Supplemental Material to Trading by Insiders and the Informativeness of Earnings Announcements

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Abstract

Section A includes empirical tests referred to in the paper for the discussion of alternative interpretations (Sections 5.1 and 5.2). Section B investigates how results might be affected by using actual rather than expected earnings announcement dates as discussed in Section 5.3. In line with the concerns presented in Section 5.4, we control for potential firm-specific heterogeneity in Section C. Section D discusses the different implied volatility measures already introduced in Section 5.5 and details the construction of each of them. Section E present the results of the joint estimation of the analyst and insider effect, and the effect of 13D filings and insiders. Section F compares our measure of relevance with alternative ones. Section G examines results in the cross-section of option liquidity. Section H shows the regression tables underlying the figures in the paper. Section I describes how we filter EDGAR log files.

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A Alternative interpretation

Figure A.1: EA and insider trading: number of buys and sells

The hollow dots shows the estimate of γ_B and the 95% confidence intervals depending on the number of past transactions since the last earnings announcement, while the solid dots show the estimate of γ_S depending on the number of transactions.

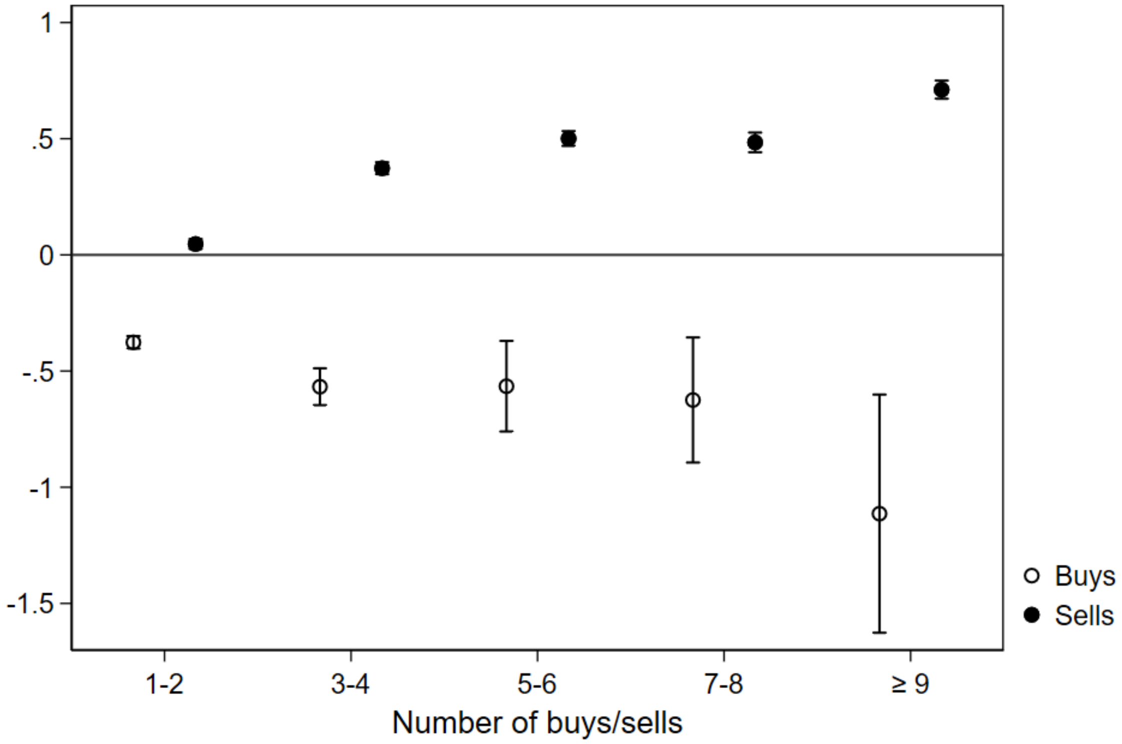


Table A.1: Insider trading and EA relevance: by reporting lag

This table shows the results of a regression of implied volatility on corporate insider purchases and sales. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R) \dfrac{1}{T-t} (\gamma)$	2.532***
	(0.006)
High lag $\times \mathbf{1}(T > t_R) (1/T-t)\, CBuys$	-0.151***
	(0.019)
High lag $\times \mathbf{1}(T > t_R) (1/T-t)\, CSales$	0.052***
	(0.005)
Medium lag $\times \mathbf{1}(T > t_R) (1/T-t)\, CBuys$	-0.100***
	(0.015)
Medium lag $\times \mathbf{1}(T > t_R) (1/T-t)\, CSales$	0.066***
	(0.003)
Low lag $\times \mathbf{1}(T > t_R) (1/T-t)\, CBuys$	-0.179***
	(0.013)
Low lag $\times \mathbf{1}(T > t_R) (1/T-t)\, CSales$	0.034***
	(0.002)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.953
Obs	2,928,937
Difference in coefficients	
Buys: high - medium	-0.051
F-value	(3.37)
Buys: high - low	0.028
F-value	(1.37)
Buys: medium - low	0.079
F-value	(14.55)
Sales: high - medium	-0.014
F-value	(3.42)
Sales: high - low	0.018
F-value	(10.16)
Sales: medium - low	0.032
F-value	(53.45)

B Actual versus expected earnings announcement dates

Our analysis rests on the implicit assumption that market participants know the earnings announcement dates with sufficient precision, so they can know which options are treated and which are not. Market expectations about the announcement date are not observable directly, so instead we need to rely on a proxy. In our main analysis we use the actual earnings announcement dates as such proxy.

Typically, market participants are informed about the earnings announcement date via so-called earnings notifications. These notifications are mandatory since Reg FD became effective in 2001. However, most earnings notifications occur relatively close to the earnings announcement date, approximately 10 trading days (see Chapman (2018)). Market participants are likely to have formed expectations about the timing of the next earnings announcement date even before the official earnings notifications. In our analysis we analyze up to 90 calendar days before the next earnings announcement. Even if we precisely know the date of the earnings notification, we would need a proxy for market expectations in the remaining time, which represents the bulk of our sample.

In the extreme event that earnings announcement dates are unpredictable, we would not expect that the earnings announcement produces a wedge in implied volatility between options maturing before or after the next earnings announcement. In the event that earnings announcement dates are fairly predictable, the actual announcement dates would be a reliable proxy for the expected dates. We evaluate the plausibility of this assumption in the following and investigate the sensitivity of our findings with respect to this assumption.

First, we examine the deviation between the expected and the actual earnings date. We estimate expected earnings announcement dates based on the current year's end of the fiscal quarter and add the number of business days between the end of the fiscal quarter and the earnings announcement date from the same quarter of the firm's last fiscal year. Table B.1 summarizes the deviation from the actual earnings announcement date and the expected date for each quarter, and the average across a given firm year. The deviations between the expected and the actual earnings announcement dates are small, as the mean value is 0. Even the top and bottom 10% are small with values of -2 and 4.[1] We cross-tabulate the number of options

[1]The number of observations decreases because we do not observe the deviation for the first year in the sample,

classified as 'treated' and 'control' under either the expected or the actual earnings announcment dates. Given these small deviations, it is not surprising that the treatment status assigned to daily option observations that depends on whether a given option expires before or after the next earnings announcement date does not change much irrespective of whether we use teh expected or the actual earnings announcement dates. As shown in Table B.2 the majority of option days, 97%, that are classified as treated under expected earnings dates would also be classified as treated under the actual earnings dates. Similarly, 98% of option days classified as control according to expected dates would be classified as such according to the actual dates.

Second, we use expected instead of actual earnings announcement dates as a further robustness check. Table B.3 shows the results using the expected earnings announcement dates. We confirm a negative estimate for γ_B and a positive estimate for γ_S, though we note that the economic magnitude of γ_S is smaller.

Next, we investigate whether the precision of our estimates are affected by the deviation between expected and actual earnings announcement dates. To do so, we sort our observations into 3 groups (bottom 25%, medium 50% and top 25%) based on the quarter-specific absolute deviation between the expected and the actual earnings announcement date. The results in Table B.4 show that the estimates for γ_B are very comparable for all three groups. The estimate for γ_S only slightly differs between the low deviation and the medium deviation group, however, the difference is economically small.

Table B.1: Summary statistics

This table shows the summary statistics for the number of business days between the expected earnings announcement date and the actual earnings announcement date. The expected earnings announcement date is calculated as the the current year's end of the fiscal quarter plus the number of business days between the end of the fiscal quarter and the earnings announcement date from the same quarter of the firm's last fiscal year.

Variable	Obs.	Mean	S.D.	10pct	50pct	90pct
Deviation Q1	4,104	0	3	-2	0	4
Deviation Q2	3,876	0	3	-2	-1	4
Deviation Q3	4,171	0	4	-2	-1	4
Deviation Q4	4,118	-0	5	-2	0	4
Mean firm-year deviation	3,113	0	2	-2	-0	2
Mean absolute firm-year deviation	3,113	2	1	1	2	4

and because some earnings announcements could be missing.

Table B.2: Treatment under actual and expected earnings announcements

This table tabulates the number of daily options that are treated, as they expire after the next earnings announcement, and control, as they expire before the next earnings announcement, based on actual and expected earnings announcement dates.

	Control (expected)	%	Treated (expected)	%	Sum
Control (actual)	1,586,435	99%	21,373	1%	1,608,172
Treated (actual)	25,555	3%	942,000	97%	967,555

Table B.3: Insider trading and EA relevance: expected earnings dates

This table shows the results of a regression of implied volatility on corporate insider purchases and sales. The treatment status of option day observations is based on expected earnings announcement dates rather than the actual dates. Column 1 shows the results of a regression of implied volatility on the square root of the time to maturity interacted with a dummy variable indicating whether the option expires before the next earnings announcement and a dummy variable that is Columns 2 to 4 add different sets of fixed effects or control variables. Maturity pol. refers to controlling for the time to maturity of the option measured in years and its square root as well as the interaction of the linear and the square root term with the insider buy or sell variables. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility	(1)	(2)	(3)	(4)
$\mathbf{1}(T > t_R)\frac{1}{T-t}(\gamma)$	2.498***	2.501***	2.378***	2.387***
	(0.011)	(0.011)	(0.007)	(0.007)
CBuys	4.684***	-12.203**		
	(0.144)	(5.303)		
CSells	-1.063***	-10.225***		
	(0.026)	(0.948)		
$\mathbf{1}(T > t_R)\frac{1}{T-t}CBuys\,(\gamma_B)$	-0.158***	-0.161***	-0.165***	-0.172***
	(0.014)	(0.014)	(0.008)	(0.008)
$\mathbf{1}(T > t_R)\frac{1}{T-t}CSales\,(\gamma_S)$	0.079***	0.078***	0.045***	0.040***
	(0.002)	(0.002)	(0.002)	(0.002)
Maturity pol.	Yes	Yes	Yes	Yes
IT maturity pol.	No	Yes	No	Yes
Fixed effects	Day & firm	Day & firm	Day × firm	Day × firm
Adjusted R2	0.759	0.760	0.947	0.948
Obs	2,659,372	2,659,372	2,659,372	2,659,372

Table B.4: Insider trading and deviation from expected announcement date

This table reports the results of the regression shown in column 4 of Table B.3 for three different groups based on the absolute deviation between the expected and the actual earnings announcement date in business days. Firm-quarters are sorted in the low group, consisting of the bottom 25%, the medium group consisting of the middle 50%, and the high group consisting of the top 25%. Column 4 tests the equality of the coefficient estimates for the low and medium group, column 5 the equality of the medium and high group, while column 6 tests the equality of the low and the high group. Standard errors, shown in parentheses, in columns 1 are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility Sample	(1) Low	(2) High	(3) (1)-(2)
$\mathbf{1}\left(T > t_R\right) \frac{1}{T-t} CBuys\left(\gamma_B\right)$	-0.15***	-0.13***	-0.02
	(0.01)	(0.02)	(0.02)
$\mathbf{1}\left(T > t_R\right) \frac{1}{T-t} CSales\left(\gamma_S\right)$	0.05***	0.04***	0.01***
	(0.00)	(0.00)	(0.00)

C Unobserved heterogeneity in earnings announcement relevance

Table C.1: Insider trading and EA relevance: controlling for firm-specific relevance

This table shows the results of a regression of implied volatility on corporate insider purchases and sales. Maturity pol. refers to controlling for the time to maturity of the option measured in years and its square root as well as the interaction of the linear and the square root term with the insider buy or sell variables. Column 2 includes the control for an interaction term of each firm dummy and the expression $\mathbf{1}\left(T > t_{R_{i,t}}\right)\left(\frac{1}{T-t}\right)$. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility	(1)	(2)
$\mathbf{1}\left(T > t_R\right)\frac{1}{T-t}CBuys\left(\gamma_B\right)$	-0.044***	-0.050***
	(0.006)	(0.007)
$\mathbf{1}\left(T > t_R\right)\frac{1}{T-t}CSales\left(\gamma_S\right)$	0.017***	0.016***
	(0.002)	(0.001)
Maturity pol.	Yes	Yes
IT maturity pol.	No	Yes
Fixed effects	Day × firm	Day × firm
Relevance × firm FE	Yes	Yes
Adjusted R2	0.957	0.958
Obs	2,928,937	2,928,937

D Estimating implied volatility

The main dependent variable in the paper is the variance under the risk-neutral measure. To extract this quantity, most of the previous literature focuses on three methods: the non-parametric method proposed by Bakshi et al. (2003) (BKM), the non-parametric method proposed by Demeterfi et al. (1999) (DDKZ) and used in the VIX computation, and the implied volatility computed by OptionMetrics, which relies on the log-normality of returns as Black-Scholes formula. This appendix explains how we applied each of the methods and discusses their advantages and disadvantages. Nonetheless, any methodology delivers the same main results.

Regardless of the method, to avoid major effects of illiquidity and to be able to compute the implied variance, we drop observations (firm-date-maturity-strike quadruplets) that satisfy one of these conditions:

- There is no information about the underlying price
- The bid price is zero
- The ask price is lower or equal to the bid price
- OptionMetrics does not provide the implied volatility (this is a signal of non-standard options)

We also net the discounted dividends from the underlying spot price using the projected ex-dividend date and dividend amount provided by OptionMetrics. We use as rate of discount the zero-coupon yield provided by OptionMetrics linearly interpolated across the available maturities.

Non-parametric

The non-parametric methods assume that we observe a continuum of strikes and we integrate the weighted option prices across all strikes to obtain the risk-neutral variance. Unfortunately, we only observe a finite number of strikes and for most of them liquidity is low. There are two ways to proceed using OptionMetrics data. The first one consists of using the quoted midpoints of each available option, similar to BKM. The second one relies on the volatility surface provided by OptionMetrics and has also been used extensively, e.g. Driessen et al.

(2013). Although the second approach provides smoother estimates, the interpolation algorithm used by OptionMetrics across strikes and maturities, eliminates any jump across strikes or along the term structure. Hence, by construction, eliminates the variation from which we identify the effect. As a consequence, we rely on quoted midpoints. In-the-money and out-of-the money options carry the same information due to the put-call parity; hence, as it is usual in the literature, we keep out-of-the-money options to reduce the impact of early exercise. Since we need to assume a wide range of strikes, we drop any date-firm-maturity triplet with less than six out-of-the-money options to compute the non-parametric measures. Then we apply the following discretized version of the original BKM formula:

$$IV_{i,t,\tau}^{BKM^2} = \frac{(e^{r\tau}V - \mu^2)}{\tau}$$

$$\mu = e^{r_{t,\tau}\tau} - 1 - \frac{e^{r_{t,\tau}\tau}}{2V_{i,t,\tau}} - \frac{e^{r_{t,\tau}\tau}}{6W_{i,t,\tau}} - \frac{e^{r_{t,\tau}\tau}}{24X_{i,t,\tau}}$$

$$V_{i,t,\tau} = \sum_{K_{i,t,\tau,k} > S_{i,t,\tau}} \frac{1 - ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)}{K_{i,t,\tau,k}^2}(C_{i,t,\tau,k} + C_{i,t,\tau,k-1})(K_{i,t,\tau,k} - K_{i,t,\tau,k-1}) +$$
$$\sum_{K_{i,t,\tau,k} \leq S_{i,t,\tau}} \frac{1 + ln\left(\frac{S_{i,t,\tau}}{K_{i,t,\tau,k}}\right)}{K_{i,t,\tau,k}^2}(P_{i,t,\tau,k} + P_{i,t,\tau,k-1})(K_{i,t,\tau,k} - K_{i,t,\tau,k-1})$$

$$W_{i,t,\tau} =$$
$$\sum_{K_{i,t,\tau,k} > S_{i,t}} \frac{6\, ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right) - 3\left(ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)\right)^2}{K_{i,t,\tau,k}^2} \frac{(C_{i,t,\tau,k} + C_{i,t,\tau,k-1})}{2}(K_{i,t,\tau,k} - K_{i,t,\tau,k-1}) +$$
$$\sum_{K_{i,t,\tau,k} \leq S_{i,t}} \frac{6\, ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right) - 3\left(ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)\right)^2}{K_{i,t,\tau,k}^2} \frac{(P_{i,t,\tau,k} + P_{i,t,\tau,k-1})}{2}(K_{i,t,\tau,k} - K_{i,t,\tau,k-1})$$

$$X_{i,t,\tau} =$$

$$\sum_{K_{i,t,\tau,k}>S_{i,t,\tau}} \frac{6\left(ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)\right)^2 - 2\left(ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)\right)^3}{K^2_{i,t,\tau,k}}(C_{i,t,\tau,k} + C_{i,t,\tau,k-1})(K_{i,t,\tau,k} - K_{i,t,\tau,k-1}) +$$

$$\sum_{K_{i,t,\tau,k}\leq S_{i,t,\tau}} \frac{6\left(ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)\right)^2 - 2\left(ln\left(\frac{K_{i,t,\tau,k}}{S_{i,t,\tau}}\right)\right)^3}{K^2_{i,t,\tau,k}}(C_{i,t,\tau,k} + C_{i,t,\tau,k-1})(K_{i,t,\tau,k} - K_{i,t,\tau,k-1})$$

where $C_{i,t,\tau,k}$ refers to the midpoint of call option prices, $P_{i,t,\tau,k}$ refers to put option prices, and K is the strike price. r is the zero-coupon yield provided by OptionMetrics interpolated linearly. $S_{i,t,\tau}$ is the spot price minus the discounted expected dividends from t to τ. The subscripts indicate the firm (i), the day (t), the maturity (τ), and the strike (k). Strikes are numbered from the lowest to the highest such that $K_{i,t,\tau,k} > K_{i,t,\tau,k-1} \forall k$. We also construct the DDKZ measure using the following discretized formula:

$$IV^{DDKZ^2}_{i,t,\tau} = \frac{1}{\tau}\left(\sum_{k=1}^{N_{i,t,\tau}} \frac{e^{r_{t,\tau}\tau}(Q_{i,t,\tau,k} + Q_{i,t,\tau,k-1})}{K^2_{i,t,\tau,k}}(K_{i,t,\tau,k} - K_{i,t,\tau,k-1}) - \left(\frac{e^{r_{t,\tau}\tau} Si,t,\tau}{K_{i,t,\tau,0}} - 1\right)\right)$$

where $Q_{i,t,\tau,k}$ is the midpoint quote of the option (puts or calls). K_0 is the strike closest to the spot price. $k = \{1, ..., N_{i,t,\tau}\}$ indeces both out-of-the-money put and call options.

The discrete approximation takes two arbitrary decisions: i) prices across strikes are interpolated linearly and ii) prices below the minimum strike or above the maximum strike are not considered. Both of these decisions, as well as any alternate one, create noise in our implied volatility estimator. However, this noise is likely to be unrelated to the term structure, and more importantly, unrelated to insider trading. Nonetheless, to avoid extreme noisy observations, we drop those firm-date-maturity triplets for which:[2]

- DDKZ volatility exceeds 200% (573 triplets)
- BKM volatility exceeds 200% (186 triplets)
- OptionMetrics at-the-money volatility exceeds 200% (3,850 triplets)
- One of the measures doubles the mean of the three measures (97 triplets)

[2]These filters do not change the results as they exclude 0.13% of the sample.

In the paper we focus on the BKM measure because it measures the implied quadratic variation in the presence of jumps while DDKZ captures the integrated variance if the process is continuous. Nonetheless, we repeat all the results using the DDKZ measure and the closest-to-at-the-money OptionMetrics volatility for the same set of firm-date-maturity triplets and results are almost identical (see Tables in this section).

Parametric

Patell and Wolfson (1979) and Dubinsky et al. (2019), among others, hinge on the implied volatility provided by OptionMetrics. This volatility is the result of discretizing Black-Scholes into a binomial model and compute the volatility of an American option. This approach has the advantage that we can obtain the implied volatility with just one option per firm-date-maturity. But it carries some disadvantages. First, note that discretizing is not an issue anymore but it translates into an aggregation issue. In particular, the implied volatility across strikes is different. We follow Dubinsky et al. (2019) and use the closest to at-the-money available option. This option owns the highest Vega and, therefore, its price is the most affected by the earnings announcement risk. As a consequence, the identification would be cleaner.

The second disadvantage is the parametric assumption. The abovementioned papers assumed the Black-Scholes model holds, at least to some extent. However, if insiders exploit their private information, Black-Scholes model does not hold because the signal the market receives from these trades is extremely asymmetric (see illustrative example below). Therefore, the methodology would be incorrect under the alternative hypothesis. Nonetheless, given the consistency of results for the subset of firm-day-maturity triplets in which we can compute the non-parametric volatility, this disadvantage does not seem to play a major role. Hence, we re-estimate the main results with every observation for which we observe the parametric implied volatility to increase the sample size and assess the consequences of sample selection.

Illustrative example

This example illustrates why Black-Scholes implied volatility might provide the wrong conclusions in the presence of informed traders. In particular, we show that the implied volatility computed using Black-Scholes increases after insiders trade, even if the risk-neutral volatility decreases.

Assume that at time 0 there is an asset with price S_0 and payoff at T equal to V_T. Consider the canonical model in which the risk-neutral probability of the payoff is such that $V_T = e^{r-\frac{\sigma^2}{2}T+\sigma\epsilon_T}S_0$ and $\epsilon_T \sim \mathcal{N}(0,T)$. Following Glosten and Milgrom (1985), a risk-neutral informed investor, who knows v_T with certainty, trades one unit the asset at time 1. Consider for simplicity that investors know he is indeed informed and the information investors learn does not change the Radon-Nikodym derivative that links the risk-neutral and physical probability measures, for instance, it is idiosyncratic to the firm.

Due to risk-neutrality, the informed investor always trade. She buys if the liquidation value exceeds the forward price, $V_T > e^{r(T-1)}S_0 \equiv F_0$, and sells otherwise. Therefore, the asset prices after the informed agent buys are given by:

$$S_1 = e^{-r(T-1)}\mathbb{E}(V_T|V_T > F_0) \qquad C_1(K) = e^{-r(T-1)}\mathbb{E}\left((V_T-K)^+|V_T > F_0\right)$$

where $C_1(K)$ indicates the price of a call option with strike price K, and $\mathbb{E}$ denotes the expectation under the risk-neutral measure. To ease the exposition, we use $(a)^+$ to denote the maximum between a and 0. Since we aim to show a counterexample in which Black-Scholes provides the wrong prediction, we focus on the call option after the informed investor buys. Nonetheless, a similar procedure will provide counterexamples in the other situations.

First, we prove the intuitive result that the risk-neutral variance of the asset decreases with the new information. To ease the exposition we refer to the logarithm of the price, liquidation value and forward price as s, v, and f respectively. We define $\tau = T-1$.

Lemma 1. *The risk-neutral variance is lower after updating the beliefs with the new information*

$$\mathbb{V}\left(v_T - s_1|v_T > f_0\right) < \mathbb{V}(v_T - v_1) = \sigma^2\tau$$

Proof. $v_T - v_1 = r - \frac{\sigma^2}{2}T - v_1 + \sigma\epsilon_T$. Hence the conditional distribution $v_T - v_1|v_T > f_0$ is a truncated normal whose variance is given by:

$$\mathbb{V}\left(v_T - s_1|v_T > f_0\right) = \sigma^2 T\left[1 - \frac{\phi(\alpha)}{1-\Phi(\alpha)}\left(\frac{\phi(\alpha)}{1-\Phi(\alpha)} - \alpha\right)\right]$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ denote the pdf and cdf of the standard normal distribution. α is the standardized truncation threshold: $\alpha = \dfrac{f_0 - r - \frac{\sigma^2}{T}T - v1}{\sigma\sqrt{T}}$. Therefore, the variance is lower iff $\dfrac{\phi(\alpha)}{1-\Phi(\alpha)} > \alpha$. The left-hand side of the equation is the inverse Mills ratio; hence, the inequality is true for all α (see Gordon, 1941). □

Then, we prove that Black-Scholes implied variance is higher than the initial one. To do that, we show that the Black-Scholes formula using the initial implied volatility (σ) results in a lower call price than the one based on risk-neutral pricing under the truncated distribution. Since the derivative of the Black-Scholes formula with respect to volatility, named Vega, is positive for the whole support, the implied volatility must be higher to equal the call price.

Lemma 2. *The call price is higher than the one predicted by Black-Scholes using the unconditional risk-neutral volatility* σ*.*

$$C_1(K) > BS(K, \sigma, v_1, r, \tau)$$

where $BS(k, s, v, r, \tau)$ *refers to the Black-Scholes function with strike price* k*, volatility* s*, spot price* v*, risk-free rate* r*, and maturity* τ*.*

Proof. Denote as $g(v, r, \tau)$ and $G(v, r, \tau)$ the pdf and cdf of v_T given v_1 assumed by the Black-Scholes model for a maturity equal to τ and an interest rate equal to r. Then,

$$BS(K, \sigma, v_1, r, \tau) = e^{-r\tau} \int_K^\infty (v - K)^+ g(v) dv < e^{-r\tau} \int_{max\{F_0, K\}}^\infty (v - K)^+ \frac{g(v)}{G(F_0)} dv = C_1(K)$$

□

This example illustrates the problem of using Black-Scholes in an extreme setting. The more symmetric is the posterior signal received from the trade, the more reliable is Black-Scholes. There are many missing ingredients that would contribute to relax the problem and are likely to play a role. For instance, investors might not be able to distinguish informed an uninformed agents; informed agents might not know the actual liquidation value but just a noisy signal of that value, etc.

Table D.1: The relevance of earnings announcements - Different volatility measures

The first column of this table repeats the fourth column of Table D.1 which includes the baseline specification to estimate λ. Then, column (2) repeats the estimation using the implied volatility measure developed by Demeterfi et al. (1999). Column (3) and (4) use the implied volatility provided by OptionMetrics. While column (3) uses the same sample as the other measures, column (4) includes every other option for which we have implied volatility. Standard errors are clustered at the day-firm level and presented within parenthesis. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility	Restricted BKM	Restricted DDKZ	Restricted OptionMetrics	Whole OptionMetrics
$\mathbf{1}(T > t_R) \frac{1}{T-t}$ (γ)	2.647***	2.504***	2.620***	2.243***
	(0.019)	(0.018)	(0.019)	(0.015)
Maturity pol.	Yes	Yes	Yes	Yes
Fixed Effects	Day $\times$ firm	Day $\times$ firm	Day $\times$ firm	Day $\times$ firm
Ajusted R2	0.953	0.964	0.971	0.942
Obs.	2,928,937	2,928,937	2,928,937	5,592,397

Table D.2: Insider trading and EA relevance: Alternative measures of implied volatility

This table shows the results of a regression of implied volatility on corporate insider purchases and sales. Panel A uses a dummy variable for insider buys and sells which is set to 1 for the first insider purchase (sale) after the last quarterly earnings announcement, and to 0 in case there has been no insider buy (sell) since the last earnings announcement. Panel B uses the cumulative number of buys and sells, respectively, since the last quarterly earnings announcement instead of the dummy. Column 1 estimates implied volatility according to Demeterfi et al. (1999), and column 2 uses the implied volatility of the closest to at-the-money option provided by OptionMetrics, while we restrict attention to observations for which we can calculate our standard measure of implied volatility according to Bakshi et al. (2003). Column 3 uses the same measure as column 2 and the whole sample. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Panel A: Number of insider purchases and sales

Dep. var.: implied volatility Sample Measure	(1) Restricted DDKZ	(2) Restricted OptionMetrics	(3) Whole OptionMetrics
$\mathbf{1}\left(T > t_R\right) \dfrac{1}{T-t} \left(\gamma\right)$	2.398***	2.495***	2.495***
	(0.005)	(0.005)	(0.005)
$\mathbf{1}\left(T > t_R\right) \dfrac{1}{T-t} CBuys \left(\gamma_B\right)$	-0.146***	-0.157***	-0.157***
	(0.006)	(0.006)	(0.006)
$\mathbf{1}\left(T > t_R\right) \dfrac{1}{T-t} CSales \left(\gamma_S\right)$	0.051***	0.059***	0.059***
	(0.001)	(0.001)	(0.001)
Maturity pol.	Yes	Yes	Yes
IT maturity pol.	Yes	Yes	Yes
Fixed effects	Day × firm	Day × firm	Day × firm
Adjusted R2	0.964	0.971	0.971
Obs	2,928,937	2,928,937	2,928,937

Panel B: Dummy for insider purchases and sales

Dep. var.: implied volatility	(1)	(2)	(3)
Sample	Restricted	Restricted	Whole
Measure	DDKZ	OptionMetrics	OptionMetrics
$\mathbf{1}\,(T > t_R)\,\frac{1}{T-t}\,(\gamma)$	2.391***	2.474***	2.474***
	(0.007)	(0.007)	(0.007)
$\mathbf{1}\,(T > t_R)\,\frac{1}{T-t}Buy\ (d)$	-0.364***	-0.374***	-0.374***
	(0.012)	(0.012)	(0.012)
$\mathbf{1}\,(T > t_R)\,\frac{1}{T-t}Sale\ (d)$	0.244***	0.298***	0.298***
	(0.008)	(0.009)	(0.009)
Maturity pol.	Yes	Yes	Yes
IT maturity pol.	Yes	Yes	Yes
Fixed effects	Day × firm	Day × firm	Day × firm
Adjusted R2	0.964	0.971	0.971
Obs	2,928,937	2,928,937	2,928,937

Table D.3: Insider trading and firm characteristics: DDKZ

This table reports the results of the regression shown in column 4 of Table 3 for the top 25% and bottom 25% of firms sorted according to certain characteristics at the year end. Panel E is an exception and sorts firms according to the existence of Universal Demand Laws in the state of incorporation. Column 3 tests the equality of the coefficient estimates for the low and high group. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility Sample	(1) Low	(2) High	(3) Low - High
Panel A: insider filing demand on EDGAR			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.096***	-0.174***	0.078***
	(0.014)	(0.013)	(0.019)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.045***	0.083***	-0.038***
	(0.002)	(0.005)	(0.005)
Panel B: stock return volatility			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.115***	-0.130***	0.015
	(0.018)	(0.010)	(0.020)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.035***	0.054***	-0.020***
	(0.003)	(0.002)	(0.004)
Panel C: share of idiosyncratic volatility			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.288***	-0.131***	-0.157***
	(0.014)	(0.011)	(0.018)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.045***	0.055***	-0.010**
	(0.003)	(0.004)	(0.004)
Panel D: R&D			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.172***	-0.153***	-0.018
	(0.011)	(0.014)	(0.018)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.018***	0.034***	-0.016***
	(0.003)	(0.002)	(0.003)
Panel E: litigation risk (states with Universal Demand Laws versus states without)			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.221***	-0.144***	-0.076**
	(0.032)	(0.007)	(0.032)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.049***	0.056***	-0.105***
	(0.005)	(0.001)	(0.005)
Day × firm	Yes	Yes	Yes
Maturity Pol.	Yes	Yes	Yes
IT maturity Pol.	Yes	Yes	Yes

Table D.4: Insider trading and firm characteristics: OptionMetrics ATM

This table reports the results of the regression shown in column 4 of Table 3 for the top 25% and bottom 25% of firms sorted according to certain characteristics at the year end. Panel E is an exception and sorts firms according to the existence of Universal Demand Laws in the state of incorporation. Column 3 tests the equality of the coefficient estimates for the low and high group. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility Sample	(1) Low	(2) High	(3) Low - High
Panel A: insider filing demand on EDGAR			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.109***	-0.184***	0.076***
	(0.014)	(0.013)	(0.019)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.055***	0.090***	-0.035***
	(0.002)	(0.005)	(0.005)
Panel B: stock return volatility			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.091***	-0.142***	0.051***
	(0.016)	(0.010)	(0.019)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.036***	0.065***	-0.029***
	(0.003)	(0.002)	(0.004)
Panel C: share of idiosyncratic volatility			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.260***	-0.150***	-0.110***
	(0.013)	(0.012)	(0.018)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.055***	0.068***	-0.013***
	(0.003)	(0.004)	(0.005)
Panel D: R&D			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.182***	-0.153***	-0.029*
	(0.009)	(0.015)	(0.018)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.021***	0.041***	-0.020***
	(0.003)	(0.002)	(0.003)
Panel E: litigation risk (states with Universal Demand Laws versus states without)			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	(0.029)	(0.007)	(0.029)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.045***	0.065***	-0.110***
	(0.005)	(0.001)	(0.005)
Day × firm	Yes	Yes	Yes
Maturity Pol.	Yes	Yes	Yes
IT maturity Pol.	Yes	Yes	Yes

Table D.5: Insider trading and firm characteristics: OptionMetrics ATM (whole sample)

This table reports the results of the regression shown in column 4 of Table 3 for the top 25% and bottom 25% of firms sorted according to certain characteristics at the year end. Panel E is an exception and sorts firms according to the existence of Universal Demand Laws in the state of incorporation. Column 3 tests the equality of the coefficient estimates for the low and high group. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility Sample	(1) Low	(2) High	(3) Low - High
Panel A: insider filing demand on EDGAR			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.100***	-0.173***	0.073***
	(0.011)	(0.011)	(0.015)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.047***	0.092***	-0.045***
	(0.002)	(0.004)	(0.005)
Panel B: stock return volatility			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.117***	-0.098***	-0.018
	(0.015)	(0.009)	(0.017)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.064***	0.065***	-0.001
	(0.003)	(0.002)	(0.003)
Panel C: share of idiosyncratic volatility			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.217***	-0.086***	-0.130***
	(0.011)	(0.010)	(0.015)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.060***	0.072***	-0.012***
	(0.002)	(0.003)	(0.004)
Panel D: R&D			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.169***	-0.151***	-0.018
	(0.008)	(0.014)	(0.016)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.019***	0.039***	-0.020***
	(0.002)	(0.001)	(0.003)
Panel E: litigation risk (states with Universal Demand Laws versus states without)			
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.199***	-0.138***	-0.060***
	(0.020)	(0.006)	(0.020)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.022***	0.060***	-0.082***
	(0.004)	(0.001)	(0.004)
Day × firm	Yes	Yes	Yes
Maturity Pol.	Yes	Yes	Yes
IT maturity Pol.	Yes	Yes	Yes

Table D.6: Insider trading characteristics: DDKZ

This table reports the results of the regression shown in column 4 of Table 3 for different groups of trade and insider characteristics using implied volatility according to Demeterfi et al. (1999). Panel A distinguishes between filings that are late and on time, respectively. Panel B compares trade occuring in the different periods until the next earnings announcement. Panel C compares insider types, and Panel D considers different periods between the time between the trade and the report. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Panel A: Timeliness of filings

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)(\gamma)$	2.399***
	(0.005)
Filed on-time $\times \mathbf{1}(T > t_R)\,({}^1\!/_{T-t})\,CBuys\,(\gamma_B)$	-0.131***
	(0.006)
Filed on-time $\times \mathbf{1}(T > t_R)\,({}^1\!/_{T-t})\,CSales\,(\gamma_S)$	0.051***
	(0.001)
Filed late $\times \mathbf{1}(T > t_R)\,({}^1\!/_{T-t})\,CBuys\,(\gamma_B)$	-0.453***
	(0.031)
Filed late $\times \mathbf{1}(T > t_R)\,({}^1\!/_{T-t})\,CSales\,(\gamma_S)$	-0.013
	(0.030)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.964
Obs	2,928,937

Panel B: Months to the next earnings announcement

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)(\gamma)$	2.357***
	(0.005)
1 month $\times\mathbf{1}(T > t_R)(1/T-t)\,CBuys\,(\gamma_B)$	-0.293***
	(0.033)
1 month $\times\mathbf{1}(T > t_R)(1/T-t)\,CSales\,(\gamma_S)$	-0.100***
	(0.006)
2 months $\times\mathbf{1}(T > t_R)(1/T-t)\,CBuys\,(\gamma_B)$	-0.261***
	(0.013)
2 months $\times\mathbf{1}(T > t_R)(1/T-t)\,CSales\,(\gamma_S)$	0.044***
	(0.003)
3 months $\times\mathbf{1}(T > t_R)(1/T-t)\,CBuys\,(\gamma_B)$	-0.063***
	(0.009)
3 months $\times\mathbf{1}(T > t_R)(1/T-t)\,CSales\,(\gamma_S)$	0.101***
	(0.002)
Maturity pol.	Yes
IT $\times$ type maturity pol.	Yes
Fixed effects	Day $\times$ firm
Adjusted R2	0.964
Obs	2,928,937

Panel C: Insider types

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)(\gamma)$	2.409***
	(0.005)
Officer $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.060***
	(0.012)
Officer $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.045***
	(0.001)
Director $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.218***
	(0.008)
Director $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.053***
	(0.004)
Beneficial owner $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.110***
	(0.011)
Beneficial owner $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.015**
	(0.007)
Other $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.371***
	(0.074)
Other $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.103***
	(0.014)
Maturity pol.	Yes
IT $\times$ type maturity pol.	Yes
Fixed effects	Day $\times$ firm
Adjusted R2	0.964
Obs	2,928,937
Day $\times$ firm	Yes
Maturity Pol.	Yes
IT maturity Pol.	Yes

Table D.7: Insider trading characteristics: OptionMetrics ATM

This table reports the results of the regression shown in column 4 of Table 3 for different groups of trade and insider characteristics using implied volatility provided by OptionMetrics. Panel A distinguishes between filings that are late and on time, respectively. Panel B compares trade occuring in the different periods until the next earnings announcement. Panel C compares insider types, and Panel D considers different periods between the time between the trade and the report. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Panel A: Timeliness of filings

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)(\gamma)$	2.496***
	(0.005)
Filed on-time $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.143***
	(0.006)
Filed on-time $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.060***
	(0.001)
Filed late $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.436***
	(0.030)
Filed late $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.050*
	(0.030)
Maturity pol.	Yes
IT $\times$ type maturity pol.	Yes
Fixed effects	Day $\times$ firm
Adjusted R2	0.971
Obs	2,928,937

Panel B: Months to the next earnings announcement

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)(\gamma)$	2.444***
	(0.005)
1 month $\times \mathbf{1}(T > t_R)(1/T-t)\, CBuys\, (\gamma_B)$	-0.384***
	(0.034)
1 month $\times \mathbf{1}(T > t_R)(1/T-t)\, CSales\, (\gamma_S)$	-0.121***
	(0.006)
2 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CBuys\, (\gamma_B)$	-0.280***
	(0.013)
2 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CSales\, (\gamma_S)$	0.051***
	(0.003)
3 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CBuys\, (\gamma_B)$	-0.057***
	(0.009)
3 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CSales\, (\gamma_S)$	0.121***
	(0.003)
Maturity pol.	Yes
IT $\times$ type maturity pol.	Yes
Fixed effects	Day $\times$ firm
Adjusted R2	0.971
Obs	2,928,937

Panel C: Insider types

Dep. var.: implied volatility	(1)
$\mathbf{1}\left(T > t_R\right)\left(\frac{1}{T-t}\right)(\gamma)$	2.505***
	(0.005)
Officer $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\left(\gamma_B\right)$	-0.071***
	(0.013)
Officer $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\left(\gamma_S\right)$	0.053***
	(0.001)
Director $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\left(\gamma_B\right)$	-0.206***
	(0.008)
Director $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\left(\gamma_S\right)$	0.062***
	(0.004)
Beneficial owner $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\left(\gamma_B\right)$	-0.144***
	(0.010)
Beneficial owner $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\left(\gamma_S\right)$ CSales	0.029***
	(0.007)
Other $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\left(\gamma_B\right)$	-0.351***
	(0.074)
Other $\times \mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\left(\gamma_S\right)$	-0.114***
	(0.013)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.971
Obs	2,928,937
Day × firm	Yes
Maturity Pol.	Yes
IT maturity Pol.	Yes

Table D.8: Insider trading characteristics: OptionMetrics ATM (whole sample)

This table reports the results of the regression shown in column 4 of Table 3 for different groups of trade and insider characteristics using the implied volatility provided by OptionMetrics for the whole sample. Panel A distinguishes between filings that are late and on time, respectively. Panel B compares trade occuring in the different periods until the next earnings announcement. Panel C compares insider types, and Panel D considers different periods between the time between the trade and the report. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Panel A: Timeliness of filings

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\,(1/T-t)\,(\gamma)$	2.098***
	(0.004)
Filed on-time $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.105***
	(0.005)
Filed on-time $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.071***
	(0.001)
Filed late $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.381***
	(0.024)
Filed late $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.207***
	(0.020)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.942
Obs	5,592,397

Panel B: Months to the next earnings announcement

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)(\gamma)$	2.152***
	(0.061)
1 month $\times \mathbf{1}(T > t_R)(1/T-t)\, CBuys\,(\gamma_B)$	-0.189
	(0.140)
1 month $\times \mathbf{1}(T > t_R)(1/T-t)\, CSales\,(\gamma_S)$	-0.165***
	(0.025)
2 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CBuys\,(\gamma_B)$	-0.291***
	(0.062)
2 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CSales\,(\gamma_S)$	0.051***
	(0.017)
3 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CBuys\,(\gamma_B)$	-0.063
	(0.048)
3 months $\times \mathbf{1}(T > t_R)(1/T-t)\, CSales\,(\gamma_S)$	0.169***
	(0.018)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.725
Obs	5,592,397

Panel C: Insider types

Dep. var.: implied volatility	(1)
$\mathbf{1}\,(T > t_R)\,(1/T-t)\,(\gamma)$	2.106***
	(0.004)
Officer $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.069***
	(0.009)
Officer $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.066***
	(0.001)
Director $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.163***
	(0.006)
Director $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.070***
	(0.003)
Beneficial owner $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.067***
	(0.009)
Beneficial owner $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.015***
	(0.004)
Other $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.247***
	(0.045)
Other $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.177***
	(0.006)
Maturity pol.	Yes
IT $\times$ type maturity pol.	Yes
Fixed effects	Day $\times$ firm
Adjusted R2	0.942
Obs	5,592,397
Day $\times$ firm	Yes
Maturity Pol.	Yes
IT maturity Pol.	Yes

E Analysts, Schedule 13D filers and insiders

In the paper, we show that information from analysts and the information from 13D filings and their amendments reduce the informativeness of earnings announcements. Likewise, we show that insider buys reduce and sales increase the informativeness of these announcements. Nonetheless, we have shown those results independently. Since analysts might react to insider trading or corporate executives might react to analyst forecasts, these effects could be related. Table E.2 presents the results of including in the regression analyst revisions and insider trades at the same time. Hence, if one drives the other, one of them will become insignificant. Instead, we observe that the sign, significance, and even magnitude are very close to the baseline specification.

In Table E.2, we split 13D filers into institutional and non-institutional investors. Institutional investors include investment companies, investment advisors, insurance companies, and banks, while non-institutional investors are individuals, corporations or parent companies. We find that transactions of both groups substitute the information content of the next earnings announcement, while the effect appears to be more pronounced for institutional investors. We find that the magnitude of the effect of stake increases is approximately halved when we control for the impact of insider buys, which suggests that stake increases and some insider buys may carry similar pieces of information.

Table E.1: Insider trading, analyst and earnings relevance

The first column of this table repeats the first column of Table 4 which includes the effect of upward and downward analyst revisions relative to the mean forecast. Columns (2) to (5) repeat the same estimation including the effect of insider trading as well. Each column uses a different benchmark to sign the analyst forecast. Finally, each panel considers one of the implied volatility measures considered before. Standard errors are clustered at the day-firm level and presented within parenthesis. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)
Benchmark:	Mean	Mean	Median	Own	Recom.
Dep. var: Nonparametric implied volatility (Bakshi et al., 2003)					
$\mathbf{1}(T > t_R)\frac{1}{T-t}$	3.238‡	3.121‡	3.107‡	2.886‡	2.663‡
	(0.012)	(0.012)	(0.011)	(0.008)	(0.008)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CBuys$		-0.107‡	-0.117‡	-0.117‡	-0.146‡
		(0.008)	(0.008)	(0.008)	(0.008)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CSales$		0.049‡	0.047‡	0.048‡	0.056‡
		(0.001)	(0.001)	(0.001)	(0.001)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CUpward$	-0.159‡	-0.153‡	-0.174‡	-0.155‡	-0.076‡
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CDownward$	-0.113‡	-0.135‡	-0.166‡	-0.494‡	-0.087‡
	(0.014)	(0.014)	(0.013)	(0.011)	(0.004)
Dep. var: Nonparametric implied volatility (Demeterfi et al., 1999)					
$\mathbf{1}(T > t_R)\frac{1}{T-t}$	3.092‡	2.980‡	2.964‡	2.753‡	2.530‡
	(0.011)	(0.011)	(0.010)	(0.007)	(0.007)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CBuys$		-0.103‡	-0.113‡	-0.111‡	-0.140‡
		(0.007)	(0.007)	(0.007)	(0.007)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CSales$		0.048‡	0.045‡	0.047‡	0.055‡
		(0.001)	(0.001)	(0.001)	(0.001)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CUpward$	-0.151‡	-0.146‡	-0.165‡	-0.147‡	-0.077‡
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CDownward$	-0.122‡	-0.140‡	-0.169‡	-0.496‡	-0.086‡
	(0.013)	(0.013)	(0.012)	(0.010)	(0.004)
Dep. var: Parametric implied volatility by OptionMetrics					
$\mathbf{1}(T > t_R)\frac{1}{T-t}$	3.237‡	3.105‡	3.090‡	2.880‡	2.640‡
	(0.011)	(0.011)	(0.010)	(0.007)	(0.007)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CBuys$		-0.111‡	-0.122‡	-0.118‡	-0.150‡
		(0.007)	(0.007)	(0.007)	(0.007)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CSales$		0.056‡	0.053‡	0.055‡	0.064‡
		(0.001)	(0.001)	(0.001)	(0.001)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CUpward$	-0.161‡	-0.154‡	-0.176‡	-0.161‡	-0.084‡
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
$\mathbf{1}(T > t_R)\frac{1}{T-t} \times CDownward$	-0.109‡	-0.127‡	-0.158‡	-0.524‡	-0.089‡
	(0.013)	(0.013)	(0.012)	(0.010)	(0.004)
Maturity pol.	Yes	Yes	Yes	Yes	Yes
Revision maturity pol.	Yes	Yes	Yes	Yes	Yes
IT maturity pol.	No	Yes	Yes	Yes	Yes
Fixed effects	Day × firm	Day × firm	Day × firm	Day × firm	Day × firm
Obs.	2,928,937	2,928,937	2,928,937	2,928,937	2,928,937

Table E.2: Insider trading, 13D filings and earnings relevance

The first column of this table repeats the fourth column of Table 4 which includes the effect of increases and decreases of stakes by Schdedule 13D filers relative to the mean forecast. Columns 2 distinguishes between 13D filers that are either classified as an institutional investor if they are an investment company, an investment adviser, bank, or insurance company as specified in item 12, and as a non-institutional investor otherwise. Column 3 and 4 repeat the same estimation while including the effect of insider trading as well. Standard errors are clustered at the day-firm level and presented within parenthesis. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Dep. var.: implied volatility	(1)	(2)	(3)	(4)
Dep. var: Nonparametric implied volatility (Bakshi et al., 2003)				
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)$	2.664***	2.664***	2.550***	2.550***
	(0.004)	(0.004)	(0.006)	(0.006)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,13D$	-0.341***		-0.154***	
	(0.028)		(0.030)	
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,13D$	-0.229***		-0.236***	
	(0.025)		(0.025)	
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,13D\,inst$		-0.407***		-0.163**
		(0.065)		(0.066)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,13D\,inst$		-0.391***		-0.348***
		(0.047)		(0.046)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,13D\,noninst$		-0.322***		-0.155***
		(0.030)		(0.032)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,13D\,noninst$		-0.188***		-0.207***
		(0.029)		(0.029)
$\mathbf{1}(T > t_R)\,(1/T-t)\,Insider\,CBuys$			-0.147***	-0.147***
			(0.007)	(0.007)
$\mathbf{1}(T > t_R)\,(1/T-t)\,Insider\,CSales$			0.051***	0.051***
			(0.001)	(0.001)
Maturity pol.	Yes	Yes	Yes	Yes
IT maturity pol.	Yes	Yes	Yes	Yes
Fixed effects	Day × firm	Day × firm	Day × firm	Day × firm
Adjusted R2	0.953	0.953	0.953	0.953
Obs	2,901,294	2,901,294	2,901,294	2,901,294

Table E.2: Insider trading, 13D filings and earnings relevance (continued)

Dep. var.: implied volatility	(1)	(2)	(3)	(4)
Dep. var: Nonparametric implied volatility (Demeterfi et al., 1999)				
$\mathbf{1}(T > t_R)\left(\frac{1}{T-t}\right)$	2.520***	2.520***	2.412***	2.412***
	(0.004)	(0.004)	(0.005)	(0.005)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,13D$	-0.307***		-0.128***	
	(0.025)		(0.026)	
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,13D$	-0.228***		-0.237***	
	(0.022)		(0.022)	
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,13D\,inst$		-0.433***		-0.200***
		(0.059)		(0.061)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,13D\,inst$		-0.373***		-0.332***
		(0.043)		(0.042)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,13D\,noninst$		-0.276***		-0.117***
		(0.027)		(0.028)
$\mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,13D\,noninst$		-0.187***		-0.208***
		(0.026)		(0.026)
$\mathbf{1}(T > t_R)\,(1/T-t)\,Insider\,CBuys$			-0.142***	-0.142***
			(0.007)	(0.007)
$\mathbf{1}(T > t_R)\,(1/T-t)\,Insider\,CSales$			0.050***	0.050***
			(0.001)	(0.001)
Maturity pol.	Yes	Yes	Yes	Yes
IT maturity pol.	Yes	Yes	Yes	Yes
Fixed effects	Day × firm	Day × firm	Day × firm	Day × firm
Adjusted R2	0.963	0.963	0.964	0.964
Obs	2,901,294	2,901,294	2,901,294	2,901,294

Table E.2: Insider trading, 13D filings and earnings relevance (continued)

Dep. var.: implied volatility	(1)	(2)	(3)	(4)
Dep. var: Parametric implied volatility by OptionMetrics				
$\mathbf{1}\left(T > t_R\right)\left(\frac{1}{T-t}\right)$	2.638***	2.638***	2.510***	2.510***
	(0.004)	(0.004)	(0.005)	(0.005)
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\, 13D$	-0.369***		-0.178***	
	(0.026)		(0.025)	
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\, 13D$	-0.256***		-0.269***	
	(0.022)		(0.022)	
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\, 13D\, inst$		-0.515***		-0.262***
		(0.064)		(0.062)
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\, 13D\, inst$		-0.357***		-0.309***
		(0.045)		(0.044)
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CBuys\, 13D\, noninst$		-0.329***		-0.160***
		(0.027)		(0.028)
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) CSales\, 13D\, noninst$		-0.230***		-0.257***
		(0.025)		(0.026)
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) Insider\, CBuys$			-0.150***	-0.150***
			(0.006)	(0.006)
$\mathbf{1}\left(T > t_R\right)\left(1/T-t\right) Insider\, CSales$			0.059***	0.059***
			(0.001)	(0.001)
Maturity pol.	Yes	Yes	Yes	Yes
IT maturity pol.	Yes	Yes	Yes	Yes
Fixed effects	Day × firm	Day × firm	Day × firm	Day × firm
Adjusted R2	0.970	0.970	0.971	0.971
Obs	2,901,294	2,901,294	2,901,294	2,901,294

F Comparison with other relevance measures

One of the contributions of the paper is to suggest a forward looking measure of earnings relevance that can be easily related to daily variables and it is valid under weak assumptions. In Figure F.1, we compare our measure of earnings relevance with other alternative measures across different firms and across different years. Each row of subfigures refers to a different alternative measure out of the three we consider: the option-based measures by Patell and Wolfson (1981) (PW) and Dubinsky et al. (2019) (DJKS), and the ex-post measure based on abnormal returns proposed by Beaver et al. (2018) (TCU). The left graph scatters the alternative measure computed for every firm in the sample for which we have at least 20 earnings announcements against our proposed measure. On the other side, we plot the yearly median of each measure. In general, every measure correlates significantly with our proposed measure and they share the same time-series pattern, which provides support to our measure. The rest of the section describes how we constructed each measure and an interpretation of the differences with our measure.

To construct our measure, we estimate the following regression equation using the 90 days prior to each announcement:

$$ln(IV_{i,t,T}^2) = \mu_{i,t} + \sum_{j=1}^{2} \lambda_j^{a_i} (T-t)^{j/2} + \gamma^{a_i} \mathbf{1}\left(T > t_{R_{i,t}}\right) \frac{1}{T-t} + \varepsilon_{i,t,T}$$

where subscripts i, t, T denote firm, time, and maturity; and the subscript a_i emphasizes that we estimate it per announcement. IV is the nonparametric risk-neutral volatility estimator proposed by Bakshi et al. (2003), t_R is the day of the announcement, and γ^{a_i} is the relevance of the earnings announcement a as a proportion of the annual variance. Then, we use the median of the estimates of γ^{a_i} for a given firm to construct the scatter plots, and the median of the same estimates by year to construct the time-series plots. Note that this modeling is much more general and robust than the baseline model because it considers a different term structure ($\lambda_j^{a_i}$) per announcement. Yet, results are very similar.

As explained in the main text, Patell and Wolfson (1981) propose measuring the earning relevance of the announcement by exploiting the time-series variation of implied volatility before the announcement. Precisely, the estimator is given by:

$$\hat{\sigma}_{\pi,PW}^2 = \frac{IV_{t_2,T}^2 - IV_{t_1,T}^2}{(T-t_2)^{-1} - (T-t_1)^{-1}}, \ (t_1 < t_2 < t_R \text{ and } T > t_R).$$

To implement it, for each day and maturity, we compute the weekly change in OptionMetrics implied variance of the at-the-money options. Then, we average across the 90 days before an earnings announcement and across all expiration dates after the announcement. We use weekly changes and the OptionMetrics estimator to follow PW; however, these decisions are not crucial. Finally, $\hat{\sigma}^2_{\pi,PW}$ measures the relevance in absolute terms instead of relative to the annual variance; hence we normalize the estimator by dividing it by the mean of the implied variance of options that expire before the earnings announcement.

We observe in the scatter plot that both measures are highly correlated (65.6%). Nonetheless, the time-series estimator is on average 1.5 times higher than our estimator. Besides, this estimator provides several negative relevance estimates while there is only one using our proposed estimator. The line graph provides more insight on how this estimator works. We observe how in 2008 as volatility raised, this estimator doubled, this is due to the peak in market volatility and not necessarily due to more informative earnings announcements. Due to the mean reversion of volatility, volatility decreased during 2009 leading to even a negative estimated relevance of the announcement.

Dubinsky et al. (2019) propose a similar estimator using the term structure:

$$\hat{\sigma}^2_{\pi,DJKS} = \frac{IV^2_{t,T_1} - IV^2_{t,T_2}}{(T_1 - t)^{-1} - (T_2 - t)^{-1}}, \ (t_R < T_1 < T_2).$$

In this case, for each day we compute the difference between the at-the-money OptionMetrics implied variance of each option and the one with a longer maturity as long as both maturities are posterior to the announcement. We then average across maturities and days for a given announcement. Similar to the previous case, we normalize the estimator by the implied variance of options that expire before the earnings announcement.

The scatter plot shows that this measure closely agrees with our measure, indeed their correlation is 78.6%. Moreover, we observe that there are very few firms with negative earnings announcements. In the time-series graph we observe a peak in 2008 as we did in the previous case but of smaller magnitude. This peak arises because after the huge jump in volatility in 2008, investors expected a reversion; therefore, we observe a steep downward sloping term-structure. As discussed in the main text, a downward sloping term structure leads to a positive bias in the measure proposed by DJKS.

Beaver et al. (2018) construct a test of significance of earnings announcement whose intuition closely relates to our definition of relevance. We follow their procedure:

1. Create an estimation period of 130 days before the announcement until 10 days before, and 10 to 130 days after the announcement.
2. We aggregate the data to 3-days cumulative returns.
3. We estimate the market model using the S&P500 as benchmark and data of the estimation period.
4. We construct the abnormal return as the cumulative return from the day before to the day after the announcement minus the predicted return from the market model.
5. We construct the U-statistic as the squared abnormal return over the residual variance of the market model in the estimation period.

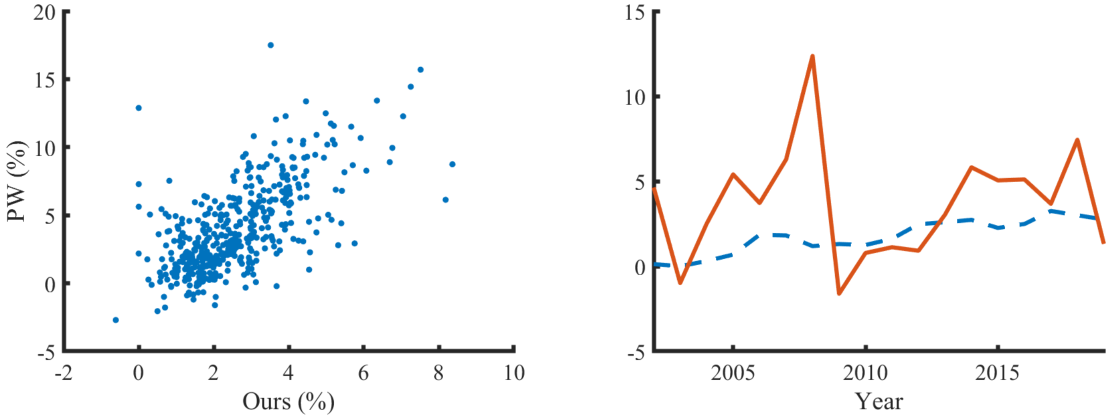
Finally, we subtract one to make it comparable to the other measures. The interpretation is similar to our γ since it is the ratio of the squared abnormal return on the announcement date over the idiosyncratic variance. The main difference is that this measure focus on the idiosyncratic part while ours is the ratio of the variance of returns.

Although this measure is expost it correlates strongly with our ex-ante measure (63.5%). However, their magnitudes are hard to compare. The time-series plot replicates the increasing trend found by Beaver et al. (2018) and shows that relevance kept increasing after the end of their sample period (December 2011). A very similar pattern arises using our measure.

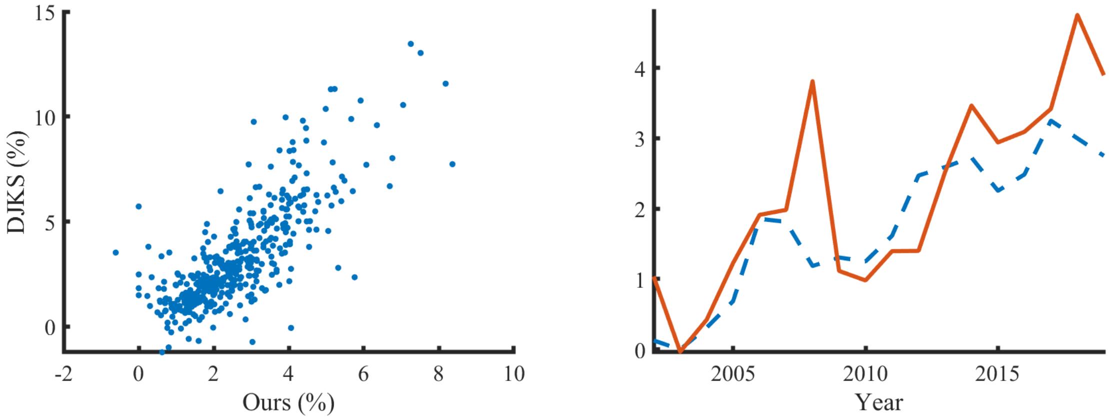
Figure F.1: Comparison earnings announcement relevance measures

Left-hand figures plot the median relevance of earnings announcement for each firm according to alternative measures (y-axis) with respect to the measure we use in the paper (x-axis). Right-hand figures plot the median relevance per year using three different measures (solid orange line) and our measure as benchmark (dashed blue line).

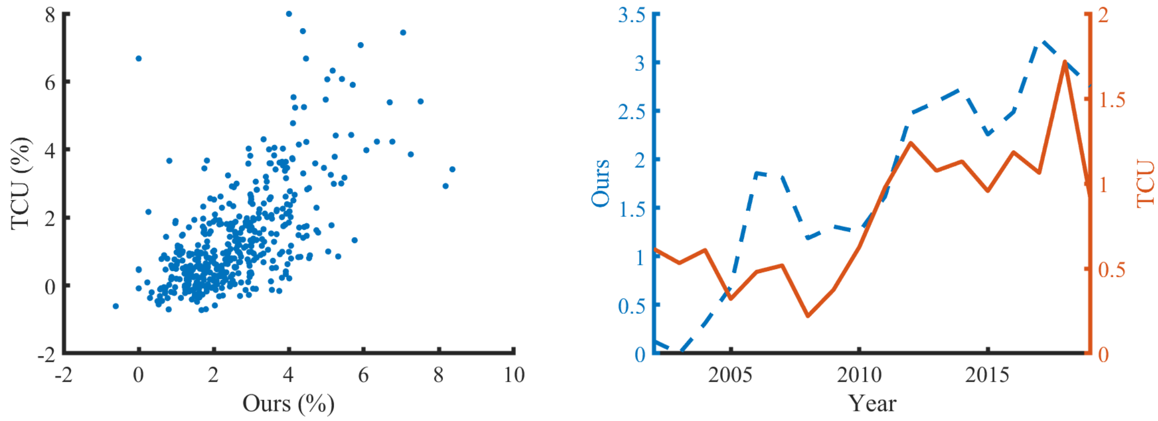
Option-based measure by Patell and Wolfson (1981)



Option-based measure by Dubinsky et al. (2019)



Expost measure by Beaver et al. (2018)



G Option liquidity

In this section we investigate how our results vary with option liquididy. To that end we calculate the average value of total open interest of each firm-day-maturity-triplet in a given firm-quarter. We then sort the observations by open interest for each quarter and create groups.

Figure G.1 shows how our measure of earnings announcement relevance varies over open interest deciles. We find that the measure of earnings announcement relevance decreases with open interest. This may be a consequence of liquidity but it may also be the result of firms without a liquid option market being less monitored; thus, relying more on earnings announcements.

Table G.1 examines the effects of insider buys and sells in samples of high (top 25%) and low (bottom 25%) open interest respectively. The findings indicate that the effect of insider purchases is negative for both groups, but more pronounced in the sample of low open interest. Conversely, we only find the positive effect of insider sales in the sample of high open interest. When open interest is in the bottom 25%, we even find a negative effect of insider sales. These findings could be consistent with the notion that a lower monitoring of low-liquidity firms leads to more opportunities to profit from foreknowledge.

Figure G.1: EA relevance by open interest deciles

These plots depict the estimate of the relevance of earnings announcements, and the 95% con dence intervals across deciles of open interest.

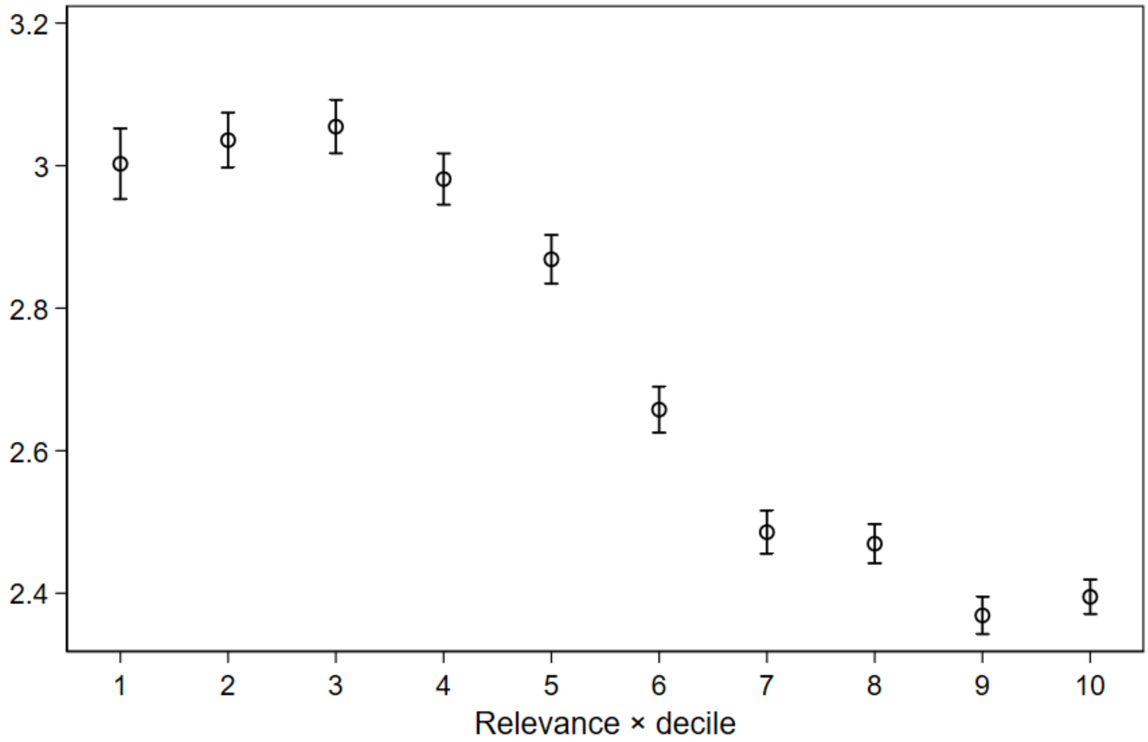


Table G.1: Insider trading, earnings relevance and option liquidity

This table reports the results of the regression shown in column 4 of Table 3 for the top 25% and bottom 25% of firms sorted according to open interest each quarter. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Sample	(1) Low	(2) High	(3) Low - High
Dep. var: Nonparametric implied volatility (Bakshi et al., 2003)			
$\mathbf{1}(T > t_R)(1/T-t)\,CBuys\,(\gamma_B)$	-0.216***	-0.166***	-0.050***
	(0.013)	(0.013)	(0.018)
$\mathbf{1}(T > t_R)(1/T-t)\,CSales\,(\gamma_S)$	-0.016***	0.082***	-0.099***
	(0.004)	(0.002)	(0.005)
Dep. var: Nonparametric implied volatility (Demeterfi et al., 1999)			
$\mathbf{1}(T > t_R)(1/T-t)\,CBuys\,(\gamma_B)$	-0.200***	-0.163***	-0.037**
	(0.012)	(0.011)	(0.016)
$\mathbf{1}(T > t_R)(1/T-t)\,CSales\,(\gamma_S)$	-0.016***	0.079***	-0.096***
	(0.004)	(0.002)	(0.004)
Dep. var: Parametric implied volatility by OptionMetrics			
$\mathbf{1}(T > t_R)(1/T-t)\,CBuys\,(\gamma_B)$	-0.205***	-0.182***	-0.023
	(0.012)	(0.011)	(0.016)
$\mathbf{1}(T > t_R)(1/T-t)\,CSales\,(\gamma_S)$	-0.009**	0.089***	-0.098***
	(0.004)	(0.002)	(0.005)
Day × firm	Yes	Yes	Yes
Maturity Pol.	Yes	Yes	Yes
IT maturity Pol.	Yes	Yes	Yes

H Tables underlying figures

Table H.1: Insider trading characteristics

This table reports the results of the regression shown in column 4 for different groups of trade and insider characteristics. Panel A distinguishes between filings that are late and on time, respectively. Panel B compares trade occuring in the different periods until the next earnings announcement. Panel C compares insider types, and Panel D considers different periods between the time between the trade and the report. Standard errors, shown in parentheses, are clustered at the firm-day level. Table 6 describes the variables. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Panel A: Timeliness of filings

Dep. var.: implied volatility	(1)
$\mathbf{1}\left(T>t_R\right)\frac{1}{T-t}\left(\gamma\right)$	2.536***
	(0.006)
Filed on-time $\times\mathbf{1}\left(T>t_R\right)\left(1/T-t\right)$	-0.136***
	(0.007)
Filed on-time $\times\mathbf{1}\left(T>t_R\right)\left(1/T-t\right)$	0.052***
	(0.001)
Filed late $\times\mathbf{1}\left(T>t_R\right)\left(1/T-t\right)$	-0.484***
	(0.035)
Filed late $\times\mathbf{1}\left(T>t_R\right)\left(1/T-t\right)$	-0.022
	(0.033)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.953
Obs	2,928,937
Difference in coefficients	
Buys: Filed on time - filed late	0.348
F-value	(92.74)
Sales: Filed on time - filed late	0.074
F-value	(5.06)

Panel B: Months to the next earnings announcement

Dep. var.: implied volatility	(1)
$\mathbf{1}\,(T > t_R)\,\frac{1}{T-t}\,(\gamma)$	2.490***
	(0.006)
1 month $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.292***
	(0.037)
1 month $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.104***
	(0.006)
2 months $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.270***
	(0.015)
2 months $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.049***
	(0.004)
3 months $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.065***
	(0.010)
3 months $\times\mathbf{1}\,(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.105***
	(0.003)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.954
Obs	2,928,937
Difference in coefficients	
Buys: 1 month - 2 months	-0.022
F-value	(0.29)
Buys: 1 month - 3 months	-0.227
F-value	(35.60)
Sales: 1 month - 2 months	-0.153
F-value	(343.99)
Sales: 1 month - 3 months	-0.209
F-value	(855.31)

Panel C: Insider types

Dep. var.: implied volatility	(1)
$\mathbf{1}(T > t_R)\dfrac{1}{T-t}(\gamma)$	2.547***
	(0.006)
Officer $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.053***
	(0.013)
Officer $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.046***
	(0.002)
Director $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.231***
	(0.009)
Director $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.056***
	(0.004)
Beneficial owner $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.121***
	(0.013)
Beneficial owner $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	0.010
	(0.007)
Other $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CBuys\,(\gamma_B)$	-0.423***
	(0.081)
Other $\times \mathbf{1}(T > t_R)\,(1/T-t)\,CSales\,(\gamma_S)$	-0.106***
	(0.016)
Maturity pol.	Yes
IT × type maturity pol.	Yes
Fixed effects	Day × firm
Adjusted R2	0.953
Obs	2,928,937
Difference in coefficients	
Buys: officer - director	0.178
F-value	(104.04)
Buys: officer - beneficial owner	0.068
F-value	(12.22)
Buys: director - beneficial owner	-0.110
F-value	(45.43)
Sales: officer - director	-0.010
F-value	(5.13)
Sales: officer - beneficial owner	0.036
F-value	(22.64)
Sales: director - beneficial owner	0.046
F-value	(31.79)

I Filtering EDGAR log files

We retrieve the EDGAR log files from the https://www.sec.gov/dera/data/edgar-log-file-data-set.html. This website hosts internet search traffic for EDGAR filings for the period from February 2003 to June 2017. For the purposes of our analysis, we construct a measure of relative attention to insider trading, i.e., we compute the ratio of the number of logs in a given year for insider filings scaled by the number of insider filings, and the number of logs for 10K and 10Q filings scaled by the number of these filings in a given year. We apply the following filter to the log files (Ryans, 2017):

1. We restrict attention to observations with non-missing values for CIK, date, accession, and IP address.
2. We keep records where *code* is equal to 200, as this indicates that the requested document has been successfully delivered by the server.
3. We limit attention to filings, and remove access to index pages by removing records where *idx* is equal to 1.
4. We remove records by web crawlers, i.e., observations where *crawler* is equal to 1.
5. We remove records of IP addresses with more than 500 requests on a given day that satisfy the above criteria, as these are likely generated by a crawler.

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