“Talk more” or “Talk better”? The economic consequences of narrative R&D disclosures—An examination of China’s corporate bond market

Abstract

This paper investigates how the narrative R&D disclosures of listed firms influence their bond issuance spreads under China’s mandatory R&D disclosure regime. Taking advantage of machine learning and textual analysis techniques, we construct measures of narrative R&D disclosures based on disclosure quantity and readability. We find a robust positive relationship between the quantity of narrative R&D disclosures and bond issuance spreads, and the increased information risk premium originating from more opaque information environments of disclosing firms is the internal mechanism. Further evidence shows that readability of narrative R&D disclosures can alleviate this positive relationship between narrative R&D disclosure quantity and bond issuance spreads. Moreover, we find the heterogeneous effect of narrative R&D disclosures on the issuance spreads of different types of bonds. And more narrative R&D disclosures can reduce the probability of corporate bond issuance and the ratio of firms’ bond financing. Overall, our research demonstrates an unexpected impact of mandatory narrative R&D disclosure on corporate bond issuance costs, indicating that “talking more” does not necessarily deliver clearer R&D-related information.

Keywords: Narrative R&D disclosures; Bond issuance spreads; Information asymmetry; Textual analysis

JEL: D82, G12, G32, M41

1. Introduction

Research and development (R&D) investment has been treated as an important contributor to economic growth (Brown & Petersen, 2009; Kogan et al., 2017). Given the great importance of R&D projects for firms' productivity and future performance, outside stakeholders are especially concerned with firms' R&D-related information (Lev, 1999; Narayanan et al., 2000). Previous studies have indicated the substantial implications of quantitative R&D-related information, such as R&D expenditures and patent applications, for capital market outcomes (Kothari et al., 2002; Lev et al., 2005), but the impact of nonquantitative R&D disclosures (e.g., narrative disclosures) has remained relatively unexplored. Narrative disclosures provide a channel for managers to communicate R&D-related information and bridge the gap between a firm's financial statement numbers and its underlying business fundamentals (Hanley & Hoberg, 2010; Li et al., 2010; Merkley, 2014). However, it is unclear whether market participants view narrative R&D disclosures as informative given the high complexity and uncertainty of R&D activities. Although several studies have investigated how narrative R&D disclosures affect a firm's stock price crash risk (Andreou et al., 2021), the market value of equity (Lu et al., 2023; Nekhili et al., 2016), analyst forecasts (Li & Yao, 2020), insider trading (Huang & Liang, 2024) and bank loans (Liang et al., 2024), few studies have examined the consequences of such disclosures in the bond market despite their close link with firm's future risks. To fill this gap, this study examines the relation between narrative R&D disclosures and a firm's bond issuance spreads in the Chinese bond market.

It is intriguing to investigate the economic consequences of narrative R&D disclosures from the perspective of bond investors. First, the Chinese corporate bond market has grown substantially over the past several decades. By the end of 2020, the balance of China's bond market had exceeded RMB 100 trillion, becoming the world's second-largest bond market after that of the United States. The public debt market provides continuous and significant financial resources to Chinese listed firms. Based on this background, it is especially important to understand the factors influencing the

costs of debt. While prior studies have examined the impact of quantitative disclosures of R&D information on a firm's debt financing behaviors (Eberhart et al., 2008; Hsu et al., 2015; Saidi & Žaldokas, 2021; Shi, 2003, Liang et al, 2024), their conclusions are mixed. In particular, the role of narrative R&D disclosures in bond spread remains largely underexplored in the literature. Second, bond investors are more sensitive to the quality of public disclosures than banks or other private creditors who possess more sophisticated abilities and have access to alternative information channels. In addition, bond investors, as public market participants, are decentralized in their debt rights. Empirical evidence shows that they are less efficient in overseeing and monitoring information-problematic firms (Dhaliwal et al., 2011a; Ramakrishnan & Thakor, 1984). Given the considerable heterogeneity of firms' creditors and the current research gap, whether and how bond investors price a firm's narrative R&D disclosures is a pertinent question demanding empirical investigation.

Our sampling of Chinese firms offers the advantage of testing this research question. In 2012, the China Securities Regulatory Commission (CSRC) began requiring listed companies to disclose information related to R&D activity in their annual reports in accordance with the "No. 2 Standard on the Content and Format of Information Disclosure for Publicly Issued Securities Companies - Content and Format of Annual Reports" (CFAR-2012)[1].The policy can date back to 2001 and was continuously adjusted with the most significant amendments made in 2012.[2] CFAR-2012 requires listed companies to report thorough details regarding the objectives, progress, potential impacts on future performance of existing R&D projects as well as future R&D plans and the resources they require. Therefore, China's mandatory R&D

[1] The accounting standards in most countries only set specific rules to regulate quantitative disclosures of R&D-related information in financial statements. These rules are quite rigid regarding the inclusion of R&D expenses in financial statements, making the transmission of R&D-related information rather limited in firms' financial reports. For example, in accordance with IAS 38, an entity is permitted to recognize a self-created (at cost) intangible asset if and only if: (1) It is possible that the future economic benefits attributable to this asset will eventually flow into the enterprise; (2) The cost owing to an asset can be measured reliably; (3) The probability of future economic benefits is based on reasonable and supportable assumptions about conditions that will exist over the life of the asset; (4) The probability recognition criterion is always considered to be satisfied for intangible assets that are acquired separately or arise from contractual as well as other legal rights. China's setting is unique in that the narrative R&D disclosure policy is mandated.

[2] To clearly illustrate the background of the Chinese narrative R&D disclosure regime, we present the requirements of the different versions of CFAR on the narrative R&D disclosure of listed companies in Appendix A.

disclosure regime provides us with a large sample of public firms undertaking ample narrative R&D disclosures with which we can examine the relationship between narrative R&D disclosures and the cost of debt.

Adopting a sample of bond issuers from 2008 to 2020 in China and using machine learning and textual analysis techniques to construct proxies for narrative R&D disclosures, we find that more narrative R&D disclosures are associated with greater bond issuance spreads. Meanwhile, the readability of narrative R&D disclosures can alleviate the adverse impact of narrative R&D disclosures on bond issuance spreads. We propose and validate that higher information risk premium originating from more complex information environments of disclosing firms plays as the potential channel through which narrative R&D disclosures increase bond issuance spreads.

The empirical results suggest that the positive relationship between narrative R&D disclosures and bond issuance spreads is strengthened for firms with managers who are more strongly motivated to make obfuscation disclosures (i.e., firms in more competitive environments, firms with high industry growth) but weakened for firms with more sophisticated market participant following (i.e., firms with more media coverage, institutional investors, and short sellers). Further analysis shows that the positive effect of narrative R&D disclosures on bond spreads mainly occurs in firms with lower R&D investments, indicating that increased narrative R&D disclosures may not convey authentic R&D-related information. In addition, there is a heterogeneous effect of narrative R&D disclosure on the issuance spread of different bond types, with short-term commercial paper and medium-term notes affected greater. Additionally,, we find that more narrative R&D disclosures reduce the probability of corporate bond issuance and the ratio of firms' bond financing. Our main findings are robust after alleviating selection bias concerns, mitigating omitted variable concerns, and using alternative measures.

Our paper makes several contributions to the literature mainly from two aspects.

For one thing, it extends the research on R&D-related textual information disclosure. As a burgeoning topic in recent years, the driver factors and economic consequences of narrative R&D disclosures are largely under explored. Scant studies

that have investigated the economic effect of narrative R&D disclosures concentrated mainly on the stock market, providing evidence that narrative R&D disclosures are informative for equity investors and are related to better market efficiency and a firm's future value (Andreou et al., 2021; Lu et al., 2023; Nekhili et al., 2016). Unlike stock market participants, bond investors pay more attention to the risks arising from narrative R&D disclosures since they only have a fixed claim on a firm's income (Shi, 2003). The most relevant paper to our research is Huang and Liang (2024). Consistent with their findings, we also demonstrate that more narrative R&D disclosures indeed aggravate the information asymmetry rather than provide valid and authentic information to the capital market. Distinct from their research, we mainly explore how bond investors evaluate narrative R&D disclosures, providing further supporting evidence that investors suffer higher information processing costs with R&D-related textual information disclosures (Huang and Liang, 2024).

For another, our study contributes to the understanding of the role of R&D-related information in bond pricing. Although prior studies document that quantitative R&D information is an important determinant of debt yield spreads (Eberhart et al., 2008; Hsu et al., 2015; Saidi & Žaldokas, 2021; Shi, 2003), few studies explore how bond investors price a firm's narrative R&D disclosures. We thus enrich the literature on the determinants of bond yield spreads at issuance from the perspective of narrative R&D disclosures. Moreover, despite the quantity of narrative R&D disclosures, we further examine the moderating effect of the readability of R&D-related texts, providing a more comprehensive picture of the impact of narrative R&D disclosures on bond investors' decision-making.

The remainder of this paper is organized as follows. Section 2 develops the hypotheses. Section 3 describes the data, sample selection, and research design. Section 4 reports and discusses the empirical results. Section 5 discusses the endogeneity and robustness checks. Section 6 presents our conclusions.

2. Hypothesis development

In the literature, firms' bond issuing spreads are usually measured by bond yield

spreads, which are the difference between the bond's yield to maturity and the yield of a non-risky bond with similar remaining maturity. At the firm-specific level, the bond issuing spreads are mainly determined by two factors: firms' default risks and the degree of information asymmetry (Duffie & Lando, 2001; Merton, 1974).

Of the two, "default risk" refers to firms' abilities and willingness to repay their debt, which are mainly associated to corporate financial status or governance (Borisova & Megginson, 2011; Boubakri & Ghouma, 2010; Carlson & Lazrak, 2010; Cremers et al., 2007; Qiu & Yu, 2009), shareholder characteristics (Baran & King, 2010; Ge et al., 2020), the leverage ratio (Flannery et al., 2012), firms' strategies (Davydenko & Strebulaev, 2007; Flannery & Öztekin, 2012), suppliers' and customers' information asymmetry (Chen et al., 2013), information acquisition costs (Jaskowski & Rettl, 2023) and so on. Information risk is the likelihood and potential magnitude of loss for bond holders originating from corporate information asymmetry(DeBoskey & Gillett, 2013). Greater information asymmetry can intensify shareholders' expropriations of debt holders' interests. The potential benefit loss will then be considered in advance and priced into bond issuance spreads. Meanwhile, effective and sufficient information disclosures can help mitigate the conflicts between bondholders and shareholders, thus decreasing bond issuing spreads (Ahmed et al., 2002; Yu, 2005). In a nutshell, Debt investors' evaluations of firms' default and information risks are interpreted in bond yield spreads.

Given the complex and professional nature of R&D-related information, the impact of narrative R&D disclosures on information risks perceived by bond investors can be ambiguous. On the one hand, enormous narrative R&D disclosures are supplementary to R&D-related financial information, presenting a more complete picture of firms' R&D activities to outsiders. Under this assumption, narrative R&D disclosures are helpful in eliminating information asymmetry and reducing information risks, so bond investors will charge a lower yield for bonds issued by companies with more narrative R&D disclosures (Dhaliwal et al., 2011b).

On the other hand, the mandatory regime of narrative R&D disclosures in China's capital market can distort managers' incentives of making disclosure decisions.

Although public companies are forced to provide more detailed information regarding their R&D activities under China's mandatory disclosure institution, the quality of narrative R&D disclosures cannot be guaranteed, especially when managers' manipulations of information disclosures are difficult to detect. Unlike quantitative financial information disclosures, the effectiveness of qualitative narrative disclosures highly depend on managers' intentions. Regulators face more challenges to monitor unstructured and subjective textual information than to oversight comparable financial numbers. Despite the mandatory disclosure requirement, management enjoys wide latitude in determining the specific details, formats, layouts and even presentation styles of narrative disclosures (Davis & Tama-Sweet, 2012; Henry & Leone, 2016; Loughran & McDonald, 2014). Managers may introduce bias into narrative R&D disclosures out of various motives without being detected. In this case, more narrative R&D disclosures will obfuscate and dampen firms' information environments, hence exacerbating information risks.

More specifically, R&D-related disclosures usually entail significant proprietary costs because they are closely related to firms' competitiveness in the product market. There are extensive studies demonstrating that managers concerned about proprietary costs can engage in strategic reporting to discourage competitors from snatching their industry shares by obscuring mandatory disclosures of sensitive information despite potential rigorous regulation penalties (Bagnoli & Watts, 2010; Ellis et al., 2012; Rawson, 2022). In our research scenario, managers considering proprietary costs are prone to obfuscate narrative R&D disclosures, thus conveying invalid or even distorted information. It can be highly costly for bond investors to acquire and understand such diverse disclosures. The risks of distorted information then can be priced into bond issuance spreads.

In addition, investors with limited time and abilities are hindered in comprehending the embedded information in firms' narrative R&D disclosures due to the complexities and irregularities of such disclosures (Blankespoor et al., 2020; Booker et al., 2023). Recently, a significant number of studies have demonstrated that individual investors are faced with processing costs as new information arrives

(Hirshleifer & Teoh, 2003), impeding investors to incorporate firms' disclosures. In contrast to regular operating activities, R&D investments are highly heterogeneous across different companies or industries. Massive amounts of scientifically complicated and technically uncommon languages are unavoidable when narrative R&D disclosures are made, make financial reports more complicated and costly to process (Henry & Leone, 2016).[3] Considering that unsophisticated investors dominate China's capital market, voluminous R&D disclosures from public firms are more likely to impose processing costs and exacerbate information asymmetry.

The opaque information environments resulted from more narrative R&D disclosures can exaggerate the associated uncertainties about the bond's underlying value, yielding a greater bond issuing spreads (Goldstein & Yang, 2015; Jaskowski & Rettl, 2023). In other words, with more narrative R&D disclosures increasing information asymmetry, bond investors will demand higher issuing spreads for disclosing firms.

Based on the above analysis, we propose the first hypothesis:

H1: *The quantity of narrative R&D disclosures is positively associated with bond issuance spreads.*

Hypothesis 1 investigates the impact of narrative R&D disclosures from the perspective of the disclosing quantity, while qualitative features may have a mediating effect since investors' processing and absorption of narrative information disclosures is an integrated and complex process (Masson & Waldron, 1994). Specifically, readability is an important qualitative feature of narrative R&D disclosures. "Readability" refers to a combination of various factors involving interest, legibility and ease of understanding for readers. Ambiguous and hard-to-read texts in financial reports can heavily interfere with investors' ability to comprehend reports. However, the inclusion of more readable words, sentences or expressions in qualitative disclosures can facilitate investors' interpretations of complicated and obscure narrative R&D

[3] For example, a Chinese public company in the high-tech industry known as Quick Intelligent Equipment Co., Ltd. (Stock Code: 603203) included numerous technical expressions in its narrative R&D disclosures in fiscal year 2017, such as "High-speed and High-precision Motion Control", "Precision Optical Modules", "SMT Pre- and Post-Oven Inspection", "Post Wave Soldering Joint", or "FPC High Density Microvia Solder Joint Inspection", which made its financial reports difficult to process.

disclosures and reduce information processing costs (Loughran & McDonald, 2014). Moreover, a higher readability of R&D-related texts indicates that managers have fewer incentives to obfuscate narrative R&D disclosures and imply their greater willingness to sincerely communicate R&D-related information to outsiders. Under this scenario, there is less possibility that narrative R&D disclosures will be distorted. In contrast, narrative R&D disclosures that are difficult to read will impair their effectiveness in conveying new information. In line with the above argument, we propose the second hypothesis:

H2: *The positive relationship between narrative R&D disclosures and bond issuance spreads is attenuated when the readability of narrative R&D disclosures is higher.*

3. Research design

3.1 Sample selection and data sources

This paper selects Chinese A-share listed companies that issued bonds between 2008 and 2020 as the initial research sample. To avoid the influences of new Chinese accounting standards enacted in 2007, our sample starts from 2007. Since the annual report of a firm is generally published in the next year, so the data series on bond issuance begins in 2008. We downloaded the firms' annual reports from the Juchao Information Collection Website[4] via a crawler program and China's government working reports from the official website of the State Council.[5] To facilitate subsequent processing, we use the *pdfplumber* to convert the PDF-version annual reports to HTML-version ones and delete all the images in the report. We use machine learning and textual analysis techniques to construct proxies for narrative R&D disclosures. The bond issuance data come from the Wind and iFinD databases. Other financial and governance data used in this paper come from the CSMAR database.

In addition, we used various filters to clean our samples. We exclude (1) firms in the financial sectors (2) firms with negative assets; (3) firms with "special treatment"

[4] Link: http://www.cninfo.com.cn/new/fulltextSearch?notautosubmit=&keyWord=833637.
[5] Link: http://www.gov.cn/zhengce/zhengcewenjianku/index.htm.

(ST) status or with "particular transfer" (PT) status; (4) firms issuing convertible bonds, financial bonds, or floating rate bonds; and (5) firms with missing onservations for calculating control variables. Finally, these filters enable us to construct a final sample consisting of 3,716 bonds issued from 386 listed firms. The bond types include medium-term notes, corporate bonds, and short-term commercial paper. We winsorize all continuous variables at the 1st and 99th percentile levels to mitigate the possible influence of outliers.

3.2 Variable measurement

3.2.1 Measurement of narrative R&D disclosures

Following Merkley (2014) and Huang and Liang (2024), we create a vocabulary of R&D-related keywords in the Chinese context from a corpus through a word embedding approach[6] called word2vec[7]. Then, we use the textual analysis method to construct proxies for narrative R&D disclosures. First, we filtered out six seed words for R&D-related information by manually reading the firms' annual reports and following previous studies (e.g., Merkley, 2014; James & Shaver, 2016; Hu et al., 2018; Rawson, 2022).[8] Next, we randomly selected 3000 copies of firms' annual reports and China's government work reports from 2007 to 2020 as the corpus, applying the continuous bag of words (CBOW)[9] algorithm to produce word embeddings. Then, we calculate the word similarity in the word embeddings to expand the seed keyword list. Finally, we obtained a Chinese R&D-related dictionary containing 395 words or phrases.

We construct two proxies for narrative R&D disclosure characteristics, which are

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[6] A word embedding format generally tries to map a word to a vector using a dictionary. In this approach, words and documents are represented in the form of numeric vectors in a manner allowing similar words to have similar vector representations. The extracted features are input into a machine learning model, where they are compatible with text data and preserve their semantic and syntactic information.

[7] Word2Vec is a word embedding method developed by Google in 2013.

[8] Merkley (2014) and James and Shaver (2016) construct R&D dictionaries in the English-language context. We created their Chinese versions using Google Translate.

[9] Word2vec contains two groups of word embedding methods: continuous bag of words and skip-grams. CBOW includes inputs such as words or phrases that are adopted by the neural network model. On this basis, it predicts the targeted word that closely relates to the context of various words entered as input. Once trained, the CBOW model generates numerical vectors, which capture the semantics of words in a continuous vector space and can be used in various natural language processing (NLP) tasks.

the quantity (*NarRD*) and the readability (*NarRead*) of narrative R&D disclosures. To measure the quantity of narrative R&D disclosure (*NarRD*), first, we parse the Chinese words or phrases in annual reports using "jieba" in Python[10] and eliminate the stop words. Then, we use the constructed R&D dictionary to identify and count R&D-related disclosures. We measure *NarRD* as the number of R&D-related keywords or phrases divided by the total number of words in the annual report. To avoid the magnitude of *RDText* being too small, we multiply it by 1000. A larger *NarRD* means more narrative R&D disclosures in a firm's annual report.

We now explain the measurement of the readability of narrative R&D disclosure (*NarRead*). Since we are mainly concerned about the readability of R&D-related texts in this paper rather than the readability of entire annual reports, identifying R&D-related texts is required first. Specifically, R&D-related text is identified via the keyword searching method with Python. We searched for R&D-related keywords in annual reports with Python codes. Then, we extracted 100 words before and after the R&D keywords as R&D-related texts.[11] Referring to the study of Wang et al. (2018), we calculate the natural logarithm of the total list of uncommon words[12] in the R&D-related texts and then take the reciprocal as the proxy for the readability of narrative R&D information (*NarRead*). A larger *NarRead* represents greater readability of R&D-related texts.

3.2.2 Measurement of bond issuance spreads

Following Lin and Su (2022), we calculate bond issuance spreads (*Spread*) by subtracting the yield to maturity of the bond from the yield to maturity of the government bond of the same remaining maturity. This measure is commonly used as a proxy for public debt investors' evaluation of the risks of issuing firms. Higher bond issuance spreads indicate more riskiness that investors attach to the firms.

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[10] "Jieba" is an open-source software package for Chinese text segmentation.

[11] We chose a total of 200 words related to R&D-related keywords based on our manual reading of 500 annual reports, suggestions from the financial staff of listed firms and judgment experience. The R&D-related texts vary in length, and the number 200 is simply an average quantity.

[12] The list of uncommon words is based on *Subcommon Characters in Modern Chinese (1998).*

3.3 Regression models

To examine the impact of narrative R&D disclosure on bond issuance spreads, we specify a multivariate regression as follows:

$$Spread_{i,t+1} = \beta_0 + \beta_1 NarRD_{i,t} + \beta Controls_{i,t} + \sum Firm + \sum Year + \varepsilon_{i,t} \quad (1)$$

where *NarRD* is the measure of the quantity of narrative R&D disclosures for firm *i* in year *t* and *Spread* is the measure of the issuance spreads of bonds for firm *i* in year *t+1*. *Controls* refers to an extensive set of control variables that are associated with bond issuance pricing based on prior literature (Gong et al., 2018). To capture the impact of narrative R&D information disclosure rather than the impact of R&D activities themselves, we control for the number of invention patents (*InvPat*), R&D expenditure amount (*RDExp*), and the number of R&D staff (*RDStaff*). We also control for firm characteristic variables, including firm size (*Size*), profitability (*ROE*), leverage (*Lev*), shareholding ratio of the largest shareholder (*TopHold*), property rights (*SOE*), board size (*Board*), the proportion of independent directors (*IndDir*), fixed asset investment amount (*CapExp*), default risk (*ZScore*), market value to tangible assets ratio (*Mtr*), and bond issuance size (*BondSize*). We include firm fixed effects (*Firm*) and year fixed effects (*Year*). Finally, we use firm clustered standard errors to alleviate cross-sectional dependence in the data. All variable definitions are available in **Appendix B**.

To test Hypothesis 2, we modify Eq. (2) to include *NarRead* and the interaction term between *NarRD* and *NarRead*. The regression model is as follows:

$$\begin{aligned} Spread_{i,t+1} = {} & \beta_0 + \beta_1 NarRD_{i,t} + \beta_2 NarRD_{i,t} \times NarRead_{i,t} + \\ & \beta_3 NarRead_{i,t} + \beta Controls_{i,t} + \sum Firm + \sum Year + \varepsilon_{i,t} \end{aligned} \quad (2)$$

3.4 Descriptive statistics and correlations

Table 1 reports the descriptive statistics of the main variables used in this paper. The mean and median values of *Spread* are 1.455 and 1.271, respectively, which indicates that the interest rate of credit bonds issued by the firm is significantly higher than the interest rate of government bonds with the same maturity in the same period;

that is, the credit risk premium is significant. The mean value of *NarRD* is 2.912, indicating that on average, R&D-related words account for 2.912 ‰ of the total number of words in the annual report. The *NarRD* values are volatile, ranging from 0.145 to 22.832, with a standard deviation of 3.075 in our sample, indicating that there are great differences in narrative R&D disclosures among listed companies in China. In terms of other control variables, the sample firms that issue bonds are relatively large (mean *Size* = 24.637) and have heavy debt (mean *Lev* = 0.617). The mean value of *SOE* is 0.708, suggesting that among the firms that issue bonds, state-owned firms dominate.

[Insert Table 1 Here]

Table 2 presents pairwise correlations between the narrative R&D disclosure measure, bond issuance pricing, and control variables used in the main regression model. Both the Pearson and Spearman correlations between *NarRD* and *Spread* are significantly positive, which provides preliminary evidence in support of Hypothesis 1, indicating that more narrative R&D disclosures increase the issuance spreads of bonds. In addition, *NarRD* is significantly and positively correlated with three innovation characteristic variables, i.e., the number of invention patents (*InvPat*), the R&D expenditure amount (*RDExp*), and the number of R&D staff *(RDStaff*), suggesting that the *NarRD* measure constructed in this paper can effectively capture firms' descriptions of their innovation activities.

[Insert Table 2 Here]

4. Empirical results

4.1 Baseline regressions

4.1.1 Narrative R&D disclosure and bond issuance spreads – test of Hypothesis 1

Table 3 reports the estimation results for our baseline regression. In Column (1), where control variables are not included, the coefficient of *NarRD* is 0.089 (t=3.25), which is statistically significant at the 1% level. In Column (2), after adding a set of

control variables, we still observe a significantly positive relation between *NarRD* and *Spread*, whereby the coefficient is 0.081 (t=3.01). This finding suggests that more narrative R&D disclosures increase bond issuance spreads, which supports Hypothesis 1. In addition, this result is economically significant. For instance, the coefficient of 0.081 implies that a one-standard deviation increase in narrative R&D disclosures is associated with a 17.12% increase in bond issuance spreads relative to the mean[13], suggesting that the economic impact of narrative R&D disclosures on a firm's bond issuance spreads is remarkable.

With regard to control variables, we find that *Spread* significantly and negatively relates to the number of invention patents (*InvPat*) and R&D expenditure amount (*RDExp*), suggesting that bond investors perceive R&D-related financial information and nonfinancial information differently. In addition, we find that firms with a larger size and greater proportion of independent directors show lower bond issuance spreads, while firms with a higher debt ratio, more concentrated ownership and greater capital expenditure show greater bond issuance spreads.

[Insert Table 3 Here]

4.1.2 Considering the readability of narrative R&D disclosures – test of Hypothesis 2

Hypothesis 2 predicts that the positive relationship between narrative R&D disclosure and bond issuance spreads is weakened when the readability of narrative R&D disclosure is greater. Columns (1) and (2) of **Table 4** report the empirical results supporting this hypothesis. We find that regardless whether control variables are added, the coefficients of the interaction term *NarRD*×*NarRead* are significantly negative. This finding indicates that the greater readability of narrative R&D disclosures can signal the willingness of managers to convey authentic R&D information and reduce the information processing costs for bond investors, thus alleviating the negative impact that more narrative R&D disclosures have on a firm's bond issuance spreads.

[13] The economic significance is computed as 0.081 (coefficient on *NarRD*) ×3.075 (the sample standard deviation of *NarRD*) ÷ 1.455 (the sample mean of *Spread*) =17.12%.

[Insert Table 4 Here]

4.2 Mechanism analysis

As previously discussed, we propose two channels through which more narrative R&D disclosures affect bond issuance spreads: (1) managers' obfuscation disclosure of narrative R&D information due to proprietary costs and (2) the high information processing costs associated with R&D information. To further elaborate the mechanisms hypothesized, we investigate the conditions under which the positive relationship between narrative R&D disclosure and bond issuance spreads could be attenuated or accentuated. Specifically, we conduct a series of cross-sectional tests, whereby we expect the above positive relation to be more pronounced for firms with managers more strongly motivated to obfuscation disclosure and less pronounced for firms with more sophisticated market participants following.

4.2.1 The motivation behind managers' obfuscation disclosure

We argue that managers have incentives and opportunities to strategically distort or obfuscate narrative R&D information disclosures to avoid proprietary costs, which leads to a less transparent information environment for firms, thus increasing the information risk premium demanded by bond investors. We examine three conditions under which managers may be more motivated to obfuscation to avoid proprietary costs associated with R&D information. First, prior studies document that the proprietary cost is greater for firms in more competitive environments because rivals may opportunistically exploit proprietary information, which damages firms' competitive position (Cao et al., 2018). Therefore, we use the degree of product market competition to capture the motivation behind managers' obfuscation disclosure. According to the study of Bustamante and Donangelo (2017), product market competition is measured by the Herfindahl–Hirschman industry concentration index; the higher the index is, the lower the degree of market competition. Specifically, we define *PMC* as a dummy variable that equals 1 if a firm's product market competition is higher than the sample median and 0 otherwise. Columns (1) and (2) of **Table 5** report the grouping results

based on *PMC*. The results show that the positive relation between narrative R&D disclosure and bond issuance spreads is only positively significant in firms with intense product market competition, which is consistent with our expectation.

Second, the industry life cycle may also influence the proprietary costs of R&D-related disclosure. Companies in an industry that is at the growth stage face a greater threat of potential competitors' entry, which may increase proprietary costs. We define *InGrowth* as a dummy variable that equals 1 if the average industry sales growth rate in the past three years is higher than the sample median and 0 otherwise. Columns (3) and (4) of **Table 5** report the grouping results based on *InGrowth*. We find that narrative R&D disclosure has a significant impact on bond issuance spreads only for firms with high industry growth.

Third, corporate financial information disclosure and nonfinancial information disclosure are affected by the same corporate governance environment, and managers' motives in their information disclosure decisions are usually consistent. Therefore, we use a firm's discretionary accruals calculated based on the Jones (1991) model to capture managers' motivation to manipulate narrative R&D information. We define *DA* as a dummy variable that equals 1 if a firm's discretionary accruals are greater than the sample median and 0 otherwise. Columns (5) and (6) of **Table 5** report the grouping results based on *DA*. The results suggest that the positive relation between narrative R&D disclosure and bond issuance spreads is significant only for firms with greater discretionary accruals.

Overall, these findings are consistent with our theoretical inference that managers' motivation to obfuscate R&D information disclosure causes more narrative R&D disclosures to in fact increase corporate information asymmetry, which leads bond investors to demand higher information risk premiums and increases corporate bond issuance spreads.

[Insert Table 5 Here]

4.2.2 The information processing costs of bond investors

We contend that more narrative R&D disclosures increase investors' information processing costs due to the technical and complicated nature of R&D information, which prevents investors from absorbing valuable information from public disclosures effectively, thus demanding higher risk premiums. If this contention holds, we expect the positive relationship between narrative R&D disclosure and bond issuance spreads to be weakened when investors' information processing costs are lower. The information processing and dissemination role of sophisticated capital market participants can help bond investors better understand a firm's complicated R&D-related information, thereby reducing their information processing costs. We consider the role of three types of sophisticated capital market participants: media coverage, institutional investors, and short sellers.

First, prior research has documented the role of news media in improving firms' information environment (Bushee, 2001; Tetlock, 2010). In this paper, media coverage is measured by the number of news items mentioning a firm in their titles and content. We define *Media* as a dummy variable that equals 1 if the amount of news about the firm is greater than the sample median and 0 otherwise. Columns (1) and (2) of **Table 6** report the results for *Media*. The results show that more narrative R&D disclosures positively affect bond issuance spreads only in firms with less media coverage.

Second, as professional investors in the capital market, institutional investors have great advantages in collecting and processing information. The prior literature shows that with increasing institutional ownership, more heterogeneous information at the firm level can be revealed (Bartov et al., 2000; Bushee, 2001), which helps reduce information processing costs for bond investors. We define *InstiHold* as a dummy variable that equals 1 if the institutional ownership of the firm is greater than the sample median and 0 otherwise. Columns (3) and (4) of **Table 6** report the grouping results for *InstiHold*. We find that there is no significant positive relation between narrative R&D disclosure and bond issuance spreads when firms have greater institutional ownership.

Third, short sellers have expertise in collecting and processing complicated

information, and their trading behaviors convey valuable news to the capital market, thus helping improve the information environment (Chen et al., 2022). In the Chinese capital market, where short selling is partially restricted, not all public firms can be short-selling targets. Therefore, we define *Short* as a dummy variable that equals 1 if the firm's stocks are allowed to be sold short in the current year and 0 otherwise. Columns (5) and (6) of **Table 6** report the grouping results based on *Short*. The results show that the positive relation between narrative R&D disclosure and bond issuance spreads is weakened for firms that are short-selling targets.

Taken together, these cross-sectional analyses further strengthen our main inference that more narrative R&D disclosures may increase information processing costs and prevent bond investors from accurately assessing firms' innovation activities. When more sophisticated market participants process and transmit corporate public disclosures, bond investors have greater access to firms' R&D information, thus reducing the information risk premium demanded.

[Insert Table 6 Here]

4.3 Further analysis

4.3.1 Consideration of R&D investments

To further validate our hypothesis that managers may manipulate narrative R&D disclosures to decrease the transmission of authentic information regarding firms' R&D activities, we conducted group testing based on firms' actual R&D expenditures. Our hypothesis predicts that narrative R&D disclosures are more likely to suffer from obfuscation when the amount of narrative R&D disclosures does not match (or, especially, outweighs) the amount of firms' actual R&D expenditures. **Table 7** reports the empirical results. We define *H_RdExp* as 1 if a firm's R&D ratio to total assets is greater than the sample median and 0 otherwise. We can note that more narrative R&D disclosures will increase firms' bond spreads only when firms' R&D ratio is relatively lower, with the coefficient of *NarRD* on *Spread* being significantly positive in groups for which *H_RdExp* equals 1. However, *NarRD* does not have an effect on *Spread* in

groups for which *H_RdExp* equals 0. This result is consistent with our hypothesis that managers may obfuscate the disclosure of narrative R&D information.

[Insert Table 7 Here]

4.3.2 Distinguishing between different types of bonds

We examine the heterogeneous effect of narrative R&D disclosure on the issuance spreads of different types of bonds since different types of bonds have differences in terms of issuance maturity, risks and returns. We partition bonds into three types: short-term commercial paper, medium-term notes and corporate bonds. Among these types, the issuance maturity of short-term commercial paper is shorter, while the issuance maturity of corporate bonds is longer. Risk-averse investors generally choose short-term commercial paper, while investors who pursue long-term high returns generally choose corporate bonds. Medium-term notes are in between.

Table 8 reports the empirical results. We find that the coefficients between narrative R&D disclosure and the issuance spreads of short-term commercial paper (*Spread_ST*) as well as the issuance spreads of medium-term notes (*Spread_MT*) are significantly positive, while the coefficient between *NarRD* and the issuance spreads of corporate bonds (*Spread_CB*) is insignificant. These findings are consistent with our theoretical logic. Short-term bond investors tend to be risk averse and prefer short-term returns. Therefore, a firm's narrative R&D disclosure is more likely to enhance the risk perception of such investors, thereby increasing the risk premium they demand. However, long-term investors who choose corporate bonds pay more attention to the long-term development of companies and can to an extent tolerate the uncertainty and risk conveyed by narrative R&D disclosure; thus, they may not demand a higher risk premium.

[Insert Table 8 Here]

4.3.3 Narrative R&D disclosure and the probability of corporate bond issuance

We further examine the impact of narrative R&D disclosure on the probability of corporate bond issuance. According to the findings of this paper, more narrative R&D disclosures increase the cost of bond issuance, which may reduce the probability of corporate bond issuance. Specifically, we use only firms with one bond issued as the sample, which helps to control for the impact of firm-level heterogeneity. We define *BondProb* as a dummy variable that equals 1 in the year when the bond was successfully issued and 0 in other years when no bond was issued or when the bond failed to be issued. We also partition bonds into three types: short-term commercial paper (*BondProb_ST)*, medium-term note (*BondProb_MT)* and corporate bond (*BondProb_CB)*. The empirical results reported in **Table 9** suggest that more narrative R&D disclosures reduce the probability of corporate bond issuance, especially for short-term commercial paper.

[Insert Table 9 Here]

4.3.4 Narrative R&D disclosure and bond financing ratio

To validate our results with more solid evidence, similarly, we investigate the impact of narrative R&D disclosures on firms' bond financing ratios. We divide a firm's amount of bond financing at the end of the year by the amount of total assets (*BondRatio*) and the increment of a firm's bond financing by its amount of total assets at the end of the year (*DBondRatio*) separately to measure the degree to which firms resort to bond financing. The regression results are shown in **Table 10**. With all the control variables included, *NarRD* is significantly and negatively associated with both *BondRatio* and *DBondRatio*, indicating that more narrative R&D disclosures will decrease firms' access to public bond financing. This result is consistent with our main finding.

[Insert Table 10 Here]

5. Endogeneity and robustness checks

5.1 Alleviating selection bias concerns

This paper investigates the impact of narrative R&D disclosures on bond issuance spreads based on a sample of bond issuers. However, many firms that disclose narrative R&D information do not issue bonds and are not included in the sample. The lack of randomness in the sample selection may lead to biased estimation results. Therefore, we exploit the Heckman two-stage approach to alleviate self-selection bias concerns. In the first stage, we use a probit model to estimate the probability that a firm issues a bond (*BondProb*). The explanatory variables are the set of variables in the previous year that may affect a firm's bond issuance behavior, including firm size (*Size*), profitability (*ROE*), leverage (*Lev*), shareholding ratio of the largest shareholder (*TopHold*), property rights (*SOE*), board size (*Board*), the proportion of independent directors (*IndDir*), fixed asset investment amount (*CapExp*), default risk (*ZScore*), market value to tangible assets ratio (*Mtr*), and cash holding (*Cash*). Moreover, we introduce two instrumental variables: the number of listed companies issuing bonds in the same industry (*SameInd*) and the number of listed companies issuing bonds in the same region (*SameReg*). In the second stage, we include the inverse Mills ratio (*IMR*) estimated from the first-stage regression as an additional control variable in the baseline regression, i.e., Eq. (1), to control for selection bias.

Table 11 reports the Heckman two-stage regression results. Column (1) shows the first-stage results. We find that the coefficients of *SameInd* and *SameReg* are positive and significant at the 1% level, indicating that the instrumental variables are appropriate. More importantly, as shown in Columns (2) and (3), the coefficients of *NarRD* in the second stage are still significantly positive, suggesting that our main results remain unchanged after alleviating selection bias concerns.

[Insert Table 11 Here]

5.2 Mitigating omitted variable concerns

In our main analysis, we include an extensive set of control variables that are correlated with bond issuance costs. To further mitigate problems arising from the eventuality that omitted variables drive our results, we use the instrumental variable approach. Referring to the research of Lin et al. (2020), we take the annual average of narrative R&D disclosure of companies in the same industry that have never issued bonds as the instrumental variable (*NarRD_IV)* for the narrative R&D disclosure of bond-issuing companies. Columns (1) and (2) of **Table 12** report the results of the two-stage least squares regression.[14] Column (1) shows the first-stage results, where the control variables are the same as those in Eq. (1). The coefficient of *NarRD_IV* is positive and significant at the 1% level, indicating that the instrument we selected is a suitable instrument variable that satisfies the correlation requirement. In addition, the narrative R&D disclosure of companies that have never issued bonds will not directly affect the bond issuance costs of the bond-issuing firm, thus meeting the exclusivity requirement. Column (2) shows that the coefficient of *NarRD* is positive and significant at the 5% level after we use instrumental variables to solve the endogeneity problem, which further supports the conclusions of this paper. In addition, we further control for bond-level characteristics. *RaType* refers to the type of bond interest rate, which equals 1 for a fixed interest rate and 0 for a progressive interest rate. *PayType* refers to the method of bond interest payment, which equals 0 for a discount bond, 1 for a coupon bond and 2 for a zero-coupon bond. Columns (3) and (5) of **Table 12** report the empirical results after we control for bond-level characteristics, which suggests that our baseline findings are robust.

[Insert Table 12 Here]

5.3 Alternative measures

First, to eliminate the systematic differences in the narrative R&D disclosure of

[14] The Cragg-Donald Wald F statistic is 15.53(>10), implying our instrument is less likely to be subject to weak instrumental problems.

different industries, we construct an alternative measure of *NarRD* by subtracting the industry mean of narrative R&D disclosure (*NarRD_Ind*). Second, considering that firms usually disclose narrative R&D information in the management discussion and analysis (MD&A) section of annual reports, we calculate the proportion of the number of R&D-related keywords or phrases in the MD&A section (*NarRD_MDA*) as another alternative measure of *NarRD.* Third, we directly use the yield to maturity of corporate bonds to measure the cost of bond issuance (*Rate*). **Table 13** reports the empirical results after using these alternative measures. Regardless whether we add control variables, we observe significant positive relationships between narrative R&D disclosure and bond issuance spreads, suggesting that our main findings are robust.

[Insert Table 13 Here]

6. Conclusion

R&D-related information is a matter of great concern to capital market participants. Researchers are interested in exploring the economic consequences of R&D-related disclosures. Despite the quantitative financial information that is provided, there is an increasing amount of narrative R&D disclosures in firms' annual reports. Both regulators and researchers attach great attention to the qualitative portion of R&D-related disclosures. Different from most of present papers which mainly focus on stock investors, we turn to another important yet commonly ignored group of stakeholders: bond investors. Taking China's mandatory regime of narrative R&D disclosures as our research scenario, we investigate how the narrative R&D disclosures of Chinese listed firms affect their bond issuance spreads. Controlling for both firm- and bond-level characteristics, our results show that the quantity of firms' narrative R&D disclosures is positively related to their bond issuance spreads. Moreover, readability undermines the positive relationship between narrative R&D disclosures and bond issuing spreads. We propose that higher information risks associated with narrative R&D disclosures are the main contributors to greater bond spreads. Management's obfuscation and the higher information processing costs originating from more narrative R&D disclosures

intensify a firm's information asymmetry, thereby increasing information risk. The results of channel analysis and robustness tests further support our findings. In addition, we find a heterogeneous effect of narrative R&D disclosure on the spreads of different types of bonds. Finally, we find that more narrative R&D disclosures are associated with a lower probability of corporate bond issuance and a lower bond financing ratio. Our research has several implications for practice.

First, our results afford managers insight regarding the potential negative effects of invalid narrative R&D disclosures on firms' external financing, especially in the public bond market. Managers should evaluate the potential economic consequences of their quantitative disclosures from the standpoints of different interested parties. A more rational disclosure decision based on comprehensive considerations is needed in the future.

Second, regulators should reevaluate the effectiveness of the mandatory narrative R&D disclosure regime in China's capital market given that R&D-related information is both sensitive and complicated and that narrative disclosures are subjective. "Talk more" does not mean "Talk better". More detailed and sophisticated regulations should be enacted to improve the current narrative R&D disclosure institution.

Third, with the rapid enhancement of regulatory policies and the rapid increase in the number and type of information release channels, too much information is attracting investors' attention and undermining the efficiency of their investing decisions. Investors should equip themselves with necessary skills to process and discern redundant information of various degrees of authenticity and formality and to assess the original information channels. Advanced information processing capabilities can help investors recognize potential risks and obtain higher returns.

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Appendix A: The requirements of narrative R&D disclosure in China.

This table describes the requirements of CFAR on the narrative R&D disclosure of listed companies, which were revised in 2005, 2012 and 2021, respectively.

Version of CFAR	Requirements
CFAR2001	Public firms' disclosures are supposed be decision-making related and focused on major investments, R&D projects, construction in progress and such information which is helpful for investors to know more about firms' future development.
CFAR2005	Public firms are supposed to notify their investors about future opportunities or challenges concerned by the management, and disclose the development strategies, as well as the new products to be developed, and new R&D projects to be invested.
CFAR2012	Public firms are supposed to clearly state the purposes, progress, and targets of current R&D projects and their expected impact on the future development, as well as their future plans for innovation during the reporting period. Specifically, public firms are supposed to illustrate the total amount of R&D expenditures in the current year and its proportion on latest audited net assets and operating revenues. If the proportion changes for above 30%, they should clarify the reasons for those changes. Public firms are also supposed to disclose important changes in their core competitiveness (such as key technical dominance, proprietary equipment, patents, non-patented technologies, etc.) and their impact on the company during the reporting period. In addition, public firms are supposed to disclose their staff or teams equipped with their R&D projects. If there is a great change in their R&D staff team, they are supposed to explain why those changes happen and clarify what impact on firms' future progress.
CFAR2021	The same as CFAR2012, but new requirements for public firms in ChiNext and STAR Market to targeted disclose information that can reflect the industry competitiveness, such as technology, R&D outputs, R&D investments, R&D staff team, etc.

Appendix B: Variable definitions

	Definition
Variables used in the baseline regression	
NarRD	The quantity of narrative R&D disclosure, which is measured as the number of R&D-related keywords or phrases divided by the total words of annual report (see Subsection 3.2.1).
NarRead	The readability of narrative R&D disclosure, which is measured as the natural logarithm of the total uncommon words in R&D-related texts, and then take the reciprocal (see Subsection 3.2.1).
Spread	The issuance spreads of bond, which is measured as the yield to maturity of the bond minus the yield to maturity of the government bond with the same remaining maturity.
InvPat	The natural logarithm of the number of invention patents.
RDExp	The ratio of R&D expenditure amount to operating revenue.
RDStaff	The ratio of the number of R&D staffs to the total number of employees in the enterprise.
Size	Natural logarithm of total assets.
ROE	Return on equity, measured as net profit divided by total equity.
Lev	The ratio of total liabilities to total assets.
TopHold	The shareholding ratio of the largest shareholder.
SOE	A dummy variable that equals 1 if the firm is a state-owned enterprise and 0 otherwise.
Board	Natural logarithm of the number of board members.
IndDir	The ratio of the number of independent directors to the total number of directors on the board.
CapExp	The ratio of net fixed assets to total assets.
ZScore	Default risk by referring to study of Altman (1968).
Mtr	Ratio of current closing price to tangible assets; tangible assets is measured as the total assets minus net intangible assets and net goodwill divided by paid-in capital.
BondSize	Natural logarithm of the bond issuance size.
Other variables used in the mechanism analysis	
PMC	A dummy variable that equals 1 if a firm's product market competition is higher than the sample median and 0 otherwise.
InGrowth	A dummy variable that equals 1 if the average industry sales growth rate in the past three years is higher than the sample median and 0 otherwise.
DA	A dummy variable that equals 1 if firm's discretionary accruals are higher than the sample median and 0 otherwise. Discretionary accruals were calculated based on the Jones (1991) model.
Media	A dummy variable that equals 1 if the amount of media news about the firm is higher than the sample median and 0 otherwise. Media coverage is measured by the number of news items mentioning the firm in the title and content.
InstiHold	A dummy variable that equals 1 if the institutional ownership of the firm is higher than the sample median and 0 otherwise.
Short	A dummy variable that equals 1 if the firm is allowed to be sold short in the current year and 0 otherwise.
Other variables used in the further analysis	
H_RdExp	A dummy variable that equals 1 if firm's R&D expenditure ratio to total assets is higher than the sample median and 0 otherwise.
Spread_ST	The issuance cost of short-term commercial paper, which is measured as the yield to maturity of the bond minus the yield to maturity of the government bond with the same remaining maturity.
Spread_MT	The issuance cost of medium-term note, which is measured as the yield to maturity of the bond minus the yield to maturity of the government bond with the same remaining maturity.

Spread_CB	The issuance cost of corporate bond, which is measured as the yield to maturity of the bond minus the yield to maturity of the government bond with the same remaining maturity.
BondProb	The probability of bond issuance, which equals 1 in the year when the bond was successfully issued and 0 in other years when no bond was issued, or bond failed to be issued.
BondProb_ST	The probability of bond (i.e., short-term commercial paper) issuance, which equals 1 in the year when the bond was successfully issued and 0 in other years when no bond was issued, or bond failed to be issued.
BondProb_MT	The probability of bond (i.e., medium-term note) issuance, which equals 1 in the year when the bond was successfully issued and 0 in other years when no bond was issued, or bond failed to be issued.
BondProb_CB	The probability of bond (i.e., corporate bond) issuance, which equals 1 in the year when the bond was successfully issued and 0 in other years when no bond was issued, or bond failed to be issued.
BondRatio	Firms' bond financing ratio, which is calculated by dividing a firm's amount of bond financing at the end of the year by the amount total assets.
DBondRatio	Change of firms' bond financing ratio, calculated by dividing the increment amount of a firm's bond financing by its amount of total assets at the end of the year.
Other variables used in the endogeneity and robustness checks	
Cash	Natural logarithm of firm's cash holdings.
SameInd	Natural logarithm of the number of listed companies issuing bonds in the same industry.
SameReg	Natural logarithm of the number of listed companies issuing bonds in the same region.
NarRD_IV	The annual average of narrative R&D disclosure of companies in the same industry that have never issued bonds.
RaType	The type of bond interest rate, which equals 1 for fixed interest rate and 0 for progressive interest rate.
PayType	The method of bond interest payment, which equals 0 for discount bond, 1 for coupon bond and 2 for zero-coupon bond.
NarRD_Ind	Alternative measure of *NarRD*, measured as *NarRD* subtract firm's industry mean of narrative R&D disclosure.
NarRD_MDA	The proportion of the number of R&D-related keywords or phrases in the MD&A section.
Rate	The yield to maturity of corporate bonds.

Table 1 Descriptive statistics.

This table presents descriptive statistics for the variables used in the main tests. The variables are defined in Appendix B. All the continuous variables are winsorized at the 1% and 99% levels.

Variable	Obs.	Mean	Std	Min	Median	Max
Spread	3716	1.455	1.375	-3.144	1.271	7.078
NarRD	3716	2.912	3.075	0.145	1.989	22.832
NarRead	3716	0.175	0.023	0.128	0.173	0.361
InvPat	3716	0.721	1.227	0.000	0.000	6.176
RDExp	3716	1.480	1.931	0.000	0.510	10.100
RDStaff	3716	5.244	6.713	0.000	2.600	39.030
Size	3716	24.637	1.250	21.783	24.520	27.962
ROE	3716	0.068	0.072	-0.295	0.070	0.265
Lev	3716	0.617	0.122	0.266	0.636	0.844
TopHold	3716	0.364	0.146	0.088	0.342	0.770
SOE	3716	0.708	0.455	0.000	1.000	1.000
Board	3716	2.318	0.179	1.946	2.303	2.708
IndDir	3716	0.389	0.072	0.231	0.364	0.667
CapExp	3716	0.283	0.213	0.001	0.258	0.876
ZScore	3716	3.685	2.737	0.295	3.085	21.355
Mtr	3716	0.781	0.791	0.061	0.509	7.242
BondSize	3716	2.237	0.704	0.095	2.197	4.615

Table 2 Correlation matrix.

This table reports the Pearson (Spearman) correlation between the variables used in the regression analysis on the upper (lower) diagonal. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. The detailed definitions of the variables are provided in Appendix B.

	Spread	*NarRD*	*InvPat*	*RDExp*	*RDStaff*	*Size*	*ROE*	*Lev*	*TopHold*
Spread	1	0.149***	-0.198***	0.042	-0.022	-0.403***	-0.033	0.031	-0.228***
NarRD	0.122***	1	0.241***	0.653***	0.461***	-0.185***	0.027	-0.172***	-0.172***
InvPat	-0.204***	0.085***	1	0.329***	0.301***	0.294***	0.034	-0.027	0.024
RDExp	0.076***	0.489***	0.231***	1	0.716***	-0.050***	0.024	-0.182***	-0.142***
RDStaff	0.028	0.293***	0.239***	0.605***	1	-0.012	0.007	-0.083***	-0.137***
Size	-0.381***	-0.193***	0.313***	-0.131***	-0.046***	1	-0.036	0.384***	0.273***
ROE	0.018	-0.015	0.104***	0.056***	0.004	-0.089***	1	-0.190***	0.035
Lev	0.036	-0.094***	-0.031	-0.179***	-0.026	0.383***	-0.223***	1	0.014
TopHold	-0.204***	-0.118***	0.034	-0.156***	-0.111***	0.265***	0.000	-0.010	1
SOE	-0.381***	-0.210***	-0.002	-0.283***	-0.199***	0.341***	-0.194***	0.180***	0.304***
Board	-0.067***	-0.101***	0.038	-0.220***	-0.169***	0.092***	0.163***	0.003	0.034
IndDir	-0.165***	-0.042***	0.151***	0.045***	0.076***	0.319***	-0.184***	0.124***	0.111***
CapExp	-0.153***	-0.220***	0.061***	-0.117***	-0.150***	0.194***	-0.089***	-0.003	0.129***
ZScore	0.025	0.022	-0.028	-0.024	-0.027	-0.256***	0.314***	-0.189***	-0.136***
Mtr	0.053***	0.164***	0.009	0.197***	0.090***	-0.424***	0.347***	-0.466***	-0.112***
BondSize	-0.336***	-0.172***	0.222***	-0.128***	-0.119***	0.709***	-0.059***	0.218***	0.292***

(The table is continued on the next page.)

Table 2 (continued)

	SOE	*Board*	*IndDir*	*CapExp*	*Zscore*	*Mtr*	*BondSize*
Spread	-0.368***	-0.071***	-0.144***	-0.148***	0.093***	0.137***	-0.333***
NarRD	-0.304***	-0.114***	0.031	-0.181***	0.188***	0.270***	-0.165***
InvPat	0.022	0.024	0.181***	0.101***	-0.001	-0.065***	0.207***
RDExp	-0.235***	-0.245***	0.086***	-0.022	0.048***	0.207***	-0.074***
RDStaff	-0.172***	-0.134***	0.047***	-0.058***	0.049***	0.091***	-0.093***
Size	0.344***	0.130***	0.296***	0.195***	-0.347***	-0.590***	0.708***
ROE	-0.168***	0.129***	-0.081***	-0.154***	0.360***	0.295***	-0.046***
Lev	0.210***	0.008	0.116***	-0.036	-0.341***	-0.610***	0.220***
TopHold	0.317***	0.036	0.118***	0.118***	-0.163***	-0.113***	0.296***
SOE	1	0.154***	0.071***	0.198***	-0.283***	-0.422***	0.305***
Board	0.148***	1	-0.288***	0.173***	-0.101***	-0.086***	0.146***
IndDir	0.104***	-0.396***	1	0.079***	-0.160***	-0.131***	0.175***
CapExp	0.223***	0.187***	0.064***	1	-0.359***	-0.115***	0.229***
ZScore	-0.174***	-0.025	-0.160***	-0.333***	1	0.382***	-0.289***
Mtr	-0.378***	-0.043***	-0.118***	-0.133***	0.383***	1	-0.370***
BondSize	0.308***	0.138***	0.164***	0.249***	-0.218***	-0.268***	1

Table 3 Narrative R&D disclosure and bond issuance spreads: Test of Hypothesis 1.

This table presents the results of Eq. (1) accounting for the relationship between narrative R&D disclosures and bond issuance spreads. The dependent variable is *Spread*, which is measured as the yield to maturity of the bond minus the yield to maturity of the government bond with the same remaining maturity. *NarRD* proxies for the quantity of narrative R&D disclosure based on machine learning methods. The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)
	Spread	*Spread*
NarRD	0.089***	0.081***
	(3.25)	(3.01)
InvPat		-0.074***
		(-2.72)
RDExp		-0.101***
		(-3.24)
RDStaff		-0.007
		(-1.29)
Size		-0.229**
		(-2.03)
ROE		0.474
		(1.40)
Lev		1.353***
		(2.92)
TopHold		1.805***
		(3.44)
SOE		0.179
		(1.00)
Board		-0.189
		(-0.84)
IndDir		-1.053**
		(-2.34)
CapExp		0.703***
		(2.70)
Zscore		0.038
		(1.43)
Mtr		-0.112*
		(-1.78)
BondSize		-0.062
		(-1.59)
Constant	1.204***	6.182**
	(15.40)	(2.32)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	3716	3716
Adj. R^2	0.63	0.64

Table 4 Considering the readability of narrative R&D disclosure: Test of Hypothesis 2.

This table presents the empirical results of the role of narrative R&D disclosure quality in the relation between narrative R&D disclosure and bond issuance spreads. *NarRead* proxies for the readability of narrative R&D disclosure. The detailed definition of this variable is provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)
	Spread	*Spread*
NarRD×NarRead	-1.708**	-2.735***
	(-2.05)	(-3.33)
NarRead	-3.545	-6.207**
	(-1.48)	(-2.58)
NarRD	0.029	-0.016
	(0.72)	(-0.39)
InvPat		-0.080***
		(-2.94)
RDExp		-0.105***
		(-3.38)
RDStaff		-0.008
		(-1.57)
Size		-0.280**
		(-2.45)
ROE		0.450
		(1.32)
Lev		1.342***
		(2.88)
TopHold		1.985***
		(3.77)
SOE		0.180
		(1.02)
Board		-0.109
		(-0.48)
IndDir		-0.979**
		(-2.14)
CapExp		0.653**
		(2.50)
Zscore		0.040
		(1.51)
Mtr		-0.106*
		(-1.72)
BondSize		-0.063
		(-1.61)
Constant	1.384***	7.297***
	(34.23)	(2.69)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	3716	3716
Adj. R^2	0.64	0.64

Table 5 Mechanism analysis: The motivation of manager's obfuscation disclosure.

The table reports the grouping results based on the motivation of manager's obfuscation disclosure due to proprietary costs. *PMC* is a dummy variable that equals 1 if a firm's product market competition is higher than the sample median and 0 otherwise. *InGrowth* is a dummy variable that equals 1 if the average industry sales growth rate in the past three years is higher than the sample median and 0 otherwise. *DA* is a dummy variable that equals 1 if firm's discretionary accruals are higher than the sample median and 0 otherwise. The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	PMC=1	*PMC*=0	*InGrowth=1*	*InGrowth=0*	*DA=1*	*DA=0*
	Spread	*Spread*	*Spread*	*Spread*	*Spread*	*Spread*
NarRD	0.207***	-0.007	0.103***	0.026	0.080*	0.050
	(5.61)	(-0.17)	(3.36)	(0.32)	(1.84)	(1.12)
InvPat	-0.054	-0.090*	-0.053*	-0.088	-0.110**	-0.016
	(-1.36)	(-1.70)	(-1.75)	(-0.81)	(-2.34)	(-0.36)
RDExp	-0.067	-0.105*	-0.132***	0.049	-0.213***	-0.022
	(-1.27)	(-1.84)	(-3.69)	(0.34)	(-3.70)	(-0.48)
RDStaff	0.003	-0.009	-0.000	-0.027*	0.008	0.003
	(0.28)	(-0.99)	(-0.07)	(-1.67)	(0.85)	(0.34)
Size	-0.340**	0.095	-0.420***	0.561	-0.194	-0.256
	(-2.29)	(0.42)	(-3.45)	(1.59)	(-0.93)	(-1.44)
ROE	-0.308	1.233	0.082	0.247	0.275	1.212**
	(-0.70)	(1.15)	(0.18)	(0.26)	(0.37)	(2.10)
Lev	0.753	0.701	1.738***	-0.837	0.653	0.779
	(1.15)	(0.83)	(3.35)	(-0.64)	(0.84)	(1.00)
TopHold	2.570***	0.352	1.396**	4.189**	2.683**	1.868**
	(3.92)	(0.28)	(2.32)	(2.29)	(2.57)	(2.54)
SOE	-0.110	0.318	0.465**	0.075	0.188	-0.099
	(-0.49)	(0.65)	(2.20)	(0.15)	(0.76)	(-0.33)
Board	-0.434	-0.142	-0.518*	0.190	-0.486	-0.148
	(-1.19)	(-0.23)	(-1.95)	(0.25)	(-0.89)	(-0.46)
IndDir	-1.274*	-1.238	-1.058*	-2.013*	-0.653	-1.279**
	(-1.66)	(-1.18)	(-1.89)	(-1.70)	(-0.61)	(-2.21)
CapExp	1.269***	-0.396	0.161	0.974**	-0.229	0.532*
	(3.13)	(-0.50)	(0.38)	(2.03)	(-0.27)	(1.65)
Zscore	0.047	-0.002	0.033	0.078	-0.003	0.022
	(1.28)	(-0.03)	(1.18)	(1.01)	(-0.08)	(0.34)
Mtr	-0.079	-0.131	-0.089	-0.131	-0.159	0.009
	(-0.77)	(-0.97)	(-1.21)	(-0.86)	(-1.57)	(0.09)
BondSize	-0.111**	0.022	-0.039	-0.074	-0.100	-0.052
	(-2.06)	(0.35)	(-0.87)	(-0.90)	(-1.50)	(-1.01)
Constant	9.344***	-0.462	11.432***	-13.442	6.743	7.183*
	(2.71)	(-0.09)	(3.88)	(-1.57)	(1.30)	(1.69)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	2218	1457	2970	746	1689	2027
Adj. R^2	0.67	0.65	0.63	0.72	0.62	0.69

Table 6 Mechanism analysis: The information processing costs of bond investors.

The table reports the grouping results based on the information processing costs of bond investors. We consider the information dissemination role of three types of sophisticated market participants: media coverage, institutional investors and short sellers. *Media* is a dummy variable that equals 1 if the amount of news about the firm is higher than the sample median and 0 otherwise. *InstiHold* as a dummy variable that equals 1 if the institutional ownership of the firm is higher than the sample median and 0 otherwise. The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Media =0	*Media* =1	*InstiHold=0*	*InstiHold=1*	*Short=0*	*Short=1*
	Spread	*Spread*	*Spread*	*Spread*	*Spread*	*Spread*
NarRD	0.143***	-0.015	0.074**	0.016	0.076*	0.058
	(3.74)	(-0.35)	(2.06)	(0.33)	(1.77)	(1.47)
InvPat	-0.113**	-0.050	-0.035	-0.029	-0.071	-0.065*
	(-2.07)	(-1.34)	(-0.68)	(-0.90)	(-1.17)	(-1.93)
RDExp	-0.090*	-0.146***	-0.224***	0.004	-0.048	-0.116***
	(-1.80)	(-3.38)	(-4.43)	(0.09)	(-0.59)	(-2.84)
RDStaff	-0.001	-0.019***	-0.006	-0.008	-0.001	-0.010
	(-0.13)	(-2.60)	(-0.69)	(-1.13)	(-0.06)	(-1.37)
Size	-0.410**	0.141	-0.467**	-0.229	-0.641**	0.139
	(-2.50)	(0.74)	(-2.31)	(-1.45)	(-2.57)	(0.89)
ROE	0.238	0.902*	0.079	0.943**	0.801	0.477
	(0.36)	(1.86)	(0.12)	(2.04)	(1.02)	(1.17)
Lev	1.027	2.050**	0.029	2.127***	2.036**	0.331
	(1.43)	(2.50)	(0.04)	(3.19)	(2.22)	(0.52)
TopHold	1.568*	2.184***	2.369**	1.260*	3.017***	1.009
	(1.84)	(3.03)	(1.99)	(1.93)	(3.37)	(1.27)
SOE	-0.161	0.525**	0.249	0.098	-0.357	0.243
	(-0.53)	(2.57)	(0.90)	(0.39)	(-0.77)	(1.31)
Board	-0.506	-0.152	-0.328	0.109	0.534	-0.712**
	(-1.10)	(-0.50)	(-0.82)	(0.40)	(1.43)	(-2.10)
IndDir	-0.907	-1.007*	-0.290	-0.854*	-0.762	-1.419**
	(-0.90)	(-1.81)	(-0.29)	(-1.71)	(-0.87)	(-2.16)
CapExp	0.802*	0.632	0.656	0.468	-0.894	1.202***
	(1.67)	(1.60)	(1.01)	(1.56)	(-1.42)	(3.60)
Zscore	-0.009	0.046	0.034	0.033	0.133***	0.006
	(-0.26)	(0.94)	(0.83)	(0.83)	(3.06)	(0.19)
Mtr	0.002	-0.174	-0.094	-0.120	-0.231**	-0.140*
	(0.02)	(-1.51)	(-0.89)	(-1.37)	(-2.02)	(-1.66)
BondSize	-0.077	-0.059	-0.180***	-0.013	0.073	-0.116**
	(-1.22)	(-1.15)	(-2.59)	(-0.28)	(0.99)	(-2.43)
Constant	11.615***	-3.689	13.579***	4.723	14.022**	-0.572
	(3.03)	(-0.81)	(2.89)	(1.26)	(2.37)	(-0.15)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	2218	1457	2970	746	1689	2027
Adj. R^2	0.67	0.65	0.63	0.72	0.62	0.69

Table 7 Further analysis: Consideration of R&D investments.

The table reports the grouping results based on firms' actual R&D expenditures. We divided the whole sample into two subsamples. *H_RdExp* is a dummy variable that equals 1 if firms' R&D investment ratio to total assets is above the sample median and 0 otherwise. The detailed definitions of this variable are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(1)	(2)
	H_RdExp=0	*H_RdExp =0*	*H_RdExp =1*	*H_RdExp =1*
	Spread	*Spread*	*Spread*	*Spread*
NarRD	0.122***	0.097**	0.006	0.003
	(2.70)	(2.02)	(0.17)	(0.07)
InvPat		-0.082		-0.101***
		(-1.39)		(-2.78)
RDExp		-0.170		-0.100***
		(-1.43)		(-2.74)
RDStaff		-0.013		-0.010
		(-1.24)		(-1.27)
Size		-0.187		-0.160
		(-0.71)		(-1.16)
ROE		0.224		-0.073
		(0.29)		(-0.13)
Lev		0.725		1.631***
		(0.65)		(2.85)
TopHold		0.761		2.506***
		(0.73)		(3.33)
SOE		-0.088		0.188
		(-0.35)		(0.72)
Board		-0.452		-0.189
		(-0.91)		(-0.58)
IndDir		1.570		-1.979***
		(1.51)		(-3.12)
CapExp		0.955		0.726**
		(1.43)		(2.02)
Zscore		0.041		0.045
		(0.84)		(1.14)
Mtr		0.064		-0.160*
		(0.44)		(-1.69)
BondSize		-0.039		-0.081
		(-0.63)		(-1.57)
Constant	1.123***	5.467	1.440***	4.870
	(9.95)	(0.92)	(12.72)	(1.45)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	1600	1600	2040	2040
Adj. R^2	0.728	0.732	0.664	0.677

Table 8 Further analysis: Distinguishing between different types of bonds.

This table presents the baseline regression results after distinguishing bonds into three types: short-term commercial paper (*Spread_ST*), medium-term note (*Spread_MT*) and corporate bond (*Spread_CB*). The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)
	Spread_ST	*Spread_MT*	*Spread_CB*
NarRD	0.079**	0.178*	0.031
	(2.56)	(1.69)	(0.29)
InvPat	-0.070**	-0.050	-0.071
	(-2.17)	(-0.66)	(-0.68)
RDExp	-0.080**	-0.159	0.056
	(-2.29)	(-1.51)	(0.39)
RDStaff	-0.007	-0.026*	0.009
	(-1.19)	(-1.75)	(0.74)
Size	-0.283**	0.369	-0.926**
	(-2.10)	(1.08)	(-2.21)
ROE	0.461	-1.226	4.198***
	(1.21)	(-1.06)	(2.82)
Lev	1.682***	0.745	3.291**
	(3.01)	(0.45)	(2.02)
TopHold	2.306***	1.709	1.771
	(3.47)	(1.27)	(0.84)
SOE	0.286	-0.506	0.110
	(1.06)	(-1.49)	(0.23)
Board	-0.269	-0.882	-0.226
	(-0.99)	(-1.17)	(-0.17)
IndDir	-1.011**	-0.190	-3.507
	(-2.01)	(-0.11)	(-1.24)
CapExp	0.538*	-1.254	-0.328
	(1.87)	(-1.00)	(-0.35)
Zscore	0.057*	0.167	-0.096
	(1.86)	(1.24)	(-1.34)
Mtr	-0.153*	-0.246	0.187
	(-1.96)	(-0.91)	(1.30)
BondSize	-0.092*	0.080	-0.151
	(-1.82)	(0.69)	(-1.51)
Constant	7.080**	-6.322	24.000**
	(2.20)	(-0.81)	(2.38)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	2611	410	515
Adj. R^2	0.65	0.70	0.74

Table 9 Further analysis: Narrative R&D disclosure and the probability of corporate bond issuance.

This table presents the results of narrative R&D disclosure on the probability of corporate bond issuance. *BondProb* is a dummy variable that equals 1 in the year when the bond was successfully issued and 0 in other years when no bond was issued or bond failed to be issued. We also partition bonds into three types: short-term commercial paper (*BondProb_ST*), medium-term note (*BondProb_MT*) and corporate bond (*BondProb_CB*). The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	BondProb	*BondProb_ST*	*BondProb_MT*	*BondProb_CB*
NarRd	-0.147**	-0.147*	-0.291	-0.114
	(-2.21)	(-1.94)	(-1.29)	(-0.55)
InvPat	-0.096	-0.213	0.031	0.133
	(-0.82)	(-1.61)	(0.11)	(0.23)
RdExp	-0.017	-0.038	-0.012	-0.104
	(-0.24)	(-0.49)	(-0.04)	(-0.32)
RdStaff	-0.011	-0.013	0.033	-0.003
	(-0.89)	(-0.96)	(0.64)	(-0.09)
Size	1.112***	1.174***	1.515	-0.146
	(3.93)	(3.65)	(1.52)	(-0.11)
Roe	0.894	1.376	7.347**	3.963
	(1.12)	(1.44)	(2.07)	(0.98)
Lev	2.614**	2.368*	-5.164	1.158
	(2.52)	(1.95)	(-1.20)	(0.30)
TopHold	-2.032	-1.480	-2.549	4.437
	(-1.53)	(-0.99)	(-0.46)	(0.93)
Soe	0.137	-0.261	2.614	12.788
	(0.27)	(-0.48)	(0.82)	(0.01)
Board	0.124	-0.429	5.727**	6.361
	(0.14)	(-0.46)	(2.17)	(1.42)
IndDir	-1.169	-1.285	13.812*	-5.920
	(-0.56)	(-0.57)	(1.75)	(-0.58)
CapExp	0.681	1.355	-0.663	-5.445
	(0.70)	(1.26)	(-0.18)	(-1.15)
ZScore	-0.022	0.018	-0.938**	-0.210
	(-0.45)	(0.35)	(-2.55)	(-1.04)
Mtr	-0.120	-0.208	-0.266	0.238
	(-0.93)	(-1.28)	(-0.39)	(0.62)
Bond	0.127***	0.089***	0.088***	0.372***
	(11.98)	(8.38)	(3.83)	(7.10)
Firm	*Yes*	*Yes*	*Yes*	*Yes*
Year	*Yes*	*Yes*	*Yes*	*Yes*
N	2927	1997	617	954
Log Likelihood	-588.32	-438.56	-67.73	-55.32

Table 10 Further analysis: Narrative R&D disclosure and bond financing ratio.

This table presents the results of narrative R&D disclosure on firms' bond financing ratio. *BondRatio* is calculated by dividing a firm's amount of bond financing at the end of the year by the amount total assets, and *DBondRatio* is calculated by dividing the increment amount of a firm's bond financing by its amount of total assets at the end of the year. Both above measures can represent the degree of public firms' utilization of bond financing. The detailed definitions of this variable are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	BondRatio	*BondRatio*	*DBondRatio*	*DBondRatio*
NarRD	-0.111***	-0.141***	-0.039	-0.061*
	(-2.80)	(-3.72)	(-1.23)	(-1.88)
InvPat		-0.197*		-0.074
		(-1.86)		(-0.69)
RdExp		0.035		0.007
		(0.97)		(0.21)
RdStaff		-0.019*		-0.002
		(-1.85)		(-0.23)
Size		0.265		0.965***
		(1.25)		(6.04)
Roe		0.242		0.072
		(1.48)		(0.59)
Lev		8.112***		3.988***
		(9.14)		(5.58)
TopHold		0.727		0.244
		(0.69)		(0.26)
Soe		0.614		-0.631
		(1.21)		(-1.47)
Board		-0.484		0.300
		(-0.59)		(0.39)
IndDir		-1.676		1.492
		(-0.85)		(0.83)
CapExp		-1.605*		-2.339***
		(-1.68)		(-2.85)
ZScore		-0.036		-0.006
		(-1.51)		(-0.54)
Mtr		-0.165*		0.076
		(-1.73)		(1.44)
Bond		-0.002		0.007***
		(-1.42)		(4.10)
Intercept	4.260***	-3.965	1.027***	-23.631***
	(29.15)	(-0.76)	(8.47)	(-5.82)
Firm	*Yes*	*Yes*	*Yes*	*Yes*
Year	*Yes*	*Yes*	*Yes*	*Yes*
N	5012	5011	4896	4895
Adj_R^2	0.43	0.46	-0.03	-0.01

Table 11 Endogeneity: Alleviating selection bias concerns.

This table presents the baseline regression results after using the Heckman two-stage model. Column (1) shows the first-stage result. *SameInd* refers to the number of listed companies issuing bonds in the same industry. *SameReg* refers to the number of listed companies issuing bonds in the same region. Columns (2) and (3) shows the second-stage results. *IMR* refers to the inverse Mills ratio estimated from the first-stage regression. The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)
	BondProb	*Spread*	*Spread*
SameInd	0.009***		
	(19.44)		
SameReg	0.003***		
	(5.38)		
NarRD		0.100***	0.081***
		(3.65)	(3.06)
IMR		0.315***	0.594***
		(3.01)	(4.10)
InvPat			-0.073***
			(-2.72)
RDExp			-0.113***
			(-3.55)
RDStaff			-0.007
			(-1.33)
Size	0.632***		0.000
	(46.19)		(0.00)
ROE	0.141***		0.441
	(4.57)		(1.30)
Lev	1.047***		1.929***
	(10.11)		(3.99)
TopHold	-1.395***		1.277**
	(-14.30)		(2.39)
SOE	0.035		0.218
	(1.06)		(1.24)
Board	-0.239***		-0.176
	(-2.73)		(-0.79)
IndDir	-0.596**		-0.931**
	(-2.30)		(-2.10)
CapExp	-0.712***		0.517**
	(-7.08)		(2.00)
Zscore	-0.000		0.032
	(-0.12)		(1.21)
Mtr	-0.140***		-0.178***
	(-7.77)		(-2.83)
BondSize			-0.059
			(-1.53)
Cash	-0.756***		
	(-8.01)		
Constant	-19.718	0.929***	-0.051
	(-0.19)	(7.88)	(-0.02)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	31917	3716	3716
Pseudo R^2/ Adj. R^2	0.54	0.64	0.64

Table 12 Endogeneity: Mitigating omitted variable concerns.

This table presents the baseline regression results after mitigating omitted variable concerns. Columns (1) and (2) shows the results after using instrumental variable approach. *NarRD_IV* refers to the annual average of narrative R&D disclosure of companies in the same industry that have never issued bonds. Columns (3) and (4) shows the results after controlling for bond-level characteristics. *RaType* refers to the type of bond interest rate, which equals 1 for fixed interest rate and 0 for progressive interest rate. *PayType* refers to the method of bond interest payment, which equals 0 for discount bond, 1 for coupon bond and 2 for zero-coupon bond. The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	Instrumental variable approach		Controlling for bond-level characteristics		
	Spread	*Spread*	*Spread*	*Spread*	*Spread*
NarRD_IV	0.287***				
	(2.84)				
NarRD		1.297**	0.081***	0.079***	0.079***
		(2.26)	(3.04)	(2.99)	(2.96)
InvPat	-0.042*	-0.020	-0.073***	-0.074***	-0.074***
	(-1.92)	(-0.43)	(-2.69)	(-2.76)	(-2.78)
RDExp	-0.012	-0.103*	-0.104***	-0.114***	-0.113***
	(-0.27)	(-1.70)	(-3.33)	(-3.64)	(-3.61)
RDStaff	-0.009*	0.003	-0.007	-0.006	-0.006
	(-1.71)	(0.32)	(-1.29)	(-1.09)	(-1.07)
Size	0.237**	-0.555**	-0.228**	-0.220**	-0.220**
	(2.44)	(-2.38)	(-2.03)	(-1.98)	(-1.98)
ROE	0.277	0.208	0.457	0.515	0.534
	(1.30)	(0.47)	(1.35)	(1.51)	(1.57)
Lev	0.969***	0.293	1.327***	1.431***	1.461***
	(2.88)	(0.37)	(2.87)	(3.11)	(3.17)
TopHold	-0.865**	2.857***	1.827***	1.739***	1.714***
	(-2.06)	(3.36)	(3.48)	(3.33)	(3.28)
SOE	-0.010	0.181	0.182	0.143	0.136
	(-0.08)	(0.72)	(1.02)	(0.79)	(0.75)
Board	0.769***	-1.139**	-0.175	-0.228	-0.244
	(4.53)	(-2.10)	(-0.77)	(-1.02)	(-1.09)
IndDir	1.087***	-2.363***	-1.050**	-1.020**	-1.019**
	(3.82)	(-2.78)	(-2.33)	(-2.30)	(-2.31)
CapExp	0.198	0.378	0.708***	0.693***	0.688***
	(1.19)	(1.04)	(2.72)	(2.68)	(2.66)
Zscore	0.039**	-0.007	0.038	0.042	0.042
	(2.31)	(-0.20)	(1.45)	(1.60)	(1.60)
Mtr	-0.244***	0.191	-0.109*	-0.122**	-0.125**
	(-5.09)	(1.22)	(-1.75)	(-1.97)	(-2.03)
BondSize	0.005	-0.068	-0.070*	-0.093**	-0.090**
	(0.20)	(-1.40)	(-1.78)	(-2.39)	(-2.30)
RaType			-0.131**		0.107
			(-2.13)		(1.58)
PayType				-0.302***	-0.334***
				(-7.96)	(-7.89)
Constant	-6.405***	14.720**	6.271**	6.647**	6.623**
	(-2.71)	(2.55)	(2.36)	(2.53)	(2.52)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	3716	3716	3716	3716	3716
Adj. R^2	0.97	0.41	0.64	0.65	0.65

Table 13 Robustness checks: Alternative measures.

This table presents the results of the main regression that utilizes alternative measures of the independent variables and dependent variables. The detailed definitions of the variables are provided in Appendix B. The t statistics, based on standard errors clustered at the firm level and corrected for heteroscedasticity, are reported in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(3)	(4)
	Alternative measures for narrative R&D disclosures				Alternative measures for bond issuance costs	
	Spread	*Spread*	*Spread*	*Spread*	*Rate*	*Rate*
NarRD_Ind	0.085***	0.073***				
	(3.08)	(2.68)				
NarRD_MDA			0.012*	0.012*		
			(1.91)	(1.88)		
NarRD					0.047**	0.041*
					(2.02)	(1.77)
InvPat		-0.075***		-0.083***		-0.074***
		(-2.76)		(-2.86)		(-3.15)
RDExp		-0.098***		-0.113***		-0.040
		(-3.13)		(-3.42)		(-1.52)
RDStaff		-0.007		-0.005		-0.002
		(-1.29)		(-1.00)		(-0.58)
Size		-0.221**		-0.185		-0.323***
		(-1.97)		(-1.55)		(-3.19)
ROE		0.475		0.413		0.237
		(1.40)		(1.12)		(0.95)
Lev		1.352***		1.195**		1.299***
		(2.92)		(2.41)		(3.19)
TopHold		1.781***		1.694***		1.566***
		(3.39)		(3.06)		(3.50)
SOE		0.182		0.141		0.227
		(1.02)		(0.80)		(1.40)
Board		-0.194		-0.208		-0.307
		(-0.85)		(-0.87)		(-1.53)
IndDir		-1.046**		-0.965**		-1.462***
		(-2.31)		(-2.05)		(-3.30)
CapExp		0.726***		0.785***		0.572***
		(2.79)		(2.88)		(2.70)
Zscore		0.038		0.042		0.015
		(1.42)		(1.37)		(0.70)
Mtr		-0.115*		-0.197***		-0.126**
		(-1.83)		(-2.82)		(-2.48)
BondSize		-0.062		-0.052		0.038
		(-1.60)		(-1.27)		(1.12)
Constant	1.485***	6.258**	1.378***	5.467*	4.005***	11.625***
	(88.87)	(2.35)	(33.30)	(1.92)	(59.49)	(4.81)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3716	3716	3418	3418	3716	3716
Adj. R^2	0.63	0.64	0.64	0.65	0.79	0.80