Precision of information in daily stock prices and cost of equity

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Abstract

The precision of the information reflected in stock prices can reduce investors' uncertainty about the value of the firm. We estimate the precision of information in daily stock returns, and show that when the information impounded into daily stock returns is more precise, expected returns are lower. Also, public disclosures increase the precision of information in prices, and stock returns during quarterly earnings announcement days contain more precise information than those during nonannouncement days. But, regardless of the source of the information, public or private, after controlling for information asymmetry, we find that the average precision of information in prices is associated with lower expected stock returns. Our findings are consistent with the argument that increasing the precision of the information available to investors decreases the cost of equity.

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1. Introduction

The precision of information reflected in stock prices can reduce investors' uncertainty about firm value (e.g., Grossman and Stiglitz, 1980; Leland, 1992), and may lower the cost of equity, as shown by Lambert, Leuz, and Verrecchia (2012). We estimate the precision of information impounded in daily stock prices, and examine its relation with corporate disclosures and the cost of equity capital.

In estimating the precision of information impounded in daily stock prices, we use a methodology similar to that used by Hodrick (1987) for the analysis of the information in forward and spot exchange rates, and by Biais, Hillion, and Spatt (1999) for the analysis of information in the opening stock prices. Specifically, we regress long-term stock returns (3-13 months around each day) on daily stock returns and use the slope coefficient on the daily stock returns as a measure of precision. Long-term stock returns serve as a proxy for the change in the fundamental value of the firm. If daily returns contain no information on the change in the long-term value of the firm, the precision coefficient will be 0, and it is expected to increase toward 1 as the precision of information in daily stock returns increases.

We find that the precision coefficient converges to 1, on average, during earnings announcement days; and it is much lower (about 0.68, on average) during nonannouncement days. This pattern persists as we increase the length of the return window from three to 13 months. This finding suggests the precision of information impounded into daily stock prices is higher on days that contain public disclosures. During earnings announcements, a large quantity of the information is released to the market, and the precision of information is therefore higher than during nonannouncement days.[1] We also find that the precision of

[1] During nonannouncement days, even if informed investors hold substantial information on the firm, they will try to trade without revealing it (see Kyle, 1989; Mederano and Vives, 2001).

information released during nonannouncement days is higher for firms that provide public disclosures during the quarter, such as management earnings guidance, and for firms with lower information asymmetry, as reflected by lower bid-ask spreads and lower price impact.

Information asymmetry and information precision are negatively correlated, as would be expected. However, in the recent decade, information asymmetry has decreased, while the precision of information of large firms during nonannouncement days has decreased as well. The timing of this structural change coincides with Regulation Fair Disclosure (REG FD) that disallowed selective disclosure. Prohibiting private communication between managers and analysts is likely to reduce information asymmetry across investors, but is also likely to reduce the total amount of information available to investors; apparently, this reduction in the amount of information has also resulted in a reduction in the precision of total information available to investors. Our empirical findings also suggest the precision of information released during earnings announcements has increased over time; this increase has occurred primarily after 2002, the period after the enactment of the Sarbanes Oxley Act (SOX).

Finally, we find that higher precision of information is associated with a lower cost of equity capital, after taking into consideration size, book-to-market, and momentum factors. Both the precision of the information on nonannouncement days, which are the majority of days during the year, and the incremental precision of information in earnings announcement days (the three days around quarterly earnings announcements, 12 days during each year) are negatively associated with expected abnormal stock returns, after controlling for the information asymmetry between investors. Overall, these findings are consistent with Lambert et al. (2012) in that precise information decreases the cost of equity regardless of whether the information is public or private.

This study contributes to the literature that examines the relation between information precision and the cost of equity. Prior studies find a negative relation between the quality of financial information and the cost of equity (e.g., Francis, LaFond, Olsson, and Schipper 2005, Leuz and Verrecchia 2000). To the extent that high-quality reporting is more precise, these findings suggest that precise public information lowers the cost of equity. Similarly, Botosan, Plumlee and Xie (2004) test the relation between information asymmetry and the properties of analysts' forecasts, and find that the precision of public information in analysts' forecasts is negatively correlated with the cost of equity capital. We estimate the precision of information in stock prices, which in liquid markets reflects both the public and private information of investors, and find it is negatively associated with cost of equity capital, after controlling for information asymmetry.[2]

2. Research Design

2.1. Measuring Precision

We estimate the precision of information impounded in daily stock prices, using methodology similar to that used by Hodrick (1987) for the analysis of the information in forward and spot exchange rates, and by Biais et al. (1999) for the analysis of information in the opening stock prices. Consider the following regression:

$$RET_i(t-\tau, t+\tau) = \mu_0 + \mu_1 RET(t)_i + \varepsilon_i$$

The independent variable is a vector of daily returns for firm i. The dependent variable is the cumulative return for a window starting τ days before and ending τ days after day t.

[2] If and when information asymmetry affects the cost of equity is an ongoing debate in the literature. Easley and O'Hara (2004) argue that investors demand higher returns to holding stocks with greater private information. Lambert et al. (2012) and Armstrong, Taylor, Core, and Verrecchia (2011), however, conclude that with perfect competition, information asymmetry does not affect the cost of equity. Lambert et al. (2012) argue that even if information asymmetry is not priced, the precision of average information, public and private, will affect the cost of equity. Similarly, Hughes et al. (2007) find that information asymmetry should not be a stand-alone priced factor. Empirical evidence on this issue is also under debate (see, e.g., Core, Guay, and Verdi, 2008; Mohanram and Rajgopal, 2009).

The slope coefficient is a measure of the average precision of information impounded in daily stock returns. If information on the value of the firm drives the stock returns in day t, the slope coefficient will be one. However, if daily stock returns contain noise, the slope coefficient will be attenuated to 0.

The empirical equation we estimate here allows the precision coefficient to be different during and outside quarterly earnings announcements, as in eq. (1):

$$RET3M(T)_{it} = \gamma_{0t} + \gamma_{1t} ANND_{it} + \gamma_{2t} RET(T)_{it} + \gamma_{3t} ANND_{it} \times RET(T)_{it} + \varepsilon_{it}\,. \qquad (1)$$

The independent variable, $RET(T)_{it}$, is firm i's daily stock return in day t during calendar year T. $ANND_{it}$ is an indicator variable that equals 1 in the three-day window around the four quarterly earnings announcements of year T (12 days in total), and $ANND_{it} \times RET(T)_{it}$ is a multiplicative variable that allows the slope coefficient to be different for earnings announcement days. The dependent variable, $RET3M(T)_{it}$, is the cumulative stock return in the three months surrounding the month containing day t.

Consider, for example, a company with 252 trading days in calendar year 2012. $RET(2012)_{it}$ is a vector of 252 observations of daily stock returns in calendar year 2012. RET3M(2012) is a vector of 252 observations, constructed as follows: for all trading days in June 2012, $RET3M_{it}$ is the cumulative return from May 1, 2012, through July 31, 2012; for all trading days in July 2012, $RET3M_{it}$ is the cumulative return from June 1, 2012, through August 31, 2012, and similarly for all months. $ANND_{it}$ is a vector of 252 observations where 12 of the observations corresponding to quarterly earnings announcement days are equal to 1, and the remaining 240 observations corresponding to nonannouncement days are equal to 0.

The coefficient γ_{2t} captures the average precision of nonannouncement daily stock returns for company i in calendar year t. The coefficient γ_{3t} captures the *incremental* precision of information released during quarterly earnings announcements by firm i during calendar year t. The sum $[\gamma_{2t} + \gamma_{3t}]$ represents the average precision of information released during quarterly earnings announcements by firm i during calendar year t.

By estimating eq. (1) for each firm/year, we obtain a firm-specific annual measure of precision of information released during nonannouncement days, and a measure of the precision of information released during earnings announcement days. Note that the slope coefficients in eq. (1) measure the precision of the information, not its information content (often measured by the regression's adjusted-R^2).[3] The information in daily returns can be precise but with low information content, so the coefficient γ_2 could be close to 1 and, at the same time, the adjusted-R^2 could be low. For convenience, we label the coefficient γ_2 NONANN (precision of information released during nonannouncement days); we also label the coefficient γ_3 ANN (precision of information released during earnings announcement days).[4]

2.2. Changes in information precision after Regulation Fair Disclosure

Precision of information is likely to be affected by new regulation, such as REG FD and SOX. REG FD, which came into effect after 2000 is likely to reduce information asymmetry by preventing selective disclosures, but could also reduce the total amount of information available to investors. SOX, which became effective after 2002, aimed at increasing the reliability of financial disclosures, primarily earnings. Both REG FD and SOX are expected to be more effective for firms with larger information asymmetry and less reliable earnings, respectively, namely, smaller firms. Using eq. (2), we test whether the

[3] Ball and Shivakumar (2008) regress annual stock returns on short-window returns around quarterly earnings announcements, and find that returns during announcement days explain only a small fraction of annual returns. Ball and Easton (2013) regress earnings on daily stock returns, and find that the coefficient on returns increases significantly in earnings announcement days. They argue that news released during these days signal a more transitory effect than news released during non-earnings announcement days. Both studies focus on timeliness, not precision.

4 Our results are similar when we use a one-month window, a five-month window, and a seven-month window instead of a three-month window as the dependent variable in eq. (1). Also, as we show later, our results are similar if we replace the symmetric window with a forward-looking return window.

precision of information and information asymmetry changed after the year 2000 for small and large firms:

$$DEPVAR_{it} = \beta_0 + \beta_1 REGFD_{it} + \eta_{it} \qquad (2)$$

$$DEPVAR_{it} = \{NONANN_{it}, ANN_{it}, [NONANN_{it} + ANN_{it}], BAS_{it}\}.$$

REGFD is an indicator variable that equals 1 for years after 2000, and 0 otherwise. The set of dependent variables ($DEPVAR_{it}$) contains the precision measures NONANN, ANN, and NONANN+ANN, and the bid-ask spread (BAS) as a measure of information asymmetry. Each model is estimated with firm fixed effects.

2.3. The determinants of information precision

Precision of information should be associated with firm risk, information supply, and information asymmetry. We use firm size and book-to-market ratio as measures of firm risk. Information supply is measured by the number of analysts that follow the firm, and by whether the firm issues management forecasts. Information asymmetry is represented by the bid-ask spread.[5] First, we focus on the determinants of precision in nonannouncement days, and estimate eq. (3) with firm and year fixed effects:

$$NONANN_{it} = \delta_0 + \delta_1 MV_{it} + \delta_2 BM_{it} + \delta_3 ANA_{it} + \delta_4 GUID_{it} + \delta_5 BAS_{it} + \eta_{it}. \qquad (3)$$

The dependent variable in eq. (3) is NONANN (the precision of information released during nonannouncement days). The first explanatory variable is firm size (MV_{it}), measured as the natural logarithm of the market value of equity at the beginning of each year. Atiase (1985) and Collins, Kothari, and Rayburn (1987) argue that smaller firms attract lower media and analyst coverage, resulting in lower information production outside their earnings-announcement windows. This argument suggests a positive association between firm size and NONANN ($\delta_1 > 0$). The second explanatory variable is the book-to-market ratio (BM_{it}),

[5] We also use price impact as an alternative measure of information asymmetry and report results in Table 9.

measured as the book value of equity divided by the market value of equity at the beginning of each year. To the extent that higher book-to-market ratios reflect mature businesses, information released during nonannouncement days is likely to be more precise ($\delta_2 > 0$).

The third variable in the model is the natural logarithm of the number of financial analysts following the firm (ANA_{it}). Financial analysts contribute to the dissemination of information by providing earnings forecasts. We expect the precision of information to increase with analysts' coverage during nonannouncement days ($\delta_3 > 0$).

The frequency of earnings guidance has been increasing over time, and more firms are using earnings guidance to reduce the uncertainty about their performance (Houston, Lev, and Tucker, 2010). Much of the guidance is given immediately after earnings, but firms that provide guidance usually update investors during the quarter on news that can affect their previously provided forecasts. Therefore, guidance can reduce noise throughout the year. For example, rumors will have a lower effect on stock prices, because managers are known to continuously update investors on news. Because most guidance is provided outside the earnings announcement window, we expect its effect on NONANN to be positive ($\delta_4 > 0$). We measure guidance (GUID) as an indicator variable that equals 1 for firms that issued management earnings forecasts, and 0 otherwise.

The fifth explanatory variable in the model is the bid-ask spread (BAS), a proxy for information asymmetry. The relation between information asymmetry and information precision is not a-priori clear, because private information can increase precision as well as public information (e.g., Lambert et al. 2012).

We also use a model that explains the precision of information released during earnings announcements:

$$NONANN + ANN_{it} = \phi_0 + \phi_1 MV_{it} + \phi_2 BM_{it} + \phi_3 ANA_{it} + \phi_4 GUID_{it} + \phi_5 BAS_{it} + \omega_{it} \ . \quad (4)$$

The dependent variable in eq. (4) is NONANN+ANN (the precision of information released during earnings announcements). The independent variables in eq. (4) are the same as in eq. (3). We expect the sign of the coefficients on size (ϕ_1), book-to-market (ϕ_2), and bid-ask-spreads (ϕ_5) to be the same as their counterparts in eq. (3). However, we expect the coefficients on analysts' coverage (ϕ_3) and management guidance (ϕ_4) to be smaller than δ_3 and δ_4, respectively, in eq. (3), because analysts' revisions and management forecasts are mostly issued outside earnings announcement windows.

2.4. Information precision and the cost of equity capital

Lambert et al. (2012) argue that providing more precise information is expected to decrease the cost of capital, even in the presence of information asymmetry. We test this prediction using the following equation:

$$ABRET_{it+1} = \theta_0 + \theta_1 NONANN_{it} + \theta_2 ANN_{it} + \theta_3 BAS_{it} + \omega_{it}. \quad (5)$$

$ABRET_{it+1}$ is the average monthly risk-adjusted stock returns starting from February of year t+1 through January of year t+2.[6] To adjust stock returns for risk, we use Daniel, Grinblatt, Titman, and Wermers' (1997) size, book-to-market, and momentum quintile portfolios. NONANN is the precision of information released during nonannouncement days, ANN is the incremental precision of information released during earnings announcements, and BAS is the bid-ask spread. The model is estimated with firm and year fixed effects.

3. Sample Selection and Descriptive Statistics

The initial sample includes all firms for which four quarterly earnings announcement dates are available on COMPUSTAT and at least 200 trading days are available on CRSP.

[6] To estimate precision of daily returns in December of year t, the monthly returns in January of year t+1 are used see eq. 1 above.

This sample includes 126,762 firm/year observations over the period 1972-2012. Because some of our tests require bid-ask spreads and management forecasts, the sample is reduced to 50,490 firm/years. Table 1 presents details on the sample. Management forecasts are taken from First Call and Capital IQ data bases. First Call data end on 2010 and Capital IQ data start on 2001.[7] We create an indicator variable that equals 1 each year for firms with management forecasts available either on First Call or Capital IQ. We calculate bid-ask spreads and price impact using TAQ data. To adjust stock returns for risk, we use Daniel et al.'s (1997) size, book-to-market, and momentum quintile portfolios, with data available on R. Russ Wermers' website.

(Table 1 about here)

Figure 1 presents average annual precision coefficients (NONANN, ANN, and NONANN+ANN) from 1972 to 2012. NONANN seems to be decreasing over time, suggesting the information released during nonannouncement days has become less precise. ANN slightly increases over time, which means that incremental precision of information released during earnings announcements increased over time. The sum NONANN+ANN, which measures the precision of information released during earning announcements, seems to have increased over time, and especially during the last decade.

(Figure 1 about here)

Figure 2 presents the effective bid-ask spreads during nonannouncement and announcement days. The measure of information asymmetry is the effective bid-ask spreads (BAS). We compute the effective bid-ask spread using TAQ data, which are available from 1993, as $[2\times(|P_{it}-V_{it}|/V_{it})]$, where P_{it} is the trading price and V_{it} is the security's bid-ask midpoint at the time of the transaction. The daily effective bid-ask spread is calculated by averaging the effective bid-ask spreads of all transactions during that day, and the average

[7] The coverage of First Call before 1999 is limited. Results with guidance data that start on 1999 are qualitatively similar to those presented in Table 4 below.

daily effective bid-ask spread for the year (BAS_{it}) is used as a measure of information asymmetry. Bid-ask spreads sharply declined after 2000 and stabilized around 2004. Also, bid-ask spreads are slightly larger during earnings announcements, a finding consistent with Lee, Mucklow, and Ready (1993).

(Figure 2 about here)

Table 2 presents average precision coefficients for different return windows. We estimate eq. (1) with firm fixed effects, increasing the return window of the dependent variable from three up to 13 months. When the dependent variable is defined as the surrounding three months, the average precision of information released during non-announcement days is 0.674, and the average incremental precision of information released during quarterly earnings announcements is 0.210; that is, the precision of information released during quarterly earnings announcements is (0.674 + 0.210 =) 0.884, significantly higher at the 0.01 level than the precision of information released during nonannouncement days. The average precision of daily returns during nonannouncement days remains relatively stable as we increase the return window to 13 months; however, the average precision of information released during earnings announcements is close to 1.00 for all windows longer than five months. The results in Table 2 suggest the precision of information released during earnings announcement days is higher than that released outside earnings announcements, and that this finding is not sensitive to the length of the surrounding return window.

(Table 2 about here)

4. Results

4.1. Change in precision after REG FD

Panel A of Table 3 presents means of the precision variables and the bid-ask spread. We present statistics separately for small firms (below-median market value of equity) and large firms (above-median market value of equity). The average precision of information released during nonannouncement days (NONANN) increased after 2000 for small firms (at the 0.01 level), but decreased for large firms after 2000 (at the 0.01 level).

Following REG FD, large firms that often maintained close relations with financial analysts were unable to selectively disclose information to analysts, which may explain the decrease in the precision of information released during nonannouncement days that we document for large firms. The decimalization of stock prices after 2000 and the general decrease in trading costs may have also affected the precision of information released during nonannouncement days. Lower trading costs enable more private information to be traded into stock prices. Apparently, the decrease in trading costs had a bigger impact on smaller firms, and the precision of the information released during nonannouncement days increased.

The incremental precision of information released during earnings announcements (ANN) increased after 2000 for small firms (at the 0.01 level) and remained similar for large firms. The precision of information released during earnings announcements (NONANN+ANN) increased for small firms (at the 0.01 level) and remained the same for large firms. Finally, average bid-ask spreads decreased substantially after 2000 for both small and large firms. Overall, information asymmetry has decreased after 2000 for both small and large firms, while the precision of information increased only for small firms.

Panel B presents slope coefficients obtained from estimating eq. (2). The results are virtually identical to those in panel A: the precision measures improved for small firms after 2000 but are basically unchanged for large firms. The bid-ask spreads decreased for both small and large firms.

(Table 3 about here)

4.2. Cross-sectional analysis of precision

Table 4 presents descriptive statistics and a correlation matrix (Pearson above diagonal and Spearman below diagonal). The correlations between NONANN and ANN are negative (Pearson = -0.15, Spearman = -0.16), suggesting that when the precision of information released during nonannouncement days is high, the incremental precision of information released during earnings announcements tends to be lower, and vice versa. This result supports the argument that when earnings are less precise, the demand for more precise information outside earnings announcements increases.

Larger firms release more precise information during nonannouncement days, as reflected by the positive correlations between NONANN and MV (Pearson = 0.08, Spearman = 0.15). Surprisingly, firms with larger book-to-market ratios release less precise information during nonannouncement days (Pearson = -0.02, Spearman = -0.07), but the Pearson correlation is close to 0. In addition, analysts' coverage is associated with more precise information released during nonannouncement days, as reflected by the positive correlations between NONANN and ANA (Pearson = 0.11, Spearman = 0.16). Furthermore, management guidance is positively associated with the precision of information released during nonannouncement days, as reflected by the positive correlations between NONANN and GUID (Pearson = 0.09, Spearman = 0.12). Finally, companies with larger bid-ask spreads release less precise information during nonannouncement days, as reflected by the negative correlations between NONANN and BAS (Pearson = -0.18, Spearman = -0.19).

The correlations between the precision of information released during earnings announcement days (NONANN+ANN) and the main research variables are in the same direction, but smaller, probably because our precision measure is much noisier for earnings, as it is based only on 12 trading days.

Larger firms are followed by more analysts (Pearson = 0.79, Spearman = 0.80) and have smaller bid-ask spreads (Pearson = -0.69, Spearman = -0.90). Also, the bid-ask spread is negatively correlated with analysts' coverage (Pearson = -0.56, Spearman = -0.76).

(Table 4 about here)

Column 1 of Table 5 presents results of estimating eq. (3), with year and firm fixed effects and with standard errors clustered based on year and firm. The coefficient on firm size (MV) is unexpectedly negative and significant at the 0.01 level (-0.070, t = -6.70). Also, the coefficient on the book-to-market ratio is positive (0.045, t = 3.41) and significant at the 0.01 level. This result suggests companies with larger book-to-market ratios release more precise information during nonannouncement days.

Analysts' coverage is not associated with information precision, but the coefficient on earnings guidance is positive (0.032, t = 3.48) and significant at the 0.01 level. This result means that releasing earnings guidance increases the precision of information in nonannouncement days. Finally, the coefficient on BAS is negative and significant at the 0.01 level, suggesting companies with larger information asymmetry, as measured by the bid-ask spread, release less precise information outside earnings announcement.

We also estimate eq. (3) without the bid-ask variable and without firm fixed effects (columns 2 and 3). The exclusion of the bid-ask variable and firm fixed effects has a significant effect on the results. When we exclude fixed effects, the coefficient on MV is no longer negative. Also, the coefficient on analysts' coverage becomes positive and significant at the 0.01 level.

Column (4) presents results for estimating eq. (4) with NONANN+ANN as the dependent variable (the precision of information released during earnings announcements). The results suggest that larger firms release less precise information during earnings announcements, as reflected by the negative coefficient on MV (-0.068, t = -3.53). Also, the coefficient on BM is positive (0.060, t = 2.85) and significant at the 0.01 level, suggesting companies with larger book-to-market ratios provide more precise information during earnings announcements. In addition, greater analysts' coverage and issuing management guidance are not associated with the precision of information released during earnings announcements, probably because most analysts' and management forecasts are provided outside the earnings announcement windows.

Column (5) provides results of estimating eq. (4), but the dependent variable is ANN—the *incremental* precision of information released during earnings announcements. Note that positive (negative) coefficients on the independent variables indicate higher (lower) precision relative to nonannouncement days. We also added NONANN as an additional independent variable. The purpose of this column is to highlight the substitution between precision of information released outside and within earnings announcements. The coefficient on NONANN is negative and significant at the 0.01 level (-0.538, t = -14.73), suggesting that higher precision during nonannouncement days is associated with lower incremental precision of information released during earnings announcements. Also, the results are consistent with those reported in column (1); that is, the coefficient on firm size is negative (at the 0.05 level), the coefficient on BM is positive (at the 0.05 level), and the coefficient on BAS is negative (at the 0.01 level).

(Table 5 about here)

4.3 Precision and the cost of capital

Table 6 presents abnormal returns for quintile portfolios formed based on precision measures and bid-ask spreads. We use a time-calendar portfolio approach to accumulate returns. In each year t, stocks are sorted into quintile portfolios based on the precision of information released during nonannouncement days (NONANN). In each quintile portfolio, stocks are held from February of year t+1 to January of year t+2. For each of the five portfolios, average returns are computed for each month, and the time-series of daily returns are regressed on Fama and French's (1993) three factors (MRKT, SMB, HML). We also create similar quintile time-calendar portfolios for the incremental precision of information released during earnings announcements (ANN), the precision of information released during earnings announcements (NONANN+ANN), and effective bid-ask spreads (BAS).

As the table shows, firms with larger information precision outside earnings announcements earn lower subsequent abnormal returns, consistent with the arguments that larger precision translates to lower cost of capital. We do not find any association between the precision of information released during earnings announcements and subsequent abnormal stock returns. Firms with larger effective bid-ask spreads earn larger subsequent abnormal returns, consistent with the argument that more information asymmetry increases the cost of capital.

The effect of precision on stock returns in this univariate portfolio analysis is quite large. The quintile portfolio of firms with low NONANN earns a monthly abnormal return of 0.60%, whereas the quintile portfolio of firms with high NONANN earns only 0.15%. In annual terms, the difference between the high and low quintiles is 5.4%. Next, we use a multivariate analysis that controls for information asymmetry and firm fixed-effects. The effect of precision on subsequent abnormal returns is more modest.

(Table 6 about here)

Table 7 presents results for estimating eq. (5)—the association between information precision and expected stock returns. The equation is estimated with firm and year fixed effects, and with double-clustered standard errors. As the table shows, higher precision of information, both during and outside earnings announcements, reduces the cost of capital, whereas information asymmetry, measured by the bid-ask spread, increases the cost of capital.

The coefficients on NONANN are negative and significant at the 0.01 level, in all specifications, suggesting that precision of information released during nonannouncement days reduces the cost of capital. In particular, the coefficient on NONANN in the first specification is -0.513, which means that an increase in precision from the first to the third quartile, from 0.180 to 0.796 according to Table 4, decreases monthly abnormal returns by 0.316%, or about 3.8% annually. After controlling for bid-ask spreads (BAS) in specification 5, the coefficient on NONANN is -0.406, which means that an increase in precision from the first to the third quartile, decreases monthly abnormal returns by 0.25%, or about 3% annually.

Furthermore, the *incremental* precision of information released during earnings announcements further decreases the cost of capital, as reflected by the negative coefficient on ANN (-0.009, significant at the 0.05 level). The precision of information released during earnings announcements (NONANN+ANN) has the strongest negative effect on the cost of capital per unit of precision; the coefficient on NONANN+ANN is -0.15 (significant at the 0.01 level). Finally, the coefficient on BAS is positive and significant at the 0.01 level (11.73, t = 4.13), suggesting information asymmetry increases the cost of capital.

Our result is consistent with Lambert et al. (2012), who suggest the precision of average information should be priced. We find that the effect of precision on expected returns exists after controlling for information asymmetry.

(Table 7 about here)

4.4. Robustness tests

We conducted several sensitivity analyses to check whether our results hold in different settings. For each setting, we replicated the entire analysis; however, to save space, we report in Table 8 only the results of estimating eq. (5) for each setting.

The main analysis uses the bid-ask spread (BAS) as a measure of information asymmetry. However, bid-ask spreads may also capture other components of transaction costs, such as inventory risk. We performed our tests using the price impact (PI) instead of the bid-ask spread. PI measures the adverse-selection component of trading costs, and it may be a more accurate measure of information asymmetry. Following Huang and Stoll (1996), we define price impact as $PI_{it} = 100 \times D_{it} \times \{[(V_{it} + 30) - V_{it}]/V_{it}\}$, where V_{it} is the security's bid-ask midpoint at the time of the transaction, and (Vit+30) is the bid-ask midpoint 30 minutes after the transaction, or at 4 p.m. for transactions completed during the last half hour of trading. D_{it} is equal to 1 when a buyer initiated the transaction, and equal to -1 when a seller initiated it. We use the Lee and Ready (1991) algorithm to determine the direction of the trade. We use TAQ data to estimate the price impact of each transaction.[8] We calculate the daily price impact by averaging the price impact of all transactions during that day, and use the average daily price impact for the year (PI_{it}) as a measure of information asymmetry.

Specification (1) of Table 8 reports the results of estimating eq. (5) with PI instead of BAS. The coefficient on PI is positive and significant at the 0.01 level, suggesting information asymmetry is positively associated with the cost of capital. Also, after we control for price impact (PI), the precision of information released during nonannouncement days and the incremental precision of information released during earnings announcement

[8] Trades and quotes with time stamps outside regular trading hours (9:30 a.m. to 4:00 p.m.) are deleted from the sample, as are a small number of trades and quotes representing possible data errors or with unusual characteristics (Bessembinder, 1999). Specifically, we omit trades if they are indicated in the TAQ database to be coded out of time sequence, or coded as involving an error or a correction. Trades indicated to be exchange acquisitions or distributions, or that involve nonstandard settlement (TAQ Sale Condition codes A, C, D, N, O, R, and Z), are also omitted, as are trades that are not preceded by a valid same-day quote. We omit quotes if either the ask or bid price is non-positive, or if the differential between the ask and bid prices exceeds $5 or is non-positive. We also omit quotes associated with trading halts or designated order imbalances, or that are non-firm (TAQ quote condition codes 4, 7, 9, 11, 13, 14, 15, 19, 20, 27, and 28).

days are both negatively associated with expected stock returns (the coefficient on NONANN is -0.512 and the coefficient on ANN is -0.031, both significant at the 0.05 level or better). Hence, using bid-ask spreads as a measure of information asymmetry does not drive the results.

In estimating the precision measures in eq. (1), we assume daily stock returns are serially independent; dependence might lead to a biased slope coefficient. As a robustness check, we computed the autocorrelation in daily stock returns for each firm/year and find the autocorrelation is not significantly different from zero at the 0.05 level for 31,208 firm/year observations (62% of the sample). We re-estimated eq. (5) using only the 31,208 firm/year observations for which the autocorrelation in daily stock returns is close to 0. The results are reported in specification (2). As before, the coefficients on NONANN are negative and significant at the 0.01 level and the coefficients on BAS and PI are positive and significant at the 0.01 level. The coefficient on ANN is negative but not significant at the 0.10 level, suggesting the impact of precision of information released during earnings announcements is similar to that released during non-announcement days.

We obtain the precision measures by estimating eq. (1) with raw daily stock returns. We use raw returns because we aim to capture all information in stock returns, both market-wide and firm-specific. Changes in the information environment can affect the risk loadings and the interaction between the returns of individual stocks and the market (Hughes, Liu, and Liu 2007; Patton and Verardo, 2012). As a robustness check, we construct precision measures using abnormal daily returns (based on size, book-to-market, and momentum factors). We re-estimated eq. (5) using the new precision measures and report the results in specification (3). The results are similar to those reported in Table 7, suggesting that using raw daily stock returns in constructing the precision measure does not drive our results.

To construct our precision measures, we estimate eq. (1) using symmetric windows around the month containing the daily return. For instance, the three-month window used in eq. (1), as well as the other windows reported in Table 2, includes the same number of months before and after the month containing the daily return. As a robustness check, we constructed the precision measures using a forward-looking window—a three-month window that includes the month containing the daily returns and the subsequent two months. Using these forward-looking precision measures, we re-estimate eq. (5) and report the results in specification (4) of Table 8. The results are similar to those reported in Table 7, suggesting that using symmetric return windows does not drive the results.

To alleviate concerns of endogeneity or spurious correlation between the precision measures and expected stock returns, we compute the fitted values from eq. (3) and eq. (4), excluding BAS from the analysis, and use those fitted values as our new precision measures. Specifically, we obtain expected precision measures based on size, book-to-market, analysts' coverage, and management guidance, and use these measures in estimating eq. (5). The results, which are reported in specification (5) of Table 8, are consistent with those in Table 7. Overall, results in Table 8 provide support to our main finding: information precision is positively associated with the cost of capital, whereas information asymmetry is negatively associated with the cost of capital.

(Table 8 about here)

7. Summary and Conclusions

This study examines the precision of information impounded in daily prices, its relation to corporate disclosures, and its association with the cost of equity capital. We estimate the precision of information using a methodology similar to that used by Hodrick (1987) and Biais et al. (1999). In particular, we regress long-window stock returns on daily returns. The long-term returns serve as a proxy for the fundamental change in the value of the firm, and the slope coefficient on daily returns is our measure of precision. Less precise information in daily returns will result in a slope coefficient closer to 0, whereas more precise information in daily stock returns will yield a slope coefficient closer to 1. We use this measure to examine the impact of precision on the cost of equity capital.

We find that precision of information is negatively associated with the cost of equity, as predicted by theory. These results may have policy implications. Information asymmetry among investors has been a long-standing concern to securities regulators (e.g., Loss and Seligman, 2001). Regulations aimed at reducing information asymmetry, as REG FD, which prevents companies from making selective disclosures, can also lower the precision of total information. We indeed find a decrease in the average precision of information in daily stock returns after 2001 when REG FD came into effect. If, as we show empirically, precision of information decreases the cost of equity, regulators should take into consideration the effect of new regulation on precision and not just on information asymmetry.

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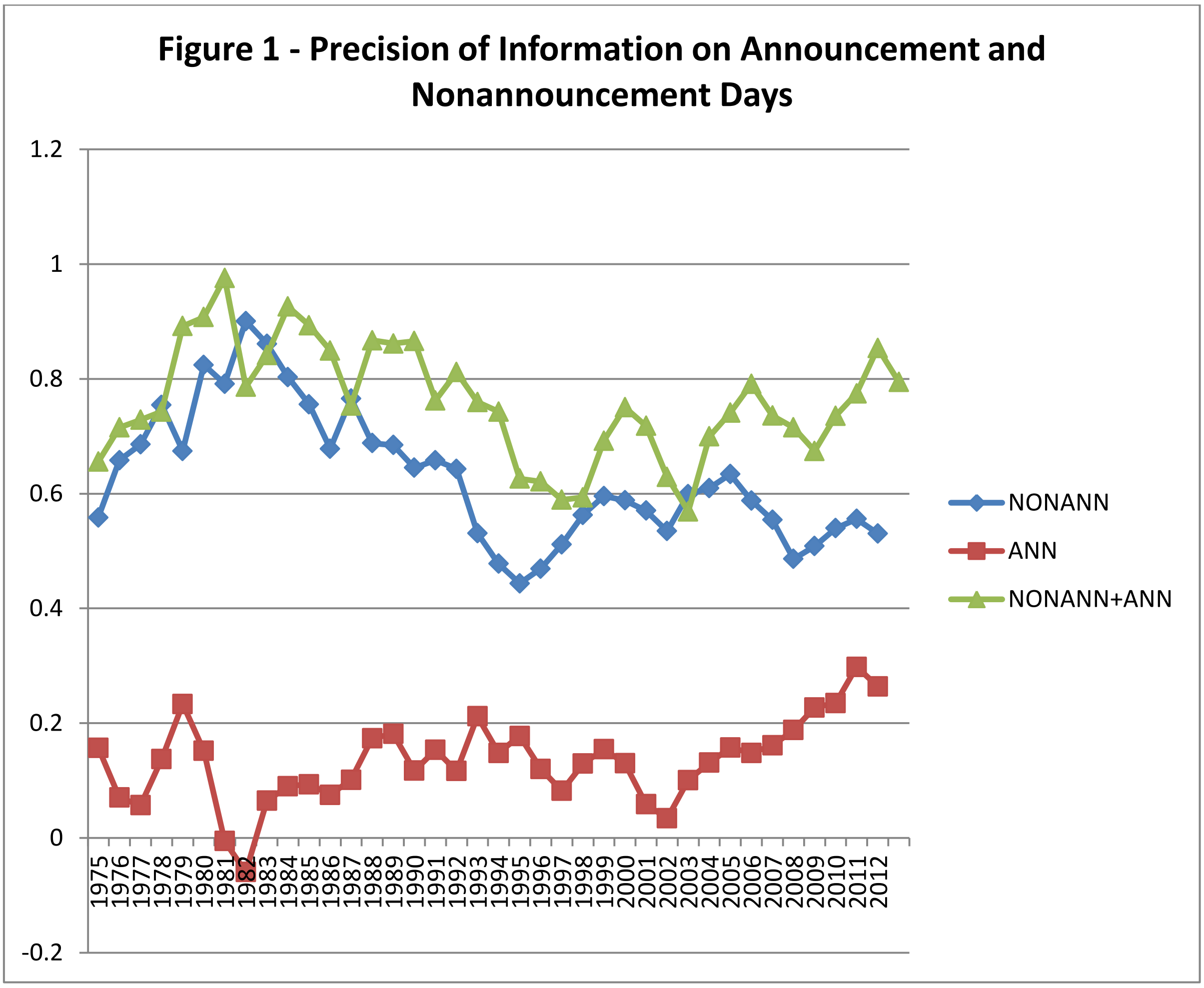
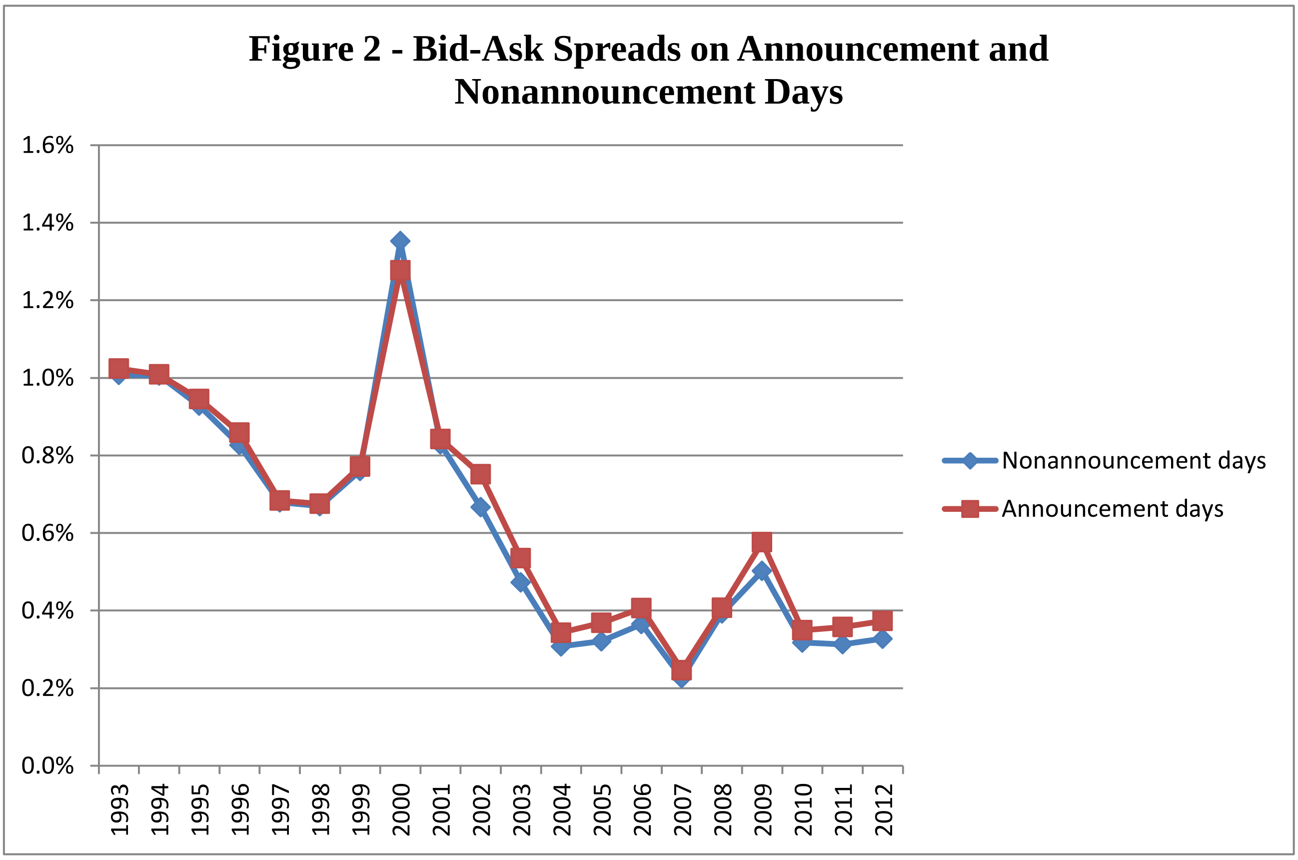


Note: The figure presents annual precision measures for announcement and nonannouncement days. For each stock and calendar year, we estimate Eq. (1) using the 252 or so trading days:

$$RET3M(T)_{it} = \gamma_{0t} + \gamma_{1t} ANND_{it} + \gamma_{2t} RET(T)_{it} + \gamma_{3t} ANND_{it} RET(T)_{it} + \varepsilon_{it}, \qquad (1)$$

where $RET(T)_{it}$ is firm i's daily stock return during calendar year T; $RET3M(T)_{it}$ is the return in the three months surrounding the month containing day t; and $ANND_{it}$ is an indicator variable that equals "1" in the 12 days around quarterly earnings announcements during calendar year T, and "0" otherwise. The coefficient γ_2 captures the average precision of information released in non-announcement days (labeled NONANN), and the coefficient γ_3 captures the *incremental* precision of information released in earnings announcement days (labeled, ANN). The sum NONANN+ANN represents the precision of information released during earnings announcement days. Then, we compute average annual NONANN and ANN, and plot the three-years moving average in the graph. The sample includes 126,762 firm/year observations.



Note: The figure presents average effective bid-ask spreads during announcement and nonannouncement days for each year between 1993 and 2012, for NYSE firms.

Table 1
Sample selection

Criterion	Obs.
Firm-years with four quarterly earnings announcement dates on COMPUSTAT and at least 200 trading days on CRSP between 1972 and 2012	126,762
Observations with available risk-adjustment data based on Daniel et al. (1997) for year t+1. Assignment of stocks into benchmark portfolios with data available on R. Russ Wermers' website: http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm	98,896
Observations between 1993 and 2012	64,699
Observations with bid-ask spread data from TAQ	50,490

Table 2
Precision measures for different time horizons

	γ_1	γ_2 NOANN	γ_3 ANN	R-Square	$\gamma_{2+}\gamma_3$ NOANN+ANN
RET3M (3 months)	-0.007***	0.674***	0.210***	3.7%	0.884
RET5M (5 months)	-0.000	0.669***	0.275***	4.7%	0.944
RET7M (7 months)	0.004***	0.672***	0.330***	6.0%	1.002
RET9M (9 months)	0.005***	0.649***	0.373***	7.0%	1.022
RET11M (11 months)	-0.001	0.628***	0.356***	7.8%	0.984
RET13M (13 months)	0.001**	0.631***	0.379***	8.7%	1.010

Note: The table presents precision coefficients for nonannouncement and announcement days for return windows ranging from three to thirteen months. We estimate Eq. (1) using different return windows, for the entire sample, and with firm fixed effects:

$$RETXM(T)_{it} = \gamma_{0t} + \gamma_{1t} ANND_{it} + \gamma_{2t} RET(T)_{it} + \gamma_{3t} ANND_{it} RET(T)_{it} + \varepsilon_{it},$$

Where $RETXM(T)_{it}$ is the return in the X months surrounding the month containing day t, where X ranges from 3 to 13 months. For example, for the daily returns in June, RET5M is the cumulative return from April 1 to August 31); $RET(T)_{it}$ is firm i's daily stock return; and $ANND_{it}$ is an indicator variable that equals “1” for the 12 days around quarterly earnings announcements during calendar year T, and "0" otherwise. The coefficient γ_2 captures the average precision of information released in non-announcement days (labeled NONANN), and the coefficient γ_3 captures the incremental precision of information released in earnings announcement days (labeled, ANN). The sample includes 126,762 firm/year observations between 1972 and 2012. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 3
The change in information asymmetry and information precision after Regulation Fair Disclosure (REGFD)

Panel A	Small Firms			Large Firms		
	before REGFD 1993-2000	**After REGFD 2001-2012**	**T-test Diff**	**before REGFD 1993-2000**	**After REGFD 2001-2012**	**T-test Diff**
# Observations	12,661	19,800		13,242	21,401	
NONANN	0.450	0.526	12.57	0.605	0.580	-4.49
ANN	0.058	0.177	6.41	0.190	0.210	1.12
NONANN+ANN	0.507	0.703	10.48	0.795	0.790	-0.28
BAS	0.040	0.034	-14.30	0.011	0.004	-92.33

Panel B:

Time Period	Small Firms	Large Firms
NONANN	0.047 (5.21)***	-0.029 (-3.99)***
ANN	0.120 (4.21)***	0.008 (0.34)
NONANN + ANN	0.167 (5.77)***	-0.021 (-0.87)
BAS	-0.002 (-4.41)***	-0.005 (-76.97)***

Note: This table presents results of estimating whether the Bid-Ask spread and the precision of information released during announcement and non-announcement days have changed after 2000. NONANN denotes precision of information released during nonannouncement days; ANN denotes precision of information released during earnings announcements (see Table 2 for details). BAS is the average effective bid-ask spread during the year. Panel A presents averages for small (below median market value of equity) and large (above median market value of equity) firms both before and after 2000 (t-tests for differences are included). Panel B estimates the following regression with firm fixed-effects and reports slope coefficients (t-tests in parentheses). REGFD is an indicator variable that equals "1" for years after 2000 (2001-2012), and "0" otherwise.

$$DEPVAR_{it} = \beta_0 + \beta_1 REGFD_{it} + \eta_{it}$$
$$DEPVAR_{it} = \{NONANN_{it}, ANN_{it}, (NONANN_{it} + ANN_{it}), BAS_{it}\}$$

The sample includes 67,104 firm-year observations between 1993 and 2012. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 4
Determinants of precision - Descriptive statistics and correlations

Panel A: Descriptive Statistics

Variable	Mean	Std. Dev.	5th Pctl.	25th Pctl.	50th Pctl.	75th Pctl.	95th Pctl.
ANN	0.185	1.611	-2.385	-0.608	0.141	0.965	2.897
NONANN	0.552	0.524	-0.048	0.180	0.433	0.796	1.571
NONANN+ANN	0.736	1.616	-1.594	-0.127	0.556	1.464	3.632
MV	12.44	1.95	9.43	11.03	12.36	13.73	15.82
BM	0.719	0.649	0.138	0.340	0.562	0.878	1.806
ANA	1.27	0.97	0.00	0.00	1.25	2.05	2.88
GUID	0.319	0.466	0	0	0	1	1
BAS	0.020	0.026	0.001	0.003	0.010	0.026	0.073

Panel B: Correlation Matrix

	ANN	NONANN	NONANN +ANN	MV	BM	ANA	GUID	BAS
ANN		-0.15	0.95	0.03	0.01	0.02	0.00	-0.03
NONANN	-0.16		0.17	0.08	-0.02	0.11	0.09	-0.18
NONANN+ANN	0.93	0.16		0.05	0.00	0.06	0.03	-0.08
MV	0.04	0.15	0.09		-0.40	0.79	0.33	-0.69
BM	0.01	-0.07	-0.02	-0.44		-0.28	-0.14	0.36
ANA	0.03	0.16	0.09	0.80	-0.35		0.39	-0.56
GUID	0.00	0.12	0.05	0.34	-0.17	0.40		-0.27
BAS	-0.04	-0.19	-0.11	-0.90	0.35	-0.76	-0.34	

Note: Panel A presents descriptive statistics for the main variables. Panel B presents a Pearson (above diagonal) and Spearman (below diagonal) correlation matrix for the main variables. The sample includes 50,490 firm-year observations between 1993 and 2012 (the period over which data on bid-ask spreads and management earnings guidance are available). ANN and NONANN are estimated using a return window of three months, as described in Table 2. *MV* is the natural logarithm market value of equity at the beginning of the year. *BM* is the book-to-market ratio (book value of equity divided by market value of equity) at the beginning of the year. *ANA* denotes the natural logarithm of the number of analysts covering the firm. *GUID* is an indicator variable that equals “1” for firms that issued management earnings forecasts, and "0" otherwise. *BAS* is the average effective bid-ask spread during the year.

Table 5
Determinants of precision – Regression results

	NONANN	NONANN	NONANN	NONANN +ANN	ANN
	(1)	(2)	(3)	(4)	(5)
NONANN					-0.538 (-14.73)***
MV	-0.070 (-6.70)***	0.004 (0.65)	-0.032 (-3.37)***	-0.068 (-3.53)***	-0.036 (-2.08)**
BM	0.045 (3.41)***	0.005 (0.45)	0.019 (1.70)*	0.060 (2.85)***	0.040 (2.07)**
ANA	-0.004 (-0.39)	0.046 (5.02)***	-0.000 (-0.04)	0.014 (0.51)	0.015 (0.65)
GUID	0.032 (3.48)***	0.049 (5.09)***	0.034 (3.67)***	0.018 (0.77)	0.003 (0.14)
BAS	-4.806 (-10.89)***			-5.872 (-7.93)***	-3.654 (-5.86)***
Firm effects	YES	NO	YES	YES	YES
Year effects	YES	YES	YES	YES	YES
Observations	50,490	50,490	50,490	50,490	50,490
Adj. R^2	2.00%	1.34%	0.31%	0.25%	2.71%

Note: The Table presents estimation results for NONANN, ANN, NONANN+ANN as dependent variables. All regressions, except column (2) include firm and year fixed-effects and errors that are clustered by firm and year. The sample includes 50,490 firm-year observations between 1993 and 2012. For details on the estimation of NONANN and ANN, see Table 2. *MV* is the natural logarithm market value of equity at the beginning of the year. *BM* is the book-to-market ratio (book value of equity divided by market value of equity) at the beginning of the year. *ANA* denotes the natural logarithm of the number of analysts covering the firm. *GUID* is an indicator variable that equals “1” for firms that issued management earnings forecasts, and "0" otherwise. *BAS* is the average effective bid-ask spread during the year. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 6
The Association between precision and expected stock returns
Univariate Portfolio Analysis

Quintile Portfolios	**NONANN 1993-2012 (N = 50,490)**	**ANN 1993-2012 (N = 50,490)**	**NONANN+ANN 1993-2012 (N = 50,490)**	**BAS 1993-2012 (N = 50,490)**
Low	0.60% (4.48)***	0.29% (2.18)**	0.33% (2.51)***	0.11% (0.91)
2	0.49% (3.89)***	0.30% (2.45)**	0.50% (4.00)***	0.16% (1.45)
3	0.32% (2.76)***	0.50% (4.00)***	0.41% (3.25)***	0.17% (1.29)
4	0.21% (1.68)	0.42% (3.50)***	0.28% (2.42)**	0.40% (2.38)**
High	0.15% (0.99)	0.27% (2.13)**	0.26% (1.96)**	0.95% (3.63)***

Note: The table presents future abnormal stock returns for portfolios formed based on precision measures and bid-ask spreads. In each year t, stocks are sorted into quintile portfolios based on the precision of information released during nonannouncement days (NONANN), the incremental precision of information released during earnings announcements (ANN), the precision of information released during earnings announcements (NONANN+ANN), and effective bid-ask spreads (BAS). Stocks are held from February of year t+1 to January of year t+2. For each of the five portfolios, average returns are computed for each month, and the time-series of daily returns are regressed on Fama and French's (1993) three factors (MRKT, SMB, HML).

Table 7
The Association between precision and expected stock returns

		Independent Variables				
Model	**Dependent Variable**	**NONANN**	**ANN**	**NONANN +ANN**	**BAS**	**Observations Adj-R^2**
1	$\boldsymbol{ABRET_{it+1}}$	-0.513 (-4.83)***				50,490 0.32%
2	$\boldsymbol{ABRET_{it+1}}$		-0.006 (-0.53)			50,490 0.01%
3	$\boldsymbol{ABRET_{it+1}}$			-0.055 (-3.67)***		50,490 0.04%
4	$\boldsymbol{ABRET_{it+1}}$	-0.530 (-4.87)***	-0.033 (-2.39)**			50,490 0.34%
5	$\boldsymbol{ABRET_{it+1}}$	-0.406 (-4.31)***	-0.022 (-1.65)*		41.77 (5.71)***	50,490 2.24%

Note: This table presents results of estimating Eq. (5) with year and firm fixed effects, and year and firm double-clustered errors.

$$ABRET_{it+1} = \theta_0 + \theta_1 NONANN_{it} + \theta_2 ANN_{it} + \theta_3 BAS_{it} + \omega_{it} \qquad (5)$$

$ABRET_{it+1}$ is the average monthly risk-adjusted stock return for year t+1 (from February of year t+1 to January of year t+2) in percentage terms, so for example 1 is 1% average monthly return. We adjust monthly returns for size, book-to-market, and momentum quintile portfolios. NONANN is the precision of information released during nonannouncement days; ANN is the incremental precision of information released during earnings announcements (see Table 2 for details); BAS is the average bid-ask spread during the year. The sample includes 50,490 firm-years between 1993 and 2012. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Table 8
The Association between precision and expected stock returns
Sensitivity analysis

	Dependent Variable = $ABRET_{it+1}$				
Specification	**NONANN**	**ANN**	**BAS**	**PI**	**Obs. Adj-R^2**
(1) Using PI instead of BAS	-0.512 (-4.80)***	-0.031 (-2.26)**		0.632 (4.19)***	50,490 0.93%
(2) Autocorrelation in daily stock returns in close to zero	-0.248 (-2.94)***	-0.019 (-1.14)	56.67 (5.35)***		31,208 2.07%
	-0.263 (-3.04)***	-0.023 (-1.36)		1.050 (4.01)***	31,208 1.10%
(3) Precision measures are obtained using abnormal daily stock returns	-0.250 (-3.17)***	-0.047 (-2.64)***	38.33 (5.07)***		47,589 1.36%
	-0.339 (-4.36)***	-0.054 (-2.95)***		0.626 (3.22)***	47,589 0.58%
(4) Precision measures are obtained using forward looking return window	-1.016 (-4.97)***	-0.027 (-1.87)*	40.57 (5.78)***		50,490 2.30%
	-1.321 (-5.44)***	-0.038 (-2.69)***		0.621 (4.15)***	50,490 1.09%
(5) Precision measures are the fitted values from Eq. (2) and (3)	-5.162 (-4.53)***	-8.733 (-5.02)***	37.84 (5.59)***		50,490 1.51%
	-6.810 (-6.37)***	-9.681 (-4.23)***		0.626 (3.46)**	50,490 0.84%

Note: The table presents results of estimating Eq. (5) – the association between information precision and expected abnormal stock returns – for different specifications. All regressions include year and firm fixed effects, and year and firm double-clustered errors. See Table 2 for details on the measurement of precision and Table 5 for equation specification. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

Specification (1): We use Price Impact (PI) instead of Bid-Ask Spreads (BAS) as an explanatory variable. PI is defined as $PI_{it} = 100 * D_{it} * (V_{it}+30 – V_{it})/ V_{it}$, where V_{it} is the security's bid-ask midpoint at the time of the transaction, and Vit+30 is the bid-ask midpoint thirty minutes after the transaction (or at 4 p.m. for trades completed during the last half hour of trading). D_{it} is equal to "1" if the transaction was initiated by a buyer and "-1" if it was initiated by a seller.

Specification (2): The analysis is conducted for firm/year observations for which the autocorrelation in daily stock returns is not significantly different from zero at the 0.05 level (31,208 firm/year observations between 1993 and 2012).

Specification (3): The precision measures are obtained using abnormal stock returns instead of raw returns.

Specification (4): The precision measures are obtained using a forward-looking return window. Specifically, instead of using a symmetric 3-month window, we use a window that starts at the first trading day of the month containing the daily return.

Specification (5): The precision measures NONANN and ANN are computed as the fitted values from Eq. (2) and Eq. (3), excluding the bid-ask spread variable, respectively.