

Earnings Announcements: Ex-ante Risk Premia*

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January 2023

*We thank Zachary Kaplan, Xiumin Martin, Asaf Manela, and seminar participants at Washington University in St. Louis for helpful comments and suggestions.

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Abstract

In this paper, we provide an estimate of the ex-ante risk premia on earnings announcements based on the option market. We find that the risk premia are time-varying and have predictive power on future stock returns. The well-documented positive post-earnings-announcement drift (PEAD) is present only when the risk premia are high. After controlling for the announcement risk premia, the PEAD factor of the literature no longer has any abnormal returns. Moreover, while trading option straddles is not profitable unconditionally, conditional on high ex-ante risk premia, it becomes profitable even net of transaction costs.

JEL Classification: G11, G14

Keywords: Earnings, risk premia, post-earning drift, option market, straddles

1 Introduction

Earnings announcements reveal the most important fundamental information to investors and have been studied extensively in the literature. One central question in asset pricing is on the risk premia. Existing studies, such as Chari et al. (1988), Ball and Kothari (1991), Cohen et al. (2007), and Lamont and Frazzini (2007), find that U.S. stocks earn higher returns during earnings announcement months than during non-announcement months. Barber et al. (2013) show that the findings hold globally. However, existing studies analyze only the ex-post risk premia or the long-term average. Prior to each earnings announcement, investors clearly have their respective return expectation on holding the stocks that is likely to be different from the previous one, but this ex-ante risk premium has not been addressed in the literature.

This paper extracts the ex-ante risk premia on earnings announcements from the option market. Intuitively, investors who have high expectations on a stock can bid up the call prices prior to the announcement, and hence the option market may contain rich information about the investor's expected return on the stock. Based on the FOMC risk premium model recently developed by Liu et al. (2022), we recover the risk premia for each earnings announcement date (the EAD risk premia) from the option market. This estimate is ex-ante because it is obtained based on data prior to the announcement. Our EAD risk premia are the first real-time risk premia estimation in the literature.

We provide convincing evidence that the EAD risk premia are economically large and time-varying. Empirically, we assume a two-state jump model for the stock price around the announcement, and estimate the upward and downward drift sizes, as well as the corresponding EAD risk premia for a total of 3812 announcements for 357 S&P 500 firms during the period from 2010 to 2021. We find that, on average, the upward (downward) drift size during the announcements is 246 (351) basis points, with a volatility of 1.63% (1.58%). The average of the corresponding EAD risk premia is 15 basis points (bps). The volatility of

the risk premia is as large as 16 bps, suggesting significant variation of uncertainty during different earnings announcements for different firms.

We next show that our estimated EAD risk premia contain substantial predictive information on future stock returns. When we use this ex-ante measure to predict realized EAD returns, the out-of-sample R-squared is positive for 58% of the firms, and greater than 1% for 34% of them. Sorting stocks into terciles, we find a significant difference between the realized EAD returns of the low and high portfolios.

Our study sheds new economic insights on existing findings about the positive post-earnings-announcement drift (PEAD). As our estimate of the EAD risk premia is able to provide a direct ex-ante measure of the risk for each single announcement, we are able to examine the performance of the PEAD factor for announcements associated with higher and lower risk separately. We find that PEAD presents only when our estimated ex-ante risk premia are high, but vanish when the risk premia are low. In particular, PEAD leads to a return spread of 6.02% (with a t-statistics of 4.98) for the subsample of earnings announcements associated with high EAD risk premia, and the same return spread is -0.46% (with a t-statistics of -0.61) for the subsample when the EAD risk premia are low.

There are two explanations for the existence of PEAD: information delay and risk premia (Ball and Brown (1968), Fama (1970), Foster et al. (1984), Bernard and Thomas (1989), Bernard and Thomas (1990), Angrist and Krueger (2001), Richardson et al. (2010), and Hung et al. (2015)). Our findings are consistent with asset pricing theory that they are the compensation for taking the greater risk, supporting the risk premia channel explaining the existence of PEAD.

Finally, our study identifies the economic source of profits for trading straddles. It is well-recognized that straddle returns during earnings announcements carry information of jump risk premium (Coval and Shumway (2001), Ang et al. (2006), Cremers et al. (2015), and Dubinsky et al. (2019)). We show that our estimated EAD risk premia indeed capture the risk

presented in straddles. Such findings contain important investment implications. Due to the existence of transaction costs, investors are not able to construct profitable trading strategies by selling straddles. However, our ex-ante estimates of the EAD risk premia enable us to identify announcements with higher uncertainty before the arrival of each announcement. Then, we find that, by limit attention to these high risk announcements, the average return of selling straddles on earnings announcement days is 0.56%, which is economically large and statistically significant.

Our paper contributes to the understanding of the market reactions to EAD. Hecht and Vuolteenaho (2006), Kothari et al. (2006), Sadka and Sadka (2009), Cready and Gurun (2010), So and Wang (2014), and Savor and Wilson (2016) investigate the contemporaneous reaction, by focusing on the return decomposition and distinguish cash flow news and discount rate news released by earnings, while Ball and Brown (1968), Fama (1970), Foster et al. (1984), Bernard and Thomas (1989), Bernard and Thomas (1990), Angrist and Krueger (2001), Richardson et al. (2010), and Hung et al. (2015) explore the lagged reaction by looking at longer term after earnings published (i.e. PEAD). Our ex-ante risk premia measure sheds new light on these empirical findings and contribute to both lines of literature.

Our paper adds in addition to the study of predicting stock returns around corporate events (Ederington and Lee (1996), Drake et al. (2012), Chesney et al. (2015), Gharghori et al. (2017), and Augustin et al. (2019)). In our set-up, instead of examining various behavior explanations, we directly measure the underlying expected returns before the information releases from option prices, which fully extracts the expectation and compensation. Our measure is real-time and varies across different firms and different earnings. With our measure, one can easily understand the risk-return trade-off based on the conditional information embedded in option prices, and distinguish high risk premium EAD from low risk premium EAD.

Our paper is closely related to the growing line of research on the information flow between stock market and derivative market. A large body of studies investigates the informed trading

in option market and shows that the information extracted from option prices and trading volume could predict future expected returns of underlying assets (Easley et al. (1998), Ofek et al. (2004), Pan and Poteshman (2006), Ni et al. (2008), Cremers and Weinbaum (2010), Bollerslev et al. (2014), and Ge et al. (2016)). Other studies concentrate on the recovery of the information of the underlying asset returns from option prices (Ross (2015), Martin and Wagner (2019), Tang (2019), Kadan and Manela (2019), Jensen et al. (2019), Kadan and Tang (2020), and Kadan et al. (2023)). These methods typically do not impose specific forms of investor preferences, but they often require a large number of reliable prices of options with different strike prices for empirical implementations. In contrast, Liu et al. (2022) show that the use of limited short maturity options can recover market risk premium around the FOMC meetings. In our paper, we apply their method to individual earnings events and to identify the risk premium and return variation.

The rest of the paper proceeds as follows. Section 2 discusses the data and estimation methodology. Section 3 presents the empirical evidence using data with daily frequency and minute-by-minute frequency. Section 4 explores the application on unresolved puzzles in asset pricing Section 4 concludes.

2 Methodology

In this section, we introduce the methodology we use to recover the earnings announcement date premia (EAD premia) for individual stocks. We first revisit the model developed in Liu et al. (2022), then we describe how to apply it to individual stock options.

2.1 The model in Liu, Tang and Zhou (2022)

In this subsection, we briefly review the recovery of the Federal Open Market Committee (FOMC) risk premium introduced in Liu et al. (2022) for an easier understanding of our

applications. Assume a discrete-time model with $t = 0, 1$, and an event occurs between $t = 0-$ and $t = 0+$. Under a two-state model, an asset with price S_0 at $t = 0$ jumps up to S_u or down to S_d immediately upon the arrival of the event, where $S_u = (1 + u)S_0$, and $S_d = (1 - d)S_0$. Assume the existence of two call and two put options written on this asset, which mature at time $t = 0+$. Denote their prices at time $t = 0-$ as $C_1, C_2, P_1,$ and P_2 , and their corresponding strike prices as $K_1^C, K_2^C, K_1^P,$ and K_2^P . Assume further that $S_u > K_1^C > K_2^C > S_d$, and that $S_u > K_2^P > K_1^P > S_d$. Then the upward and downward drift sizes can be recovered by:

$$\begin{aligned} u &= \frac{C_1 K_2^C - C_2 K_1^C}{S_{0-} (C_1 - C_2)} - 1, \\ d &= 1 - \frac{P_2 K_1^P - P_1 K_2^P}{S_{0-} (P_2 - P_1)}, \end{aligned} \tag{1}$$

and the implied state prices π_u and π_d by:

$$\begin{aligned} \pi_u &= \frac{C_1 - C_2}{K_2^C - K_1^C}, \\ \pi_d &= \frac{P_1 - P_2}{K_1^P - K_2^P}. \end{aligned} \tag{2}$$

Under a representative agent model, where the agent follows an Epstein-Zin preference in Ai and Bansal (2018) with the intertemporal elasticity of substitution parameter, ψ , and the relative risk aversion coefficient, γ , and when the underlying asset S_0 is the market, the risk premium is further recovered by:

$$\widehat{E}(r) = \frac{d \left(1 - \left(\frac{1+u}{1-d}\right)^\alpha\right)}{\frac{d}{u} + \left(\frac{1+u}{1-d}\right)^\alpha}, \tag{3}$$

where $\alpha = \frac{1}{\frac{\psi-\gamma}{1-\frac{1}{\psi}}} < 0$, and $\gamma \geq \psi$ and $1 \geq \frac{1}{\psi}$. While Liu et al. (2022) focus their attention to the FOMC meetings, we apply equations (1) – (3) to recover the market risk premium right before earnings announcements.

2.2 Application to EAD

Next, we consider applying the above methodology in more detail to recover the EAD premia for individual stocks. Let the asset S_0 be a stock of interest, and the event be the earnings announcement. We can directly apply (1) and (2) to recover drift sizes and state prices.

One potential concern is that individual stock options may suffer from liquidity issues such that there is a significant disparity between risk premia estimated from bid and ask prices, in contrast to the market index options used by Liu et al. (2022). To preserve information from both the buying and selling ends, we derive an upper and a lower bound on risk premium estimates using bid and ask prices. Here we specify C_1 and C_2 as the average of the bid and ask prices. Let α_1 and α_2 be the half bid-ask spread, the present values of the payoff provided by C_1 and C_2 are bounded by the bid and ask prices:

$$\begin{aligned} C_1(1 - \alpha_1) &< \pi_u((1 + u)S_0 - K_1^C) < C_1(1 + \alpha_1), \\ C_2(1 - \alpha_2) &< \pi_u((1 + u)S_0 - K_2^C) < C_2(1 + \alpha_2). \end{aligned}$$

Rearranging the terms, we have:

$$\begin{aligned} ((1 - \alpha_1)C_1 - (1 + \alpha_2)C_2)(1 + u)S_0 &< (1 - \alpha_1)C_1K_2^C - (1 + \alpha_2)C_2K_1^C, \\ ((1 - \alpha_2)C_2 - (1 + \alpha_1)C_1)(1 + u)S_0 &< (1 - \alpha_2)C_2K_1^C - (1 + \alpha_1)C_1K_2^C. \end{aligned}$$

By no arbitrage condition, $(1 + \alpha_2)C_2 > (1 - \alpha_1)C_1$, we have the lower bound on u :

$$\underline{u} = \frac{(1 + \alpha_2)C_2K_1^C - (1 - \alpha_1)C_1K_2^C}{((1 + \alpha_2)C_2 - (1 - \alpha_1)C_1)S_0} - 1 < u. \quad (4)$$

To estimate the upper bound, we define

$$\bar{u} = \frac{(1 - \alpha_2)C_2K_1^C - (1 + \alpha_1)C_1K_2^C}{((1 - \alpha_2)C_2 - (1 + \alpha_1)C_1)S_0} - 1, \quad (5)$$

It is not always true that $\bar{u} > u$. The condition for this inequality is $(1 - \alpha_2)C_2 > (1 + \alpha_1)C_1$. When it holds, \bar{u} serves as an upper bound of u .¹

Similarly, for the downward state, let θ_1 and θ_2 be the half bid-ask spread of put options P_1 and P_2 . We have that under the condition $(1 - \theta_1)P_2 > (1 + \theta_2)P_1$, the lower and upper bound of d is given by

$$\begin{aligned} \underline{d} &= 1 - \frac{(1 + \theta_1)P_1K_2^P - (1 - \theta_2)P_2K_1^P}{((1 + \theta_1)P_1 - (1 - \theta_2)P_2)S_0}, \\ \bar{d} &= 1 - \frac{(1 - \theta_1)P_1K_2^P - (1 + \theta_2)P_2K_1^P}{((1 - \theta_1)P_1 - (1 + \theta_2)P_2)S_0}. \end{aligned} \quad (6)$$

When applying (3) to individual stocks, we adopt the calibration method to determine the level of α .² As $\widehat{E}(r)$ is increasing in both u and d , it is straightforward that the upper bound for $\widehat{E}(r)$ is

$$\overline{\widehat{E}(r)} = \frac{\bar{d} \left(1 - \left(\frac{1+\bar{u}}{1-\bar{d}} \right)^\alpha \right)}{\frac{\bar{d}}{\bar{u}} + \left(\frac{1+\bar{u}}{1-\bar{d}} \right)^\alpha}, \quad (7)$$

and the lower bound is:

$$\underline{\widehat{E}(r)} = \frac{\underline{d} \left(1 - \left(\frac{1+\underline{u}}{1-\underline{d}} \right)^\alpha \right)}{\frac{\underline{d}}{\underline{u}} + \left(\frac{1+\underline{u}}{1-\underline{d}} \right)^\alpha}. \quad (8)$$

Empirically, we use (1) – (3) to recover information about the EAD premia, and use (4) – (8) to bound these estimates.³

3 EAD Risk Premia Estimation

In this section, we estimate the EAD risk premia following the methodology in Section 2. We use both daily and intra-daily data to show patterns of the risk premia.

¹Empirically, this condition is satisfied for 99.14% of the observations. We drop all the observations that violate this condition when estimating the upper bound.

²See Section 3.2.2 for details.

³Empirically, we drop all observations that violate $\overline{\widehat{E}(r)} \geq \underline{\widehat{E}(r)}$.

3.1 Data and sample

Our main focus is to recover the EAD risk premia for stocks included in the S&P 500 index. We identify the earnings announcement dates as the identical dates between the report date of quarterly earnings (RDQ) from CompuStat and announce date (ANNDATS) from I/B/E/S. We obtain daily option prices from OptionMetrics and individual stock prices from CRSP. Due to the limited trading activities of the option market in the early years, we focus on the post-2010 period after weekly options were actively traded. Thus, our sample period spans from January 2010 to December 2021 and covers 23,116 earning announcements. We also obtain minute-by-minute option quote data from the CBOE exchange to explore intra-daily patterns of the EAD risk premia.

We choose options with life spans covering the 24-hour time interval right before earnings announcements. To better identify the EAD risk premia, we only consider options that mature within three days and expire after an announcement. Our sample only retains options with the shortest maturity for each announcement. To get better estimation results for the EAD risk premia, we apply two major filters to ensure the contracts in our estimation are actively traded. We require the bid-ask spread to mid-price ratio of the option to be lower than 0.2, and the trading volume to be positive. We estimate the drift sizes in (1) based on two calls and two puts with the closest strike prices to the underlying stock price.

The screening criteria described above significantly reduce our sample size. Table 1 reports summary statistics of firm characteristics of the sample before and after the filtration. After applying these filters, the number of effective earnings dates in our sample dropped from 23,116 to 3,812. However, our research scope is still representative since the firm characteristics are similar in size, value, past returns, and market beta. For example, the average, standard deviation, and median of the CAMP beta of the whole sample are 1.03, 0.38, and 1.01, respectively, compared to 1.08, 0.35, and 1.07 for the reduced sample.

3.2 Empirical issues in the estimation

Before proceeding to the estimation of the EAD risk premia, we discuss two empirical issues and how we deal with them. The first one is some details about how to match the timeline of the theoretical model, and the second one is to determine the value of α in (3).

3.2.1 Match timeline

Since we focus on immediate jumps in stock prices around earnings calls, it is necessary to construct an accurate timeline to separate pre-EAD and post-EAD periods clearly. We specify day 0 as the trading day right before each announcement, where no information is formally released.

If earnings are announced on non-trading dates, we define the previous closest trading date as day 0. For earnings announced on trading days, we identify those after the market close time (4:00 pm) as post-market announcements and those before market open time (9:00 am) as pre-market announcements. For post-market announcements, as the earnings information is not already incorporated into asset prices until the market closes, the day relative to EAD is set as day 0 for the announcement day. In contrast, for the pre-market announcements, we label the trading day before the announcement day as day 0, since the closing prices on that day reflect the information from earnings. Such a classification rule can guarantee that the events arrive between day 0 and day 1, which corresponds to the time points $t = 0-$ and $t = 0+$ in our model. There are 48% post-market announcements and 44% pre-market announcements. The remaining 8% are during the market time. We exclude them to cleanly identify the information arrival time.

3.2.2 Determine parameter value

To estimate the EAD risk premia, we also need to determine the level of α in (3). We use the data during January 1996 to December 2010 as training period to select this value. In

this way, our estimation does not suffer a look-ahead bias. We search for the optimal level of α to maximize the R-square:

$$R^2 = 1 - \frac{\sum_{i=1}^N \sum_{t=1}^T \left(\tilde{r}_{it} - \widehat{E}(r)_{it} \right)^2}{\sum_{i=1}^N \sum_{t=1}^T \left(\tilde{r}_{it} - \bar{r}_{it} \right)^2}, \quad (9)$$

where \tilde{r}_{it} is the realized return for firm i from day t to day $t + 1$, $\widehat{E}(r)_{it}$ is the risk premium estimates for firm i on day t , and \bar{r}_{it} is the pooling average of historical returns for firm i . The goal is to choose a level of α to best fit the realized returns.⁴

3.3 Drift size estimates

Our sample covers 3812 earnings announcement dates associated with 357 firms. Panel A of Table 2 reports the summary statistics of the prices, moneyness, and maturities of options used in the estimation. The mean prices of C_1 , C_2 , P_1 , and P_2 are \$ 1.91, \$ 2.61, \$1.89, and \$2.55, respectively. The middle 90% of moneyness ranging from 0.9727 to 1.0287. The strike prices are very likely to fall within the drift range in our estimation, satisfying the condition required by the model. There are 880 EAD risk premia estimated by one-day maturity options, and 1,371 estimated by two-day maturity contracts, the rest are estimated by options with three days of maturity. The short maturity guarantees that our measure capture almost exclusively the risk from the earnings announcements.

Summary statistics of estimated drift sizes, state prices, and the sum of state prices are presented in Panel B. We standardize the estimates to daily horizon according to the option maturities. This helps us to match the estimated variables with realized ones. The daily

⁴In this optimization, we also carefully consider the synchronicity issues between options and stocks markets. As Cremers and Weinbaum (2010) claim, because the option market closes two minutes after stock market in the US, option prices could contain information that is not yet incorporated in the underlying securities prices. Option data in OptionMetrics are captured by 3:59 pm after March 2008 to provide more synchronized option data with underlying securities. But for the periods between 2005 and 2008, option prices were captured by 4:02 pm. Thus, we drop EADs that are published from 4:00 to 4:02 pm between 2005 and 2008.

upward and downward drifts are estimated as 2.46% and 2.51% on average, with standard deviations of 1.63% and 1.58%, respectively. This magnitude translates to an annual return of 619.92% and 632.52%. The estimates are consistent with the stylized fact that a large component of the annual return of a typical stock is driven by the EAD returns (Vuolteenaho (2002), Frazzini and Lamont (2007), and Lochstoer and Tetlock (2020)).

The mean of state prices of upside and downside drifts are 0.5104 and 0.4907, respectively. The time interval of interest is only a few days, thus, we set the interest rate to zero for expositional simplicity. When the interest rate is set to zero, the relation of $\pi_u + \pi_d = 1$ should hold. Since the state prices are estimated independently from call and put options, this relation is not guaranteed to hold empirically. To check this, we calculate $\pi_u + \pi_d$ for each estimated pair. The mean of $\pi_u + \pi_d$ equals 1.0011 with a standard deviation of 0.0423. This implies the option market’s efficiency and our estimation methodology’s accuracy.

To evaluate the precision of our drift sizes estimates, following Liu et al. (2022), for each stock i , we consider the pseudo predictor,

$$\hat{r}_i = \begin{cases} u_i & \text{if } \tilde{r}_i > 0; \\ -d_i & \text{if } \tilde{r}_i < 0, \end{cases} \quad (10)$$

where \tilde{r}_i is the realized EAD return from day 0 to day 1 for firm i . The reason that the predictor is considered as “pseudo” is that it uses the directional information of the realized returns. However, as pointed out in Liu et al. (2022), this pseudo predictor can be very useful in evaluating the precision of drift size estimate. To follow their method, we estimate a “pseudo” out-of-sample (OOS) R-squared for each stock i :

$$R_{OOS,i}^2 = 1 - \frac{\sum_{t=1}^{T_i} (\tilde{r}_{t,i} - \hat{r}_{t,i})^2}{\sum_{t=1}^{T_i} (\tilde{r}_{t,i} - \bar{r}_{t,i})^2}, \quad (11)$$

where $\bar{r}_{t,i}$ is a standard benchmark equal to the historical average of realized return of the past 252 trading days, and T_i is the sample length for stock i . In ideal cases, when the

option implied drift sizes are the same as the realized ones, the OOS R-squared is 100%, i.e., the pseudo prediction has zero prediction error. We estimate the pseudo OOS R-squared to examine how close this is true. A sufficiently high OOS R-squared indicates an accurate estimation.

To better illustrate the prediction performance, we only consider firms with at least 15 announcements. There are totally 100 firms considered in this analysis. Table 3 presents the summary statistics of the “pseudo” OOS R-squared and the correlation coefficient between pseudo predictors and realized returns. The average “pseudo” OOS R-squared is 55.76%, with the middle 90% observations ranging from 40.61% to 70.54%. This large OOS R-squared indicates that our drift size estimates are quite reasonable. The correlation coefficients range from 0.6470 to 0.8832 for the middle 90% of the distribution, with an average of 0.7841, suggesting that our drift sizes estimates are strongly correlated with realized returns.

3.4 EAD risk premia estimates

To continue with the EAD risk premia estimation, We next follow (9) to calibrate the parameter α in (3). According to our calibration result, $\alpha = -1.138$. If we assume the conventional level of the intertemporal elasticity of substitution $\psi = 1.5$, the relative risk aversion equals 1.046, which lies in the reasonable range documented by literature. The EAD risk premia and corresponding upper and lower bounds are calculated following (3), (7), and (8).

Table Table 4 reports summary statistics of the EAD risk premia and their upper and lower bounds, as well as the corresponding realized EAD returns. The realized EAD returns are from day 0 to day 1. The average estimated EAD risk premium is 15 bps, with average upper and lower bounds to be 26 bps and 10 bps, respectively. Comparably, the average realized EAD return is 11 bps. Notice that the EAD returns are considerably higher than the non-EADs’ returns, which is 4 bps on average. This pattern is consistent with the

earnings premium literature (see Cohen et al. (2007); Frazzini and Lamont (2007); Savor and Wilson (2016)). The average realized return can be considered as an ex-post estimate of the unconditional risk premium for the announcements in our sample. This estimate falls between the upper and lower bounds of risk premium, which validates our estimation procedure.

To further explore the risk premia behavior around the EAD, we also estimate the risk premia for other days with a similar methodology and present the pattern in Figure 1. This figure displays the average of risk premia, risk premia bounds, and realized returns around the EAD. A clear pattern can be seen from the figure is that the risk premia and corresponding bounds gradually increase from 3 bps to 11 bps as the EAD approaches. The increasing risk premia incorporate forthcoming uncertainty and risk compensation required by investors. After the EAD, when the uncertainty is resolved, the risk premium crashes to about 1 bps. Our estimates clearly exhibit the same pattern, matching well with the realized returns.

Finally, we test the predictive power of our estimated EAD risk premia. For each year, we divide the whole sample into observations with high EAD risk premium, medium EAD risk premium, and low EAD risk premium groups, according to 33th and 67th percentile.⁵ The summary statistics of the EAD returns among three groups are reported in Table 5. From the table, we can find that the average realized EAD return of the portfolio formed by stocks with high estimated EAD risk premia is 30 bps, while that associated with low EAD risk premia is -1 bps. The difference is 31 bps, with a t-statistic of 2.00, indicating that the estimated EAD risk premia can substantially predict EAD returns cross-sectionally.

⁵We subgroup the sample first by year to control economic condition change over different years in our sample.

3.5 Drift sizes and risk premium: high-frequency scenario

To better understand the pattern of the EAD risk premia before earnings announcements and its potential predictability of realized returns, we investigate at a much finer frequency in this section. We obtain minute-by-minute option quote data from the CBOE exchange. We select three representative companies, NVIDIA Corporation (NVDA), Cisco Systems Inc (CSCO), and Microsoft Corp (MSFT), which cover different levels of the EAD risk premia. Our sample covers 30, 28, and 33 announcements for the three firms NVDA, CSCO, and MSFT, respectively.

Panel A of Table 6 reports summary statistics of EAD risk premia estimation for these three firms with daily option prices. From the table we can see that the mean of estimated EAD risk premia ranges from 12 bps to 51.

The minute-by-minute data set contains option quote prices for all available option contracts for every minute during market trading hours. We estimate the drift sizes and the EAD risk premia for all available option data. Similar to daily cases, we select two call and two put options that are closest to the money, and with the shortest maturity horizon for the estimation. Panel B of Table 6 presents the summary statistics of the minute-by-minute drift sizes, state prices, and risk premium on day 0 of each announcement, and the corresponding realized overnight return from day 0 to day 1. At a much finer frequency, the summation of the state prices of upward and downward states, $\pi_u + \pi_d$, equals 0.9975, 0.9999, and 0.9997, for the three firms, respectively. This implies that our estimation method is still valid even in high-frequency situations. With high-frequency data, we are able to use close-to-open stock return to identify realized EAD returns. The overnight return from the market close time on day 0 to the market open time on day 1 could provide a cleaner and more accurate market reaction to the earnings announcements. Therefore, we use the realized overnight return to evaluate the predictability in this section.

To better illustrate the dynamics of the EAD risk premia, we plot the estimated EAD

risk premia by minute from day -3 to day 1, as shown in Figure 2.⁶ Consistent with our previous results shown at a daily frequency, there is a build-up in the EAD risk premia as the earnings announcement date approaches. This is consistent with the theory: as the event is right around the corner, agents face greater uncertainty and need to be compensated with a higher risk premium. After the earnings are announced and the uncertainty is resolved, the jump risk premium collapses to a much lower level as a normal period. In addition, from the high-frequency data, we can clearly see that the volatility of the estimated EAD risk premia is much higher on day 0 compared to other days, further supporting the theory.

To examine the predictive power of drift sizes estimated by tick data, we again construct the pseudo predictor following (10), where \tilde{r}_i represents the overnight realized returns for firm i . One may concern that option closing prices could potentially suffer from sudden increase in the trading volume, given that option prices regularly jump up or down due to the limited market depth. To reduce the noises, for each EAD, we construct “tick average pseudo predictor”, which averages available pseudo predictor of all minutes on day 0, and compare it with the daily pseudo predictors. We present the time series prediction comparison, and show the corresponding pseudo prediction OOS R-squared in Figure 3. Firstly, the figure shows a strong link between the realized return and the two pseudo predictors over time, suggesting the accuracy of return magnitude on individual level. Secondly, “tick average pseudo predictor” has same performance with “daily pseudo predictor”, which further demonstrates our the estimation accuracy.

4 Applications of Our Estimates

In this section, we present two applications of our estimated EAD risk premia. First, we provide strong evidence that the economic channel of post-earnings-announcement drift is

⁶For each minute, we average the estimates of the EAD risk premia across different announcements, and construct confidence intervals based on the standard errors.

risk premium compensation. Second, we use the EAD risk premia to differentiate returns of selling straddles on the EAD ex-ante, leading to potential profitable trading opportunities, even after accounting for transaction costs.

4.1 Economic channel of PEAD

Post-earnings-announcement drift (PEAD) is one of the most robust anomalies that challenge the efficient market paradigm. Ball and Brown (1968) first show that even after earnings are announced, cumulative abnormal returns (CAPM model adjusted) continue to drift up for firms with high earnings surprise (SUE) and down for firms with low SUE.⁷ Bernard and Thomas (1989) discuss two potential explanations of PEAD. The first explanation is due to delayed information in the price responses. Alternatively, PEAD can be a result of risk compensation required by the investors. The literature provides mixed evidence supporting both explanations (Bernard and Thomas (1989), Angrist and Krueger (2001), Hung et al. (2015), etc). With our ex-ante estimate of the EAD risk premia, we are able to provide additional evidence for this debate.

Following the convention in the literature, we examine the PEAD by the cumulative abnormal return (CAR) of CAPM over the 60 trading days after an announcement. We first show that the well-known pattern of PEAD also exist in our sample. The left panel of Figure 5 depicts the time series of the value-weighted CARs for quintile portfolios sorted by SUE⁸. We can clearly see a divergence in CARs of high and low SUE portfolios, consistent with what is documented in the literature.

Next, we separate the whole sample into two subsamples divided by the median of our estimated EAD risk premia. If PEAD compensates the EAD risk premia, then the pattern should be more significant in the high EAD risk premia subsample, as observations in this

⁷Fama (1970), Foster et al. (1984), Bernard and Thomas (1989), Bernard and Thomas (1990), Richardson et al. (2010) also find consistent empirical evidence.

⁸SUE is calculated as I/B/E/S actual earnings per share minus the median analyst consensus forecast before the corresponding announcements.

sample are during announcements of higher uncertainty. Otherwise, if PEAD is due to price delay effect, both samples should exhibit similar patterns. The middle and right panels of Figure 5 presents CARs for subsamples with higher-than-median and lower-than-median estimated EAD risk premia, respectively. We find that PEAD is substantially more pronounced for the subsample when the EAD risk premia are high, and the pattern no longer exists for the subsample when they are low. More precisely, we report the CARs from day 2 to day 60 after the announcement in Table 7⁹. For the subsample with higher-than-median EAD risk premia, the portfolio with the most negative SUE has an average CAR of -3.08%, while the one with the most positive SUE has an average CAR of 2.94%, leading to a striking difference of 6.02%. On the contrary, the average CARs of the portfolio with the most negative SUE is -0.27%, while that of the portfolio with the most positive SUE is surprisingly lower, which is -0.73%. We can see that PEAD completely vanishes for the announcements with a low uncertainty, reinforce the risk premium explanation of the PEAD.

4.2 Differentiate straddle returns

Many studies document that straddle returns carry jump risk premium and volatility risk premium (Coval and Shumway (2001), Ang et al. (2006), Cremers et al. (2015), and Dubinsky et al. (2019)). Specifically, Dubinsky et al. (2019) found that returns of holding a straddle portfolio during EAD periods are more negative than during non-EAD periods, indicating a higher jump risk premium during EAD periods. However, due to the existence of transaction costs, the opposite position of selling a straddle portfolio is not on average profitable. Our estimated EAD risk premia allow us to empirically identify earnings announcements with high jump risk premia ex-ante, and only trade when the potential benefit is large, leading to a profitable trading strategy.

We start with exploring straddle returns around earnings announcements. The straddle

⁹Returns on day 1 is considered as immediate market reactions after the announcement.

returns of long positions (short positions) are calculated from purchasing (selling) ATM call and put options at the offer (bid) price and selling (buying) the position at the bid (offer) at the close time of the **next trading day**. This calculation estimates the forward return of a straddle after accounting for transaction costs. We estimate straddle returns for all announcement days (day 0) in our sample, as well as the trading day before (day -1) and after the announcement (day 1).

The average long and short straddle returns are reported in Table 8. For all days, the one-day straddle is not on average profitable regardless of the long or short position, which suggests the efficiency of the options market. Figure 4 displays the pattern of the straddle return variation around EADs. We can see that, though always being negative, the average return of selling a straddle is larger and the average return of buying a straddle is lower on day 0. This pattern of straddle returns is consistent with Dubinsky et al. (2019), which interpret this pattern as evidence of a negative, increase in magnitude, variance risk premium or jump risk premium of underlying stocks.

We next divide our sample into subsamples of higher-than-median and lower-than-median EAD risk premia. We expect that during those announcements with higher-than-median EAD risk premia, the increase in the returns of selling straddles is so large that it dominates the transaction costs.

Panel B of Table 8 provides summary statistics of returns of selling straddles on day 0 for both subsamples. The average returns are 0.39% and -0.17% for announcements associated with higher-than-median and lower-than-median EAD risk premia estimates, respectively. This leads to an economically large and statistically significant difference, which equals 0.56%. Therefore, we show that, we are able to profitably trade on the jump risk premia even with the existence of transaction costs based on our ex-ante estimates of the EAD risk premia.

5 Conclusion

In this paper, we study investors return expectations during earnings announcements. Using information from option markets, we find that the ex-ante risk premia are time-varying and have predictive power on future stock returns. Our study provides the first time-varying risk premia estimates in the earnings announcements literature, complementing a number of studies in this area. Our estimates are robust in a number of ways, and to the use of intraday data in particular.

We also provide new insights on two stylized facts. First, we find that the well-documented positive post-earnings-announcement drift (PEAD) is present only when the risk premia are high, consistent with a risk explanation of the PEAD rather than the one due to information delay. Second, while trading option straddles is not profitable in general, we find that the performance can be improved substantially during periods of high announcement risk premia.

How investors react and how different assets (such as EFTs) perform during earnings announcements are important questions in the literature. It is thus of interest to explore the implications of the risk premia on decision-making and performance evaluation. It is also of interest to study the ex-ante earnings announcements risk premia in the global markets. All of these appear as related topics for future research.

References

- H. Ai and R. Bansal. Risk preferences and the macroeconomic announcement premium. *Econometrica*, 86(4):1383–1430, 2018.
- A. Ang, J. Chen, and Y. Xing. Downside risk. *The review of financial studies*, 19(4):1191–1239, 2006.
- J. D. Angrist and A. B. Krueger. Instrumental variables and the search for identification: From supply and demand to natural experiments. *Journal of Economic perspectives*, 15(4):69–85, 2001.
- P. Augustin, M. Brenner, and M. G. Subrahmanyam. Informed options trading prior to takeover announcements: Insider trading? *Management Science*, 65(12):5697–5720, 2019.
- R. Ball and P. Brown. An empirical evaluation of accounting income numbers. *Journal of accounting research*, pages 159–178, 1968.
- R. Ball and S. P. Kothari. Security returns around earnings announcements. *Accounting Review*, pages 718–738, 1991.
- B. M. Barber, E. T. De George, R. Lehavy, and B. Trueman. The earnings announcement premium around the globe. *Journal of Financial Economics*, 108(1):118–138, 2013.
- V. L. Bernard and J. K. Thomas. Post-earnings-announcement drift: delayed price response or risk premium? *Journal of Accounting research*, 27:1–36, 1989.
- V. L. Bernard and J. K. Thomas. Evidence that stock prices do not fully reflect the implications of current earnings for future earnings. *Journal of accounting and economics*, 13(4):305–340, 1990.
- T. Bollerslev, J. Marrone, L. Xu, and H. Zhou. Stock return predictability and variance risk premia: Statistical inference and international evidence. *Journal of Financial and Quantitative Analysis*, 49(3):633–661, 2014.

- V. V. Chari, R. Jagannathan, and A. R. Ofer. Seasonalities in security returns: The case of earnings announcements. *Journal of Financial Economics*, 21(1):101–121, 1988.
- M. Chesney, R. Crameri, and L. Mancini. Detecting abnormal trading activities in option markets. *Journal of Empirical Finance*, 33:263–275, 2015.
- D. A. Cohen, A. Dey, T. Z. Lys, and S. V. Sunder. Earnings announcement premia and the limits to arbitrage. *Journal of Accounting and Economics*, 43(2-3):153–180, 2007.
- J. D. Coval and T. Shumway. Expected option returns. *The journal of Finance*, 56(3):983–1009, 2001.
- W. M. Cready and U. G. Gurun. Aggregate market reaction to earnings announcements. *Journal of Accounting Research*, 48(2):289–334, 2010.
- M. Cremers and D. Weinbaum. Deviations from put-call parity and stock return predictability. *Journal of Financial and Quantitative Analysis*, 45(2):335–367, 2010.
- M. Cremers, M. Halling, and D. Weinbaum. Aggregate jump and volatility risk in the cross-section of stock returns. *The Journal of Finance*, 70(2):577–614, 2015.
- M. S. Drake, D. T. Roulstone, and J. R. Thornock. Investor information demand: Evidence from google searches around earnings announcements. *Journal of Accounting research*, 50(4):1001–1040, 2012.
- A. Dubinsky, M. Johannes, A. Kaeck, and N. J. Seeger. Option pricing of earnings announcement risks. *The Review of Financial Studies*, 32(2):646–687, 2019.
- D. Easley, M. O’hara, and P. S. Srinivas. Option volume and stock prices: Evidence on where informed traders trade. *The Journal of Finance*, 53(2):431–465, 1998.
- L. H. Ederington and J. H. Lee. The creation and resolution of market uncertainty: the impact of information releases on implied volatility. *Journal of Financial and Quantitative Analysis*, 31(4):513–539, 1996.

- E. F. Fama. Efficient capital markets: A review of theory and empirical work. *The journal of Finance*, 25(2):383–417, 1970.
- G. Foster, C. Olsen, and T. Shevlin. Earnings releases, anomalies, and the behavior of security returns. *Accounting Review*, pages 574–603, 1984.
- A. Frazzini and O. A. Lamont. The earnings announcement premium and trading volume. *Available at SSRN 986940*, 2007.
- L. Ge, T.-C. Lin, and N. D. Pearson. Why does the option to stock volume ratio predict stock returns? *Journal of Financial Economics*, 120(3):601–622, 2016.
- P. Gharghori, E. D. Maberly, and A. Nguyen. Informed trading around stock split announcements: Evidence from the option market. *Journal of financial and quantitative analysis*, 52(2):705–735, 2017.
- P. Hecht and T. Vuolteenaho. Explaining returns with cash-flow proxies. *The Review of Financial Studies*, 19(1):159–194, 2006.
- M. Hung, X. Li, and S. Wang. Post-earnings-announcement drift in global markets: Evidence from an information shock. *The Review of Financial Studies*, 28(4):1242–1283, 2015.
- C. S. Jensen, D. Lando, and L. H. Pedersen. Generalized recovery. *Journal of Financial Economics*, 133(1):154–174, 2019.
- O. Kadan and A. Manela. Estimating the value of information. *The Review of Financial Studies*, 32(3):951–991, 2019.
- O. Kadan and X. Tang. A bound on expected stock returns. *The Review of Financial Studies*, 33(4):1565–1617, 2020.
- O. Kadan, F. Liu, and X. Tang. Recovering implied volatility. *Management Science*, forthcoming, 2023.

- S. Kothari, J. Lewellen, and J. B. Warner. Stock returns, aggregate earnings surprises, and behavioral finance. *Journal of Financial Economics*, 79(3):537–568, 2006.
- O. Lamont and A. Frazzini. The earnings announcement premium and trading volume, 2007.
- H. Liu, X. Tang, and G. Zhou. Recovering the fomo risk premium. *Journal of Financial Economics*, 145(1):45–68, 2022.
- L. A. Lochstoer and P. C. Tetlock. What drives anomaly returns? *The Journal of Finance*, 75(3):1417–1455, 2020.
- I. W. Martin and C. Wagner. What is the expected return on a stock? *The Journal of Finance*, 74(4):1887–1929, 2019.
- S. X. Ni, J. Pan, and A. M. Poteshman. Volatility information trading in the option market. *The Journal of Finance*, 63(3):1059–1091, 2008.
- E. Ofek, M. Richardson, and R. F. Whitelaw. Limited arbitrage and short sales restrictions: Evidence from the options markets. *Journal of Financial Economics*, 74(2):305–342, 2004.
- J. Pan and A. M. Poteshman. The information in option volume for future stock prices. *The Review of Financial Studies*, 19(3):871–908, 2006.
- S. Richardson, İ. Tuna, and P. Wysocki. Accounting anomalies and fundamental analysis: A review of recent research advances. *Journal of Accounting and Economics*, 50(2-3):410–454, 2010.
- S. Ross. The recovery theorem. *The Journal of Finance*, 70(2):615–648, 2015.
- G. Sadka and R. Sadka. Predictability and the earnings–returns relation. *Journal of financial economics*, 94(1):87–106, 2009.
- P. Savor and M. Wilson. Earnings announcements and systematic risk. *The Journal of Finance*, 71(1):83–138, 2016.

- E. C. So and S. Wang. News-driven return reversals: Liquidity provision ahead of earnings announcements. *Journal of Financial Economics*, 114(1):20–35, 2014.
- X. Tang. Variance asymmetry managed portfolios. *Available at SSRN 3108007*, 2019.
- T. Vuolteenaho. What drives firm-level stock returns? *The Journal of Finance*, 57(1): 233–264, 2002.

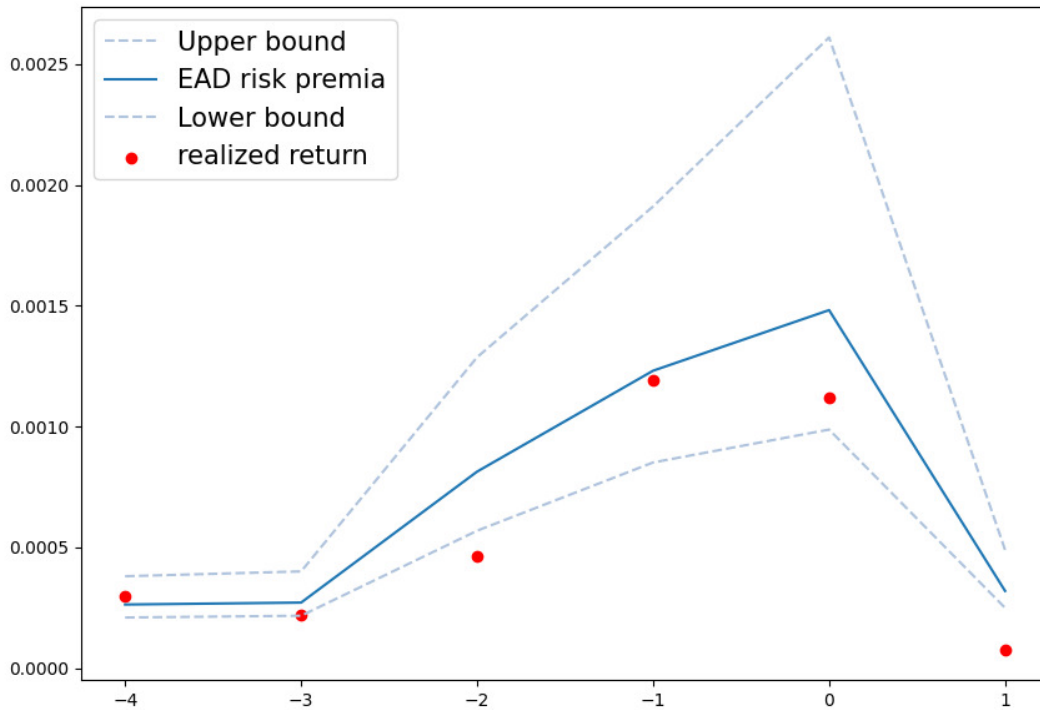


Figure 1: Risk Premium Estimates around Earnings Announcements

Notes: The figure displays the estimation of risk premium, upper bound and lower bound of risk premium, and the realized forward returns around earnings announcements. The sample period spans from January 2010 to December 2021. The sample includes earnings announcements for firms included in S&P 500 index, after applying the filters described in Section 3.1. All numbers are computed as pooling averages over quarters and over firms.

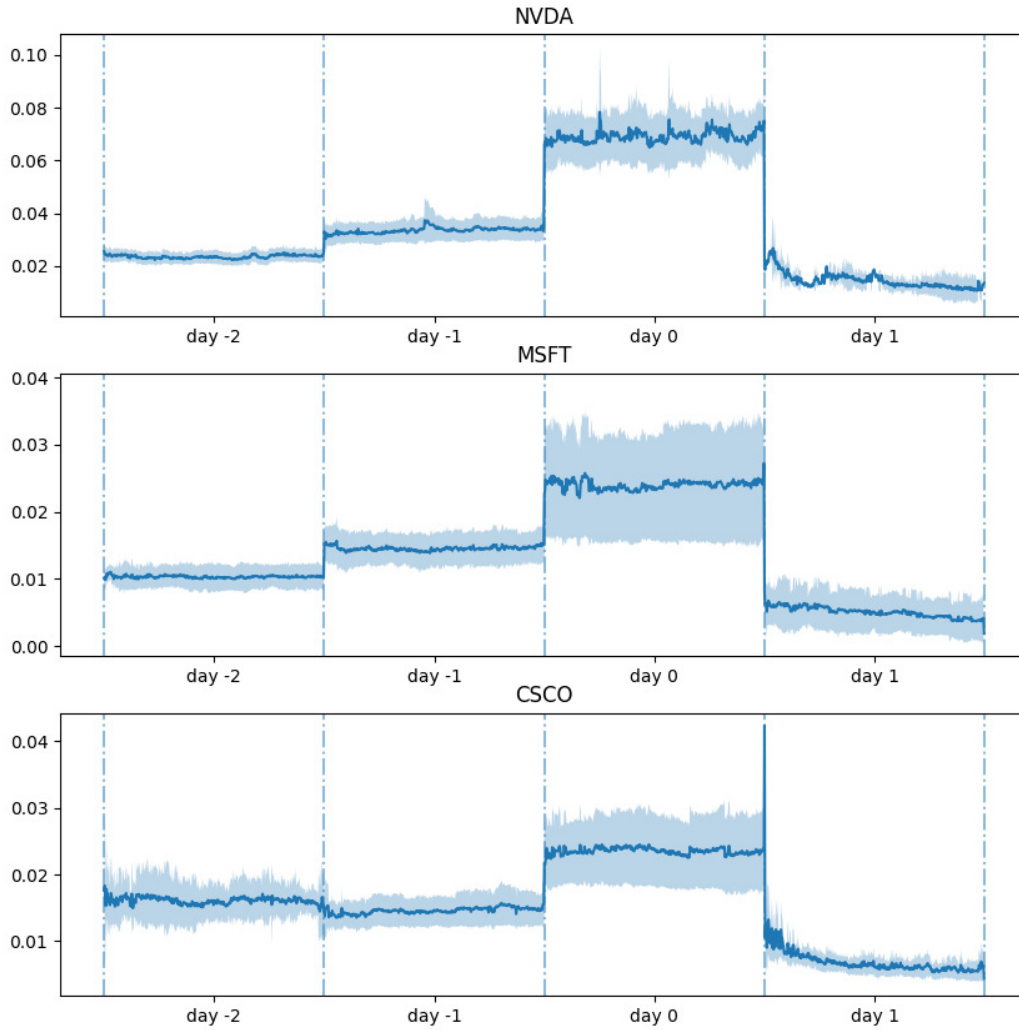


Figure 2: Minute-by-Minute Risk Premium Estimates around Earnings Announcements
 Notes: The figure shows the dynamic of risk premium estimates around earnings announcements from the beginning of day -3 to the end of day 1, with day 0 being the announcement day. The risk premia are estimated by tick option price data at minute-by-minute frequency. The blue line shows the time series average across all earnings for the same firm, and the shaded area represents the 95% confidence interval. The estimated values are available from 9:30 am to 4:00 pm, covering the option market trading time of the day. The sample includes options written on the three individual firms: NVIDIA Corporation (NVDA), Microsoft Corp (MSFT), and Cisco Systems Inc (CSCO). The sample period spans from January 2010 to December 2021.

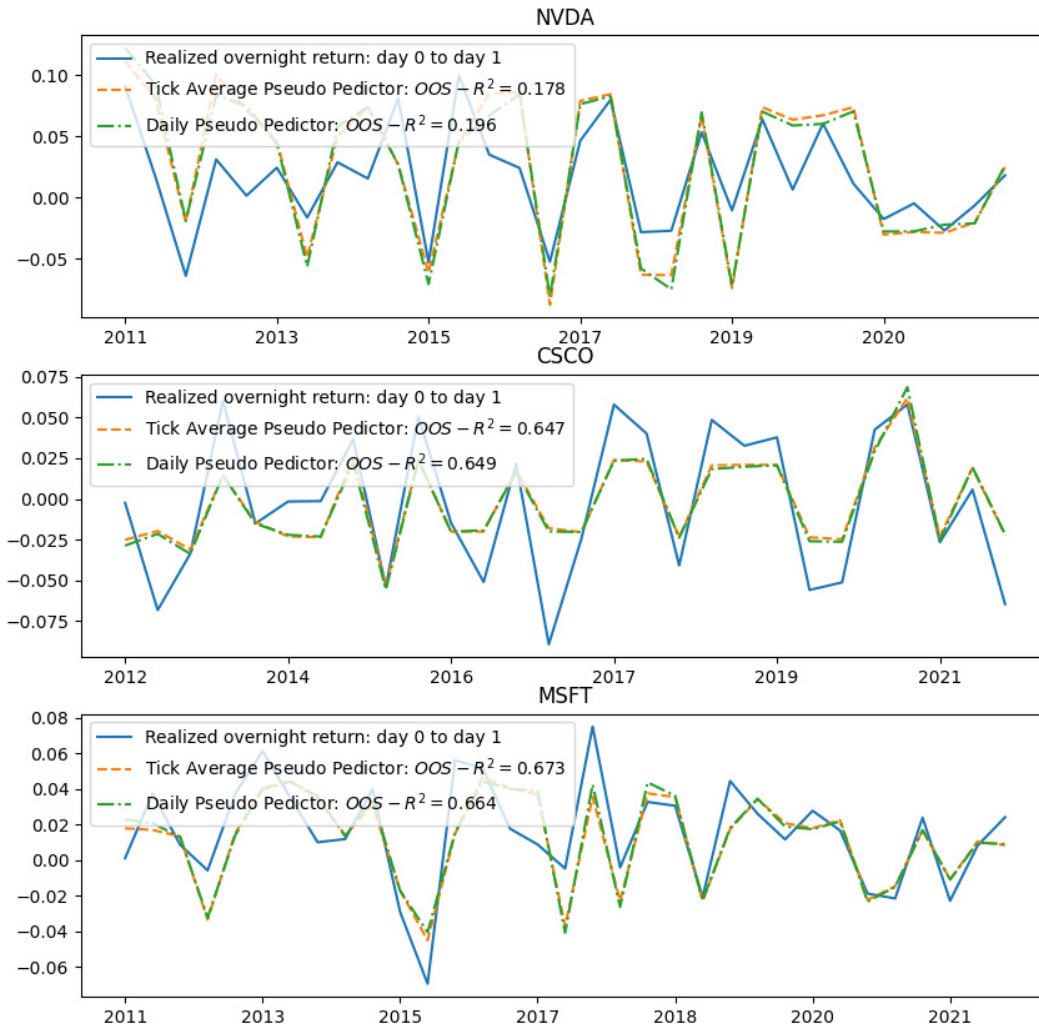


Figure 3: Pseudo Prediction

Notes: The figure presents the time series of the pseudo prediction on day 0, following (10), and the realized overnight announcement returns from day 0 to day 1. The pseudo prediction is estimated with both daily option prices and the daily average of drift estimates with minute-by-minute option prices. The sample includes options written on the three individual firms: NVIDIA Corporation (NVDA), Microsoft Corp (MSFT), and Cisco Systems Inc (CSCO). The sample period spans from January 2010 to December 2021.

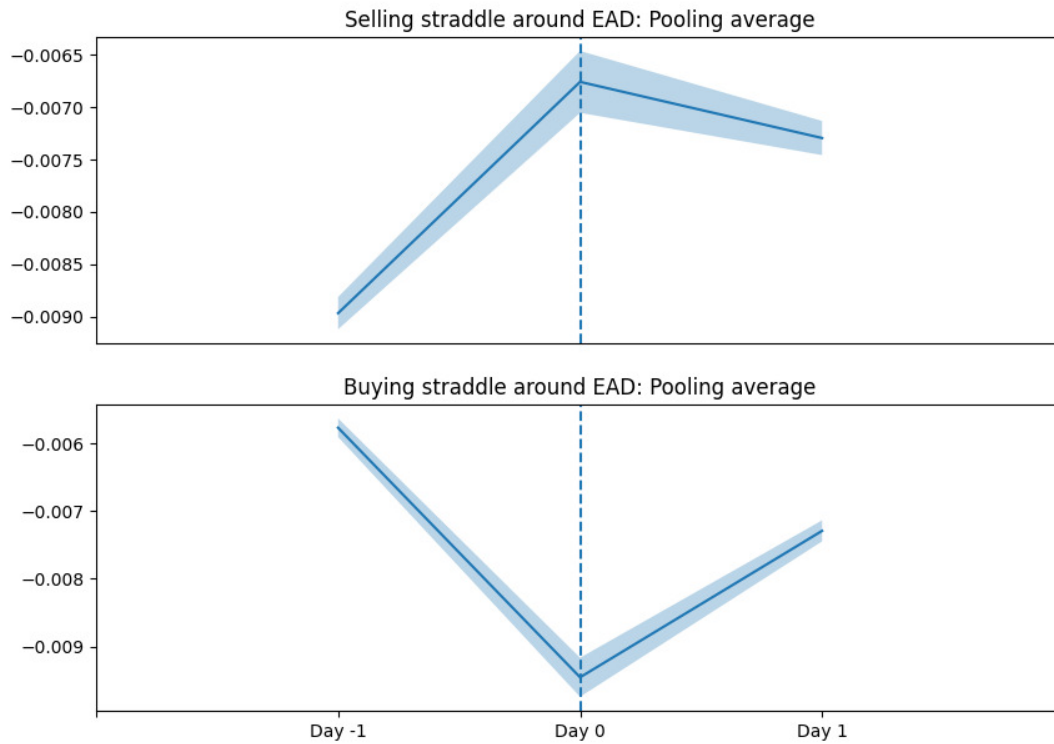


Figure 4: Straddle Returns around Earnings Announcements

Notes: The figure displays the pooling average of daily returns on at-the-money delta-neutral straddles around earnings announcements. The top panel presents returns of selling at the bid prices and buying at the offer prices. The bottom panel presents returns of buying at the offer prices and selling at the bid prices. The holding period for all straddles is one-day. The sample period spans from January 2010 to December 2021. The sample includes earnings announcements for firms included in S&P 500 index, after applying the filters described in Section 3.1.

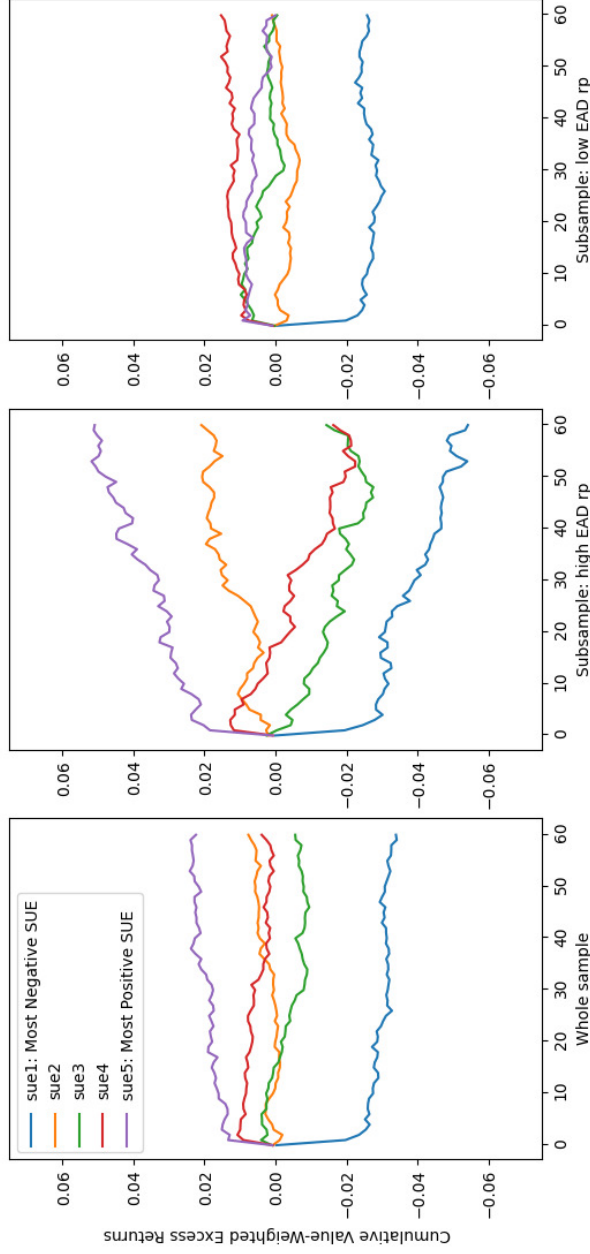


Figure 5: CARs following Earnings Announcements for Analyst-based SUE Portfolios

Notes: The left panel displays buy-and-hold value-weighted cumulative abnormal return for quintile portfolios sorted by analyst-based SUE. The middle panel and right panel present results of high risk premia group and low risk premia group, divided by the median of our estimated ex-ante EAD risk premia. The sample period spans from January 2010 to December 2021. The sample includes earnings announcements for firms included in S&P 500 index. All numbers are computed as pooling averages over quarters and over firms.

Table 1: Summary Statistics of Firm Characteristics

This table presents summary statistics of firm characteristics for the sample before and after applying the filters described in Section 3.1. The sample period spans from January 2010 to December 2021. The sample includes all S&P 500 stocks during the sample period. *MktCap* is the log of the market capitalization; *BTM* is the log of book-to-market ratio; *Beta* is the estimated CAPM beta using the past 252 trading days. *Mom* is the log of the gross return over the past twelve months.

	<i>MktCap</i>	<i>BTM</i>	<i>Beta</i>	<i>Mom</i>
Full Sample (N = 23,064)				
Mean	16.81	0.49	1.03	0.16
Std. Dev.	1.06	0.40	0.38	0.33
Median	16.69	0.39	1.01	0.13
After Filtration (N = 3,812)				
Mean	17.67	0.44	1.08	0.16
Std. Dev.	1.15	0.38	0.35	0.36
Median	17.69	0.34	1.07	0.12

Table 2: Summary Statistics of Drift Sizes and State Prices Estimates

The table reports summary statistics of the variables associated with the estimation of drift sizes and state prices (Panel A) and the estimated drift sizes and state prices (Panel B). The estimation includes options written on individual firms with maturity shorter than three days and covers the earnings announcements. On each earnings announcement day in our sample, we use the prices of two call and put options that have strike prices closest to the money, and follow (1) and (2) to estimate drift sizes and state prices. The estimation uses option closing prices on day 0, defined in Section 3.2.1. The sample includes all earnings announcements for S&P 500 firms from January 2010 to December 2021.

Variable	Obs	Mean	Std. Dev.	5%	25%	50%	75%	95%
Panel A: Summary Statistics of Related Variables								
C_1	3812	1.9130	3.3330	0.2550	0.6250	1.1100	2.1213	5.6250
C_2	3812	2.6098	3.6801	0.5750	0.9900	1.6100	2.9950	7.2225
P_1	3812	1.8852	3.1769	0.2550	0.6300	1.1150	2.1113	5.5613
P_2	3812	2.5523	3.5251	0.5578	0.9850	1.5700	2.9250	6.9500
K_1^C	3812	1.0085	0.0096	1.0003	1.0027	1.0057	1.0102	1.0287
K_2^C	3812	0.9913	0.0089	0.9727	0.9894	0.9939	0.9969	0.9993
K_1^P	3812	0.9913	0.0089	0.9727	0.9894	0.9939	0.9969	0.9993
K_2^P	3812	1.0085	0.0096	1.0003	1.0027	1.0057	1.0102	1.0287
Maturity	3812	2.1288	0.7577	1.0000	2.0000	2.0000	3.0000	3.0000
Panel B: Summary Statistics of Drift Sizes and State Prices								
u	3812	0.0246	0.0163	0.0089	0.0137	0.0197	0.0296	0.0583
d	3812	0.0251	0.0158	0.0096	0.0145	0.0202	0.0303	0.0573
π_u	3812	0.5104	0.0624	0.4096	0.4700	0.5100	0.5500	0.6100
π_d	3812	0.4907	0.0612	0.4000	0.4500	0.4900	0.5250	0.5980
$\pi_u + \pi_d$	3812	1.0011	0.0423	0.9400	0.9800	1.0000	1.0200	1.0700

Table 3: OOS R-Squared of Pseudo prediction

This table reports summary statistics of the out-of-sample (OOS) R-squared of time-series pseudo prediction in (10), and the Pearson correlation coefficient between pseudo predictors and realized returns. We construct pseudo predictors on day 0, and calculate realized returns using closing prices on day 0 and day 1. The OOS R-squared calculation follows that in (11). The sample includes all earnings announcements for S&P 500 firms from January 2010 to December 2021.

	Obs	Mean	Std. Dev.	5%	25%	50%	75%	95%
Pseudo OOS R^2	100	0.5576	0.0933	0.4061	0.4974	0.5551	0.6192	0.7054
Correlation Coefficient	100	0.7841	0.0742	0.6470	0.7379	0.7917	0.8331	0.8832

Table 4: Summary Statistics of the EAD Risk Premia Estimates

This table reports summary statistics of the estimated EAD risk premia. We use options written on corresponding firm stocks with maturities shorter than three days and that cover the earnings announcements. On each earnings announcement, we use the prices of two call and put options that have strike prices closest to the money, and follow (3) to estimate the EAD risk premia. Also, we use the corresponding bid and ask prices to estimate the upper and lower bounds of EAD risk premia following (7) and (8). The parameter level follows calibration discussed in Section 3.2.2. Realized returns are calculated using closing prices on day 0 and day 1. The sample includes all earnings announcements for S&P 500 firms from January 2010 to December 2021.

	Obs	Mean	Std. Dev.	5%	25%	50%	75%	95%
rp	3812	0.0015	0.0016	0.0003	0.0006	0.0010	0.0018	0.0045
\overline{rp}	3812	0.0026	0.0026	0.0004	0.0008	0.0016	0.0037	0.0084
\underline{rp}	3812	0.0010	0.0011	0.0002	0.0004	0.0007	0.0012	0.0030
Realized returns	3812	0.0011	0.0386	-0.0646	-0.0260	0.0006	0.0290	0.0669

Table 5: Tercile Realized Returns Sorted by the EAD Risk Premia

This table reports average and volatility of the realized returns from day 0 to day 1 of earnings announcements for tercile portfolios sorted by our estimated ex-ante EAD risk premia. The table also reports difference and t-statistics between the high and low portfolio. The sample includes all earnings announcements for S&P 500 firms from January 2010 to December 2021.

	Obs	Mean	Std. Dev.
High EAD RP	1270	0.0030	0.0451
Medium EAD RP	1266	0.0005	0.0384
Low EAD RP	1276	-0.0001	0.0309
High minus Low		0.0031	
<i>t</i> -stat		2.00	

Table 6: Summary Statistics of the High-Frequency Estimation

This table reports summary statistics of the estimated EAD risk premium at daily frequency (Panel A) and the estimated drift sizes and state prices at minute-by-minute frequency and the corresponding realized close-to-open returns from day 0 to day 1 (Panel B) for three firms, Nvidia Corporation (NVDA), Cisco Systems Inc (CSCO), and Microsoft Corp (MSFT). At each minute on the announcement day, we choose four option contracts with a life span shorter than 3 days and strike prices closest to the money, to estimate parameters following the methodology described in Section 2. The sample includes all earnings announcements for three firms from January 2010 to December 2021.

	Obs	Mean	Std. Dev.	5%	25%	50%	75%	95%
Panel A: Estimation with Daily Option Prices								
NVDA	30	0.0051	0.0032	0.0014	0.0028	0.0049	0.0064	0.0094
CSCO	28	0.0014	0.0009	0.0008	0.0010	0.0012	0.0016	0.0025
MSFT	33	0.0012	0.0006	0.0004	0.0007	0.0012	0.0017	0.0020
Panel B: Estimation with Minute-by-Minute Option Prices								
NVDA								
u	10,856	0.0622	0.0231	0.0242	0.0456	0.0658	0.0783	0.0989
d	10,856	0.0598	0.0215	0.0205	0.0440	0.0656	0.0758	0.0873
π_u	10,856	0.4895	0.0398	0.4200	0.4700	0.4900	0.5100	0.5500
π_d	10,856	0.5080	0.0420	0.4400	0.4800	0.5100	0.5300	0.5800
$\pi_u + \pi_d$	10,856	0.9975	0.0302	0.9500	0.9900	1.0000	1.0100	1.0400
rp	10,856	0.0050	0.0025	0.0014	0.0027	0.0052	0.0066	0.0095
$r_{overnight}$	30	0.0161	0.0432	-0.0527	-0.0149	0.0163	0.0437	0.0866
CSCO								
u	10,893	0.0245	0.0093	0.0151	0.0197	0.0226	0.0254	0.0428
d	10,893	0.0248	0.0094	0.0161	0.0201	0.0230	0.0254	0.0547
π_u	10,893	0.5044	0.0412	0.4400	0.4800	0.5000	0.5300	0.5700
π_d	10,893	0.4956	0.0420	0.4200	0.4600	0.5000	0.5200	0.5650
$\pi_u + \pi_d$	10,893	0.9999	0.0162	0.9800	0.9900	1.0000	1.0100	1.0200
rp	10,893	0.0014	0.0007	0.0007	0.0010	0.0012	0.0015	0.0026
$r_{overnight}$	28	-0.0037	0.0452	-0.0670	-0.0434	-0.0020	0.0384	0.0579
MSFT								
u	12,348	0.0259	0.0115	0.0102	0.0156	0.0227	0.0363	0.0443
d	12,348	0.0265	0.0124	0.0103	0.0153	0.0227	0.0375	0.0460
π_u	12,348	0.5043	0.0391	0.4400	0.4800	0.5070	0.5300	0.5600
π_d	12,348	0.4953	0.0391	0.4400	0.4700	0.4900	0.5160	0.5600
$\pi_u + \pi_d$	12,348	0.9997	0.0153	0.9800	0.9900	1.0000	1.0100	1.0200
rp	12,348	0.0012	0.0006	0.0004	0.0007	0.0012	0.0015	0.0022
$r_{overnight}$	33	0.0152	0.0299	-0.0253	-0.0041	0.0166	0.0354	0.0583

Table 7: Quintile Portfolios Sorted by Analyst-based SUE

This table reports cumulative abnormal returns from day 2 to day 60 of after earnings announcements of the portfolios sorted by analyst-based SUE in the previous announcement, as well as the difference with t-statistics between the high and low quintiles. The sample includes all earnings announcements for S&P 500 firms from January 2010 to December 2021. We report results for both the full sample and two subsamples divided by the median of our estimated ex-ante EAD risk premia.

	Whole Sample	High EAD RP	Low EAD RP
Low	-0.0108	-0.0308	-0.0027
2	0.0088	0.0183	0.0040
3	-0.0088	-0.0125	-0.0067
4	-0.0070	-0.0287	0.0052
High	0.0088	0.0294	-0.0073
High minus Low	0.0196	0.0602	-0.0046
<i>t</i> -stat	2.97	4.98	-0.61

Table 8: Daily Straddle Returns around EADs

Panel A of this table reports average returns of at-the-money straddles around EADs and corresponding t-statistics. The sample includes all earnings announcements for S&P 500 firms from January 2010 to December 2021. The holding period for all straddles is one day. The left column presents returns of long straddles bought at the offer prices and sold at the bid prices on the next trading day. The right panel presents returns of short straddles sold at the bid prices and bought at the offer prices on the next trading day. Panel B reports return summary statistics of short straddles on the announcement day for subsamples divided by the median of our estimated ex-ante EAD risk premia.

Panel A: Daily Straddle Returns Around EADs								
Days to EAD	Long Straddle		Short Straddle					
	Mean	<i>t</i> -stat	Mean	<i>t</i> -stat				
-1	-0.0058	-82.11	-0.0090	-113.87				
0	-0.0095	-64.19	-0.0068	-44.78				
1	-0.0073	-91.73	-0.0073	-87.76				

Panel B: Straddle Returns for Subsamples								
	Obs	Mean	Std. Dev.	5%	25%	50%	75%	95%
High EAD RP	1214	0.0039	0.0136	-0.0215	-0.0040	0.0055	0.0136	0.0236
Low EAD RP	1215	-0.0017	0.0102	-0.0224	-0.0067	0.0006	0.0052	0.0109
High minus Low				0.0056				
<i>t</i> -stat				11.53				