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The Price of Macroeconomic Uncertainty: Evidence from Daily Option Expirations*

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ABSTRACT

Using recently available daily S&P 500 index option expirations, we examine the *ex ante* pricing of uncertainty surrounding key economic releases and the determinants of risk premia associated with these releases. The cost of insurance against price, variance, and downside risk is higher for options that span U.S. CPI, FOMC, Nonfarm Payroll, and GDP releases compared to neighboring expirations. We calculate release-driven forward equity and variance risk premia and find that premia vary considerably across economic releases and increase with risk aversion as well as with monetary policy and real economic uncertainty. The empirical framework presented in this paper can be used to examine the ex ante pricing of a wide variety of events.

JEL classification: E44, G1, G12,

Keywords: Variance Risk, Uncertainty, Risk Premium, Macroeconomic Releases, FOMC, Inflation, Tail Risk

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I. Introduction

Uncertainty about macroeconomic fundamentals has broad implications for both real and financial outcomes (see Cascaldi-Garcia et al. (2021) for a review of the literature), and economic policymakers are dependent on incoming data when determining a path of policy.[1] The extent to which uncertainty about economic announcements is reflected in financial markets has been largely debated in the literature. While this literature has extensively examined reactions of financial markets to macroeconomic releases (see Ederington and Lee (1993); Fleming and Remolona (1999); Andersen, Bollerslev, Diebold, and Vega (2003); and Beber and Brandt (2006); among others), this paper uses recently available daily equity option expirations on the S&P 500 index to examine the *ex ante* pricing of the uncertainty of releases and the risk premia associated with them. To do so, we compare option-implied measures and option trading volumes for expirations that span key U.S. macroeconomic releases to those of neighboring options, and we explore how the desire to hedge macroeconomic releases is reflected in equity and variance risk premia.

Cboe introduced weekly option expirations on the S&P 500 index in 2005 (see Andersen, Fusari, and Todorov (2017) for discussion) and added expirations for every trading day in 2022. Trading in short-dated option expirations comprised approximately 46 percent of total options activity in 2021.[2] This rich expiration grid provides insurance against risks associated with any given release, presenting a unique opportunity to

[1]See speeches by the Federal Reserve Board's Chairman Jerome Powell on October 8, 2019, "Data-Dependent Monetary Policy in an Evolving Economy," and by Federal Reserve Board's Governor Christopher Waller on September 12, 2022, "The economic outlook - time to let the data do the talking."

[2]See "Cboe Plans to List SPX Tuesday, Thursday-Expiring Weeklys Options."

examine to what extent these risks are priced in the options market.

We first employ an empirical strategy which compares option-implied measures for the daily expirations that span U.S. CPI, GDP, FOMC, and Nonfarm Payrolls releases to those of neighboring expirations that do not. Over the weeks preceding a release week, the cost of insurance against price, variance, and downside tail risk is higher for option expirations spanning releases. At-the-money (ATM) options spanning releases are up to 7.5% more expensive than neighboring control expirations. Delta 10 puts are significantly more expensive than delta 10 calls for options spanning releases, with a difference of up to 6.4% with respect to control expirations. Variance risk premia for options spanning FOMC releases are 44% larger than for control options. Moreover, trading volumes for options that span economic releases are significantly higher than volumes for control options, indicating that the desire to hedge uncertainty related to these events is reflected in both option prices and trade quantities.

To examine how the cost of insurance for these releases translates to risk premia, we exploit the expiration grid to construct forward equity risk premia (Gao and Martin (2021) and Gandhi, Gormsen, and Lazarus (2022)) and variance risk premia (Carr and Wu (2009), Bollerslev, Tauchen, and Zhou (2009), and Todorov (2010)) associated with each economic release. We observe significant time-series variation in the risk premia associated with these releases. For example, forward equity risk premia for U.S. CPI releases range from a minimum of 54 basis points (annualized) for the release on May 12, 2017, to a significant 12.2% for the January 12, 2023, release during the current inflationary period. More generally, risk premia associated with these releases are larger during periods of heightened risk aversion (Bekaert, Engstrom, and Xu (2022)), real economic uncertainty (Jurado, Ludvigson, and Ng (2015)), and monetary policy uncertainty (Baker, Bloom, and Davis (2016)). Equity and variance risk premia associated with CPI and FOMC announcements are more closely related to the inflation component of economic uncertainty than to its labor or output components in our sample, while premia associated with GDP and nonfarm payrolls are more closely related to the labor component of economic uncertainty.

Our results for the significantly higher cost of insurance associated with options that span key economic releases and for the dynamics of risk premia associated with these releases remain robust to a variety of specifications. Our results remain robust to considering alternative windows around economic releases, option-implied measures, and economic uncertainty measures. Our results also remain robust when we consider all option expirations or remove option expirations that span more than one release. Moreover, when we consider a larger set of economic releases, our results confirm that the key economic releases considered are those where investors' desire to hedge risk is most concentrated.

These results relate to the implications of extant conceptual frameworks connecting asset prices, releases or events, and uncertainty. Ai and Bansal (2018) provide a general framework for the set of preferences that yields event risk premia. The model in Pástor and Veronesi (2013) and Kelly, Pástor, and Veronesi (2016) yields a positive price of risk of political uncertainty, as government policies, which are uncertain to the eyes of investors, affect firm profitability and, therefore, the evolution of the economy. Shaliastovich (2015) reconciles the desire to hedge rare and infrequent events reflected in derivative prices with the observed dynamics of macroeconomic fundamentals. In this model, investors' uncertainty comes in the form of confidence about the evolution of the economy that is subject to jumps. The model in Wachter and Zhu (2022) allows investors to learn about regime shifts on announcement days and is consistent with the evidence that the equity premium is higher on macroeconomic announcement days and that option-implied volatility declines following these announcements. The model in Piazzesi (2005) focuses on FOMC announcements assuming that the Fed's target rate follows a jump process. Finally, the empirical model in Londono and Xu (2023) disentangles the role of risk aversion and macroeconomic uncertainty in explaining equity risk premia.

Our work is related to the broad literature examining implications of macroeconomic and policy uncertainty. A branch of this literature focuses on the dynamic relation between uncertainty and financial or macroeconomic outcomes (Bloom (2009); Jurado et al. (2015); Baker et al. (2016); Berger, Dew-Becker, and Giglio (2020); Dew-Becker, Gilgio, and Kelly (2021); and Ludvigson, Ma, and Ng (2021); among others). The recent availability of daily option expirations helps us isolate the ex ante price of uncertainty associated with macroeconomic releases.

Our paper is also related to a recent literature that examines option prices surrounding other events. Kelly et al. (2016) use a global panel of options surrounding relatively infrequent political elections and summits to estimate the price of political uncertainty. Liu, Tang, and Zhou (2022) use a two-state, two-period model with jumps in order to estimate the risk premia associated with FOMC announcements, implementing a machine learning algorithm to impute additional expirations on the expiration grid. Wright (2020) uses weekly options to estimate variance risk premium on the eve of FOMC and employment releases. More generally, Andersen et al. (2017) motivate the use of weekly expiration options to understand market participants' pricing of diffusive and jump risks. Our paper builds on this literature by exploiting the rich expiration grid of daily options and implied term structure of equity and variance risk premia to isolate the ex ante price of risk associated with a set of key macroeconomic releases one week before a given release. Importantly, the empirical framework presented in this paper can provide ex ante pricing associated with any given trading day by using observable option prices over the preceding weeks.

This paper proceeds as follows: Section II describes the data and construction of cost of insurance measures; Section III discusses whether cost of insurance increases for expirations that span economic releases; Section IV investigates the time variation in release-driven forward equity and variance risk premia; and Section V concludes.

II. Data

Our sample period covers option expirations and macroeconomic releases from January 2017 through May 2023. Macroeconomic release dates are identified using the Bloomberg U.S. Economic Calendar. In our main analysis, we examine announcements related to employment (change in Nonfarm Payrolls), inflation (CPI), output (advance estimate of GDP), and the monetary policy rate (FOMC), which frequently appear in the literature as key announcements for financial markets, (see, for instance, Savor and Wilson (2013); Flannery and Protopapadakis (2002); Lucca and Moench (2015); Chan and Gray (2018); and Gardner, Scotti, and Vega (2022)).[3] We provide details regarding the set of macroeconomic releases in Table 1.

[Insert Table 1 here]

CPI and Nonfarm Payrolls are announced monthly at 8:30 am based on the schedule

[3]In Section IV.C, we extend the analysis to a larger set of releases.

of releases provided by the Bureau of Labor Statistics. The advanced estimate of GDP is announced every quarter at 8:30 am on the dates in the schedule of releases provided by the Bureau of Economic Analysis. FOMC monetary policy rates are announced right after each of the 8 routine FOMC meetings each year.

Options data are obtained from Optionmetrics. We apply an initial set of filters from Andersen et al. (2017). For each expiration, we require at least 10 distinct strike prices. We restrict moneyness to be greater than or equal to -15 and less than or equal to 5. Moneyness is defined as $\frac{ln(\frac{K}{P_t})}{\sqrt{T}\times\sigma_{ATM}}$, where K is the option's strike price, P_t is the price of the S&P 500 index on trade date t, T is the time to expiration in years, and σ_{ATM} is the option-implied volatility for options with $0.40 <= |\Delta| <= 0.60$, where Δ is the option's reported delta. We further require the ratio of the option's best bid and best offer to be less than 5 and greater than 0. On each trade date, we remove quotes for out-of-the-money puts and calls at each end of the moneyness spectrum until the extreme quote midpoint is smaller than all other quote midpoints positioned closer to the ATM strike. In addition, we examine option expirations with 7 to 21 calendar days to expiration ($7 \leq T_{caldays} \leq 21$). Cboe only offered Monday, Wednesday, and Friday expirations prior to May 2022.[4] We don't consider releases for which the gap between neighboring options is larger than 2 trading days. These initial filters leave us with 3,375,792 option-day observations across all strikes and 1,119 unique option expirations in the full expiration-trading day sample.

We examine the following option-implied measures to approximate the cost of hedging against price changes, downside tail risk, and variance risk, respectively: implied

[4] In Section IV.C, we show that results are qualitatively similar when we restrict attention to the more recent period with five expirations per week. Moreover, results are also qualitatively similar when we use three expirations per week throughout the entire sample.

volatility, risk reversal, and variance risk premium. Each measure is described below.

Implied Volatility ($IV_{t,T,k}$), as reported by Optionmetrics, is used for ATM options with $0.40 <= |\Delta| <= 0.60$, resulting in multiple observations per expiration-trading day. Optionmetrics computes implied volatilities using a proprietary pricing algorithm based on the Cox, Ross, and Rubinstein (1979) model. The estimates for IV reflect the cost of insurance against the price risk associated with an event.

Risk Reversal ($RR_{t,T}$) is defined as the difference in implied volatilities between put options with a delta of -0.10 and call options with a delta of 0.10, resulting in one observation per expiration-trading day. We obtain these implied volatilities by linearly interpolating between adjacent options on the strike grid. RR reflects the cost of insurance against crash or downside tail risk; that is, how much investors are willing to pay to hedge the risk against a large drop in the price of the S&P 500 in excess of how much they pay to hedge the risk of a price increase (Brunnermeier, Nagel, and Pedersen (2008)).

Variance Risk Premium ($VRP_{t,T,k}$) is computed as the difference between implied variances of ATM options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration (Bollerslev et al. (2009)), resulting in multiple observations per expiration-trading day. To compute realized variances, we obtain tick data for the S&P 500 (SPX) from Refinitiv Tick History after applying corrections and cancellations. We then augment these data with market opening and closing prices for the S&P 500. Liu, Patton, and Sheppard (2015) provide support for the use of the trade-based 5-minute realized variance as an estimator of the quadratic variation of equity indexes. The estimates for VRP reflect the cost of insurance against increases in volatility associated with an event.

Table 2 presents descriptive summary statistics for all expirations in our sample for implied volatility, risk reversal, and variance risk premium, as well as for forward release-driven equity and variance risk premia, which we describe in more detail in Section IV. The cost of insurance against price, downside tail, and variance risk displays considerable time variation during the sample period considered. Option-implied measures display significant time variation. The time series average of implied volatility is 20.53%, with a standard deviation of 11.07%; the average risk reversal is 9.32% with a standard deviation of 5.66%; and the average variance risk premium is 1.79% with a standard deviation of 3.90%.

[Insert Table 2 here]

III. The desire to hedge macroeconomic releases

We first employ an empirical strategy conceptually similar to that of Kelly et al. (2016), comparing option-implied measures for treatment options with expirations that span the release day to preceding control option expirations that expire before a given release day. To account for the term structure of implied volatility, we compute option-implied measures for treatment and control options with 7 to 21 calendar days to expiration ($7 \leq T_{caldays} \leq 21$).[5]

[5]Beber and Brandt (2006) and Kelly et al. (2016) exclude options with less than a week to expiration due to implied volatilities being inaccurate at these horizons. Furthermore, Bryzgalova, Pavlova, and Sikorskaya (2022) estimate that over 50% of retail option trading activity takes place in options with less than a week to expiration. In Section IV.C, we show that results are qualitatively similar when we vary the estimation window to 1 and 3 weeks; $7 \leq T_{caldays} \leq 14$ and $7 \leq T_{caldays} \leq 28$, respectively.

III.A. Are investors willing to pay more to hedge economic releases?

We examine to what extent risks are priced for a given release. Specifically, we estimate the following regressions for release event i, trading day t, and option expiration T separately for each release type:

$$y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}, \tag{1}$$

where $y_{i,t,T}$ is the option-implied measure being considered, α_i denote release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. Standard errors are clustered by release date. Results are presented in Table 3.

[Insert Table 3]

The estimates for the coefficients associated with $Treat$ indicate that the cost of insurance against price, downside tail, and variance risk for options that span releases are generally statistically higher than those of neighboring option expirations. Implied volatilities of treated options are between 44 basis points (GDP) and 134 basis points (FOMC) larger than control options, which represents an increase between 2.5% (GDP) and 7.5% (FOMC) with respect to the implied volatilities for control options. The difference between the implied volatilities of delta 10 puts and delta 10 calls is up to 58 basis points larger (Nonfarm Payrolls) for options spanning releases, a 6.3% increase with respect to control options. Variance risk premia for are up to 63 basis points larger (FOMC), a 44% increase from control options. These results indicate that price, tail, and variance risks are priced for key economic releases.

III.B. Is the desire to hedge releases reflected in trade quantities?

To examine whether the desire to hedge uncertainty on release days is reflected in trade quantities, Figure 1 presents the average contract trading volume for treatment (blue series) and control options (red series) over the event days leading up to each release type.

[Insert Figure 1 here]

For our sample of economic releases, expirations spanning CPI, Nonfarm Payrolls, and GDP releases are more actively traded than neighboring control options, with trading activity in treatment options increasing substantially when options have two weeks to expiration. Interestingly, trading in option expirations spanning FOMC releases is generally lower than for expirations spanning other key releases. These results suggest that daily option expirations are, indeed, being actively used by investors to hedge risks associated with releases.

Nevertheless, for both control and treatment options, trading volumes are considerably high. The average trading volume across release types in control options for these event days is 170,160 contracts, which should reduce concerns about potential liquidity issues when comparing option-implied measures between control and treatment options.

Option open interest provides an alternative measure of the desire to hedge releases, as all trading may not reflect the opening of new option contracts in a zero net supply market. In Appendix Figure A1, we confirm that open interest in options spanning releases is larger than for preceding option expirations. Similarly to results for trading volume, open interest in options spanning FOMC releases are statistically indistinguishable from control options.

IV. Release-driven Risk Premia

To examine how the cost of insurance for these releases translates to risk premia, we construct a novel series of forward equity risk premia (Gao and Martin (2021) and Gandhi et al. (2022)) and variance risk premia (Carr and Wu (2009), Bollerslev et al. (2009), and Todorov (2010)) for each expiration using options surrounding economic releases with 7 to 21 calendar days to expiration ($7 \leq T_{caldays} \leq 21$). We also investigate the fundamental determinants of variations in forward risk premia across releases.

IV.A. Forward expected return and variance risk premia

We calculate measures of forward returns and variance risk premia for each release as follows:

Forward Expected Return ($\mathcal{F}^{ERP}_{t,n:m}$) over horizon $n : m$, which corresponds to the daily option expirations surrounding a given release, is obtained by applying the approach of Gandhi et al. (2022) to our sample of daily option expirations. Specifically, we compute a forward analog of the equity risk premium using the Gao and Martin (2021) LVIX ($\mathcal{L}_{t,T_n}$) defined as:

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

where P_t is the price of the S&P 500 index on trade date t, $p_{t,T_n}(K)$ ($c_{t,T_n}(K)$) 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 expiration-trading day. We numerically integrate across options using the approach of Martin (2017), among others. As discussed in these papers, in the case of an unconstrained investor with log utility over terminal wealth who is fully invested in the stock market, the LVIX reflects expected returns. Without log utility, the LVIX provides a lower bound on expected returns assuming that $\text{cov}_t(M_{t,t+n+m}R_{t,t+n+m}, r_{t,t+m+n}) \leq \text{cov}_t(M_{t,t+n}R_{t,t+n}, r_{t,t+n})$, where r is the log return of the market portfolio.

Forward Variance Risk Premium ($\mathcal{F}^{VRP}_{t,(n:m)}$), is calculated as the difference between forward implied variance over horizon $(n : m)$ and the expected realized variance over the same horizon, which corresponds to the daily option expirations surrounding a given release. Forward implied variance is defined as:

$$\mathcal{F}^{\sigma^2}_{t,(n:m)} = \frac{T_{n+m}\sigma^2_{t,T_{n+m}} - T_n\sigma^2_{t,T_n}}{T_{n+m} - T_m}, \tag{3}$$

where T is the time to expiration in years and σ^2 is the average implied variance of ATM options on trade date t, which as for the equity risk premium also results in one observation per expiration-trading day. We approximate the expected realized variance as a trailing average of daily realized variance with window length corresponding to the length of the forward horizon $(n : m)$.

Table 2 shows summary statistics for the forward risk premia across all expiration-trading days, and risk premia averaged across trading days for each individual release event are presented in Figures 2 and 3 for equity and variance risk premia, respectively. The average annualized forward daily expected equity risk premium is 2.4%, and the average annualized forward daily variance risk premium is 1.4%. However, as reflected in their standard deviations, and as can be seen from the figures, there is significant time-series variation in these premia, with premia reaching significantly elevated levels during the onset of the COVID-19 pandemic during 2020 and during the 2022 and 2023 inflationary period. Importantly, release premia for all announcements have increased substantially starting in 2022 without a commensurate increase in market volatility, perhaps as economic policymakers have communicated "data-dependence," relying on incoming economic data when making monetary policy decisions. In the case of U.S. CPI (red circles), release equity premia range from an annualized 54 basis points (May 12, 2017) to a significant 12.2% (January 12, 2023) during the current inflationary period, while variance premia range between -4% (March 11, 2020) to 21.9% (January 12, 2023). While the literature refers to Nonfarm Payrolls as the "King" of macroeconomic releases, CPI releases are associated with larger risk premia later in our sample.

[Insert Figure 2 here]

[Insert Figure 3 here]

IV.B. Forward risk premia and uncertainty

We examine the determinants of the variations in risk premia across economic releases. In particular, we explore whether release premia are higher during periods of heightened risk aversion, real economic uncertainty, and monetary policy uncertainty. Risk aversion (RA) is measured using the estimate in Bekaert et al. (2022), which uses an asset pricing model with nonlinearities to incorporate higher-order moment information from a wide range of financial and risk variables. To measure real economic uncertainty and its labor, ourput, and inflation components, we use the Jurado et al. (2015) real activity uncertainty index (RU). RU is calculated as the average of the volatility of the onemonth forecast error of a set of real economic indicators. Finally, to measure monetary policy uncertainty, we use the Baker et al. (2016) monetary policy uncertainty (MPU) index. This index represents a scaled frequency count of newspaper articles containing terms related to U.S. monetary policy and uncertainty.

We estimate regressions similar to Liu et al. (2022) at the expiration-trading day-release event level of observation separately for each release, risk premium, and either uncertainty or risk aversion, as follows:

$$y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}, \tag{4}$$

where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a measure of risk aversion or uncertainty (RU, RA, or MPU). We scale RA, RU, and MPU by their respective full sample standard deviations to facilitate interpretations. These covariates are adjusted in order to ensure that they are ex ante; that is, all the information used to calculate each risk aversion or uncertainty measure is available at the same time as the estimation date of forward risk premia. These measures of risk aversion and uncertainty are correlated over our sample period, with pairwise correlations ranging from 0.44 to 0.63. Regressions are estimated using available covariate data, and standard errors are clustered by option expiration. Results are presented in Table 4.

[Insert Table 4 here]

Each column corresponds to a different regression specification. The estimates indicate that release premia are significantly larger during periods of heightened risk aversion and real economic and monetary policy uncertainty. In particular, a one standard deviation increase in RU is associated with up to a 80 basis point (GDP) increase in annualized forward equity premia and up to a 93 basis point (GDP) increase in forward variance risk premia. A one standard deviation increase in RA is associated with up to a 288 basis point (Nonfarm Payrolls) increase in forward risk premia and up to a 333 basis point (FOMC) increase in forward variance risk premia. Unsurprisingly, MPU coefficients are larger for FOMC releases: A one standard deviation increase in MPU is associated with a 172 basis point increase in forward FOMC risk premia and a 260 basis point increase in forward FOMC variance risk premia.

We disentangle the inflation, labor, and output components of RU to explore up to what extent risk premia associated with each announcement type are related to specific sources of uncertainty. The RU components are calculated using subsets of economic indicators related to each uncertainty component and are obtained from Londono, Ma, and Wilson (2021). The results for the positive and significant relation between RU and equity and variance risk premia documented in Table 4 hold for the RU components in almost all cases. Interestingly, however, as the estimated coefficients and R-squareds suggest, risk premia associated with CPI and FOMC announcements are more closely related to inflation uncertainty than to labor or output uncertainty. For instance, a one-standard deviation increase in inflation RU is associated with a 146 basis point increase in CPI forward risk premia, compared to 43 basis points for total RU and 101 and 37 basis points for labor and output RU, respectively. In contrast, premia associated with GDP and nonfarm payrolls are more closely related to labor RU.

[Insert Table 5 here]

IV.C. Additional Tests

We perform a a set of additional tests to assess the robustness of our results for cost of insurances and risk premia. For brevity, these results are relegated to the appendix.

We first examine whether our main results are robust to different estimation windows. Results are qualitatively similar when we vary the window over which option-implied measures are computed to ($7 \leq T_{caldays} \leq 14$) and ($7 \leq T_{caldays} \leq 28$), instead of the benchmark ($7 \leq T_{caldays} \leq 21$) window. Results for the cost of insurance and risk premia, respectively, are available in Appendix Tables A1, A2, and A3 for the one-week window and in Tables A4, A5, and A6 for the three-week window.

We then explore whether our main results extend to other related option-implied measures in the literature. Results are qualitatively similar when we consider the implied volatility slope of Kelly et al. (2016) as an alternative measure of tail risk. This slope measures the steepness of the function that relates implied volatility to the option's delta. Results are also qualitatively similar when risk reversals are constructed using delta 25 calls and puts. These results are available in Appendix Table A7.

We also examine whether release risk premia are higher when an alternative measure of real economic uncertainty is used. Results available in Appendix Table A8 are qualitatively similar when we use the Scotti (2016) uncertainty index. This index uses a dynamic factor model to compute weights for the averaging of squared release surprises.

While overlap between our sample of releases is minimal, we reconsider our main results after removing a small set of expirations that are the closest spanning options for more than one release in our sample. Results are qualitatively similar when using this approach and are available in Appendix Table A9 for costs of insurance and Tables

A10 and A11 for risk premia.

We examine to what extent moving from 3 expirations per week to 5 expirations per week affects our results. Results are qualitatively similar when we restrict attention to the most recent period where 5 expirations per week are available. Results are also qualitatively similar when we consider three expirations per week throughout the entire sample (that is, ignoring Tuesday and Thursday expiration options). Results for the cost of insurance are available in Appendix Table A12 and Appendix Table A13 for the period with five expirations per week and using three expirations per week, respectively. Results for risk premia for the sample with three expirations per week are available in Appendix Table A14 and A15.

In addition to comparing option-implied measures for neighboring options, we examine whether the forward risk premia for releases are larger than all other option expirations in our sample. Using a regression specification with trading day fixed effects to account for the level of risk premia in the equity term structure, and first expiration day of the week fixed effects to account for seasonality in the full series of risk premia, we find that our estimates of release risk premia are indeed larger on CPI, FOMC, and Nonfarm Payrolls release days. Estimates for GDP releases become statistically insignificant. Results are available in Appendix Table A16.

Finally, we expand our analysis to 27 additional U.S. preliminary and final economic releases, including releases related to output, prices, confidence, sentiment, and trade. When considering release events that aren't spanned by the same expirations as for the key U.S. CPI, FOMC, advance GDP, and Nonfarm Payrolls releases, we find that the cost of insurance against price, tail, and variance risk are somewhat larger options that span other employment and inflation releases, including the ADP Employment, Initial Jobless

Claims, ISM Manufacturing, and Markit Manufacturing PMI's, though most of these estimates are marginally statistically significant. The majority of additional releases that we examine are not priced in our sample. Results are available in Appendix Table A17. Our evidence then suggests that U.S. CPI, FOMC, advance GDP, and Nonfarm Payrolls are the releases where investors' desire to hedge risk is concentrated.

V. Conclusion

The recent availability of daily option expirations provides a unique opportunity to understand up to what point investors are willing to pay to hedge the risk associated with macroeconomic releases. Our evidence suggest that the price to hedge S&P 500 index price changes, large downside movements, and variance risk is significantly higher for options that span macroeconomic releases related to inflation, production, employment, and monetary policy rates, with respect to control options that do not span these releases. Options spanning releases are not only more expensive, but also more actively traded than neighboring control options, which suggests that the desire to hedge these releases is reflected in both quantities and prices. Our evidence confirms that investors price macroeconomic uncertainty associated with releases. Not all economic releases are the same and some should elicit a higher risk premium. Accordingly, we calculate forward return and variance risk premia associated with each economic release and explore the determinants of the variation in premia across releases. While the literature refers to Nonfarm Payrolls as the "King" of macroeconomic releases, CPI releases are associated with larger risk premia during 2022, as policy makers have communicated dependence on incoming economic data. We find that both return and variance risk premia increase in episodes of heightened macroeconomic and monetary policy uncertainty. Although we have centered attention on U.S. macroeconomic releases, the empirical framework proposed in this paper can be used to examine the ex ante pricing of risk associated with a wide variety of domestic and international events.

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Table 1:
Releases

This table details the sample of releases examined. CPI denotes scheduled releases of the Consumer Price Index. FOMC denotes monetary policy decisions made at scheduled meetings of the Federal Open Market Committee. GDP denotes the scheduled releases of advanced estimates of Gross Domestic Product. Nonfarm Payrolls denotes scheduled releases of the change in total Nonfarm Payroll employment.

Release Type	Release Time	Frequency	#Releases
CPI	8:30 AM	Monthly	75
FOMC	Post meeting	8/year	51
GDP (Advance)	8:30 AM	Quarterly	26
Nonfarm Payrolls	8:30 AM	Monthly	74

Table 2:
Outcome variables, summary statistics

This table presents descriptive statistics of the outcome variables across all expirations. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and a delta 10 call, $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration, $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. Variables are reported in percentage points. We report the mean, median, standard deviation (Std. Dev.) and the 25th and 75th percentiles (Pct.).

Outcome	#Observations	Mean	Median	Std. Dev.	25th Pct.	75th Pct.
$IV_{t,T,k}$	250,216	20.53	18.71	11.07	13.76	24.81
$RR_{t,T}$	11,684	9.32	8.06	5.66	5.97	11.16
$VRP_{t,T,k}$	250,216	1.79	1.27	3.90	0.47	2.56
$\mathcal{F}^{ERP}_{t,(n:m)}$	11,693	2.39	1.62	2.96	0.83	2.90
$\mathcal{F}^{VRP}_{t,(n:m)}$	11,693	1.41	1.05	4.56	0.27	2.34

Table 3:
Cost of hedging release price, downside tail, and variance risk

This table presents results for regressions comparing option-implied measures for treatment options spanning economic releases to neighboring expirations over the weeks leading up to a release week. Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type, as follows:

$$y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T},$$

where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denotes release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI			FOMC		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
Treat	0.71***	0.39***	0.20***	1.34***	0.55***	0.63***
t-statistic	(4.40)	(4.99)	(3.02)	(6.08)	(4.80)	(4.30)
Adj. R^2	0.79	0.66	0.49	0.84	0.77	0.48
Release FE	Y	Y	Y	Y	Y	Y
Observations	30,945	1,539	30,945	20,765	1,047	20,765
	GDP			Nonfarm Payrolls		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
Treat	0.44**	0.23**	0.45*	0.89***	0.58***	0.29**
t-statistic	(2.16)	(2.40)	(1.92)	(3.81)	(5.01)	(2.09)
Adj. R^2	0.90	0.80	0.28	0.90	0.80	0.28
Release FE	Y	Y	Y	Y	Y	Y
Observations	10,316	543	10,316	31,442	1,542	31,442

Table 4:
Determinants of release risk premia

This table presents results for regressions at the expiration-trading day-release event level of observation separately for each release, risk premium, risk aversion, and uncertainty type. The regression setting is the following:

$$y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T},$$

where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a measure of uncertainty or risk aversion (RU, RA, or MPU). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. RU is the Jurado et al. (2015) real uncertainty index. RA is the Bekaert et al. (2022) risk aversion index. MPU is the Baker et al. (2016) monetary policy uncertainty index. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	2.57***	-6.25***	0.82***	2.77***	-7.98***	0.76*	1.35***	-7.23***	-0.03	2.17***	-9.49**	1.37**
	(8.21)	(-4.72)	(2.65)	(6.99)	(-5.06)	(1.81)	(4.61)	(-15.72)	(-0.05)	(8.39)	(-2.15)	(2.54)
RU	0.43***			0.56***			0.80***			0.73***		
	(4.68)			(2.75)			(3.07)			(2.85)		
RA		2.15***			2.62***			2.20***			2.88***	
		(6.74)			(7.00)			(25.17)			(2.71)	
MPU			1.45***			1.72***			1.43***			1.14***
			(5.79)			(5.44)			(2.92)			(4.38)
Adj. R^2	0.13	0.37	0.32	0.19	0.55	0.39	0.56	0.85	0.49	0.19	0.37	0.09
Observations	774	777	774	533	533	533	270	270	270	778	778	778

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	2.55***	-7.03***	-0.54	3.28***	-10.51***	-0.13	1.20***	-8.74***	-0.56	1.89***	-3.43	0.02
	(5)	(-2.69)	(-1.29)	(5.35)	(-3.9)	(-0.26)	(3.73)	(-13.63)	(-0.77)	(7.14)	(-1.14)	(0.04)
RU	0.4***			0.6**			0.93***			0.5***		
	(3.28)			(2.4)			(2.86)			(3.2)		
RA		2.31***			3.33***			2.55***			1.37*	
		(3.57)			(5.11)			(16.54)			(1.89)	
MPU			2.25***			2.6***			1.74***			1.59***
			(5.26)			(5.99)			(3.24)			(5.56)
Adj. R^2	0.04	0.16	0.30	0.10	0.40	0.41	0.54	0.82	0.53	0.07	0.07	0.15
Observations	774	777	777	533	533	533	270	270	270	778	778	778

Table 5:
Components of real uncertainty

This table presents results for regressions at the expiration-trading day-release event level of observation separately for each release, risk premium, and component of real uncertainty: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a component of real uncertainty (inflation, labor, or output). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. The real uncertainty components are calculated using the methodology in Jurado et al. (2015) with a subset of economic variables related to inflation, labor, and output, and were provided by Londono et al. (2021). Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.4***	2.31***	3.05***	1.44***	2.48***	3.41***	0.95***	1.17***	2.13***	1.53***	1.75***	2.84***
	(8.48)	(8.16)	(9.59)	(8.25)	(6.67)	(8.47)	(4.08)	(3.61)	(6.86)	(6.26)	(7.45)	(8.43)
Inflation	1.46***			1.72***			1.24***			1.31***		
	(6.69)			(5.99)			(3.06)			(5.28)		
Labor		1.01***			1.28***			1.47***			1.64***	
		(6.74)			(4.48)			(3.81)			(3.27)	
Output			0.37**			0.48			1.04**			0.9***
			(2.02)			(1.6)			(2.01)			(2.67)
Adj. R^2	0.33	0.16	0.03	0.42	0.23	0.05	0.35	0.56	0.33	0.13	0.20	0.09
Observations	796	796	796	533	533	533	270	270	270	811	811	811

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.75***	2.27***	2.87***	1.26***	2.82***	4.01***	0.76***	0.94***	2.1***	0.96***	1.54***	2.33***
	(5.14)	(4.97)	(5.39)	(6.84)	(5.13)	(6.5)	(3.42)	(2.81)	(6.26)	(7.11)	(6.67)	(7.9)
Inflation	1.74***			2.32***			1.41***			1.27***		
	(4.72)			(5.49)			(3.02)			(5.58)		
Labor		0.71			1.54***			1.76***			1.15***	
		(1.48)			(4.04)			(3.87)			(3.69)	
Output			-0.01			0.31			1.2*			0.56**
			(-0.04)			(0.79)			(1.91)			(2.18)
Adj. R^2	0.13	0.02	0.00	0.35	0.15	0.01	0.33	0.58	0.32	0.11	0.09	0.03
Observations	796	796	796	533	533	533	270	270	270	811	811	811

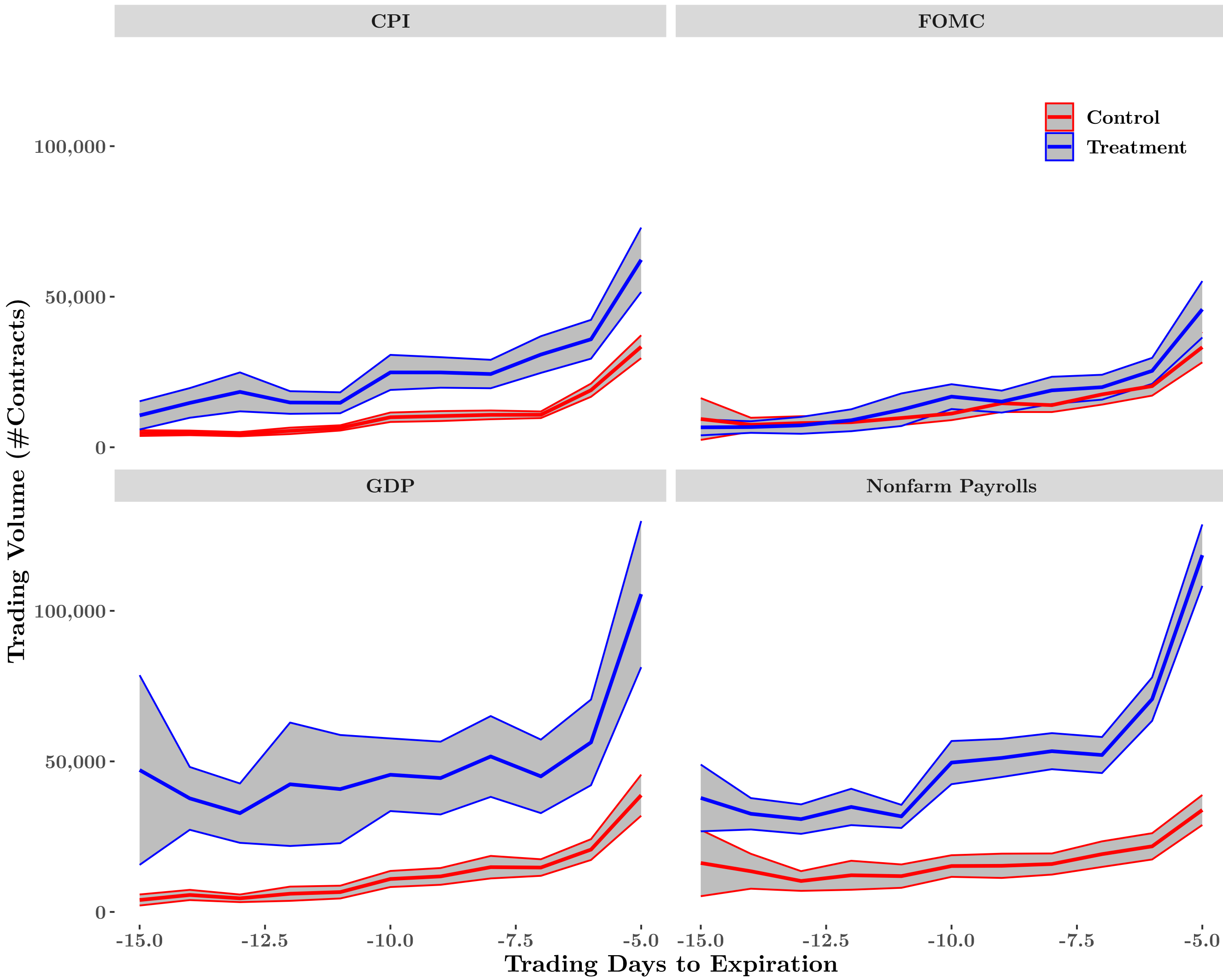

Figure 1: Trading Activity in Options Spanning Releases This figure compares average daily contract trading volumes for options that span a given release (blue series) to a neighboring option expiration which does not (red series) in the event days leading up to each options expiration date. 95% confidence intervals are shaded in gray.

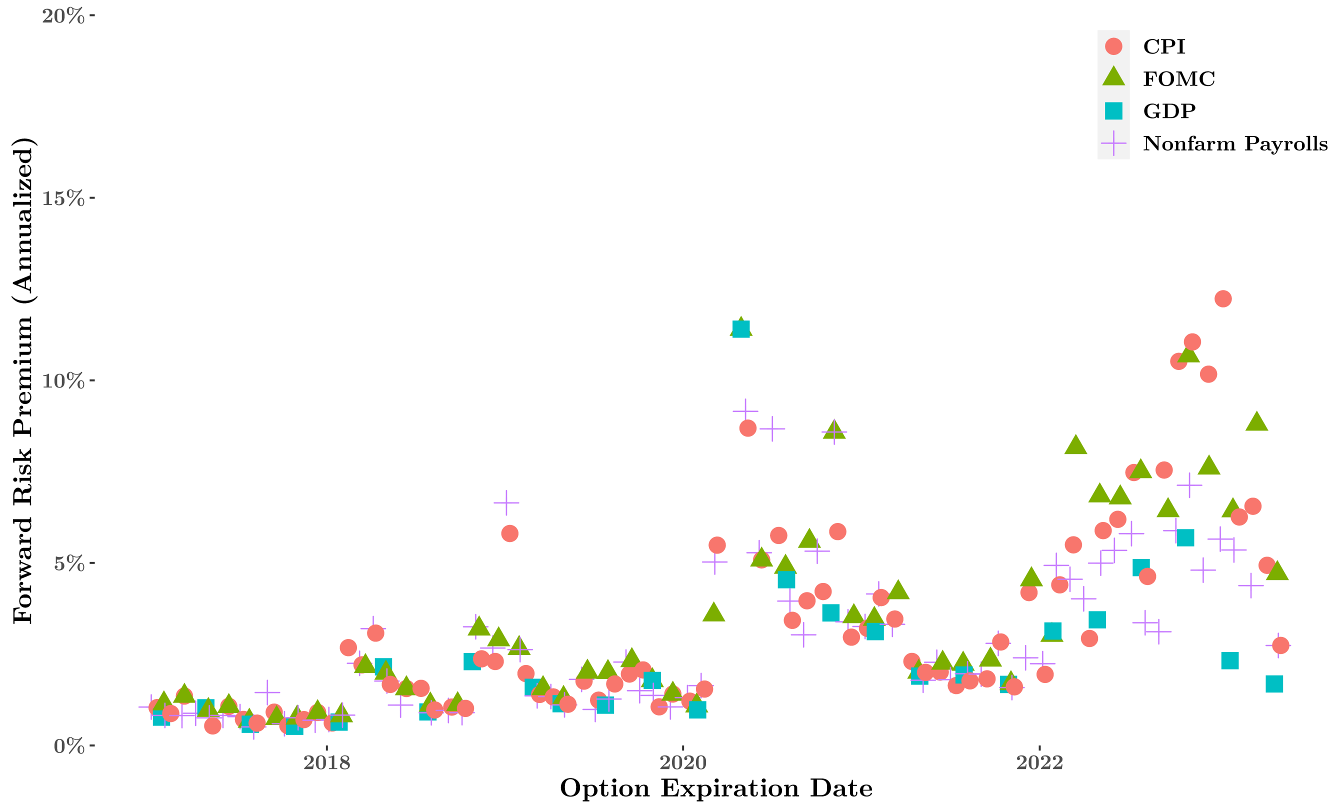

Figure 2: Release Forward Risk Premia This figure presents estimated annualized forward release risk premia by option expiration date for CPI (red circles), FOMC (green triangles), GDP (blue squares), and Nonfarm Payrolls (purple crosses) releases. Forward release risk premia, $(\mathcal{F}^{ERP}_{t,n:m})$ over horizon $n:m$, which corresponds to the daily option expirations surrounding a given release, are obtained by applying the approach of Gandhi et al. (2022). The April 4, 2020 Nonfarm Payrolls release is not shown. Values are reported in percentage points.

Figure 3: Release Forward Variance Risk Premia This figure presents estimated annualized forward release variance risk premia by option expiration date for CPI (red circles), FOMC (green triangles), GDP (blue squares), and Nonfarm Payrolls (purple crosses) releases. Forward release variance risk premia, ($\mathcal{F}^{VRP}_{t,n:m}$) are calculated as the difference between forward implied variance over horizon $(n : m)$ and a trailing average daily realized variance with window length corresponding to the forward horizon. Values are reported in percentage points.

Appendix to "The Price of Macroeconomic Uncertainty: Evidence from Daily Options"

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

1. Figure A1 examines open interest in options spanning releases.
2. Table A1 examines the cost of hedging release price, downside tail, and variance risk using an estimation period of 1 week.
3. Table A2 examines the determinants of risk premia using an estimation period of 1 week.
4. Table A3 examines the components of real uncertainty using an estimation period of 1 week.
5. Table A4 examines the cost of hedging release price, downside tail, and variance risk using an estimation period of 3 weeks.
6. Table A5 examines the determinants of risk premia using an estimation period of 3 weeks.
7. Table A6 examines the components of real uncertainty using an estimation period of 3 weeks.
8. Table A7 examines the cost of hedging using alternative option-implied tail measures.
9. Table A8 examines the determinants of release premia using an alternative measure of uncertainty.
10. Table A9 examines the cost of hedging release price, downside tail, and variance risk, removing a small set of expirations that span more than one release in our sample.
11. Table A10 examines the determinants of release premia, removing a small set of expirations that span more than one release in our sample.
12. Table A11 examines the components of real uncertainty, removing a small set of expirations that span more than one release in our sample.
13. Table A12 examines the cost of hedging release price, downside tail, and variance risk since the introduction of 5 option expirations per week.

14. Table A13 examines the cost of hedging release price, downside tail, and variance risk using 3 expirations per week throughout the sample.

15. Table A14 examines the determinants of release premia using 3 expirations per week throughout the sample.

16. Table A15 examines the components of real uncertainty using 3 expirations per week throughout the sample.

17. Table A16 compares release risk premia to premia for all other expirations.

18. Table A17 examines the cost of hedging release price, downside tail, and variance risk using an expanded set of releases.

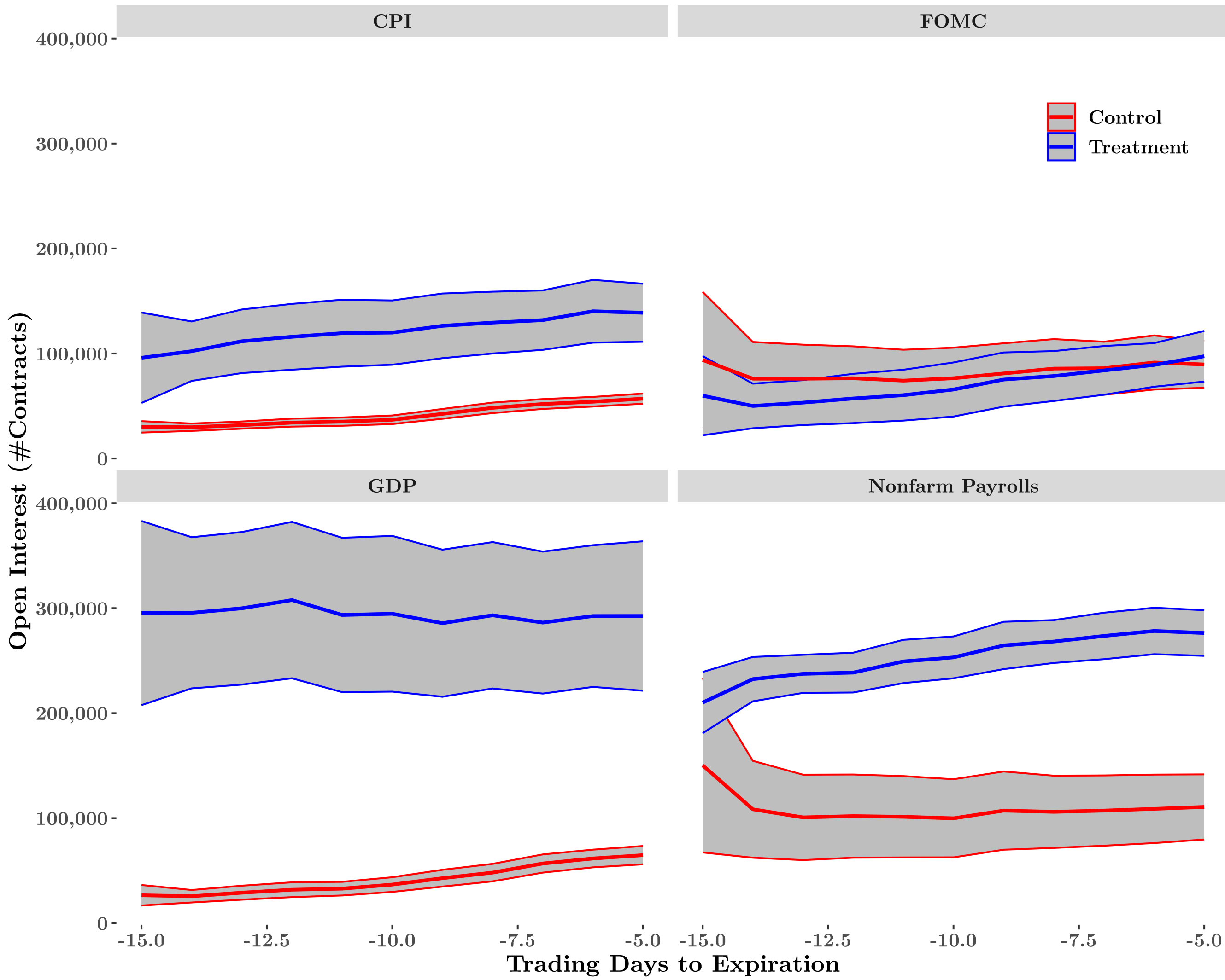

Figure A1: Open Interest in Options Spanning Releases This figure compares average daily contract open interest for options that span a given release (blue series) to a neighboring option expiration which does not (red series) in the event days leading up to each options expiration date. 95% confidence intervals are shaded in gray.

Table A1:
Cost of hedging release price, downside tail, and variance risk: Estimation window of 1 week

This table presents results for regressions comparing option-implied measures for treatment options spanning economic releases to neighboring expirations with time to expiration ($7 \leq T_{caldays} \leq 14$). Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denotes release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and a delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI			FOMC		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.73***	0.42***	0.08	1.86***	0.6***	0.77***
t-statistic	(2.72)	(3.11)	(0.5)	(5.82)	(3.53)	(4.52)
Adj. R^2	0.83	0.73	0.47	0.86	0.79	0.65
Release FE	Y	Y	Y	Y	Y	Y
Observations	15,355	851	15,355	10,679	587	10,679
	GDP			Nonfarm Payrolls		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.62	0.41***	0.38	1.16***	0.67***	0.43*
t-statistic	(1.64)	(3.7)	(1.63)	(2.71)	(3.41)	(1.95)
Adj. R^2	0.93	0.86	0.61	0.93	0.79	0.36
Release FE	Y	Y	Y	Y	Y	Y
Observations	4,931	293	4,931	15,571	854	15,571

Table A2:
Determinants of release risk premia: estimation window of 1 week

This table presents results for regressions using options with time to expiration ($7 \leq T_{caldays} \leq 14$) at the expiration-trading day-release event level of observation separately for each release, risk premium, risk aversion, and uncertainty type: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a measure of uncertainty or risk aversion (RU, RA, or MPU). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. RU is the Jurado et al. (2015) real uncertainty index. RA is the Bekaert et al. (2022) risk aversion index. MPU is the Baker et al. (2016) monetary policy uncertainty index. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.65***	-6.95***	0.89**	2.8***	-8.42***	0.97*	1.33***	-6.92***	-0.09	2.24***	-8.49*	1.48***
	(7.88)	(-4.97)	(2.51)	(6.63)	(-4.01)	(1.86)	(4.09)	(-12.69)	(-0.12)	(7.98)	(-1.87)	(2.72)
RU	0.41***			0.57**			0.77***			0.69***		
	(4.3)			(2.51)			(2.78)			(2.72)		
RA		2.32***			2.74***			2.1***			2.66**	
		(6.9)			(5.52)			(21.06)			(2.43)	
MPU			1.43***			1.59***			1.41***			1.07***
			(5.19)			(4.11)			(2.88)			(4.28)
Adj. R^2	0.11	0.38	0.28	0.17	0.51	0.33	0.53	0.83	0.49	0.18	0.33	0.08
Observations	425	428	425	298	298	298	146	146	146	426	426	426

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.64***	-5.52	-0.62	3.32***	-11.86***	-0.05	1.09***	-9.34***	-0.79	1.98***	-5.26***	0.43
	(4.83)	(-1.44)	(-1.27)	(5.04)	(-3.73)	(-0.08)	(2.9)	(-8.68)	(-0.9)	(6.7)	(-3.88)	(1.15)
RU	0.29**			0.63**			1.01***			0.58***		
	(2)			(2.03)			(2.73)			(3.68)		
RA		1.95**			3.66***			2.67***			1.83***	
		(2.08)			(4.77)			(10.19)			(5.66)	
MPU			2.25***			2.58***			1.86***			1.46***
			(4.86)			(4.61)			(2.92)			(4.96)
Adj. R^2	0.02	0.10	0.26	0.09	0.40	0.38	0.54	0.80	0.51	0.12	0.16	0.15
Observations	425	428	428	298	298	298	146	146	146	426	426	426

Table A3:
Components of real uncertainty: estimation window of 1 week

This table presents results for regressions at the expiration-trading day-release event level of observation separately for each release, risk premium, and component of real uncertainty: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a component of real uncertainty (inflation, labor, or output). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. The real uncertainty components are calculated using the methodology in Jurado et al. (2015) with a subset of economic variables related to inflation, labor, and output, and were provided by Londono et al. (2021). Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.4***	2.41***	3.15***	1.39***	2.5***	3.45***	0.86***	1.15***	2.11***	1.64***	1.89***	2.96***
	(7.85)	(7.91)	(9.17)	(7.43)	(6.29)	(8.09)	(3.48)	(3.31)	(6.17)	(5.66)	(6.71)	(8.16)
Inflation	1.23***			1.48***			1.04***			1.09***		
	(6.29)			(5.88)			(3.03)			(4.96)		
Labor		0.95***			1.21***			1.36***			1.49***	
		(4.94)			(4.03)			(3.61)			(3.01)	
Output			0.16			0.27			0.59*			0.51**
			(1.29)			(1.35)			(1.76)			(2.46)
Adj. R^2	0.31	0.13	0.01	0.40	0.21	0.03	0.35	0.54	0.29	0.14	0.19	0.08
Observations	425	425	425	298	298	298	146	146	146	426	426	426

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.73***	2.33***	3.06***	1.16***	2.84***	4.1***	0.65**	0.81**	2.09***	1.15***	1.65***	2.59***
	(4.62)	(5.11)	(5.5)	(5.72)	(4.74)	(6.21)	(2.52)	(2.05)	(5.4)	(6.51)	(6.35)	(8.39)
Inflation	1.56***			2.04***			1.24***			1.14***		
	(5.04)			(5.25)			(2.75)			(5.54)		
Labor		0.84**			1.51***			1.82***			1.3***	
		(2.41)			(3.33)			(3.67)			(5.44)	
Output			-0.03			0.17			0.81*			0.43***
			(-0.11)			(0.57)			(1.82)			(2.71)
Adj. R^2	0.19	0.03	0.00	0.33	0.14	0.00	0.30	0.58	0.33	0.15	0.15	0.06
Observations	425	425	425	298	298	298	146	146	146	426	426	426

Table A4:
Cost of hedging release price, downside tail, and variance risk: Estimation window of three weeks

This table presents results for regressions comparing option-implied measures for treatment options spanning economic releases to neighboring expirations with time to expiration ($7 \leq T_{caldays} \leq 28$). Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denote release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI			FOMC		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.61***	0.35***	0.222***	0.95***	0.44***	0.18
t-statistic	(3.78)	(4.97)	(3.14)	(5.15)	(4.15)	(1.37)
Adj. R^2	0.76	0.64	0.69	0.83	0.74	0.75
Release FE	Y	Y	Y	Y	Y	Y
Observations	46,626	2,174	46,626	31,756	1,479	31,756
	GDP			Nonfarm Payrolls		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.26	0.15	-0.01	0.81***	0.49***	0.61
t-statistic	(1.36)	(1.2)	(-0.2)	(3.65)	(5.12)	(1.58)
Adj. R^2	0.89	0.75	0.86	0.84	0.77	0.22
Release FE	Y	Y	Y	Y	Y	Y
Observations	15,664	746	15,664	49,538	2,249	49,538

Table A5:
Determinants of release risk premia: estimation window of 3 weeks

This table presents results for regressions using options with time to expiration ($7 \leq T_{caldays} \leq 28$) at the expiration-trading day-release event level of observation separately for each release, risk premium, risk aversion, and uncertainty type: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a measure of uncertainty or risk aversion (RU, RA, or MPU). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. RU is the Jurado et al. (2015) real uncertainty index. RA is the Bekaert et al. (2022) risk aversion index. MPU is the Baker et al. (2016) monetary policy uncertainty index. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.52***	-6.22***	0.76**	2.78***	-7.57***	0.61*	1.36***	-7.62***	-0.09	2.17***	-9.08**	1.36***
	(8.25)	(-4.75)	(2.43)	(7.2)	(-5.47)	(1.76)	(4.69)	(-18.87)	(-0.13)	(9.25)	(-2.4)	(2.79)
RU	0.45***			0.57***			0.86***			0.7***		
	(5.03)			(2.92)			(3.17)			(3.09)		
RA		2.14***			2.53***			2.31***			2.78***	
		(6.73)			(7.61)			(29.6)			(3.05)	
MPU			1.48***			1.81***			1.52***			1.11***
			(5.63)			(7.1)			(2.97)			(4.46)
Adj. R^2	0.15	0.38	0.35	0.21	0.56	0.46	0.59	0.86	0.51	0.20	0.41	0.10
Observations	1,125	1,128	1,125	773	773	773	384	384	384	1,145	1,145	1,145

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.5***	-7.32***	-0.54	3.26***	-9.38***	-0.27	1.2***	-8.74***	-0.59	1.8***	-2.85	-0.01
	(5.05)	(-3.36)	(-1.27)	(5.47)	(-3.97)	(-0.75)	(3.88)	(-20.45)	(-0.86)	(7.56)	(-0.93)	(-0.02)
RU	0.45***			0.6***			0.96***			0.46***		
	(3.88)			(2.6)			(3.2)			(3.33)		
RA		2.39***			3.06***			2.56***			1.2	
		(4.38)			(5.34)			(26.93)			(1.63)	
MPU			2.27***			2.66***			1.78***			1.51***
			(5.26)			(7.76)			(3.48)			(5.98)
Adj. R^2	0.06	0.19	0.33	0.11	0.38	0.47	0.56	0.81	0.54	0.08	0.07	0.17
Observations	1,125	1,128	1,128	773	773	773	384	384	384	1,145	1,145	1,145

Table A6:
Components of real uncertainty: estimation window of 3 weeks

This table presents results for regressions at the expiration-trading day-release event level of observation separately for each release, risk premium, and component of real uncertainty: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a component of real uncertainty (inflation, labor, or output). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. The real uncertainty components are calculated using the methodology in Jurado et al. (2015) with a subset of economic variables related to inflation, labor, and output, and were provided by Londono et al. (2021). Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.4***	2.29***	3.03***	1.48***	2.47***	3.42***	0.97***	1.16***	2.20***	1.55***	1.83***	2.9***
	(8.99)	(8.36)	(9.61)	(8.92)	(6.87)	(8.68)	(4.19)	(3.64)	(7.11)	(7.12)	(8.31)	(9.15)
Inflation	1.2***			1.43***			1.08***			1.11***		
	(6.61)			(6.09)			(3)			(5.83)		
Labor		1***			1.26***			1.51***			1.49***	
		(6.61)			(4.73)			(4)			(3.51)	
Output			0.24**			0.33*			0.71**			0.54***
			(2.02)			(1.77)			(2.09)			(2.94)
Adj. R^2	0.34	0.17	0.04	0.43	0.26	0.06	0.35	0.60	0.37	0.16	0.21	0.10
Observations	1,125	1,125	1,125	773	773	773	384	384	384	1,145	1,145	1,145

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.9***	2.11***	3.04***	1.3***	2.78***	3.99***	0.76***	0.93***	2.13***	0.9***	1.54***	2.29***
	(6.76)	(5.18)	(5.97)	(7.26)	(5.31)	(6.65)	(3.47)	(3.04)	(6.35)	(7.03)	(7.18)	(8.13)
Inflation	1.53***			1.9***			1.21***			1.07***		
	(5.3)			(5.68)			(3.06)			(6.23)		
Labor		1.18***			1.48***			1.72***			1.02***	
		(5.13)			(4.6)			(4.46)			(3.55)	
Output			0.18			0.23			0.78**			0.33**
			(0.99)			(1.03)			(2.09)			(2.37)
Adj. R^2	0.22	0.09	0.01	0.36	0.17	0.01	0.34	0.60	0.35	0.13	0.09	0.03
Observations	1,125	1,125	1,125	773	773	773	384	384	384	1,145	1,145	1,145

Table A7:
Cost of hedging release price, downside tail, and variance risk: alternative option-implied tail measures

This table presents results for regressions comparing option-implied measures for treatment options spanning economic releases to neighboring expirations over the weeks leading up to a release week. Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denote release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $RR_{t,T}$ is the difference in implied volatility between a delta 25 put and delta 25 call, and $Slope_{t,T}$ is the slope of a regression relating out-of-the-money put options implied volatility to its delta. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI		FOMC	
	$RR_{t,T}$	$Slope_{t,T}$	$RR_{t,T}$	$Slope_{t,T}$
Treat	0.27***	0.418***	0.28***	0.72***
t-statistic	(5.09)	(3.29)	(4.52)	(3.76)
Adj. R^2	0.65	0.66	0.77	0.82
Release FE	Y	Y	Y	Y
Observations	1,540	30,945	1,047	20,765
	GDP		Nonfarm Payrolls	
	$RR_{t,T}$	$Slope_{t,T}$	$RR_{t,T}$	$Slope_{t,T}$
Treat	0.1*	0.15	0.37***	0.74***
t-statistic	(1.72)	(1.05)	(5.35)	(4.01)
Adj. R^2	0.80	0.83	0.80	0.88
Release FE	Y	Y	Y	Y
Observations	543	10,316	1,542	31,442

Table A8:
Determinants of release risk premia: Scotti uncertainty index

This table presents results for regressions examining the empirical determinants of expiration-trading day release forward risk premia. $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. RU is the Scotti (2016) real activity uncertainty index. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)				
Variable	CPI	FOMC	GDP	NFP
Constant	1.79***	1.59***	1.32***	2.44***
	(8.01)	(5.89)	(4.2)	(3.54)
RU	0.54***	1.36***	1.13**	0.49***
	(3.98)	(2.94)	(2.35)	(4.57)
Adj. R^2	0.18	0.24	0.21	0.05
Observations	530	366	190	535

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)				
Variable	CPI	FOMC	GDP	NFP
Constant	1.1***	1.34***	1.22***	1.34***
	(4.38)	(4.52)	(3.43)	(4)
RU	0.65***	1.63***	1.3**	0.63***
	(3.46)	(2.71)	(2.05)	(4.34)
Adj. R^2	0.16	0.23	0.20	0.08
Observations	530	366	190	535

Table A9:
Cost of hedging release price, downside tail, and variance risk: Expirations spanning 1 release type

This table presents results for regressions comparing option-implied measures for treatment options spanning one type of economic release in our sample to neighboring expirations over the weeks leading up to a release week. Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denote release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI			FOMC		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.71***	0.39***	0.198***	1.3***	0.51***	0.47***
t-statistic	(4.21)	(4.61)	(2.89)	(6.23)	(5.47)	(5.93)
Adj. R^2	0.77	0.65	0.48	0.80	0.72	0.49
Release FE	Y	Y	Y	Y	Y	Y
Observations	29,550	1,418	29,550	17,599	862	17,599
	GDP			Nonfarm Payrolls		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.46**	0.27**	0.23***	0.8***	0.53***	0.22*
t-statistic	(2.08)	(2.74)	(3.54)	(3.6)	(5.06)	(1.8)
Adj. R^2	0.86	0.74	0.58	0.91	0.80	0.26
Release FE	Y	Y	Y	Y	Y	Y
Observations	9,371	501	9,371	30,616	1,520	30,616

Table A10:
Determinants of release risk premia: expirations spanning 1 release type

This table presents results for regressions for options spanning one type of economic release in our sample at the expiration-trading day-release event level of observation separately for each release, risk premium, risk aversion, and uncertainty type: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a measure of uncertainty or risk aversion (RU, RA, or MPU). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. RU is the Jurado et al. (2015) real uncertainty index. RA is the Bekaert et al. (2022) risk aversion index. MPU is the Baker et al. (2016) monetary policy uncertainty index. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.62***	-6.09***	0.92***	2.94***	-10.92***	1.11**	1.59***	-6.82***	0.86**	2.15***	-9.62**	1.34**
	(7.8)	(-4.29)	(2.74)	(6.8)	(-5.53)	(2.13)	(6.12)	(-7.8)	(2.24)	(8.48)	(-2.19)	(2.5)
RU	0.5***			0.52***			0.47***			0.71***		
	(5.4)			(3.15)			(6.63)			(2.75)		
RA		2.13***			3.33***			2.11***			2.89***	
		(6.27)			(6.98)			(10.86)			(2.73)	
MPU			1.44***			1.54***			0.8***			1.11***
			(5.42)			(3.76)			(2.8)			(4.34)
Adj. R^2	0.12	0.35	0.31	0.09	0.56	0.31	0.30	0.67	0.26	0.18	0.39	0.09
Observations	713	716	713	440	440	440	249	249	249	767	767	767

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.62***	-6.93**	-0.57	3.52***	-15.7***	-0.12	1.45***	-7.83***	0.45	1.85***	-3.65	-0.03
	(4.68)	(-2.48)	(-1.25)	(5.04)	(-4.51)	(-0.16)	(5.42)	(-5.36)	(1.45)	(7.09)	(-1.23)	(-0.08)
RU	0.44***			0.48**			0.53***			0.45***		
	(2.82)			(2.19)			(4.79)			(3.04)		
RA		2.3***			4.55***			2.33***			1.39*	
		(3.33)			(5.28)			(6.51)			(1.93)	
MPU			2.29***			2.67***			1.01***			1.54***
			(5.07)			(4.13)			(3.78)			(5.48)
Adj. R^2	0.03	0.15	0.29	0.03	0.43	0.38	0.29	0.60	0.30	0.06	0.08	0.16
Observations	713	716	716	440	440	440	249	249	249	767	767	767

Table A11: Components of real uncertainty: expirations spanning 1 release type

This table presents results for regressions for options spanning one type of economic release in our sample at the expiration-trading day-release event level of observation separately for each release, risk premium, and component of real uncertainty: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a component of real uncertainty (inflation, labor, or output). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. *Inflation*, *Labor*, and *Output* are the Jurado et al. (2015) real uncertainty index estimated for inflation, labor, and output variables separately. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.46***	2.43***	3.21***	1.55***	2.79***	3.54***	1.11***	1.54***	2.05***	1.53***	1.79***	2.88***
	(7.47)	(8.04)	(9.46)	(7.81)	(7.01)	(8.36)	(6.12)	(5.98)	(6.94)	(6.06)	(7.5)	(8.13)
Inflation	1.19***			1.28***			0.72***			1.11***		
	(5.91)			(5.2)			(4.16)			(5.22)		
Labor		1.01***			1***			0.79***			1.53***	
		(5.79)			(3.6)			(4.8)			(3.09)	
Output			0.19			-0.07			0.24*			0.54**
			(1.18)			(-0.33)			(1.9)			(2.57)
Adj. R^2	0.30	0.14	0.02	0.37	0.10	0.00	0.41	0.24	0.08	0.14	0.20	0.09
Observations	713	713	713	440	440	440	249	249	249	767	767	767

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.77***	2.25***	3.19***	1.25***	3.15***	4.13***	0.9***	1.35***	1.97***	0.94***	1.59***	2.33***
	(4.95)	(4.94)	(5.69)	(6.49)	(5.24)	(6.29)	(7.31)	(5.37)	(6.23)	(7.2)	(6.59)	(8.05)
Inflation	1.59***			1.82***			0.82***			1.06***		
	(5.02)			(4.74)			(4.6)			(5.65)		
Labor		1.12***			1.25***			0.96***			1.01***	
		(3.58)			(2.67)			(5.48)			(3.4)	
Output			0.04			-0.39			0.28**			0.31**
			(0.14)			(-1.14)			(2.15)			(1.97)
Adj. R^2	0.19	0.06	0.00	0.31	0.06	0.02	0.39	0.26	0.08	0.12	0.08	0.03
Observations	713	713	713	440	440	440	249	249	249	767	767	767

Table A12:
Cost of hedging release price, downside tail, and variance risk: since introduction of 5 expirations per week

This table presents results for regressions comparing option-implied measures for treatment options spanning economic releases to neighboring expirations since the introduction of five expirations per week. Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denote release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI			FOMC		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	1.88***	0.55***	0.68***	1.9***	0.74***	0.74***
t-statistic	(5.96)	(4.97)	(4.53)	(8.17)	(4.25)	(5.78)
Adj. R^2	0.88	0.47	0.69	0.79	0.42	0.47
Release FE	Y	Y	Y	Y	Y	Y
Observations	6,935	231	6,935	4,899	158	4,899
	GDP			Nonfarm Payrolls		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.05	-0.18	0.23	0.5*	0.57***	0.18
t-statistic	(0.28)	(-1.35)	(1.86)	(2.17)	(5.45)	(1.68)
Adj. R^2	0.91	0.48	0.55	0.88	0.56	0.69
Release FE	Y	Y	Y	Y	Y	Y
Observations	2,402	80	2,402	6,538	213	6,538

Table A13:
Cost of hedging release price, downside tail, and variance risk: 3 expirations per week

This table presents results for regressions comparing option-implied measures for treatment options spanning economic releases to neighboring expirations over the weeks leading up to a release week. Monday, Wednesday, and Friday expirations are used throughout the entire sample. Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denotes release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	CPI			FOMC		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.8***	0.41***	0.27***	1.44***	0.55***	0.71***
t-statistic	(4.69)	(5.17)	(3.61)	(5.65)	(4.81)	(4.73)
Adj. R^2	0.78	0.66	0.49	0.83	0.77	0.48
Release FE	Y	Y	Y	Y	Y	Y
Observations	32,159	1,542	32,159	21,391	1,059	21,391
	GDP			Nonfarm Payrolls		
	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$	$IV_{t,T,k}$	$RR_{t,T}$	$VRP_{t,T,k}$
$Treat$	0.49**	0.25**	0.46*	0.86***	0.54***	0.3**
t-statistic	(2.4)	(2.46)	(2.05)	(3.54)	(4.56)	(2.23)
Adj. R^2	0.90	0.81	0.29	0.90	0.80	0.28
Release FE	Y	Y	Y	Y	Y	Y
Observations	10,534	547	10,534	31,692	1,540	31,692

Table A14:
Determinants of release risk premia: 3 expirations per week

This table presents results for regressions using 3 expirations per week throughout the entire sample at the expiration-trading day-release event level of observation separately for each release, risk premium, risk aversion, and uncertainty type: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a measure of uncertainty or risk aversion (RU, RA, or MPU). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. RU is the Jurado et al. (2015) real uncertainty index. RA is the Bekaert et al. (2022) risk aversion index. MPU is the Baker et al. (2016) monetary policy uncertainty index. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.29***	-5.32***	1.11***	2.46***	-7.2***	0.81*	1.38***	-7.22***	-0.04	2.05***	-9.22**	1.52***
	(9.47)	(-6.13)	(3.75)	(7.46)	(-7.55)	(1.83)	(4.57)	(-15.54)	(-0.05)	(7.99)	(-2.06)	(2.84)
RU	0.45***			0.58***			0.8***			0.75**		
	(5.03)			(2.88)			(3.06)			(2.38)		
RA		1.88***			2.38***			2.19***			2.78**	
		(9.19)			(10.66)			(24.89)			(2.58)	
MPU			1.12***			1.51***			1.43***			0.94***
			(5.21)			(4.67)			(2.98)			(3.7)
Adj. R^2	0.21	0.43	0.30	0.26	0.57	0.39	0.55	0.85	0.49	0.17	0.36	0.06
Observations	772	775	772	533	533	533	274	274	274	767	767	767

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Constant	2.04***	-5.67***	-0.04	2.68***	-8.96***	-0.04	1.27***	-8.91***	-0.56	1.71***	-2.84	0.28
	(5.78)	(-2.87)	(-0.11)	(5.71)	(-6.67)	(-0.09)	(3.58)	(-17.77)	(-0.79)	(8.32)	(-0.97)	(0.78)
RU	0.43***			0.64***			0.92***			0.47***		
	(3.72)			(2.62)			(2.84)			(2.64)		
RA		1.89***			2.85***			2.59***			1.17*	
		(3.89)			(8.68)			(22.1)			(1.67)	
MPU			1.65***			2.22***			1.77***			1.27***
			(5.26)			(5.28)			(3.38)			(4.8)
Adj. R^2	0.09	0.20	0.29	0.17	0.43	0.44	0.52	0.84	0.53	0.06	0.06	0.11
Observations	772	775	775	533	533	533	274	274	274	767	767	767

Table A15:
Components of Real Uncertainty: 3 expirations per week

This table presents results for regressions using 3 expirations per week throughout the entire sample at the expiration-trading day-release event level of observation separately for each release, risk premium, and component of real uncertainty: $y_{i,t,T} = \alpha + \beta \cdot X_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is the risk premium type being considered and $X_{i,t,T}$ is a component of real uncertainty (inflation, labor, or output). $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium, and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. $Inflation$, $Labor$, and $Output$ are the Jurado et al. (2015) real uncertainty index estimated for inflation, labor, and output variables separately. Estimates are reported in percentage points. Right-hand side variables are scaled by their respective historical standard deviations. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Forward Equity Risk Premia ($\mathcal{F}^{ERP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.42***	2.11***	2.8***	1.42***	2.18***	3.09***	0.95***	1.2***	2.17***	1.57***	1.7***	2.82***
	(8.37)	(9.17)	(11.22)	(8.41)	(6.96)	(9.18)	(4.07)	(3.63)	(6.73)	(6.32)	(6.56)	(8.2)
Inflation	1***			1.25***			1.03***			1.03***		
	(6.67)			(5.86)			(3.14)			(4.82)		
Labor		0.95***			1.22***			1.39***			1.59***	
		(6.27)			(4.59)			(3.8)			(2.73)	
Output			0.27**			0.37**			0.62**			0.57**
			(2.57)			(2.05)			(1.97)			(2.13)
Adj. R^2	0.35	0.22	0.07	0.40	0.30	0.09	0.36	0.56	0.32	0.12	0.19	0.08
Observations	772	772	772	533	533	533	274	274	274	767	767	767

Panel B: Forward Variance Risk Premia ($\mathcal{F}^{VRP}_{t,(n:m)}$)

	CPI			FOMC			GDP			Nonfarm Payrolls		
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.81***	1.76***	2.54***	1.23***	2.26***	3.4***	0.75***	1.01***	2.19***	1***	1.47***	2.20***
	(6.32)	(5.87)	(6.89)	(7.55)	(5.5)	(7.07)	(3.4)	(2.8)	(5.78)	(7.6)	(7.05)	(8.78)
Inflation	1.23***			1.58***			1.2***			0.93***		
	(5.89)			(5.54)			(3.14)			(5.44)		
Labor		1.02***			1.48***			1.66***			1.02***	
		(4.15)			(4.32)			(3.86)			(2.89)	
Output			0.22			0.33			0.71*			0.33*
			(1.37)			(1.48)			(1.83)			(1.86)
Adj. R^2	0.23	0.12	0.02	0.34	0.23	0.04	0.34	0.56	0.29	0.09	0.07	0.03
Observations	772	772	772	533	533	533	274	274	274	767	767	767

Table A16:
Release risk premia: all expirations

This table presents results for regressions comparing forward risk premia for option expirations spanning economic releases to all other option expirations. Regressions are estimated for trading day t and option expiration T: $y_{t,T} = \alpha_d + \alpha_t + \beta_1 \cdot CPI_{t,T} + \beta_2 \cdot FOMC_{t,T} + \beta_3 \cdot GDP_{t,T} + \beta_4 \cdot NFP_{t,T} + \epsilon_{i,t,T}$, where $y_{t,T}$ is the risk premium type considered, α_d denotes first expiration of the week fixed effects, α_t denotes trading day fixed effects, and $CPI_{t,T}$, $FOMC_{t,T}$, $GDP_{t,T}$, and $NFP_{t,T}$ are indicators equal to one for each release type and zero otherwise. $\mathcal{F}^{ERP}_{t,(n:m)}$ is the forward equity risk premium and $\mathcal{F}^{VRP}_{t,(n:m)}$ is the forward variance risk premium. Estimates are reported in percentage points. Standard errors are clustered by expiration. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Release	$\mathcal{F}^{ERP}_{t,(n:m)}$	$\mathcal{F}^{VRP}_{t,(n:m)}$
CPI	0.35***	0.65***
	(2.82)	(2.84)
FOMC	0.78***	1.48***
	(4.87)	(4.96)
GDP	-0.15	-0.07
	(-1.01)	(-0.27)
Nonfarm Payrolls	0.30***	0.65***
	(2.75)	(3.62)
Adj. R^2	0.71	0.64
First of Week FE	Y	Y
Trade Date FE	Y	Y
#Observations	11,945	11,945

Table A17:
Cost of hedging release price, downside tail, and variance risk: additional releases

This table presents results for regressions comparing option-implied measures for treatment options spanning additional economic releases to neighboring expirations over the weeks leading up to a release week. Only releases which aren't spanned by the same expirations as U.S. CPI, FOMC, GDP, and Nonfarm Payrolls releases are considered. Regressions are estimated for release event i, trading day t, and option expiration T separately for each release type: $y_{i,t,T} = \alpha_i + \beta \cdot Treat_{i,t,T} + \epsilon_{i,t,T}$, where $y_{i,t,T}$ is each one of the option-implied measures considered, α_i denote release date fixed effects, and $Treat_{i,t,T}$ is an indicator variable equal to one for options with expirations that span the release date and zero otherwise. $IV_{t,T,k}$ is the implied volatility of at-the-money options, $RR_{t,T}$ is the difference in implied volatility between a delta 10 put and delta 10 call, and $VRP_{t,T,k}$ is the difference between the implied variance of at-the-money options and a trailing average of daily 5-minute realized variances on the S&P 500 with a window length corresponding to the days to expiration. Estimates are reported in percentage points. Standard errors are clustered by release date. ***,**,* indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Release	Outcome	$Treat$	t-statistic	Adj. R^2	Observations
ADP Employment Change	$IV_{t,T,k}$	0.68	2.23	0.91	22,776
CB Consumer Confidence	$IV_{t,T,k}$	0.08	0.41	0.90	24,439
Chicago PMI	$IV_{t,T,k}$	0.24	1.96	0.90	23,083
Construction Spending (%MoM)	$IV_{t,T,k}$	0.62	1.98	0.92	12,705
Durable Goods Orders	$IV_{t,T,k}$	0.36	0.72	0.77	21,681
Empire Manufacturing	$IV_{t,T,k}$	-0.16	-0.58	0.88	13,124
Existing Home Sales	$IV_{t,T,k}$	0.45	1.04	0.79	26,341
Factory Orders (%MoM)	$IV_{t,T,k}$	0.86	1.77	0.84	11,348
GDP (%QoQ a.r.) (final)	$IV_{t,T,k}$	0.88	1.02	0.81	12,516
GDP (%QoQ a.r.) (sec.)	$IV_{t,T,k}$	0.88	1.02	0.81	12,516
Housing Starts	$IV_{t,T,k}$	0.30	1.21	0.83	29,452
ISM Manufacturing	$IV_{t,T,k}$	0.60	2.14	0.92	14,497
Industrial Production (%MoM)	$IV_{t,T,k}$	0.30	1.10	0.84	27,531
Initial Jobless Claims	$IV_{t,T,k}$	0.37	2.05	0.84	97,972
Leading Index (%MoM)	$IV_{t,T,k}$	0.49	1.26	0.81	29,865
Markit Manufacturing PMI	$IV_{t,T,k}$	0.63	2.13	0.91	13,442
New Durable Goods Orders (%MoM) (final)	$IV_{t,T,k}$	0.25	1.08	0.86	4,328
New Home Sales	$IV_{t,T,k}$	0.33	0.83	0.78	27,154
PPI	$IV_{t,T,k}$	0.20	0.88	0.90	21,483
Personal Income (%MoM)	$IV_{t,T,k}$	0.50	1.16	0.84	25,910
Personal Spending (%MoM)	$IV_{t,T,k}$	0.50	1.16	0.84	25,654
Retail Sales	$IV_{t,T,k}$	0.22	0.71	0.86	24,062
Trade Balance	$IV_{t,T,k}$	0.40	1.20	0.85	19,219
U. Mich. Consumer Sentiment (final)	$IV_{t,T,k}$	0.32	0.68	0.83	25,066
UM Consumer Sentiment	$IV_{t,T,k}$	0.28	1.41	0.90	24,342
Wholesale Inventories	$IV_{t,T,k}$	0.61	1.14	0.83	21,164
Wholesale Inventories (%MoM) (final)	$IV_{t,T,k}$	0.04	0.25	0.96	15,750

Release	Outcome	$Treat$	t-statistic	Adj. R^2	Observations
ADP Employment Change	$RR_{t,T}$	0.41	3.00	0.80	1,032
CB Consumer Confidence	$RR_{t,T}$	0.03	0.45	0.77	1,195
Chicago PMI	$RR_{t,T}$	0.27	3.64	0.79	1,168
Construction Spending (%MoM)	$RR_{t,T}$	0.12	0.86	0.82	483
Durable Goods Orders	$RR_{t,T}$	0.17	1.06	0.75	1,039
Empire Manufacturing	$RR_{t,T}$	0.31	1.50	0.75	606
Existing Home Sales	$RR_{t,T}$	0.15	0.94	0.76	1,265
Factory Orders (%MoM)	$RR_{t,T}$	0.40	1.60	0.60	516
GDP (%QoQ a.r.) (final)	$RR_{t,T}$	0.20	1.30	0.81	556
GDP (%QoQ a.r.) (sec.)	$RR_{t,T}$	0.20	1.30	0.81	556
Housing Starts	$RR_{t,T}$	0.20	1.64	0.75	1,365
ISM Manufacturing	$RR_{t,T}$	0.15	1.09	0.82	563
Industrial Production (%MoM)	$RR_{t,T}$	0.23	1.75	0.75	1,273
Initial Jobless Claims	$RR_{t,T}$	0.10	1.56	0.77	4,553
Leading Index (%MoM)	$RR_{t,T}$	0.16	1.10	0.77	1,408
Markit Manufacturing PMI	$RR_{t,T}$	0.10	0.80	0.82	523
New Durable Goods Orders (%MoM) (final)	$RR_{t,T}$	0.20	1.08	0.66	251
New Home Sales	$RR_{t,T}$	0.10	0.72	0.75	1,301
PPI	$RR_{t,T}$	0.32	1.99	0.77	915
Personal Income (%MoM)	$RR_{t,T}$	0.22	2.23	0.79	1,213
Personal Spending (%MoM)	$RR_{t,T}$	0.22	2.23	0.79	1,213
Retail Sales	$RR_{t,T}$	0.22	1.73	0.78	1,037
Trade Balance	$RR_{t,T}$	0.24	1.50	0.73	871
U. Mich. Consumer Sentiment (final)	$RR_{t,T}$	0.18	1.53	0.79	1,150
UM Consumer Sentiment	$RR_{t,T}$	0.36	2.52	0.77	1,120
Wholesale Inventories	$RR_{t,T}$	0.31	2.46	0.78	1,012
Wholesale Inventories (%MoM) (final)	$RR_{t,T}$	0.13	1.26	0.85	830

Release	Outcome	$Treat$	t-statistic	Adj. R^2	Observations
ADP Employment Change	$VRP_{t,T,k}$	0.41	2.71	0.24	22,776
CB Consumer Confidence	$VRP_{t,T,k}$	0.00	-0.02	0.21	24,439
Chicago PMI	$VRP_{t,T,k}$	0.03	0.65	0.21	23,083
Construction Spending (%MoM)	$VRP_{t,T,k}$	0.38	2.32	0.22	12,705
Durable Goods Orders	$VRP_{t,T,k}$	0.23	1.51	0.21	21,681
Empire Manufacturing	$VRP_{t,T,k}$	0.01	0.11	0.46	13,124
Existing Home Sales	$VRP_{t,T,k}$	0.31	1.24	0.26	26,341
Factory Orders (%MoM)	$VRP_{t,T,k}$	0.39	1.60	0.55	11,348
GDP (%QoQ a.r.) (final)	$VRP_{t,T,k}$	0.40	1.05	0.29	12,516
GDP (%QoQ a.r.) (sec.)	$VRP_{t,T,k}$	0.40	1.05	0.29	12,516
Housing Starts	$VRP_{t,T,k}$	0.25	2.13	0.39	29,452
ISM Manufacturing	$VRP_{t,T,k}$	0.36	2.45	0.23	14,497
Industrial Production (%MoM)	$VRP_{t,T,k}$	0.09	0.89	0.44	27,531
Initial Jobless Claims	$VRP_{t,T,k}$	0.20	2.19	0.30	97,972
Leading Index (%MoM)	$VRP_{t,T,k}$	0.29	1.43	0.30	29,865
Markit Manufacturing PMI	$VRP_{t,T,k}$	0.36	2.29	0.22	13,442
New Durable Goods Orders (%MoM) (final)	$VRP_{t,T,k}$	0.07	1.25	0.65	4,328
New Home Sales	$VRP_{t,T,k}$	0.15	1.18	0.22	27,154
PPI	$VRP_{t,T,k}$	-0.01	-0.14	0.20	21,483
Personal Income (%MoM)	$VRP_{t,T,k}$	0.22	1.09	0.32	25,910
Personal Spending (%MoM)	$VRP_{t,T,k}$	0.22	1.09	0.31	25,654
Retail Sales	$VRP_{t,T,k}$	0.09	0.76	0.44	24,062
Trade Balance	$VRP_{t,T,k}$	0.33	2.06	0.44	19,219
U. Mich. Consumer Sentiment (final)	$VRP_{t,T,k}$	0.27	1.24	0.31	25,066
UM Consumer Sentiment	$VRP_{t,T,k}$	0.00	-0.03	0.25	24,342
Wholesale Inventories	$VRP_{t,T,k}$	0.23	0.93	0.31	21,164
Wholesale Inventories (%MoM) (final)	$VRP_{t,T,k}$	0.00	0.00	0.17	15,750