

Financial disclosure readability and innovative firms' cost of debt

Citation for published version (APA):

Hoffmann, A. O. I., & Kleimeier, S. (2021). Financial disclosure readability and innovative firms' cost of debt. *International Review of Finance*, 21(2), 699-713. <https://doi.org/10.1111/irfi.12292>

Document status and date:

Published: 01/06/2021

DOI:

[10.1111/irfi.12292](https://doi.org/10.1111/irfi.12292)

Document Version:

Publisher's PDF, also known as Version of record

Document license:

Taverne

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy

If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.

Financial disclosure readability and innovative firms' cost of debt

Arvid O. I. Hoffmann¹  | Stefanie Kleimeier^{2,3,4}

¹University of Adelaide Business School, Adelaide, South Australia, Australia

²School of Business and Economics, Maastricht University, Maastricht, The Netherlands

³Faculty of Management, Open Universiteit, Heerlen, The Netherlands

⁴University of Stellenbosch Business School, Cape Town, South Africa

Correspondence

Arvid O. I. Hoffmann, University of Adelaide Business School, 10 Pulteney Street, SA 5005, Adelaide, Australia.

Email: arvid.hoffmann@adelaide.edu.au

Abstract

Innovative firms confront potential lenders with various risks, including possible innovation failure, uncertain R&D investment payoffs, cash flow volatility, and low collateral value of hard-to-value intangible assets. As a result, these firms might struggle to obtain financing. More readable financial disclosures could mitigate the informational risk around innovative firms' fundamentals, ease their monitoring by lenders, and thus ultimately reduce these firms' cost of debt. In this regard, we find that while all firms can overcome information uncertainty about their firm fundamentals and reduce their spreads by having more readable financial disclosures, there is an additional benefit in terms of readability further lowering the cost of debt for innovative firms. The additional benefit that innovative firms can achieve from having more readable financial disclosures, however, is limited to situations of more pronounced information asymmetry where there is no previous lending relationship.

KEYWORDS

bank loans, cost of debt, financial disclosure readability, information asymmetry, information uncertainty, innovation, R&D

JEL CLASSIFICATION

G21; G32; O32

1 | INTRODUCTION

Bank loans are an important source of external capital for innovative firms, enabling them to avoid the costly dilution of ownership stakes associated with equity financing, while simultaneously providing an alternative to the complicated process of issuing corporate bonds (Kerr & Nanda, 2015). However, the market value of innovative firms often rests on hard-to-value intangible assets with low collateral value, while their cash flows are volatile (Hochberg, Serrano, & Ziedonis, 2018). The potential of innovation failure and the uncertain payoffs of R&D investments are additional sources of risk that reduce innovative borrowers' access to credit (Hu, Li, & Zhu, 2017). Accordingly, it might prove both difficult and costly for innovative firms to obtain bank loans.

In this paper, we examine to what extent financial disclosure readability mitigates informational risk around innovative firms' fundamentals and reduces their cost of debt. Apart from quantitative accounting information, qualitative information as revealed in a firm's financial disclosures is expected to play an important role in assessing its creditworthiness and risk (Beyer, Cohen, Lys, & Walther, 2010). Indeed, consistent with the notion that less readable disclosures are harder to understand and generate more informational risk, recent work finds that poorer readability of the narrative portion of mandated filings is associated with wider offering credit spreads (i.e., higher cost of debt) for newly issued corporate bonds (Bonsall & Miller, 2017) and stricter nonprice loan terms (Ertugrul, Lei, Qiu, & Wan, 2017).

We contribute to the literature by bridging the currently disconnected streams of research on the cost of debt of innovative firms and the effect of financial disclosure readability, while also examining whether financial disclosure readability has a different effect on the cost of debt of innovative firms in situations where the difference in information uncertainty between innovative firms as "insiders" and lenders as "outsiders" is more or less pronounced because of the absence or presence of a previous lending relationship. That is, we examine the role of information asymmetry.

On the one hand, previous research on the financing of innovative firms through bank loans examined how patents can decrease information asymmetry regarding the value of innovative firms' R&D activity, reducing these firms' cost of debt (Francis, Hasan, Huang, & Sharma, 2012). However, this literature has not examined financial disclosure readability as an alternative channel to reduce innovative firms' cost of debt by decreasing the informational risk regarding firm fundamentals.

On the other hand, prior literature on financial disclosure readability and the cost of debt studied how such readability can decrease uncertainty about firm fundamentals when issuing debt (Bonsall & Miller, 2017) and the impact of textual features on price and nonprice contract terms (Ertugrul et al., 2017). However, this literature has not focused on innovative firms and the unique circumstances they face when trying to obtain bank financing as an alternative to issuing equity or debt. The current research thus addresses an important gap in the existing literature's understanding regarding the drivers of innovative firms' cost of debt, financial disclosure readability, and information asymmetry.

2 | DATA AND METHODOLOGY

To address aforementioned research questions, we examine bank loans raised by public, nonfinancial, U.S. borrowers. We construct our sample by combining loan information obtained from the Loan Pricing Corporation's DealScan database with company data from Compustat (North America) and Bonsall, Leone, Miller, and Rennekamp's (2017) Bog Index scores for financial disclosure readability.

We compile our data set as follows. First, we obtain data on all loans raised by publicly listed, nonfinancial, U.S. firms from the Loan Pricing Corporation's DealScan database. We define our dependent variable, the cost of debt, as the *all-in spread* drawn above LIBOR.

Second, we differentiate between loans made to innovative versus noninnovative firms. We identify innovative firms based on their R&D intensity, and therefore restrict our sample to loans raised by public borrowers with information on their R&D expenses available in Compustat. Generally, a higher ratio of R&D to assets indicates a more innovative firm. Acknowledging that the distribution of R&D intensity is skewed to the right, we follow Coles, Daniel, and Naveen (2008) and consider firms to be innovative if their R&D-to-assets ratio is above the 75th percentile for the universe of nonfinancial U.S. firms in Compustat during our sample period. Accordingly, our *Innovative firm* dummy equals 1 if the borrower's R&D intensity exceeds 15%, and 0 otherwise. Alternatively, we define innovativeness based on patent filings and create two proxies. That is, we consider a firm's number of patent applications per million \$ of assets and the firm's number of patent applications per million \$ of sales. An innovative firm is a firm whose patent-to-assets or patent-to-sales ratio is above 0.05 patents per million \$ of assets (sales), a level that reflects the 95th percentile of our in-sample distribution. This cut-off level balances two effects: A lower cutoff level might lead to a misclassification of noninnovative borrowers as innovative while a higher cutoff level might significantly reduce the number of innovative borrowers, reducing the statistical power of our analysis.

Third, we further restrict our sample to loans raised by borrowers for which a Bog Index readability score is available. This score measures financial disclosure readability based on plain English attributes of the borrowers' 10 K filings where the use of passive verbs, style problems, and long sentences decrease readability, while attributes that make writing more interesting increase readability. Further details on the development of the Bog Index and evidence about its validity is presented in Bonsall et al. (2017), while the actual Bog Index data is publicly available from these authors' personal website. A higher Bog Index equates to a less readable document. To facilitate interpretation of our results, we define our *Readability proxy* as the inverse of the Bog Index so that a higher score reflects a more readable financial disclosure. We winsorize the financial disclosure readability measure at the 1st and 99th in-sample percentile. We match each loan to the Bog Index score of the borrower's 10K filing that is closest to the loan signing date.

Finally, we include in our empirical models a standard set of loan-specific and borrower-specific control variables including several fixed effects from DealScan and Compustat. We include industry fixed effects to mitigate potential omitted variable bias. Borrower variables are observed in the year before loan signing (Francis et al., 2012). Table 1 summarizes our variable definitions and data sources. Our final sample includes 12,913 loans raised by 2,232 public, nonfinancial, U.S. borrowers between 1992 and 2016. We estimate OLS regressions and infer statistical significance based on robust standard errors that are clustered at the borrower level.

Table 2 reports descriptive statistics. On average, innovative firms are smaller, less profitable, and less leveraged than noninnovative firms. Loans to these firms are smaller, shorter-term, and more likely to be secured. They are raised by borrowers with less experience as previous borrowers and arranged by banks of lower reputation. On average, innovative borrowers pay a higher spread of 329.83 bps, compared to 214.25 bps for noninnovative borrowers. Figure 1 graphically illustrates the distribution of financial disclosure readability, indicating that, overall, innovative firms have a lower level of financial disclosure readability compared to noninnovative firms.

3 | RESULTS

Panel A of Table 3 presents our baseline results. Column 1 shows that innovative firms pay a higher spread compared to noninnovative firms. This result is robust to including borrower controls in Column 2 and loan and lender controls in Column 3, respectively. This finding is consistent with the literature that innovative firms represent higher informational risk to lenders compared to noninnovative firms (Hochberg et al., 2018; Hu et al., 2017). Columns 1 to 3 also show that a better financial disclosure readability is associated with paying a lower spread, consistent with the literature on better readability being associated with lower informational risk regarding a firm's fundamentals (Bonsall & Miller, 2017). Importantly, Column 4 indicates that financial disclosure readability can counteract the higher cost of debt faced by innovative firms.

TABLE 1 Variable definition and sources

Category and variable	Definition	Units	Source
Dependent variable			
All-in spread drawn	All-in spread drawn above LIBOR	bps	DealScan
Firm characteristics			
Readability	Inverse of the Bog Index score provided by Bonsall et al. (2017) where a higher value indicates better readability of financial reports. The Bog Index score of the borrower's 10K (annual report) filing that is closest to the loan signing date is used. 10K filings that take place more than 2 years before or after the loan signing date are excluded. The proxy is winsorized at the 1st and 99th in-sample percentile	Index	https://kelley.iu.edu/bpm/activities/bogindex.html (authors' calculations)
R&D intensity	R&D to assets ratio calculated as R&D expenses divided by total assets in year before loan signing	Ratio	Compustat
Innovative firm	Dummy equal to 1 if R&D intensity in year before loan signing is above the 75th percentile in the Compustat universe of U.S. nonfinancial firms during the sample period (this is equivalent to R&D to assets above 15%), 0 otherwise	0/1	Compustat
Innovative firm _{patents/assets}	Dummy equal to 1 if patents to assets ratio (calculated as the number of patent applications divided by total assets in \$ million) in year before loan signing is at least 0.05, e.g. at or above the 95th percentile of the in-sample distribution, 0 otherwise	0/1	Compustat, Patstat
Innovative firm _{patents/sales}	Dummy equal to 1 if patents to sales ratio (calculated as the number of patent applications divided by sales in \$ million) in year before loan signing is at least 0.05, e.g. at or above the 95th percentile of the in-sample distribution, 0 otherwise	0/1	Compustat, Patstat
Firm size	Total assets in year before loan signing	\$m	Compustat
Profitability	Sum of net income plus depreciation divided by total assets in year before loan signing	Ratio	Compustat
Leverage	Sum of long-term debt and current portion of long-term debt divided by total assets in year before loan signing	Ratio	Compustat
Loan characteristics			
Loan size	Size of the loan tranche	\$m	DealScan
Loan maturity	Maturity of the loan tranche	Months	DealScan
Multiple tranches	Dummy equal to 1 if loan tranche belongs to a multi-tranche deal, 0 otherwise	0/1	DealScan

(Continues)

TABLE 1 (Continued)

Category and variable	Definition	Units	Source
Performance pricing	Dummy equal to 1 if loan contract contains performance pricing, 0 otherwise	0/1	DealScan
Financial covenants	Dummy equal to 1 if loan contract contains financial covenants, 0 otherwise	0/1	DealScan
Multiple base rates	Dummy equal to 1 if loan contract contains multiple base rates, 0 otherwise	0/1	DealScan
Term loan	Dummy equal to 1 if loan is a term loan, 0 otherwise	0/1	DealScan
Secured	Dummy equal to 1 if loan is secured, 0 otherwise	0/1	DealScan
Lender characteristics			
Lead arranger reputation	Market share of lead arranger in year before loan signing with market share based on loan volume, average across all lead arrangers	Percent (1,0=1%)	DealScan (authors' calculations)
Former lead	Dummy equal to 1 if at least one of the current lead arrangers has arranged a loan for the borrower in the 36 months prior to loan signing, 0 otherwise	0/1	DealScan (authors' calculations)
Fixed effects			
Year	Fixed effects categories based on the year of loan signing	0/1	DealScan
Borrower rating	Fixed effects categories based on the borrower's S&P Senior Debt at Close: AAA, AA, A, BBB, BB, B, CCC, CC, C, D, NR (Not rated)	0/1	DealScan
Borrower industry	Fixed effects categories based on the borrower's 2-digit SIC code	0/1	Compustat
Loan purpose	Fixed effects categories based on the loan's purpose: capital structure, corporate restructuring, general corporate purpose, undisclosed	0/1	DealScan
Lead arranger	Fixed effects categories based on the lead arranger of the loan, available only for loans arranged by a single lead arranger	0/1	DealScan

TABLE 2 Descriptive statistics

	Panel A: All loans (N = 12,931)				Panel B: Loans to innovative borrowers (N = 712)				Panel C: Loans to noninnovative borrowers (N = 12,219)						
	Mean		SD		Mean		SD		Mean		SD				
	10th	50th	90th		10th	50th	90th		10th	50th	90th				
Cost of debt															
All-in spread drawn (bps)	220.61	184.85	37.50	187.50	400.00	329.83	252.00	85.00	275.00	625.00	214.25	178.13	37.50	175.00	400.00
Borrower characteristics															
R&D intensity	0.04	0.09	0.00	0.01	0.11	0.29	0.27	0.16	0.22	0.48	0.03	0.03	0.00	0.01	0.08
Innovative industry	0.43	0.50	0	0	1	0.63	0.48	0	1	1	0.42	0.49	0	0	1
Readability	46.45	7.34	37.00	46.00	56.00	42.44	6.73	33.00	43.00	51.00	46.69	7.30	37.00	46.00	56.00
Assets (\$m)	5,588.31	20,594.72	70.32	894.09	10,948.00	756.11	2,803.95	11.92	81.94	1,653.56	5,869.88	21,141.47	91.62	991.50	11,441.90
Leverage	0.30	0.30	0.01	0.26	0.60	0.22	0.53	0.00	0.09	0.52	0.31	0.28	0.01	0.27	0.61
Profitability	0.05	0.39	-0.03	0.08	0.17	-0.24	0.91	-0.77	-0.02	0.18	0.07	0.32	-0.01	0.08	0.17
Borrower rating index	3.28	3.30	0.00	4.00	8.00	0.83	2.15	0.00	0.00	5.00	3.42	3.30	0.00	5.00	8.00
Loan characteristics															
Loan size (\$m)	418.54	943.04	10.00	150.00	1,000.00	105.30	329.24	2.00	15.00	230.00	436.79	963.74	15.00	150.00	1,000.00
Loan maturity (months)	46.92	23.39	12.00	59.00	72.00	34.60	21.72	12.00	36.00	60.00	47.64	23.28	12.00	60.00	72.00
Multiple tranches	0.52	0.50	0	1	1	0.43	0.50	0	0	1	0.53	0.50	0	1	1
Performance pricing	0.45	0.50	0	0	1	0.23	0.42	0	0	1	0.46	0.50	0	0	1
Financial covenants	0.62	0.48	0	1	1	0.61	0.49	0	1	1	0.62	0.48	0	1	1
Multiple base rates	0.55	0.50	0	1	1	0.41	0.49	0	0	1	0.56	0.50	0	1	1
Term loan	0.30	0.46	0	0	1	0.33	0.47	0	0	1	0.30	0.46	0	0	1
Secured	0.50	0.50	0	1	1	0.71	0.45	0	1	1	0.49	0.50	0	0	1
Lender characteristics															
Lead arranger reputation	6.33	6.24	0.04	4.72	15.63	2.58	4.71	0.00	0.10	9.66	6.54	6.25	0.09	5.04	15.67
Former lead	0.48	0.50	0	0	1	0.26	0.44	0	0	1	0.49	0.50	0	0	1

Note: This table provides descriptive statistics for our sample of 12,913 loans raised by 2,232 public, nonfinancial U.S. borrowers between 1992 and 2016. Innovative borrowers are firms with an R&D intensity above the 75th percentile in the Compustat universe of nonfinancial U.S. firms during the sample period (this is equivalent to an R&D to assets ratio above 15%).

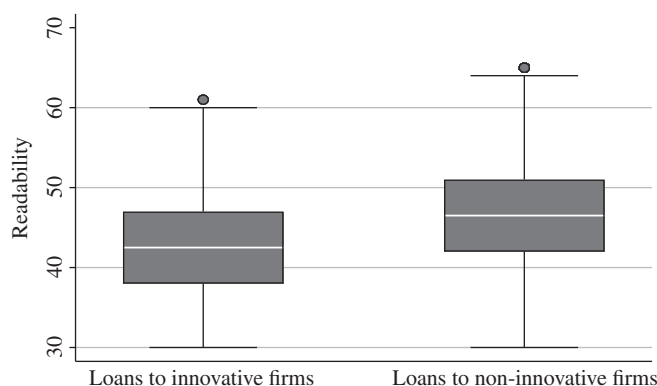


FIGURE 1 Financial disclosure readability. Note: This figure shows box plots for the distribution of financial disclosure readability for our samples of 712 loans to innovative versus 12,219 loans to noninnovative firms. The box ranges from the 25th to the 75th percentile with the white line indicating the median. The height of the box thus reflects the interquartile range (IQR). The whiskers are drawn to span all data points within $1.5 \times$ IQR of the nearer quartile. Dots indicate data points with outside values

After controlling for borrower, loan, and lender characteristics, innovative firms pay on average a 140.92 bps higher spread than noninnovative firms do. For the average loan of \$105.3 million raised by an innovative firm, this translates into $\$105.3 \text{ million} \times 140.92 \text{ bps} = \1.48 million higher interest payments per loan per year. Better financial disclosure readability benefits all firms, but there is a pronounced difference between innovative versus non-innovative firms. In particular, for noninnovative firms, our estimated coefficient of -0.89 for *Readability* indicates that per unit of improved readability, the cost of debt falls by close to one basis point. A one standard deviation improvement in readability (7.30) is thus associated with a $7.30 \times 0.89 \text{ bps} = 6.50 \text{ bps}$ lower spread. Similarly, an improvement in readability from the 10th to the 90th percentile is associated with a $(56-37) \times 0.89 \text{ bps} = 16.91 \text{ bps}$ lower spread. Compared to the average spread for noninnovative firms of 214.25 bps, this reduction of 6.50 bps, while statistically significant, is economically relatively small. For innovative firms, however, there is an *additional* reduction in the cost of debt associated with better financial disclosure readability as indicated by the coefficient of -2.78 of our interaction effect of *Innovative firm* * *Readability*. Thus, per unit of improved readability, the cost of debt for innovative firms falls by $0.89 + 2.78 = 3.67 \text{ bps}$. A one standard deviation improvement in readability (6.73) is thus associated with a $6.73 \times 3.67 \text{ bps} = 24.70 \text{ bps}$ lower spread. Similarly, an improvement in readability from the 10th to the 90th percentile is associated with a $(51-33) \times 3.67 \text{ bps} = 66.06 \text{ bps}$ lower cost of debt. Compared to the average spread for innovative firms of 329.83 bps, this reduction is both statistically significant and economically relevant, and substantially larger compared to noninnovative firms.¹

Importantly, Panel B of Table 3 indicates that our results as presented in Column 4 of Panel A are robust to alternative model specifications. Specifically, in Column 1 of Panel B we employ propensity score matching to match each of our 712 loans made to innovative firms to a comparable loan made to a noninnovative firm. We use nearest-neighbor matching with propensity scores obtained from a logit regression which includes five borrower characteristics (i.e., readability, firm size, leverage, profitability, and borrower rating) and the loan's purpose as baseline variables.² In Column 2, we focus on the subsample of loans arranged by a single lead arranger and add lead arranger fixed effects to our model specification. Finally, we categorize innovative versus noninnovative firms based on their patent filings in Columns 3 and 4.

Table 4 presents results allowing us to investigate whether financial disclosure readability has a different effect on the cost of debt of innovative firms in situations where the difference in the level of information uncertainty between the firm and its lenders is more or less pronounced. That is, we examine the role played by the information asymmetry between innovative firms as “insiders” and their lenders as “outsiders.” Lu, Chen, and Liao (2010) define

TABLE 3 Financial disclosure readability and innovative firm's cost of debt

		All-in spread drawn							
		Panel A: Main analyses				Panel B: Robustness checks			
Dependent variable	(1)	(2)	(3)	(4)	Propensity score matched sample	Lead arranger fixed effects	Innovative firm _{patents/assets}	Innovative firm _{patents/sales}	
Innovative firm	90.23*** (6.83)	40.81*** (3.22)	22.54** (2.08)	140.92** (2.25)	143.11* (1.87)	70.04 (1.52)	112.44* (1.70)	133.41** (2.13)	
Readability	-0.90*** (-2.68)	-1.69*** (-5.25)	-1.06*** (-3.71)	-0.89*** (-3.06)	0.99 (0.85)	-0.82*** (-2.84)	-1.03*** (-3.55)	-0.97*** (-3.34)	
Innovative firm * Readability				-2.78** (-1.99)	-3.30* (-1.89)	-1.83* (-1.83)	-2.62* (-1.90)	-2.97** (-2.18)	
Borrower controls									
Ln[firm size]		-34.05*** (-18.57)	-13.29*** (-6.24)	-13.28*** (-6.23)	-17.57** (-2.53)	-11.95*** (-5.84)	-13.81*** (-6.38)	-13.74*** (-6.36)	
Leverage		60.25*** (5.53)	50.29*** (5.44)	50.58*** (5.41)	48.14* (1.70)	69.68*** (6.79)	48.49*** (5.26)	49.40*** (5.35)	
Profitability		-40.70* (-1.73)	-38.35* (-1.91)	-38.12* (-1.90)	-16.09 (-1.10)	-45.88** (-2.56)	-40.04* (-1.96)	-39.91** (-1.98)	
Loan controls									
Ln[loan size]			-12.68*** (-6.90)	-12.68*** (-6.88)	-10.76 (-1.49)	-12.05*** (-6.30)	-12.79*** (-6.94)	-12.70*** (-6.88)	
Ln[loan maturity]			-6.59** (-2.08)	-6.60** (-2.09)	-34.28*** (-3.35)	-1.82 (-0.57)	-7.05** (-2.23)	-7.19** (-2.26)	
Multiple tranches			0.50 (0.14)	0.54 (0.15)	-10.12 (-0.76)	5.46 (1.41)	0.14 (0.04)	0.42 (0.12)	

(Continues)

TABLE 3 (Continued)

Dependent variable	All-in spread drawn							
	Panel A: Main analyses				Panel B: Robustness checks			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Performance pricing			-27.54*** (-7.25)	-27.53*** (-7.24)	-8.83 (-0.77)	-17.07*** (-3.96)	-27.98*** (-7.39)	-27.80*** (-7.33)
Financial covenants			1.72 (0.31)	1.91 (0.34)	-36.10** (-2.14)	12.77** (2.00)	1.65 (0.30)	1.98 (0.36)
Multiple base rates			-55.85*** (-9.72)	-55.84*** (-9.73)	-94.47*** (-7.77)	-57.45*** (-8.73)	-56.07*** (-9.82)	-56.20*** (-9.86)
Term loan			71.43*** (16.25)	71.29*** (16.22)	134.99*** (7.87)	58.41*** (11.92)	71.54*** (16.25)	71.29*** (16.25)
Secured			54.81*** (13.07)	54.86*** (13.08)	40.63*** (2.74)	46.58*** (10.65)	55.60*** (13.19)	55.45*** (13.17)
Lender controls								
Lead arranger reputation			-2.08*** (-8.40)	-2.08*** (-8.40)	-4.73*** (-4.82)	-0.07 (-0.13)	-2.12*** (-8.54)	-2.11*** (-8.50)
Former lead			-14.35*** (-4.96)	-14.15*** (-4.90)	-3.34 (-0.32)	-0.16 (-0.05)	-14.47*** (-5.03)	-14.26*** (-4.96)
Fixed effects								
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower rating	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan purpose	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead arranger	No	No	No	No	No	Yes	No	No

(Continues)

TABLE 3 (Continued)

Dependent variable	All-in spread drawn							
	Panel A: Main analyses				Panel B: Robustness checks			
	(1)	(2)	(3)	(4)	Propensity score matched sample (1)	Lead arranger fixed effects (2)	Innovative firm ^{patents/assets} (3)	Innovative firm ^{patents/sales} (4)
N	12,931	12,931	12,931	12,931	1,424	8,172	12,931	12,931
Adjusted R ²	0.279	0.359	0.463	0.463	0.457	0.648	0.463	0.463

Note: The table reports OLS regression results. Our sample consists of 12,913 loans raised by 2,232 public, nonfinancial U.S. borrowers between 1992 and 2016. Innovative borrowers are firms with an R&D intensity above the 75th percentile in the Compustat universe of nonfinancial U.S. firms during the sample period (this is equivalent to an R&D to assets ratio above 15%). Panel A presents the main analyses while Panel B presents robustness checks. In Panel B, model (1) is based on a propensity-score-matched subsample where each of the 712 loans made to innovative firms is matched to a comparable loan made to a noninnovative firm. Model (2) is based on the subsample of loans with a single lead arranger. Models (3) and (4) employ alternative proxies for the borrower's innovativeness based on patent filings. Innovative borrowers are firms whose patent-to-assets or patent-to-sales ratio is above 0.05 (this is equivalent to the 95th percentile of the in-sample distribution). For each independent variable, the top row reports the estimated coefficient, the bottom row reports *t*-statistics. Standard errors are robust and clustered at the borrower level.

*10% significance.

**5% significance.

***1% significance.

TABLE 4 The role of information asymmetry

		All-in spread drawn					Panel B: Loans arranged by uninformed, new lead arrangers				
		Panel A: Loans arranged by informed, former lead arrangers									
Dependent variable		Propensity score matched sample					Propensity score matched sample				
		Baseline (1)	(2)	(3)	(4)	(5)	Baseline (1)	(2)	(3)	(4)	(5)
		firm _{patents/assets}	firm _{patents/assets}	Lead arranger fixed effects	Innovative firm _{patents/assets}	Innovative firm _{patents/sales}	Lead arranger fixed effects	Innovative firm _{patents/assets}	Innovative firm _{patents/assets}	Innovative firm _{patents/sales}	Innovative firm _{patents/sales}
Innovative firm		0.23 (0.00)	67.31 (0.50)	58.83 (0.82)	-51.61 (-1.02)	48.65 (0.85)	93.39* (1.67)	186.02*** (2.59)	171.64** (2.00)	153.39** (2.12)	
Readability		-0.81** (-2.40)	0.52 (0.23)	-0.61 (-1.45)	-0.82** (-2.45)	-0.75** (-2.24)	-0.89** (-2.44)	-0.85** (-2.15)	-1.12*** (-2.81)	-1.05*** (-2.64)	
Innovative firm * Readability		-0.83 (-0.60)	-2.53 (-0.85)	-2.24 (-1.42)	0.80 (0.73)	-1.46 (-1.12)	-2.22* (-1.83)	-3.54** (-2.22)	-3.86** (-2.19)	-3.24** (-2.08)	
Borrower controls											
Ln[firm size]		-10.86*** (-4.51)	-11.60 (-1.01)	-8.33** (-2.53)	-10.60*** (-4.39)	-10.49*** (-4.34)	-13.73*** (-5.21)	-15.63*** (-5.18)	-16.58*** (-5.41)	-16.49*** (-5.38)	
Leverage		45.27*** (5.32)	59.70* (1.74)	56.43*** (6.06)	45.79*** (5.33)	45.22*** (5.25)	78.70*** (5.25)	68.43*** (5.27)	64.21*** (4.96)	65.75*** (5.11)	
Profitability		-237.22*** (-7.90)	-128.03*** (-3.58)	-190.47*** (-6.39)	-227.71*** (-7.48)	-226.28*** (-7.46)	-27.86* (-1.67)	-21.58 (-1.33)	-24.30 (-1.44)	-23.80 (-1.44)	
Loan controls											
Ln[loan size]		-11.44*** (-5.10)	-16.31 (-1.52)	-16.25*** (-5.58)	-11.29*** (-5.06)	-11.27*** (-5.04)	-9.17*** (-3.57)	-11.80*** (-4.54)	-11.87*** (-4.56)	-11.73*** (-4.50)	
Ln[loan maturity]		-4.23 (-1.27)	-11.39 (-0.59)	1.06 (0.25)	-4.08 (-1.22)	-4.04 (-1.21)	-4.02 (-0.89)	-7.73 (-1.58)	-8.63* (-1.77)	-8.81* (-1.80)	

(Continues)

TABLE 4 (Continued)

All-in spread drawn											
Panel A: Loans arranged by informed, former lead arrangers						Panel B: Loans arranged by uninformed, new lead arrangers					
Dependent variable	Baseline		Propensity score matched sample		Lead arranger fixed effects		Innovative firm _{patents/assets}		Innovative firm _{patents/sales}		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Multiple tranches	3.10 (0.82)	-5.07 (-0.26)	4.95 (0.98)	3.24 (0.85)	3.21 (0.84)	-2.52 (-0.45)	-1.49 (-0.09)	4.82 (0.90)	-3.26 (-0.59)	-2.82 (-0.51)	
Performance pricing	-28.05*** (-6.18)	-45.73 (-1.60)	-15.70** (-2.41)	-27.77*** (-6.10)	-27.79*** (-6.12)	-30.42*** (-5.59)	-25.81* (-1.81)	-19.18*** (-3.46)	-31.23*** (-5.74)	-30.73*** (-5.63)	
Financial covenants	11.62* (1.80)	47.46 (1.52)	28.06*** (2.81)	10.79* (1.67)	10.81* (1.68)	-5.06 (-0.65)	-47.81** (-2.53)	5.49 (0.70)	-6.11 (-0.78)	-5.40 (-0.69)	
Multiple base rates	-23.60*** (-3.18)	-41.44 (-1.59)	-44.06*** (-4.07)	-23.06*** (-3.10)	-22.87*** (-3.08)	-74.57*** (-9.88)	-89.76*** (-5.97)	-63.14*** (-7.78)	-74.85*** (-9.94)	-75.24*** (-10.02)	
Term loan	49.30*** (11.21)	61.83** (2.40)	46.65*** (7.76)	49.22*** (11.19)	49.33*** (11.20)	85.63*** (12.82)	164.61*** (7.19)	64.58*** (9.67)	86.23*** (12.91)	85.80*** (12.86)	
Secured	34.98*** (7.47)	9.00 (0.31)	36.40*** (5.67)	34.83*** (7.44)	34.98*** (7.48)	60.90*** (10.30)	71.76*** (3.53)	48.44*** (8.86)	62.27*** (10.56)	62.04*** (10.52)	
Lender controls											
Lead arranger reputation	-1.10*** (-3.65)	-1.23 (-0.71)	-0.24 (-0.33)	-1.09*** (-3.61)	-1.08*** (-3.59)	-3.19*** (-9.25)	-5.54*** (-4.54)	-0.42 (-0.66)	-3.27*** (-9.45)	-3.26*** (-9.41)	
Fixed effects											
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Borrower rating	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Borrower industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

(Continues)

TABLE 4 (Continued)

		All-in spread drawn					
		Panel A: Loans arranged by informed, former lead arrangers			Panel B: Loans arranged by uninformed, new lead arrangers		
		Propensity score matched sample		Propensity score matched sample			
Dependent variable		Baseline (1)	Innovative firm _{patents/assets} (4)	Innovative firm _{patents/assets} (5)	Baseline (1)	Innovative firm _{patents/assets} (4)	Innovative firm _{patents/assets} (5)
Loan purpose	Yes	6,146	366	0.481	0.606	0.553	0.553
Lead arranger	No	6,146	3,203	6,146	6,146	6,146	6,785
N		6,146	366	0.481	0.606	0.553	0.553
Adjusted R ²		0.554	0.481	0.553	0.606	0.422	0.421

Note: The table reports OLS regression results. Our full sample consists of 12,913 loans raised by 2,232 public, nonfinancial U.S. borrowers between 1992 and 2016. Panel A focuses on the subsample of loans arranged by former lead arrangers while Panel B focuses on the subsample of loans arranged by new lead arrangers. Innovative borrowers are firms with an R&D intensity above the 75th percentile in the Compustat universe of nonfinancial U.S. firms during the sample period (this is equivalent to an R&D to assets ratio above 15%). In both panels, model (1) is our baseline regression and replicates model (4) of Panel A in Table 3. Model (2) is based on a propensity-score-matched subsample where each of the loans made to innovative firms is matched to a comparable loan made to a noninnovative firm. Model (3) is based on a subsample of loans with a single lead arranger. Models (4) and (5) employ alternative proxies for the borrower's innovativeness based on patent filings. Innovative borrowers are firms whose patent-to-assets or patent-to-sales ratio is above 0.05 (this is equivalent to the 95th percentile of the in-sample distribution). For each independent variable, the top row reports the estimated coefficient, the bottom row reports t-statistics. Standard errors are robust and clustered at the borrower level.

*10% significance.

**5% significance.

***1% significance.

information uncertainty as investor uncertainty about the true fundamental value of the firms in which they invest. Information asymmetry, however, relates to *differences* in information uncertainty in that some investors are likely to know more about a firm's fundamental value because they have private information. That is, market participants have unequal information sets (Lu et al., 2010, p. 2267).

To identify situations where the difference in information uncertainty between the innovative firm and its lenders, and thus information asymmetry, is likely to vary, we split our sample into loans arranged by syndicates including former versus new lead arrangers. We define *Former lead* as a syndicate in which at least one of the current lead arrangers arranged a loan for the borrower in the past 3 years. These former lead arrangers have already screened the borrower in the past, and given the average (median) loan maturity of 46.92 (59.00) months, they are likely to be currently monitoring the borrower. Doing so reduces the information asymmetry between the innovative firm and its lender through the latter's access to private information (Boot, 2000).

Table 4 shows the relevant regression results for the subsamples of loans by former lead arrangers in Panel A versus loans by new lead arrangers in Panel B. The coefficients of *Readability* itself are significant in both panels, indicating that for all firms, financial disclosure readability decreases information uncertainty and therefore reduces the cost of debt. However, the coefficient of the interaction effect of *Innovative firm* * *Readability* is only significant in Panel B, indicating that the previously reported additional benefit that innovative firms obtain from financial disclosure readability in terms of a further reduction in the cost of their debt as compared to noninnovative firms is limited to situations of more pronounced information asymmetry where there has been no previous lending relationship. Please note that in Table 4, we replicate not only our main result from Table 3, but also those from all the robustness checks.

4 | CONCLUSION

Innovative firms represent various risks to lenders, including potential innovation failure, uncertain R&D investment payoffs, cash flow volatility, and low collateral value of hard-to-value intangible assets. As a result, these firms typically have to pay higher spreads on their bank loans compared to noninnovative firms. In this paper, we demonstrate that while all firms can overcome information uncertainty about their firm fundamentals and reduce their spreads by having more readable financial disclosures, there is an additional benefit for innovative firms.

The additional benefit that innovative firms can achieve from having more readable financial disclosures, however, is limited to situations of more pronounced information asymmetry where there is no previous lending relationship. Overall, the results suggest that investments to facilitate lenders' understanding of a firm's fundamentals as revealed by the qualitative information in their financial disclosures pay off, in particular for innovative firms dealing with new lead arrangers.

While we focused on the price terms of bank loans, future research building on our present work may extend our analyses and also explore the association between financial disclosure readability and nonprice terms. Finally, as is the case with all syndicated loan studies (e.g., Berg, Saunders, & Steffen, 2016; Graham, Li, & Qiu, 2008; Hertzfel & Officer, 2012; Ivashina, 2009; Qian & Strahan, 2007), our results only apply to the subsample of borrowing firms and not to all firms in general.

ORCID

Arvid O. I. Hoffmann  <https://orcid.org/0000-0003-4148-5078>

ENDNOTES

¹ As a robustness check, we also consider alternative cutoff levels ranging from 2.5 to 35% of R&D to assets. With respect to the significance of the "Innovative firm * Readability" interaction coefficient, we find that our preferred specification of

Column 4 in Panel A of Table 3 is robust in the range from 10 to 27.5% of R&D to assets. At levels below 10%, we misclassify noninnovative borrowers as innovative. At levels above 27.5%, our sample contains too few innovative firms to deliver statistical significance. We similarly confirm the robustness for Columns 3 and 4 in Panel B of Table 3. Results are available upon request.

² Specifically, we execute the propensity score matching in STATA using the "PSMATCH2" procedure, which is publicly available at <https://ideas.repec.org/c/boc/bocode/s432001.html>

REFERENCES

- Berg, T., Saunders, A., & Steffen, S. (2016). The total cost of corporate borrowing in the loan market: Don't ignore the fees. *Journal of Finance*, 71(3), 1357–1392.
- Beyer, A., Cohen, D. A., Lys, T. Z., & Walther, B. R. (2010). The financial reporting environment: Review of the recent literature. *Journal of Accounting and Economics*, 50(2), 296–343.
- Bonsall, S. B., Leone, A. J., Miller, B. P., & Rennekamp, K. (2017). A plain English measure of financial reporting readability. *Journal of Accounting and Economics*, 63(2), 329–357.
- Bonsall, S. B., & Miller, B. P. (2017). The impact of narrative disclosure readability on bond ratings and the cost of debt. *Review of Accounting Studies*, 22(2), 608–643.
- Boot, A. W. A. (2000). Relationship banking: What do we know? *Journal of Financial Intermediation*, 9(1), 7–25.
- Coles, J. L., Daniel, N. D., & Naveen, L. (2008). Boards: Does one size fit all? *Journal of Financial Economics*, 87(2), 329–356.
- Ertugrul, M., Lei, J., Qiu, J., & Wan, C. (2017). Annual report readability, tone ambiguity, and the cost of borrowing. *Journal of Financial and Quantitative Analysis*, 52(2), 811–836.
- Francis, B., Hasan, I., Huang, Y., & Sharma, Z. (2012). Do banks value innovation? Evidence from US firms. *Financial Management*, 41(1), 159–185.
- Graham, J. R., Li, S., & Qiu, J. (2008). Corporate misreporting and bank loan contracting. *Journal of Financial Economics*, 89(1), 44–61.
- Hertzel, M. G., & Officer, M. S. (2012). Industry contagion in loan spreads. *Journal of Financial Economics*, 103(3), 493–506.
- Hochberg, Y. V., Serrano, C. J., & Ziedonis, R. H. (2018). Patent collateral, investor commitment, and the market for venture lending. *Journal of Financial Economics*, 130(1), 74–94.
- Hu, J., Li, G., & Zhu, F. (2017). Regional financial developments and research and development investment–cash flow sensitivity: Evidence on Chinese public high-tech companies. *International Review of Finance*, 17(4), 627–643.
- Ivashina, V. (2009). Asymmetric information effects on loan spreads. *Journal of Financial Economics*, 92(2), 300–319.
- Kerr, W. R., & Nanda, R. (2015). Financing innovation. *Annual Review of Financial Economics*, 7(December), 445–462.
- Lu, C.-W., Chen, T.-K., & Liao, H.-H. (2010). Information uncertainty, information asymmetry and corporate bond yield spreads. *Journal of Banking & Finance*, 34(9), 2265–2279.
- Qian, J., & Strahan, P. E. (2007). How laws and institutions shape financial contracts: The case of Bank loans. *Journal of Finance*, 62(6), 2803–2834.

How to cite this article: Hoffmann AOI, Kleimeier S. Financial disclosure readability and innovative firms' cost of debt. *International Review of Finance*. 2021;21:699–713. <https://doi.org/10.1111/irfi.12292>