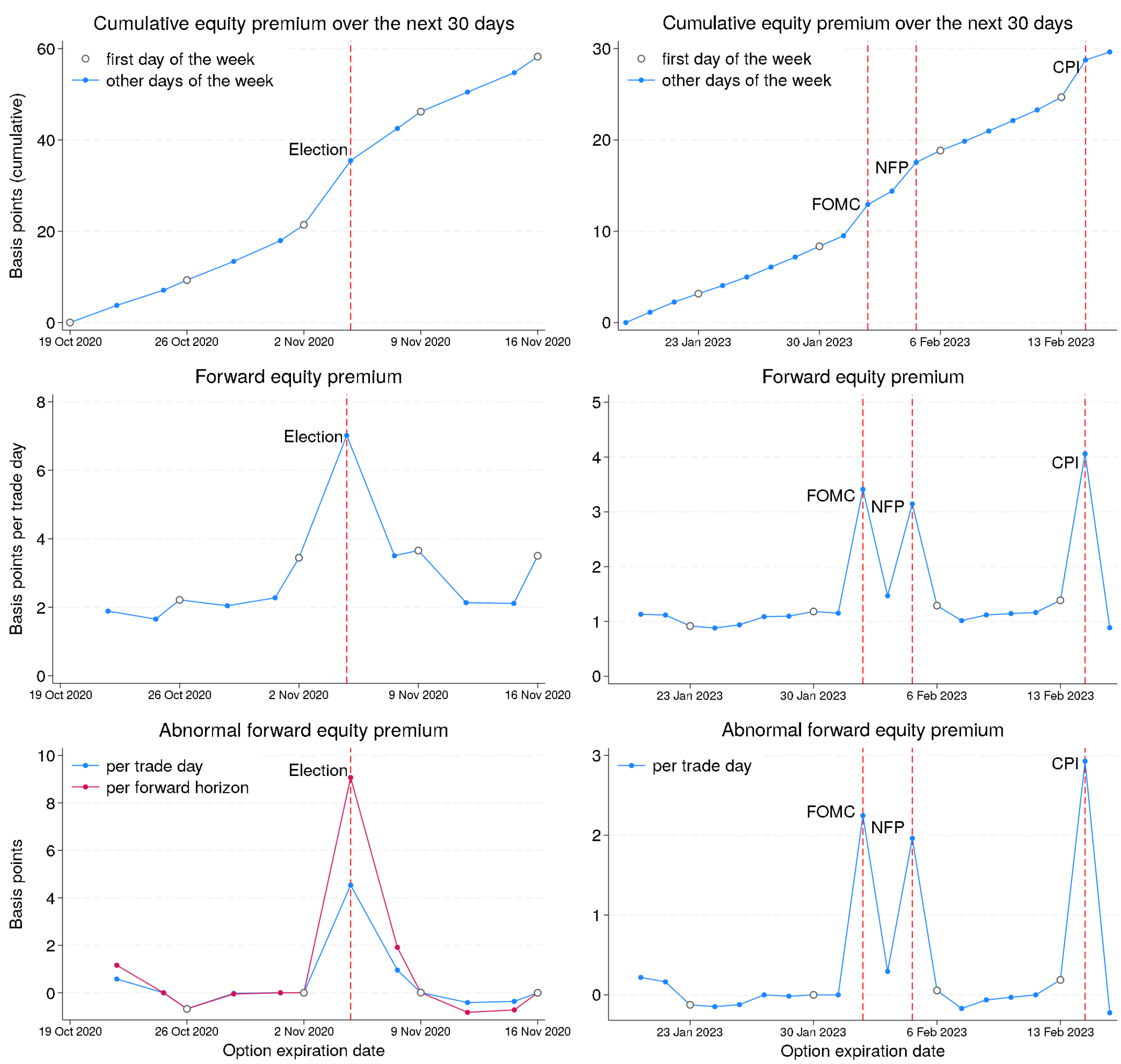
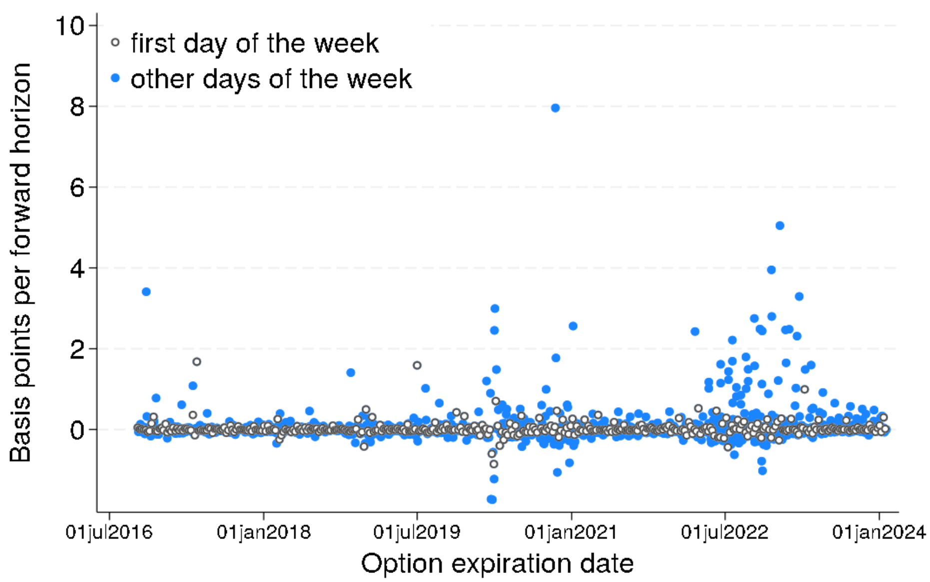


Figure 3: Abnormal Forward Daily Equity Premia by Forward Period

This figure reports the time series of average abnormal forward equity premia across estimation days for each forward period in our sample. In Panel A, we separate forward premia expiration dates into two sub samples: expiration dates that are the first trade day of the week (white dots) and expiration dates that are not the first trade day of the week (blue dots). In Panel B, forward periods spanning CPI releases (red dots), FOMC releases (green dots), NFP releases (yellow dots), and Elections (purple dots) are marked separately. Forward premia are reported in basis points.

Panel A. Abnormal Forward Equity Premia Per Forward Period



Panel B. Abnormal Forward Equity Premia Per Forward Period, Color-Coded

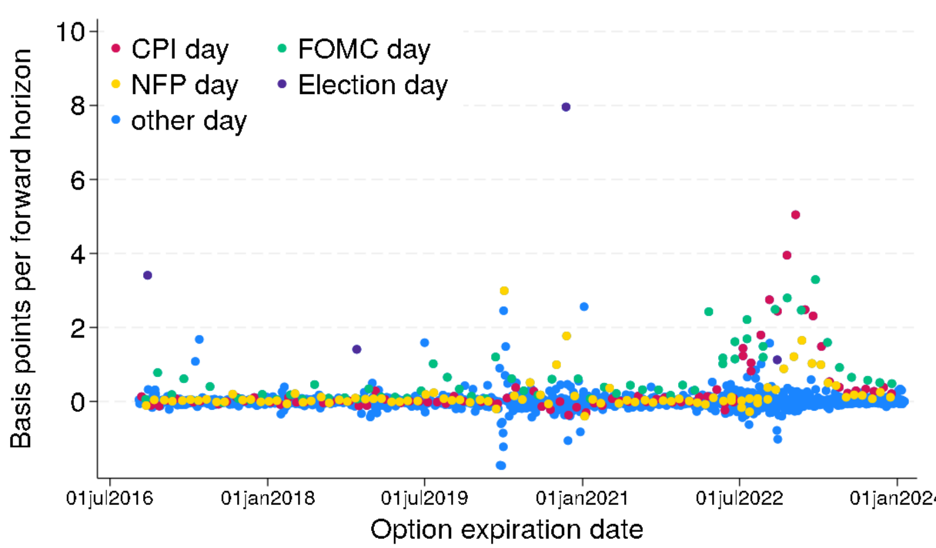


Figure 4: Excess Stock Returns on Macroeconomic Release Dates, Oct. 1996-Dec. 2023

This figure reports results for the following regression of realized excess stock returns on indicator variables for each of the 50 macroeconomic releases and an additional indicator variable for presidential elections:

$$r_t^{stock} - r_t^f = \alpha + \Sigma_{m=1}^{M} (\gamma_m I_{m,t}) + \delta I_t^{election} + \epsilon_t.$$

Excess stock returns, $r_t^{stock} - r_t^f$, are from Ken French's data library. $I_{m,t} = 1$ if macroeconomic release m occurs on day t and zero otherwise. $I_t^{election} = 1$ on the days following presidential election dates. The regression is estimated on daily data from October 31, 1996, to December 31, 2023. Panel A reports the estimated γ coefficients, with statistically significant releases labeled with the release name and statistically insignificant releases labeled with their release number (listed in Appendix Table A3). The estimated values of α and δ are $\widehat{\alpha} = -0.74$ bp (t =-0.27) and $\widehat{\delta} = -2.45$ bp (t =-0.05). Panel B reports the estimated γ coefficient multiplied by the number of releases of release m per year for each macroeconomic release.

Panel A. Additional excess return per release

Panel B. Additional excess return per year

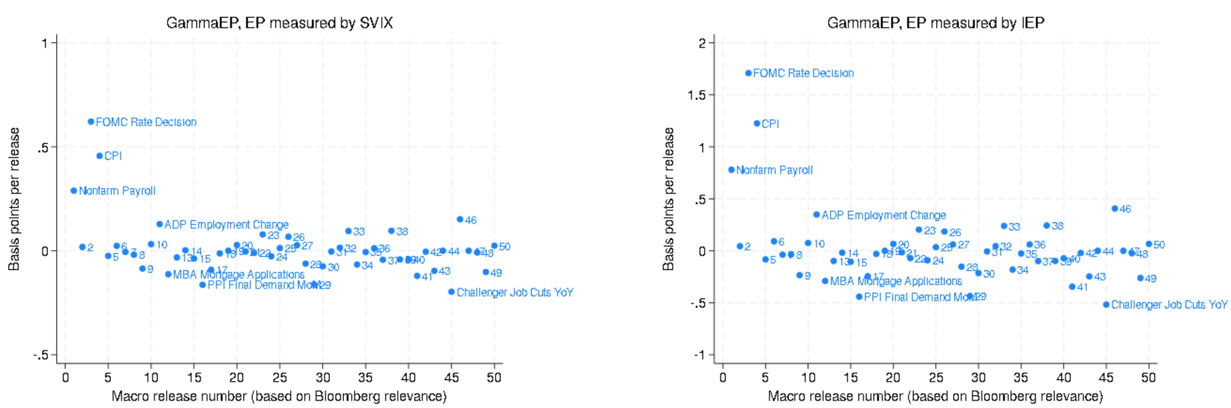
Figure 5: Equity Premia on Macroeconomic Release Dates

This figure reports results for the following regression of abnormal equity premia per forward period on indicator variables for each of the 50 macroeconomic releases and an additional indicator variable for presidential elections:

$$A_e^{EP} \times H_e = \alpha + \Sigma_{m=1}^{M} \left(\gamma_m I_{m,e}\right) + \delta I_e^{election} + \epsilon_e,$$

where A_e^{EP} is the average across available trade dates of $A_{t,e}^{SVIX}$, the abnormal equity premium under the SVIX measure, $I_{m,e} = 1$ if macroeconomic release m occurs over forward period e and zero otherwise. $I_t^{election} = 1$ for forward periods spanning presidential elections. H_e is the length of the forward period in trading days. Panel A reports the estimated γ coefficients (based on separate regressions for the equity premium measured by SVIX or IEP). Releases for which γ values are statistically significant are labeled with the release name and statistically insignificant estimates are instead labeled with their release number (listed in Appendix Table A3). Panel B reports for the estimated γ coefficient multiplied by the number of releases of release type m per year for each macroeconomic release.

A. Additional abnormal equity premium per release



B. Additional abnormal equity premium per year

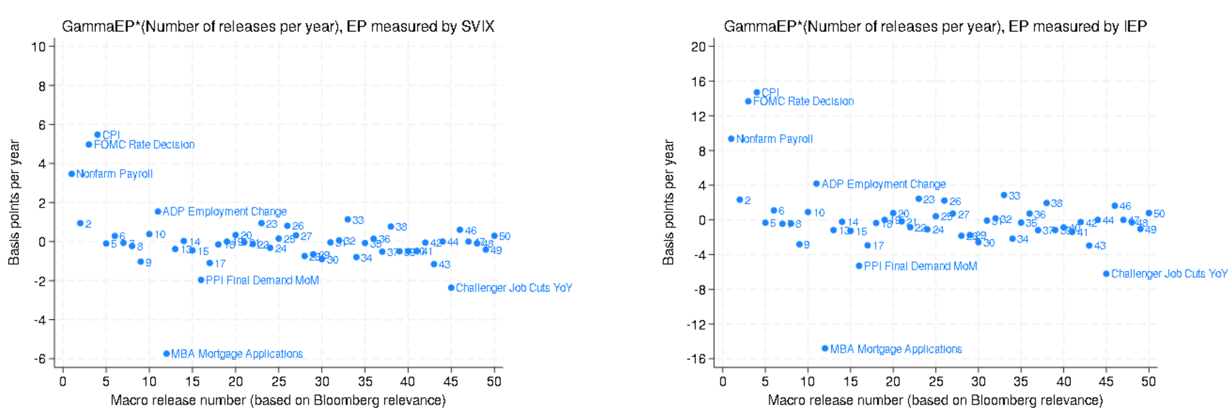


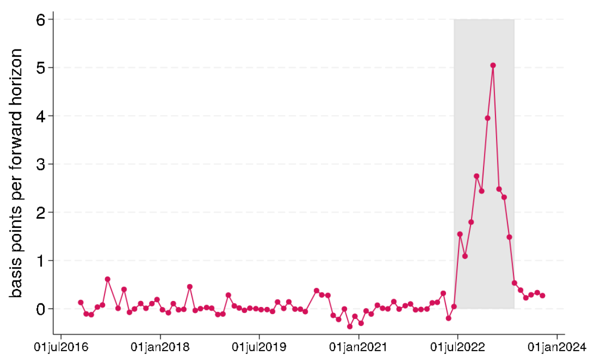
Figure 6: Time-variation in the CPI Announcement Risk Premium

This figure shows the components of the abnormal expected return for CPI announcements, $\mu_t^m - \mu_t$, based on the asset pricing framework introduced in Section V:

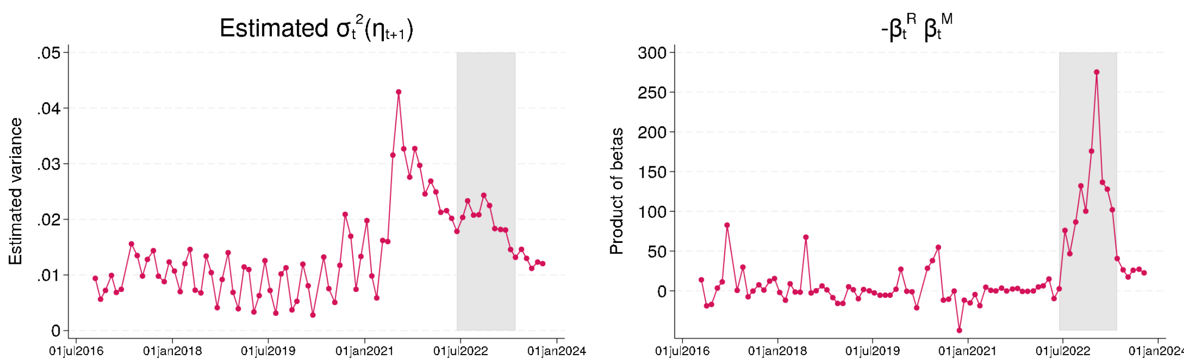
$$\mu_t^m - \mu_t = -R_{t+1}^F \beta_t^R \beta_t^M \sigma_t^2(\eta_{t+1}),$$

where $R_{t+1}^F \approx 1$ is the risk-free rate on day $t+1$, β_t^R is the return sensitivity to the macroeconomic news released, β_t^M is the stochastic discount factor sensitivity to the macroeconomic news released, and $\sigma_t^2(\eta_{t+1})$ is the conditional variance of released news.

Panel A. Abnormal equity premium $\mu_t^m - \mu_t$



Panel B. Decomposing $\mu_t^m - \mu_t$ into $\sigma_t^2(\eta_{t+1})$ and $-\beta_t^R \beta_t^M$



Panel C. Inflation news betas and inflation news uncertainty

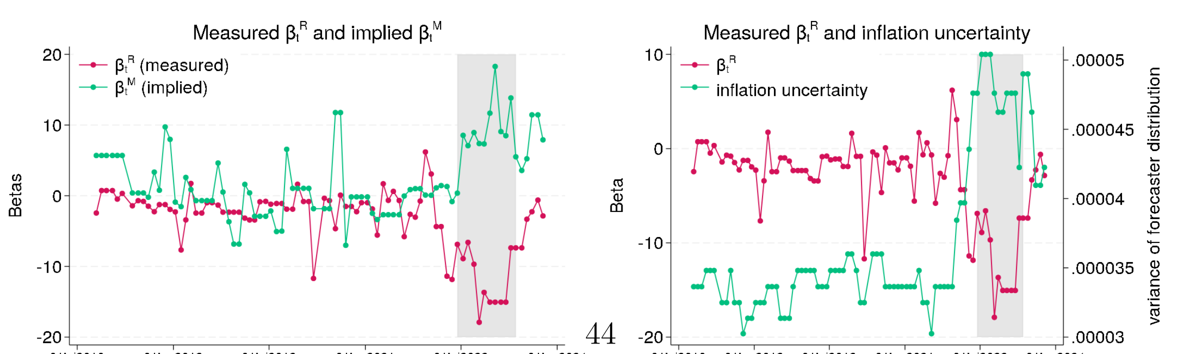
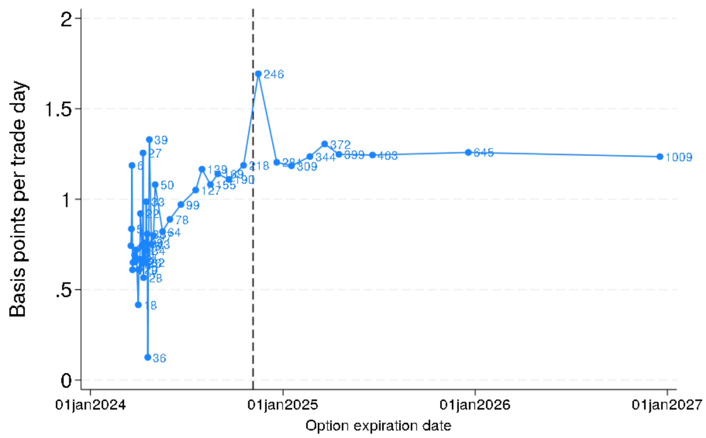


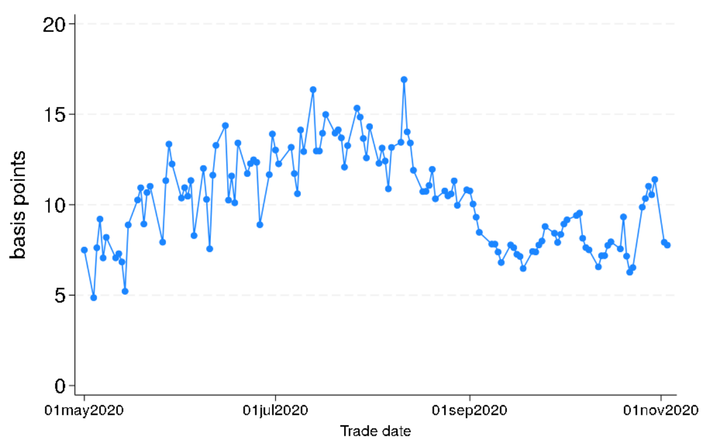
Figure 7: Pricing an Event Over Time

This figure illustrates how our abnormal equity premium methodology can be used to track the risk premia associated with an even over time. The top panel shows the term structure of forward risk premium over the next year as of March 14, 2024, with marker labels denoting the days to expiration for each option expiration and the vertical line indicating the November 5, 2024, election. Panel B and C reports how abnormal forward premia for the the 2020 and 2024 elections vary over time.

Panel A. Forward equity premiums over the next year on Mar 14, 2024



Panel B. Time series of the 2020 election abnormal risk premium



Panel C. Time series of the 2024 election abnormal risk premium

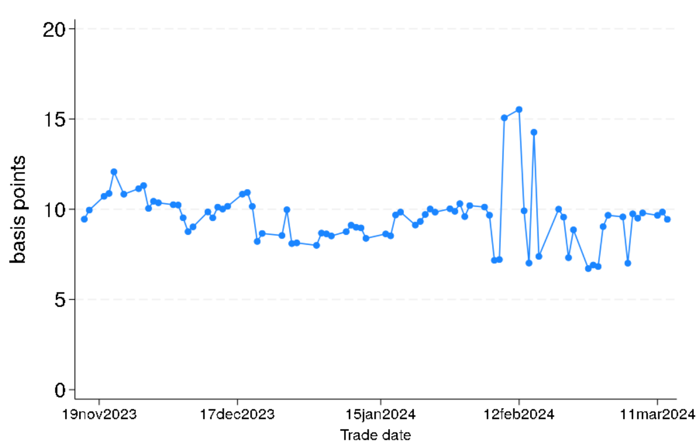


Table 1:
Data Availability

This table shows the availability of options data, separated by expiration year and expiration day of the week. Panel A shows the unique option expiration dates, e, and Panel B shows all trade-expiration date observations, (t, e).

Panel A: Number of Unique Option Expiration Dates, e

	Expiration date day of the week					
	Monday	Tuesday	Wednesday	Thursday	Friday	Total
2016	11	1	12	0	9	33
2017	46	9	52	3	47	157
2018	48	7	51	2	51	159
2019	48	7	51	4	51	161
2020	48	6	52	5	49	160
2021	47	7	52	3	50	159
2022	45	38	52	34	51	220
2023	45	51	52	51	51	250
2024	2	4	4	4	4	18
Total	340	130	378	106	363	1,317

Panel B: Number of Trade Date-Expiration Observations, (t, e)

	Expiration date day of the week					
	Monday	Tuesday	Wednesday	Thursday	Friday	Total
2016	135	16	165	0	130	446
2017	706	139	805	47	722	2,419
2018	730	106	779	32	779	2,426
2019	740	108	789	62	788	2,487
2020	740	94	804	78	755	2,471
2021	720	109	802	46	767	2,444
2022	669	387	780	326	762	2,924
2023	678	775	792	776	776	3,797
2024	18	40	37	34	31	160
Total	5,136	1,774	5,753	1,401	5,510	19,574

Table 2:
The Distribution of Forward Equity Premia

This table reports the following descriptive statistics of forward risk premia: the total number (count), the average (avg), the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles (p5, p25, p50, p75, p95, respectively), and the standard deviation (sd). Panel A and B present summary statistics of forward and abnormal risk premium, respectively. Risk premia are shown under the SVIX and IEP measures and are reported in basis points per day. Panel C reports summary statistics of the abnormal risk premia under different quantile regressions (QR) specifications. The specifications include estimating at the median quantile ($\mathcal{T} = 0.5$) and the 0.3 quantile ($\mathcal{T} = 0.3$), and conditioning on the first forward period expiration of the week ($I_{e=fow}$), time to expiration ($T_{t,e}$), and time to expiration squared ($T_{t,e}^2$).

Panel A: Forward Equity Premium Summary Statistics

Equity premium measure	count	avg	p5	p25	p50	p75	p95	sd
		Basis points per trade day						
SVIX	19,574	1.48	0.38	0.66	1.06	1.81	3.69	1.47
IEP	19,574	4.16	1.12	1.89	3.00	5.03	10.14	4.11

Panel B: Abnormal Forward Equity Premium Summary Statistics

Equity premium measure	count	avg	p5	p25	p50	p75	p95	sd
		Basis points per trade day						
SVIX	19,574	0.06	-0.22	-0.03	0.00	0.05	0.45	0.46
IEP	19,574	0.15	-0.62	-0.10	0.00	0.14	1.25	1.29
		Basis points per forward period						
SVIX	19,574	0.07	-0.30	-0.04	0.00	0.06	0.57	0.60
IEP	19,574	0.18	-0.84	-0.13	0.00	0.18	1.60	1.70

Panel C: Effect of Model Choice on Abnormal Forward Equity Premia for the SVIX measure

$\mathcal{T}$	Regressors	count	avg	p5	p25	p50	p75	p95	sd
			Basis points per forward period						
0.5	constant,	19,574	0.08	-0.41	-0.08	0.00	0.13	0.76	0.57
0.5	constant, I_{fow},	19,574	0.05	-0.36	-0.05	0.00	0.10	0.55	0.55
0.5	constant, I_{fow}, Term,	19,574	0.05	-0.27	-0.04	0.00	0.06	0.47	0.47
0.5	constant, I_{fow}, Term, Term^2	19,574	0.05	-0.23	-0.04	0.00	0.05	0.45	0.47
0.3	constant, I_{fow}, Term, Term^2	19,574	0.12	-0.10	-0.00	0.01	0.11	0.58	0.46

Table 3:
Decomposing the Variation in Forward Equity Premia

This table reports results for a decomposition of the variation of the trade date-forward period panel. We report the time series standard deviation (Std. dev.) of the trade date-level median forward premia, $Median_t$, in the left column and the time series average (Avg.) of trade date-level standard deviations, SD_t, in the right column. Results are reported for raw and abnormal forward premia using the SVIX and IEP models of expected returns.

	Equity premium measure	Median EP (across expirations) by trade date: $Median_t$	Std. dev. of EP (across expirations) by trade date: SD_t
(1)	Raw SVIX	Std. dev.= 1.31	Avg.= 0.35
(2)	Abnormal SVIX		Avg.= 0.25
(3)	Raw IEP	Std. dev.=3.67	Avg.= 0.99
(4)	Abnormal IEP		Avg.= 0.69

Table 4:
Forward Periods with Significant Abnormal Premia

This table reports all forward periods with significant abnormal premia. After averaging abnormal premia across available trade dates for each forward period e, we estimate the following regression using the time series of average abnormal forward premia:

$$A_e^{SVIX} \times H_e = \alpha + \beta I_e + \epsilon_e,$$

where A_e^{SVIX} is the average abnormal forward equity premia (per trade day) for the forward period ending on date e, H_e is the length of the forward period in trade days, and I_e is an indicator variable equal to one for all observations pertaining to one forward period in each regression and zero otherwise. Statistically significant forward periods are sorted in order of economic significance measured by $\hat{\beta}$ in column (4). Column (2) reports the end date of each forward period. Column (3) reports the associated event(s). For forward periods not spanning CPI, FOMC, and NFP releases, we use the online archives of the Wall Street Journal to identify scheduled event(s). The p-values are reported in column (5). Column (6) reports the length of each forward period in trade days. We additionally report the trade date average of raw forward premia, in basis points, over the forward period for the SVIX and IEP models of expected returns in columns (7) and (8), respectively.

(1) No.	(2) Forward Period	(3) Event(s)	(4) $\hat{\beta}$ (bp)	(5) p-value	(6) Period Length	(7) SVIX Equity Prem. (bp)	(8) IEP Equity Prem. (bp)
1	2020-11-04	Presidential Election	7.897	< 0.001	2	13.43	36.48
2	2023-01-12	CPI	4.981	< 0.001	1	6.60	17.59
3	2022-12-13	CPI	3.886	< 0.001	1	5.47	14.65
4	2016-11-09	Presidential Election	3.343	< 0.001	2	4.95	14.32
5	2023-03-22	FOMC	3.227	< 0.001	1	4.64	12.40
6	2020-04-03	NFP	2.927	< 0.001	2	20.68	59.41
7	2022-12-14	FOMC	2.731	< 0.001	1	4.29	11.49
8	2022-10-13	CPI	2.683	< 0.001	1	5.60	15.40
9	2021-01-06	Electoral College Count, Georgia Runoff	2.494	< 0.001	2	6.39	17.68
10	2022-11-02	FOMC	2.421	< 0.001	1	5.71	15.49
11	2023-02-14	CPI	2.414	< 0.001	1	3.51	9.38
12	2023-02-01	FOMC	2.399	< 0.001	1	3.67	9.76
13	2020-04-01	Covid-19	2.386	< 0.001	1	10.96	31.61
14	2022-11-10	CPI	2.372	< 0.001	1	5.72	15.41
15	2022-03-16	FOMC	2.359	< 0.001	2	8.01	22.35
16	2023-03-14	CPI	2.245	< 0.001	1	3.49	9.34
17	2022-07-27	FOMC	1.902	< 0.001	2	5.37	14.90
18	2022-09-13	CPI	1.729	< 0.001	1	4.06	11.28
19	2020-11-06	FOMC, NFP	1.704	< 0.001	2	7.78	21.35
20	2017-05-08	French Presidential Election Runoff	1.611	< 0.001	1	2.31	6.77
21	2023-02-03	NFP	1.583	< 0.001	1	2.82	7.53
22	2023-05-03	FOMC	1.527	< 0.001	1	2.66	7.13
23	2019-07-01	Trump-Xi G-20 Bilateral	1.522	< 0.001	1	2.65	7.87
24	2023-04-12	CPI	1.418	0.002	1	2.88	7.71
25	2020-04-08	Covid-19	1.416	0.002	2	20.01	56.93
26	2018-11-07	Midterm Election	1.341	0.004	2	4.52	13.41
27	2022-06-15	FOMC	1.332	0.004	2	5.25	14.61
28	2022-09-21	FOMC	1.284	0.005	2	4.50	12.47
29	2022-07-13	CPI	1.275	0.006	2	5.69	15.76
30	2023-01-06	NFP	1.144	0.013	1	2.97	7.95
31	2020-03-04	FOMC	1.133	0.014	2	3.59	10.80
32	2022-11-09	Midterm Election	1.057	0.022	1	4.48	12.06
33	2022-05-04	FOMC	1.034	0.025	2	4.00	11.19
34	2017-04-24	French Presidential Election First Round	1.015	0.028	3	3.20	9.32
35	2023-03-10	NFP	0.959	0.038	1	2.24	5.99
36	2019-07-31	FOMC	0.951	0.039	2	2.26	6.75
37	2020-10-02	NFP	0.926	0.045	2	5.72	15.49
38	2023-04-10	NFP	0.925	0.045	1	2.78	7.47

Table 5:
Macroeconomic Release Equity Premia Statistics

This table reports equity premium statistics for all forward periods in our sample and for forward periods spanning CPI, FOMC, and NFP releases. Panel A reports results using the forward SVIX and Panel B reports results for the forward IEP. Row 1 of each panel reports the number of forward periods in our sample, row 2 reports the average forward premium per forward period in the full sample in bp, row 3 reports the yearly average of forward premia per annum in the full sample in percent, row 4 reports the number of forward periods spanning CPI, FOMC, and NFP releases, row 5 reports average forward premia per period for each release type in bp, row 6 reports average release forward premia per annum (avg. forward premia per release forward period times number of releases per year) in percent. We also report the share of total premia account for by CPI, FOMC, and NFP releases in our sample, as well as the share of total forward periods spanning these releases.

Panel A: SVIX as Equity Premium Measure

(1) No. fwd. periods	1,317			
(2) Avg. EP per fwd period (bps)	2.04			
(3) Avg. EP per year (pct)	3.68%			
	CPI	FOMC	NFP	All
(4) No. release fwd. periods	87	58	86	226
(5) Avg. release EP per fwd period (bps)	2.66	2.90	2.54	2.68
(6) Avg. release EP per year (pct)	0.32%	0.23%	0.30%	
(4)/(1), % of fwd periods	6.61%	4.40%	6.53%	17.16%
(6)/(3), % of total EP	8.61%	6.27%	8.13%	22.59%

Panel B: IEP as Equity Premium Measure

(1) No. fwd. periods	1,317			
(2) Avg. EP per fwd period (bps)	5.74			
(3) Avg. EP per year (pct)	10.36%			
	CPI	FOMC	NFP	All
(4) No. release fwd. periods	87	58	86	226
(5) Avg. release EP per fwd period (bps)	7.48	8.16	7.17	7.56
(6) Avg. release EP per year (pct)	0.90%	0.65%	0.86%	
(4)/(1), % of fwd periods	6.61%	4.40%	6.53%	17.16%
(6)/(3), % of total EP	8.61%	6.26%	8.16%	22.61%

Table 6:
Pricing the Economic Calendar

This Table illustrates an example of how the methodology to estimate forward event premia (Londono and Samadi (2023)) and abnormal premia developed in this paper can be used to estimate risk pricing for the upcoming economic calendar. Forward premia are estimated using option prices on June 10, 2024, for the following four weeks of economic releases. Raw and abnormal forward premia using the SVIX are reported. Release days with abnormal premia falling in above the 80th percentiles of the historical distribution from August 2022 are highlighted. Premia are reported in basis points per trade day. Forward premia for the upcoming month of daily forward periods are available at www.pricingthecalendar.com.

S&P 500 Forward Premia: Jun 10, 2024

DATE	EVENT(S)	SVIX (BP)	ABN. SVIX (BP)
Jun 11, 2024		0.35	−0.05
Jun 12, 2024	Consumer Price Index, Fed Interest Rate Decision	1.37	0.95
Jun 13, 2024	Producer Price Index	0.54	0.09
Jun 14, 2024	Michigan Consumer Sentiment Index	0.41	−0.05
Jun 17, 2024		0.48	0.00
Jun 18, 2024	Retail Sales	0.44	−0.05
Jun 20, 2024		0.56	0.06
Jun 21, 2024	S&P Global Manufacturing PMI, S&P Global Services PMI	0.57	0.06
Jun 24, 2024		0.52	0.00
Jun 25, 2024		0.44	−0.09
Jun 26, 2024		0.45	−0.08
Jun 27, 2024	Gross Domestic Product	0.49	−0.04
Jun 28, 2024	Personal Consumption Expenditures	0.68	0.14
Jul 1, 2024	ISM Manufacturing PMI	0.63	0.09
Jul 2, 2024		0.53	0.00
Jul 3, 2024	ADP Employment Change, FOMC Minutes, ISM Services PMI	0.35	−0.18
Jul 5, 2024	Average Hourly Earnings, Nonfarm Payrolls	0.98	0.46
Jul 8, 2024		0.52	0.00

This table reports daily forward S&P 500 equity premia (Londono and Samadi, 2023) and abnormal equity premia (Knox, Londono, Samadi, and Vissing-Jorgensen, 2024) for each upcoming trade date. Forward periods with abnormal premia above the 80th percentile of the historical distribution since September 2022 are highlighted. Source: LiveVol

Appendix to "Equity Premium Events"

This Appendix provides additional description and empirical evidence to supplement the analyses provided in the main text. Below, we list the content.

1. Table A1 reports expiration-level descriptive statistics for the daily option expirations in our sample.

2. Table A2 reports retail trading activity statistics for our sample.

3. Section A details our approach to group 124 macroeconomic variables tracked in the Bloomberg Economic Calendar into 50 releases.

4. Table A3 reports the grouping of the 124 macroeconomic variables into 50 releases.

5. Section B discusses the relative negative correlation condition underlying the forward SVIX.

6. Section C discusses the approximation error of our estimated forward expected returns.

7. Table A4 reports the covariance of daily realized returns over various horizons.

8. Section D details the estimation of the Tetlock (2023)'s implied equity premium (IEP) growth optimal (GO) weights.

9. Figure A1 reports the estimated GO weights.

10. Figure A2 compares the LVIX, SVIX, and IEP models of expected returns at the one year horizon.

11. Table A5 reports the estimation fit of various QR specifications.

12. Table A6 reports multiple-testing adjusted p-values for the data-driven analysis.

13. Table A7 reports multivariate results examining expected returns in the cross-section of macroeconomic releases.

14. Section E reports additional results on the cross-section of macroeconomic releases.

15. Figure A3 reports univariate results for excess stock returns on macroeconomic release dates.

16. Figure A4 reports univariate results for expected return over forward periods spanning macroeconomic release dates.

Table A1:
Daily Option Expiration Descriptive Statistics

This table provides descriptive statistics for trade date-expiration level daily options data aggregated to the expiration level. For each variable, we report the mean, standard deviation, and select percentiles of expiration-level statistics. #Strikes is the daily average number of unique strike prices for a given expiration. Min. Moneyness is the daily average minimum moneyness (K/P_t) across available strike prices for a given expiration. Max. Moneyness is the daily average maximum moneyness across available strike prices for a given expiration. Min. Call Delta is the daily average of minimum call option delta across available strike prices for a given expiration. Max. Put Delta is the daily average maximum put option delta across available strike prices for a given expiration. Spread is the daily average of the within trade date median of percentage bid-ask spread for at-the-money ($0.4 \leq \Delta \leq 0.6$) options for a given expiration. Volume is the sum of trading volume across all contracts and trade dates for a given expiration. Open Interest is the daily average total open interest across all contracts for a given expiration.

	Statistic							
	Count	Mean	P5	P25	P50	P75	P95	SD
#Strikes	1,319	196	113	148	170	226	362	72
Min. Moneyness	1,319	0.39	0.22	0.28	0.31	0.59	0.63	0.16
Max. Moneyness	1,319	1.30	1.13	1.18	1.27	1.43	1.53	0.15
Min. Call Delta	1,319	0.0012	0.0003	0.0004	0.0008	0.0012	0.0041	0.0027
Max. Put Delta	1,319	-0.0007	-0.0026	-0.0007	-0.0004	-0.0003	-0.0002	0.0028
Spread	1,319	1.7%	0.8%	1.0%	1.3%	2.5%	3.6%	1.0%
Volume	1,319	711,794	247,697	382,350	550,289	959,135	1,647,535	465,153
Open Interest	1,319	147,499	25,507	44,745	66,961	210,671	465,326	169,173

Table A2:
Retail Trading Activity

This table reports average daily shares of retail volume (in contracts) using the proxy of Bryzgalova et al. (2023). Trade date-expiration level daily retail volume shares are grouped by year of the trade date, trading days to expiration, and expirations following CPI, FOMC, NFP releases or other expirations. This analysis uses option trade data obtained from the Cboe. Trades with a price of quantity less than or equal to zero are removed. Trades with prices below the prevailing best bid minus the bid-ask spread or above the best ask plus the bid-ask spread are removed. Trades with a prevailing bid-ask spread that is less than or equal to zero are removed. Cancelled trades are removed. Results are presented for trade dates from 2017 through 2023.

2017				
Days to Expiration	Other	CPI	FOMC	NFP
0	0.00%	0.00%	0.00%	0.00%
1	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	0.00%	0.00%
12	0.00%	0.00%	0.00%	0.00%
13	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.00%	0.00%	0.00%
15	0.00%	0.00%	0.00%	0.00%
16	0.00%	0.00%	0.00%	0.00%
17	0.00%	0.00%	0.00%	0.00%
18	0.00%	0.00%	0.00%	0.00%
19	0.00%	0.00%	0.00%	0.00%
20	0.00%	0.00%	0.00%	0.00%

2018				
Days to Expiration	Other	CPI	FOMC	NFP
0	0.00%	0.00%	0.00%	0.00%
1	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%
6	0.00%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	0.00%	0.00%
12	0.00%	0.00%	0.00%	0.00%
13	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.00%	0.00%	0.00%
15	0.00%	0.00%	0.00%	0.00%
16	0.00%	0.00%	0.00%	0.00%
17	0.00%	0.00%	0.00%	0.00%
18	0.00%	0.00%	0.00%	0.00%
19	0.00%	0.00%	0.00%	0.00%
20	0.00%	0.00%	0.00%	0.00%

2019				
Days to Expiration	Other	CPI	FOMC	NFP
0	0.01%	0.00%	0.00%	0.00%
1	0.00%	0.00%	0.00%	0.00%
2	0.00%	0.00%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%
4	0.00%	0.00%	0.00%	0.00%
5	0.00%	0.00%	0.00%	0.00%
6	0.01%	0.00%	0.00%	0.00%
7	0.00%	0.00%	0.00%	0.00%
8	0.00%	0.00%	0.00%	0.00%
9	0.00%	0.00%	0.00%	0.00%
10	0.00%	0.00%	0.00%	0.00%
11	0.00%	0.00%	0.00%	0.00%
12	0.00%	0.00%	0.00%	0.00%
13	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.00%	0.00%	0.00%
15	0.00%	0.00%	0.00%	0.00%
16	0.09%	0.00%	0.00%	0.00%
17	0.00%	0.00%	0.00%	0.00%
18	0.00%	0.00%	0.00%	0.00%
19	0.00%	0.00%	0.00%	0.00%
20	0.00%	0.00%	0.00%	0.00%

2020				
Days to Expiration	Other	CPI	FOMC	NFP
0	0.42%	1.26%	0.00%	0.34%
1	0.45%	1.00%	0.00%	0.40%
2	0.59%	3.11%	0.00%	0.73%
3	1.48%	0.40%	0.00%	0.28%
4	1.27%	3.76%	0.00%	1.70%
5	1.91%	7.30%	4.24%	0.10%
6	0.85%	7.14%	7.00%	0.00%
7	0.38%	0.17%	0.12%	0.00%
8	1.13%	0.00%	5.58%	0.02%
9	1.69%	0.03%	0.34%	0.11%
10	0.23%	0.01%	0.11%	0.56%
11	0.27%	0.40%	0.55%	0.03%
12	0.44%	0.07%	0.16%	0.08%
13	0.22%	0.36%	0.41%	0.00%
14	0.71%	1.19%	0.79%	0.00%
15	2.50%	0.12%	0.14%	0.07%
16	0.10%	0.12%	0.47%	0.07%
17	0.21%	0.07%	0.11%	0.23%
18	0.21%	0.33%	0.06%	0.54%
19	0.64%	0.11%	0.01%	0.08%
20	0.21%	1.07%	0.00%	0.00%

2021				
Days to Expiration	Other	CPI	FOMC	NFP
0	0.92%	1.16%	0.32%	0.76%
1	0.99%	0.64%	2.13%	1.07%
2	0.52%	0.31%	0.49%	0.45%
3	0.38%	0.28%	0.49%	0.34%
4	0.23%	0.10%	0.21%	0.26%
5	0.13%	0.04%	0.13%	0.10%
6	0.15%	0.11%	0.33%	0.31%
7	0.26%	0.12%	0.11%	0.22%
8	0.22%	0.16%	0.10%	0.12%
9	0.19%	0.45%	0.06%	0.07%
10	0.12%	0.36%	0.17%	0.12%
11	0.15%	0.28%	0.25%	0.19%
12	0.22%	0.44%	0.16%	0.18%
13	0.31%	0.72%	0.22%	0.33%
14	0.23%	0.21%	0.09%	0.13%
15	0.23%	0.36%	0.17%	0.11%
16	0.24%	0.29%	0.00%	0.26%
17	0.13%	0.05%	0.20%	0.14%
18	0.27%	0.00%	0.23%	0.05%
19	0.14%	0.14%	0.00%	0.01%
20	0.17%	0.49%	0.00%	0.04%

2022				
Days to Expiration	Other	CPI	FOMC	NFP
0	3.51%	3.00%	1.83%	3.31%
1	2.33%	3.33%	2.68%	3.48%
2	1.39%	1.28%	0.98%	1.68%
3	1.05%	0.75%	0.89%	1.89%
4	0.81%	1.32%	0.00%	0.79%
5	0.63%	0.11%	0.25%	0.47%
6	0.72%	0.72%	0.82%	0.35%
7	0.78%	0.43%	0.39%	0.72%
8	0.63%	0.73%	1.20%	0.81%
9	0.80%	0.53%	0.82%	0.45%
10	0.72%	0.00%	0.00%	0.36%
11	0.62%	0.40%	0.82%	0.48%
12	0.53%	0.61%	0.46%	0.32%
13	0.79%	0.63%	0.64%	0.44%
14	0.54%	1.07%	0.29%	0.19%
15	0.50%	0.24%	0.88%	0.21%
16	0.71%	0.36%	0.48%	0.00%
17	0.56%	0.17%	0.59%	0.00%
18	0.42%	0.13%	0.45%	0.36%
19	0.44%	0.35%	0.00%	0.33%
20	0.25%	0.00%	0.00%	0.19%

2023				
Days to Expiration	Other	CPI	FOMC	NFP
0	3.81%	4.11%	2.81%	3.12%
1	1.97%	1.84%	2.55%	0.95%
2	1.21%	0.87%	0.91%	1.14%
3	1.06%	0.73%	0.60%	1.08%
4	0.73%	0.00%	0.31%	0.64%
5	0.59%	1.05%	0.33%	0.62%
6	0.74%	0.34%	0.49%	0.81%
7	0.73%	0.36%	0.25%	0.68%
8	0.59%	0.41%	0.29%	0.74%
9	0.58%	0.17%	1.50%	0.88%
10	0.60%	0.36%	0.84%	0.57%
11	0.66%	0.48%	0.31%	0.49%
12	0.55%	0.97%	0.28%	0.47%
13	0.60%	1.38%	0.54%	0.34%
14	0.58%	0.85%	0.29%	0.28%
15	0.48%	0.89%	0.48%	0.31%
16	0.44%	0.30%	0.00%	0.71%
17	0.64%	0.05%	0.21%	1.15%
18	0.78%	0.29%	0.00%	0.17%
19	0.65%	0.62%	0.00%	0.13%
20	0.38%	0.00%	0.10%	0.29%

A. Procedure to Group Macroeconomic Variables into 50 releases

Our procedure for grouping the 124 macroeconomic variables tracked in the Bloomberg Economic Calendar into 50 releases is as follows:

1. For each variable, determine the first announcement date available, T_i^{min}.

2. Sort the variables based on Bloomberg's relevance score, from most to least relevant.

3. Define a set of 124 daily dummy variables $D_{i,t}$, with $i = 1, \ldots, 124$, and $D_{i,t} = 1$ if date t is an announcement date for variable i.

4. For each variable, regress $D_{i,t}$ on $D_{1,t}, \ldots, D_{i-1,t}$ using daily data from T_i^{min} and later.

   - If an $R^2 = 1$ emerges, determine (by looking at the underlying releases) whether the variable i is from the same release as one of the more relevant variables 1 to $i - 1$. This is the case for 62 variables. We then use only one combined release dummy and label it based on the most relevant variable included in the release measured by the Bloomberg relevance variable.
   - For seven variables, R^2 values close to 1 in cases where the less relevant variable is in fact from the same release as a more relevant variable, but one of the two variables involved has one or a few errors in the release date. In each case, we use only one combined release dummy, labelling releases based on the most relevant variable according to the Bloomberg relevance variable.
   - For four variables, we get R^2 values above 0.80 despite the variables not being a part of a release of a more relevant variable. This occurs when two variables tend to be released on the same dates, but as part of different economic releases. We drop these variables to avoid multi-collinearity issues (none of these four variables are significantly correlated with the four variables we find to be assocaited with abnormal equity premia).
   - One variable has data only for 2023, and we drop it.

Based on this method, we group variables into 50 (=124-62-7-4-1) macroeconomic releases. The groupings of macroeconomic variables are reported in Appendix Table A3.

Table A3: Grouping of Macroeconomic Variables Into 50 Releases

This table lists the grouping of 124 macroeconomic variables tracked in the Bloomberg Economic Calendar into 50 releases. Variables are grouped using the approach detailed in Appendix A.

Release No.	Macro variable
1	Nonfarm Payroll
1	Unemployment Rate
1	Change in Manufact. Payrolls
1	Continuing Claims
1	Average Hourly Earnings MoM
1	Average Hourly Earnings YoY
1	Change in Private Payrolls
1	Average Weekly Hours All Employees
1	Underemployment Rate
1	Labor Force Participation Rate
2	Initial Jobless Claims
3	FOMC Rate Decision (Upper Bound)
3	FOMC Rate Decision (Lower Bound)
3	Interest on Reserve Balances Rate
4	CPI MoM
4	CPI YoY
4	CPI Ex Food and Energy MoM
4	CPI Ex Food and Energy YoY
4	CPI Core Index SA
4	CPI Index NSA
4	Real Avg Weekly Earnings YoY
4	Real Avg Hourly Earning YoY
5	GDP Annualized QoQ
5	GDP Price Index
5	Personal Consumption
5	Core PCE Price Index QoQ
6	ISM Manufacturing
6	ISM Prices Paid
6	ISM New Orders
6	ISM Employment
7	U. of Mich. Sentiment
7	U. of Mich. 1 Yr Inflation
7	U. of Mich. 5-10 Yr Inflation
7	U. of Mich. Expectations
7	U. of Mich. Current Conditions

Release No.	Macro variable
8	Retail Sales Advance MoM
8	Retail Sales Ex Auto MoM
8	Retail Sales Ex Auto and Gas
8	Retail Sales Control Group
9	Conf. Board Consumer Confidence
9	Conf. Board Expectations
9	Conf. Board Present Situation
10	Durable Goods Orders
10	Durables Ex Transportation
10	Cap Goods Orders Nondef Ex Air
10	Cap Goods Ship Nondef Ex Air
10	Factory Orders Ex Trans
11	ADP Employment Change
12	MBA Mortgage Applications
13	New Home Sales
13	New Home Sales MoM
14	Housing Starts
14	Building Permits
15	Industrial Production MoM
15	Capacity Utilization
15	Manufacturing (SIC) Production
16	PPI Final Demand MoM
16	PPI Final Demand YoY
16	PPI Ex Food and Energy MoM
16	PPI Ex Food and Energy YoY
16	PPI Ex Food, Energy, Trade MoM
16	PPI Ex Food, Energy, Trade YoY
17	Existing Home Sales
17	Existing Home Sales MoM
18	Personal Income
18	Personal Spending
18	PCE Core Deflator MoM
18	PCE Core Deflator YoY
18	PCE Deflator YoY
18	Real Personal Spending
18	PCE Deflator MoM
19	Factory Orders
20	Trade Balance
21	Empire Manufacturing
22	Leading Index
23	MNI Chicago PMI
24	Wholesale Inventories MoM
24	Wholesale Trade Sales MoM

Release No.	Macro variable
25	ISM Services Index
25	ISM Services Prices Paid
25	ISM Services New Orders
25	ISM Services Employment
26	Philadelphia Fed Business Outlook
27	Import Price Index MoM
27	Import Price Index YoY
27	Export Price Index MoM
27	Export Price Index YoY
27	Import Price Index ex Petroleum MoM
28	Pending Home Sales MoM
28	Pending Home Sales NSA YoY
29	Employment Cost Index
30	Monthly Budget Statement
31	Richmond Fed Manufact. Index
32	Current Account Balance
33	Net Long-term TIC Flows
33	Total Net TIC Flows
34	FHFA House Price Index MoM
35	Dallas Fed Manf. Activity
36	Chicago Fed Nat Activity Index
37	NFIB Small Business Optimism
38	FOMC Meeting Minutes
39	JOLTS Job Openings
40	NAHB Housing Market Index
41	Nonfarm Productivity
41	Unit Labor Costs
42	Wards Total Vehicle Sales
43	Consumer Credit
44	Business Inventories
45	Challenger Job Cuts YoY
46	House Price Purchase Index QoQ
47	Housing Starts MoM
47	Building Permits MoM
48	Kansas City Fed Manf. Activity
49	Household Change in Net Worth
50	Advance Goods Trade Balance
50	Retail Inventories MoM

B. Relative Negative Correlation Condition

The one-period forward rate of expected returns in k periods is

$$\begin{aligned} F_{t,k} &= \frac{E_t\left(R_{t,t+k}R_{t+k,t+k+1}\right)}{E_t\left(R_{t,t+k}\right)} \\ &\approx 1 + E_t\left(R_{t,t+k}R_{t+k,t+k+1}\right) - E_t\left(R_{t,t+k}\right) \\ &= 1 + E_t\left(R_{t,t+k}\right)\, E_t\left(R_{t+k,t+k+1}\right) + Cov_t\left(R_{t,t+k}, R_{t+k,t+k+1}\right) - E_t\left(R_{t,t+k}\right) \\ &\approx 1 + \left[E_t\left(R_{t,t+k}\right) + E_t\left(R_{t+k,t+k+1}\right) - 1\right] + Cov_t\left(R_{t,t+k}, R_{t+k,t+k+1}\right) - E_t\left(R_{t,t+k}\right) \\ &= E_t\left(R_{t+k,t+k+1}\right) + Cov\left(R_{t,t+k}, R_{t+k,t+k+1}\right), \end{aligned}$$

where both approximation lines use a first order approximation around $x = 0$ and $y = 0$.

Using the fact that, empirically, $Cov\left(R_{t,t+k}, R_{t+k,t+k+1}\right) \approx 0$, then, the expected forward return is approximately the difference in expected returns:

$$E_t\left(R_{t+k,t+k+1}\right) \approx 1 + E_t\left(R_{t,t+k}R_{t+k,t+k+1}\right) - E_t\left(R_{t,t+k}\right).$$

In our implementation, we use the SVIX, S_t^k, to measure a lower bound for expected returns, where the expected return is

$$E_t\left(R_{t,t+k}\right) = S_t^k - C_t^k,$$

with $C_t^k = Cov(M_{t,t+k}R_{t,t+k}, R_{t,t+k}) \leq 0$ denoting the NCC term. Our implemented measure of the forward expected return is, therefore, a lower bound of the true forward expected return so long as $C_t^{k+1} \leq C_t^k$.

C. Forward Rates and Expected Forward Returns

Define the k-period gross forward rate of expected returns as:

$$F_{t,k} = \frac{E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}R_{t+k}\right)}{E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}\right)}, \tag{15}$$

where $E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}R_{t+k}\right)$ is the expected k-period gross return and $E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}\right)$ is the expected $(k-1)$-period gross return. Given that both of these inputs are observable and have tradeable prices, an investor at time t can lock into earning this forward rate in period $t+k$. The forward rate of expected returns is therefore analogous to the forward yields that are widely used in the yield curve literature (and computed using the relative yield of zero coupon bonds of different maturities).

Although the forward rates of expected returns on the stock market are an economically interesting quantity in their own right, it is not our object of empirical interest. Instead, we wish to study the time t expected return in k periods, $E_t\left(R_{t+k}\right)$. To understand the distinction, note that the k-period forward rate of expected returns can be stated:

$$\begin{aligned} F_{t,k} &= \frac{E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}\right)E_t\left(R_{t+k}\right) + Cov_t\left(R_{t+1}R_{t+2}...R_{t+k-1}, R_{t+k}\right)}{E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}\right)} \\ &= E_t\left(R_{t+k}\right) + \frac{Cov_t\left(R_{t+1}R_{t+2}...R_{t+k-1}, R_{t+k}\right)}{E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}\right)}, \end{aligned}$$

where the first line uses the identity $Cov(X,Y) = E(XY) - E(X)E(Y)$ and the second line simplifies. The difference between a forward expected return and the tradeable forward rate of expected returns for the same forward period is thus determined by the discounted covariance of future returns:

$$E_t\left(R_{t+k}\right) - F_{t,k} = -\frac{Cov_t\left(R_{t+1}R_{t+2}...R_{t+k-1}, R_{t+k}\right)}{E_t\left(R_{t+1}R_{t+2}...R_{t+k-1}\right)}. \tag{16}$$

One can therefore use forward rates and forward expected returns interchangeably, i.e., assume $E_t\left(R_{t+k}\right) \approx F_{t,k}$, if the the covariance between multi-period cumulative returns and the subsequent period return is small relative to actual expected forward returns. In Table A4, we assess the size of this approximation in daily return data by estimating the covariance of 1 to 20 day (cumulative) realized returns with the next day realized return over our sample period (2016-2023). We show empirically that the covariances for daily returns are very small as a fraction of the average 1-day returns over the same period.[12]

[12]the average daily return is 0.0004 (or 4 basis points) and the covariance with the next day return is -0.00002 (which is approximately 5 percent of the daily return).

The return covariance analysis is related to an extensive literature that studies the auto-correlation of the stock market (see Lewellen (2019) for discussion). While the literature has focused on tests of market efficiency and time series momentum, we examine how large the covariance of returns with future returns are compared to expected 1-day returns.

Table A4: Covariance of Daily Returns

This table shows the average k-day cumulative returns, the standard deviation of the k-day cumulative returns, and the covariance of the k-day cumulative returns with the next day return. Daily returns are on the S&P 500 index and the statistic are measured over the sample period 2016-2023.

	$mean(R_{t+1}R_{t+2}...R_{t+k})$	$\sigma(R_{t+1}R_{t+2}...R_{t+k})$	$Cov(R_{t+1}R_{t+2}...R_{t+k}, R_{t+k+1})$
k = 1-day	1.0004	0.0116	-.000020
k = 2-day	1.0008	0.0170	-.000023
k = 3-day	1.0012	0.0194	-.000031
k = 4-day	1.0016	0.0218	-.000024
k = 5-day	1.0020	0.0244	-.000039
k = 6-day	1.0024	0.0256	-.000019
k = 7-day	1.0028	0.0282	-.000036
k = 8-day	1.0032	0.0290	-.000017
k = 9-day	1.0036	0.0315	-.000026
k = 10-day	1.0040	0.0325	-.000023
k = 11-day	1.0045	0.0343	-.000020
k = 12-day	1.0049	0.0358	-.000029
k = 13-day	1.0053	0.0371	-.000021
k = 14-day	1.0057	0.0387	-.000034
k = 15-day	1.0061	0.0396	-.000025
k = 16-day	1.0066	0.0412	-.000029
k = 17-day	1.0070	0.0421	-.000025
k = 18-day	1.0074	0.0433	-.000026
k = 19-day	1.0078	0.0443	-.000029
k = 20-day	1.0082	0.0453	-.000021

Table A5:
QR Model Fit For Different Regression Specifications

This table reports model fits for various quantile regression specifications. On each trade date t, we fit the term structure of forward risk premium using a quantile regression model:

$$Q_{F_{t,e}|x_{t,e}}(\mathcal{T}) = x_{t,e}\beta_{t,\mathcal{T}},$$

where $Q_{F_{t,e}|x_{t,e}}(\mathcal{T})$ is the $\mathcal{T}$'th quantile of forward expected returns on date t and $x_{t,e}$ is a vector containing the conditioning variables. The goodness of fit measure, the pseudo$-R^2$, is estimated as 1 minus the ratio between the sum of absolute deviations in the parameterized model and the sum of absolute deviations in the null (non-conditional) quantile model. The table presents summary statistics of the goodness of fit measure across trade dates for a given model specification.

	count	mean	p5	p25	p50	p75	p95	sd
$Q_{F_{t,e}\|a_t}(0.5)$	1,809	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00
$Q_{F_{t,e}\|a_t,I_{e=fow}}(0.5)$	1,809	0.15	0.00	0.04	0.11	0.22	0.45	0.14
$Q_{F_{t,e}\|a_t,I_{e=fow},T_{t,e}}(0.5)$	1,809	0.39	0.07	0.22	0.40	0.56	0.72	0.21
$Q_{F_{t,e}\|a_t,I_{e=fow},T_{t,e}}(0.3)$	1,809	0.48	0.12	0.30	0.49	0.66	0.79	0.21
$Q_{F_{t,e}\|a_t,I_{e=fow},T_{t,e},T^2_{t,e}}(0.5)$	1,809	0.50	0.15	0.34	0.52	0.68	0.81	0.21

D. Estimation of Implied Equity Premium Growth Optimal Weights

For comparability to Tetlock (2023)'s IEP estimates, we use a similar approach to estimate Growth Optimal (GO) portfolio weights $w_{k,t}$ using option data from 2009. GO portfolio weights are estimated using recursive (expanding) window of seemingly unrelated regressions (SUR) of variance premium on higher order risk neutral moments of expected excess market returns for horizons of 30, 60, 90, 180, and 360 days:

$$\begin{aligned}
E_t^*(\tilde{R}^2_{T_n=30}) - E_t(\tilde{R}^2_{T_n=30}) &= \alpha_{T_n=30} - R^{-1}_{f,t,T_n=30} \sum_{k=1}^{4} w_{k,t} E_t^*(\tilde{R}^{k+2}_{T_n=30}) + \epsilon_{t,T_n=30} \\
E_t^*(\tilde{R}^2_{T_n=60}) - E_t(\tilde{R}^2_{T_n=60}) &= \alpha_{T_n=60} - R^{-1}_{f,t,T_n=60} \sum_{k=1}^{4} w_{k,t} E_t^*(\tilde{R}^{k+2}_{T_n=60}) + \epsilon_{t,T_n=60} \\
E_t^*(\tilde{R}^2_{T_n=90}) - E_t(\tilde{R}^2_{T_n=90}) &= \alpha_{T_n=90} - R^{-1}_{f,t,T_n=90} \sum_{k=1}^{4} w_{k,t} E_t^*(\tilde{R}^{k+2}_{T_n=90}) + \epsilon_{t,T_n=90} \\
E_t^*(\tilde{R}^2_{T_n=180}) - E_t(\tilde{R}^2_{T_n=180}) &= \alpha_{T_n=180} - R^{-1}_{f,t,T_n=180} \sum_{k=1}^{4} w_{k,t} E_t^*(\tilde{R}^{k+2}_{T_n=180}) + \epsilon_{t,T_n=180} \\
E_t^*(\tilde{R}^2_{T_n=360}) - E_t(\tilde{R}^2_{T_n=360}) &= \alpha_{T_n=360} - R^{-1}_{f,t,T_n=360} \sum_{k=1}^{4} w_{k,t} E_t^*(\tilde{R}^{k+2}_{T_n=360}) + \epsilon_{t,T_n=360}
\end{aligned} \tag{17}$$

For identification of GO portfolio weights, we impose a cross-horizon linear restriction, requiring that the GO weights of a given order be equal across all horizons:

$$w_{k,t,T_1} = w_{k,t,T_2}, \forall T_1 = 30, ..., 360, T_2 = 30, ..., 360. \tag{18}$$

Risk neutral moments of expected excess returns are estimated using the following approach (Bakshi and Madan (2000); and Carr and Madan (2001)):

$$\begin{aligned}
&R^{-1}_{f,t,T_n} E_t^*(\tilde{R}^{k+1}_{T_n}) = \\
&\frac{j!}{P_t^j} \left[\int_0^{F_{t,T_n}} (K - F_{t,T_n})^{j-2} p_{t,T_n}(K) dK + \int_{F_{t,T_n}}^{\infty} (K - F_{t,T_n})^{j-2} c_{t,T_n}(K) dK \right].
\end{aligned} \tag{19}$$

We use options with a.m. settlement, without special settlement, and with time to expiration greater than or equal to 7 days and less than or equal to 549 days. We remove options with missing implied volatility, which occurs when the option midquote is below intrinsic value or when the Optionmetrics implied volatility calculation fails to converge. We use option expirations with at least 10 distinct strike prices and a moneyness range (K/P_t) from 95% to 105%.

Constant maturity risk-neutral moments are obtained using linear interpolation. Variance premia are estimated as the difference between risk-neutral and physical variance, where physical variance is estimated using a T_n-step ahead forecast of realized variance coming from an recursive window estimation of an ARFIMA(0,d,0) model.

Daily realized variance is estimated using trades in the SPY ETF obtained from TAQ from 2005. We require that transaction prices and quantities are positive, trades take place during regular trading hours, trades are not marked as corrected, the trade condition code not be 1, 4, 7, 8, 9, A, B, C, D, G, H, K, L, N, P, R, S, U, V, W, Y, or Z, and that the trade comes from the most active exchange on that day. We use the median transaction price for each timestamp.

We use the approach of Barndorff-Nielsen, Hansen, Lunde, and Shephard (2009) and Patton and Sheppard (2015), where the daily RV estimator is the average of 10 sub-sampled RV estimators based on 10 staggered sets of 78 non-overlapping intervals coming from 79 trade prices equally spaced in trade time. The first RV estimator uses prices 1, 11, 21, ..., 781, the second uses prices 2, 12, 22, ..., 782, and the tenth uses prices 10, 20, 30, ..., 790.

Estimates of GO portfolio weights are presented in Figure A1, and estimates for the LVIX, SVIX, and IEP for the one year horizon are presented in Figure A2. Estimates are quantitatively similar to those of Tetlock (2023), who shows that these weights can be interpreted as futures (k=1), and swaps based on market variance, skewness, and kurtosis (k=2,3,4, respectively) positions by an unconstrained rational log utility investor (Shiller, Fischer, and Friedman (1984) and Campbell and Kyle (1993)).

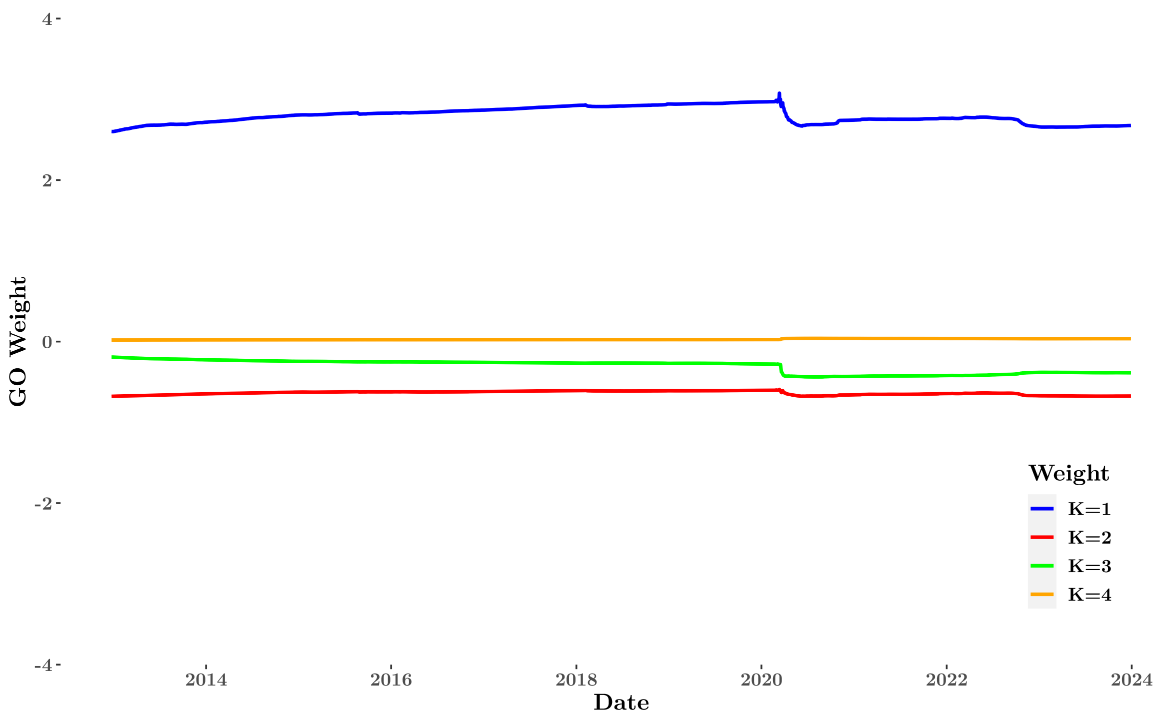


Figure A1: Estimated GO Portfolio Weights. This figure presents estimated Growth Optimal (GO) portfolio weights. GO portfolio weights are estimated using recursive window SUR regressions of variance premium on higher order risk neutral moments of expected excess market returns for horizons of 30, 60, 90, 180, and 360 days.

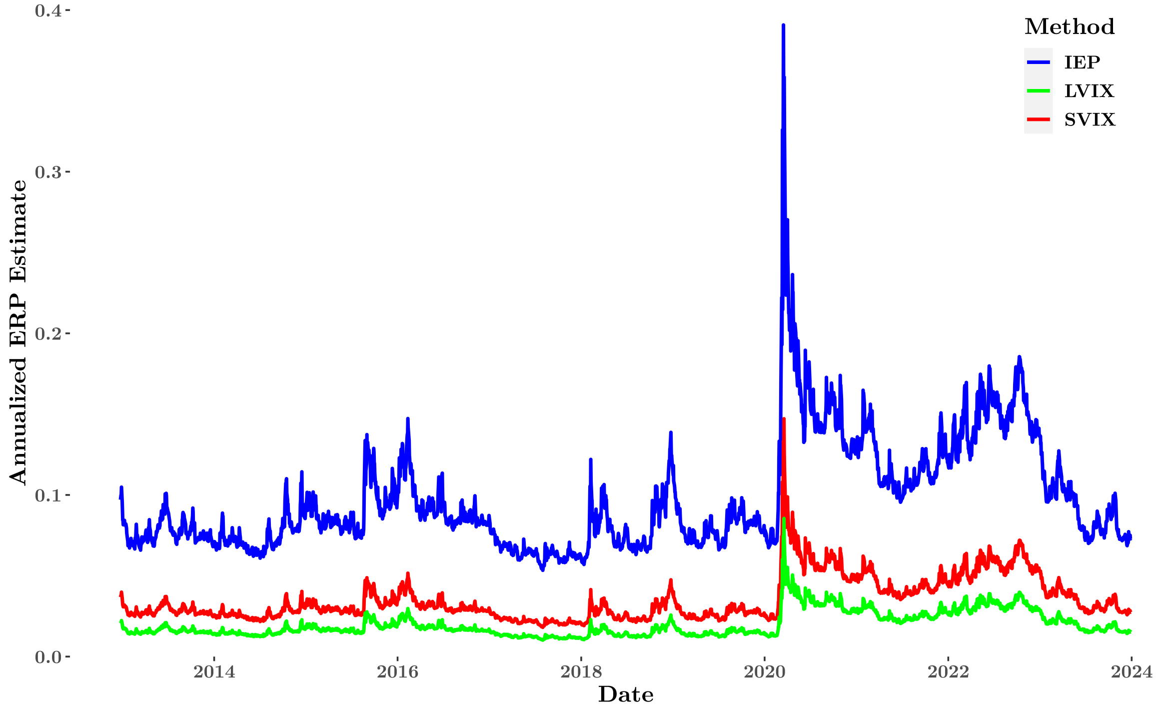


Figure A2: Comparison of SVIX and IEP. This figure compares estimates of the Gao and Martin (2021) LVIX, Martin (2017) SVIX and Tetlock (2023) IEP models of the equity premium at the one year horizon.

Table A6:
Multiple Testing Adjusted p-values for Data-Driven Analysis

This table reports all forward periods with significant abnormal premia. After averaging abnormal premia across available trade dates for each forward period e, we estimate the following regressions:

$$A_e^{SVIX} \times H_e = \alpha + \beta I_e + \epsilon_e,$$

where A_e^{SVIX} is the average abnormal forward equity premia (per trade day) for the forward period ending on date e, H_e is the length of the forward period in trade days, and I_e is an indicator variable equal to one for all observations pertaining to one forward period in each regression and zero otherwise. Statistically significant forward periods are sorted in order of economic significance measured by $\hat{\beta}$ in column (4). Column (2) reports the end date of each forward period. Column (3) reports the associated event(s). For forward periods not spanning CPI, FOMC, and NFP releases, we use the online archives of the Wall Street Journal to identify scheduled event(s). The p-values are reported in column (5). Column (6) reports the length of each forward period in trade days. We additionally report the trade date average of raw forward premia over the forward period for the SVIX and IEP models of expected returns in columns (7) and (8), respectively. We also report multiple testing adjusted p-values using the Holm (1979) and Benjamini and Hochberg (1995) (FDR of 0.05) corrections.

(1) No.	(2) Forward Period	(3) Event(s)	(4) $\hat{\beta}$ (bp)	(5) Holm p-value	(6) BH p-value	(7) Period Length	(8) SVIX Equity Prem. (bp)	(9) IEP Equity Prem. (bp)
1	2020-11-04	Presidential Election	7.897	< 0.001	< 0.001	2	13.43	36.48
2	2023-01-12	CPI	4.981	< 0.001	< 0.001	1	6.60	17.59
3	2022-12-13	CPI	3.886	< 0.001	< 0.001	1	5.47	14.65
4	2016-11-09	Presidential Election	3.343	< 0.001	< 0.001	2	4.95	14.32
5	2023-03-22	FOMC	3.227	< 0.001	< 0.001	1	4.64	12.40
6	2020-04-03	NFP	2.927	< 0.001	< 0.001	2	20.68	59.41
7	2022-12-14	FOMC	2.731	< 0.001	< 0.001	1	4.29	11.49
8	2022-10-13	CPI	2.683	< 0.001	< 0.001	1	5.60	15.40
9	2021-01-06	Electoral College Count, Georgia Runoff	2.494	< 0.001	< 0.001	2	6.39	17.68
10	2022-11-02	FOMC	2.421	< 0.001	< 0.001	1	5.71	15.49
11	2023-02-14	CPI	2.414	< 0.001	< 0.001	1	3.51	9.38
12	2023-02-01	FOMC	2.399	< 0.001	< 0.001	1	3.67	9.76
13	2020-04-01	Covid-19	2.386	< 0.001	< 0.001	1	10.96	31.61
14	2022-11-10	CPI	2.372	< 0.001	< 0.001	1	5.72	15.41
15	2022-03-16	FOMC	2.359	< 0.001	< 0.001	2	8.01	22.35
16	2023-03-14	CPI	2.245	0.001	< 0.001	1	3.49	9.34
17	2022-07-27	FOMC	1.902	0.046	0.003	2	5.37	14.90
18	2022-09-13	CPI	1.729	0.224	0.011	1	4.06	11.28
19	2020-11-06	FOMC, NFP	1.704	0.277	0.013	2	7.78	21.35
20	2017-05-08	French Presidential Election Runoff	1.611	0.606	0.028	1	2.31	6.77
21	2023-02-03	NFP	1.583	0.758	0.034	1	2.82	7.53
22	2023-05-03	FOMC	1.527	1.000	0.050	1	2.66	7.13
23	2019-07-01	Trump-Xi G-20 Bilateral	1.522	1.000	0.050	1	2.65	7.87
24	2023-04-12	CPI	1.418	1.000	0.103	1	2.88	7.71
25	2020-04-08	Covid-19	1.416	1.000	0.103	2	20.01	56.93
26	2018-11-07	Midterm Election	1.341	1.000	0.170	2	4.52	13.41
27	2022-06-15	FOMC	1.332	1.000	0.175	2	5.25	14.61
28	2022-09-21	FOMC	1.284	1.000	0.226	2	4.50	12.47
29	2022-07-13	CPI	1.275	1.000	0.233	2	5.69	15.76
30	2023-01-06	NFP	1.144	1.000	0.522	1	2.97	7.95
31	2020-03-04	FOMC	1.133	1.000	0.537	2	3.59	10.80
32	2022-11-09	Midterm Election	1.057	1.000	0.778	1	4.48	12.06
33	2022-05-04	FOMC	1.034	1.000	0.864	2	4.00	11.19
34	2017-04-24	French Presidential Election First Round	1.015	1.000	0.937	3	3.20	9.32
35	2023-03-10	NFP	0.959	1.000	1.000	1	2.24	5.99
36	2019-07-31	FOMC	0.951	1.000	1.000	2	2.26	6.75
37	2020-10-02	NFP	0.926	1.000	1.000	2	5.72	15.49
38	2023-04-10	NFP	0.925	1.000	1.000	1	2.78	7.47

Table A7:
Equity Premia on Macroeconomic Release Dates, Oct 2016-Dec 2023

This table reports results of the following regression of abnormal equity premia per forward period on indicator variables for each of the 50 macroeconomic releases and an additional indicator variable for presidential elections.

$$A_e^{EP} \times H_e = \alpha + \Sigma_{m=1}^{M} (\gamma_m I_{m,e}) + \delta I_e^{election} + \epsilon_e$$

where A_e^{SVIX} is the average across available trade dates of $A_{t,e}^{SVIX}$, $I_{m,e} = 1$ $I_{m,t} = 1$ if macroeconomic release m occurs over forward period e and zero otherwise. $I_t^{election} = 1$ for forward periods spanning November presidential elections. H_e is the length of the forward period in trading days. Releases for which γ values are statistically significant are labeled with the release name and statistically insignificant estimates are instead labeled with their release number (listed in Appendix Table A3). Panel B reports for the estimated γ coefficient multiplied by the number of releases of release type m per year for each macroeconomic release. Robust standard errors are used.

Regressor	Coefficient	t-stat	Regressor	Coefficient	t-stat
$I_{1,e}$ (Nonfarm payroll)	0.29	3.90	$I_{26,e}$	0.07	0.90
$I_{2,e}$	0.02	0.37	$I_{27,e}$	0.03	0.47
$I_{3,e}$ (FOMC)	0.62	10.14	$I_{28,e}$	-0.06	-1.11
$I_{4,e}$ (CPI)	0.46	6.93	$I_{29,e}$	-0.16	-1.76
$I_{5,e}$	-0.02	-0.28	$I_{30,e}$	-0.07	-1.32
$I_{6,e}$	0.02	0.33	$I_{31,e}$	0.00	-0.05
$I_{7,e}$	-0.01	-0.08	$I_{32,e}$	0.01	0.17
$I_{8,e}$	-0.02	-0.29	$I_{33,e}$	0.09	1.20
$I_{9,e}$	-0.09	-1.17	$I_{34,e}$	-0.07	-0.88
$I_{10,e}$	0.03	0.56	$I_{35,e}$	-0.01	-0.12
$I_{11,e}$ (ADP Employment Change)	0.13	2.01	$I_{36,e}$	0.01	0.25
$I_{12,e}$	-0.11	-2.75	$I_{37,e}$	-0.04	-0.69
$I_{13,e}$	-0.03	-0.55	$I_{38,e}$	0.10	1.64
$I_{14,e}$	0.00	0.04	$I_{39,e}$	-0.04	-0.80
$I_{15,e}$	-0.04	-0.58	$I_{40,e}$	-0.04	-0.59
$I_{16,e}$	-0.16	-3.01	$I_{41,e}$	-0.12	-1.46
$I_{17,e}$	-0.09	-1.65	$I_{42,e}$	0.00	-0.06
$I_{18,e}$	-0.01	-0.18	$I_{43,e}$	-0.10	-1.76
$I_{19,e}$	na		$I_{44,e}$	na	
$I_{20,e}$	0.03	0.48	$I_{45,e}$	-0.20	-2.32
$I_{21,e}$	0.00	-0.05	$I_{46,e}$	0.15	1.62
$I_{22,e}$	-0.01	-0.15	$I_{47,e}$	na	
$I_{23,e}$	0.08	1.25	$I_{48,e}$	-0.01	-0.13
$I_{24,e}$	-0.03	-0.50	$I_{49,e}$	-0.10	-1.26
$I_{25,e}$	0.01	0.21	$I_{50,e}$	0.02	0.43
			$I_e^{election}$	3.58	17.64
			Constant	0.05	1.97
			N	1,199	
			R^2	0.32	

E. Additional Results on the Cross-section of Macroeconomic Releases

Figure A3 reports a univariate version of Figure 4 in which we include only one macroeconomic release at a time when explaining realized excess stock returns. Similarly, Figure A4 reports a univariate version of Figure 5 in which we include only one macroeconomic release at a time when explaining the equity premium.

Figure A3: Excess Stock Returns on Macroeconomic Release Dates

This figure is based on regressions of realized excess stock returns on one of the 50 macroeconomic releases and an additional indicator variable for elections

$$r_t^{stock} - r_t^f = \alpha + \gamma_m I_{m,t} + \delta I_t^{election} + \epsilon_t.$$

A separate regression is estimated for each macroeconomic release m. Excess stock returns are from Ken French's data library. $I_{m,t} = 1$ if there is a release of macroeconomic release m occurring on day t and $I_t^{election} = 1$ on the day following November presidential election dates. The regression is estimated on daily data from October 31, 1996, to December 31, 2023. The figure reports the estimated γ coefficients, with statistically significant releases labeled with the release name and statistically insignificant releases are labeled with their release number (listed in Appendix Table A3). Robust standard errors are used.

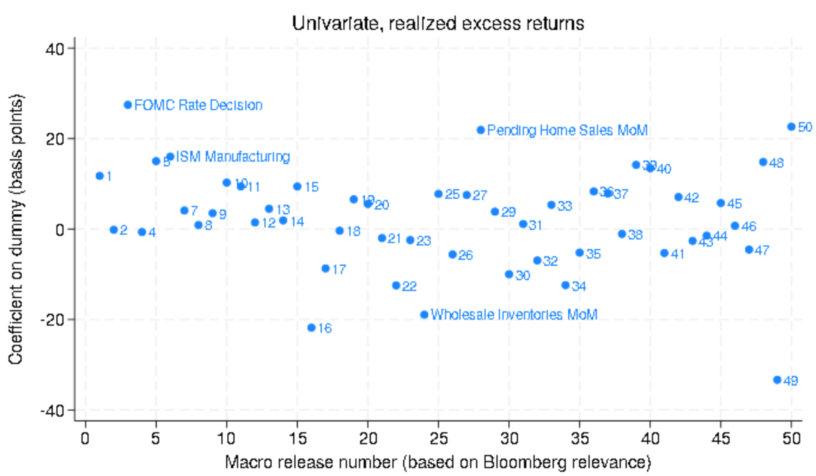


Figure A4: Equity Premia on Macroeconomic Release Dates

The figure is based on a regression of abnormal equity premia per forward period on indicator variables for one of the 50 macroeconomic releases and an additional indicator variable for elections

$$A_e^{SVIX} \times H_e = \alpha + \gamma_m I_{m,e} + \delta I_e^{election} + \epsilon_e.$$

A separate regression is estimated for each macroeconomic release m. A_e^{SVIX} is the average across trade dates of $A_{t,e}^{SVIX}$, $I_{m,t} = 1$ if there is a release of macroeconomic release m over forward period e and $I_t^{election} = 1$ if there is a presidential election over forward period e. Robust standard errors are used. Releases for which γ values are statistically significant are labelled with the release name and statistically insignificant estimates are labelled with their release number (listed in Appendix Table A3). Robust standard errors are used.

Additional abnormal equity premium per release, EP measured by SVIX