Information asymmetry and capital structure: Evidence from regulation FD ☆

Reining Petacchi *

MIT Sloan School of Management, Cambridge, MA 02142, USA

ABSTRACT

This study uses Regulation Fair Disclosure (FD) as a plausibly exogenous shock to the information environment to identify the causal effect of information asymmetry on corporate financing behavior. Although Regulation FD prevents firms from selectively disclosing material information to market professionals in the equity market, firms can still do so to banks and rating agencies in the debt market. The standard's differential disclosure requirements lead to differential changes in the information environments between the two markets, providing a reasonably useful setting to examine the effect of information asymmetry on firms' capital structure. I find that firms with a high level of information asymmetry increase debt more than firms with a low level of information asymmetry post-Regulation FD. The results suggest that managers adjust the target leverage ratios to rely more on debt when facing higher costs of equity.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

Prior research shows that information asymmetry in the equity market is an important determinant of capital structure decisions (e.g., Bharath et al., 2009; Agarwal and O'Hara, 2007). Due to the higher equity cost of capital, firms with higher information asymmetry in the equity market are more likely to use debt financing. While previous studies have established a link between equity market information risk and capital structure, this link is less clear, because information risk can also affect the cost of debt.[1] Moreover, previous studies usually relate the level of information asymmetry to capital structure, and a level-based approach is subject to an omitted variable problem. This study addresses these limitations of the literature

[1] In this paper, I use information asymmetry and information risk interchangeably. The information risk is the risk faced by less informed investors when trading against better informed investors (see the discussion below and in Section 2).

by using Regulation Fair Disclosure (FD) as a plausibly exogenous shock to the equity market information environment to identify the causal effect of information asymmetry on firms' capital structure.

Regulation FD provides a potentially useful setting to examine whether information asymmetry affects firms' financing decisions because the standard imposes differential disclosure requirements between the equity market and the debt market. In the equity market, the regulation prohibits any selective disclosure of material information by firms to favored market professionals.[2] In the debt market, in contrast, it exempts credit rating agencies and does not apply to banks.[3] Because Regulation FD primarily affects the equity market and has little impact on the debt market, it is reasonable to assume that the information risk does not change in the debt market surrounding Regulation FD. Therefore, the change in firms' capital structure is clearly associated with the change in information risk in the equity market.

I hypothesize that Regulation FD changes corporate disclosure channels and that such change in turn affects firms' financing decisions. The hypothesis is built on the literatures on corporate disclosure and financing choices. In the disclosure literature, prior studies find an inverse relation between voluntary disclosure and information asymmetry among investors (Brown et al., 2004; Brown and Hillegeist, 2007). Information asymmetry among investors is further linked with cost of capital (Easley and O'Hara, 2004; Easley et al., 2002). Therefore, through asymmetric information among investors, corporate disclosure can affect a firm's financing costs.

Regulation FD narrows firms' disclosure channels in the equity market by eliminating the selective disclosure channel. Its impact on the information environment is unlikely to be uniform across firms. Gomes et al. (2007) show that while large firms are able to compensate the loss of selective disclosure by attracting more analyst following and making more earnings pre-announcements, small firms are unable to do so and they now face a higher cost of equity capital. Chen et al. (2010) find a reduction in the implied cost of equity capital post-Regulation FD only for large and medium firms. Wang (2007) finds that firms replacing private earnings guidance with nondisclosure after Regulation FD suffer deterioration in their information environments whereas firms replacing private guidance with public guidance enjoy an improvement. Overall these findings in prior studies suggest that after the implementation of Regulation FD, firms may increase, maintain, or decrease the level of information flow to the equity market. Since the regulation has little impact on the debt market, firms with improved information environments in the equity market may find equity financing relatively cheaper than debt financing and rely more on the equity market to raise capital. In contrast, firms with worsened information environments in the equity market may have incentives to turn to the debt market, where private disclosure is still available. My results support this prediction.

In this study, I focus on the information asymmetry among investors and not on the information asymmetry between firm insiders and outside investors. The information asymmetry between the firm and its investors is intrinsic to the firm and arises because firm managers have better information than outside investors. Prior studies typically use market reactions to the announcements of important company events to proxy for intrinsic information asymmetry (e.g., Dierkens, 1991; Agarwal and O'Hara, 2007). Larger market reactions suggest more unanticipated information in the announcement and therefore, larger information gaps between the firm and its investors. In contrast, the information asymmetry between market participants represents heterogeneity of investors' information sets and can be viewed as extrinsic to the firm.[4] Proxies for extrinsic information asymmetry usually rely on patterns in security transaction data (e.g., order imbalances, bid–ask spreads). Since, by providing equal access to firm disclosures, the goal of Regulation FD is to reduce information asymmetry across different classes of investors, the regulation's direct and intended effects should be on extrinsic information asymmetry among investors.

I use several proxies for extrinsic information asymmetry among investors. In the main analysis, I measure extrinsic information asymmetry using the adjusted probability of information-based trading (AdjPIN) developed by Duarte and Young (2009), which is ultimately based on the market microstructure model by Easley et al. (1996). This measure gauges the extent of information asymmetry from the estimation of the arrival of information-based trades. In a set of supplemental analyses, I further use two alternative constructs to proxy for equity market information risk. The first construct follows models in Glosten and Harris (1988) and Hasbrouck (1991). It extracts the adverse selection component of the bid–ask spread from the serial covariance properties of the observed asset returns. The second construct is based on Llorente et al. (2002), which measures the amount of private information trading based on the interaction between trading volume and asset returns. All of these proxies have been widely applied in the finance and accounting literatures.[5]

---

[2] Rule 100(b)(1) of Regulation FD enumerates four categories of persons to whom selective disclosure may not be made absent a specified exclusion. The first three are securities market professionals: (1) broker–dealers and their associated persons; (2) investment advisers, certain institutional investment managers and their associated persons; and (3) investment companies, hedge funds, and affiliated persons. The fourth category of persons is any holder of the issuer's securities, under circumstances in which it is reasonably foreseeable that such holder would purchase or sell securities on the basis of the information.

[3] Rule 100(b)(2) of Regulation FD exempts an entity whose primary business is the issuance of credit ratings, provided that the information is collected solely for the purpose of developing a credit rating, and the entity's ratings are publicly available. It also sets out exclusions for communications made to a person who owes the issuer a duty of trust or confidence (e.g., attorney, investment banker, and accountant) and to any person who expressly agrees to maintain the information in confidence. Therefore, banks are excluded from Regulation FD, as long as they agree to hold private information in confidence. For details on the final rule, see http://www.sec.gov/rules/final/33-7881.htm.

[4] The definitions of extrinsic information asymmetry and intrinsic information asymmetry follow Agarwal and O'Hara (2007).

[5] See, for example, Verrecchia and Weber (2006), Ferreira and Laux (2007), Sidhu et al. (2008), Bharath et al. (2009), Akins et al. (2012), Shroff et al. (2013), etc.

I find that relative to firms facing a low level of information asymmetry, firms facing a high level of information asymmetry tend to be smaller firms that have weak earnings performance and fewer incentives to disclose publicly prior to the adoption of Regulation FD. I also find that these firms tend to experience larger increases in both analyst forecast errors and analyst forecast dispersion, and they attract fewer analysts post-Regulation FD. The findings suggest that firms with high information risk may not be able to replace private disclosure perfectly with public disclosure, and they experience deterioration in their equity market information environment after Regulation FD.

To examine the link between capital structure and information risk, I employ two research designs. In the main analysis, I use a difference-in-differences method to control for time specific effects. This design is commonly used in the studies of regulatory changes (e.g., Low, 2009; Altamuro and Beatty, 2010). Since I am interested in the cross-sectional change in capital structure due to information asymmetry, I am essentially using a difference-in-difference-in-differences model, where the third differencing variable is the level of information asymmetry. In the supplementary analysis, I also use a two-stage least squares (2SLS) model under which Regulation FD acts as an instrumental variable.[6] This model has the benefit of showing that Regulation FD gives a strong enough shock to the information environment to make changes in capital structure plausible.

To employ the difference-in-difference-in-differences model, I need a control group composed of firms not affected by the standard. I identify two control groups. The first is constructed based on the methodology in Wang (2007). Wang's (2007) methodology allows me to use publicly available data to identify a group of firms that rely mainly on public disclosures to release earnings related news in the pre-Regulation FD period. Since Regulation FD prohibits releasing any material information to a privileged few, the rule is least likely to affect these public disclosers, who use limited private guidance. The second control group consists of firms holding open conference calls prior to the adoption of Regulation FD. Under the assumption that open call firms tend to have open disclosure policies, I expect Regulation FD to have a limited impact on these firms.

My main finding is that under the difference-in-difference-in-differences model, firms with low information asymmetry do not change their leverage relative to the control group. In contrast, firms with high information asymmetry increase leverage relative to the control group. These findings hold whether leverage is measured by book leverage or market leverage, and whether extrinsic information asymmetry is measured by AdjPIN, the adverse selection component of the spread, or the amount of private information trading. Moreover, the results cannot be explained away by changes in the cost of debt. To mitigate the concern of confounding events surrounding the implementation of Regulation FD (e.g., the Internet bubble, the economic recession, the disclosure of accounting scandals, etc), I rerun the analysis using 1998, 1999, and 2001 as hypothetical implementation years of Regulation FD and find weaker or no results. The fact that year 2000 gives the strongest results suggests that Regulation FD is a strong driving force behind the findings. Consistent with the main findings, I also find information asymmetry positively associated with leverage using the 2SLS approach. Given that cost of capital is increasing in the level of extrinsic information asymmetry and Regulation FD has limited impact on the cost of debt, my findings are consistent with the view that managers make a trade-off to increase the use of debt when facing increased costs of equity. The paper thus provides empirical evidence of the effect of information risk on corporate financing choices.

The paper proceeds as follows. Section 2 develops the hypothesis. I discuss the research design in Section 3. Section 4 conducts capital structure analysis, and Section 5 concludes.

2. Hypothesis development

Effective October 23, 2000, the SEC passed Regulation FD that prohibits the disclosure of material nonpublic information to selective recipients unless the same information is released simultaneously to the general public. The goal of the regulation is to create a level playing field for all investors in accessing material corporate information. In the final rule, the Commission further states that Regulation FD will enhance investor confidence in the integrity of the capital markets by reducing "the potential for corporate management to treat material information as a commodity to be used to gain or maintain favor with particular analysts or investors" (SEC, 2000). In this paper, I use Regulation FD as a plausibly exogenous shock to firms' information environments to investigate whether information risk affects corporate financing decisions.

The adoption of Regulation FD is a potentially useful setting for testing the relation between information risk and capital structure, because the rule virtually has no impact on the debt market information environment. In the private debt market, firms with high costs of public disclosure can still privately convey information to banks. In the public debt market, rating agencies still have access to selective information.[7] Because of Regulation FD's differential impact on the equity and debt markets, firms now face more constraints in disclosing information in the equity market than in the debt market.

---

[6] I thank the reviewer for suggesting this approach.

[7] The fact that Regulation FD applies to bond analysts should have small influences on firms' capital structures. First, the public bond market is relatively small compared to the bank loan market. In 2005, the total US corporate bond issuance was $753 billion, while the total outstanding syndicated loan was $1.6 trillion (sources: Federal Reserve Board and Securities Industry and Financial Markets Association). Moreover, credit rating agencies, one of the major information intermediaries in the bond market, are excluded from Regulation FD (Rule 100(b)(2) of Regulation FD). Finally, I use information asymmetry among investors to link the information environment to cost of capital, and the degree of information asymmetry among bond investors should be small. Unlike the equity market, the bond market is essentially an institutional market. There are smaller differences in bond investors' technical expertise to acquire and process information.

The impact of Regulation FD on firms' equity market information environments is not uniform across firms. Gomes et al. (2007) find that while large firms are able to replace the loss of information flow from selective disclosure by attracting more analyst following and making more earnings pre-announcements, small firms are not able to do so. As a result, small firms face a deteriorated information environment and a higher cost of equity capital post-Regulation FD. Focusing on disclosure practices, Wang (2007) finds that roughly half of the firms that rely on private earnings guidance replace private guidance with nondisclosure instead of public guidance, and these firms suffer deterioration in their equity market information environments. She also finds that firms who replace private guidance with public guidance enjoy an improvement in their equity market information environments. Since Regulation FD affects firms with different characteristics differently, I expect cross-sectional variation in changes in extrinsic information asymmetry in the equity market. That is, some firms may experience a decrease in extrinsic information asymmetry whereas others may experience an increase.

Extrinsic information asymmetry among security investors is positively related to the cost of capital. Easley and O'Hara (2004) demonstrate theoretically that securities with greater private information relative to public information have higher required returns (i.e., higher costs of capital). The higher return reflects the fact that private information increases the risk to uninformed investors of holding the security, because informed investors are better able to adjust their portfolio weights to incorporate the new information. In equilibrium, uninformed investors require compensation for bearing such risk. Easley et al. (2002) provide empirical support that information risk is priced.

I predict that information risk is positively related to changes in debt financing after the implementation of Regulation FD. Firms with low information risk tend to be those that do not rely much on selective disclosure prior to the new regulation and are likely to increase or maintain the same level of disclosure as before. In contrast, firms with high information risk tend to be those that favor selective disclosure over public disclosure. If these firms' optimal disclosure strategy does not allow them to replace selective disclosure fully with public disclosure, their equity market information environments are likely to deteriorate when selective disclosure is no longer available post-Regulation FD. The poorer information environment leads to a higher cost of equity capital. Consequently, these firms have incentives to turn to the debt market, where they face fewer constraints in privately communicating with capital providers and can, therefore, obtain relatively lower costs of capital.

However, if the information disclosed in the debt market can perfectly spill over to the equity market, the debt market will have no informational advantage over the equity market after Regulation FD. In addition, if lenders in the debt market realize that certain types of firms need to rely more on them to raise capital and increase the borrowing costs, the debt market will have no cost advantage over the equity market. The null hypothesis (of no economic consequences) predicts that firms' capital structure remains unaffected by the standard.

3. Research design

3.1. Measuring extrinsic information asymmetry

I measure extrinsic information asymmetry using the adjusted probability of information-based trading (AdjPIN) developed by Duarte and Young (2009), which is in turn based on the market microstructure model by Easley et al. (1996). The probability of information-based trading is commonly known as PIN. Duarte and Young (2009) decompose PIN into an information asymmetry component (adjusted PIN) and a non-information asymmetry component. Duarte et al. (2008) find that PIN is one of the most important determinants of changes in the cost of equity related to Regulation FD. Several other papers have also used PIN (or AdjPIN) to study a broad range of topics in accounting and finance.[8]

In addition to PIN, measures of extrinsic information asymmetry are also often based on bid–ask spreads. The spread is comprised of three types of costs facing market makers: order processing costs, inventory holding costs, and adverse selection costs. The adverse selection costs compensate market makers for the risk of trading with the better informed, and hence, reflect the degree of information asymmetry among investors.

Spread-based measures are not as suitable for this study as PIN. This is because the tick size changes several times around the implementation of Regulation FD, making it empirically challenging to estimate the regulation's impact on the spread and its components. In 1997, both the NASDAQ and the NYSE reduced the minimum price increment from one-eighth dollar to one-sixteenth dollar. In addition, in January 2001, just 3 months after the introduction of Regulation FD, the NYSE abandoned its tradition of trading in fractions and switched to decimals. The NASDAQ followed and decimalized shortly thereafter on April 9, 2001. The lower tick size has resulted in smaller quoted and effective bid–ask spreads (Bessembinder, 1999, 2003). It also affects the adverse selection component of the spread (Chakravarty et al., 2005). Unlike spreads, the PIN model is based on order imbalances, which are less likely to be affected by the changes in tick size.[9] Although I view PIN as a

[8] For example, Brown et al. (2004) and Brown and Hillegeist (2007) use PIN to study the impact of firms' disclosure policies on the information environment. Vega (2006) uses PIN to study the effect of private and public information on the post-announcement drift. Ferreira and Laux (2007) use PIN to study the association between corporate governance and information flow. Chen et al. (2007) use PIN to show that private information has a positive impact on the sensitivity of real investment to stock price. Akins et al. (2012) use AdjPIN to study the relation between investor competition and the pricing of information asymmetry.

[9] Smaller tick size lowers trading costs. It is possible that private information that was too costly to trade on now becomes more tradable, and, thus, there are more informed traders after the tick size change. However, lower trading costs will also lead to more trading by the uninformed. As long as the increase in the informed orders is similar to the increase in the uninformed orders, order imbalances and, thus, PIN should not be affected by the tick size change.

more appropriate measure for the purpose of this study, spread-based measures are popular and well accepted in the literature. Therefore, in Section 4.3, I conduct supplemental analyses using the adverse selection component of the spread as an alternative proxy for extrinsic information asymmetry.

3.2. Difference-in-difference-in-differences method

I use the difference-in-difference-in-differences research design to discern the unique effect of Regulation FD on capital structure. A difference-in-differences design is commonly used in the studies of regulatory changes (e.g., Bertrand and Mullainathan, 2003; Low, 2009). Since I am interested in the cross-sectional changes in capital structure due to information asymmetry, I include the level of information asymmetry as the third differencing variable.

To employ a difference-in-difference-in-differences design, I must identify a control group of firms that are not affected by the regulation and use their capital structure as the comparison base. A natural control group is American Depository Receipts (ADRs) and non-U.S. companies with securities listed on the U.S. exchanges, because both of them are exempted from Regulation FD. However, ADRs and foreign issuers are not suitable control firms for this study. Foreign firms have more financing choices than U.S. firms; therefore, the changes in their capital structure are not comparable to the changes for the U.S. firms. For example, when facing higher costs of capital in the U.S. equity market, U.S. firms must rely more on the debt market to raise capital and show an increase in leverage. In contrast, foreign firms can raise capital not only in the U.S. debt market, but also in their own home countries' equity and debt markets. Thus, their capital structure may remain unchanged.[10] The wider financing choices render foreign companies an invalid control sample. Anecdotal evidence also shows that foreign issuers may be following the practice of U.S. firms and voluntarily complying with the regulation.[11] This raises the question whether foreign securities are indeed unaffected by Regulation FD.

I attempt to circumvent the lack of a natural control group by following a novel methodology developed by Wang (2007), which in turn is based on Matsumoto (2002). The methodology in Wang (2007) allows me to use public data to construct a sample of firms that use mainly public disclosures to convey information before the adoption of Regulation FD. These firms have an open disclosure policy and do not rely on private guidance. Therefore, I do not expect Regulation FD to have a significant impact on them.

Using Wang's (2007) methodology to construct the control sample is advantageous, because the approach uses only public information and, thus, can apply to all firms with available data. However, the method is also subject to the limitation that it may misclassify firms and introduce noise to the analysis. To address the concern, in a set of supplementary tests, I use firms that held open conference calls before the implementation of Regulation FD as an alternative control group. Firms with an open call policy are less likely to be affected by Regulation FD, because presumably such firms do not rely much on selective communication. However, since conference calls are only one mechanism of disclosure, I cannot rule out the possibility that the treated group contains firms that have an open disclosure policy but use means other than conference calls to communicate with investors. Moreover, the conference call data are available only from March 1999 on.[12] Therefore, I must infer firms' disclosure policies throughout the entire pre-Regulation FD period (1996–1999) based on less than a year of data. Because of these drawbacks, I rely on Wang's (2007) method to construct the control group in the main analysis and employ open call firms in the supplementary analysis.

I estimate a model of the following form to test whether extrinsic information asymmetry in the equity market explains cross-sectional variation in changes in capital structure:

$$\text{Leverage}_{it} = \alpha_t + \beta_i + c\text{Treat}_i * \text{FD}_t + \delta\text{Treat}_i * \text{FD}_t * \text{InfoAsym}_i + \varphi\text{InfoAsym}_i * \text{FD}_t + \gamma\text{Controls}_{it} + \varepsilon_{it} \tag{1}$$

where Leverage is either book leverage or market leverage. I define book leverage as debt to book value of assets and market leverage as debt to market value of assets.[13] α_t is year fixed effects and β_i is firm fixed effects. Treat and FD are dummy variables. Treat equals 1 if the firm is not classified as a public discloser by Wang's (2007) methodology and 0 otherwise. FD equals 1 if the observation is from the post-Regulation FD period and 0 otherwise. I correct standard errors to allow for clustering of errors at the firm level. InfoAsym is the firm's average AdjPIN in the pre-Regulation FD period.[14] Because the

---

[10] It is also possible that U.S firms may cross list in foreign exchanges, thereby mitigating the effect of Regulation FD on their capital structure. However, prior research shows that the number of U.S. firms cross listed in foreign countries is relatively small. For example, Sarkissian and Schill (2010) document that only 60 U.S. firms have a foreign listing in the pre-Regulation FD period of 1996–2000, and this number reduced to 52 in the post-Regulation FD period of 2001–2006. Moreover, any cross-listing of U.S. firms will bias against me finding results on changes in their capital structure.

[11] For example, Citigroup's 2005 Depository Receipts Information Guide states that "many non-U.S. companies with securities trading in the U.S. (including DR issuers) have voluntarily opted to comply with the requirements of Regulation FD."

[12] The conference call data are from Bushee et al. (2004), who use data providers Bestcalls.com and Thomson First Call to identify open versus closed conference calls. Bestcalls.com provides data starting from March 1999.

[13] I define book leverage and market leverage following Fama and French (2002). Market value of assets is defined as book value of assets (Compustat Item 6) minus book value of equity plus market value of equity. Book value of equity is defined as total assets less total liabilities (Item 181) and preferred stock (Item 10) plus deferred taxes (Item 35). When preferred stock is missing, it is replaced with the redemption value of preferred stock if available; if not, then it is replaced with the carrying value. Market value of equity is defined as common shares outstanding (Item 25) times price (Item 199).

[14] I use the pre-Regulation FD information asymmetry to measure each firm's information risk, because presumably this information asymmetry is pre-determined relative to the new regulation. I thank the reviewer for making this suggestion.

model includes both firm and year fixed effects, it is not necessary to include the main effects of Treat and FD and the interaction term of Treat∗InfoAsym. These variables are either time invariant (Treat and Treat∗InfoAsym), which will be absorbed by the firm fixed effects, or year specific (FD), which will be absorbed by the year fixed effects.

In Eq. (1) the coefficient c captures the differential changes in leverage between the treated and the control firms (conditional on InfoAsym being zero), and the coefficient φ captures the differential changes in leverage among firms with different levels of information asymmetry. The variable of interest is the triple interaction term Treat∗FD∗InfoAsym, where the coefficient δ captures the differential changes in leverage (relative to the control firms) between the treated firms with high and low levels of information asymmetry. The hypothesis predicts that the cross-sectional variation in information risk is positively related to changes in firms' reliance on debt financing; hence, $\delta > 0$.

Following the literature (e.g., Rajan and Zingales, 1995; Hovakimian et al., 2001; Fama and French, 2002; Agarwal and O'Hara, 2007), I include a set of firm characteristics as controls. They are intrinsic information asymmetry between the firm and its investors, growth opportunities, dividend payout, non-debt tax shields, asset tangibility, profitability, and firm size. Previous studies have found that firms with higher leverage tend to be larger firms and have higher intrinsic information asymmetry, lower growth opportunities, lower dividend payouts, lower non-debt tax shields, more tangible assets, and lower profitability.

Intrinsic information asymmetry can confound the interpretation of the results if it is correlated with extrinsic information asymmetry. Following Dierkens (1991) and Agarwal and O'Hara (2007), I use abnormal returns around quarterly earnings announcements, AbRet, as the proxy for intrinsic information asymmetry. Higher abnormal returns indicate more unanticipated information in the earnings announcements and thus larger information gaps between firm managers and outside investors. AbRet is the average of the absolute cumulative abnormal returns (ACAR) of the quarterly earnings announcements for the year. I compute absolute cumulative abnormal return around earnings announcement day 0 as $ACAR = |\Pi_{t=-1}^{+1}(1 + AR_t) - 1|$, where AR is abnormal return computed based on market model residuals estimated over the pre-announcement window ($-200, -11$).

I measure growth opportunities using the market-to-book ratio, MTB, and research and development expenditure, R&D. MTB is the market value of assets divided by the book value of assets. R&D is research and development expense (Item 46) divided by total assets. For firms with missing R&D expenses, I replace the missing R&D values with industry-year average.[15] Dividend payout, Dividend, is a dummy variable equal to 1 if common stock dividends (Item 21) are positive and 0 otherwise. I use depreciation expenses to proxy for non-debt tax shields. Depreciation is depreciation and amortization expense (Item 14) divided by total assets. Asset tangibility, PPE, is defined as net plant, property, and equipment (Item 8) divided by total assets. Profitability, Profit, is defined as operating income before interest, taxes, and depreciation (Item 13) divided by total assets. Size is the log of net sales (Item 12).[16]

3.3. Sample selection

Given that firms' capital structures are stable over time (Leary and Roberts, 2005; Lemmon et al., 2008), I need a sufficiently long sample period to detect any change in capital structures. I use an eight-year sample period from 1996 to 2004. I start the sample period in 1996 to closely follow Wang (2007), who uses 1996–1999 to classify firms' disclosure policies in the pre-Regulation FD period.[17] I end the sample period in 2004 so that the pre- and post-periods have an equal number of years. Moreover, former SEC Chairman Christopher Cox (in office from 2005 to 2009) adopted policies that delayed the SEC's investigations and discouraged corporate penalties. It is unclear to what extent Regulation FD was enforced while Cox was the Chairman.[18] I specify 1996 to 1999 as the period before Regulation FD and 2001 to 2004 as the period after Regulation FD, omitting the regulatory change year of 2000.

To construct the control sample, I follow Wang's (2007) methodology and run the analysis in the pre-Regulation FD period using all Compustat firms with non-missing required variables. 5,285 Firms enter the analysis, of which 973 are classified as private disclosers, 993 are classified as public disclosers, 2,915 are classified as non-disclosers, and 404 firms are unclassified. The 993 pre-Regulation FD public disclosers are the candidates for the control group.[19] Appendix A provides the detailed estimation process and descriptive statistics.

---

[15] When firms do not separately report R&D expenses, the variable is missing in Compustat. Koh and Reeb (2014) find that firms who fail to provide information about their R&D expenditures in the financial statements on average have substantive amounts of R&D. Therefore, I set missing R&D to the industry-year mean, where industry is defined according to the Fama and French (1997) 48-industry classifications. Setting the missing R&D to the industry average is also common in the management literature (see Koh and Reeb, 2014). The results are very similar if I assume the missing R&D as zero.

[16] All of the continuous variables are winsorized at the 1st and 99th percentiles to reduce the effect of outliers.

[17] Wang (2007) starts the sample period in 1996 for the following two reasons. First, effective in December 1995, the Private Securities Litigation Reform Act provides broader safe harbor provisions for voluntary disclosures. Second, starting in the mid-nineties, managers started to provide earnings guidance more pervasively.

[18] See Government Accountability Office (GAO) March 2009 report "Securities and Exchange Commission, Greater Attention Needed to Enhance Communication and Utilization of Resources in the Division of Enforcement," as well as GAO May 2009 "Testimony Before the Subcommittee on Securities, Insurance, and Investment, Senate Committee on Banking, Housing, and Urban Affairs." For media articles, see, for example, http://www.cfo.com/printable/article.cfm/13606254.

[19] Wang's (2007) methodology relies on Thomson First Call's Company Issued Guideline database to classify firms into public, private, and non-disclosers. Anilowski et al. (2007) and Chuk et al. (2013) find that First Call is more likely to cover firms with higher analyst following and its coverage became more

I further require that the 993 pre-Regulation FD public disclosers also exist in the post-Regulation FD period and have the required data for the capital structure analysis. 273 Firms pass this data screening and are the control firms in the main analysis.[20] The initial treated sample consists of all of the U.S. firms with AdjPIN available from Duarte and Young (2009) and exist both pre- and post-Regulation FD with required data for the capital structure analysis. Excluding firms classified as the control group, 1,399 firms are left. In summary, the final sample consists of 1,672 firms, of which 273 are the controlled and 1,399 are the treated.

Table 1 reports the industry distribution for the sample firms and for all available firm-years on Compustat during the sample period. The sample contains firms in every economic sector and does not show any particular industry clustering.

4. Capital structure analyses

4.1. Descriptive statistics

Table 2 Panel A shows the mean values of AdjPIN in the pre-Regulation FD period. I find that the pre-Regulation FD AdjPIN varies substantially in the cross section. Treated firms in the middle quintile have an average AdjPIN of 0.15, similar to the magnitude of the AdjPIN for the control firms. However, treated firms in the first quintile have an average AdjPIN of 0.101, and this number is almost tripled to 0.287 for firms in the fifth quintile. To explore why some firms have high levels of extrinsic information asymmetry, but others do not, I compare selected ex ante firm characteristics and changes in analyst behavior between treated firms in the top (Q5) and bottom (Q1) quintiles of AdjPIN. Table 2 Panel B reports the results.

Firms with complex financial information and firms with high litigation costs are more likely to disclose publicly (Bushee et al., 2003; Skinner, 1994). Because these firms make less use of selective disclosure, they should have a lower level of extrinsic information asymmetry. Following Bushee et al. (2003), I use membership in high technology industries and revenue volatility as proxies for financial information complexity.[21] I denote a firm to have high litigation costs if it is in a high litigation risk industry and also suffers an earnings decrease for at least 4 quarters during the pre-Regulation FD period.[22] Consistent with the prediction, relative to firms in the fifth quintile, firms in the first quintile have higher litigation costs and more complex financial disclosures (when proxied by revenue volatility).

Miller (2002) finds that firms increase public disclosure when they experience sustained strong earnings performance. Greater disclosure reduces information risk. Moreover, larger firms tend to have a more open disclosure policy and more analyst or media following; therefore, their information environments tend to be more transparent than smaller firms. Consistent with these expectations, firms in the first quintile are larger in size and have stronger firm performance, as measured by ROE or ROA, than firms in the fifth quintile.[23]

I also explore whether analyst behavior changes differently for firms with different levels of information asymmetry. If after Regulation FD, the information environment for firms in the fifth quintile deteriorates to a larger extent than the information environment for firms in the first quintile, we would expect firms in the fifth quintile to have lower analyst following and worse analyst performance than firms in the first quintile. Consistent with the prediction, I find that, relative to firms in the first quintile, firms in the fifth quintile gain less analyst following and have larger increases in both forecast errors and forecast dispersion.[24,25]

Table 2 Panel C reports descriptive information on variables used in the capital structure analysis. The sample firms on average finance 56% of the asset book value from borrowing, and the number drops to 44% when measuring the assets at market value. On average, the three-day absolute CAR at earnings announcements is 5% during the sample period. An average firm has a market-to-book ratio of 1.6; has 31% of its assets belonging to long-term assets; incurs R&D expenditures

---

(*footnote continued*)

complete after 1998. The fact that First Call's coverage may be incomplete prior to Regulation FD suggests some public disclosers may be misclassified as non-disclosers. This introduces noise to the analysis (as the treated may include public disclosers), which should bias against finding results.

[20] Requiring the firms to also exist in the post-Regulation FD period and to have non-missing Compustat and CRSP data for the capital structure analysis reduces the number of public disclosers to 584. Requiring non-missing AdjPIN data in the pre-Regulation FD period further reduces the number of public disclosers to 273.

[21] Following Bushee et al. (2003), SIC codes classified as high-tech industries include: Drugs (2833–2836); Electric Distribution Equipment (3612–3613); Electrical Industrial Apparatus (3621–3629); Household Audio & Video Equipment (3651–3652); Communications Equipment (3661–3669); Electron Tubes (3671); Printed Circuit Boards (3672); Semiconductors & Related Devices (3674); Magnetic and Optical Recording Media (3695); Telephone Communications (4812–4822); Radio & TV Broadcasting (4832–4899); and Computer and Data Processing Services (7370–7379). I measure revenue volatility as the standard deviation of quarterly revenue measured over 3 years, including and preceding the current year.

[22] Following Francis et al. (1994), SIC codes classified as high litigation risk industries include: Biotechnology (2833-2836, 8731-8734); Computers (3570-3577, 7370-7374); Electronics (3600-3674); and Retailing (5200-5961).

[23] Untabulated analyses further show that Q1 firms are more likely to have credit ratings than Q5 firms. Credit rating agencies are exempt from Regulation FD. Jorion et al. (2005) find that the information content of credit ratings increased after Regulation FD, possibly because credit analysts at rating agencies have access to confidential information that is no longer made available to equity analysts. Since credit ratings are publicly available, this suggests that Q1 firms are less likely to suffer a deterioration of information environment than Q5 firms.

[24] I define 'forecast dispersion' as the standard deviation of individual analysts' most recent earnings forecast in the 90 days prior to the earnings announcement. I define 'analyst following' as the number of analysts making annual earnings per share forecast. I define 'forecast error' as the absolute value of the difference between the actual earnings per share and the median of individual analysts' most recent earnings forecast in the 90 days prior to the earnings announcement. I scale the forecast error by the stock price at fiscal quarter end.

[25] The difference in changes in forecast dispersion between Q1 and Q5 firms is only significant using a one-tailed test.

Table 1
Industry distribution.
 This table reports the industry distribution for the sample firms and for the whole Compustat population during the sample period.

Industry	Sample firms (%)	Compustat population (%)
01–09 Agriculture	0.3	0.4
10–19 Mining & Construction	7.1	7.8
20–27 Food, Paper & Finished Goods	11.0	6.3
28–29 Chemicals & Pharmaceuticals	7.0	6.9
30–34 Rubber, Leather, and Metal Works	8.0	4.1
35–36 Machinery & Electronics	10.8	11.1
37–39 Other Equipment & Machinery	8.0	7.5
40–49 Transportation, Telecom & Utilities	11.3	9.9
50–51 Wholesalers	3.8	3.5
52–59 Retailers	7.6	5.4
60–69 Banks	13.2	19.9
70–79 Personal & Business Services	8.0	13.1
80–99 Miscellaneous & Other Services	3.8	4.0
Total	100	100

representing 9.5% of its assets and depreciation expenses representing 4% of its assets; makes profits representing 12% of its assets; and has annual sales of $3.8 billion. Dividend has a median value of 1, which suggests that the majority of firms pay out dividends during the sample period.

4.2. Regression results on changes in capital structure

Table 3 contains the central results of the capital structure analysis using book leverage and then market leverage. In both specifications, the coefficient on Treat∗FD∗InfoAsym is positive and significant (0.369, t-statistic of 1.908 for the book leverage specification; 0.330, t-statistic of 2.034 for the market leverage specification). This suggests that, relative to control firms, treated firms with high information asymmetry increase their leverage more post-Regulation FD than treated firms with low information asymmetry. I further find that firms with low information asymmetry do not change their leverage any differently from the control firms. In contrast, firms with high information asymmetry increase leverage relative to the control firms.[26] These results show a positive link between information risk and capital structure.

I set all the control variables to their mean values and find that compared to firms with InfoAsym at the 25th percentile, firms with InfoAsym at the 75th percentile increase their book leverage by additional 2.67 percentage points relative to the control firms. Compared to the average change in book leverage of 1.57 percentage points for the treated firms, this increase is economically significant. The average book assets for the treated group are $8,785 million. Therefore, compared to firms with InfoAsym at the 25th percentile, firms with InfoAsym at the 75th percentile raise an additional $235 million of debt relative to the control firms. I also find that, consistent with the pecking order theory, increases in intrinsic information asymmetry between managers and investors tend to increase leverage, and increases in profitability tend to reduce leverage.

A natural question emerging from the results is that, if firms can reduce information asymmetry and enjoy lower cost of capital by eliminating selective disclosure, why did they not voluntarily choose to do so prior to Regulation FD? Whether firms employ open disclosure policies depends on the relative benefits (e.g., lower costs of capital) and costs of being open. The potential costs of being open include losing the use of selective information to exchange favorable recommendations from analysts, facing higher proprietary costs and litigation risk, and increasing the risk of misinterpretation of complicated information by less skilled users.[27] For firms with high information risk, managers may have perceived that these costs exceeded the benefits of an open communication policy and, therefore, decided to convey information privately. In this paper, I do not explore why firms choose one disclosure policy over the other. Rather, I focus on using the exogenous change in information environments that resulted from Regulation FD to investigate whether information risk affects firms' financing decisions.

Overall, Table 3 provides evidence consistent with the hypothesis that information risk affects corporate financing behavior. Using the plausibly exogenous changes in disclosure policy caused by Regulation FD, I find that firms with low extrinsic information asymmetry in the equity market do not show any change in leverage relative to the control firms; however, firms with high extrinsic information asymmetry become more highly levered than the control firms. Firms with low information asymmetry tend to be those that do not use much selective disclosure prior to Regulation FD and therefore,

---

[26] Specifically, I center InfoAsym at the 25th and 75th percentiles and rerun Eq. (1). After centering, the coefficient on Treat∗FD measures the differential change in leverage between the treated firms and the control firms at the 25th and 75th percentiles of InfoAsym. I find that when InfoAsym is centered at the 25th percentile, the coefficient on Treat∗FD is insignificant for both book leverage and market leverage (t-statistics of 0.06 and 0.35). In contrast, when InfoAsym is centered at the 75th percentile, the coefficient on Treat∗FD becomes significant for both book leverage and market leverage (t-statistics of 1.92 and 2.15).

[27] See Laderman (1998) and Unger (2000, 2001) for discussions on why firms may prefer selective disclosures.

Table 2
Descriptive statistics.

  This table reports summary statistics. Panel A reports the means of AdjPIN in the pre-Regulation FD period. Panel B reports descriptive information on selected firm characteristics existing prior to Regulation FD and changes in analyst behavior pre- and post-Regulation FD. Panel C reports descriptive information on the variables used in the capital structure analysis. *AdjPIN* is the adjusted probability of information-based trading from Duarte and Young (2009); *Book Leverage* is debt to BV of assets; *Market Leverage* is debt to MV of assets; *AbRet* is abnormal returns around quarterly earnings announcements; *MTB* is MV of assets divided by BV of assets; *R&D* is research and development expense divided by total assets, with missing values set to industry-year average; *Dividend* =1 if the firm distributes common stock dividends in the year, and 0 otherwise; *Depreciation* is depreciation and amortization expense divided by total assets; *PPE* is net property, plant, and equipment divided by total assets; *Profit* is operating income before interest, taxes, and depreciation divided by total assets; *Size* is the log of net sales; *High-tech Industry* =1 if the firm belongs to high-tech industries, and 0 otherwise; *Rev Volatility* is the standard deviation of quarterly revenue, measured over three years including and preceding the current year; *Litigation Cost* =1 if the firm is in a high litigation risk industry and also suffers an earnings decrease for at least 4 quarters in the pre-Regulation FD period, and 0 otherwise; *ROE* is operating income before depreciation divided by BV of equity; *ROA* is operating income before depreciation divided by total assets; *Sales* is net sales measured in millions; *Analyst Following* is the number of analysts making annual EPS forecasts; *Forecast Dispersion* is the standard deviation of individual analysts' most recent earnings forecast in the 90 days prior to the earnings announcement; *Forecast Error* is the absolute value of the difference between the actual earnings per share and the median of individual analysts' most recent earnings forecast in the 90 days prior to the earnings announcement, scaled by the stock price at the fiscal quarter end. In Panel B the pre-Regulation FD firm characteristics are measured at the means of the variables and the change variables are the differences in the means pre- and post-Regulation FD.

Panel A: Average AdjPIN prior to Regulation FD

	Control Group	Q1	Q2	Q3	Q4	Q5
Pre-FD AdjPIN	0.149	0.101	0.128	0.153	0.191	0.287

Panel B: Pre-FD firm characteristics and changes in analyst behavior

Variables	Q1	Q5	Test of difference (*p*-value)
Pre-Regulation FD firm characteristics			
High-tech industry	0.087	0.073	0.267
Rev volatility	274.472	7.126	< 0.001
Litigation cost	0.148	0.120	0.081
ROE	0.422	0.257	< 0.001
ROA	0.141	0.095	< 0.001
Sales	7568	172	< 0.001
Changes in analyst behavior			
ΔAnalyst following	1.124	0.188	< 0.001
ΔForecast error	0.001	0.003	0.077
ΔForecast dispersion	0.006	0.017	0.119

Panel C: Descriptive information on variables in the capital structure analysis

Variables	*N*	Mean	Median	Std Dev.
Book Leverage	11,786	0.555	0.557	0.210
Market Leverage	11,786	0.437	0.413	0.241
AbRet	11,786	0.048	0.038	0.037
MTB	11,786	1.646	1.274	1.214
R&D	11,786	0.095	0.012	0.321
Dividend	11,786	0.573	1	0.495
Depreciation	11,786	0.041	0.037	0.032
PPE	11,786	0.312	0.254	0.247
Profit	11,786	0.120	0.120	0.117
Size	11,786	6.632	6.726	1.971
Sales	11,786	3826	834	11,396

are less likely to be affected by the new regulation. In contrast, firms with high information asymmetry tend to be those that rely on selective disclosure to convey information in the equity market. These firms that seek to raise capital after Regulation FD are likely to turn to the debt market where selective disclosure is still available and, therefore, they can obtain a relatively lower cost of capital.[28]

---

[28] A recent paper by Lambert, Leuz, and Verrecchia (2011) shows that the communication of information to investors affects both the average precision of investors and the information asymmetry. In perfectly competitive markets, the average precision, not the information asymmetry, affects cost of capital. Their results suggest that, if the U.S. equity market is in perfect competition, my findings are driven by changes in average precision, not changes in information risk. However, it is empirically challenging to separate these two effects, because Regulation FD affects the overall information flow and thus will affect both average precision and information asymmetry. Lambert, Leuz, and Verrecchia (2011) also suggest that "empirically, average precision and information asymmetry may both change simultaneously, making it difficult to distinguish one from the other."

Table 3

Changes in capital structure.

This table presents regression analysis of changes in capital structure associated with Regulation FD. *Book Leverage* is debt to BV of assets; *Market Leverage* is debt to MV of assets; *InfoAsym* is the average *AdjPIN* in the pre-Regulation FD period; *Treat*=1 if the firm is not classified as a public discloser by Wang's (2007) methodology, and 0 otherwise; *FD*=1 if the observation is from the post-Regulation FD period, and 0 otherwise; *AbRet* is abnormal returns around quarterly earnings announcements; *MTB* is MV of assets divided by BV of assets; *R&D* is research and development expense divided by total assets, with missing values set to industry-year average; *Dividend*=1 if the firm distributes common stock dividends in the year, and 0 otherwise; *Depreciation* is depreciation and amortization expense divided by total assets; *PPE* is net property, plant, and equipment divided by total assets; *Profit* is operating income before interest, taxes, and depreciation divided by total assets; *Size* is the log of net sales. *t*-statistics are in brackets and are calculated based on White heteroscedastic consistent standard errors clustered by firm.

	[1]	[2]
	Book Leverage	Market Leverage
Treat × FD	−0.044	−0.036
	[−1.573]	[−1.553]
Treat × FD × InfoAsym	0.369*	0.330**
	[1.908]	[2.034]
InfoAsym × FD	−0.479**	−0.415***
	[−2.566]	[−2.686]
Control variables		
AbRet	0.244***	0.461***
	[5.223]	[9.768]
MTB	−0.001	−0.050***
	[−0.160]	[−7.325]
R&D	−0.022	−0.022
	[−1.516]	[−1.629]
Dividend	−0.026***	−0.043***
	[−3.424]	[−6.133]
Depreciation	0.448***	0.009
	[2.611]	[0.031]
PPE	0.021	0.058*
	[0.626]	[1.726]
Profit	−0.257***	−0.366***
	[−4.912]	[−6.305]
Size	0.027***	0.034***
	[4.385]	[5.658]
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	11,786	11,786
Adjusted R^2	0.800	0.841

* Significance at the 10% level (two-tailed test).
** Significance at the 5% level (two-tailed test).
*** Significance at the 1% level (two-tailed test).

4.3. Alternative proxies for extrinsic information risk

To validate my results further, in this section I rerun the analysis using three additional measures for extrinsic information asymmetry that are not based on the PIN model. The first measure is the private information trading measure suggested by Llorente et al. (2002). The second and third measures are the adverse selection component of the bid–ask spread estimated using two different empirical models of price formation. One is the methodology suggested in Glosten and Harris (1988) and adopted by Brennan and Subrahmanyam (1996). The other is the framework in Foster and Viswanathan (1993), which is ultimately based on Hasbrouck (1991). I estimate these measures for all common stocks in CRSP that have the required data for the capital structure analysis. I then compute the mean values of these measures for each firm in the pre-Regulation FD period. Appendix B details the methodology of these three measures.

Table 4 reports the results of changes in capital structure using the three alternative proxies for extrinsic information asymmetry. Columns [1] and [2] show that firms with high levels of private information trading tend to experience larger increases in leverage post-Regulation FD. The coefficient on the triple interaction term Treat∗FD∗InfoAsym is positive and significant for both book leverage (0.166, *t*-statistic of 1.775) and market leverage (0.186, *t*-statistic of 2.850). Turning to columns [3] and [4], I find that the adverse selection component estimated using the method of Glosten and Harris (1988) is positively associated with the change in market leverage, but is only weakly associated with the change in book leverage where the coefficient on Treat∗FD∗InfoAsym is only significant at the one-tailed 10% level. Similarly, columns [5] and [6] show that, when the adverse selection component is estimated using the method of Hasbrouck (1991), it is positively associated with the change in market leverage, but only weakly associated with the change in book leverage (*p*-value=0.08, one-tailed).

Table 4
Alternative proxies for extrinsic information asymmetry.

This table uses three alternative proxies for extrinsic information asymmetry to test changes in capital structure associated Regulation FD. The three alternative proxies are the amount of private information trading constructed based on Llorente et al. (2002) and the adverse selection component of the spread estimated based on the methods of Glosten and Harris (1988) and Hasbrouck (1991). *Book Leverage* is debt to BV of assets; *Market Leverage* is debt to MV of assets; *InfoAsym* is the average extrinsic information asymmetry in the pre-Regulation FD period; *Treat* =1 if the firm is not classified as a public discloser by Wang's (2007) methodology, and 0 otherwise; *FD* =1 if the observation is from the post-Regulation FD period, and 0 otherwise; *AbRet* is abnormal returns around quarterly earnings announcements; *MTB* is MV of assets divided by BV of assets; *R&D* is research and development expense divided by total assets, with missing values set to industry-year average; *Dividend* =1 if the firm distributes common stock dividends in the year, and 0 otherwise; *Depreciation* is depreciation and amortization expense divided by total assets; *PPE* is net property, plant, and equipment divided by total assets; *Profit* is operating income before interest, taxes, and depreciation divided by total assets; *Size* is the log of net sales. *t*-statistics are in brackets and are calculated based on White heteroscedastic consistent standard errors clustered by firm.

	Amount of private information trading		Glosten-Harris model		Hasbrouck model	
	[1]	[2]	[3]	[4]	[5]	[6]
	Book Leverage	Market Leverage	Book Leverage	Market Leverage	Book Leverage	Market Leverage
Treat × FD	0.005	0.001	0.0002	−0.003	−0.0001	−0.004
	[0.782]	[0.083]	[0.033]	[−0.438]	[−0.014]	[−0.608]
Treat × FD × InfoAsym	0.166*	0.186***	0.161	0.168**	0.140	0.189**
	[1.775]	[2.850]	[1.550]	[1.973]	[1.405]	[2.183]
InfoAsym × FD	−0.122	−0.209***	−0.199**	−0.210**	−0.171*	−0.226***
	[−1.382]	[−3.643]	[−1.971]	[−2.535]	[−1.733]	[−2.637]
Control variables						
AbRet	0.165***	0.281***	0.176***	0.304***	0.158***	0.283***
	[6.904]	[9.625]	[6.851]	[9.467]	[6.091]	[8.677]
MTB	−0.002**	−0.015***	−0.002**	−0.015***	−0.002**	−0.014***
	[−2.406]	[−4.730]	[−2.256]	[−4.647]	[−2.076]	[−4.613]
R&D	−0.002	−0.004	−0.002	−0.003	−0.004	−0.004
	[−0.626]	[−0.934]	[−0.373]	[−0.598]	[−0.726]	[−0.799]
Dividend	−0.028***	−0.053***	−0.028***	−0.051***	−0.027***	−0.051***
	[−5.945]	[−10.797]	[−5.628]	[−9.950]	[−5.516]	[−9.866]
Depreciation	0.218***	0.108	0.228***	0.109	0.227***	0.107
	[2.579]	[1.215]	[2.704]	[1.246]	[2.782]	[1.305]
PPE	0.166***	0.160***	0.169***	0.160***	0.163***	0.148***
	[6.862]	[6.823]	[6.706]	[6.640]	[6.222]	[5.945]
Profit	−0.197***	−0.225***	−0.196***	−0.222***	−0.192***	−0.210***
	[−9.213]	[−9.678]	[−9.118]	[−9.337]	[−9.262]	[−9.433]
Size	0.031***	0.027***	0.031***	0.028***	0.029***	0.024***
	[9.247]	[9.227]	[8.454]	[8.905]	[7.792]	[8.175]
Firm FE	Yes	Yes	Yes	YES	YES	YES
Year FE	Yes	Yes	Yes	YES	YES	YES
Observations	31,073	31,073	29,605	29,605	27,728	27,728
Adjusted R^2	0.812	0.841	0.801	0.833	0.797	0.834

* Significance at the 10% levels (two-tailed test).
** Significance at the 5% levels (two-tailed test).
*** Significance at the 1% levels (two-tailed test).

Overall, Table 4 supports the earlier finding that Regulation FD affects capital structure through its influences on the equity market disclosure environment. Firms with high levels of information asymmetry are unlikely to fully replace private disclosure with public disclosure, which in turn leads to deterioration in the information environment and a higher cost of equity. These firms are more likely to turn to the debt market to raise capital post-Regulation FD than firms with low levels of information asymmetry. Table 4 shows that this result is robust to alternative proxies for extrinsic information asymmetry.

4.4. Open conference call firms as an alternative control group

Since Wang's (2007) methodology may introduce errors in classifying control firms, in this section I rerun the analysis using open conference call firms as an alternative control group. I obtain the conference call data from Bushee et al. (2004). Bushee et al. (2004) use Bestcalls.com to identify firms hosting open conference calls. The start of the Bestcalls database is March 1999. To avoid possible anticipation effects, I classify a firm as an open caller if it held open conference calls before 2000. 514 Firms are classified as open call firms. I further require these firms to exist in the post-Regulation FD period and have all required data for estimating Eq. (1). 118 Firms pass the data screening. I reclassify the remaining 1,554 firms in the original sample as the treated firms.

Table 5
Open conference call firms as alternative control firms.

This table presents results of changes in capital structure using open call firms as an alternative control group. *Book Leverage* is debt to BV of assets; *Market Leverage* is debt to MV of assets; *InfoAsym* is the average *AdjPIN* in the pre-Regulation FD period; *Treat*=1 if the firm is not classified as a public discloser by Wang's (2007) methodology, and 0 otherwise; *FD*=1 if the observation is from the post-Regulation FD period, and 0 otherwise; *AbRet* is abnormal returns around quarterly earnings announcements; *MTB* is MV of assets divided by BV of assets; *R&D* is research and development expense divided by total assets, with missing values set to industry-year average; *Dividend*=1 if the firm distributes common stock dividends in the year, and 0 otherwise; *Depreciation* is depreciation and amortization expense divided by total assets; *PPE* is net property, plant, and equipment divided by total assets; *Profit* is operating income before interest, taxes, and depreciation divided by total assets; *Size* is the log of net sales. *t*-statistics are in brackets and are calculated based on White heteroscedastic consistent standard errors clustered by firm.

	[1]	[2]
	Book Leverage	Market Leverage
Treat × FD	−0.032	−0.064*
	[−0.863]	[−1.710]
Treat × FD × InfoAsym	0.327	0.426*
	[1.518]	[1.726]
InfoAsym × FD	−0.464**	−0.519**
	[−2.205]	[−2.141]
Control variables		
AbRet	0.241***	0.487***
	[5.163]	[10.166]
MTB	−0.001	−0.050***
	[−0.173]	[−7.304]
R&D	−0.021	−0.020
	[−1.490]	[−1.506]
Dividend	−0.027***	−0.044***
	[−3.463]	[−6.234]
Depreciation	0.458***	0.019
	[2.666]	[0.066]
PPE	0.022	0.060*
	[0.635]	[1.772]
Profit	−0.257***	−0.370***
	[−4.844]	[−6.219]
Size	0.028***	0.035***
	[4.498]	[5.736]
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	11,786	11,786
Adjusted R^2	0.800	0.842

* Significance at the 10% levels (two-tailed test).
** Significance at the 5% levels (two-tailed test).
*** Significance at the 1% levels (two-tailed test).

Table 5 presents the regression results with open callers as the control firms. For both the book leverage and the market leverage specifications, I find that the coefficient on Treat∗FD∗InfoAsym is positive, but with weaker statistical significance compared to the main results in Table 3. Specifically, the coefficient is only significant at the 10% level (two-tailed test) for the market leverage specification (0.426, *t*-statistic of 1.726). For the book leverage specification, the significance of the coefficient further drops to the one-tailed 10% level. Overall, the result in Table 5 is still weakly consistent with the earlier finding that the equity market information risk is positively related to changes in leverage.

4.5. Is the change in capital structure really caused by Regulation FD?

The 1997 Asian and the 1998 Russian financial crises closed down debt financing, and the post-Regulation FD period coincides with the recovery of the debt market. One concern is that, if the recovery of the debt market is faster for firms with high information risk, then the results are not driven by Regulation FD but by the debt market recovery. Moreover, because the period surrounding the implementation of Regulation FD contains other events (e.g., the economic recession, the Internet bubble, the decimalization of the stock exchanges, and numerous accounting scandals), it is also possible that these confounding events are driving the results. To address these concerns, I rerun the tests using 1998, 1999, and 2001 as the hypothetical implementation years of Regulation FD. If Regulation FD is the main driving force behind the findings, I should find weaker or no results using these hypothetical implementation years.[29]

---

[29] When running the tests with hypothetical implementation years around Regulation FD, I re-estimate the control group based on Wang's (2007) methodology. For example, when 1998 is used as the implementation year, I employ the information from 1994 to 1997 (i.e., the hypothetical pre-Regulation

Untabulated analysis shows that rerunning the tests with hypothetical implementation years around Regulation FD leads to weaker or no results. For example, when I use 1998 as the implementation year (i.e., pre-Regulation FD period is from 1994 to 1997 and post-Regulation FD period is from 1999 to 2002), the coefficient on Treat∗FD∗InfoAsym becomes insignificant for both book leverage (0.243, t-statistic of 1.274) and market leverage (-0.035, t-statistic of -0.121). With 1999 as the implementation year (i.e., pre-Regulation FD period is from 1995 to 1998 and post-Regulation FD period is from 2000 to 2003), the coefficient on Treat∗FD∗InfoAsym is significant only for book leverage (0.317, t-statistic of 1.879) and is not significant for market leverage (0.035, t-statistic of 0.182). Finally, when I use 2001 as the implementation year (i.e., pre-Regulation FD period is from 1997 to 2000 and post-Regulation FD period is from 2002 to 2004), the significance level for the coefficient on Treat∗FD∗InfoAsym decreases for both book leverage and market leverage. For book leverage, Treat∗FD∗InfoAsym is significant only at the one-tailed test (0.330, t-statistic of 1.490). For market leverage, the significance level drops to the 10% level (0.346, t-statistic of 1.790). The fact that year 2000 gives the strongest result provides evidence that Regulation FD is an important driving force behind the findings.

4.6. Changes in cost of debt

One alternative explanation for the documented results is that firms with higher levels of information asymmetry in the equity market also experience greater decreases in the cost of debt. The lower cost of debt makes debt a cheaper capital source and thus increases leverage. To investigate this explanation, I examine the interest rates of the bonds issued and the bank loans raised during the sample period. I retrieve bond data from the Mergent database and bank loan data from Dealscan. I employ a regression model similar to Eq. (1) with cost of debt as the dependent variable:

$$\text{Spread}_{it} = \alpha_t + \beta_i + c\text{Treat}_i * \text{FD}_t + \delta\text{Treat}_i * \text{FD}_t * \text{InfoAsym}_i + \varphi\text{InfoAsym}_i * \text{FD}_t + \gamma\text{Controls}_{it} + \varepsilon_{it} \qquad (2)$$

For bank loans, Spread is the number of basis points above LIBOR charged on the loan. For bonds, Spread is the number of basis points above the yield of Treasury bond with similar maturity and coupon rate. After data requirements, 678 firms initiate debt both in the pre-Regulation FD and post-Regulation FD periods, among which 254 issue public bonds, 605 borrow bank loans, and 181 have both bond and bank borrowings. 540 of the 678 firms are treated firms, and 138 are control firms.

Following the literature (e.g., Beatty et al., 2002; Datta et al., 1999), I include a set of control variables related to debt pricing. The variables that are common to both public and private debt pricing are the credit rating (S&PRating), the leverage (MktLev) and size (Size) of the borrower, the maturity (Maturity) and size (DebtSize) of the debt, the credit spread (CreditSpread), the yield spread (YieldSpread), and whether the debt is secured (Security). The variables that are specific to public debt pricing are whether the issuer can redeem the bond before maturity (Redeem) and the age of the issuer (Age). The variables that are specific to private debt pricing are whether the loan is a revolving loan (Revolve) and whether the purpose of the loan is for a takeover (Takeover).[30]

Table 6 reports the results of Eq. (2). In column [1], I combine public and private debt and include control variables common to both types of debt. Since public debt and private debt may have different attributes, in columns [2] and [3], I estimate the model separately for each type of debt. The results offer no support for the cost of debt explanation. The coefficients on Treat∗FD∗InfoAsym are insignificant under all three specifications. Therefore, we cannot infer that changes in cost of debt around Regulation FD were different for firms with high levels of extrinsic information asymmetry in the equity market relative to firms with low levels of extrinsic information asymmetry. In contrast, the results support the assumption that Regulation FD has virtually no impact on the debt market information environment.

4.7. Alternative research design – two-stage least squares

I use Regulation FD as an instrumental variable and employ a two-stage least squares (2SLS) model as an alternative research design to further validate my results. Specifically, I estimate a first stage regression that identifies exogenous changes in information asymmetry due to the adoption of Regulation FD and then use the predicted values of information asymmetry to explain capital structure in the second stage regression. This research design is complementary to the difference-in-difference-in-differences approach. However, by estimating the first stage regression, a 2SLS design has the

---

(*footnote continued*)

FD period) to identify the control group. Similarly, when 1999 (2001) is used as the implementation year, I use the data from 1995 to 1998 (1997–2000) to classify the control group.

[30] I follow the procedure in Barth et al. (2008) to estimate the firm's S&P bond rating. S&PRating ranges from 1 for AAA to 22 for D; MktLev is market leverage (using book leverage yields similar results); Maturity is the number of years between the start and the end dates of the debt; DebtSize is the amount of the debt raised divided by the total assets of the borrower; CreditSpread is the difference between the Baa corporate bond and 30-year yield on the U.S. Treasury bonds; YieldSpread is the difference in the 10-year and 3-month yields on U.S. Treasury bonds; Security is a dummy variable, which equals 1 if the debt is secured and 0 otherwise; Redeem is a dummy variable, which equals 1 if the issuer can redeem the bond before maturity and 0 otherwise; Age is the number of days the firm appears on CRSP when the bond is issued; Revolve is a dummy variable, which equals 1 if the loan is a revolving loan and 0 otherwise; Takeover is a dummy variable, which equals 1 if the purpose of the loan is for takeover and 0 otherwise. S&PRating, MktLev, and Size are measured at the fiscal year end preceding the debt contract. CreditSpread and YieldSpread are measured at the month when the debt is raised.

Table 6
Changes in cost of debt.

This table examines changes in cost of debt around Regulation FD. For bank loans, *Spread* is the number of basis points above LIBOR charged on the loan and for public bonds, it is the number of basis points above the yield of Treasury bond with similar maturity and coupon rate; *InfoAsym* is the average *AdjPIN* in the pre-Regulation FD period; *Treat*=1 if the firm is not classified as a public discloser by Wang's (2007) methodology, and 0 otherwise; *FD*=1 if the observation is from the post-Regulation FD period, and 0 otherwise; *S&PRating* is the predicted S&P rating following the procedure in Barth et al. (2008) and ranges from 1 for AAA to 22 for D; *MktLev* is debt to MV of assets; *Size* is the log of net sales; *Maturity* is the number of years between the start and the end date of the debt; *DebtSize* is the amount of the debt raised divided by the total assets of the borrower; *CreditSpread* is the difference between the Baa corporate bond and 30-year yield on the U.S. Treasury bonds; *YieldSpread* is the difference in the 10-year and 3-month yield on the U.S. Treasury bonds; *Security*=1 if the borrowing is secured, and 0 otherwise; *Redeem*=1 if the issuer can redeem the bond before maturity, and 0 otherwise; *Age* is the number of days the firm appears on CRSP when the bond is issued; *Revolve* =1 if the loan is a revolving loan, and 0 otherwise; *Takeover* =1 if the purpose of the loan is for takeover, and 0 otherwise. *S&PRating*, *MktLev*, and *Size* are measured at the fiscal year end preceding the debt contract. *CreditSpread* and *YieldSpread* are measured at the month when the debt is issued. *t*-statistics are in brackets and are calculated based on White heteroscedastic consistent standard errors clustered by firm.

	[1]	[2]	[3]
	Public & Private	Public Debt	Private Debt
Treat × FD	10.765	10.248	21.550
	[0.461]	[0.226]	[1.045]
Treat × FD × InfoAsym	−33.972	−62.490	−43.162
	[−0.194]	[−0.160]	[−0.272]
InfoAsym × FD	105.576	188.487	132.458
	[0.690]	[0.584]	[0.930]
Control variables			
S&PRating	4.865***	6.049**	4.336**
	[2.843]	[2.339]	[2.286]
MktLev	217.199***	297.159***	202.178***
	[10.469]	[7.186]	[8.723]
Size	−24.326***	−31.248***	−20.642***
	[−3.174]	[−2.823]	[−2.624]
Maturity	2.118***	0.803***	3.394**
	[7.464]	[2.872]	[2.088]
DebtSize	−16.336*	42.673	−9.707
	[−1.868]	[1.048]	[−1.087]
CreditSpread	78.298***	113.591***	52.583***
	[9.114]	[7.436]	[4.584]
YieldSpread	0.571	0.321	5.116**
	[0.236]	[0.089]	[1.988]
Security	21.891***	133.067*	44.673***
	[2.915]	[1.837]	[6.222]
Redeem		25.299***	
		[2.825]	
Age		2.223	
		[0.386]	
Revolve			−23.611***
			[−5.649]
Takeover			18.438***
			[3.285]
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	6,054	2,299	3,755
Adjusted R^2	0.654	0.763	0.702

* Significance at the 10% levels (two-tailed test).
** Significance at the 5% levels (two-tailed test).
*** Significance at the 1% levels (two-tailed test).

benefit of showing that Regulation FD gives a strong enough shock to the information environment to make changes in capital structure plausible.

Table 7 reports the regression results. The result of the first-stage regression suggests that the regulatory impact on AdjPIN is economically significant (column [1]). The coefficient on the FD dummy variable indicates that a firm on average experiences a 0.9% reduction in AdjPIN after the adoption of Regulation FD. This result is consistent with findings in prior research that on average the information environment in the equity market improves after Regulation FD (e.g., Heflin et al., 2003; Eleswarapu et al., 2004). Given the average AdjPIN of 0.165 in the pre-Regulation FD period, the reduction represents a 5% drop in AdjPIN. This drop is large in magnitude, because information risk is highly persistent over time. Easley et al. (2002) document that "…individual stocks exhibit relatively low variability in the probability of information-based trading across years." Duarte and Young (2009) reach a similar conclusion with AdjPIN. I regress annual changes in AdjPIN on changes in the same set of control variables as in column [1] over the period of 1983–2004. I find that, on average,

Table 7

Changes in capital structure – 2SLS approach.

This table uses a 2SLS model to examine changes in capital structure associated with Regulation FD. *Book Leverage* is debt to BV of assets; *Market Leverage* is debt to MV of assets; *FD* = 1 if the observation is from the post-Regulation FD period, and 0 otherwise; *Predicted AdjPIN* is the fitted value of AdjPIN from the first stage; *AbRet* is abnormal returns around quarterly earnings announcements; *MTB* is MV of assets divided by BV of assets; *R&D* is research and development expense divided by total assets, with missing values set to industry-year average; *Dividend* = 1 if the firm distributes common stock dividends in the year, and 0 otherwise; *Depreciation* is depreciation and amortization expense divided by total assets; *PPE* is net property, plant, and equipment divided by total assets; *Profit* is operating income before interest, taxes, and depreciation divided by total assets; *Size* is the log of net sales; *InstOwn* is the proportion of the firm's shares held by institutions; *Coverage* is the number of analysts making annual EPS forecasts; *Volume* is the average monthly share turnover; *Volatility* is the standard deviation of the daily stock return. *t*-statistics are in brackets and are calculated based on White heteroscedastic consistent standard errors clustered by firm.

	[1]	[2]	[3]	[4]	[5]	[6]
	First Stage	Second Stage		First Stage	Second Stage	
	AdjPIN	Book Leverage	Market Leverage	AdjPIN	Book Leverage	Market Leverage
FD	−0.009***			−0.006***		
	[−5.441]			[−3.769]		
Predicted AdjPIN		1.173**	0.837*		1.315*	1.562**
		[2.499]	[1.816]		[1.913]	[2.149]
Control variables						
AbRet	0.009	0.261***	0.389***	−0.0002	0.058	0.096
	[0.457]	[5.247]	[7.300]	[−0.009]	[1.111]	[1.505]
MTB	−0.003***	0.003	−0.019***	−0.002*	0.003	−0.021***
	[−2.651]	[0.956]	[−3.897]	[−1.905]	[0.665]	[−4.488]
R&D	0.001	−0.014	−0.018*	0.008	−0.037**	−0.055**
	[0.107]	[−1.323]	[−1.724]	[1.109]	[−1.990]	[−2.535]
Dividend	−0.010***	−0.016*	−0.023**	−0.009***	−0.004	−0.004
	[−3.114]	[−1.922]	[−2.480]	[−3.097]	[−0.489]	[−0.369]
Depreciation	0.174***	0.405**	0.342*	0.099**	0.321**	0.212
	[3.137]	[2.553]	[1.805]	[2.159]	[2.275]	[1.485]
PPE	0.019	−0.008	0.004	0.015	−0.015	0.004
	[1.427]	[−0.232]	[0.109]	[1.294]	[−0.425]	[0.091]
Profit	−0.008	−0.350***	−0.412***	−0.009	−0.396***	−0.440***
	[−0.536]	[−9.537]	[−10.239]	[−0.584]	[−9.758]	[−9.459]
Size	−0.025***	0.062***	0.054***	−0.018***	0.074***	0.079***
	[−11.306]	[4.007]	[3.544]	[−9.098]	[4.566]	[4.587]
InstOwn				−0.014	−0.033**	−0.036**
				[−1.217]	[−2.027]	[−2.370]
Coverage				−0.002***	−0.003	−0.002
				[−9.919]	[−1.598]	[−1.117]
Volume				−0.071***	0.082	0.079
				[−4.005]	[1.336]	[1.226]
Volatility				0.243***	1.299***	1.495***
				[2.967]	[5.142]	[5.056]
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,667	11,667	11,667	11,527	11,527	11,527
Adjusted R^2	0.634	–	–	0.665	–	–

* Significance at the 10% levels (two-tailed test).
** Significance at the 5% levels (two-tailed test).
*** Significance at the 1% levels (two-tailed test).

the absolute value of the annual change in AdjPIN is only about 0.2%, which suggests that Regulation FD's impact on AdjPIN is 4 times larger than the average annual change.

Columns [2] and [3] show that the fitted AdjPIN is positively associated with both book leverage (1.173, *t*-statistic of 2.499) and market leverage (0.837, *t*-statistic of 1.816). The result is consistent with my prior findings that, due to the higher equity cost of capital, firms with higher extrinsic information asymmetry in the equity market are more likely to use debt financing.[31]

In columns [4]–[6], I include additional control variables that may affect information risk. Institutions influence a firm's information environment and price informativeness (El-Gazzar, 1998; Jiambalvo et al., 2002). I define institutional ownership, InstOwn, as the proportion of the firm's shares held by institutions. Prior research finds that extrinsic information asymmetry is lower for firms with larger analyst following (e.g., Brennan and Subrahmanyam, 1995; Easley

---

[31] I estimate the 2SLS model using the Stata package ivreg, which takes into account that Predicted AdjPIN in the second stage is estimated rather than observed and adjusts for the standard errors accordingly. I do not report the R^2 in the second stage, because as Wooldridge (2000) points out the R^2 for an instrumental variable estimation "is not very useful" and "has no natural interpretation." Some of the R^2 in the second stage are also negative.

et al., 1998). Coverage is the number of analysts making annual EPS forecasts in the year. Finally, Van Ness et al. (2001) investigate the relation between adverse selection cost and several corporate governance variables. They find that volume and volatility are the only variables persistently associated with adverse selection components of the spread estimated under different model specifications. Volume is the average monthly share turnover, and Volatility is the standard deviation of the daily stock return.

Including additional control variables slightly attenuates the magnitude of the coefficient on FD in the first stage regression (column [4]). However, the variable is still negative and statistically significant (-0.006, t-statistic of -3.77). More importantly, in the second stage, the fitted values of AdjPIN remain positively correlated with both book leverage and market leverage.

Overall, the results in Table 7 provide additional support for the original finding that Regulation FD changes the information environment through its influences on firms' disclosure policies. I find that the change in information asymmetry is large in magnitude and that information asymmetry is positively related to firms' reliance on debt financing. The result supports the hypothesis that information risk affects firms' financing choices.

4.8. Additional analysis and other robustness checks

I conduct several additional analyses, the results of which I summarize here without reporting the full estimates. So far, I have documented that relative to the control sample, firms with high extrinsic information asymmetry increase their leverage more after Regulation FD than firms with low extrinsic information asymmetry. The increase in leverage may come from more debt issued, less equity issued, or lower retained earnings. To obtain a more complete picture of how the capital structure changes, I examine the components related to changes in leverage: net equity issues (EIssue), newly retained earnings (ΔRE), and net debt issues (DIssue). I regress each of these three components on Treat*InfoAsym to determine the components through which leverage changes. The model takes the form

$$\text{Component}_i = \beta_1 + \beta_2 \text{Treat}_i + \beta_3 \text{Treat}_i * \text{InfoAsym}_i + \beta_4 \text{InfoAsym}_i + \gamma \Delta \text{Control}_i + \Delta \varepsilon_i \qquad (3)$$

where Component is either EIssue, ΔRE, or DIssue.

Following the balance sheet measures in Baker and Wurgler (2002), I define net equity issues (EIssue) as the change in mean BV of equity minus the change in mean retained earnings (Item 36) from pre-Regulation FD to post-Regulation FD, all divided by post-Regulation FD mean assets. ΔRE is the change in mean retained earnings from pre-Regulation FD to post-Regulation FD divided by post-Regulation FD mean assets. I define net debt issues (DIssue) as the residual change in mean assets from pre-Regulation FD to post-Regulation FD divided by post-Regulation FD mean assets.[32] ΔControl is the change in the mean control variables from pre-Regulation FD to post-Regulation FD. By differencing between the pre- and the post-Regulation FD periods, Eq. (3) removes firm fixed effects, and the year fixed effects are captured by the intercept.[33]

I find that the effect of extrinsic information asymmetry on capital structure comes mainly through new debt issues. When the dependent variable is net debt issuance, the coefficient on Treat*InfoAsym is positive and significant (0.76, t-statistic of 2.91). In contrast, when the dependent variable is either net equity issuance or newly retained earnings, the coefficient on Treat*InfoAsym is not significant (t-statistics of -0.519 and -0.048, respectively). These results suggest that more debt issues contribute to the higher leverage for firms with higher extrinsic information asymmetry. The changes in capital structure are not driven by changes in retained earnings or new equity issues.

Because Regulation FD has the least impact on banks, I expect the increase in the new debt issues for firms with high information asymmetry to come mainly from bank debt issues. I calculate the difference in the average amount of bonds and bank loans issued between the post-Regulation FD period and the pre-Regulation FD period deflated by the post-Regulation FD average assets for the treated firms in the fifth quintile of InfoAsym. Consistent with the expectation, I find that, on average, these firms increase their bond issues by 2.97% and their bank loans by 6.37%. However, the difference is only weakly significant (p-value$=0.058$, one tailed).

I conclude the paper by conducting additional robustness checks. First, I use idiosyncratic volatility (Ψ) as an alternative proxy for intrinsic information asymmetry between the firm and its shareholders. Higher idiosyncratic volatility indicates a larger amount of firm-specific information that is not shared by the market and thus higher information asymmetry between the firm and its shareholders (Krishnaswami and Subramaniam, 1999; Krishnaswami et al., 1999). I measure idiosyncratic volatility as $\Psi = \ln(1 - R^2/R^2)$, where R^2 is estimated from a firm-year regression of daily returns on contemporary market returns and lagged market returns.[34] All results hold when replacing AbRet with Ψ. Moreover, since

---

[32] The balance sheet measures in Baker and Wurgler (2002) rely on the balance sheet identity that assets equal debt plus book equity ($A=D+BE$), and book equity equals retained earnings plus equity capital contribution ($BE=RE+CC$). Therefore, new equity issuance is the change in book equity minus the change in retained earnings ($EIssue=\Delta BE - \Delta RE$) and new debt issuance is the residual change in assets ($DIssue=\Delta A - \Delta BE = \Delta A - EIssue - \Delta RE$).

[33] In this analysis four sample firms do not have non-missing data on retained earnings for both pre- and post-Regulation FD periods, so I cannot calculate their EIssue and ΔRE. The number of observations for the regressions is 1,672 when DIssue is the dependent variable and 1,668 when EIssue or ΔRE is the dependent variable.

[34] I include lagged market returns to avoid the problem of thin trading. For stocks with low liquidity, stock prices may not incorporate new information immediately, but with a lag. I also estimate Ψ by regressing daily returns on contemporary market returns and both lead and lag market returns. The results are very similar.

the capital structure of firms in the financial sector (6000s SICs) and the utility sector (4900–4999 SICs) is likely to differ from other firms, I rerun the analysis after excluding these firms from the sample. I find qualitatively similar results.

5. Conclusion

Using plausibly exogenous changes in the information environment associated with Regulation FD, I examine the relation between information risk and capital structure. Using both a difference-in-difference-in-differences design and a 2SLS design, I find that extrinsic information asymmetry in the equity market is positively associated with changes in firms' reliance on debt financing post-Regulation FD. This finding is robust to alternative proxies for extrinsic information asymmetry, and cannot be explained by changes in the cost of debt or changes in the general macro conditions. Given that cost of capital is increasing in the level of extrinsic information asymmetry, my results are consistent with the view that managers adjust the target leverage ratios to rely more on debt when facing an increased cost of equity associated with the firm's information environment. The paper thus provides empirical evidence of the effect of information risk on corporate financing choices.

This paper contributes to the literature by using Regulation FD as a plausibly natural experiment to establish a link between information risk and capital structure. The differential impacts of the standard on the equity market and the debt market make the rule change a useful setting in which to test the hypothesis. While prior studies have established a link between equity market information risk and capital structure (e.g., Bharath et al., 2009; Agarwal and O'Hara, 2007), such a link is less clear, because information risk can also affect cost of debt. Since Regulation FD primarily affects the equity market information environment and has little impact on the debt market information environment, it is reasonable to assume that any changes in capital structure are associated with changes in the equity market information risk. Therefore, this paper establishes a cleaner link between information risk and capital structure.

Appendix A. Identification of Public, Private, and Non-disclosers

Wang (2007) uses the following four equations from Matsumoto (2002) to estimate each firm's total earnings guidance:

$$\frac{\Delta EPS_{ijtq}}{P_{ijt-1,q}} = \alpha_{ijt} + \beta_{1ijt}\left(\frac{\Delta EPS_{ijtq-1}}{P_{ijt-1,q-1}}\right) + \beta_{2ijt}CRET_{ijtq} + \varepsilon_{ijt} \tag{A.1}$$

$$E[\Delta EPS_{ijtq}] = \left[\hat{\alpha}_{ijt-1} + \hat{\beta}_{1ijt-1}\left(\frac{\Delta EPS_{ijtq-1}}{P_{ijt-1,q-1}}\right) + \hat{\beta}_{2ijt-1}CRET_{ijtq}\right] * P_{ijt-1,q} \tag{A.2}$$

$$E[F_{ijtq}] = EPS_{ijt-1,q} + E[\Delta EPS_{ijtq}] \tag{A.3}$$

$$UF_{ijtq} = F_{ijtq} - E[F_{ijtq}] \tag{A.4}$$

where i indexes the firm, j indexes the industry (four-digit SIC code), q indexes the quarter, and t indexes the year. ΔEPS_{ijtq} is seasonal change in earnings per share; P is price; $CRET$ is daily excess returns cumulated from 3 days after last year same quarter's earnings announcement to 20 days before the current earnings announcement; F is analyst forecast; and UF is unexpected analyst forecast.

Eq. (A.1) models the seasonal change in EPS as a function of the prior quarter's seasonal change in EPS and cumulative daily returns. Eq. (A.1) is estimated for each firm-year. The estimation uses all firm-quarters in that year from the same industry, excluding data from the firm under estimation. The coefficients from Eq. (A.1) are then used to calculate the expected change in EPS as in Eq. (A.2). Eq. (A.3) defines the expected analyst forecast as last year same quarter EPS plus the expected seasonal change in EPS from Eq. (A.2). Finally the unexpected analyst forecast in Eq. (A.4) is the actual forecast minus the expected forecast. Wang (2007) defines the absolute value of UF as total earnings guidance.

Wang (2007) further uses the following equation to separate out private guidance from the total guidance:

$$|UF_{iq}| = \gamma_{0i} + \gamma_1 Std\Delta EPS_{iq} + \gamma_2 LOSS_{iq} + \gamma_3 PublicDisclosure_{iq} + \mu_{iq} \tag{A.5}$$

where $Std\Delta EPS$ is standard deviation of seasonal changes in EPS during the prior 3 years; $LOSS$ is a dummy variable which equals 1 if the firm reports a loss, 0 otherwise; and $PublicDisclosure$ is the number of earnings related public disclosures from First Call's Company Issued Guideline database. $Std\Delta EPS$ and $LOSS$ proxy for the predictability of earnings. Firms with harder to predict earnings are more likely to give guidance and thus, γ_1 and γ_2 are expected to be positive. Public disclosures proxy for the amount of public guidance and thus are expected to be positively associated with total guidance (i.e., $\gamma_3 > 0$).

Wang (2007) defines quarterly private earnings guidance as the absolute value of the sum of the firm-specific intercept and the error term. Annual average private guidance is the mean of the quarterly private guidance in the year. Wang (2007) then classifies firms as private disclosers if their annual private guidance ranks in the top 40 percent in every year of the firms' available years in the pre-Regulation FD period. Firms are classified as public disclosers if their mean earnings related public disclosures is 30 percent more than the average of all private disclosers. Firms are classified as non-disclosers if their mean earnings related public disclosures is 30 percent less than the average of all private disclosers.

Table 8
Estimation of private disclosers, public disclosers, and non-disclosers.

This table presents the classification results of pre-Regulation FD private disclosers, pre-Regulation FD public disclosers, and pre-Regulation FD non-disclosers. The methodology follows Wang (2007). Panel A reports the estimation results of quarterly private earnings guidance. Panel B reports descriptive statistics on earnings related public disclosers by discloser type. *UF* is unexpected analyst forecast estimated following Matsumoto (2002); *StdΔEPS* is seasonal changes in EPS during the prior three years; *LOSS* = 1 if the firm reports a loss in the quarter, and 0 otherwise; *PublicDisclosure* is the number of earnings related public disclosure in the quarter. *t*-statistics are in brackets and are calculated based on White heteroscedastic consistent standard errors.

Panel A: Estimation of pre-Regulation FD quarterly private earnings guidance

	|UF|
StdΔEPS	0.168***
	[17.72]
LOSS	0.054***
	[5.08]
PublicDisclosure	0.009**
	[2.02]
Observations	41,210
Adjusted R^2	0.27

Panel B: Descriptive statistics on the number of public disclosures

Firm type	Observations	Mean	Std Dev.	Median
Non-discloser	2915	0.027	0.172	0
Private discloser	973	0.217	0.596	0
Public discloser	993	0.585	0.876	0

* Significance at the 10% level (two-tailed test).
**Significance at the 5% levels (two-tailed test).
***Significance at the 1% levels (two-tailed test).

I apply the above estimation procedure on all Compustat firms with non-missing variables in the pre-Regulation FD period. Table 8 Panel A reports the estimation results of Eq. (A.5). Consistent with Wang (2007), the coefficients on the explanatory variables are all positive and significant. Firms with harder to predict earnings and with more public disclosures tend to provide more earnings guidance. Panel B reports descriptive information on earnings related public disclosures by firm type. There are 2,915 firms classified as non-disclosers, 973 as private disclosers, and 993 as public disclosers. On average, public disclosers issue 0.59 earnings related public disclosures per quarter and private disclosers issue 0.22 per quarter (i.e., about once per year). Non-disclosers only issue 0.03 public disclosures per quarter.

Appendix B. Estimation of private information trading and the adverse selection component of the bid–ask spread

I use three alternative proxies for extrinsic information asymmetry. The first is the amount of private information trading developed by Llorente et al. (2002). The measure is based on the argument that hedging trades generate negative autocorrelated returns and speculative trades generate positive autocorrelated returns.[35] The annual amount of private information trading can be estimated from the following firm-year regression:

$$R_{i,t+1} = c_0 + c_1 R_{i,t} + c_2 V_{i,t} * R_{i,t} + \varepsilon_{i,t+1} \tag{B.1}$$

where R is daily stock return and V is the log of daily turnover detrended by subtracting a 200 trading day moving average. Stocks with positive c_2 are associated with speculative trade (i.e., high amount of private information trading), while stocks with negative c_2 are associated with hedging trade (i.e., low amount of private information trading).

The second measure is the adverse selection component of bid–ask spread introduced in Glosten and Harris (1988). Glosten and Harris (1988) test several different model specifications and show that the following one is the most useful and parsimonious one "that captures the essence of the asymmetric information spread theory, and that yields reasonable, economically feasible estimates (p. 134)." Brennan and Subrahmanyam (1996) adopt this specification to analyze the relation between stock returns and illiquidity.

$$\Delta p_t = \lambda q_t + \psi[D_t - D_{t-1}] + \varepsilon_t \tag{B.2}$$

where p is transaction price; D is order sign that equals 1 for buy orders and -1 for sell orders; and q is signed order flow that equals D multiplying the number of shares traded. The variable portion of the price change, λ, is the adverse selection cost component.

---

[35] Hedging trades are defined as trades initiated by investors to rebalance their portfolios for risk sharing, while speculative trades are initiated by investors to speculate on their private information.

The third measure is also the adverse selection cost component, but is constructed based on the framework in Hasbrouck (1991). Hasbrouck (1991) models the adverse selection cost component as the amount by which the market maker adjusts the quote for unexpected order flow. Foster and Viswanathan (1993) follow Hasbrouck's (1991) approach, but rather than focusing on bid–ask quote, they focus on transaction price. I follow Foster and Viswanathan (1993) and estimate the following equations:

$$q_t = \alpha_q + \sum_{k=1}^{5} \beta_k \Delta p_{t-k} + \sum_{k=1}^{5} \gamma_k q_{t-k} + \tau_t$$

$$\Delta p_t = \alpha_p + \lambda \tau_t + \psi [D_t - D_{t-1}] + \varepsilon_t \tag{B.3}$$

The coefficient estimate λ in Eq. (B.3) is the adverse selection component of the price change.

I estimate the above three information asymmetry proxies for all firms in CRSP that have the available data for the capital structure analysis. I require the estimated coefficients (i.e., $\hat{c}_2$ (B.1) and $\hat{\lambda}$ in (B.2) and (B.3)) to be significant at least at 10% level. I scale $\hat{\lambda}$ by multiplying by 10,000 for presentation purpose.

References

Agarwal, P., O'Hara, M., 2007. Information Risk and Capital Structure (Working Paper). Cornell University.

Akins, B.K., Ng, J., Verdi, R.S., 2012. Investor competition over information and the pricing of information asymmetry. The Accounting Review 87 (1), 35–58.

Altamuro, J., Beatty, A., 2010. How does internal control regulation affect financial reporting? Journal of Accounting and Economics, 58–74.

Anilowski, Carol, Mei, Feng, Douglas, J. Skinner, 2007. Does Earnings Guidance Affect Market Returns? The Nature and Information Content of Aggregate Earnings Guidance. Journal of Accounting and Economics 44, 36–63.

Baker, M., Wurgler, J., 2002. Market timing and capital structure. Journal of Finance 57, 1–32.

Barth, M.E., Hodder, L.D., Stubben, S.R., 2008. Fair value accounting for liabilities and own credit risk. The Accounting Review 83 (3), 629–664.

Beatty, A., Ramesh, K., Weber, J., 2002. The importance of accounting changes in debt contracts: the cost of flexibility in covenant calculations. Journal of Accounting and Economics 33, 205–227.

Bertrand, M., Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preferences. Journal of Political Economy 111 (5), 1043–1075.

Bessembinder, H., 2003. Trade execution costs and market quality after decimalization. Journal of Financial and Quantitative Analysis 38 (4), 747–777.

Bessembinder, H., 1999. Trade execution costs on NASDAQ and the NYSE: a post-reform comparison. Journal of Financial and Quantitative Analysis 34 (3), 387–407.

Bharath, S.T., Pasquariello, P., Wu, G., 2009. Does asymmetric information drive capital structure decisions? Review of Financial Studies 22 (8), 3211–3243.

Brennan, M.J., Subrahmanyam, A., 1995. Investment analysis and price information in securities markets. Journal of Financial Economics 38, 361–381.

Brennan, M.J., Subrahmanyam, A., 1996. Market microstructure and asset pricing: on the compensation for illiquidity in stock returns. Journal of Financial Economics 41, 441–464.

Brown, S., Hillegeist, S.A., 2007. How disclosure quality affects the level of information asymmetry. Review of Accounting Studies 12, 443–477.

Brown, S., Hillegeist, S., Lo, K., 2004. Journal of Accounting and Economics. Conference calls and information asymmetry 37, 343–366.

Bushee, B.J., Matsumoto, D.A., Miller, G.S., 2004. Managerial and investor responses to disclosure regulation: the case of reg FD and conference calls. The Accounting Review 79 (3), 617–643.

Bushee, B.J., Matsumoto, D.A., Miller, G.S., 2003. Open versus closed conference calls: the determinants and effects of broadening access to disclosure. Journal of Accounting and Economics 34, 149–180.

Chakravarty, S., Van Ness, B.F., Van Ness, R.A., 2005. The effect of decimalization on trade size and adverse selection costs. Journal of Business Finance & Accounting 32 (5–6), 1063–1081.

Chen, Q., Goldstein, I., Jiang, W., 2007. Price informativeness and investment sensitivity to stock price. Review of Financial Studies 20 (3), 619–650.

Chen, Zhihong, Dan, S. Dhaliwal, Hong, Xie, 2010. Regulation fair disclosure and the cost of equity capital. Review of Accounting Studies 15 (1), 106–144.

Chuk, Elizabeth, Dawn, Matsumoto, Gregory, S. Miller, 2013. Assessing Methods of Identifying Management Forecasts: CIG vs. Researcher Collected. Journal of Accounting and Economics 55, 23–42.

Datta, S., Iskandar-Datta, M., Patel, A., 1999. Bank monitoring and the pricing of corporate public debt. Journal of Financial Economics 51, 435–449.

Dierkens, Nathalie, 1991. Information Asymmetry and Equity Issues. Journal of Financial and Quantitative Analysis 26 (2), 181–199.

Duarte, J., Young, L., 2009. Why is PIN priced. Journal of Financial Economics 91, 119–138.

Duarte, J., Han, X., Harford, J., Young, L., 2008. Information asymmetry, information dissemination and the effect of regulation FD on the cost of capital. Journal of Financial Economics 87, 24–44.

Easley, D., O'Hara, M., 2004. Information and the cost of capital. Journal of Finance 59 (4), 1553–1583.

Easley, D., Hvidkjaer, S., O'Hara, M., 2002. Is information risk a determinant of asset returns? Journal of Finance 57 (5), 2185–2221.

Easley, D., Kiefer, N.M., O'Hara, M., Paperman, J.B., 1996. Liquidity, information, and infrequently traded stocks. Journal of Finance 51 (4), 1405–1436.

Easley, D., O'Hara, M., Paperman, J., 1998. Financial analysts and information-based trade. Journal of Financial Markets 1, 175–210.

Eleswarapu, Venkat R., Rex, Thompson, Kumar, Venkataraman, 2004. The Impact of Regulation Fair Disclosure: Trading Costs and Information Asymmetry. Journal of Financial and Quantitative Analysis 39 (2), 209–225.

El-Gazzar, S.M., 1998. Predisclosure information and institutional ownership: a cross-sectional examination of market revaluations during earnings announcement periods. The Accounting Review 73 (1), 119–129.

Fama, E.F., French, K.R., 1997. Industry costs of equity. Journal of Financial Economics 43, 153–193.

Fama, E.F., French, K.R., 2002. Testing trade-off and pecking order predictions about dividends and debt. Review of Financial Studies 15 (2), 1–33.

Ferreira, M.A., Laux, P.A., 2007. Corporate governance, idiosyncratic risk, and information flow. Journal of Finance 62 (2), 951–989.

Foster, F.D., Viswanathan, S., 1993. Variations in trading volume, return volatility, and trading costs: evidence on recent price formation models. Journal of Finance 48 (1), 187–211.

Francis, J., Philbrick, D., Schipper, K., 1994. Shareholder litigation and corporate disclosures. Journal of Accounting Research 32 (2), 137–164.

Glosten, L.R., Harris, L.E., 1988. Estimating the components of the bid/ask spread. Journal of Financial Economics 21, 123–142.

Gomes, A., Gorton, G., Madureira, L., 2007. SEC regulation fair disclosure, information, and the cost of capital. Journal of Corporate Finance 13, 300–334.

Hasbrouck, J., 1991. Measuring the information content of stock trades. Journal of Finance 46 (1), 179–207.

Heflin, F., Subramanyam, K., Zhang, Y., 2003. Regulation FD and the financial information environment: Early evidence. The Accounting Review 78, 1–37.

Hovakimian, A., Opler, T., Titman, S., 2001. The debt-equity choice. Journal of Financial and Quantitative Analysis 36 (1), 1–24.

Jiambalvo, J., Rajgopal, S., Venkatachalam, M., 2002. Institutional ownership and the extent to which stock prices reflect future earnings. Contemporary Accounting Research 19 (1), 117–145.

Jorion, P., Liu, Z., Shi, C., 2005. Informational effects of regulation FD: evidence from rating agencies. Journal of Financial Economics 76, 309–330.

Koh, Ping-Sheng, David Reeb, 2014. R&D Disclosure. Working Paper, National University of Singapore.

Krishnaswami, S., Subramaniam, V., 1999. Information asymmetry, valuation, and the corporate spin-off decisions. Journal of Financial Economics 53, 73–112.

Krishnaswami, S., Spindt, P.A., Subramaniam, V., 1999. Information asymmetry, monitoring, and the placement structure of corporate debt. Journal of Financial Economics 51, 407–434.

Laderman, J.M., 1998. Wall Street's spin game (October 5). Business Week, 148–156.

Lambert, R.A., Leuz, C., Verrecchia, R.E., 2012. Information asymmetry, information precision, and the cost of capital. Review of Finance 16 (1), 1–29.

Leary, M.T., Roberts, M.R., 2005. Do firms rebalance their capital structure. Journal of Finance 60 (6), 2575–2619.

Lemmon, M.L., Roberts, M.R., Zender, J.F., 2008. Back to the beginning: persistence and the cross-section of corporate capital structure. Journal of Finance 63 (4), 1575–1608.

Llorente, G., Michaely, R., Saar, G., Wang, J., 2002. Dynamic volume-return relation of individual stocks. Review of Financial Studies 15 (4), 1005–1047.

Low, A., 2009. Managerial risk-taking behavior and equity-based compensation. Journal of Financial Economics 92, 470–490.

Matsumoto, D., 2002. Management's incentives to avoid negative earnings surprises. The Accounting Review 77 (3), 483–514.

Miller, G.S., 2002. Earnings performance and discretionary disclosure. Journal of Accounting Research 40 (1), 173–204.

Rajan, R.G., Zingales, L., 1995. What do we know about capital structure? Some evidence form international data. Journal of Finance 50 (5), 1421–1460.

Sarkissian, S., Schill, M.J., 2010. Why are U.S. Firms Listed in Foreign Markets Worth More? (Working Paper). McGill University.

SEC, 2000. Final Rule: Selective Disclosure and Insider Trading.

Shroff, Nemit, Amy, X. Sun, Hal, D. White, Weining, Zhang, 2013. Voluntary Disclosure and Information Asymmetry: Evidence from the 2005 Securities Offering Reform (December). Journal of Accounting Research 51 (no. 5), 1299–1345.

Sidhu, B., Smith, T., Whaley, R.E., Willis, R.H., 2008. Regulation fair disclosure and the cost of adverse selection. Journal of Accounting Research 46 (3), 697–728.

Skinner, D.J., 1994. Why firms voluntarily disclose bad news. Journal of Accounting Research 32 (1), 38–60.

Unger, L.S., 2001. Special Study: Regulation Fair Disclosure Revisited.

Unger, L.S., 2000. Speech by SEC Commissioner: Fallout from Regulation FD – Has the SEC Finally Cut the Tightrope?.

Van Ness, B.F., Van Ness, R.A., Warr, R.S., 2001. How well do adverse selection components measure adverse selection? Financial Management 30 (3), 77–98.

Vega, C., 2006. Stock price reaction to public and private information. Journal of Financial Economics 82, 103–133.

Verrecchia, R.E., Weber, J., 2006. Redacted disclosure. Journal of Accounting Research 44 (4), 791–814.

Wang, I.Y., 2007. Private earnings guidance and its implications for disclosure regulation. The Accounting Review 82 (5), 1299–1332.

Wooldridge, Jeffrey M., 2000. Introductory Econometrics: A Modern Approach. South-Western College Publishing.