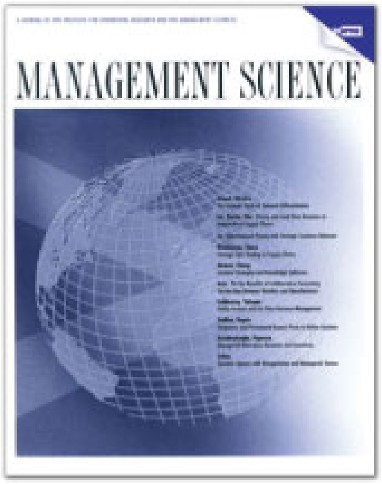

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Do Temporary Increases in Information Asymmetry Affect the Cost of Equity?

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Prior literature finds that long-lasting changes in firms' disclosure policies and information environment affect the cost of equity. Information asymmetry, however, also changes during the fiscal quarter. Firms disclose information periodically, and in between disclosure dates, traders can obtain private information, and adverse-selection risk increases. Such temporary increases in information asymmetry are usually considered to be diversifiable or too small to impact expected stock returns. In addition, investors may postpone trades or sell other assets in their portfolio on high information asymmetry days. We, however, find that returns increase significantly on days during the fiscal quarter when adverse-selection risk is high and liquidity low. Consistent with theory, we show that temporary asymmetry affects returns when investors demand liquidity and market makers bear risk for carrying capacity and providing it.

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1. Introduction

Some theories suggest that information asymmetry can affect expected stock returns.[1] Information asymmetry is often considered a long-term firm characteristic, and prior literature tests the effect of changes in firms' disclosure and information environment over quarters and years on the cost of equity.[2] Information asymmetry, however, also changes within a quarter. Firms disclose information periodically, and in between disclosure dates, traders can obtain private information, and adverse-selection risk increases. These short-term increases in information asymmetry are known to affect liquidity. Market makers widen bid-ask spreads and increase price impact on high information asymmetry days as compensation for dealing with informed traders. Our study tests whether expected returns also increase on high information asymmetry days during the quarter.

Our question, stated differently, is whether a temporary increase in information asymmetry and a decrease in liquidity affects expected stock returns. The impact of permanent liquidity change on expected returns is intuitive. High information asymmetry can dampen liquidity (e.g., Copeland and Galai 1983, Glosten and Milgrom 1985), and lower liquidity can, in theory, lead investors to ask for higher expected returns (e.g., Amihud and Mendelson 1986).[3] Prior literature indeed finds that permanent or long-term changes in information asymmetry cause expected returns to change (e.g., Leuz and Verrecchia 2000, Amihud 2002). The link between temporary increase in information asymmetry and expected returns is less obvious. Investors may, for example, have the option to postpone trades or to sell other assets in their portfolio on high information days (e.g., Constantinides 1986). Even if investors need liquidity on high information asymmetry days, the effect of a temporary increase in asymmetry on the cost of equity may be small, and its significance is an empirical question.

We use the days before earnings announcements, a time in the quarter when information asymmetry usually increases, as a test setting, and examine whether the expected increase in asymmetry leads to a higher cost of equity during those days.[4] An increase in

[1] See, for example, Amihud and Mendelson (1986) and Easley and O'Hara (2004).

[2] See, for example, Leuz and Verrecchia (2000), Amihud (2002), Easley et al. (2002), Francis et al. (2005), and Barth et al. (2013).

[3] Information asymmetry can also hinder investors' ability to efficiently allocate stocks into portfolios and lead them to ask for higher expected returns (e.g., Easley and O'Hara 2004). There is, however, an opinion that this effect of information asymmetry is diversifiable (e.g., Lambert et al. 2012, Hughes et al. 2007).

[4] The increase in asymmetry before announcements is notable, the event is frequent, and the event time is easy to identify, all of which

average returns before earnings announcements has been documented in prior literature (e.g., Chari et al. 1988, Ball and Kothari 1991, Trueman et al. 2003). We show that an increase of information asymmetry in the days before earnings announcements drives the increase in expected returns during those days. For example, we find that firms in the highest quintile of price-impact increase have a return run-up of 1.02% in the five days preceding the earnings announcement date. Whereas, firms in the lowest three quintiles of price-impact change have returns that are not statistically different than zero. The results hold in multivariate regressions after we control for size, book-to-market, and momentum; when we control for endogeneity and use expected price impact and expected bid-ask spreads as proxies of information asymmetry; when we use expected announcement dates instead of actual dates; and after we control for earnings surprise to ensure information leakage is not driving the result. We also show that short-sell constraints, noisy prices, and trading volume cannot explain our results. Based on this evidence, we conclude that when investors expect information asymmetry to increase before earnings announcements, they ask for higher expected returns for those days.

Temporary increases in price impact are found to have a greater effect on the pricing of high-turnover stocks—stocks in which trading is frequent and short-term liquidity is important. Information asymmetry will affect the cost of equity if investors need liquidity in the high asymmetry period. In the case of a temporary illiquidity, some investors may have the option to postpone their trades and the illiquidity will not change the price that they are willing to pay for the stock. We find that low-turnover stocks respond less to temporary increases in adverse-selection risk. Low-turnover stocks are held by long-term investors—the inverse of turnover is the stock's average holding period—and those investors are less likely to be concerned with temporary changes in liquidity. The role of short-term investors in the pricing of illiquidity is also demonstrated by Amihud and Mendelson (1986). In their model, the high trading costs of illiquid stocks deter short-term investors and lead to an increase in the cost of equity. In the case of temporary illiquidity, however, we find that the increase in cost of equity is more pronounced for stocks held by short-term investors.

Additionally, we find that temporary increases in price impact have greater effect on the pricing of volatile stocks. This result is consistent with Diamond and Verrecchia's (1991) idea that market markers who bear capacity risk will charge an additional premium for trading on high information asymmetry periods, a premium that will increase expected returns. Return volatility increases market making risk (e.g., Grossman and Miller 1988, Diamond and Verrecchia 1991), and the fact volatile stocks experience a greater increase in expected returns during the high information asymmetry days before announcements supports this notion that market makers have a role in the pricing of the temporary illiquidity.[5]

Our study contributes to the literature on the relation between information asymmetry and the cost of equity. A few empirical studies provide evidence that differences in information asymmetry explain the variation in expected returns across firms (e.g., Botosan 1997, Easley et al. 2002, Francis et al. 2005), and that changes in firms' information asymmetry over time impact their cost of equity (e.g., Healy et al. 1999, Leuz and Verrecchia 2000, Amihud 2002). To the best of our knowledge, our study is the first to suggest and find that temporary increases in information asymmetry affect the cost of equity. Our results support the view that an expected increase in information asymmetry leads to a higher cost of equity. There is a debate in the literature on whether information asymmetry can impact firms' cost of capital directly (i.e., not through liquidity). Easley and O'Hara (2004) present a model in which investors demand higher returns to hold stocks with greater private information. This higher return arises because informed investors are better able to shift their portfolios to incorporate new information, and uninformed investors are thus disadvantaged. Lambert et al. (2012), however, conclude that with perfect competition information asymmetry does not affect the cost of equity. Information asymmetry requires some market friction to be priced.[6] Similarly, Hughes et al. (2007) find that information asymmetry should not be a stand-alone priced factor. The robustness of the empirical evidence on this issue is also under debate, and it depends on the measure of information asymmetry used. Mohanram and Rajgopal (2009), for example, reexamine the Easley et al. (2002) evidence on the pricing of probability of informed trading (PIN)

make this a powerful setting for testing the effect of information asymmetry. For examples of other studies that use this setting to test the effect of high information asymmetry, see Christophe et al. (2004) and Chae (2005).

[5] The pricing of information asymmetry can be conceptually independent from market making risks (e.g., Easley and O'Hara 2004). And regardless of market making risk, the expected increase in transaction costs on high information asymmetry days can lead investors to ask higher expected returns for holding the stock (e.g., Amihud and Mendelson 1986), as discussed above.

[6] Lambert et al. (2012) show that in a perfect competition setting, the average precision of investor information affects the cost of equity. We test the effect of information asymmetry, that is, the distribution of information among investors, not information precision, on the cost of equity. For discussion of the difference between information asymmetry and information precision and their pricing, see, for example, Bhattacharya et al. (2012).

scores and find that PIN scores do not reflect an information asymmetry risk that is priced by investors. The adverse-selection component of trading costs (e.g., Huang and Stoll 1996), which we use in this study, has been found to be priced (e.g., Bhattacharya et al. 2012). The increase in the adverse-selection costs also reflects an illiquidity that can affect the cost of equity (e.g., Amihud and Mendelson 1986).[7]

The study also puts forward a new explanation for the increase in average returns before earnings announcements that has been documented in prior literature (e.g., Chari et al. 1988, Ball and Kothari 1991, Trueman et al. 2003). Information asymmetry is known to increase before earnings announcements (e.g., Lee et al. 1993, Eleswarapu et al. 2004), and we find it leads to an increase in expected returns on those days. Systematic risk increases at earnings announcements (e.g., Ball and Kothari 1991, Patton and Verardo 2012), and is shown to drive announcement returns higher (e.g., Barth and So 2014).[8] For the period before announcements, we, however, find that average returns are positive and significant after controlling for common beta factors, and systematic risk is not driving the increase in preannouncement returns. Irrational investor trading is another explanation offered by the literature. Trueman et al. (2003), for example, study a set of Internet firms over the sample period 1998–2000 and find that the increase in returns before earnings announcement is driven by investors' irrational exuberance about Internet stocks. Although exuberance can drive the returns of some stocks, it is less likely to cause a more persistent increase in preannouncement returns.[9] For a large sample, Frazzini and Lamont (2007) show that an increase in returns around earnings is correlated with a predictable increase in trading volume, which they also interpret as irrational buying behavior. The authors, however, do not focus on the days before earnings announcements.[10] We find that our results are not driven or affected by trading volume before announcements. Cohen et al. (2007) demonstrate that announcement returns are high for stocks with high idiosyncratic risk and conclude that high arbitrage costs prevent investors from trading away these excess returns. We find that volatile stocks experience an increase in preannouncement returns as well. This increase in returns, however, occurs only in cases that information asymmetry also increases before announcements, and the result is consistent with Diamond and Verrecchia's (1991) idea that information asymmetry leads market makers that bear capacity risk to impose a price premium.

2. Hypotheses Development

The impact of a permanent information asymmetry change on expected returns is intuitive. Increases in information asymmetry are known to dampen liquidity (e.g., Copeland and Galai 1983, Glosten and Milgrom 1985), and lower liquidity or higher transaction costs can lead investors to ask for a higher cost of equity (e.g., Amihud and Mendelson 1986). It is not obvious, however, that temporary increases in information asymmetry will lead to a higher cost of equity. Investors may have the option to wait and not trade on high information asymmetry days, or to sell other assets in their portfolio (e.g., Constantinides 1986). If investors have the (ex ante) option not to trade on high information asymmetry days, they will not be sensitive to the high expected transaction costs on those days, and cost of equity will not increase.

For information asymmetry to affect stock prices, there should be a positive probability that investors will need liquidity during the high asymmetry period (e.g., Diamond and Verrecchia 1991). In the case of temporary rise in asymmetry, this will occur if investors cannot postpone their trades passed the illiquid period. Ideally we would like to capture investor need for immediacy. Empirically, we use investor expected holding period, defined as volume divided by shares outstanding. We assume that short-term investors are less likely to postpone their trades, and long-term investors have greater flexibility to wait through temporary illiquidity periods. For example, if liquidity needs are defined as the probability that an investor will need to sell his holdings each day, greater liquidity needs implies shorter holding periods. Therefore, we expect that the pricing of stocks with shorter holding periods, or greater turnover, will be more sensitive to temporary increases in information asymmetry. Low-turnover stocks will be held by long-term investors—this is true by definition, as turnover is the inverse of the average holding period. Moreover, low-turnover stocks are less liquid and Amihud and Mendelson's (1986) clientele effect predicts that such stocks will be held by

[7] The effect of illiquidity or transaction costs on the cost of equity cannot be diversified away; for discussion of this point, see, for example, Amihud and Mendelson (1988).

[8] To test the effect of information asymmetry on returns, we use the days before announcements and exclude the day of the announcement. Whereas before earnings announcements information asymmetry usually increases, on announcement days information asymmetry may decrease because of resolution of uncertainty (e.g., Tetlock 2010). Additionally, the announcement itself can affect systematic risk and expected return (e.g., Ball and Kothari 1991, Barth and So 2014).

[9] Similarly, Aboody et al. (2010) find that stocks with extreme past return increases experience high returns in the days before earnings announcements, which can be attributed to exuberant trading of individual investors.

[10] Frazzini and Lamont's (2007) main test shows that returns in the month of an earnings announcement are correlated with a predictable increase in the monthly trading volume. For daily volume, the authors actually find an average decrease before earnings announcements and a lack of correlation between predicted volume and preannouncement returns.

long-term investors. Long-term investors are less likely than short-term investors to be concerned by temporary illiquidity. Our first hypothesis (in alternative form) is the following:

Hypothesis 1. *Temporary illiquidity causes a greater increase in the cost of equity of high-turnover stocks.*

Our second hypothesis tests the role of stock return volatility in the pricing of illiquidity. Diamond and Verrecchia (1991) show that when capacity carrying is risky, market markers will charge an additional premium for providing liquidity on high information asymmetry periods, a premium that will increase expected returns. Return volatility increases market making risk (e.g., Grossman and Miller 1988, Diamond and Verrecchia 1991). If market makers play a role in driving the cost of equity higher on high information-asymmetry periods, as suggested by Diamond and Verrecchia (1991), we expect that volatile stocks will experience a greater increase in expected returns.[11]

Hypothesis 2. *Temporary illiquidity causes a greater increase in the cost of equity of high return-volatility stocks.*

We use the days before earnings announcements to test these hypotheses. Before earnings announcements, information asymmetry is known to increase and liquidity to decrease. Traders have the opportunity and incentive to collect private information before the scheduled earnings announcements.[12] For example, Christophe et al. (2004) find that short-sellers' activity before earnings announcements suggests they hold private information on the coming earnings announcements. They find a negative relationship between levels of short selling in the five days before the announcement and the immediate postannouncement change in stock prices. Similarly, Boehmer et al. (2012) find heavier short selling a week before negative earnings surprises.[13] Analysts also obtain and disseminate private information before announcements. Bagnoli et al. (1999) document that unofficial forecasts of earnings, referred to as whisper numbers, circulate among traders and investors in the days preceding earnings announcements. These whisper numbers reflect private information obtained through discussions with stockbrokers, company officials, or as a result of private forecasting techniques. Bagnoli et al. (1999) show that the whisper forecasts are, on average, more accurate than official analysts' forecasts, and that profits can be made trading on the information. This evidence illustrates the incentives and rewards for acquisition of private information before earnings announcements.

Market makers widen bid-ask spreads and increase price impact in the days before earnings announcements as compensation for dealing with informed traders (e.g., Lee et al. 1993, Kim and Verrecchia 1994, Eleswarapu et al. 2004).[14] Kim and Verrecchia (1994) suggest that a specialist will increase the bid-ask spread around public disclosures to protect himself from traders who are better able to process the public information. Lee et al. (1993) find an increase in spreads on the day prior to, the day of, and the day after earnings announcements. Investors, too, are reluctant to trade on the high information asymmetry days before earnings announcements (e.g., Chae 2005). We test whether this increase in information asymmetry before earnings announcements also leads investors to ask for a higher cost of equity. We hypothesize that investors anticipate the increase in information asymmetry before the announcement, and price the stock accordingly.

3. Sample

We use Trade and Quote (TAQ) data to calculate our measures of information asymmetry for the main tests, and hence, the sample starts at 1993. The sample includes all quarterly earnings announcements on Compustat between 1993 and 2009 for which stock return data are available on the Center for Research in Security Prices (CRSP) for at least 52 trading days before the earnings announcement (291,233 announcements), and for which TAQ data enable us to calculate the adverse-selection component of trading costs (160,899 announcements), and analyst quarterly earnings forecasts are available on the I/B/E/S (110,343 announcements). To ensure that the results are not driven by illiquid stocks, we further eliminate stocks with a share price of \$1, and the final sample includes 109,547 quarterly earnings announcements.[15] Sample firms have higher market values, lower bid-ask spreads, higher institutional holdings, and greater analyst coverage than the average public firm in the United States during the sample years. The sample bias toward

[11] Alternatively, the pricing of information asymmetry can be conceptually independent from market making risk (e.g., Easley and O'Hara 2004).

[12] Announcement dates are usually scheduled ahead of time by firms, and anyway can be estimated (e.g., Bagnoli et al. 2002).

[13] Short sellers may have access to private information and proprietary forecasting techniques that allow them to better use public information. Christophe et al. (2010), for example, find that short sellers act prior to analysts' recommendation downgrades. Hirshleifer et al. (2011) find evidence that short sellers use accruals information in financial statements to more accurately forecast decreases in future earnings.

[14] On a related note, Coller and Yohn (1997) find an increase in bid-ask spreads before management forecast release.

[15] During parts of 1995 and 1996, trade time stamps of NASDAQ stocks might have been delayed several minutes longer than quotes (e.g., Schultz 2000). In our sample, 1,779 announcements were made by NASDAQ firms during 1995 and 1996, and the results without these observations are similar.

bigger, more liquid stocks works against the acceptance of information asymmetry as an explanation for the return run-up before earnings announcements, i.e., it increases type II error. At the same time it reduces type I error of rejecting the null hypothesis for reasons other than information asymmetry, as noisy prices, and short-selling constraints.

Our hypothesis is that an increase in information asymmetry causes returns to increase before earnings announcements. We use the adverse-selection component of trading costs, calculated based on the change in the value of the stock after trades, to gauge information asymmetry. Informed traders supposedly buy when prices are low and sell when prices are high relative to their value estimates based on private information. Thus, informed trading is associated with a permanent increase in security value after buys, and a permanent decrease after sells. Noninformational transaction costs, related to inventory and order processing, should cause only a temporary deviation of price from the value and result in price reversals after the trade. Following Huang and Stoll (1996) and Bessembinder and Kaufman (1997), we define price impact, or the adverse-selection component of trading costs as[16]

$$PriceImpact_{it} = 100 \times D_{it} \times (V_{it+30} - V_{it})/V_{it}, \qquad (1)$$

where V_{it} denotes the security's bid-ask midpoint at the time of the transaction, and V_{it+30} is the bid-ask midpoint 30 minutes after the transaction. We use the midquote in effect 30 minutes after the trade, or the 4 P.M. quotation for trades completed during the last half hour of trading;[17] D_{it} is equal to 1 when the transaction was initiated by a buyer and equal to -1 when it was initiated by a seller. The Lee and Ready (1991) algorithm is used to determine the direction of trade, D_{it}.

TAQ data are used to estimate the price impact of each transaction. 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.[18] The daily price impact is calculated by averaging the price impact of all transactions during that day. Christophe et al. (2004) find that informed investors trade within five days before the earnings announcements, and thus we use the same return window. The change in price impact before the earnings announcement (Δ*PriceImpact*) is calculated as the average daily price impact in the five days before the announcement, days 5 to 1, minus the average daily price impact during the quarter, on days 52 to 6.[19]

The change in returns before earnings announcements (Δ*PreAnnRet*), as the change in price impact, is calculated relative to returns during the quarter. It is the cumulative risk-adjusted returns five trading days before the earnings announcements minus (accumulation of five times) the average risk-adjusted returns between day 52 and day 6 before the announcement. We use Daniel et al. (1997) characteristics-based approach to risk adjust the daily returns.[20] Systematic risk may change around earnings announcement days (e.g., Ball and Kothari 1991, Barth and So 2014). This risk-adjustment approach estimates the size, book-to-market, and momentum factors for every day separately, and allows for fact different days around the announcement may have different systematic risk. We are interested in returns change due to illiquidity, and this risk adjustment leaves us with the component of returns that cannot be attributed to the standard factors of size, value, and momentum. As shown in Table 1, the mean change in returns before earnings announcements (Δ*PreAnnRet*) is positive, 0.40%.

4. Return Run-Up Before Earnings Announcements

Before testing the hypotheses, we first demonstrate that average increase in returns before earnings announcements is not due to marketwide factors. Systematic risk increases at earnings announcements (e.g., Ball and Kothari 1991, Patton and Verardo 2012). For the days before announcements, the literature documents an

[16] For example, Bhattacharya et al. (2012, 2013) use this measure as a proxy of the adverse-selection component of trading costs.

[17] This post-trade window is similar to that used by Bessembinder (2003), and it is set to ensure the market had a chance to assess the trade's information content. For robustness, we also use the quote midpoint five minutes after the trade to calculate price impact, and get results similar to those reported below.

[18] We use criteria from Bessembinder (1999). Specifically, trades are omitted 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. Quotes are omitted if either the ask or bid price is nonpositive, if the differential between the ask and bid prices exceeds $5 or is nonpositive. 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).

[19] Day 52 is about 10 trading days after the previous announcement, and the return window -52 to -6 captures the returns during the quarter without the effect of the previous announcement.

[20] We obtain from Daniel et al. (1997) the assignment of stocks into market size, book-to-market, and prior returns (or momentum) quintile portfolios for each sample year. Using returns from CRSP, we calculate the value-weighted daily returns for each of the 125 portfolios. Risk-adjusted returns are then the stock returns of a stock minus the return of the portfolio in the same size, book-to-market, and momentum quintiles.

Table 1 Descriptive Statistics

Panel A: Descriptive statistics

Variable	Mean	Median	Std. dev.	Q1	Q3
Δ*PreAnnRet*	0.40%	0.06%	8.22%	−3.48%	3.60%
Δ*PriceImpact*	0.011	0.001	0.201	−0.043	0.045
Turnover	0.083	0.057	0.080	0.029	0.107
σ*Ret*	0.030	0.026	0.018	0.017	0.037
Log*MV*	13.36	13.22	1.60	12.22	14.34
%Inst	59.1%	61.0%	26.6%	38.5%	80.9%
$EarnSurp_{t+1}$	−0.0014	0.0002	0.0187	−0.0006	0.0015

Panel B: Spearman correlations (significance in parentheses)

	Δ*PriceImpact*	σ*Ret*	*Turnover*	*%Inst*	Log*MV*	$EarnSurp_{t+1}$
Δ*PreAnnRet*	0.043 (<0.0001)	0.084 (<0.0001)	0.025 (<0.0001)	−0.026 (<0.0001)	−0.037 (<0.0001)	0.003 (0.2856)
Δ*PriceImpact*		−0.001 (0.6361)	−0.020 (<0.0001)	−0.022 (<0.0001)	−0.054 (<0.0001)	−0.034 (<0.0001)
σ*Ret*			0.381 (<0.0001)	−0.192 (<0.0001)	−0.327 (<0.0001)	−0.167 (<0.0001)
Turnover				0.278 (<0.0001)	0.162 (<0.0001)	−0.032 (<0.0001)
%Inst					0.411 (<0.0001)	0.052 (<0.0001)
Log*MV*						0.099 (<0.0001)

Notes. The sample includes 109,547 quarterly earnings announcement made between 1993 and 2009. Our proxy for the increase in information asymmetry before earnings announcement is the change price impact. Change in price impact (Δ*PriceImpact*) is the average price impact in the five trading days before the earnings announcement minus the average price impact during the quarter. Change in returns before announcements (Δ*PreAnnRet*) is the risk-adjusted returns—returns adjusted for market, size, book-to-market, and momentum factors—in the five trading days before the announcement minus the average daily risk-adjusted returns during the quarter. *Turnover* is the average daily number of shares traded during the quarter divided by shares outstanding. σ*Ret* is the standard deviation of daily returns during the quarter. Log*MV* is the logarithm of market equity value at the beginning of the quarter. *EarnSurp* is the earnings that are eventually reported at the earnings announcement minus the median forecast from I/B/E/S summary data set, divided by stock price at the beginning of the quarter. *%Inst* is the percent of stocks held by institutional investors during the quarter.

increase in returns beyond known risk factors. Chari et al. (1988), for example, document significant positive abnormal returns using the CAPM model. Ball and Kothari (1991) refine their methodology by allowing β to vary during the earnings announcement period, and find similar results. We wish to further ensure that the return run-up before announcements is not caused by systematic risk factors, and use the size, value, and momentum factors to reexamine the increase in preannouncement returns.

To test the statistical significance of the return increase in the days leading up to the earnings announcements, we run a time-calendar portfolio for days 5 to 1, and compare it to a portfolio for quarter days 52 to 6.[21] For each portfolio, the daily returns are averaged, and to control for marketwide effects, the time-series returns of each portfolio are regressed on Fama and French's (1993) three factors and Carhart's (1997) momentum factor:

$$r_t = \alpha + \beta_1 MRKT_t + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 UMD_t + \varepsilon_t. \quad (2)$$

The intercept of this regression is that portion of portfolio returns not explained by marketwide movements. The results are presented in Table 2. To allow comparison between the two portfolios, only days when stocks are held in both portfolios are included in the regression, a total of 4,252 days over the 17-year sample.

As shown in Table 2, the alpha returns, i.e., the intercept of the regression, in the five days before the announcement are on average 0.15% and significant at the 1% level (t-statistic of 3.74), whereas the alpha returns during the quarter are not different than zero—alpha is 0.01% with a t-statistic of 1.52. To compare the returns of both portfolios, a portfolio that buys stocks in the five days before the announcement and short sells the same stocks during the quarter up to day 6 is constructed. As shown in Table 2, the alpha

[21] Earnings announcements are often made concurrently by many firms. This clustering of announcements can lead to cross-sectional correlations in regression tests that accumulate returns around the earnings announcement dates. To mitigate this possible bias, we use the calendar-time approach (see, e.g., Fama 1998, Mitchell and Stafford 2000) in the following way.

Table 2 The Increase in Returns Before Announcements

Trading days	α	β_1 (MRKT)	β_2 (SMB)	β_3 (HML)	β_4 (UMD)	R-squared
(1) Five days before announcement	0.0015**	1.054**	0.821**	0.254**	−0.176**	0.208
	(3.74)	(28.17)	(11.82)	(3.63)	(−3.75)	
(2) The quarter up to five days before announcement	0.0001	1.044**	0.724**	0.175**	−0.127**	0.935
	(1.52)	(213.21)	(79.76)	(19.19)	(−20.69)	
Long (1) and short (2)	0.0013**	0.011	0.097	0.078	−0.049	0.001
	(3.20)	(0.28)	(1.39)	(1.12)	(−1.05)	

Notes. This table tests the statistical significance of the returns increase on the days before the earnings announcement. Calendar-time portfolios are created for two portfolios, one containing the five trading before each announcement, days 5 to 1, and another for the days during the quarter, days 52 to 6. For each of the two portfolios, the average returns are calculated for each calendar day, and the time series of daily returns are regressed on Fama and French's (1993) three factors (MRKT, SMB, HML) and a momentum factor (UMD). To test the significance of the return increase before announcements, a portfolio that shorts the stock during the quarter and buys it in the five days before the announcement is also presented. The sample includes 109,547 quarterly earnings announcements, and each calendar portfolio spreads over 4,252 trading days: $r_t = \alpha + \beta_1 MRKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \varepsilon_t$.

**Denotes significance at the 1% level.

returns of this portfolio are 0.13% and statistically significant at the 1% level (t-statistic of 3.20). None of the four risk factors of the portfolio, market, size, book-to-market, or momentum, are statistically different from zero. This result indicates that the increase in return before earnings announcements cannot be attributed to common risk factors.

To ensure that our results hold strictly for the preannouncement period, we conduct the time-calendar portfolio analysis in Table 2 for a five-trading-day period that ends on day 2, instead of on day 1. Results are similar. Alpha daily returns for this window that excludes day 1 are lower by a third, 0.10% with t-statistics of 2.65, but otherwise results are on a similar vein, and there is not a statistical significant difference between the coefficients of the four risk factors, market, size, book-to-market, and momentum, of the time-calendar portfolio that ends on day 2, and the portfolio presented in Table 2 that ends on day 1.

5. Information Asymmetry and Return Run-Up Before Announcements

Table 3 presents the return run-up portfolio of stocks sorted based on the increase in price impact. In each quarter, firms are sorted into five portfolios based on the change in price impact, and the average returns across quarters for each of the five portfolios, along with corresponding t-statistics, are presented in the table.

As shown in Table 3, a greater increase in price impact leads to higher returns before the earnings announcement. The returns are monotonically increasing from the low to the high price-impact portfolios. Returns are statistically significant only at the highest price-impact portfolio, 1.02%, and at the second highest price-impact portfolio (portfolio 4), 0.61%. The difference between the returns of the low and high price-impact portfolios is statistically significant at the 1% level. The table describes the characteristics of the stocks in the different price-impact quintile portfolios. The increase in price impact before announcements is not correlated with firm size or liquidity (level) proxies, and so the increase in preannouncement returns seems to be driven mostly by the increase in information asymmetry before announcements. Smaller companies tend to experience more extreme changes in price impact, and thus stocks in the high and low price-impact portfolios are smaller than stocks in the intermediate portfolios 2–4.

The magnitude of returns increase before announcements corresponds with the increase in transaction costs during that period. Stocks in the highest quintile of price impact have a cumulative return increase of 1.02% in the five days before announcements, which is about 0.20% increase in daily returns. The price impact, which is a measure of the transaction costs of these stocks, increases by similar magnitude during the five days before announcements. Price impact measures the impact of each trade, and our daily price-impact measure is an average of the price impact over all the trades during the day. The average daily price impact in the five days before announcements is higher than the average daily price impact during the quarter by 0.24%. Expecting this increase in transaction costs, investors ask for higher returns before announcements–this interpretation is consistent with our hypothesis.

Next, we test our first hypothesis on the role of investor expected holding period in the pricing of temporary illiquidity. Temporary illiquidity is expected to affect prices when investors are concerned with the short-term liquidity of the stock, as discussed in the hypothesis development above. We use investor expected holding period, or turnover defined as the average daily volume during the quarter divided by shares outstanding, to proxy for investor immediate liquidity needs, and expect that the pricing of stocks with greater turnover will be more sensitive to temporary increases in information asymmetry.

Table 3 Information Asymmetry and Preannouncement Returns

	ΔPreAnnRet	*Firm size*	*B/M*	*No. of analysts*	*%Inst*	*ΔPriceImpact*	*Bid-ask spread*	*Stock price*
Portfolios sorted on *ΔPriceImpact*	Mean (*t*-statistic)	Mean [Median]	Mean [Median]	Mean [Median]	Mean [Median]	Mean [Median]	Mean [Median]	Mean [Median]
Low	0.12%	$580 mil.	0.68	4.11	49.7%	−0.19	1.39%	$16.50
	(0.67)	[$221 mil.]	[0.53]	[3]	[47.9%]	[−0.13]	[1.08%]	[$12.80]
2	0.11%	$3,182 mil.	0.54	7.66	64.6%	−0.04	0.56%	$28.63
	(0.74)	[$838 mil.]	[0.44]	[6]	[67.1%]	[−0.03]	[0.36%]	[$23.75]
3	0.24%	$7,394 mil.	0.50	9.75	67.1%	0.00	0.41%	$34.01
	(1.37)	[$1,598 mil.]	[0.41]	[8]	[69.8%]	[−0.00]	[0.24%]	[$28.22]
4	0.61%**	$3,628 mil.	0.55	7.99	65.0%	0.038	0.53%	$28.77
	(2.74)	[$901 mil.]	[0.44]	[6]	[67.5%]	[0.028]	[0.33%]	[$23.89]
High	1.02%**	$674 mil.	0.72	4.49	56.7%	0.24	1.19%	$17.02
	(3.62)	[$240 mil.]	[0.54]	[3]	[50.5%]	[0.15]	[0.88%]	[$13.26]
High-Low	0.90%**							
	(4.30)							

Notes. This table presents the change in returns before earnings announcements as a function of information asymmetry. Our proxy of information asymmetry is price impact. Change in price impact (*ΔPriceImpact*) is the average price impact in the five trading days before the earnings announcement minus the average price impact during the quarter. Change in returns before announcements (*ΔPreAnnRet*) is the risk-adjusted returns in the five trading days before the announcement minus the average daily risk-adjusted returns during the quarter. Stocks are sorted into five equal-sized portfolios based on the change in price impact, the average preannouncement returns is calculated for each portfolio in each quarter, and the average returns over the quarters along with corresponding *t*-statistics are presented for each portfolio. *Firm size* is the market value of equity. Book-to-market (*B/M*) is the book value of equity divided by the market value of equity. *Bid-ask spread* is the average effective bid-ask spread during the quarter. *No. of analysts* is the number of analysts that issued earnings forecast. *%Inst* is the percent of stocks held by institutional investors during the quarter. *Stock price* is the stock price at the beginning of the quarter. The sample includes 109,547 quarterly earnings announcements between 1993 and 2009.

**Denotes significance at the 1% level.

Turnover is calculated as the average number of shares traded daily in days 52 to 6, divided by number of shares outstanding at the beginning of the quarter. The correlation between turnover and the average price impact during the quarter is −0.32. Short-term investors hold more liquid stocks, as predicted by Amihud and Mendelson (1986), and we predict that short-term investors will have high demand for liquidity also before announcements. Turnover is sticky, and the correlation between turnover during the quarter and turnover in the five days before earnings announcements is 0.744. This indicates that if investors trade frequently during the quarter, they are likely to maintain their high demand for liquidity and trade also before earnings announcements.[22]

To test the effect of turnover on the relation between information asymmetry and increase in expected returns, we first present the preannouncement returns for portfolios sorted on turnover and price impact. Ten portfolios are created by sorting stocks into two groups on the turnover during the quarter, and (independently) into five groups on change in price impact before announcements. The average change in preannouncement returns ($\Delta PreAnnRet$) is calculated for each of the 10 portfolios in each of the quarters, and average returns over the quarters along with the corresponding *t*-statistic are presented in Table 4. The average turnover for the low-turnover stocks is 0.029 and for the high-turnover stocks it is 0.126, which imply that the holding period (the inverse of turnover) of low-turnover stocks is about 34 trading days, and of high-turnover stocks is about 8 trading days.

As shown in Table 4, the increase in preannouncement returns is more pronounced for high-turnover stocks. A hedge portfolio that buys stock in the high-price-impact quintile and sells stock in the low quintile earns 0.67% in the low-turnover group, and 1.11% in the high-turnover group.[23] As can be seen in the table, high-turnover stocks are more liquid—they have lower bid-ask spreads on average and are more likely to draw short-term traders. Additionally, high-turnover stocks do not experience higher increase in price impact before earnings than low turnover stocks, suggesting that the greater increase in returns of high-turnover stocks cannot be assigned to the higher information asymmetry of these stocks. In Table 5, we examine our second hypothesis regarding the effect of return volatility on the relation between temporary illiquidity and

[22] Chae (2005) finds that an increase in information asymmetry before earnings announcements leads to a (time-series) decrease in trading volume. Cross sectionally, however, stocks with higher turnover still have higher trading volume before announcements.

[23] The returns difference between the two portfolios is statistically significant at the 1% level—note that we formally test the effect of turnover on relation between price impact and preannouncement returns in the regression analysis below.

Table 4 Expected Holding Period and Preannouncement Returns

	Low turnover			High turnover		
	Δ*PreAnnRet*	Δ*PriceImpact*	*Bid-ask spread*	Δ*PreAnnRet*	Δ*PriceImpact*	*Bid-ask spread*
Portfolios sorted on Δ*PriceImpact*	Mean (t-statistic) [no. of observation]	Mean [Median]	Mean [Median]	Mean (t-statistic) [no. of observations]	Mean [Median]	Mean [Median]
Low	0.13% (0.85) [$N=13{,}206$]	−0.21 [−0.16]	1.57% [1.26%]	0.15% (0.55) [$N=8{,}670$]	−0.15 [−0.12]	1.15% [0.87%]
2	0.01% (0.03) [$N=9{,}636$]	−0.03 [−0.03]	0.64% [0.42%]	0.25% (1.39) [$N=12{,}289$]	−0.03 [−0.03]	0.50% [0.33%]
3	0.07% (0.50) [$N=9{,}381$]	0.00 [−0.00]	0.44% [0.26%]	0.46%* (2.15) [$N=12{,}544$]	0.00 [0.00]	0.39% [0.24%]
4	0.25% (1.45) [$N=9{,}636$]	0.04 [0.03]	0.59% [0.37%]	0.89%** (3.08) [$N=12{,}289$]	0.04 [0.03]	0.48% [0.30%]
High	0.80%** (3.25) [$N=12{,}897$]	0.28 [0.17]	1.38% [1.05%]	1.26%** (3.06) [$N=8{,}999$]	0.20 [0.13]	0.96% [0.69%]
High-Low	0.67%** (3.96)			1.11%** (3.52)		

Notes. This table presents the relation between preannouncement returns and information asymmetry as a function of turnover, a proxy for expected holding period. Turnover is the average daily trading volume during the quarter divided by outstanding shared. Change in price impact (Δ*PriceImpact*), a proxy for information asymmetry, is the average price impact in the five trading days before the announcement minus the average price impact during the quarter. Ten portfolios are created by sorting stocks into five equal-sized groups on change in price impact, and (independently) into two groups on turnover. The average change in preannouncement returns is calculated for each portfolio in each quarter, and the average returns over the quarters along with corresponding t-statistics are presented for each portfolio. Change in preannouncement returns (Δ*PreAnnRet*) is the risk-adjusted returns in the five trading days before the announcement minus (five times) the average daily risk-adjusted returns during the quarter. *Bid-ask spread*, which is the average effective bid-ask spread during the quarter, is presented for each portfolio. High-Low portfolio is a hedge portfolio that buys the stocks in the high Δ*PriceImpact* quintile and short sells the stocks in the low Δ*PriceImpact* quintile. The sample includes 109,547 quarterly earnings announcements between 1993 and 2009.

*, **Denote significance at the 5% and 1% levels, respectively.

returns. As discussed above, return volatility is associated with market makers' inventory risk, and if market makers impose the illiquidity discount as suggested by Diamond and Verrecchia (1991), more volatile stocks are expected to experience greater increase in their cost of equity on high information asymmetry days. To test the effect of volatility, we present the preannouncement returns for portfolios sorted on return volatility and price impact. Ten portfolios are created by sorting stocks into two groups on the return volatility during the quarter, and (independently) into five groups on change in price impact before announcements. The average change in preannouncement returns ($\Delta PreAnnRet$) is calculated for each of the 10 portfolios in each of the quarters, and average returns over the quarters along with the corresponding t-statistic are presented in Table 5. Return volatility is calculated as the standard deviation or daily returns in days 52 to 6.

As shown in Table 5, the increase in preannouncement returns exists mostly among high volatility stocks. A hedge portfolio that buys stock in the high price-impact quintile and sells stock in the low quintile has positive and significant returns in the high volatility group, 1.34% with t-statistic of 4.98. In the low volatility group, the hedge portfolio yields 0.22% with t-statistic of 1.22. High-volatility stocks are, however, less liquid and have higher price impact than low-volatility stocks. In the multivariate analysis below, we test the marginal and combined effects of liquidity and volatility on expected returns.

To test the joint effect of volatility and turnover on the pricing of illiquidity, we estimate the following regression with quarter fixed effects:

$$\begin{aligned}\Delta PreAnnRet_{it} &= \alpha+\beta_1\Delta PriceImpact_{it}+\beta_2\Delta PriceImpact_{it}\times\sigma Ret_{i,t-1}\\&\quad+\beta_3\Delta PriceImpact_{it}\times Turnover_{i,t-1}\\&\quad+\beta_4\Delta PriceImpact_{it}\times\%Inst_{i,t-1}+\beta_5\sigma Ret_{i,t-1}\\&\quad+\beta_6 Turnover_{i,t-1}+\beta_7\mathrm{Log}MV_{i,t-1}+\beta_8 EarnSurp_{i,t+1}\\&\quad+\beta_9\%Inst_{i,t-1}+\varepsilon_{it}.\end{aligned}\tag{3}$$

Turnover is the average daily number of shares traded during the quarter divided by number of outstanding

Table 5 Volatility and Preannouncement Returns

	Low volatility			High volatility		
	Δ*PreAnnRet*	Δ*PriceImpact*	*Bid-ask spread*	Δ*PreAnnRet*	Δ*PriceImpact*	*Bid-ask spread*
Portfolios sorted on Δ*PriceImpact*	Mean (*t*-statistic) [no. of observations]	Mean [Median]	Mean [Median]	Mean (*t*-statistic) [no. of observations]	Mean [Median]	Mean [Median]
Low	0.07% (0.62) [$N = 7{,}547$]	−0.16 [−0.12]	1.07% [0.84%]	0.17% (0.75) [$N = 14{,}329$]	−0.21 [−0.15]	1.56% [1.26%]
2	−0.12% (−1.44) [$N = 11{,}735$]	−0.03 [−0.03]	0.44% [0.30%]	0.41 (1.90) [$N = 10{,}190$]	−0.04 [−0.03]	0.71% [0.47%]
3	0.02% (0.17) [$N = 13{,}978$]	0.00 [0.00]	0.32% [0.21%]	0.60%* (2.03) [$N = 7{,}947$]	0.00 [0.00]	0.58% [0.35%]
4	0.10% (0.64) [$N = 12{,}654$]	0.04 [0.03]	0.40% [0.26%]	1.19%** (3.50) [$N = 9{,}271$]	0.04 [0.03]	0.72% [0.46%]
High	0.29% (1.29) [$N = 8{,}842$]	0.21 [0.14]	0.89% [0.67%]	1.51%** (3.79) [$N = 13{,}054$]	0.27 [0.17]	1.41 [1.08%]
High-Low	0.22% (1.22)			1.34%** (4.98)		

Notes. This table presents the relation between preannouncement returns and information asymmetry as a function of return volatility, a proxy for market makers' risk. Volatility is the standard deviation of daily returns during the quarter. Change in price impact (Δ*PriceImpact*), a proxy for information asymmetry, is the average price impact in the five trading days before the announcement minus the average price impact during the quarter. Ten portfolios are created by sorting stocks into five equal-sized groups on change in price impact, and (independently) into two groups on volatility. The average change in preannouncement returns is calculated for each portfolio in each quarter, and the average returns over the quarters along with corresponding *t*-statistics are presented for each portfolio. Change in preannouncement returns (Δ*PreAnnRet*) is the risk-adjusted returns in the five trading days before the announcement minus (five times) the average daily risk-adjusted returns during the quarter. *Bid-ask spread*, which is the average effective bid-ask spread during the quarter, is presented for each portfolio. High-Low portfolio is a hedge portfolio that buys the stocks in the high Δ*PriceImpact* quintile and short sells the stocks in the low Δ*PriceImpact* quintile. The sample includes 109,547 quarterly earnings announcements between 1993 and 2009.

*, **Denote significance at the 5% and 1% levels, respectively.

shares at the beginning of the quarter—the log natural of one plus turnover is used to control for outliers. σRet is the standard deviation of daily returns during the quarter. We include in logarithm of equity value at the beginning of the quarter (Log*MV*), following Ball and Kothari's (1991). To control for the effect of possible information leakage, we include the earnings news that are eventually reported at the earnings announcement (*EarnSurp*). *EarnSurp* equals earnings minus the median forecast from I/B/E/S summary data set, divided by stock price at the beginning of the quarter; the variable is winsorized at the bottom and top one percentiles. %*Inst* is the percent of stocks held by institutional investors. Discussion of these control variables, and additional related tests are provided in §6 below. The regression is estimated with quarter fixed effects, and the *t*-statistics are based on standard errors that are clustered on firm and quarter.[24]

Table 6 presents the estimation results of Equation (3). As can be seen in Model 3, the coefficient of the interaction variable between price impact and return volatility is positive and significant, 0.574 with *t*-statistic is 3.18. This result supports our second hypothesis: Temporary illiquidity has greater effect on the returns of volatile stocks, stocks in which market makers' inventory risk is higher. Cohen et al. (2007) find that stocks with higher idiosyncratic volatility have higher announcement returns. They use idiosyncratic volatility as proxy for arbitrage costs, and conclude that these costs prevent investors from arbitraging away positive announcement returns. The results of Model 2 show that information asymmetry affects preannouncement returns beyond return volatility. The coefficient on the change in price impact is 0.015 with *t*-statistic of 3.99, and coefficient on return volatility is 0.225 with *t*-statistic of 1.92.[25] Only the marginal effect of the price

[24] Estimating the model based on Fama and MacBeth (1973), we get results similar to those presented in Table 6.

[25] Results do not change when, as in Cohen et al. (2007), we include the idiosyncratic volatility in the regression, and instead of the standard deviation of raw returns during the quarter, we use the standard deviation of the error term of a regression of the firm's daily stock return on the Fama and French (1993) three daily factors in the year before the earnings announcements. Similarly, when

Table 6 Regression Analysis

	Exp. sign	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Δ*PriceImpact*		0.015**	0.015**	−0.010	0.006*	−0.012	−0.004
		(3.96)	(3.99)	(−1.53)	(2.07)	(−1.76)	(−0.42)
Δ*PriceImpact* $*$ σ*Ret*	(+)			0.574**		0.492**	0.452**
				(3.18)		(2.91)	(3.02)
Δ*PriceImpact* $*$ *Turnover*	(+)				0.191**	0.114**	0.130**
					(2.97)	(2.67)	(2.82)
Δ*PriceImpact* $*$ *%Inst*							−0.016
							(−1.14)
Turnover			0.011	0.011	0.010	0.010	0.011
			(1.59)	(1.69)	(1.34)	(1.53)	(1.71)
σ*Ret*			0.225	0.228*	0.234*	0.237*	0.232*
			(1.92)	(1.98)	(1.97)	(1.99)	(2.02)
Log*MV*			−0.001	−0.001	−0.001	−0.001	−0.001
			(−1.86)	(−1.89)	(−1.72)	(−1.80)	(−1.81)
$EarnSurp_{t+1}$			0.058*	0.063*	0.060*	0.063*	0.058*
			(2.18)	(2.30)	(2.25)	(2.32)	(2.06)
%Inst			−0.002	−0.002	−0.002	−0.002	−0.002
			(−1.25)	(−1.25)	(−1.32)	(−1.29)	(−1.14)
R-square (%)		0.14	0.45	0.58	0.52	0.61	0.62

Notes. This table examines the relation between preannouncement returns and information asymmetry as a function of return volatility, which is a proxy for market makers' inventory risk, and turnover, which serves as a proxy of investor expected holding period. The dependent variable, preannouncement returns (Δ*PreAnnRet*), is the risk-adjusted returns in the five trading days before the announcement minus the average daily risk-adjusted returns during the quarter. Change in price impact (Δ*PriceImpact*) is the average price impact in the five trading days before the announcement minus the average price impact during the quarter. σ*Ret* is the standard deviation of daily returns during the quarter. *Turnover* is the average daily number of shares traded during the quarter divided by shares outstanding. Log*MV* is the logarithm of equity value at the beginning of the quarter. *EarnSurp* is the earnings that are eventually reported at the earnings announcement minus the median forecast from I/B/E/S summary data set, divided by stock price at the beginning of the quarter. *%Inst* is the percent of stocks held by institutional investors during the quarter. The sample includes 109,547 quarterly earnings announcements made between the years 1993 and 2009. The regression is estimated with quarter fixed effects, and the t-statistics are based on standard errors that are clustered on firm and quarter.

* and ** denote significance at the 5% and 1% one-sided test levels, respectively.

impact on returns increases with the rise in return volatility, as Model 3 demonstrates. Return volatility serves as a proxy for market makers' inventory risk and the results are consistent with Diamond and Verrecchia (1991), as discussed above.

The effect of illiquidity on returns is greater also for high-turnover stocks; in Model 4, the coefficient of the interaction variable between price impact and turnover is positive and significant, 0.191 with t-statistic of 2.97. Consistent with our first hypothesis, short-term liquidity is important for stocks that are traded frequently and temporary illiquidity drives their cost of equity higher.

Model 5 demonstrates that both high turnover and high volatility are required for illiquidity to affect returns; the coefficient on the interaction variable between price impact, volatility, and turnover is 0.015 (with t-statistic of 2.68), and the coefficients on the interaction variable between price impact and return volatility, and on the interaction variable between price impact and turnover are insignificantly different than zero. This result is consistent with Diamond and Verrecchia's (1991) model. Information asymmetry will affect the cost of equity when both liquidity during the high asymmetry period—turnover is our proxy for investors' short-term liquidity needs—and market makers' inventory risk is high; we use return volatility as a proxy of this risk.

High turnover is sometimes used in the literature as proxy for differences in opinion or for investor exuberance and over trading (e.g., Lee and Swaminathan 2000). To control for these alternative drivers of frequent trading, we include in the regression analyst-forecast dispersion and book-to-market as controls and get similar results—the coefficient of interaction variable between price impact, turnover, and volatility is positive and significant at the 1% level. The coefficient on book-to-market, where market and book value of equity values are measured at the beginning of the quarter, is positive, 0.004 with t-statistic of 1.63. This result suggests that the return run-up before announcements is not driven by glamour stocks. The coefficient on the standard deviation of forecast, taken from summary

controlling for analyst forecast revisions, which can increase the return volatility before announcements, we get similar results; see §6.1. The inclusion of the change in return autocorrelations before announcements—returns reversals can be related to inventory effects (see, e.g., Lehmann 1990, Hendershott and Seasholes 2007, Nagel 2012, Levi and Zhang 2012, So and Wang 2014)—in the regression analysis does not change the results either; the price impact is significant in explaining the increase in preannouncement returns.

I/B/E/S and deflated by stock price, is insignificantly different from zero, 0.006 with *t*-statistics of 0.64.[26]

As shown in Table 6, coefficient on Log*MV* is insignificant in explaining preannouncement returns beyond the price impact. Ball and Kothari (1991) find that small firms experience a greater increase in returns around earnings announcements. Size can, of course, proxy for risk, liquidity, information asymmetry, institutional holdings, stock price efficiency, etc., and there is an ongoing debate in the literature on the causes of the phenomenon. Trueman et al. (2003) and Frazzini and Lamont (2007), for example, argue that irrational trading is driving this increase in returns around announcements. Our findings demonstrate that the return run-up before announcements reflects the pricing of temporary illiquidity, and the results are robust to the inclusion of size as a control. High-turnover stocks, for example, experience greater returns run-up although they are larger than low-turnover stocks.

Large investors will be less constrained and more likely to wait out short periods of illiquidity before announcements. Therefore, the increase in price impact may have lower effect on the pricing of stocks held by large investors. To control for the effect of large investors on the pricing of illiquidity before earnings announcements, we include institutional investor holdings, %*Inst*, and an interaction variable between the change in price impact and institutional holding, Δ*PriceImpact* $*$ %*Inst*. As shown in Model 6 in Table 6, the coefficient on this interaction variable is negative, as predicted, but it is not statistically significant, −0.016 with *t*-statistics of −1.14. Hence, the presence of large investors does not mitigate the pricing effect of illiquidity before announcements. Keim and Madhavan (1995) find that institutional investors are impatient and less concerned with transaction costs when selling stocks. Institutional investors may also need to sell stocks before announcements and price the temporary increase in illiquidity as other investors.

6. Robustness Tests and Additional Analyses

6.1. Information Leakage

One alternative explanation for the return run-up before an earnings announcement is the leakage of positive news about the upcoming announcement. This can occur if earnings news is positive across time, and investors obtain private information on the nature of the news in the days before the earnings announcement.[27] To control for this possibility, we introduce the (ex post) earnings surprise as an independent variable in our cross-sectional analysis, Equation (3). The coefficient of Δ*PriceImpact* is positive and significant after controlling for earnings news. This result suggests that information asymmetry still drives the run-up in returns in the days before the earnings announcement regardless of the nature of the earnings news.

To further test this issue, we present in Table 7 the average return run-up as a function of both the earnings surprise and the change in price impact. Stocks are sorted into positive and negative earnings surprises, where positive-surprise stocks are those that report earnings higher or equal to median analyst forecast and negative-surprise stock are those that report earnings below median forecast. Stocks are also independently sorted into five equal-sized groups based on the change in price impact before earnings announcements. The average preannouncement returns are calculated for each of the 10 portfolios in each quarter, and the average returns over the quarters along with corresponding *t*-statistics are presented for each portfolio. Preannouncement returns (Δ*PreAnnRet*) are, as defined above, the risk-adjusted return five trading days before the earnings announcement minus (five times) the average daily risk-adjusted returns during the quarter.

The difference between the returns of the high and low price-impact portfolios presented in Table 7 supports our hypothesis. Within the positive surprise group, this difference in returns is 0.85%, and within the negative surprise group it is 0.80%. Average returns across the portfolios increase more before positive earnings surprises than before negative surprises, and apparently information leakage does impact the average level of preannouncement returns. The effect of information leakage on the preannouncement returns is found to be positive also in the regression analysis presented in Table 6. Yet, the fact that news leakage before earnings announcement drives the returns does not hinder our conclusion. We test the effect of information asymmetry on returns, a cost of equity effect that is independent of the news effect on returns. This cost of equity effect is captured by the difference in returns between the low and high price-impact portfolios. This result alleviates concerns that the return run-up before earnings announcements is merely driven by leakage of positive news.

Table 7 also presents that announcement returns for each of the 10 portfolios. The announcement returns are the abnormal returns on the announcement day and the following day, where similarly to preannouncement returns abnormal returns are the change in risk-adjusted return relative to the average daily risk-adjusted returns during the quarter. High price impact does not seem to be correlated with the nature of the

[26] The requirement for availability of standard deviation of forecast on summary I/B/E/S data set and positive book-to-market reduce the sample to 93,203 earnings announcements.

[27] Investors can be tipped by insiders, collect private information from clients and other third parties, or use private forecasting techniques to generate better forecasts of the upcoming news.

Table 7 Information Leakage and Preannouncement Returns

Portfolios based on Δ*PriceImpact*	Positive earnings surprises: Preannouncement returns (t-statistic) [no. of observations]	Positive earnings surprises: Announcement returns (t-statistic)	Negative earnings surprises: Preannouncement returns (t-statistic) [no. of observations]	Negative earnings surprises: Announcement returns (t-statistic)
Low	0.27% (1.44) [$N = 13{,}885$]	1.30%** (8.44)	−0.09% (−0.50) [$N = 7{,}991$]	−2.43%** (−14.08)
2	0.23% (1.57) [$N = 15{,}544$]	0.95%** (6.97)	−0.17% (−1.02) [$N = 6{,}381$]	−2.20%** (−12.74)
3	0.26% (1.53) [$N = 16{,}048$]	1.12%** (10.74)	0.23% (1.05) [$N = 5{,}877$]	−2.15%** (−11.86)
4	0.72%** (3.09) [$N = 15{,}476$]	1.35%** (10.86)	0.35% (1.60) [$N = 6{,}449$]	−2.16%** (−11.70)
High	1.18%** (3.84) [$N = 13{,}787$]	1.72%** (9.52)	0.71%* (2.17) [$N = 8{,}109$]	−2.24%** (−13.82)
High-Low	0.85%** (4.17)	0.42%** (3.16)	0.80%** (2.78)	0.19% (1.15)

Notes. This table presents the change in returns before earnings announcements as a function of the eventual earnings surprise, our proxy of information leakage. Stocks are grouped into positive and negative earnings surprises, where positive-surprise stocks are those that report earnings that higher or equal to median analyst forecast and negative-surprise stock are those that report earnings below median forecasts. Stocks are also independently sorted into five equal-sized portfolios based on the change before earnings announcements. The average returns are calculated for each of the 10 portfolios in each quarter, and the average returns over the quarters along with corresponding t-statistics are presented for each portfolio. Preannouncement returns are the return change five trading days before the earnings announcement, and the announcement returns are return change at the announcement day and the following day, where return change are calculated relative to the average daily risk-adjusted returns during the quarter. Change in price impact is the average price impact five days before the announcement minus the average price impact during the quarter. The sample includes 109,547 quarterly earnings announcements between 1993 and 2009.

*, **Denote significance at the 5% and 1% levels, respectively.

earnings news. The high price-impact portfolio attains the highest announcement returns in the positive earnings surprises group, 1.72%, and the second lowest announcement returns in the negative earnings surprises group, −2.24%. For the negative surprise group, the difference between the announcement returns in the high price-impact portfolio and the low price-impact portfolio is only 0.19% and not statistically significant. Furthermore, we find no difference between the one-year postannouncement returns of the high price-impact portfolio and the low price-impact portfolios.[28] In sum, an increase in information asymmetry before announcements leads to increase in preannouncement returns regardless of the nature of the upcoming news.

Beyond news, other trade pressures may affect preannouncement returns. To demonstrate that buy pressures are not driving our result, we calculate the net order flow for the high price-impact quintile portfolio in Table 3. Net order flow is the buyer-initiated trading volume minus seller-initiated trading volume according to Lee and Ready (1991) divided by total daily volume. We find that the average net order flow during the five days before announcements is −0.0185 with t-statistics of −4.81 for the high price-impact quintile portfolio, i.e., there are more seller than buyer initiated trades in this portfolio.[29] Therefore, the positive returns before announcements (Table 3) are not driven to buy pressures.

Finally, to ensure that other news issued just before the announcements are not driving the preannouncement return run-up, we exclude all earnings announcements that experienced a forecast revision in the week before announcements–news will presumably lead to

[28] To test the difference in postannouncement returns, we use the time-calendar portfolio methodology employed in Table 2. Specifically, we create time-calendar portfolios starting two days after the announcement and ending one year after the announcement for the low and high price-impact quintiles. We estimate a regression of the daily returns on the market, size, book-to-market, and momentum factors described in Equation (2) above for each of the portfolios, and find that the difference between the alpha returns of high and low price-impact portfolios is insignificant in both the positive and in negative surprise groups, and in the entire sample.

[29] We find there are more seller-initiated than buyer-initiated trades during the five days before announcements for both large and small trades. Trades over $50,000 (large trades) serve as a proxy for institutional activity, and trades less than $5,000 (small trades) as a proxy for individual investors' trades (e.g., Frazzini and Lamont 2007). We calculate the net order flow during the five days before announcements for each of the two trade size categories, and find it is negative for both large and small trades.

a forecast revision. Out of the 109,547 quarterly earnings announcements between 1993 and 2009, 88,517 announcements that had no forecast issued or revised (on I/B/E/S) in the week before the announcement. Performing the test presented in Table 3 with this sample, we get similar results. The portfolio returns of the low price-impact quintile are 0.13% with a t-statistic of 0.68. The returns for the high price-impact quintile are 1.08% with a t-statistic of 3.41. The difference between the returns of the high and low portfolios is 0.95% and it is significant at the 1% level. Performing the regression analysis in Table 6 for this sample, we also get similar results—the change in price impact is significant in explaining the increase in preannouncement returns.

6.2. Controlling for Endogeneity

We perform the main test with the actual price impact as a proxy of information asymmetry and find that increases in price impact before announcements coincide with the return run-up before announcements. As a robustness test, we perform the test with expected (instead of actual) increase in price impact in order to alleviate concerns of endogeneity or superfluous correlation between price impact and concurrent returns. We estimate the expected increase in price impact as a function of log value of firm's equity at the beginning of the quarter, book-to-market, percent of stocks held by institutional investors during the quarter, log value of average dollar trading volume during the quarter, and stock price. The expected value of this regression is used for the portfolio test. As in Table 3, stocks are sorted into five equal-sized portfolios based on the expected change in price impact, the average of the preannouncement returns is calculated for each of the five portfolios in each quarter, and the average returns over the quarters along with corresponding t-statistics are computed for each portfolio. The results based on expected increase are similar to those based on actual increase in price impact. The portfolio returns of the low expected price-impact quintile are 0.03% with a t-statistic of 0.18. The returns for the high expected price-impact quintile are 0.83% with a t-statistic of 2.95. The difference between the returns of the high and low portfolios is 0.80% and it is significant at the 1% level. As an additional check, we reestimate Table 6 with expected price impact and obtain similar results. For example, in Model 1 of Table 6, coefficient on expected $\Delta PriceImpact$ is 0.116 (t-statistic of 5.42).[30] Furthermore, to demonstrate that the results with this measure are not driven by the direction of trade, we split the sample based on the net order flow. Specifically, we sort stocks into those that had more buyer-initiated trades during the five days before the announcement, and those that had more seller-initiated trades, and find that within each of these groups the high price-impact quintile portfolio has higher returns than the low price-impact quintile portfolio. The difference between the high and low price-impact quintile portfolios is 1.12% with t-statistics of 2.95 for the buyer-initiated group, and 0.97% with t-statistics of 3.76 for the seller-initiated group.

Finally, we perform the analysis with bid-ask spreads, and get similar results. As in Table 3, stocks are sorted into five equal-sized portfolios based on the average bid-ask spreads in the five days before the announcement, the average of the preannouncement returns is calculated for each of the five portfolios in each quarter, and the average returns over the quarters along with corresponding t-statistics are computed for each portfolio. The returns for the low bid-ask spread quintile portfolio are 0.16% with t-statistics of 1.17, and the returns for the high bid-ask spread quintile portfolio are 0.96% with t-statistics of 3.74, and the difference between the portfolios is statistically significant at the 1% level.

6.3. Controlling for Noise in Prices

Microstructure-based frictions such as bid-ask spreads, nonsynchronous trading, and discrete price grid, might affect observed stock returns. Blume and Stambaugh (1983) refer to these frictions as noise, and show that mean returns to equal-weighted portfolios might be upward biased by the cross-sectional average of the individual security return noise. If portfolios are created by sorting on a variable correlated with the variance of noise, then the upward bias will be greater for the portfolio containing noisier securities, and the difference in mean returns across portfolios is biased. Our main test in Table 3 is based on sorting of portfolios on the change in price impact. To alleviate concerns that these results are driven by such bias or by small illiquid stocks in general, we perform the test again with value-weighted returns and gross-return-weighting method—Asparouhova et al. (2013) show that these two methods are equally effective in eliminating biases in portfolio mean return estimates. Using these two alternative methods, we find similar results to those presented in the main analysis above, and conclude that after controlling for noise in returns, information asymmetry drives the returns in the high price-impact quintile portfolios.

6.4. Short-Selling Constraints

A different explanation for the return run-up might be an increase in short-selling constraints before the earnings announcements. A reduction in the number of shares one can borrow before earnings announcements or an increase in the cost of shorting can prevent

[30] When using the increase in price impact during trading days 10 to 6 as a measure of expected price impact in days 5 to 1, we get similar results.

investors from fully incorporating negative information into prices (e.g., Miller 1977). Investors with positive information will buy stocks, and investors with negative information will not fully trade on their information. Note, however, that a short-selling constraint by itself should not lead to positive biases or run-ups in stock prices such as the one we document. For that to happen, we need to further assume that investors do not fully realize the impact of short-selling constraints on stock prices. Diamond and Verrecchia (1987) show that rational uninformed agents take the presence of short-sale constraints into account when forming their valuations, and thus, that there is no overpricing as all participants recognize that negative opinions have not made their way into the order flow.

Nonetheless, we test whether short-selling constraints drive the stock price run-up before announcements. D'Avolio (2002) uses short-selling data from a large security lending financial institution, and finds that stocks that are hard to borrow and short are generally small, illiquid stocks. We exclude 16,507 announcements made by firms with a stock price of less than \$5 or market value of equity lower than \$100 million from the sample. D'Avolio finds that quarterly 13F holdings explain more than half of the variation in sample stock-loan supply, where stocks with higher institutional holdings have higher stock-loan supply and lower shorting costs. Regression (3) presented in Table 6 demonstrates that the increase in returns before an earnings announcement is not associated with institutional holdings. To further demonstrate this point, we test the returns for portfolios sorted on the change in price impact and intuitional holdings. Stocks are sorted into three groups based on institutional holding and independently sorted into five groups based on the change in price impact before earnings announcements. The average preannouncement returns are calculated for each of the 15 portfolios in each quarter, and the average returns over the quarters along with corresponding t-statistics are computed for each portfolio. Institutional holdings are based on the 13F quarterly (from Thomson-Reuters), and the change in the price impact ($\Delta PriceImpact$) is defined in §3. The hedge portfolio that buys the high price-impact and sells the low price-impact quintile earns 0.85% in the five days before earnings announcement with a t-statistic of 3.63. The same hedge portfolio for the high institutional-holding group earns 0.66% with a t-statistic of 3.09. This result suggests that short-sell constraints may drive some of the run-up in returns before earnings announcements. Still, the difference between the returns of the high and low price-impact portfolios is significant for the high institutional-holding group, where short-sell constraints are less likely, and thus the phenomenon exists independently from short-sell constraints. Note that in the multivariate regression analysis (3) above, the institutional holdings variable is found to be insignificantly correlated with preannouncement returns.

6.5. Results with Scheduled Announcement Dates

We estimate the return run-up before *actual* announcement dates in §4. Measuring the return run-up around actual announcement dates rather than expected dates of announcement may introduce bias into our return estimates. The timing of the announcement conveys information (e.g., Chambers and Penman 1984, Kasznik and Lev 1995), where firms with good news are more likely to announce early and late announcers tend to have bad news.[31] To mitigate this possible bias, we retest our hypothesis with a subsample of firms that announced their earnings on prescheduled dates. We find similar results and discuss them below.

We obtain the scheduled announcement dates of quarterly earnings from the Thomson StreetEvents database. StreetEvents provides these data for a large sample of firms from the year 2000. After matching this database with our original sample, we obtain 44,480 quarterly earnings that were announced as scheduled for the years 2000–2004. The results with the prescheduled announcements are comparable to those presented in Table 2. The level of returns starts increasing a few days before the announcements and becomes statistically significant four days before the announcement (day 4) and stays positive and significant on days 3, 2, and 1. The returns drop on day 0 and are insignificantly different from zero in the days following the announcement.[32]

6.6. Trading Volume

Another explanation for the return run-up may be a predictable increase in trading volume (e.g., Trueman et al. 2003, Frazzini and Lamont 2007). Frazzini and Lamont (2007) show for a large sample that an increase in returns around earnings announcements is correlated with a predictable increase in trading volume, which they interpret as irrational buying behavior. The authors, however, do not focus on the days before the earnings announcement. Their main test shows that returns in the month of the earnings announcement are correlated with a predictable increase in the monthly trading volume. For the daily volume, the

[31] See Cohen et al. (2007), for example, for a discussion of this issue.

[32] The StreetEvents database provides the time of announcement—mostly whether announcements are made before or after the trading day—and enables us to separate the times before and after earnings announcements. We code the Compustat earnings date as day 0 when the announcement is made before the trading day. When the announcement is made after the trading day has closed, we code the trading day following the announcement as day 0. To avoid ambiguity, we exclude the few announcements that, according to StreetEvents, occurred during trading days.

authors actually find an average decrease before earnings announcements and a lack of correlation between predicted volume and preannouncement returns.[33] Our return results are therefore not likely to be driven by a predictable increase in trading volume. To demonstrate this, we estimate the return run-up before earnings announcements ($\Delta PreAnnRet$) used in Equation (3) above, as a function of the average increase in trading volume in prior quarters and find no relations between the variables.[34]

On the same vein, Gervais et al. (2001) find that stocks experiencing abnormally high volume tend to subsequently appreciate in value. The increase in trading volume serves as proxy for an increase in investor attention, which leads to further buying, and drives the subsequent price appreciation according to Grevais et al. Specifically, they find that when daily volume is in the top decile of trading volume in the recent 50 trading days, returns drift upward for the next several trading days. To control for this volume or attention effect, we exclude earnings announcements if the volume in the sixth day before the announcement was greater than the median trading volume in the 50 preceding days—this is a more stringent criterion than the upper decile used by Grevais et al. (2001). As in Table 3, we sort stocks into five portfolios based on the increase in price impact five days before announcements, and then exclude observations in each portfolio if the volume in the sixth day was higher than the median volume in the preceding 50 trading days. Results are similar to those presented in Table 3. The high quintile of increase in price impact has positive and significant returns, 0.79% with t-statistics of 2.60, the low quartile has zero returns, 0.04% with t-statistics of 0.19, and the different between the high and low quintiles is statistically significant. The results indicate that an increase in investor attention does not drive our results. On a similar vein, we add to the cross-sectional regression test in Table 6 a control a variable for the preannouncement volume, which equals the trading volume in the sixth day before the announcement divided by the average trading volume in the 50 days preceding it. The change in price impact, $\Delta PriceImpact$, remains positive and significant after controlling for this volume effect.

[33] Frazzini and Lamont's (2007) Table 7 and Figure 3, for example, describe a decrease in daily trading volume 10 days before earnings announcements along with a concurrent increase in average daily returns during those days.

[34] In our return-volume regression, we use the abnormal volume in the prior quarter, in the same quarter last year, or the average in the past four quarters, and find no relation between the return run-up and these past volume measures.

6.7. Regulation FD's Effect on Preannouncement Returns

In October 2000, the Securities and Exchange Commission (SEC) issued Regulation Fair Disclosure (FD) in an effort to reduce selective disclosure of material information by firms to analysts and other investment professionals. As a result of Regulation FD, information asymmetry around earnings announcements has declined (e.g., Eleswarapu et al. 2004). We find that the average returns run-up before earnings announcements has also decreased after Regulation FD.

To test the effect of Regulation FD on preannouncement returns, we use the time-calendar portfolio methodology employed in Table 2. We compare the preannouncement returns in the three years before Regulation FD, 1997–1999, to the returns in the three years after the regulation came into effect, 2001–2003. The year 2000 in which the regulation became effective is excluded. We find that the preannouncement return run-up, the alpha of Equation (2) for the hedge portfolio that sells stocks during the quarter and buys them in the five days before the announcement, decreased from 0.29% in 1997–1999 to 0.11% in 2001–2003, and the difference between the returns is statistically significant at the 1% level. Results are similar when we compare the returns in 1993–1999 to those in 2001–2009.

The decrease in preannouncement returns after Regulation FD supports our hypothesis that information asymmetry is driving the increase in expected returns before earnings announcements. Other events, such as the decimalization of price quotes and general increase in liquidity, may have also reduced the magnitude of preannouncement returns after 2000. In any case, the results of our main cross-sectional tests reported above are similar for the post–Regulation FD sample years; stocks with greater increase in price impact experience greater returns run-up before earnings announcements. Regulation FD deters selective disclosure, and it reduces but does not eliminate investor ability to attain private information before earnings announcements. Private information can still be collected from clients and other third parties or generated through private forecasting techniques.

7. Conclusion

We hypothesize and find that investors expect higher returns for holding stocks on high information asymmetry days. Investors have the option to wait and not sell stocks on high information asymmetry days or to liquidate other assets in their portfolio then. Even if temporary increases in asymmetry are priced, their effect on expected returns might be small or insignificant. We, however, find that temporary increases in asymmetry can have a substantial impact on expected returns before earnings announcements. Stocks with high turnover and volatile returns are affected the most—where frequent trading, or turnover, captures investor demand for short-term liquidity, and return volatility increases market makers' risk for carrying capacity and providing liquidity.

Our finding implies that temporary increases in adverse-selection risk present a real cost to corporations. Selective disclosure before news, for example, temporarily increases information asymmetry. Regulators concerned with the unfairness of selective disclosure enacted Regulation Fair Disclosure. We find that this regulation also reduced the run-up in expected returns before earnings announcements. On the same vein, our results suggest that more frequent disclosure, which was shown to reduce earnings management and information asymmetry (e.g., Jo and Kim 2007), can lower the cost of equity to the extent it reduces private information held by traders between disclosure dates. Adverse-selection risk can increase also because of actions of parties outside the company. Prior literature shows that tipping by analysts—the selective disclosure of forecasts days before their official release (Irvine et al. 2007)—or front running by brokers (e.g., Röell 1990, Fishman and Longstaff 1992) affect traders' wealth. Our results suggest that these temporary increases in asymmetry may also be costly for firms.

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