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Information asymmetry, information dissemination and the effect of regulation FD on the cost of capital ☆

Jefferson Duarte[a], Xi Han[b], Jarrad Harford[a], Lance Young[a,*]

[a]*Foster School of Business, University of Washington, Box 353200, Seattle, WA 98195, USA*
[b]*Tsinghua University, Beijing 100084, People's Republic of China*

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Abstract

This paper considers the impact of Regulation Fair Disclosure (FD) on firms' information environments and costs of capital. For NYSE/Amex firms we find little evidence of a change in the cost of capital attributable to Regulation FD. For Nasdaq firms we find that Regulation FD increased firms' costs of capital by 10–19 basis points per annum though the statistical significance of this change is modest for some of our models. We also show substantial cross-sectional variation in the cost of capital changes. We find that cost of capital changes were negatively related to both pre-regulation firm size and PIN. In addition to the findings regarding Regulation FD, this research contributes to a growing literature that documents links between firms' information environments and their costs of capital.
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1. Introduction

This research considers the impact of Regulation Fair Disclosure (FD) on informed trading and the cost of capital.[1] Regulation FD was adopted by the Securities and Exchange Commission (SEC) in October 2000

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*Corresponding author. Fax: +1 206 543 7472.
E-mail addresses: jduarte@u.washington.edu (J. Duarte), xihan@u.washington.edu (X. Han), jarrad@u.washington.edu (J. Harford), youngla@u.washington.edu (L. Young).
[1]Throughout this study, we use the term "cost of capital" to refer to a firm's cost of equity capital. We leave an assessment of the impact of Regulation FD on the cost of debt capital to future research. Also, we use the term "expected return" and "cost of capital" interchangeably. Clearly, in a market with asymmetric information, expected returns differ between agents. However, we use the term "expected return" to refer to the expected return as observed by econometricians. This is consistent with the usage of the terms in Easley and O'Hara (2004).

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(US Securities and Exchange Commission, 2000) and was intended to increase confidence and fairness in capital markets by prohibiting managers from selectively releasing material nonpublic information to market professionals or institutional shareholders, but not to the public at large. Before the implementation of Regulation FD, proponents argued that requiring managers to release all material disclosures to the public at large instead of select market professionals would reduce the information advantage of these professionals and thus decrease the information asymmetry in the market. Others argued that the regulation could have a chilling effect, leading managers to reduce the quality and quantity of disclosures, both formal and informal, because of uncertainty about whether a particular informal disclosure might later be judged in court to be material or whether a particular disclosure was sufficiently broad.

This study adds to the literature by considering how Regulation FD changed firms' information environments and how these changes impacted firms' expected returns. We perform this analysis on a broad cross-section of firms and control for other contemporaneous events that could have impacted firms' information environments but are not related to Regulation FD. In our analysis, we appeal to recent theoretical and empirical work in finance that suggests that elements of firms' information environments are important determinants of firms' expected returns. For instance, Easley and O'Hara (2004) present a rational expectations model in which the cost of capital depends on the split between the amount of public and private information as well on how widely private information is disseminated. The intuition is that increasing the extent to which information is disseminated reduces the cost of capital by increasing the informativeness of stock prices, which reduces the risk to uninformed investors and thus reduces the return they demand. However, if information that was previously public becomes private, then expected returns increase. This happens because informed investors can use their additional information advantage to trade with uninformed investors and hold portfolios more heavily weighted to stocks with positive private information and weighted against stocks with negative private information. The additional asymmetry increases the risk to the uninformed investors, who cannot adjust their portfolios to take account of the private information. Easley, Hvidkjaer, and O'Hara (2002) examine this notion empirically and show that information asymmetry is priced in the cross-section using a measure of information asymmetry from a structural microstructure model, the probability of informed trade or *PIN*.

This paper applies these insights to an examination of the effects of Regulation FD on firms' costs of capital. A primary contribution of this study is that we use the cost of capital as a natural measure to assess the economic consequences of Regulation FD's impact on information asymmetry and information dissemination. For instance, suppose, as opponents of the regulation suggested, that after Regulation FD's implementation, managers decided to decrease the frequency or quality of their disclosures. The resulting decrease in the dissemination of information would tend to increase firms' costs of capital. If, however, Regulation FD induces firms to make public information that was formerly private, then the amount of information asymmetry and thus firms' capital costs would decline. The economic impact of these effects is important for an overall understanding of the effect of the regulation.

To measure the impact of changes in firms' information environments on expected returns, we use an asset pricing model estimated on a broad cross-section of firms to measure the market 'prices' of information asymmetry and information dissemination. We then use these 'prices' in conjunction with proxies for both information asymmetry and information dissemination to evaluate Regulations FD's impact on capital costs. This provides a natural way to assess an important aspect of the economic impact of Regulation FD.[2] Furthermore, we contribute to the emerging literature on the relation between firms' information environments and capital costs by providing evidence of the extent to which information asymmetry and dissemination affect expected returns for a broad cross-section of firms.

A number of studies consider the effect of Regulation FD on various aspects of firms' information environments with mixed results.[3] Among these studies, the three most closely related to ours are Gomes,

[2]Other economic impacts might include the welfare impacts of Regulation FD on various market participants such as informed versus uninformed investors and investors versus managers.

[3]Heflin, Subramanyam, and Zhang (2003), Bailey, Li, Mao, and Zhong (2003), and Straser (2002) argue that firms increased disclosures after Regulation FD. Bushee, Matsumoto, and Miller (2004), Gintschel and Markov (2004), Topaloglu (2003), Eleswarapu, Thompson, and Venkataraman (2004), and Chiyachantana, Jiang, Taechapiroontong, and Wood (2004) show that effective bid-ask spreads declined

Gorton, and Madureira (2006), Jorion, Liu, and Shi (2005), and Straser (2002). While focusing on changes in disclosure, Gomes, Gorton, and Madureira (2006) briefly consider the impact of Regulation FD on the Fama and French size factor loadings. They find that after the regulation the size factor loadings increased for small firms but decreased for large firms. In contrast, we estimate the changes in cost of capital from Regulation FD using an asset pricing model, motivated by the theoretical work of Easley and O'Hara (2004), which explicitly allows firms' expected returns to vary based on changes in information asymmetry and information dissemination. To proxy for information asymmetry, we use the *PIN* measure for a broad cross-section of firms. Jorion, Liu, and Shi (2005) examine the price impact of credit downgrades and upgrades before and after Regulation FD and find that credit rating changes are more informative after Regulation FD. This suggests that information was less widely disseminated after the implementation of Regulation FD. Straser (2002) also considers the impact of Regulation FD on information asymmetry using the *PIN* measure, albeit for a small sample of firms. We differ from Straser (2002) by considering the impact of Regulation FD on *PIN* for a broad cross-section of firms, including most NYSE, Nasdaq, and Amex stocks. Furthermore, we use the cost of capital to measure the economic size of the change in *PIN*. Also, we consider the impact of Regulation FD on how widely information is disseminated and how changes in information dissemination impact the cost of capital. This is important because, as Easley and O'Hara (2004) argue, information dissemination can have important effects on the cost of capital and Regulation FD is likely to have changed how widely information is disseminated. Lastly, this study controls for other events, coincident with Regulation FD, that could have altered firms' information environments but are unrelated to the change in regulation.

The results indicate that the average NYSE/Amex firm, experienced little, if any, change in the cost of capital. The average Nasdaq firm experienced an increase in capital costs of between ten and 19 basis points per annum, though the statistical significance of this change is modest for some of our models. Furthermore, we find substantial cross-sectional variation in cost of capital changes, with the most important determinants of this variation being *PIN* and firm size. In particular, we find that changes in capital costs are decreasing in both *PIN* and firm size.

The remainder of the paper is structured as follows. Section 2 explains the hypothesis about how Regulation FD affected firms' cost of capital. Section 3 discusses our empirical methods and the results. Section 4 presents concluding remarks.

2. Hypothesis

We advance the following hypothesis regarding Regulation FD's impact on firms' expected returns.

Hypothesis. *The net result of Regulation FD was to decrease capital costs by either increasing information dissemination or decreasing information asymmetry or both.*

Because our main hypothesis depends on the terms "information dissemination" and "information asymmetry", it is worth spending a moment to formally define these terms. For this it is useful to consider the theoretical model in Easley and O'Hara (2004). Easley and O'Hara (2004) consider a model in which informed and uninformed traders receive signals about asset values and use these signals to price securities in a capital market. The informed traders receive both private and public signals, while the uninformed traders receive only public signals and attempt to infer private signals from equilibrium prices. In the model, information asymmetry is defined as the fraction of signals that are received only by informed investors. Information dissemination in the model is defined as the fraction of investors who receive private signals (the total number of signals is represented in Easley and O'Hara, 2004, as I, α is the fraction of private signals and μ is the fraction of informed traders).

Easley and O'Hara (2004) show that expected stock returns are increasing in information asymmetry and decreasing in information dissemination. The intuition for the relation between information asymmetry and expected returns is that when uninformed investors face information asymmetry they expect to lose to the

(*footnote continued*)
after Regulation FD. In contrast, Sidhu, Smith, and Whaley (2006), and Straser (2002) find that the adverse selection component of the bid-ask spread has risen after Regulation FD.

informed investors. In the model, the uninformed cannot diversify this risk because the informed investors effectively tax the uninformed and therefore the uninformed demand to be compensated for this via an increased expected return. The intuition for the relation between information dissemination and expected returns is that, the more widely private information is shared, the more the information is reflected in prices. Thus, everything else constant, increasing the number of informed investors results in prices that reflect more information. This reduces the advantage of the informed and therefore the premium demanded by the uninformed.

While the distinction between information asymmetry and information dissemination is clear in theoretical models such as Easley and O'Hara (2004), it is not necessarily clear outside such models. This is because information that is seemingly public could require costly interpretation for its pricing implications to become clear. Thus, financial statements are public in the sense that they are cheaply available however, those without sufficient training, skill, or time might not be able to use them (or at least not all of the information in them) to form signals about firm value that are useful for trading decisions. Despite this difficulty, it is useful to consider an example to make the concepts more concrete. Consider a firm that begins to webcast its conference calls with analysts. How does this affect information asymmetry and information dissemination? This depends on the extent to which the information can be cheaply and easily translated into signals about firm value. Suppose for a moment that the information released during the webcast was cheap and easy to interpret. In this case, the firm is now effectively making public what would otherwise have been a signal sent to only a small number of analysts. This results in a decrease in information asymmetry. If the information in the webcast were costly to translate into a signal about firm value because such translation required time, effort, and skills not available to all investors, then the change to webcasting would increase information dissemination. That is, the firm would effectively be passing a private signal on to a broader set of investors, namely, those who could afford to interpret the signal and become informed. Other investors who were unable or could not afford to interpret the signal would find it of no use to them in forming their expectations about the price of the firm. Also, both effects could happen simultaneously if some information were transparent and easy to understand and some information required costly analysis. Thus, it is not clear a priori whether this or any other particular corporate action affects information asymmetry, information dissemination, or both. However, the effect on the cost of capital of reducing information asymmetry and increasing information dissemination is the same. We do not attempt to classify specific types of management disclosures as "private information made public" or "private information more broadly disseminated" or to identify the effect of specific managerial actions on our proxies for information asymmetry and information dissemination. Instead, we recognize that both effects are potentially important, develop proxies for both information asymmetry and information dissemination, and use these proxies to best capture the regulation's total impact on firms' capital costs from changes in the firms' information environments.

Our hypothesis posits that, prior to Regulation FD, managers were selectively disclosing information and receiving private benefits from this selective disclosure. Furthermore, this hypothesis assumes that Regulation FD could have either of two potential effects. First, the regulation could force managers to disclose information more broadly because managers do not have enough flexibility under SEC rules to cut back on disclosures. Thus, managers could be forced to disseminate information more broadly by making additional voluntary disclosures. Second, managers could act to make formerly private signals public, for instance, by making public announcements of information that was previously disclosed only to select market professionals or by including previously private information in required disclosures. As a result of either or both of these changes, the net result would be a decrease in expected returns.

Contrary to the above hypothesis, Regulation FD could increase the cost of capital. Disclosures are costly for managers. These costs include the direct costs of making additional disclosures, such as additional time and effort to prepare formal disclosure documents and the costs of maintaining investor relations departments. Perhaps more significant, if managers disclose information broadly or make it public, they lose the ability to trade on the information and the ability to use that information to curry favor with select analysts and institutional investors. Furthermore, managers might not wish to invite the additional scrutiny that broad disclosures of information could bring or to allow competitors to have access to the information. In addition, managers face uncertainty about which disclosures might trigger SEC enforcement actions, because it is not necessarily clear how the SEC will interpret terms such as "material nonpublic information" and "broad, nonexclusionary distribution". Thus, in the face of these costs, managers could respond to the new regulation by reducing the informativeness or quantity of disclosures and keeping information held within the firm. This reduces the number of investors who are able to become informed and thus reduces information dissemination. To the extent that the new disclosure policies cause information that would previously have been made public to be kept private, information asymmetry would increase. Furthermore, some informed investors could be better able to adapt to the reduced quality or quantity of disclosures than uninformed investors. The informed traders' superior adaptability could come about because informed traders have relatively cheap access to information sources the firm cannot control but that would be prohibitively expensive to the uninformed. These might include industry experts as well as the firms' suppliers and customers. This would also increase information asymmetry. Each of these two effects would tend to increase firms' costs of capital.

We implicitly assume that the total amount of information, (i.e., the total number of signals available to potential market participants) remains unchanged. Stated in terms of the notation in the Easley and O'Hara (2004), we assume that I is a fixed constant for each firm and our hypotheses deal with changes to the parameters α (the fraction of private signals) and μ (the fraction of informed traders). There are two reasons for this assumption. First, we argue that the total amount of information about a firm is ultimately related to the firm's production processes. That is, we assume that the firm produces information as a by-product of producing goods and services. This information is both available to managers and employees as part of their jobs and is necessary for these individuals to perform their jobs. These people can trade on their information and can thus be considered (at least potential) market participants. We argue that it is unlikely that Regulation FD caused firms to alter their internal information systems or production processes to change the amount of information that the firm produces and makes available to insiders. Instead, we assume that firms would act to change the proportion of signals kept within the firm or to change their policies with respect to whom information can be revealed. We argue that altering the proportion of signals kept internal to the firm and changing to whom the firm decides to disseminate information represent uniformly less costly alternative reactions to the regulation than altering the firm's internal information systems in a way that would change the amount of information that the firm produces as part of its daily operations.

3. Empirical methods and results

This section describes the proxies we use for the firms' information environment, presents the methods we use to measure Regulation FD's effect on firms' cost of capital and presents the results.

3.1. Proxies for the information environment

To quantify the effects discussed in Section 2, we need proxies for both information asymmetry and information dissemination. As our proxy for information asymmetry, we use the *PIN* measure. Computation of *PIN* requires estimation of a structural market microstructure model introduced by Easley, Kiefer, O'Hara, and Paperman (1996), Easley, Kiefer, and O'Hara (1997), and Easley, Hvidkjaer, and O'Hara (2002), among several others. The model posits the existence of a liquidity provider who observes the flow of buy and sell orders and assesses the probability that the orders come from informed traders when setting bid and ask quotes. The order of events in the model is as follows. First, at the beginning of each day nature decides whether a private information event will occur. Private information events occur with probability a. Conditional on an information event happening on a particular day, the informed traders in the model receive a private signal. The signal is positive with probability d and negative with probability $1-d$. If the signal is positive, buy order flow for that day arrives according to a Poisson distribution with intensity parameter e_b+u and sell order flow arrives according to a Poisson distribution with intensity parameter e_s. If the signal is negative, buy order flow arrives according to a Poisson distribution with intensity parameter e_b and sell order flow arrives according to a Poisson distribution with intensity parameter e_s+u. If there is no signal, buy and sell order flow arrives by Poisson distributions with intensity parameters e_b and e_s, respectively. Using the data on the number of buys and sells for each stock, the econometrician can estimate the parameters of the model via maximum likelihood. The *PIN* is computed (suppressing the firm subscript) as

$$PIN = \frac{a \times u}{a \times u + e_s + e_b}. \tag{1}$$

While we recognize that *PIN* does not correspond exactly to any of the parameters in the rational expectations model, a growing literature shows that *PIN* is a good proxy for information asymmetry. In a companion paper to Easley and O'Hara (2004), Easley, Hvidkjaer, and O'Hara (2002) use *PIN* as a proxy for information asymmetry and find that *PIN* is significantly positively related to average returns in both an economic and a statistical sense, even after controlling for volume, bid-ask spreads, size, book-to-market, volatility, and volatility of volume. They find, for instance, that a 10 percentage point increase in *PIN* is associated with an 250 basis point increase in average annual returns. In addition, Easley, Kiefer, O'Hara, and Paperman (1996) find that *PIN* is positively related to the bid-ask spread, which is also consistent with *PIN* as a proxy for information asymmetry.

To estimate *PIN* we need data on the number of buyer- and seller-initiated trades for each firm-day. We gather these data from the Institute for the Study of Securities Markets (ISSM) (1983−1992) and the NYSE Trade and Quote (TAQ) (1993−2001) databases. We exclude all trades with nontypical settlement conditions because these could be trades under special arrangements from which the *PIN* model abstracts. We also exclude trades and quotes that occurred before the open, at the open, and those at the close and after the close. We exclude these trades and quotes to avoid including trades that occurred during the opening and closing auctions. We exclude all quotes with zero bid or ask prices, quotes for which the bid-ask spread was greater than 50% of the price, and trades with zero prices. We exclude these trades and quotes to eliminate possible data errors. Because neither the TAQ nor the ISSM database identifies trades as buyer- or seller-initiated, we use the Lee and Ready (1991) algorithm to sign the trades. Briefly stated, trades above (below) the mid-point of the bid-ask spread are considered buyer–(seller-) initiated. Trades that occur at the mid-point of the spread are classified as buyer–(seller-) initiated according to a tick test. In addition, if there were no quotes posted during the trading day, we use the tick test to sign any trades made during the day. For each firm, for each day, we compute the number of trades classified as buyer-initiated and the number of trades classified as seller-initiated. The full sample includes Amex (1983–2001), NYSE (1983–2001) and Nasdaq (1987–2001) common stocks. We exclude American Depository Receipts and closed-end funds.

For each firm in the sample we estimate *PIN* every calendar quarter numerically via maximum likelihood. The numerical maximization routine converged in virtually all cases. We require that each firm included in the sample have at least 20 valid observations per quarter from which to compute the *PIN*. Other studies, for instance, Vega (2006), estimate *PIN* using similar sample sizes; in Vega's case, 40 trading days. Time-series graphs of the cross-sectional median and quartiles of *PIN* can be found in Fig. 1. Because the Nasdaq was primarily a dealer market during this period, and thus has different microstructure characteristics that could effect the estimation of *PIN*, we present the *PIN* results for the NYSE/Amex and Nasdaq firms separately. We maintain this separation in the analysis that follows. Panel A shows the median and quartiles for NYSE firms. Panel B shows the median and quartiles for NYSE and Amex firms. Panel C shows the median and quartiles for the Nasdaq firms. The median and first and third quartiles of the *PIN* estimates in Panel A closely match those in Easley, Hvidkjaer, and O'Hara (2002). The estimates in Panels B and C are somewhat higher than the cross-sectional medians and quartiles presented in Easley, Hvidkjaer, and O'Hara (2002). We attribute this to the large number of small firms that trade on Nasdaq and Amex because, as Easley, Hvidkjaer, and O'Hara (2002) show, *PIN* is negatively correlated with size.

Table 1 presents the first quartile, median, and third quartile of *PIN*, but for various portfolios instead of for the different exchanges. The portfolios are formed based on size, book-to-market, and *PIN*. The results indicate that high book-to-market firms and small firms tend to have higher *PINs*. The median *PIN* for each portfolio is between 20% and 40%. Furthermore, while the cross-sectional variability in *PIN* within the portfolios increases for small firms, high book-to-market firms, and high *PIN* firms, in all cases the first and third quartiles are no smaller than 10% and no larger than 60%. Table 1 also presents the fraction of the firms within each portfolio for which the estimation resulted in a corner solution for a, that is, a value of zero or one.[4] For each of the portfolios, the fraction of corner solutions is small, usually less than 1%. The exceptions

[4]The estimation of parameters a and d are more sensitive to the size of the sample than the other parameters. We are concerned with corner solutions for a only because the parameter d does not enter into the computation of *PIN*.

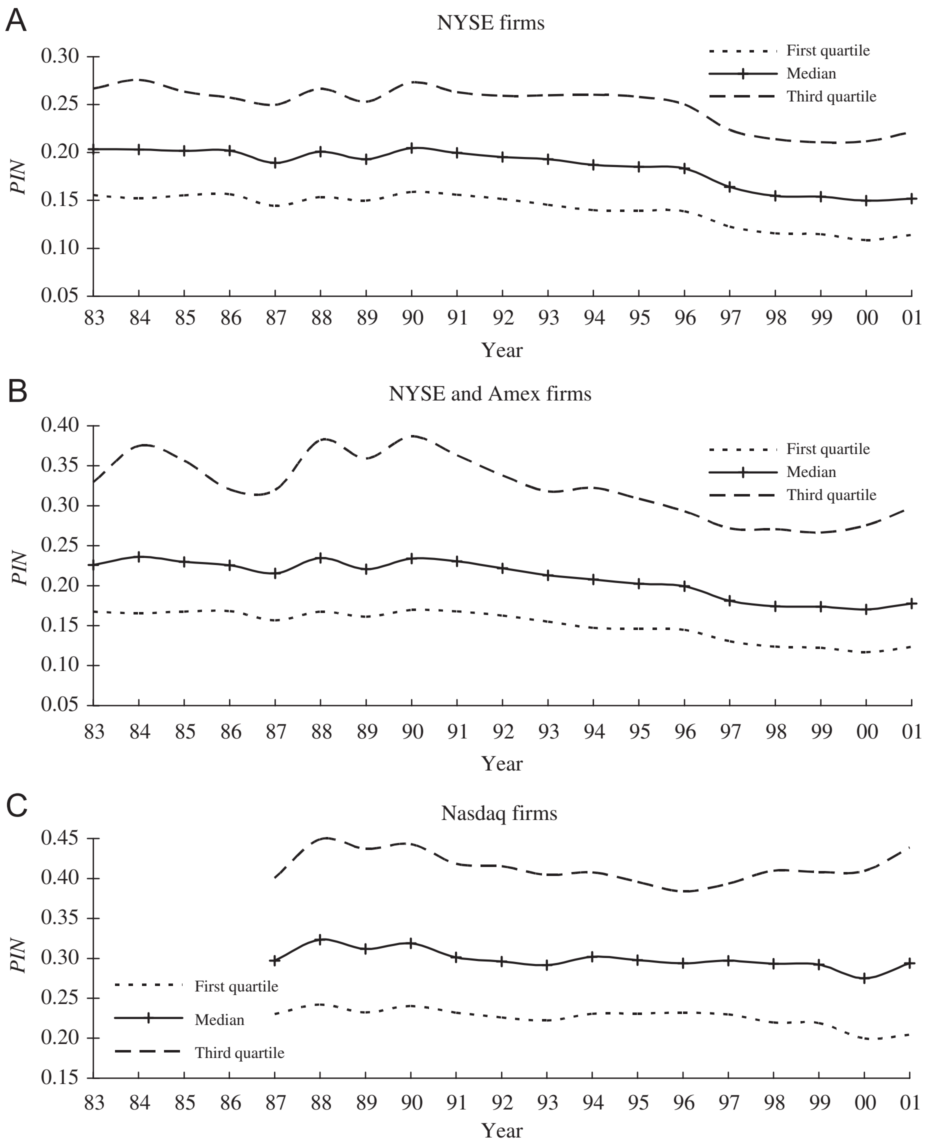

Fig. 1. The figure plots the first quartile, the median, and the third quartile of the average probability of informed trade (*PIN*) each year over the sample period (1983–2001), for NYSE firms only (Panel A), for NYSE and Amex firms (Panel B), and for Nasdaq firms only (Panel C). *PIN* is a composite variable measuring the probability of information-based trading, estimated each quarter, using Easley, Hvidkjaer, and O'Hara (2002) probability of informed trading model.

are low *PIN* firms, large firms, and low BM firms, which tend to have around 3% corner solutions. Lastly, Table 1 presents the median as well as the first and third quartiles of the *t*-statistics for the individual firm *PINs* within each portfolio. The *t*-statistics indicate that *PINs* are precisely estimated (we compute the standard error of *PIN* using the delta method and the structural microstructure model's covariance matrix). Each portfolio's median *t*-statistic is greater than five. Furthermore, even the first quartiles are all typically larger than four. We conclude from these results that the *PIN* estimation procedure produced reasonable *PIN* values for each of the exchanges, and we see no evidence of problems with the *PIN* estimates for any particular group of stocks.

Finding proxies for information dissemination is a more difficult task because they are not available in the existing literature. We identify four proxies for information dissemination. Our first proxy for information

Table 1
Summary statistics for the probability of informed trade (*PIN*) estimated quarterly

This table reports the frequency of corner solutions for parameter *a* and summary statistics on *PIN* for *BM*, *SIZE*, and *PIN* portfolios. The parameter *a* and *PIN* are estimated using Easley, Hvidkjaer, and O'Hara (2002) model, for each quarter from 1983 to 2001. The parameter *a* denotes the probability of an information event. A corner solution occurs when the estimated parameter *a* is equal to one or zero. *PIN* is a composite variable measuring the probability of information-based trading. The *PIN* *t*-statistics are computed for the individual firm's *PIN* within each portfolio. The book-to-market ratio (*BM*) is the book common equity for the fiscal year ending in calendar year $t-1$, divided by year-end market value of equity in year $t-1$. *SIZE* is the year-end market value of equity for year $t-1$, in billions of US dollars.

	Corner solutions for *a*	*PIN*			*PIN* *t*-statistics		
		Q1	Median	Q3	Q1	Median	Q3
BM (%)							
Low 10	0.02	0.14	0.20	0.27	4.93	6.20	7.40
2nd 10	0.02	0.15	0.21	0.28	4.82	6.05	7.29
3rd 10	0.02	0.14	0.20	0.28	4.75	6.03	7.28
4th 10	0.01	0.15	0.21	0.30	4.57	5.87	7.22
5th 10	0.01	0.15	0.23	0.34	4.34	5.71	7.13
6th 10	0.01	0.16	0.24	0.37	4.28	5.68	7.11
7th 10	0.01	0.17	0.26	0.39	4.24	5.63	7.09
8th 10	0.01	0.19	0.29	0.45	4.16	5.60	7.11
9th 10	0.00	0.22	0.32	0.47	4.17	5.56	7.12
High 10	0.00	0.22	0.32	0.46	3.92	5.25	6.78
Size (%)							
Low 10	0.00	0.32	0.43	0.55	3.92	5.33	6.97
2nd 10	0.00	0.28	0.40	0.53	3.97	5.43	7.04
3rd 10	0.00	0.27	0.36	0.48	4.06	5.50	7.08
4th 10	0.00	0.24	0.31	0.43	4.22	5.63	7.16
5th 10	0.00	0.21	0.27	0.36	4.16	5.52	7.03
6th 10	0.00	0.19	0.24	0.32	4.38	5.77	7.14
7th 10	0.01	0.17	0.22	0.28	4.38	5.71	7.11
8th 10	0.01	0.15	0.19	0.25	4.50	5.81	7.15
9th 10	0.02	0.13	0.17	0.23	4.63	5.88	7.12
High 10	0.04	0.10	0.14	0.19	5.10	6.25	7.47
PIN (%)							
Low 10	0.03	0.11	0.15	0.20	4.74	5.97	7.20
2nd 10	0.02	0.13	0.17	0.23	4.57	5.84	7.13
3rd 10	0.01	0.15	0.19	0.25	4.53	5.82	7.13
4th 10	0.01	0.17	0.21	0.28	4.45	5.75	7.07
5th 10	0.01	0.18	0.23	0.30	4.40	5.69	7.04
6th 10	0.00	0.21	0.26	0.34	4.26	5.66	7.07
7th 10	0.00	0.24	0.30	0.39	4.31	5.75	7.25
8th 10	0.00	0.26	0.35	0.45	4.14	5.61	7.21
9th 10	0.00	0.28	0.40	0.51	4.08	5.59	7.24
High 10	0.00	0.35	0.48	0.60	4.04	5.61	7.39

dissemination, *CDUM*, is a dummy equal to one if a firm has a credit rating. We argue that *CDUM* is a proxy for the degree of information dissemination because firms with credit ratings are analyzed by rating agencies, which then distribute information about the firms. Thus, firms with credit ratings should have more widely disseminated information than firms without credit ratings. In fact, evidence in Jorion, Liu, and Shi (2005) suggests that, post-Regulation FD, credit rating agencies disseminate information that would otherwise be narrowly held. We collect the credit rating data from the quarterly Compustat files.

Our second proxy for information dissemination, *SDUM*, is a dummy equal to one if the firm's institutional ownership percentage is higher than the full sample median ownership fraction. The results are similar if we use the fraction of institutional ownership instead of *SDUM* as a proxy for information dissemination.

The intuition for this proxy is that institutional owners are more likely to be informed than non institutional owners. Thus, the larger a firm's institutional ownership fraction, the larger the fraction of informed investors. We collect the institutional ownership data from the Thomson Financial CDA/Spectrum Institutional Money Manager (13f) Holdings database.

Our third proxy for information dissemination, *ADUM*, is a dummy equal to one if the firm is covered by analysts. The intuition behind this proxy is that, if a firm is covered by analysts, information is more widely distributed to potentially informed traders. In this context, analysts can be viewed in two ways. First, analysts can be viewed as agents who analyze information and produce private signals which they then disburse to investors. Investors who receive the signals are then informed investors. Second, analysts can be viewed as dispensers of information for the company. Under this view, analysts are agents who pass private signals to investors, who become more informed as a result of receiving the signal. Thus, we do not require that analysts necessarily produce information. Instead, we assume only that analysts spread information, regardless of its source. As Easley, Hvidkjaer, and O'Hara (2002) and Merton (1987) note, in either case, increased analyst coverage would tend to reduce the cost of capital by increasing the dissemination of information. We collect the analyst coverage information from the Institutional Brokers' Estimate System (I/B/E/S). *ADUM* is equal to one if the firm has analysts listed in I/B/E/S. Firms that do not have analysts listed in I/B/E/S have *ADUM* equal to zero.

Our fourth proxy for information asymmetry, *NEWS*, is the number of days in a particular month that a given firm is mentioned in the press.[5] The intuition behind this proxy is that information about firms is more widely disseminated when the firm is covered by the press. Thus, firms that are mentioned more often in the press are firms for which more individuals are informed about the firm. We employ a database containing dates on which a random sample of stocks in the Center for Research in Securities Prices (CRSP) database were mentioned in the press between 1980 and 2000. The data were compiled by Wesley Chan and described in detail in Chan (2003). The database contains between 20% and 25% of the firms in the CRSP database. The database records each day each firm in the sample is mentioned in publications that are covered in the Dow Jones Interactive Publications Library. The database records the existence of news on a given day, not the number of articles mentioning the firm.

Table 2 presents the average and standard deviation for *PIN*, *ADUM*, *SDUM*, *CDUM*, and *NEWS* as well as book-to-market and size for each year in the sample. All of the information dissemination proxies decline dramatically in 1987, the year that the Nasdaq firms enter the sample. This reflects the fact that Nasdaq firms are less likely to have credit ratings, significant institutional ownership or analyst and press coverage than NYSE or Amex firms. The *NEWS* variable exists only for a random subset of the sample. Thus, the averages in Table 2 represent the number of days per month that an average firm is mentioned in the press.

To analyze the change in the cost of capital associated with the implementation of Regulation FD, we begin by computing the *PIN*, *ADUM*, *SDUM*, *CDUM*, and *NEWS* for each stock in the sample for which data are available for a period immediately preceding the passage of Regulation FD and the period immediately following implementation of Regulation FD. The post-event period for this study runs from October 23, 2000 to January 23, 2001. The post-event period was chosen to end when decimalization came into effect for NYSE/Amex. We stop the post-event period at this point so we can avoid having to disentangle the effects of decimalization on *PIN*. Zhao and Chung (2006) find that *PINs* are significantly larger in the post-decimalization period. Furthermore, we wish to avoid contaminating the effects of Regulation FD with the effects of the Sarbanes-Oxley Act, which took effect in 2002. The pre-event period was chosen to mirror the post-event period in length. The pre-event period runs from July 21, 2000 to October 21, 2000. We exclude all stocks involved in the NYSE decimalization pilot program (159 stocks) because these stocks experienced the change to decimal trading increments before the rest of the market and thus have pre- and post-event periods contaminated by decimalization.

For each stock we compute pre- and post-event *PINs* using data for the dates listed above. Table 3 presents the fraction of corner solutions and the first quartile, median, and third quartile of the ratio of firms' *PIN* to their standard errors. The results are similar to the full sample in the fraction of corner solutions for a. Furthermore, for each group of stocks, the *PIN* estimates are large relative to their standard errors. Thus, it

[5] We thank the referee for suggesting this proxy.

Table 2
Summary statistics

This table presents the yearly cross-sectional mean and standard deviation for some key variables in our sample. All statistics are calculated for the entire sample of NYSE, Amex and Nasdaq firms. *SIZE* is the year-end market value of equity for year $t-1$, in billion dollars. The book-to-market ratio (*BM*) is the book common equity for the fiscal year ending in calendar year $t-1$, divided by year-end market value of equity in year $t-1$. The probability of informed trading (*PIN*) is estimated using Easley, Hvidkjaer, and O'Hara (2002) model, for each quarter from 1984 to 2001. *ADUM* is equal to one if a firm has one or more analysts, and zero otherwise. The analyst coverage data begin in 1985, so *ADUM* cannot be calculated for 1984. *SDUM* is equal to one if the fraction of shares held by large institutions exceeds the median level for the entire sample, and zero otherwise. *CDUM* is equal to one if a firm has a credit rating, and zero otherwise. The credit rating data being in 1985, therefore *CDUM* cannot be calculated for 1984. *NEWS* is the number of days in a month that a particular firm is mentioned in publications that are covered by Dow Jones Interactive Publications Library. Chan's news database ends in 2000, therefore *NEWS* cannot be calculated for 2001.

Year	Number of firms	*SIZE*		*BM*		*PIN*		*CDUM*		*ADUM*		*SDUM*		*NEWS*	
		Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Average	5,086	1.016	5.241	0.801	0.984	0.298	0.129	0.181	0.376	0.587	0.465	0.464	0.474	0.459	1.312
1984	2,067	0.711	2.665	0.784	0.452	0.288	0.135	–	–	–	–	0.470	0.477	0.371	1.188
1985	2,014	0.775	2.679	0.910	0.569	0.279	0.125	0.261	0.439	0.700	0.446	0.508	0.477	0.401	1.255
1986	1,953	0.912	3.014	0.768	0.461	0.267	0.116	0.323	0.458	0.701	0.445	0.544	0.471	0.391	1.232
1987	4,415	0.579	2.384	0.702	0.566	0.301	0.116	0.179	0.376	0.502	0.469	0.388	0.463	0.271	0.829
1988	4,593	0.505	2.198	0.932	1.600	0.324	0.126	0.177	0.379	0.491	0.465	0.383	0.463	0.277	0.892
1989	4,372	0.583	2.491	0.797	0.669	0.314	0.127	0.182	0.382	0.537	0.467	0.426	0.469	0.311	0.936
1990	4,159	0.647	2.711	0.811	1.074	0.324	0.131	0.178	0.379	0.546	0.469	0.453	0.478	0.355	1.064
1991	4,058	0.682	3.038	1.273	2.124	0.310	0.127	0.174	0.376	0.556	0.470	0.469	0.476	0.372	1.100
1992	4,984	0.714	3.308	0.842	1.318	0.311	0.134	0.143	0.347	0.494	0.479	0.418	0.473	0.378	1.090
1993	5,752	0.719	3.266	0.728	1.154	0.300	0.123	0.142	0.343	0.510	0.478	0.419	0.471	0.418	1.173
1994	6,177	0.766	3.387	0.645	0.620	0.304	0.124	0.140	0.343	0.550	0.474	0.438	0.475	0.447	1.228
1995	6,454	0.712	3.322	0.722	0.641	0.298	0.117	0.143	0.346	0.569	0.473	0.461	0.475	0.540	1.436
1996	6,659	0.941	4.555	0.649	0.710	0.296	0.116	0.144	0.347	0.604	0.467	0.463	0.473	0.574	1.471
1997	7,125	1.108	5.678	0.612	0.792	0.292	0.123	0.152	0.354	0.629	0.463	0.485	0.476	0.581	1.582
1998	7,280	1.376	7.563	0.559	0.558	0.293	0.135	0.168	0.364	0.640	0.461	0.489	0.476	0.653	1.768
1999	6,853	1.854	12.057	0.735	0.882	0.288	0.137	0.181	0.381	0.662	0.454	0.500	0.477	0.708	1.971
2000	6,484	2.308	15.122	0.747	0.861	0.284	0.146	0.188	0.387	0.651	0.456	0.504	0.479	0.759	2.095
2001	6,142	2.398	14.892	1.204	2.654	0.300	0.156	0.206	0.401	0.632	0.464	0.533	0.480	–	–

Table 3
Summary statistics for *PIN*/*SE*(*PIN*) estimated around Regulation FD

This table reports the frequency of corner solutions for parameter *a* and summary statistics for the probability of informed trading (*PIN*) *t*-statistic. The parameter *a* and *PIN* are estimated for the three month period before Regulation FD (July 21, 2000 to October 21, 2000) and the three month period after Regulation FD (October 23, 2000 to January 23, 2001), using Easley, Hvidkjaer, and O'Hara (2002) model. The parameter *a* denotes the probability of an information event. A corner solution occurs when the estimated *a* is equal to one or zero. *PIN* is a composite variable measuring the probability of information-based trading. The *PIN* *t*-statistics are computed for the individual firm's *PIN* within each portfolio. The book-to-market ratio (*BM*) is the book common equity for the fiscal year ending in calendar year $t-1$, divided by year-end market value of equity in year $t-1$. *SIZE* is the year-end market value of equity for year $t-1$, in billions of US dollars.

	Corner solutions for *a*		*PIN* *t*-statistics before FD				*PIN* *t*-statistics after FD			
	Before	After	Average	Q1	Median	Q3	Average	Q1	Median	Q3
BM (%)										
Low 10	0.04	0.05	7.00	5.20	6.26	7.59	7.22	5.72	6.95	8.06
2nd 10	0.03	0.02	6.74	5.16	6.44	7.68	7.28	5.86	6.79	7.93
3rd 10	0.04	0.01	6.79	5.11	6.44	7.79	6.98	5.71	6.79	8.02
4th 10	0.02	0.01	6.81	5.35	6.56	7.99	7.71	5.87	6.97	8.06
5th 10	0.00	0.01	6.52	5.11	6.40	7.90	7.11	5.66	6.87	8.39
6th 10	0.00	0.01	6.60	4.94	6.44	8.01	7.12	5.42	7.07	8.40
7th 10	0.01	0.00	9.68	5.20	6.61	8.00	7.02	5.59	6.90	8.49
8th 10	0.00	0.00	6.64	4.85	6.61	8.24	7.03	5.39	6.88	8.37
9th 10	0.00	0.00	6.66	4.95	6.55	8.06	7.15	5.55	7.09	8.60
High 10	0.00	0.00	6.41	4.53	6.20	7.95	6.69	4.90	6.64	8.51
SIZE (%)										
Low 10	0.00	0.00	6.98	5.08	6.84	8.52	7.48	5.60	7.63	9.53
2nd 10	0.00	0.00	6.85	5.12	6.77	8.45	7.19	5.39	7.12	8.87
3rd 10	0.00	0.00	6.66	4.74	6.75	8.34	7.18	5.63	7.24	8.67
4th 10	0.00	0.00	6.68	5.26	6.59	8.11	7.11	5.47	7.04	8.62
5th 10	0.00	0.00	6.39	4.72	6.17	7.88	6.93	5.37	6.85	8.26
6th 10	0.00	0.00	6.47	4.92	6.26	8.00	6.88	5.51	6.79	8.14
7th 10	0.00	0.00	6.49	5.11	6.35	7.61	6.65	5.46	6.52	7.78
8th 10	0.02	0.02	6.19	5.10	6.07	7.13	6.85	5.66	6.66	7.62
9th 10	0.02	0.02	9.39	5.15	6.25	7.40	7.47	5.66	6.68	7.52
High 10	0.10	0.07	8.18	5.45	6.45	7.67	7.83	5.88	6.89	7.99
PIN (%)										
Low 10	0.09	0.04	6.89	4.48	5.64	7.04	6.93	5.57	6.51	7.52
2nd 10	0.02	0.04	8.76	4.62	5.65	6.88	7.60	5.46	6.61	7.55
3rd 10	0.01	0.01	6.28	4.96	6.02	7.15	6.61	5.49	6.56	7.54
4th 10	0.01	0.01	6.21	4.81	5.95	7.14	6.50	5.42	6.48	7.46
5th 10	0.00	0.00	6.30	5.07	6.34	7.47	6.86	5.59	6.72	8.08
6th 10	0.00	0.00	6.40	5.09	6.31	7.53	7.06	5.63	6.96	8.46
7th 10	0.00	0.00	6.78	5.51	6.76	8.24	7.17	5.70	7.11	8.55
8th 10	0.00	0.00	7.20	5.53	7.21	8.81	7.35	5.77	7.37	8.91
9th 10	0.00	0.00	7.32	5.94	7.32	8.68	7.61	5.72	7.62	9.35
High 10	0.01	0.00	7.93	5.90	7.95	10.20	7.70	5.55	7.63	9.62

appears that *PINs* both before and after Regulation FD are relatively precisely estimated. In sum, we see no indication of problems with the *PIN* estimates in either the period before or the period after Regulation FD.

Analyst data, institutional ownership data, and credit-rating data are available only quarterly. This being the case, we use the quarterly data that most closely approximates the pre- and post-event period. Thus, the pre-event values for *ADUM*, *SDUM*, and *CDUM* are computed using data for the calendar quarter beginning in July 2000 and ending in September 2000. The post-event values for these variables are computed using data for the calendar quarter beginning in October 2000 and ending in December 2000. As the Chan database of news coverage ends in December 2000, the post-event values for *NEWS* are computed using data ending on December 31, 2000.

Table 4
Changes in the probability of informed trade (*PIN*) and information dissemination

This table reports the change *PIN* and various proxies for information dissemination around Regulation FD. We compare the three month period before Regulation FD (July 21, 2000 to October 21, 2000) to the three month period after Regulation FD (October, 23 2000 to January 23, 2001), for the sample of NYSE, Amex, and Nasdaq firms. The *PIN* is estimated following Easley, Hvidkjaer, and O'Hara (2002) model. *ADUM* is equal to one if a firm has one or more analysts, and zero otherwise. *SDUM* is equal to one if the fraction of shares held by large institutions exceeds the median level for the entire sample, and zero otherwise. *CDUM* is equal to one if a firm has credit rating, and zero otherwise. *NEWS* is the number of days in a month that a particular firm is mentioned in a publication that is covered by Dow Jones Interactive Publications Library. The average changes in *PIN*, *CDUM*, *ADUM*, *SDUM*, and *NEWS* are displayed with the corresponding *t*-statistics in parenthesis. The median changes in *PIN* are displayed with the corresponding *p*-values from Wilcoxan tests in parenthesis. The null hypothesis of the Wilcoxan test is that the median change in *PIN* is zero. The columns labeled "Chi-squared tests" display the frequency of rejection of the null hypothesis that the change in *PIN* is zero in a chi-squared test based on individual firm *PINs*.

Exchange	Number of firms	Average changes in					Median change in *PIN*	Chi-squared test significance level		
		PIN	*CDUM*	*ADUM*	*SDUM*	*NEWS*		1(%)	5(%)	10(%)
NYSE/AMEX	2,123	0.0026	0.0068	0.0098	−0.0024	−0.3454	0.53	0.05	0.09	0.13
		(0.83)	(3.75)	(2.54)	(−0.63)	(−1.25)	(0.12)			
NASDAQ	3,976	0.0092	0.0034	0.0176	0.0003	−0.4025	0.0075	0.04	0.08	0.11
		(5.43)	(2.84)	(5.02)	(0.07)	(−2.49)	(0.00)			

Table 4 presents a series of tests for changes in *PIN* around Regulation FD including tests for change in the average *PIN*, Wilcoxan tests for the change in the median *PIN*, and firm-level chi-squared tests for the change in *PIN*. The results show that the average NYSE/Amex firm experienced an increase in *PIN* between the pre- and post-event periods, although only the test for the median has a P-value that is close to significant at conventional levels. The average Nasdaq firm experienced a significant increase in *PIN*. In addition, Table 4 presents the results of individual firm chi-squared tests for the change in *PIN*.[6] The results show that the number of firms for which this change is significant is small, with 9% rejecting at the 5% level for the NYSE/Amex firms and 8% rejecting for the Nasdaq firms.

Table 4 shows mixed evidence with respect to the changes in the proxies for information dissemination. To see this note that the fraction of firms covered by analysts and the fraction of firms with credit ratings increased for both NYSE/Amex and Nasdaq firms. NYSE/Amex firms experienced decreases in the fraction of firms with large institutional positions, and Nasdaq firms experienced increases in the fraction of firms with large institutional positions, though neither of these changes is statistically significant. Both NYSE/Amex firms and Nasdaq firms experienced a decrease in press coverage after the implementation of the regulation, though the decrease is significant only for the Nasdaq firms.

The economic impact and the economic significance of these results are unclear, however, without further analysis. There are several reasons for this. First, because, for some of the proxies, the direction of the changes in information asymmetry and information dissemination offset one another in terms of their impact on the cost of capital, we must assess the net impact of the changes to make an inference about the validity of our hypothesis. Second, the changes outlined above do not allow us to make a judgement about the economic size of Regulation FD's effect. To make these judgments, we need to calculate the market 'prices' of information asymmetry and information dissemination so that we can calculate the direction and economic size of the net effect of the changes in Table 4 on the cost of capital. Lastly, we must account for other events that occurred in this time frame but have nothing to do with Regulation FD. In the analysis that follows, we estimate the impact of Regulation FD on the cost of capital to judge the economic impact of the regulation. Furthermore, we introduce controls for other events coincident with the implementation of Regulation FD.

[6] The chi-squared test statistic is computed as $\frac{(PIN_{\text{After},i}-PIN_{\text{Before},i})^2}{\sigma^2(PIN_{\text{After},i})+\sigma^2(PIN_{\text{Before},i})}$, where $\sigma^2(PIN_{\text{After},i})$ and $\sigma^2(PIN_{\text{Before},i})$ are the variances of the *PIN* estimators computed using the delta method.

3.2. Estimating the change in the cost of capital

To measure Regulation FD's impact on expected returns we estimate asset pricing models that include *PIN* and the proxies for information dissemination as well as beta, size, and book-to-market ratios. This model mirrors that employed by Easley, Hvidkjaer, and O'Hara (2002), except we explicitly account for the effects of information dissemination. Specifically, we estimate the following cross-sectional regression:

$$r_i = a + (\theta_1 + \theta_2 ID_i)PIN_i + \gamma_1\beta_i + \gamma_2 SIZE_i + \gamma_3 BM_i + e_i, \qquad (2)$$

where $ID_i \in \{ADUM_i, SDUM_i, CDUM_i, NEWS_i\}$.

In Eq. (2) we expect that $\theta_1 > 0$ and $\theta_2 < 0$. This reflects the intuition that increasing information asymmetry increases expected returns. At the same time, increasing the amount of information dissemination tends to reduce the premium uninformed traders demand for information asymmetry because prices become more informative as information is more widely distributed.[7]

We estimate the models separately to account for the fact that Nasdaq was primarily a dealer market during the estimation period. Furthermore, Nasdaq is known to double-count volume. These considerations could affect the Nasdaq *PIN* estimates, making them structurally different from the NYSE *PINs*.

The price and shares outstanding data to compute size come from CRSP. *SIZE* is the logarithm of the December market equity for year $t-1$. We follow Fama and French (1993) and compute the book-to-market ratio in June of year t using the book common equity (BE) for the fiscal year ending in calendar year $t-1$, divided by market value of the stock at the end of December of $t-1$. BE is the Compustat book value of stockholders' equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Depending on availability, we use redemption, liquidation, or par value (in that order) to estimate the book value of preferred stock. We eliminate negative BE firms. *BM* is the log of the book-to-market ratio. We compute the beta using the two step-procedure outlined in Fama and MacBeth (1973). Each month, we form 40 portfolios based on betas computed for the past 60 months. We then compute the full-period post-ranking betas for each portfolio and assign this beta to each firm in the portfolio. The return data come from CRSP.

For each month with the necessary data for all variables we run cross-sectional regressions of firm returns on beta, size, book-to-market, *PIN*, and *PIN* interacted with either *ADUM*, *SDUM*, *CDUM*, or *NEWS*. For the purposes of the regressions, for each month in the quarter, *ADUM*, *SDUM*, and *CDUM* are set equal to the value for the calendar quarter in which the month in question falls. For the NYSE/Amex regressions involving *PIN* and *SDUM*, the estimation period is January 1984 through December 2000. Because of the availability of data, the estimation period for the NYSE/Amex regressions involving *ADUM* and *CDUM* is January 1985 through December 2000. All Nasdaq regressions are estimated using data from January 1988 to December 2000 because the trade and quote data necessary to compute *PIN* are not available in ISSM for earlier years. Following Easley, Hvidkjaer, and O'Hara (2002), we employ the weighted least-squares procedure outlined by Litzenberger and Ramaswamy (1979) to obtain efficient coefficient estimates.

Table 5 contains the estimated coefficients from the above specifications as well as a specification that includes *PIN* only. Consistent with Easley, Hvidkjaer and O'Hara (2002), the estimated coefficients on *PIN* are positive, economically significant, and large relative to their standard errors in all of the regressions. For NYSE/Amex firms, the estimates indicate that a 10 percentage point increase in *PIN* is associated with an approximately 90 basis point increase in the annual cost of capital. This is consistent with the results in Easley, Hvidkjaer, and O'Hara (2002), if somewhat smaller, perhaps owing to a different sample period and the inclusion of the Amex stocks in our sample. The estimates for Nasdaq are closer to those found in Easley, Hvidkjaer, and O'Hara (2002) and indicate that a 10 percentage point increase in *PIN* is associated with a nearly 250 basis point increase in the cost of capital. The coefficient on *PIN* increases somewhat after including the interaction with *ADUM*, *SDUM*, *CDUM*, and *NEWS* and remains significant. The coefficient on the interaction terms are negative, consistent with their interpretation as proxies for information dissemination.

[7]This specification and the signs of the coefficients can be rigorously justified by considering the formula for expected return in Easley and O'Hara (2004). Approximating the expected return formula via a Taylor series expansion yields an expression involving the sum of the information asymmetry parameter and an interaction between the information asymmetry and information dissemination parameter.

Table 5
Fama and MacBeth regression results

The following table contains time-series averages of the monthly estimated coefficients in cross-sectional regressions involving NYSE and Amex firms, as well as for Nasdaq firms, using the weighted least-square methodology suggested by Litzenberger and Ramaswamy (1979). The dependent variable is the portfolio monthly return. Betas are post-ranking betas estimated using 40 beta portfolios. *SIZE* is the logarithm of the December market equity for year $t-1$. *BM* is the logarithm of book value divided by market value for year $t-1$. *ADUM* is equal to one if a firm has a one or more analysts and zero otherwise. *SDUM* is equal to one if the fraction of shares held by large institutions exceeds the median level for the entire sample, and zero otherwise. *CDUM* is equal to one if a firm has a credit rating, and zero otherwise. *NEWS* is the number of days in a month that a particular firm is mentioned in a publication that is covered by Dow Jones Interactive Publications Library. The *t*-statistics are inside parenthesis.

Independent variable	NYSE/Amex firms						Nasdaq firms					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Beta	−0.0001	−0.0001	0.0000	0.0000	−0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(−1.91)	(−1.89)	(−0.76)	(−0.84)	(−1.90)	(−0.80)	(−1.36)	(−1.19)	(−1.07)	(−1.19)	(−1.20)	(−1.15)
SIZE	0.0015	0.0019	0.0019	0.0018	0.0019	0.0018	0.0008	0.0019	0.0021	0.0020	0.0020	0.0019
	(3.01)	(3.80)	(3.45)	(3.10)	(3.79)	(3.24)	(1.01)	(2.11)	(2.41)	(2.31)	(2.37)	(2.16)
BM	0.0028	0.0029	0.0026	0.0026	0.0029	0.0026	0.0092	0.0088	0.0089	0.0088	0.0088	0.0088
	(3.28)	(3.31)	(2.99)	(2.87)	(3.38)	(2.86)	(6.16)	(5.78)	(5.99)	(5.79)	(5.78)	(5.77)
PIN		0.0070	0.0083	0.0077	0.0077	0.0079		0.0191	0.0196	0.0192	0.0199	0.0196
		(2.64)	(2.56)	(2.11)	(2.36)	(2.65)		(2.89)	(2.96)	(2.83)	(2.94)	(2.94)
PIN ∗ *CDUM*			−0.0065						−0.0133			
			(−2.15)						(−2.92)			
PIN ∗ *ADUM*				−0.0002						−0.0007		
				(−0.04)						(−0.22)		
PIN ∗ *SDUM*					−0.0013						−0.0020	
					(−0.43)						(−0.55)	
PIN ∗ *NEWS*						−0.0015						−0.0029
						(−2.42)						(−3.08)

The coefficients on *CDUM* and *NEWS* are highly significant for both exchanges, while those on *SDUM* and *ADUM* are not, indicating that the *CDUM* and *NEWS* coefficients are more precisely estimated than the *ADUM* and *SDUM* coefficients.[8]

Before proceeding, note that the each of the information dissemination proxies could also be a proxy for information asymmetry. At least with respect to analyst coverage, the extant literature is mixed on this point. For instance, Brennan and Subrahmanyam (1995) find that greater analyst coverage tends to reduce adverse selection costs. Thus, *ADUM* could be a proxy for *PIN*. However, Easley, O'Hara, and Paperman (1998) find that analyst coverage is not a good proxy for *PIN*. Table 6 presents the correlations between *PIN* and the information dissemination proxies for our sample. Each of the pair-wise correlations between *PIN* and the information dissemination proxies is negative and between about 0.1 and 0.5. Thus, the information dissemination proxies could be simply capturing variation in *PIN*, which would explain the negative signs on the interaction terms in the regressions in Table 5.

To examine the possibility that *ADUM*, *CDUM*, *SDUM*, and *NEWS* are weak proxies for *PIN* instead of information dissemination, we reestimate the regression in Table 5 however, we include a PIN^2 term in the regression. To understand the logic behind the inclusion of PIN^2, suppose that each of the information dissemination proxies is simply a noisy proxy for *PIN*. For instance, assume that

$$CDUM_i = bPIN_i + u_i, \tag{3}$$

[8]Because the sum of the *PIN* and *PIN* × *CDUM* coefficient estimates are small for NYSE/Amex firms, it could appear that *PIN* is priced only for firms without credit ratings. To address this possibility we run the Fama and MacBeth regressions separately for firms with and without credit ratings and find that the coefficients on *PIN* are not statistically different. Apparently, credit ratings are correlated with SIZE and BM such that, when the sample is separated into firms with and without credit ratings, the coefficient on PIN for both groups is similar. The results of this regression are available upon request.

Table 6
Correlation between the probability of informed trade (*PIN*) and information dissemination proxies

This table reports the correlation coefficients between the analyst dummy (*ADUM*), the share dummy (*SDUM*), the credit rating dummy (*CDUM*), *NEWS* and probability of informed trading (*PIN*), estimated quarterly using Easley, Hvidkjaer, and O'Hara (2002) model. The correlation coefficients are calculated for the whole sample of NYSE, Amex, and Nasdaq firms, for the period from 1985 to 2000. *ADUM* is equal to one if a firm has one or more analysts, and zero otherwise. *SDUM* is equal to one if the fraction of shares held by large institutions exceeds the median level for the entire sample, and zero otherwise. *CDUM* is equal to one if a firm has a credit rating, and zero otherwise. *NEWS* is the number of days in a month that a particular firm is mentioned in a publication that is covered by Dow Jones Interactive Publications Library. The *p*-values are in parenthesis below the correlation coefficients.

	PIN	*ADUM*	*SDUM*	*CDUM*	*NEWS*
Panel A NYSE/Amex					
PIN	1	−0.5018	−0.3880	−0.3426	−0.0986
		(<.0001)	(<.0001)	(<.0001)	(<.0001)
ADUM	−0.5018	1	0.5251	0.3754	0.0905
	(<.0001)		(<.0001)	(<.0001)	(<.0001)
SDUM	−0.3880	0.5251	1	0.3270	0.0733
	(<.0001)	(<.0001)		(<.0001)	(<.0001)
CDUM	−0.3426	0.3754	0.3270	1	0.1107
	(<.0001)	(<.0001)	(<.0001)		(<.0001)
NEWS	−0.0986	0.0905	0.0733	0.1107	1
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	
Panel B Nasdaq					
PIN	1	−0.3744	−0.2753	−0.1745	−0.1106
		(<.0001)	(<.0001)	(<.0001)	(<.0001)
ADUM	−0.3744	1	0.4731	0.2083	0.1031
	(<.0001)		(<.0001)	(<.0001)	(<.0001)
SDUM	−0.2753	0.4731	1	0.2343	0.0857
	(<.0001)	(<.0001)		(<.0001)	(<.0001)
CDUM	−0.1745	0.2083	0.2343	1	0.0872
	(<.0001)	(<.0001)	(<.0001)		(<.0001)
NEWS	−0.1106	0.1031	0.0857	0.0872	1
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	

where u is that portion of *CDUM* that is not related to *PIN*. If u_i is unrelated to cross-sectional variation in information dissemination, θ_2 would be nonzero only if there was a nonlinear relation between expected returns and *PIN*. Therefore, if *CDUM* is simply a weak proxy for *PIN*, we expect that including a PIN^2 term in the regression would result in an estimated coefficient of zero for $CDUM \times PIN$.

Table 7 presents the results of the Fama and MacBeth regressions, including PIN^2. For each of the regressions, the coefficient on the information dissemination variables is nearly unchanged. For instance, the coefficient on the $CDUM \times PIN$ for NYSE/Amex firms remains −0.0065 and significant and for Nasdaq firms changes from −0.0133 to −0.0136 while remaining significant. From this we conclude that the information dissemination proxies are not simply noisy proxies for *PIN*. In the analysis that follows, we compute the cost of capital changes using the results in Table 5. The results are essentially identical if we instead compute the changes in the cost of capital using the results in Table 7.

We compute the change in cost of capital resulting from changes in firms' information environments before and after Regulation FD as

$$\Delta r_i = \theta_1[PIN_{\text{After},i} - PIN_{\text{Before},i}] + \theta_2[PIN_i \times ID_{\text{After},i} - PIN_i \times ID_{\text{Before},i}], \tag{4}$$

where $ID_i \in \{ADUM, SDUM, CDUM, NEWS\}$.

Other events occurred during the period coincident with the implementation of Regulation FD that could impact *PIN* and information dissemination but have nothing to do with the regulation. Therefore, we do not wish to attribute the entire change in cost of capital resulting from changes in firms' information environments in this period to Regulation FD. To control for other contemporaneous events, we estimate the following

Table 7
Fama and MacBeth regression results with the probability of informed trade (*PIN*) squared

The following table contains monthly time-series averages of the estimated coefficients from cross-sectional regressions involving NYSE and Amex firms, as well as for Nasdaq firms, using the weighted least-squares methodology suggested by Litzenberger and Ramaswamy (1979). The dependent variable is the portfolio monthly return. Betas are post-ranked betas estimated using 40 beta portfolios. *SIZE* is the logarithm of the December market equity for year $t-1$. *BM* is the logarithm of book value divided by market value for year $t-1$. *ADUM* is equal to one if a firm has one or more analysts, and zero otherwise. *SDUM* is equal to one if the fraction of shares held by large institutions exceeds the median level for the entire sample, and zero otherwise. *CDUM* is equal to one if a firm has credit rating, and zero otherwise. *NEWS* is the number of days in a month that a particular firm is mentioned in a publication that is covered by Dow Jones Interactive Publications Library. The *t*-statistics are inside parenthesis.

Independent variable	NYSE/Amex firms						Nasdaq firms					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Beta	−0.0001	−0.0001	0.0000	0.0000	−0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(−1.91)	(−1.89)	(−0.78)	(−0.85)	(−1.91)	(−0.82)	(−1.36)	(−1.19)	(−1.13)	(−1.23)	(−1.26)	(−1.21)
SIZE	0.0015	0.0019	0.0019	0.0017	0.0019	0.00176	0.0008	0.0019	0.0021	0.0020	0.0020	0.001885
	(3.01)	(3.80)	(3.52)	(3.16)	(3.92)	(3.28)	(1.01)	(2.11)	(2.38)	(2.33)	(2.35)	(2.13)
BM	0.0028	0.0029	0.0026	0.0025	0.0029	0.0025	0.0092	0.0088	0.0089	0.0088	0.0088	0.0088
	(3.28)	(3.31)	(2.98)	(2.86)	(3.39)	(2.84)	(6.16)	(5.78)	(6.01)	(5.81)	(5.81)	(5.79)
PIN		0.0070	0.0115	0.0092	0.0107	0.0092		0.0191	0.0315	0.0314	0.0318	0.0317
		(2.64)	(1.44)	(1.13)	(1.54)	(1.23)		(2.89)	(2.75)	(2.81)	(2.83)	(2.75)
PIN^2			−0.0050	−0.0024	−0.0042	−0.0028			−0.0186	−0.0190	−0.0188	−0.0186
			(−0.45)	(−0.23)	(−0.45)	(−0.26)			(−1.45)	(−1.55)	(−1.51)	(−1.46)
PIN ∗ *CDUM*			−0.0065						−0.0136			
			(−2.13)						(−2.98)			
PIN ∗ *ADUM*				−0.0002						−0.0017		
				(−0.05)						(−0.52)		
PIN ∗ *SDUM*					−0.0016						−0.0025	
					(−0.51)						(−0.70)	
PIN ∗ *NEWS*						−0.0015						−0.0030
						(−2.33)						(−3.18)

cross-sectional regression:

$$\Delta r_i = c_0 + c_1 \Delta VOL_i + c_2 \Delta LARGE_i + c_3 HIGHTECH_i + c_5 SIZE_i + c_6 BM_i + c_7 PIN_i + w_i. \tag{5}$$

The term ΔVOL is the change in average share volume (expressed in units of ten million shares) before and after Regulation FD, and $\Delta LARGE$ is the change in the number of trades involving more than ten thousand shares before and after the regulation (expressed in units of one hundred trades). *HIGHTECH* is a dummy variable equal to one if a firm is classified as being in the technology industry according to the ten Fama and French industry classifications. ΔVOL and $\Delta LARGE$ are meant to capture changes in market that occurred in the same time period as the implementation of Regulation FD, such as the abrupt price declines in Internet-related stocks, that could have impacted market volume and thus *PIN* and the information dissemination proxies but are not the result of Regulation FD. We include *HIGHTECH* to account for the fact that the collapse of the Internet bubble could have had effects on *PIN* and the information dissemination proxies that are not captured by the volume variables.

We include *SIZE*, *BM*, and *PIN* in the regression to assess the cross-sectional determinants of Regulation FD's effect on firms' costs of capital. *SIZE* and *BM* are the logarithm of the firm's size and book-to-market ratio at the end of 1999. The value of *PIN* in the regression is computed using data from the period April through June 2000. All of the explanatory variables, except the dummy variables, are demeaned. Therefore, the constant in this regression reflects the change in the cost of capital purged of effects not related to Regulation FD and for firms with average *SIZE*, *BM*, and *PIN*.

Table 8 contains the results for two versions of the above regression and the average unadjusted change in the cost of capital for the NYSE/Amex and Nasdaq subsamples and for each of the information dissemination

Table 8
Firm level cross-sectional cost of capital changes

The table reports the estimated coefficients of firm-level cross-sectional regressions. The dependent variable is the change in firms' average cost of capital resulting from changes in the probability of informed trade (*PIN*) and a proxy for information dissemination, from the period three months before Regulation FD to the period three months after Regulation FD. The change in firms' average cost of capital is calculated using the Fama and MacBeth average Regression coefficients from Regression (3) in Table 5 multiplied by the changes in *PIN* and credit rating dummy (*CDUM*), or from Regression (4) in Table 5 multiplied by the changes in *PIN* and analyst dummy (*ADUM*), or from Regression (5) in Table 5 multiplied by the changes in *PIN* and institutional share dummy (*SDUM*), or from Regression (6) in Table 5 multiplied by the changes in *PIN* and *NEWS*. The change in cost of capital is annualized. The explanatory variable ΔVOL is the change in firms' average monthly trading volume, from the period three months before Regulation FD to the period three months after Regulation FD, expressed in units of ten million shares. The explanatory variable $\Delta LARGE$ is the change in firms' average number of trades with ten thousand shares or more each month, from the period three months before Regulation FD to the period three months after Regulation FD, expressed in units of one hundred trades. *SIZE* is the logarithm of the market value of equity for year-end 1999. *BM* is the logarithm of the ratio of book equity value ending in 1999 to the market value of equity ending in 1999. *PIN* is estimated using data from the second quarter of 2000. We also include a dummy variable, *HIGHTECH*, that is equal to one if the firm is involved in a high technology industry. All the explanatory variables except dummies are demeaned. The *t*-statistics are below regression coefficients inside parenthesis.

Independent variable	*ADUM*			*CDUM*			*SDUM*			*NEWS*		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
NYSE/Amex: information dissemination proxy												
Constant	0.0001	−0.0006	−0.0006	0.0001	−0.0006	−0.0007	0.0001	−0.0006	−0.0006	−0.0009	0.0000	0.0000
	(0.45)	(−1.59)	(−1.60)	(0.30)	(−1.37)	(−1.51)	(0.29)	(−1.48)	(−1.56)	(−0.49)	(−0.01)	(−0.01)
DVOL			0.0002			0.0014			0.0011			−0.0180
			(0.34)			(1.83)			(1.56)			(−4.02)
DLARGE			−0.0003			−0.0016			−0.0013			0.0185
			(−0.74)			(−3.40)			(−3.00)			(7.45)
SIZE		0.0001	0.0002		−0.0001	0.0002		0.0000	0.0002		0.0008	−0.0015
		(0.79)	(1.07)		(−0.32)	(0.97)		(−0.18)	(0.97)		(0.69)	(−1.32)
BM		0.0003	0.0003		0.0003	0.0003		0.0003	0.0003		−0.0002	0.0005
		(0.76)	(0.76)		(0.77)	(0.72)		(0.86)	(0.79)		(−0.10)	(0.25)
PIN		−0.0029	−0.0023		−0.0053	−0.0022		−0.0049	−0.0022		0.0276	−0.0068
		(−1.24)	(−0.92)		(−2.01)	(−0.79)		(−1.98)	(−0.88)		(1.67)	(−0.44)
HIGHTECH			Yes			Yes			Yes			Yes
R^2	0.000	0.003	0.004	0.000	0.004	0.015	0.000	0.004	0.013	0.001	0.010	0.201
Number of observations	1,733	1,511	1,511	1,733	1,511	1,511	1,733	1,511	1,511	369	324	324
Nasdaq: information dissemination proxy												
Constant	0.0017	0.0013	0.0010	0.0018	0.0015	0.0012	0.0019	0.0016	0.0013	0.0013	−0.0009	0.0026
	(3.92)	(2.37)	(1.51)	(4.13)	(2.76)	(1.88)	(4.33)	(2.88)	(2.01)	(0.73)	(−0.46)	(1.13)
DVOL			0.0018			0.0029			0.0028			−0.0283
			(1.75)			(2.89)			(2.70)			(−5.23)
DLARGE			−0.0022			−0.0034			−0.0033			0.0449
			(−1.85)			(−2.92)			(−2.75)			(5.68)
SIZE		−0.0019	−0.0017		−0.0016	−0.0014		−0.0016	−0.0014		0.0000	−0.0017
		(−4.50)	(−4.01)		(−3.88)	(−3.29)		(−3.89)	(−3.31)		(−0.01)	(−1.04)
BM		−0.0005	−0.0004		−0.0004	−0.0003		−0.0004	−0.0004		0.0015	0.0007
		(−0.96)	(−0.73)		(−0.78)	(−0.63)		(−0.86)	(−0.72)		(0.72)	(0.34)
PIN		−0.0197	−0.0188		−0.0179	−0.0171		−0.0187	−0.0179		0.0105	0.0044
		(−4.93)	(−4.63)		(−4.55)	(−4.27)		(−4.63)	(−4.35)		(0.67)	(0.28)
HIGHTECH			Yes			Yes			Yes			Yes
R^2	0.000	0.013	0.014	0.000	0.011	0.014	0.000	0.012	0.015	0.000	0.004	0.052
Number of observations	3,489	2,911	2,910	3,489	2,911	2,910	3,489	2,911	2,910	792	688	688

proxies. For each of the information dissemination proxies, the NYSE/Amex point estimates of the cost of capital change are small, typically around a six basis point decrease, and statistically insignificant. For the Nasdaq subsample with *CDUM* as the information dissemination proxy, the average unadjusted cost of capital change is 17 basis points and is highly significant. Including the controls in the regression yields estimates for the cost of capital change of 13 basis points and ten basis points, but the latter is significant only at the 12% level. Using *ADUM* as the information dissemination proxy, the unadjusted change in the cost of capital is 18 basis points, with a *t*-statistic of 4.13. After accounting for the controls, the estimated change in the cost of capital is between 12 and 15 basis points, with both estimates significant at conventional levels. The cost of capital change estimates computed using *SDUM* as the information dissemination proxy include an unadjusted change of 19 basis points and adjusted estimates of 16 and 13 basis points. All three estimates are significant at conventional levels. The unadjusted cost of capital change for *NEWS* is 13 basis points, but it is not significant. The adjusted change estimates are a decrease of nine basis points and an increase of 26 basis points, though neither is close to significant. However, the sample of firms for which the *NEWS* variable was available is between one-third and one-fourth of the sample for the other proxies. The average of all of the Nasdaq estimates is around 13 basis points. Thus, the evidence of cost of capital change is somewhat mixed for Nasdaq firms. On the one hand, eight of the 12 change estimates in Table 8 are positive and significant. On the other hand, the only proxies for information dissemination that have a significant coefficient in the Fama and MacBeth regressions (*NEWS* and *CDUM*) have estimates of the cost of capital change in the regression that includes all of the controls that are statistically insignificant at the usual significance levels.

In any event, the cost of capital changes, even for Nasdaq firms, do not appear to be large in an economic sense. However, to the extent that the change amounts to a permanent increase in discount rates, price effect of the change is potentially large. Therefore, one way to judge the economic size of this estimate is to consider the price impact that a permanent 13 basis point increase in the discount rate would have on a typical stock. This can be done using the results in Vuolteenaho (2002). Vuolteenaho (2002) implements a Campbell and Shiller log-linear decomposition of the variance of individual stock returns. The Campbell and Shiller decomposition uses the intuition of the familiar dividend discount model to represent the log of a stock's price as

$$p_t \approx \sum_{l=0}^{\infty} \rho^l \mathrm{E}[d_{t+l}] - \sum_{l=0}^{\infty} \rho^l \mathrm{E}[r_{t+l}], \tag{6}$$

where ρ is the discount factor emerging from the linearization, d_{t+l} is the dividend at time $t+l$, and r_{t+l} is the stock's return at time $t+l$.[9] The intuition behind the decomposition is that stock prices change because of either changes in expectations about future dividends (cash flow news) or changes in expectations about future discount rates (expected return news). Vuolteenaho (2002) finds that a typical stock in a typical month experiences price changes from revisions in expectations about future discount rates of between 40 basis points and 4% per month. As part of this calculation, he estimates that $\rho = 0.967$. In this context, assuming Regulation FD had no effect on future dividends, then the percentage price change from the 13 basis point increase in future expected discount rates would be

$$-\sum_{l=0}^{\infty} \rho^l \Delta \mathrm{E}[r_{t+l}] = -\sum_{l=0}^{\infty} (0.967)^l 0.0013 \approx -3\%. \tag{7}$$

Thus, if Regulation FD was a complete surprise to the market in the month it was implemented and if the market expected the regulation to permanently increase future expected returns by 13 basis points for the typical Nasdaq firm, then expected return news resulting from the regulation would have been about 3%, or about the same magnitude as the expected return news in a typical month.

The results in Table 8 also indicate considerable cross-sectional variation in the cost of capital changes even within the NYSE/Amex and Nasdaq subsamples. Evidence for this variation can be found by examining the coefficients on *SIZE*, *BM*, and *PIN* in the regressions. For the NYSE/Amex firms, there appears to be little or no relation between size and the cost of capital change. For Nasdaq firms, however, a firm 1% larger than average would have a cost of capital change around 14 basis points smaller than the average Nasdaq firm. The same is true of the relation between the cost of capital change and *PIN*. That is, little relation exists between the cost of capital change and *PIN* for NYSE/Amex firms, but a large, statistically significant negative relation for Nasdaq firms. For Nasdaq firms, a firm whose *PIN* was 10 percentage points larger than Nasdaq average

[9] For a complete derivation of the log-linear decomposition see Campbell (1991) and Campbell and Ammer (1993).

Table 9
Time-trend regression for quarterly change in the probability of informed trade (*PIN*) and information dissemination

This table reports estimates from time-series regressions of quarterly changes in average *PIN* and various information dissemination proxies on a constant and three dummy variables denoting the second, third and fourth quarters, respectively. The dependent variable is the quarterly change in the *PIN*, credit rating dummy (*CDUM*), analyst dummy (*ADUM*), share dummy (*SDUM*) and *NEWS*, averaged across all firms each quarter. The *PIN* is estimated following Easley, Hvidkjaer, and O'Hara (2002) model. *ADUM* is equal to one if a firm has one or more analysts, and zero otherwise. *SDUM* is equal to one if the fraction of shares held by large institutions exceeds the median level for the entire sample, and zero otherwise. *CDUM* is equal to one if a firm has credit rating, and zero otherwise. *NEWS* is the number of days in a month that a particular firm is mentioned in a publication that is covered by Dow Jones Interactive Publications Library. The corresponding *t*-statistics are below the changes in parenthesis.

Dependent variables	Explanatory variable			
	Constant	*QTRDUM2*	*QTRDUM3*	*QTRDUM4*
Panel A NYSE/Amex				
PIN change	−0.0079	0.0122	0.0112	0.0055
	(−3.58)	(3.91)	(3.58)	(1.74)
CDUM change	0.0055	−0.0017	−0.0025	0.0118
	(0.80)	(−0.17)	(−0.25)	(1.21)
ADUM change	−0.0188	0.0309	0.0237	0.0238
	(−7.01)	(8.13)	(6.23)	(6.18)
SDUM change	0.0018	0.0062	−0.0046	0.0037
	(0.53)	(1.30)	(−0.98)	(0.78)
NEWS change	−0.1196	0.2001	0.0736	0.1540
	(−1.69)	(2.00)	(0.74)	(1.52)
Panel B Nasdaq				
PIN change	−0.0106	0.0175	0.0160	0.0105
	(−3.39)	(3.97)	(3.64)	(2.34)
CDUM change	0.0072	−0.0035	−0.0051	0.0040
	(1.32)	(−0.45)	(−0.67)	(0.51)
ADUM change	−0.0197	0.0373	0.0268	0.0335
	(−6.95)	(9.30)	(6.69)	(8.25)
SDUM change	0.0089	0.0026	−0.0108	0.0051
	(2.28)	(0.47)	(−1.97)	(0.91)
NEWS change	−0.0748	0.1770	0.0088	0.0918
	(−1.40)	(2.34)	(0.12)	(1.20)

would have a cost of capital increase of about 17 basis points. There appears to be no significant relation between the cost of capital changes and the book-to-market ratio for either the NYSE/Amex or Nasdaq subsamples.

The results in Table 8 could simply reflect time trends in *PIN* and in the information dissemination proxies, or *PIN* and the information dissemination proxies are systematically different in the fourth quarter and this systematic difference could be responsible for the cost of capital changes in Table 8, not Regulation FD. To address this concern we run a time-series regression of the monthly cross-sectional average change in *PIN* and the information dissemination proxies on a constant and dummies for the second, third, and fourth calendar quarters. The results can be found in Table 9. The constant in this regression reflects the impact of any time trends and the coefficients on the dummies reflect differences in *PIN* across different calendar quarters. The sum of the constant and the fourth quarter dummy is the expected change in the variable in question in the fourth quarter of a typical year. For both NYSE/Amex and Nasdaq firms, the expected fourth quarter changes in all of the variables are close to zero. These results and the estimated coefficients in Table 5 can be used to compute the expected cost of capital change between the third and fourth quarter of an average year. For every one of the information dissemination variables, the expected change in cost of capital resulting from time trends and quarterly seasonality in *PIN* is less than one basis point. We conclude that trends and seasonality in *PIN* and the information dissemination proxies do not explain the results in Table 8.

What do we make of these results? Regulation FD had little impact on the capital costs of the larger NYSE/Amex firms and an economically modest impact on Nasdaq capital costs. The size and sign of the change in cost of capital depend not only on exchange but also on firm size and *PIN*. Furthermore, given the size of the coefficients on *SIZE* and *PIN* in the Nasdaq subsample, large stocks and high *PIN* stocks clearly could experience cost of capital decreases, even among Nasdaq firms.

The fact that, at least among Nasdaq stocks, small stocks tended to experience larger increases in expected return after the regulation than large firms could be a reflection of the difference in relative disclosure costs across firms. Because disclosure involves fixed costs, such as maintaining public and investor relations departments, small firms could have decided to cut back more drastically on public disclosures. Managers at these firms could also have reduced the number and quality of public disclosures in effort to avoid the cost of deciding which disclosures are and are not appropriate under the regulation and thus avoid the potential for SEC enforcement actions. At the same time, informed investors have recourse to alternative sources of private information that managers cannot control such as industry insiders, customers, and suppliers. These alternative sources of information allow them to partially replace the selective disclosures they no longer receive. As a result, the relative advantage of the informed increased. Meanwhile, managers at large firms have more resources to allow them to interpret the regulation and make additional disclosures with less fear of misinterpreting the regulation and drawing attention from the SEC. Thus, their increased information dissemination and reduced information asymmetry were the result of increased public disclosures and information spread to more investors.

The negative relation between *PIN* and changes in capital costs could simply reflect the fact that high *PIN* firms tended to be the firms for which the uninformed investors were at the biggest disadvantage prior to the implementation of the regulation. It is perhaps not surprising that the regulation tended to have a positive impact on these firms, in terms of their costs of capital. Nonetheless, for the average Nasdaq firm, especially considering compliance costs, the regulation appears to have had a net negative impact on value.

4. Conclusion

This study addresses one important economic consequence of Regulation FD, namely, its impact on firms' costs of capital. We contribute to a growing literature in finance that considers the impact of firms' information environments on their costs of capital by examining how changes in firms' information environments brought about by Regulation FD affected firms' costs of capital. We present evidence that, for the typical Nasdaq firm, the regulation resulted in a modest increase in the cost of capital of between ten and 19 basis points per annum. We find no significant change in the cost of capital for NYSE/Amex firms. We further find that the economic impact of the regulation varies widely among firms, with the small firms and low *PIN* firms experiencing significantly larger cost of capital increases. Although this research focuses on the impact of Regulation FD on the cost of capital, we leave to future research questions related to the SEC's stated goals for the regulation such as decreasing bias in analyst reports or reinforcing the integrity of capital markets. The regulation could have positive impacts that outweigh the impact of the apparent increase in capital costs.

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